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IBM Power Systems Virtual Server Guide for IBM AIX and Linux

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IBM Power Systems Virtual Server Guide for IBM AIX and Linux

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Note: Before using this information and the product it supports, read the information in “Notices” on page ix.

First Edition (March 2023)

This edition applies to:
IBM AIX 7.2
IBM AIX 7.1
CentOS-Stream-8
SUSE Linux Enterprise Server 12 - Minimum level: SP4 + Kernel 4.12.14-95.54.1
SUSE Linux Enterprise Server 15 - Minimum level: SP1 + kernel 4.12.14-197.45-default
Red Hat Enterprise Linux 8.1, 8.2, 8.3, 8.4, 8.6

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Preface

This IBM® Redbooks® publication delivers a how-to usage content perspective describing deployment, networking, and data management tasks on the IBM Power Systems Virtual Server using sample scenarios.

The team during the content development utilized available documentation, IBM Power Systems Virtual Server environment, and additional software and hardware resources to:

- Document IBM Power Systems Virtual Server networking and data management deployment scenarios.
- Document migrations use case scenarios.
- Document backups case scenarios.
- Document disaster recovery case scenarios.

This book addresses topics for IT architects, IT specialists, developers, sellers, and anyone looking to implement and manage workloads in the IBM Power Systems Virtual Server. Moreover, this publication provides documentation to transfer the how-to-skills to the technical teams, and solution guidance to the sales team. This book compliments the documentation available at IBM Documentation and aligns with the educational materials provided by IBM Systems Technical Education.

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IBM Power Systems Virtual Server

From the AS/400 and RS/6000 models in the 1990s to the POWER10 released this in late 2021, IBM Power Systems are the first choice for many companies with high-risk environments that need low-risk infrastructure. In fact, most of the Fortune 100 have IBM Power Systems running their most mission-critical workloads. IBM Power Systems Virtual Servers (will be known as PowerVS for the remainder of this section) continue this tradition.

Until now, moving your Power Systems server workloads to the cloud was something of an utopic idea, and the chance to have your IBM i, AIX, or Linux on Power to a public or hybrid Cloud, might seem difficult and costly. However, these challenges can now be addressed with the IBM Power Systems Virtual Server offering.

This chapter introduces and presents the conceptual foundations of the IBM Power Systems Virtual Server service.

The chapter introduces the following concepts:

1.1 Overview

The Power Systems Virtual Server (Power Virtual Server) is an IBM Power Systems service offering hosted by IBM data centers. It delivers enterprise-class compute with the flexibility of hybrid cloud deployment. You can use the Power Virtual Servers to deploy a virtual server (also known as a logical partition (LPAR) or a virtual machine (VM),) in a matter of minutes. As a result, IBM Power Systems clients who have typically relied upon on-premises-only infrastructure can now quickly and economically extend their Power IT resources off-premises.

Power Systems servers are confined from others servers with separate networks and direct-attached storage in the data centers. The internal networks are fenced but offer connectivity options to IBM Cloud infrastructure or on-premises environments. This infrastructure design enables essential enterprise software certification and support as the Power Systems Virtual Server architecture is identical to certified on-premises infrastructure.

Power Systems customers interested in modernization can benefit from deploying the workloads to Power Systems Virtual Server instead of moving their applications to a new platform that can be expensive and high risk. You can access a stack of enterprise services from IBM – all with pay-as-you-use billing that lets you quickly scale up and out. IBM Power Systems Virtual Server enables clients to take full advantage of this trend with the ability to provision AIX, IBM i, or Linux instances connected to the cloud.

1.1.1 What is an IBM Power Systems Virtual Server?

PowerVS deliver flexible compute capacity for IBM Power Systems workloads. Integrated with the IBM Cloud platform for on-demand provisioning, this offering provides a secure and scalable server virtualization environment built upon the advanced Reliability, Availability, and Scalability (RAS) features and leading performance of the Power Systems platform.

IBM PowerVS is an **Infrastructure as a Service (IaaS)** offering that enables IBM Power Systems customers to extend their on-premises environments to the IBM Cloud.

IBM Power Virtual Servers are co-located with IBM Cloud. IBM Power Virtual Servers, therefore, have separate networking hardware and direct-attached storage systems but come with connectivity options to allow IBM Power Virtual Server instances to easily integrate with IBM Cloud services. This enables PowerVS to maintain key enterprise software certification and support as the PowerVS architecture is identical to certified on-premises infrastructure. The virtual servers, also known as logical partitions (LPAR), run on IBM Power Systems hardware with the PowerVM hypervisor.

With the PowerVS, you can quickly create and deploy one or more virtual servers (that are running either the AIX, IBM i, or Linux operating systems). After you provision the PowerVS, you get access to infrastructure and physical computing resources without the need to manage or operate them. However, you must manage the operating system and the software applications and data. Figure 1-1 on page 3 represents a responsibility assignment (RACI) matrix for PowerVS.

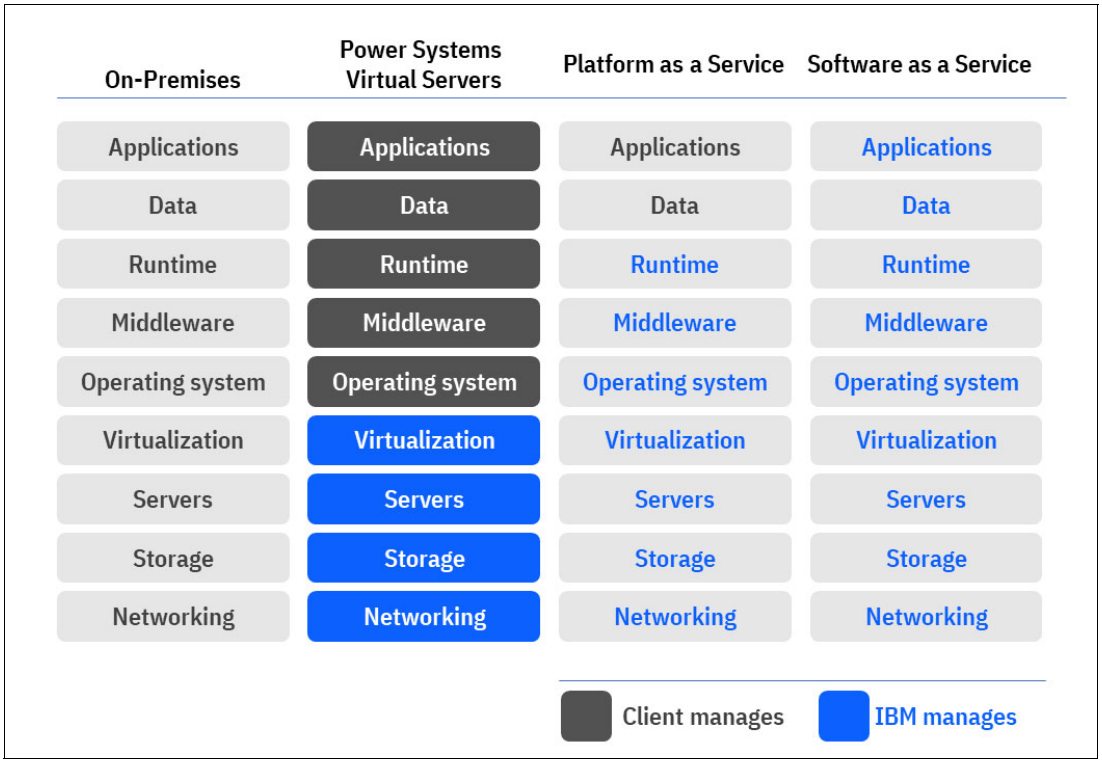


Figure 1-1 RACI Matrix Power Virtual Servers

1.2 IBM Power Systems Virtual Server key concepts

For organizations that want to extend their IBM Power Systems workloads to the IBM Cloud, PowerVS offers a straightforward path to implementing a hybrid Cloud. But the organizations should understand how PowerVS works and what it can provide before committing to the service.

No "one-size-fits-all" solution exists for cloud adoption. Organizations should consider their own cost and benefit equation and then decide on the best model.

In this section, we will present some of the key concepts for the PowerVS.

1.2.1 PowerVS workspace versus PowerVS instance

Before you create a virtual server, you must understand the difference in terminology between a PowerVS workspace and a PowerVS instance. You can think of the PowerVS workspace as a container for all PowerVS instances at a specific geographic region. PowerVS instance is a virtual server, also known as logical partitions (LPAR). The workspace can contain multiple PowerVS instances.

You cannot create a workspace across multiple geographic regions. If you need instances in two different geographic regions, you will need to create two workspaces.

You can have multiple workspaces in the same geographic region, for example, this can help you to separate development and test environments from the production environment.

Note: For a complete list of supported data centers, see Creating a PowerVS workspace.

1.2.2 Potential consumers

The potential consumers of the Power Virtual Server service offering are the IT Administrators, Managed Service providers/Cloud Service Providers (MSPs/CSPs), Independent Software Vendors (ISVs), and Application Developers.

IT Administrators

The people who manage infrastructure technology are interested in migrating to the cloud to speed up time for value their Power workloads, shift capital expense to operating expense, and improve business resilience and scalability. It allows clients to manage a truly hybrid environment with flexible burst environments for spikes in usage, development and test environments, or production workloads.

Managed Service providers/Cloud Service Providers (MSPs/CSPs)

Service providers are interested in expanding the level of service they can offer their clients. Many MSPs already have client workloads running on Power, and they can provide additional services around the cloud.

Independent Software Vendors (ISVs)

Companies that sell software as a service can take this capability to deploy infrastructure to host their software on the cloud for client basis.

Application Developers

Companies with Power servers have subject matter experts in AIX, IBM i, and Linux development. They want to continue developing mission-critical applications and then deploy on-premises.

1.3 Key concepts and features for Power Systems Virtual Server

Note: For a complete list of supported data centers, see Creating a PowerVS workspace.

1.3.1 Compute

The following IBM Power Systems can host a PowerVS Instances:

- IBM Power System E980 (9080-M9S).
- IBM Power System S922 (9009-22A/9009-22G).

Note: There is a core-to-vCPU ratio of 1:1. For shared processors, fractional cores round up to the nearest whole number. For example, 1.25 cores equal 2 vCPUs. For more information on processor types, see What's the difference between capped and uncapped shared processor performance? How does they compare to dedicated processor performance? If the machine type is S922 and operating system is IBM i, IBM i supports maximum of 4 cores per VM.

1.3.2 Server placement groups

Server placement groups provide you control over the host or server on which a new virtual machine (VM) is placed. By using server placement groups, you can build high availability within a data center.

You can apply an **affinity** or **anti-affinity** policy to each VM instance within a server placement group:

- **affinity policy -** all VMs in that placement group are launched on the same server.
- **anti-affinity policy** - all VMs in that placement group are launched on different servers.

1.3.3 VM pinning

You can choose to **'none'**, **'soft'** or **'hard'** pin a VM to the host where it is running:

- If the pin is not set or it is set to soft the VM will be automatically migrated or remote restarted during maintenance windows or in case of host failure.
- When you **soft** pin a VM. PowerVS automatically migrates the VM back to the original host after the host is back to its operating state.
- The **hard** pin option restricts any VM (licensing restriction with the host) movement during maintenance windows or in case host failure. hard pin VMs will be stopped if the frame is down.

1.3.4 Shared Processor Pool

A shared processor Pool (SPP) is a pool of processor capacity that is shared between a group of virtual server instances. Unlike a virtual server instance that has a dedicated and defined maximum amount of processing capacity, you can set the reserved cores in SPP that are guaranteed to be available at the pool level.

The benefits of using an SPP are as follows:

- Provides control over licensing costs by limiting the number of processors an uncapped partition can use, which reduces the number of software licenses.
- Provides a better overall ability to reserve and manage processor resources.

The PowerVS always has at least one defined SPP as the default pool. You can add up to 63 more SPPs to a single PowerVS workspace. The SPP is used and shared by a set of virtual server instances of the same machine type (host).

You can specify the host affinity and anti-affinity between two or more SPPs with shared processor pool placement groups. For more information, see Configuring shared processor pool placement group.

1.3.5 Storage

IBM Power Virtual Servers have separate direct-attached NVMe-based flash systems:

- Flash storage from IBM FS9000 series devices.
- 16/32 Gb SAN infrastructure.

Each IBM Flash system will represent a PowerVS Storage Pool.

Each PowerVS Instance is configured with four Virtual Fibre Channel adapters: two are mapped to Virtual Fibre Channel adapters on one VIOS and the other two are mapped to Virtual Fibre Channel adapters on the other VIOS.

Figure 1-2 shows an example with two Instances (VMs) with dual Virtual I/O Server.

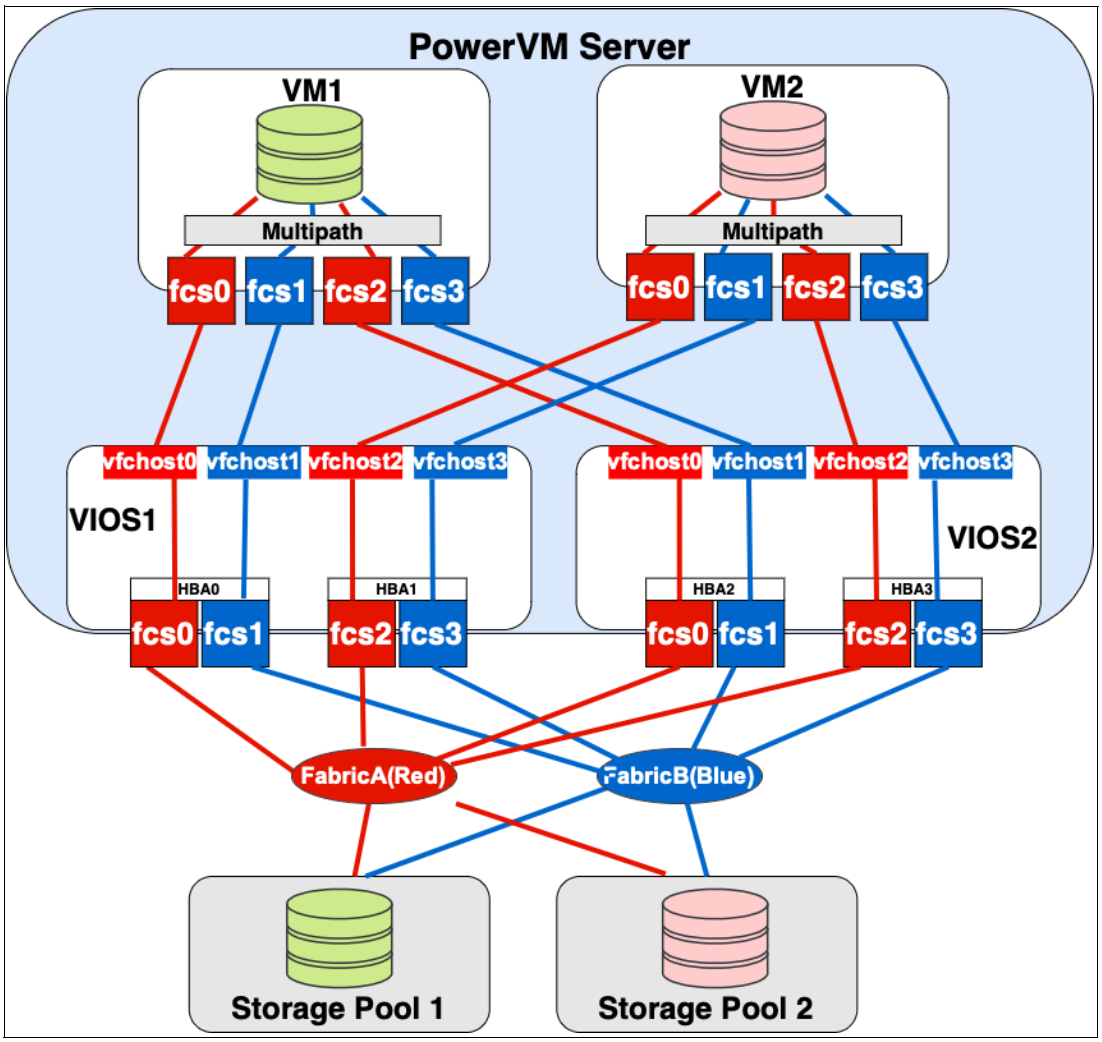


Figure 1-2 Storage definition on Power Virtual Servers

1.3.6 Storage Tiers

For each PowerVS Instance, you must select a storage tier - **Tier 1** or **Tier 3**. The storage tiers in PowerVS are based on I/O operations per second (IOPS). It means that the performance of your storage volumes is limited to the maximum number of IOPS based on volume size and storage tier:

- **Tier 3** storage is currently set to **3 IOPS/GB**.
- **Tier 1** storage is currently set to **10 IOPS/GB.**

For example, a 100 GB **Tier 3** storage volume can receive up to 300 IOPs, and a 100 GB **Tier 1** storage volume can receive up to 1000 IOPS.

After the IOPS limit is reached for the storage volume, the I/O latency increases.

Note: Tier 3 storage tier is not suitable for production workloads. When you are choosing a storage tier, ensure that you consider not just the average I/O load, but more importantly the peak IOPS of your storage workload.

1.3.7 Storage pools

You can now attach storage volumes to a VM instance from different storage tiers and pools, other than the storage pool the VM instance's root (boot) volume is deployed in. To accomplish this, you must modify the VM instance and set the **storagePoolAffinity** property to **false**. The VM instance **storagePoolAffinity** property is set to **true** by default.

Note: For Snapshots, cloning/restoring all volumes must be from the same storage pool. Enabling anti-affinity will break these functionalities.

Storage pool options:

- **Affinity:** Use this option to select an existing VM instance or an existing volume as the affinity object. The new volume is created in the same storage pool where the affinity object resides. If you are using VM instance as an affinity object, the storage pool that is selected is based on the VM instance's root (boot) volume.
- **Anti-affinity:** Use this option to specify one or more existing VM instances or one or more volumes as the anti-affinity objects. The new volume is created in a different storage pool than the storage pool where one or more anti-affinity objects reside.
- **Auto-select pool:** Use this option to allow the system to automatically select a storage pool, for the desired storage tier, that has sufficient capacity.

The use of volume affinity policy (affinity or anti-affinity) requires the availability of multiple storage pools. You might experience the following errors when you use a volume affinity policy:

- If an additional storage provider is not available to fulfill the requested policy, you might receive an error that indicates the inability to locate a storage provider to create a volume by using the requested volume affinity policy.

If additional storage providers exist but the storage providers do not have sufficient space to fulfill the requested policy, you might receive an error that indicates the inability to locate a storage provider with enough available capacity to satisfy the requested volume size.

1.3.8 Snapshots, cloning, and restoring

PowerVS provides the capability to capture full, point-in-time copies of entire logical volumes or data sets. Using IBM FlashCopy® feature, the PowerVS API lets you create delta snapshots, volume clones, and restore your disks.

Taking a snapshot

The snapshot interface allows you to create a relationship between your source disks and a target disks (target disks are created as part of the snapshot API) at time T1. The snapshot API tracks the delta changes done to the source disk beyond time T1. This enables the user to restore the source disks to their T1 state at later point in time.

There are several use cases for the snapshot feature. For example, an administrator plans to upgrade the middleware on his system but wants to be able to revert to its original state

before proceeding with an upgrade. If the middleware fails, the administrator can restore the source disk to its previous state.

Best practices:

- Before you take a snapshot, ensure that all of the data is flushed to the disk. If you take a snapshot on a running virtual machine (VM) and did not flush the file system, you might lose some content that is residing in memory.
- It is recommended that you quiesce all of the applications on the snapshot volume.

Restrictions and considerations:

- Parallel VM snapshot operations from different VM nodes for the same shared volume are not allowed.
- You cannot restore a VM if you are taking a snapshot and there are clone (full-copy) FlashCopy operations that are running in the background. The FlashCopy operations must first complete.
- Some of the attributes of source disks cannot be changed while the disks are in a snapshot relationship. For example, you cannot resize the source disks when there are snapshot relationships in place for those disks.

Volumes that are in a snapshot relationship cannot be detached from the VM.

Cloning a volume

The clone operation creates a full copy of the volume. You can select multiple volumes and initiate a group clone operation. When multiple volumes are selected, the clone operation ensures that a consistent data copy is created.

The clone operation continues to copy data from the source disks to target disks in the background. Depending on the size of the source disks and the amount of data to be copied, the clone operation can take a significant amount of time.

Note: You cannot modify the source or target disk attributes, such as disk size, while the clone operation is in progress.

Best practice:

- Quiesce all of the applications on the volume that you want to clone.

Restrictions and considerations:

- When the clone operation is performed on a volume that is in-use, the PowerVS creates a consistent group snapshot and re-creates the copy of the cloned volume by using the group snapshot.

Restoring a snapshot

The restore operation restores all of the volumes that are part of a VM snapshot back to the source disks. While it restores the VM, the PowerVS creates a backup snapshot, which can be used if the restore operation fails. If the restore operation succeeds, the backup snapshots are deleted. If the restore operation fails, you can pass in the restore_fail_action query parameter with a value of retry to retry the restore operation. To roll back a previous disk state, you can pass in the restore_fail_action query parameter with a value of rollback. When the restore operation fails, the VM enters an **Error** state.

Best practices:

- During the restore operation, it is critical that your source disks be quiesced. Your source disks cannot be in use. Shut down all of your applications, including file systems and

volume managers. If you are running an AIX VM, make sure that the disks are freed from the LVM by varying it off.
- If you plan to restore the boot disks, your VM must be shut down. If the VM has volumes that are hosting external database applications, quiesce all of your applications and ensure that there are no active IO transactions on the disk. Failure to do so can lead to data corruption and put the VM in maintenance mode.

Restrictions and considerations

If the restore operation fails, reach out to your storage support administrator. A failed restore operation can leave behind incomplete states, which might require a cleanup initiative from an IBM operation's team.

If you choose to restore a shared volume on one VM, you cannot perform the snapshot, restore, clone, or capture operations on the other VMs that are using the shared volume (while the restore operation is running).

1.3.9 Power Virtual Servers network

IBM Power Virtual Servers have separate networking hardware:

- Cisco Nexus9000 N9K-C9364C (Spine 10 G)
- Cisco Nexus9000 9348GC-FXP (Leaf 1 G)
- Cisco Nexus9000 93180YC-FX (Leaf 25 G)
- Cisco UCS - APIC controller
- Cisco ASR1001-HX Routers
- Avocent ACS8032DAC-400

PowerVS networking environment

When you create a PowerVS, you can select a private or public network interface.

Public network

- Easy and quick method to connect to a PowerVS instance.
- IBM configures the network environment to enable a secure public network connection from the internet to the PowerVS instance.
- Connectivity is implemented by using an IBM Cloud Virtual Router Appliance (VRA) and a Direct Link Connect connection.
- Protected by firewall and supports the following secure network protocols:
  - SSH
  - HTTPS
  - Ping
  - IBM i 5250 terminal emulation with SSL (port 992)

Private network

- Allows your PowerVS instance to access existing IBM Cloud resources, such as IBM Cloud Bare Metal Servers, Kubernetes containers, and Cloud Object Storage.
- Uses a Direct Link Connect connection to connect to your IBM Cloud account network and resources.
- Required for communication between different PowerVS instances.

PowerVS network architectures consist of one or more of the following networks:

- **IBM Cloud infrastructure networks** - While the following infrastructure network environments offer different features and are managed separately, they can be connected to each other to provide layer-3 IPv4 traffic flow:

  - **Classic** - Classic network resources include VLANs, subnets, and SSL Virtual Private Network (VPN) access. Bring Your Own IP (BYOIP) is not supported.
  - **Virtual Private Cloud (VPC)** - VPC network resources include subnets, floating IPs, security groups, and VPN gateways. Bring Your Own IP (BYOIP) is supported.
  - **Power Systems** - Power Systems network resources include subnets BYOIP is supported. Bring Your Own IP (BYOIP) is supported.
- **Overlay networks** - These networks exist in the IBM Cloud VMware Shared and VMware Dedicated offerings. While technically hosted in the IBM Cloud classic infrastructure environment, these networks are implemented in VMware NSX and under your direct control, including the IP addressing schema. BYOIP is supported. Therefore, overlay networks cannot be routed by the IBM Cloud infrastructure networks; access is through tunnels.
- **External**:
  - **Internet** - Access the internet through resources that are hosted in any of these three infrastructure environments.
  - **Remote** - Connect remote networks to your IBM Cloud networks. You can use the following services to connect to a remote network:
    - **Internet VPN** - Uses the public internet to connect remote networks and their IBM Cloud networks through a VPN. The VPN is terminated on gateway devices or a service within IBM Cloud.
    - **Direct Link** - Direct Link is a suite of offerings that enable the creation of direct, private connections between your remote, on-premises network and IBM Cloud, without traversing the public internet. For more information, see Getting started with IBM Cloud Direct Link (2.0).

Use cases

These use cases describe the following deployment topologies:

- Connecting PowerVS to IBM Cloud classic infrastructure by using IBM Cloud Direct Link (2.0). Typical use cases for this topology are as follows:
  - Use IBM Cloud classic x86 resources to create tiered applications across different hardware platforms, that is, x86 application servers and Power database servers.
  - Build a backup and restore environment based on IBM Spectrum® Protect Cloud Blueprints for both IBM Spectrum Protect and IBM Spectrum Protect Plus topologies. Also, see AIX Backups with PowerVS.
  - Connecting PowerVS to the IBM Cloud VPC infrastructure environment by using Direct Link (2.0) Connect. A typical use case for this topology is to use IBM Cloud VPC x86 resources to create tiered applications across different hardware platforms, that is, x86 application servers and Power database servers
  - Connecting PowerVS to on-premises network by using Megaport or Direct Link (2.0) Connect. A typical use case for this topology is that you require access to your Power virtual servers from your external networks, such as networks on your on-premises. This topology uses Megaport services or Direct Link (2.0) Connect.
  - Connecting two PowerVS environments by using Megaport or Direct Link Connect. This topology connects two or more Power virtual server environments together by using Megaport services or Direct Link (2.0) Connect. Connecting two or more environments together enables use cases, such as disaster recovery.
  - Connecting PowerVS to an on-premises network through the IBM classic infrastructure by using private SSL connection and a jump server. This is a specific use case for connecting to the classic environment so that the SSL VPN connection can be used to access your PowerVS for operations and administration tasks.
  - Connecting PowerVS to an on-premises network through the IBM Cloud classic infrastructure by using an internet IPsec VPN connection. This use case describes how to connect to the classic environment so that an IPsec VPN connection can be used to

access your classic and PowerVS. Typically, this network architecture is used for small production environments or proof-of-concept, development, and test purposes.

Connecting PowerVS to an on-premises network through an IBM Cloud classic infrastructure by using a private Direct Link. A Direct Link enables your remote networks to connect to IBM Cloud over a private connection that does not use public networks.

Note: For more information, see Network architecture diagrams.

1.3.10 Images

PowerVS provides AIX, IBM i and Linux stock images or you can bring your own customized operating system (OS) image (OVA format).

This table lists the support for AIX, IBM i, and Linux operating system:

- **AIX** – PowerVS supports AIX 7.1, or later.
- **IBM i** – PowerVS supports IBM i 7.1, or later. Clients running IBM i 6.1 must first upgrade the OS to a current support level before migrating to the PowerVS.
- **Linux** - PowerVS supports the following ppc64le Linux distributions:
  - SUSE Linux Enterprise 12 and 15.
  - Red Hat Enterprise Linux 8.1, 8.2, 8.3, 8.4, and 8.6.

Note: If you use an unsupported version, it is subject to outages during planned maintenance windows with no advanced notification given.

Stock images

The operating system version levels of the stock images are subject to change:

- PowerVS typically provides stock images for the last three major versions (example: Technology Level) of the supported OS. Any update to the OS stock image is planned only when the image level is certified for PowerVM environment.
- Any unsupported and older stock images are periodically removed from the offering. You will be notified three weeks before the images are removed.
- VMs deployed by using stock images that are being removed can continue to operate without any issues. You are recommended to follow operating system vendor's guidelines to update the OS as needed.

Full Linux subscription provides Red Hat Enterprise Linux and SUSE Linux Enterprise Server stock images that can be used for SAP and non-SAP applications. PowerVS Instances do not have direct access to the IBM Cloud Satellite® server and will require a proxy server, see Full Linux subscription for PowerVS for more details.

Bring your own image

You can bring your own customized AIX, IBM i or Linux operating system (OS) image to deploy within a PowerVS.

Before you can use a custom image as the boot volume, review the following information:

- You must have a basic understanding of IBM Cloud Object Storage concepts.
- If you do not have an existing image, you can use IBM PowerVC to capture and export an image for use with a PowerVS. For more information, see Capturing a virtual machine and Exporting images. To capture and export an image by using IBM PowerVC, the PowerVC private environment must contain N_Port ID Virtualization (NPIV) data volumes. The

PowerVS does not support captured images from environment with shared Storage Pools (SSP) vSCSI data volumes.

- Alternatively, if you have already deployed a virtual server instance, you can capture it and redeploy a new virtual server instance.

For more details about migrating your workloads to PowerVS, see Importing a boot image and Deploying a custom image within a PowerVS.

1.3.11 High Availability and Disaster Recovery options

Typically, organizations review their IT services in terms of recovery time objectives (RTOs) (time until the service resumes) and recovery point objectives (RPOs) (amount of data lost), as shown in Figure 1-3.

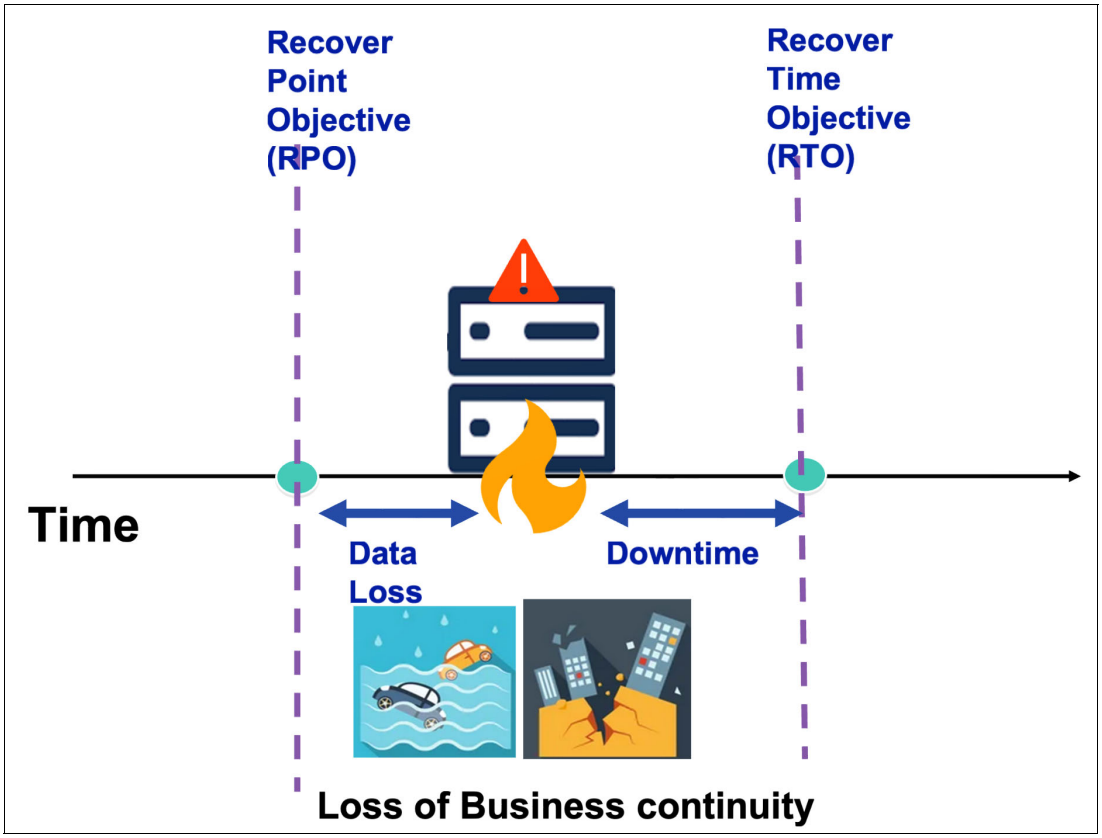


Figure 1-3 RPO/RTO Diagram

The RTO is the amount of time an application can be down without causing substantial business damage and the time it takes for the system to recover from a loss.

The RPO is the point in time after a failure when data preservation is required. Recovery processing preserves data modifications that occurred before the breakdown or disaster by at least this period.

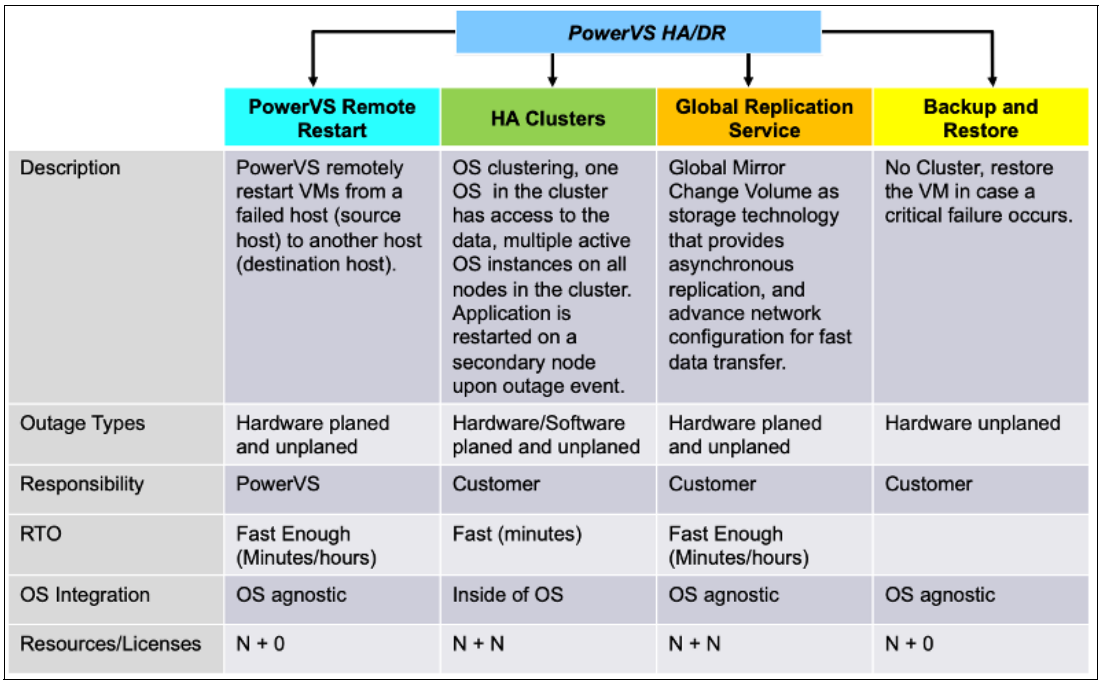
Both High Availability (HA) and Disaster Recovery (DR) are essential for business continuity:

- HA generally addresses local (single cloud region) outages that are planned and unplanned that have the following characteristics:
  - Planned outage management, software, and hardware.
  - Unplanned outage management, hardware failure for example.

- Can provide an RPO of zero.
- DR generally addresses the loss of sites that have the following characteristics:
  - Catastrophic events that cause the cloud region to become unavailable.
  - Advanced configurations involve continuous data replication providing a zero or near-zero RPO.
  - Less advanced options involve saving point in time copies to provide an RPO equal to the time since the last save operation.

When you design architecture for a cloud service, consider your availability requirements and how to respond to potential interruptions in the service. To be successful, you cannot assume the PowerVS instance will always be there, or always work the way you expect.

The PowerVS provides multiple solutions to support business continuity plans as shown in Figure 1-4.



	PowerVS Remote Restart	HA Clusters	Global Replication Service	Backup and Restore
Description	PowerVS remotely restart VMs from a failed host (source host) to another host (destination host).	OS clustering, one OS in the cluster has access to the data, multiple active OS instances on all nodes in the cluster. Application is restarted on a secondary node upon outage event.	Global Mirror Change Volume as storage technology that provides asynchronous replication, and advance network configuration for fast data transfer.	No Cluster, restore the VM in case a critical failure occurs.
Outage Types	Hardware planed and unplaned	Hardware/Software planed and unplaned	Hardware planed and unplaned	Hardware unplaned
Responsibility	PowerVS	Customer	Customer	Customer
RTO	Fast Enough (Minutes/hours)	Fast (minutes)	Fast Enough (Minutes/hours)	
OS Integration	OS agnostic	Inside of OS	OS agnostic	OS agnostic
Resources/Licenses	N + 0	N + N	N + N	N + 0

Figure 1-4 PowerVS HA/DR business continuity plan

PowerVS Remote Restart

The PowerVS restarts the instances (VMs) on a different host system if a hardware failure occurs. This process provides basic High Availability (HA) capabilities to protect in case of Power Systems failure.

Restrictions and considerations:

- The **hard** pin option restricts the VM to be restarted to a different host.
- The Remote Restart is not protecting your VMs in case of storage hardware failure.

High Availability (HA) Clusters

High Availability (HA) clusters are groups of two or more computers and resources, such as disks and networks, which are connected and configured so that if one fails, a HA manager, such as PowerHA or Pacemaker, performs a failover. The failover transfers the state data of applications from the failing computer to another computer in the cluster and re-initiates their operation there. This process provides HA of services running within the HA cluster.

Restrictions and considerations:

- You can use a monthly subscription model when you purchase PowerHA SystemMirror for AIX Standard Edition. For more information, see Standard Edition monthly pricing options.
- By using the PowerVS, you do not have access to the HMC, VIOS, and the host system. Therefore, any PowerHA functions that require access to these capabilities, such as Resource Optimized High Availability (ROHA) and Active Node Halt Policy (ANHP), are not available.
- You should use Server placement groups with anti-affinity policy to make sure the VMs will run on different systems.
- You should use the Storage pool anti-affinity policy to make sure you have disks from different controllers, and if is possible to create mirror VGs.

Global Replication Service

Disasters are unplanned events that cause severe damage, incur a loss to our business, and affect all organizations. Since most workloads nowadays run-on cloud infrastructure, it is essential to have robust and resilient cloud infrastructure that is prepared to handle these catastrophic hits and have minimal impact on business.

The IBM PowerVS provides a set of APIs that can enable disaster recovery (DR) solution for your virtual server instances. IBM Cloud infrastructure internally uses Global Mirror Change Volume (GMCV) as storage technology that provides asynchronous replication, and advance network configuration for fast data transfer.

The scope of the GRS service is to create and manage replicated resources that include the following items:

- Volume lifecycle operations support on replicated volumes.
- APIs to manage volume groups through create, update, delete, start, and stop operations.
- Virtual server instance life-cycle operations by using replicated volumes.
- Onboard auxiliary volume on secondary site for volume recovery.

Locations that support global replication service:

- You can use the GRS location APIs to determine the locations that support storage replication and their mapped location. For more information, see all disaster recovery locations supported by Power System Virtual Server.

Best practices for Global Replication Service:

- You must set the bootable flag explicitly on onboarded volumes, if required.
- Start the onboarding of auxiliary volumes only when the master volumes and volume-group are in consistent copying state.
- When you add or remove a master or auxiliary volume from a volume-group from one site, you must perform the same operation from other site to keep the data is in sync.
- You must delete the volumes from primary and secondary site. Volumes are charged when you delete auxiliary volume but fail to delete the master volume.
- You must use primary sites for all the volume operations and perform operations on auxiliary volume on secondary site only during failover.

Limitations of Global Replication Service:

- You cannot perform a snapshot restore operation in auxiliary volumes.
- The volume-group update operation can fail upon a mismatch in volume-group and volume replication states. If the volume group is in an error state, you can use the volume-group action API to reset the volume group status for availability.
- When you delete a volume from a site, the replicated volume that is managed on its corresponding remote site moves to error state in an interval of 24 hours.

- When the volume is resized from a site, the replicated-enabled volume on its corresponding remote site is also resized after an interval of 24 hours.
- When you perform any operation on a volume that is deleted, it fails.

Business Continuity through backup and restore

Your PowerVS configuration and data are not backed up automatically. It is customer responsibility to backup their own data.

Backup strategies for PowerVS:

- **Image capture -** produces a storage FlashCopy of the VM and works for any Operating System (OS). You can use image capture to store VM images within your account (locally) as a part of your image catalog, or directly to IBM Cloud Object Storage, or both.
- **IBM Spectrum Protect -** provides scalable data protection for physical file servers, applications, and virtual environments.
- A common IBM i backup strategy is to use IBM Backup, Recovery, and Media Services (BRMS) and IBM Cloud Storage Solutions (ICC). Together, these products automatically back up your LPARs to IBM Cloud Object Storage.
- **FalconStor Virtual Tape Library (VTL)** is an optimized backup and deduplication solution that provides tape library emulation, high-speed backup or restore, data archival to supported S3 clouds for long-term storage, global data deduplication, enterprise-wide replication, and long-term cloud-based container archive, without requiring changes to the existing environment.
- **Snapshots** - PowerVS provides the capability to capture full, point-in-time copies of entire logical volumes or data sets.

Note: Importing and exporting images requires a considerable amount of processing power and network bandwidth. As a result, you can submit only one import or export request before it is queued. Typically, users import or export system disks (rootvg disks) that are smaller in size (less than **1 TB**) to facilitate the transfer to and from Cloud Object Storage. If your image size is greater than **1 TB**, your transfer might take a long time and is prone to failure. The maximum image size that you can import, or export is **10 TB**.

For more information on how to create and configure an PowerVS running the FalconStor VTL software in the IBM Cloud, see FalconStor VTL for IBM Deployment Guide.

For best practices and guidelines on AIX backup performance on IBM PowerVS, see AIX Backup Performance Best Practices and Guidelines on IBM PowerVS.

For a complete tutorial on backing up and restoring IBM i VM data, see Backing up and restoring data in an IBM i VM.

1.4 Creating a Power Systems Virtual Server

Before creating a virtual server, you must understand the difference in terminology between a Power Systems Virtual Server service and a Power Systems Virtual Server instance. You can think of the Power Systems Virtual Server service as a container for all Power Systems Virtual Server instances at a specific geographic region. The Power Systems Virtual Server service is available from the Resource list in the Power Systems Virtual Server user interface. The service can contain multiple Power Systems Virtual Server instances. For example, you can have two Power Systems Virtual Server services, one in Dallas, Texas, and Washington, DC. Each service can contain multiple Power Systems Virtual Server instances.

Before you create your first Power Systems Virtual Server instance, you must log in to IBM Cloud as shown in Figure 1-5.

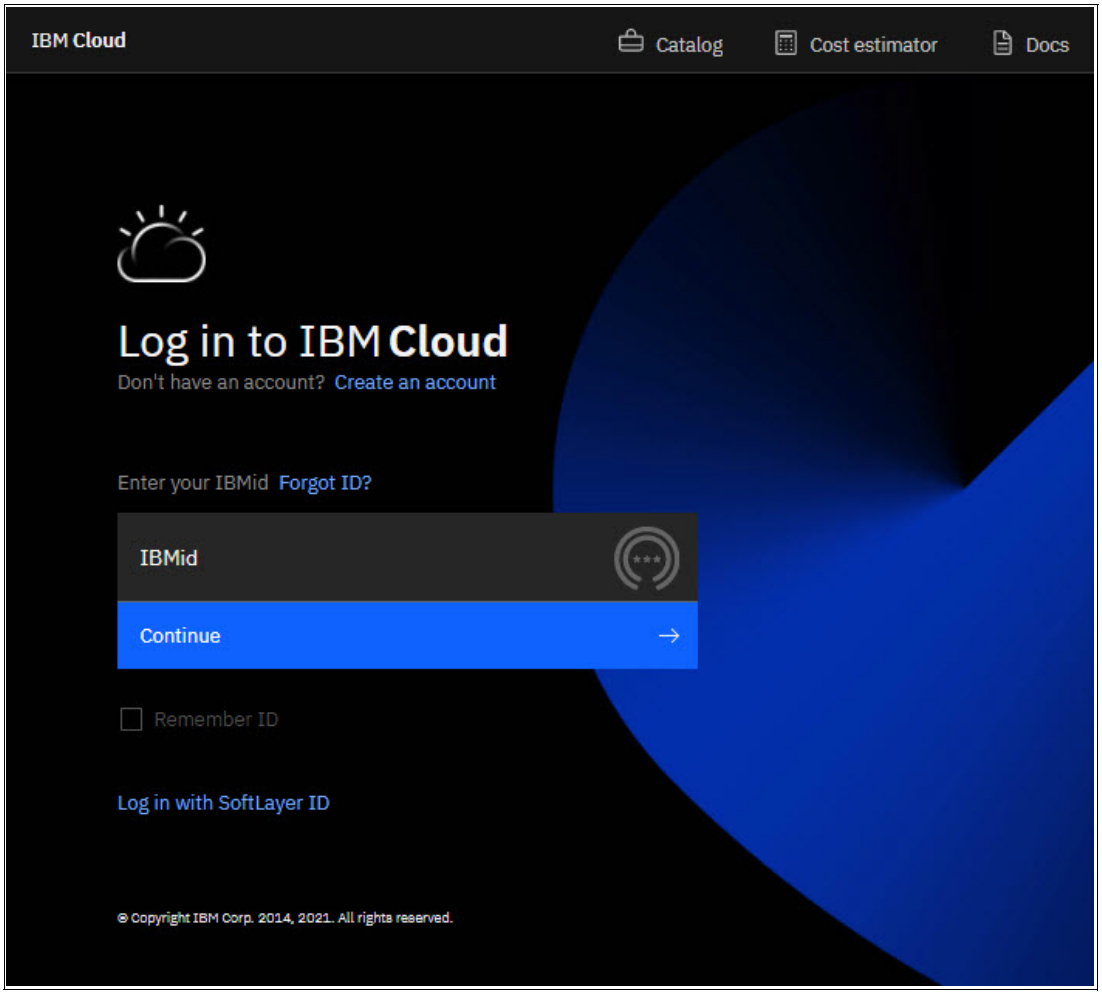


Figure 1-5 Log in to IBM Cloud (https://cloud.ibm.com/login)

If you do not have an account, create one.

To create an IBM Cloud account, go to *https://cloud.ibm.com/registration*.

1.4.1 IBM Cloud Dashboard

The Dashboard involves many carefully arranged parts and details and points to good documentation. In addition, many menus, links, and icons help you fully manage your environment, your Virtual Server instances, and associated resources. Refer to figure Figure 1-6 on page 17.

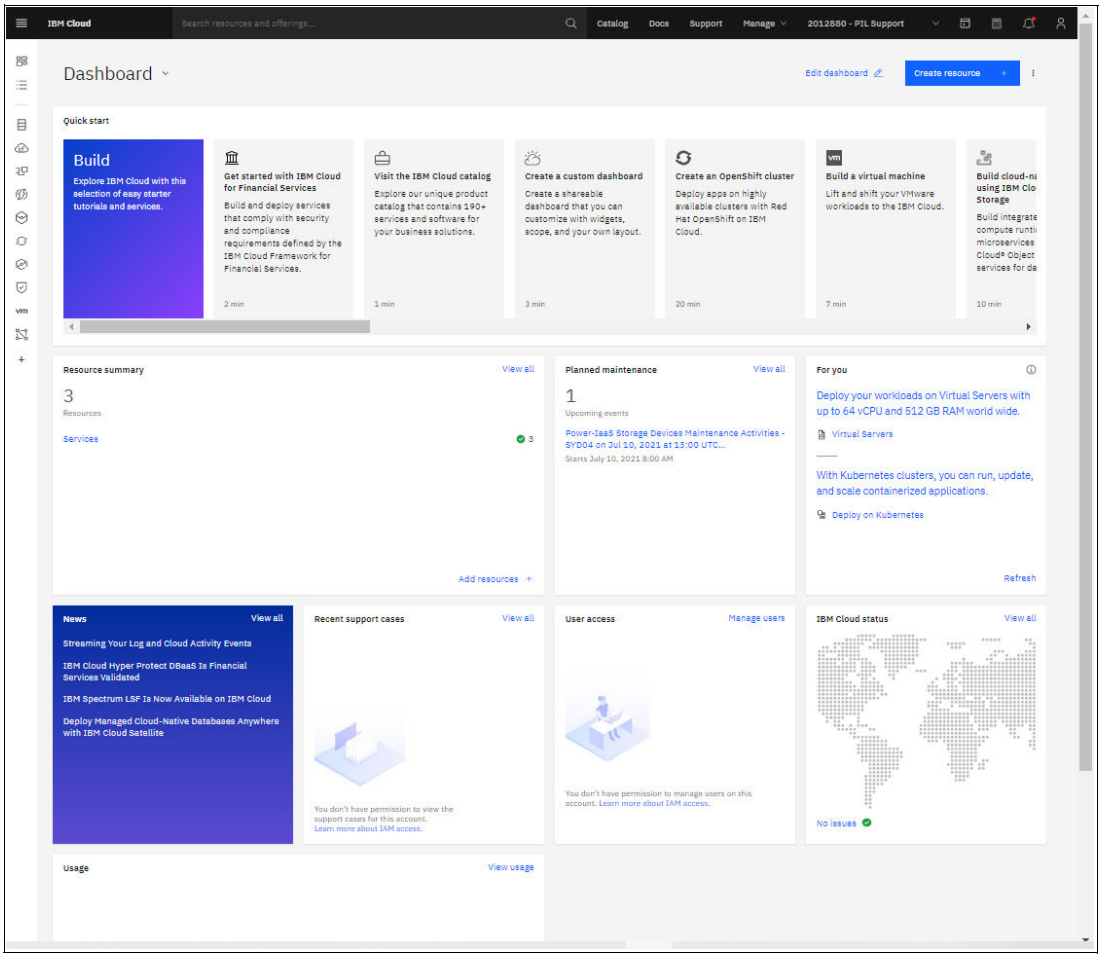


Figure 1-6 IBM Cloud Dashboard

Dashboards are customizable. So you can create a Dashboard that ensures what is displayed is relevant to you. For example, the dashboards you create can be scooped to specific resources, and You can share the dashboards with users in your account to group resources for particular projects or teams.

You can enable securely authenticate users, control access to Virtual Server resources with resource groups, and allow access to specific resources for a set of users with access groups. This service is based on an Identity and Access Management (IAM) mechanism, the one-stop shop for all user and resource management in the IBM Cloud. You can assign IAM authorizations based on the following criteria:

- Individual users.
- Access groups.
- Specific types of resources.
- Resource groups.

For more information about IAM go to:

`https://www.ibm.com/security/services/identity-access-management/cloud-iam-services`

1.4.2 IBM Cloud Catalog

The IBM Cloud Catalog is an inventory of all offerings provided by IBM Cloud as shown in Figure 1-7. It gives a stack with various products, including computing, storage, networking, end-to-end developer solutions for application development, testing and deployment, security management services, traditional and open source databases, and cloud-native services.

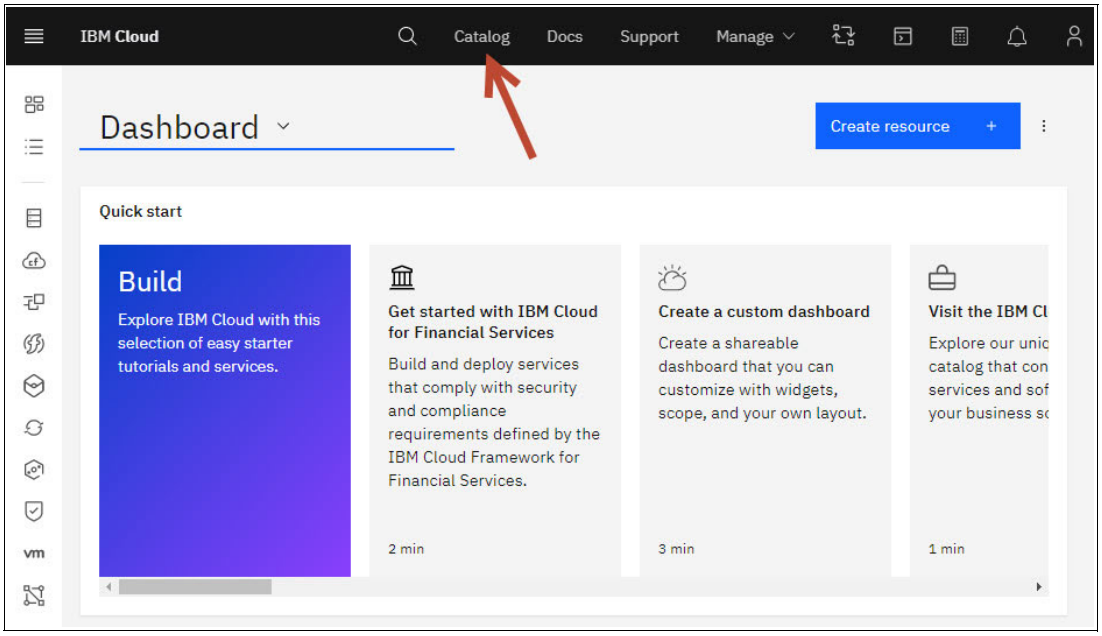


Figure 1-7 IBM Cloud Catalog

The offering relies on services, software, and consulting. You can share the catalog as shown in Figure 1-8 on page 19.

Services

It contains a Portfolio of managed services for infrastructure, developer tools, and more to build your applications on the public cloud.

Software

List of software solutions that take advantage of a simplified installation process.

Consulting

To get help, from technical to strategic and more, from IBM and our network of partners.

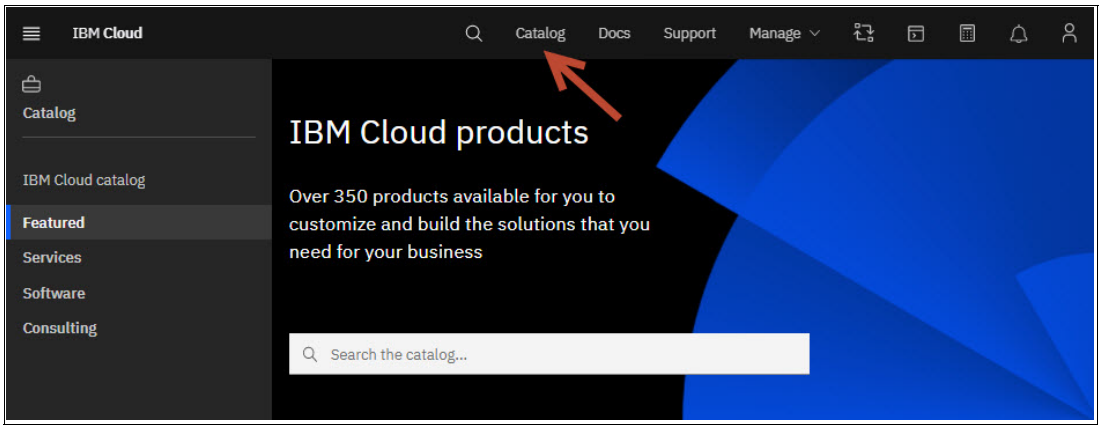


Figure 1-8 IBM Cloud Catalog search

1.5 Power Systems Virtual Server service

To create a Power Systems Virtual Server service, you must search for Power Systems Virtual Server in the catalog's search box and click the Power Systems Virtual Server tile as shown in Figure 1-9.

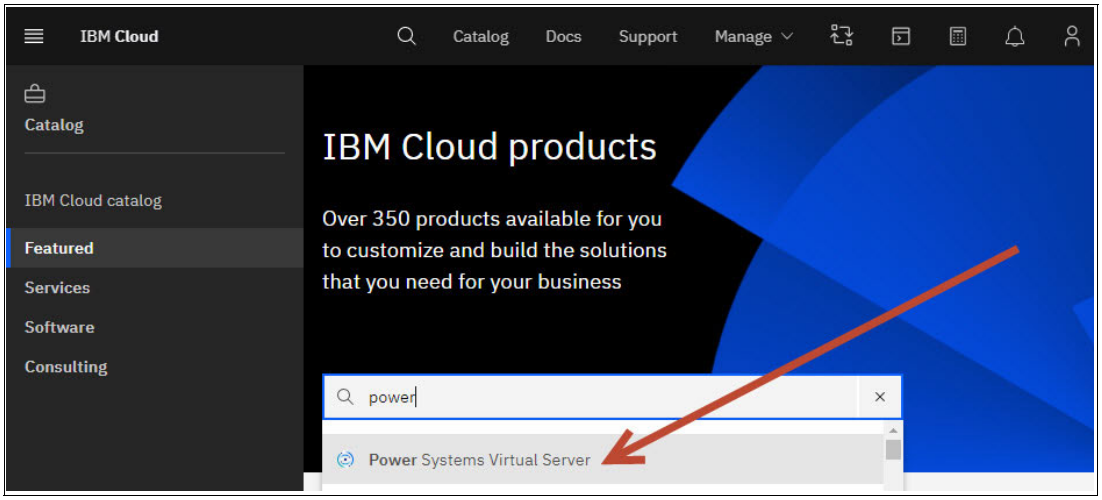


Figure 1-9 Search for Power Systems Virtual Server

After clicking to the Power Systems Virtual Server tile, a new window comes up, where you can specify a name for your service and choose where you want to deploy your Power Systems Virtual Server instances. Refer to Figure 1-10 on page 20.

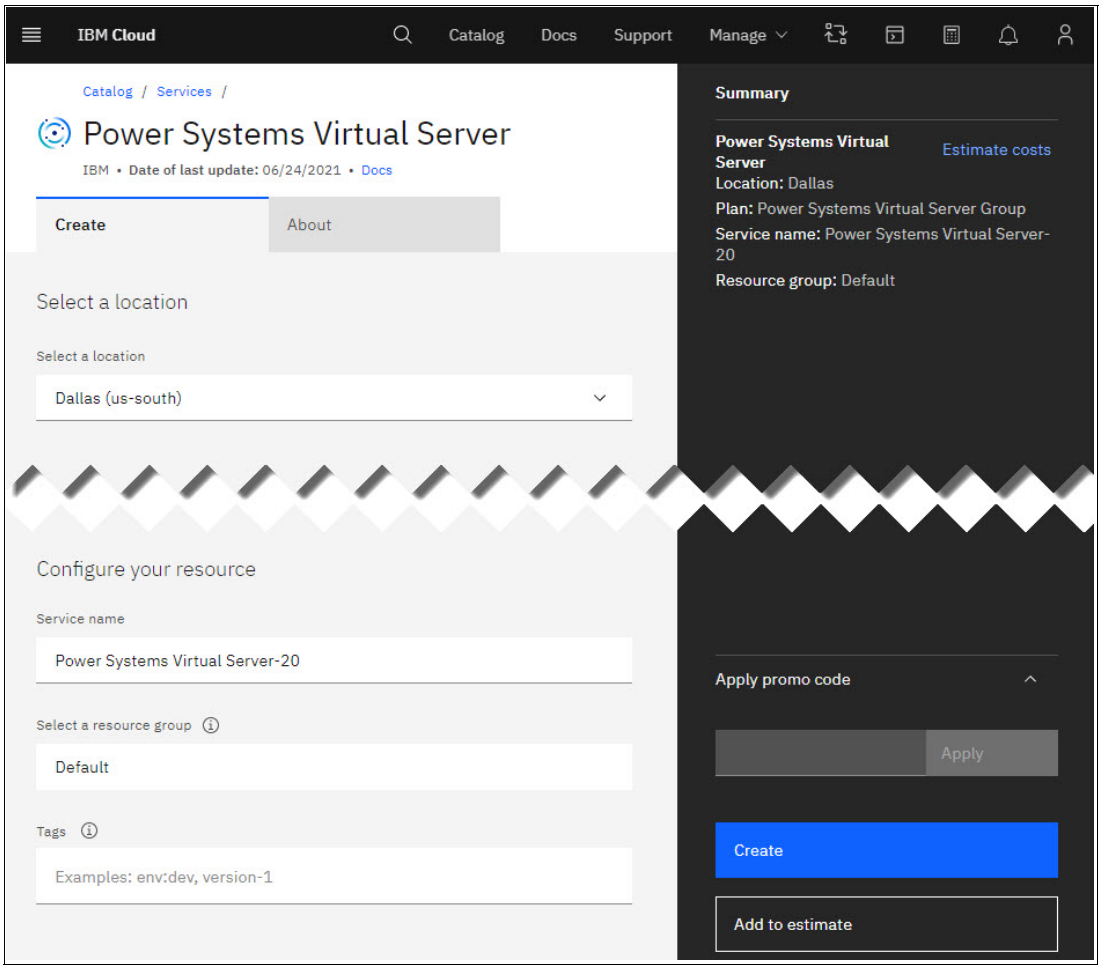


Figure 1-10 Service name and location

After clicking **Create** (the blue button), you get into another page titled Resource List, which contains your list of account resources. You can use this page to view and manage your platform and infrastructure resources in your IBM Cloud.

Another way to access the Resource List page is by clicking the navigation menu (the top-left *hamburger* icon) and then click Resource List on the Dashboard menu. Refer to Figure 1-11.

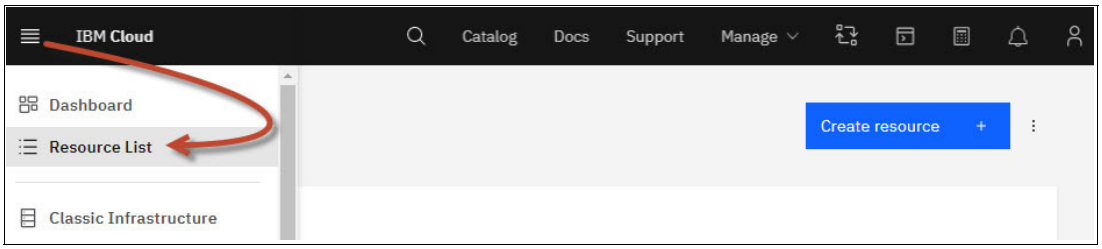


Figure 1-11 Resource List on Dashboard menu

You can search for resources from anywhere in the IBM Cloud by entering the resource or tag in the search field from the menu bar. Figure 1-12 on page 21 shows the result of a Power Systems Virtual Server that you have created. All Power Systems Virtual Servers are under **Services and software** resources.

Each resource is displayed in its row, and an Actions icon is included at the end of the row. Click the Actions icon to start, stop, rename, or delete a resource.

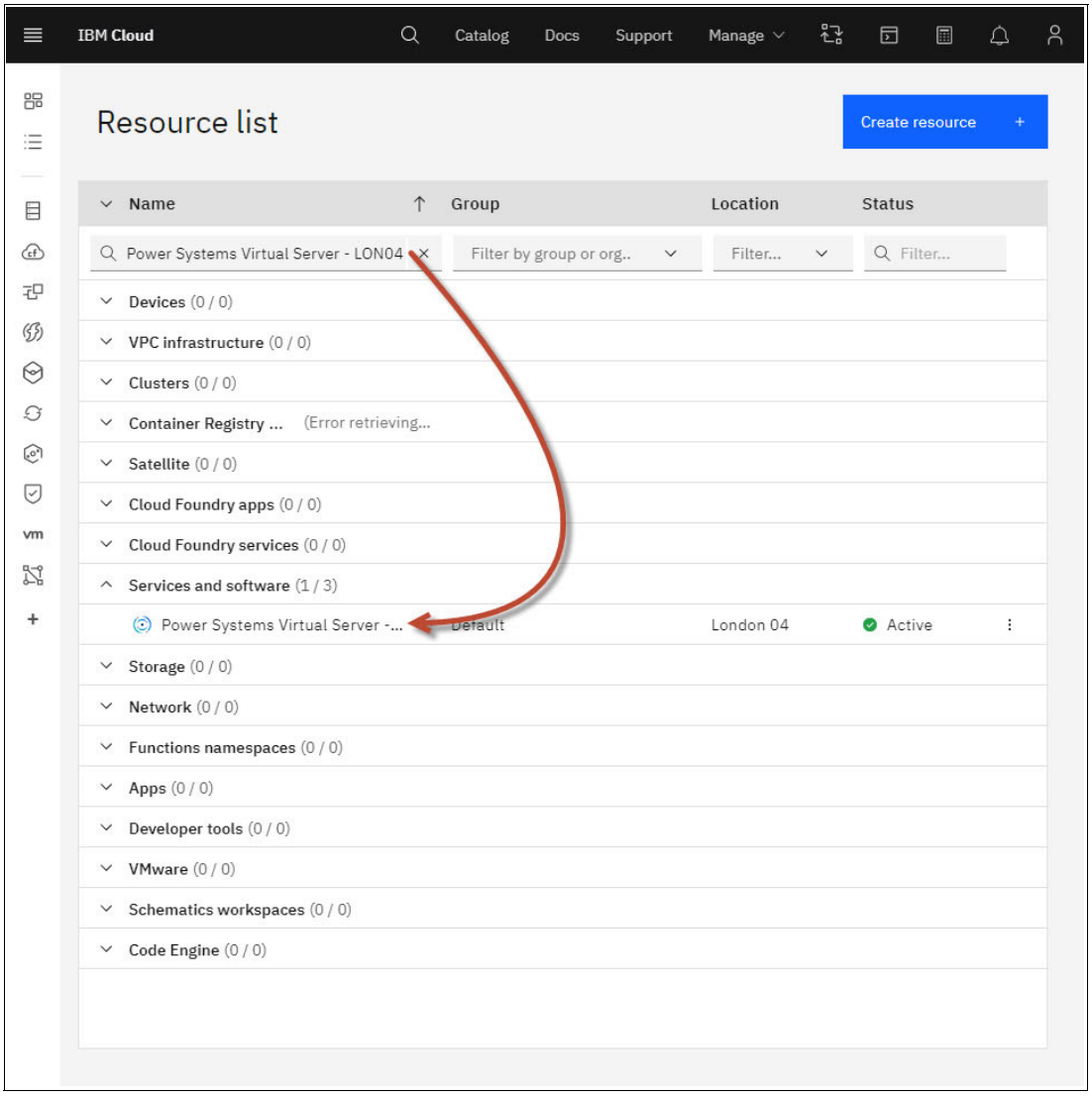


Figure 1-12 Search for resources in the IBM Cloud

1.6 Power Systems Virtual Server instance

You can work with your resources in various ways from your resource list. To directly manage the Power Systems Virtual Server service, click the resource's name to go to the resource details page as shown in Figure 1-13 on page 22.

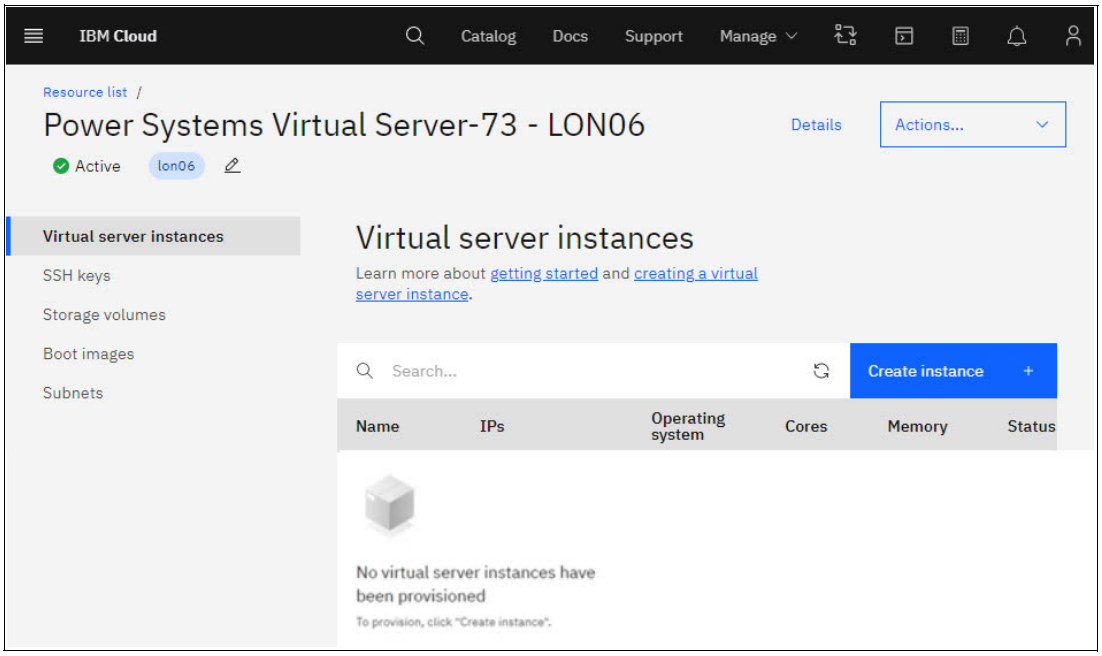


Figure 1-13 Virtual servers instances section

Click **Create instance button** to create a Power Systems Virtual Server instance (VSI), for example LPAR or VM, then complete the required fields under the Virtual servers instances section. The total due per month is dynamically updated in the Order Summary based on your selections as shown in Figure 1-14. You can easily create a cost-effective Power Systems Virtual Server instance that satisfies your business needs.

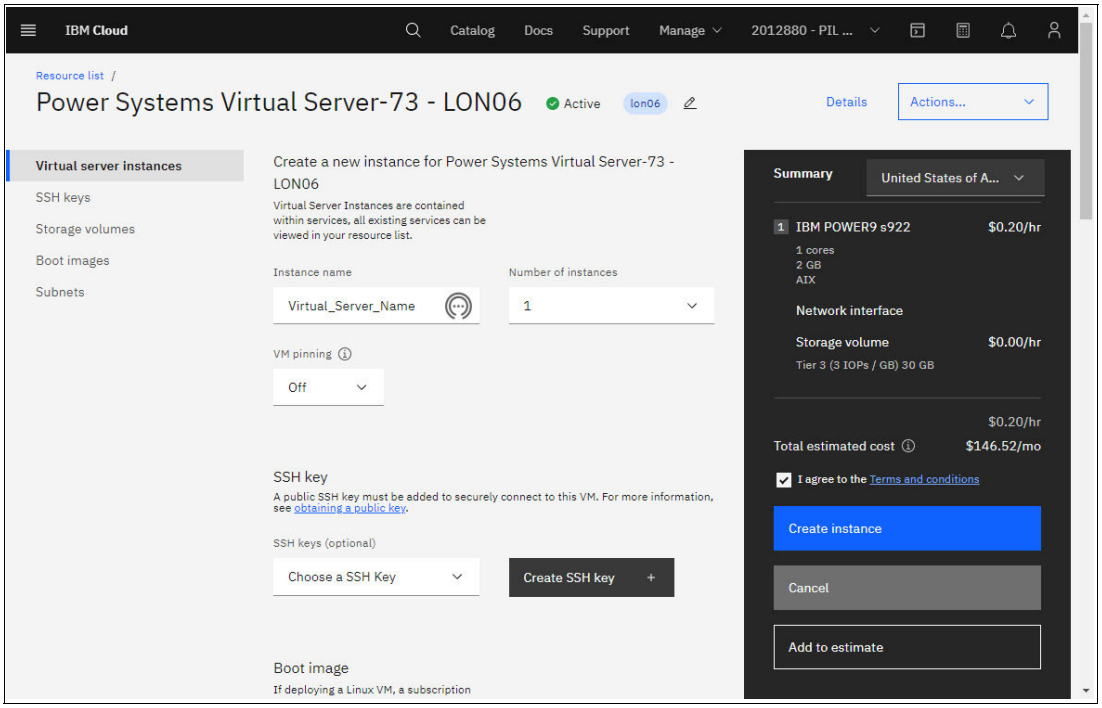


Figure 1-14 Virtual servers instances section and summary cost

Additionally to the instance, you need to provide details for the following fields:

Number of instances

Specify the number of instances that you want to create for the Power Systems Virtual Server. If you specify more than one instance, additional options are available, such as hosting all instances on the same server or not, and VM pinning. You can choose to soft pin or hard pin a VM to the host where it is running. When you soft pin a VM for high availability, PowerVC automatically migrates the VM back to the original host after the host is back to its operating state. The hard pin option restricts the movement of the VM during remote restart, automated remote restart, DRO, and live partition migration.

SSH key

Choose an existing SSH key or create one to connect to your Power Systems Virtual Server securely.

Machine type

Specify the machine type. The machine type that you select determines the number of maximum cores and maximum memory that is available.

Cores

There is a core-to-vCPU ratio of 1:1. For shared processors, fractional cores round up to the nearest whole number. For example, 1.25 cores equal two vCPUs.

Memory

Select the amount of memory for the Power Systems Virtual Server.

Boot image

When you select Boot image, the Power Systems Virtual Server user interface allows you to select boot images from a group of stock images or the list of stock images in your catalog.

Attached volumes

You can either create a new data volume or attach an existing one that you defined in your account.

Network interfaces

At least one private or public network is required. Network interfaces are created by adding a public network, private network, or both. When adding an existing private network, you can choose a specific IP address or have one auto-assigned.

1.6.1 VSI ready to use

After clicking Create an instance, you receive some pop-up messages about your instance, network, and disk space creation. Then you see the main VSI panel as shown in Figure 1-15. Note the status sequence: initially Build, then Warning, and finally Active.

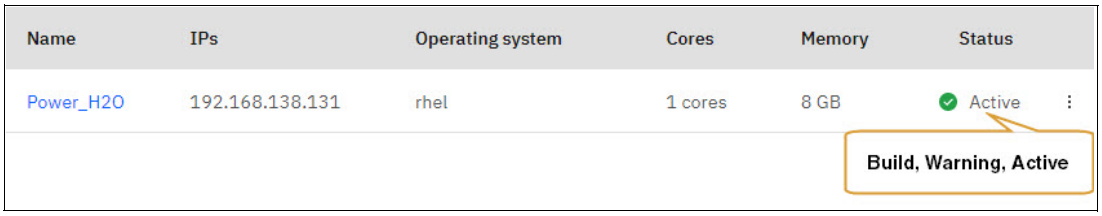


Figure 1-15 VSI status

Now that you have your VSI running, you see an Actions icon included at the end of the row. By clicking the icon, you get a pop-down menu where you can shutdown, restart, open a console, or delete your instance as shown in Figure 1-16. If you click the open console, you get a new window with the login prompt for your system.

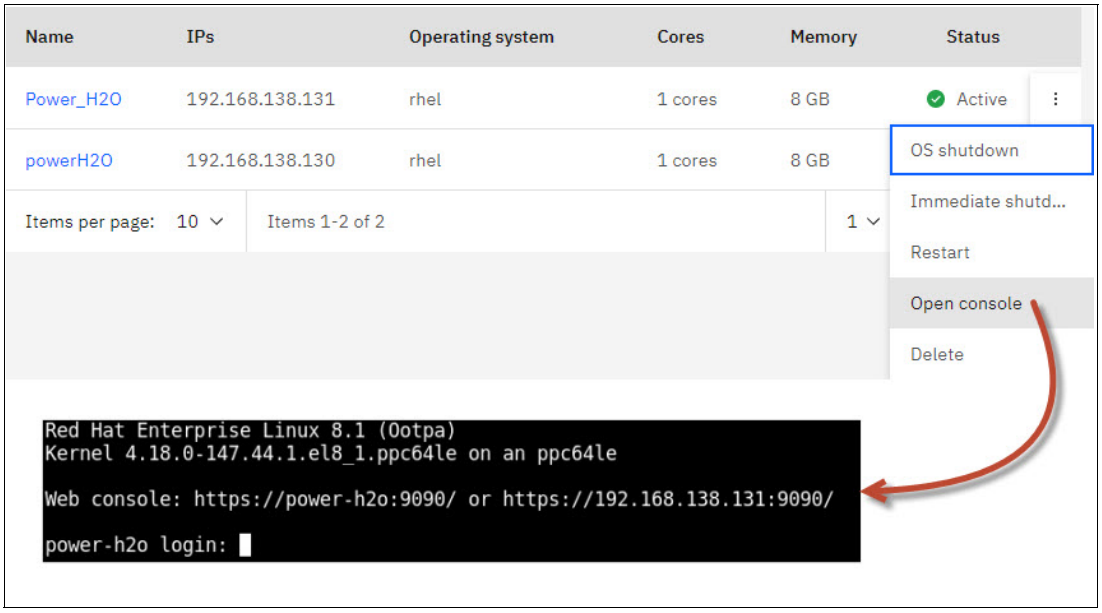


Figure 1-16 Open VSI console

The following chapters in this publication expand and show more details about managing the Virtual Server instances and the associated resources.

2

IBM Power Systems Virtual Server backup and migration overview

IBM Power Systems Virtual Server resources offer simple offering to grow your infrastructure at your own rate. You can deploy new Instance that are easy managed and run workloads on the Cloud.

The starting point is planning the methodology to use and the optimal goal.

This chapter provides the following sections:

2.1 A brief introduction

IBM Power Systems Virtual Server is the scalable, cost-effective way to run your IBM AIX, IBM i and Linux workloads in the IBM public cloud.

A key question for AIX clients looking to take advantage of its benefits is:

- how do I move my existing workloads to Power Systems Virtual Server?

At the highest level, the process for most clients involves performing a save on-premises, transferring the save to Power Systems Virtual Server and performing a restore.

For some clients using Power Virtualization Center (PowerVC), the move to Power Systems Virtual Server involves using PowerVC to capture an Open Virtualization Appliance (OVA) image of the AIX workload and transferring the OVA to Power Systems Virtual Server.

For others, capturing a copy of an image by way of the **mksysb** command and restoring it to a Power Systems Virtual Server is a simple option. Completing the migration processing actuality, however, involves many important details. AIX, Power Systems Virtual Server and networking skills are required.

The goal of this publication is to provide step-by-step instructions for moving an AIX workload to Power Systems Virtual Server using one of these most popular methods and providing a view of alternatives.

We conclude with some additional networking considerations when migrating multiple systems.

Note: The focus of the chapter is migrating the AIX operating system (OS) and disk/file system configuration. Although the techniques described here can be used to move at least an initial save of a specific application, going into specific database or application requirements or synchronizing the data after a migration is beyond the scope of this book.

2.1.1 Migration of an AIX image Using Cloud Object Storage

We will demonstrate how to install a **mksysb** backup from an on-premises system to a Power Systems Virtual Server Instance using IBM Aspera® file transfer onto Cloud Object Storage and restore it into a Power Systems Virtual Server Instance.

Having a fully operational Power Virtual Server environment is a prerequisite for this approach.

Setting up the Power Virtual Server is beyond the scope of this chapter but you can find it in Chapter 4, “Recommendations for IBM AIX and Linux deployments on IBM Power Systems Virtual Server” on page 77.

Also note that there are migration options other than **mksysb**. We can choose to migrate an AIX VM to IBM cloud using the export feature of PowerVC. For this we need to make sure that the AIX VM which we are migrating is managed by PowerVC. This is out of scope for this publication but there are tutorials to step through a PowerVC based migration.

For more information to learn how to create an ova image of a VM using IBM PowerVC, refer to the following website:

https://www.ibm.com/docs/en/powervc/2.0.0?topic=images-exporting

Solution components and requirements

Components migration using Aspera and Cloud Object Storage:

- AIX Virtual Server Instance.
- Cloud Object Storage Service and APIs.
- Aspera client on a notebook.
- **`Curl`** command and other optional AIX commands.
- **`mksysb`** for AIX.

Requirements

In addition to having a fully operational Power Virtual Server environment as a prerequisite, the migration requires a **`mksysb`** backup taken from the on-premises system to be migrated. For the purposes of this publication, there is an image already captured and saved from an on-premises system named hugo-vasco as shown in Figure 2-1.

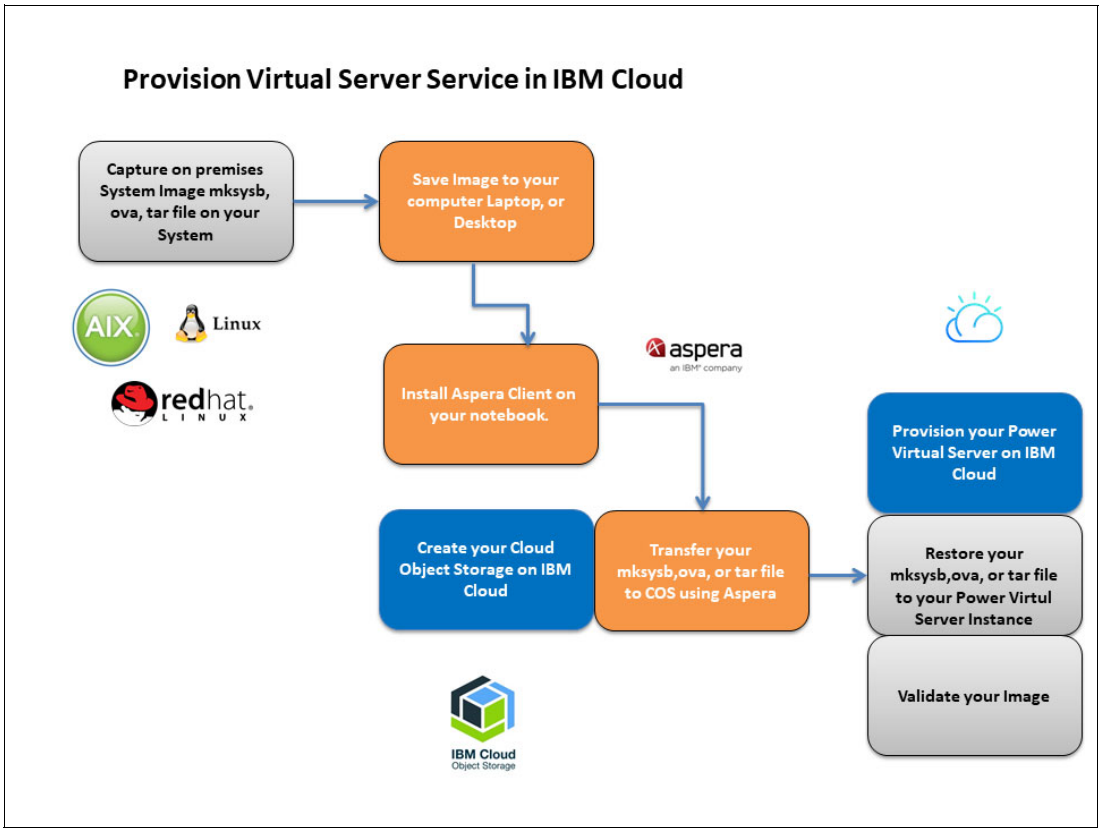


Figure 2-1 Provision a Virtual Server

Some of these components were already used and created if you followed the steps in 1.6, “Power Systems Virtual Server instance” on page 21. The boxes in gray are components you have already completed if you completed before. Our focus for this lab will be the 3 steps in the blue boxes. Instructions for the 3 optional steps in the orange boxes are included for your reference or to try out as it is more representative of a real-world scenario. Each step will have multiple instructions so we tried be as detailed as possible. We are also bringing you other alternatives to do the same work on this publication.

The steps included instructions with panel captures and red boxes indicating areas of focus and explicit commands to execute in your environment. Screen captures and naming conventions can be different depending on your environment.

2.1.2 Implementation

This section describes the recovery of an mksysb backup that was previously uploaded to our cloud bucket, to a virtual machine instance on IBM Cloud.

Migration by way of Aspera and Cloud Object Storage

Select you Power Systems. Check that you have an active Power Systems Virtual Server. Refer to Figure 2-2.

Tip: Use the Resource List on the left side pull-down menu and look under Services to find your instance.

This scenario uses Hugo-Vasco-AIX on-premises and Hugo-Vasco-Oncloud-AIX in the IBM Cloud.

Figure 2-2 Select service from Service list

Check that you have an mksysb image that we will be using onto your machine.

Note: The **mksysb** command creates a backup of the operating system (that is, the root volume group). Creating a mksysb of the on-premises system is out of the scope of this lab but you can find more information at the following website:

https://www.ibm.com/support/knowledgecenter/en/ssw_aix_72/m_commands/mksysb.html

2.1.3 Creating an instance of IBM Cloud Object Storage in IBM Cloud

At this point, this section describes how to create an instance of a IBM COS (Cloud Object Storage), describes how to use the tool of the IBM Cloud Object Storage, creates your buckets, defines security and downloads and uploads objects.

What is IBM Cloud Object Storage?

Cloud object storage is a format for storing unstructured data in the cloud.

Object storage is considered a good fit for the cloud because it is elastic, flexible and it can more easily scale into multiple petabytes to support unlimited data growth.

The architecture stores and manages data as objects compared to block storage, which handles data as blocks, and logical volumes and file storage which store data in hierarchical files. IBM Cloud Object Storage (COS) makes it possible to store practically limitless amounts of data, simply and cost effectively. It is commonly used for data archiving and backup; for web and mobile applications; and as scalable, persistent storage for analytics.

Flexible storage class tiers with a policy-based archive let you effectively manage costs while meeting data access needs.

The integrated IBM Aspera high-speed data transfer option makes it easy to transfer data to and from IBM Cloud Object Storage, and query-in-place functionality allows you to run analytics directly on your data.

Login to the IBM cloud console, and go to the Catalog and search for the Object Storage tile and select it as shown in Figure 2-3.

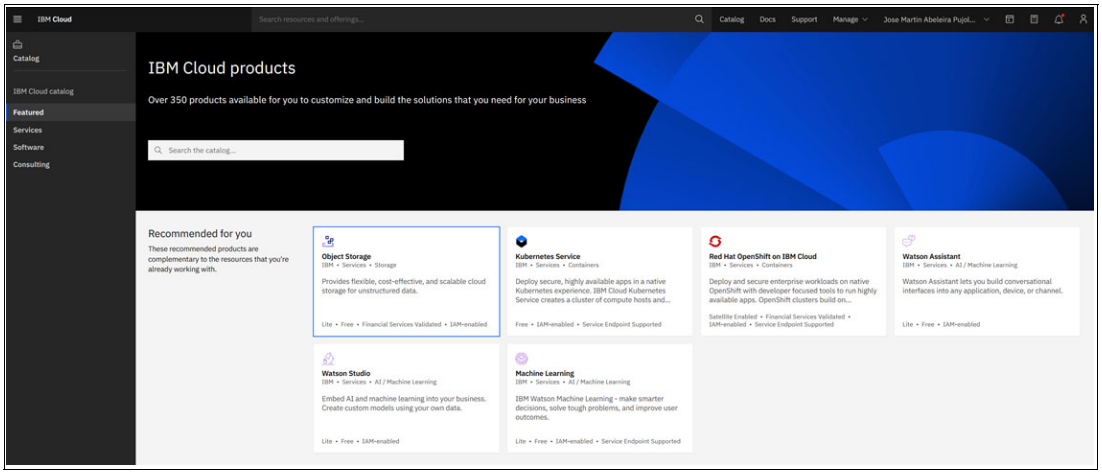


Figure 2-3 Create an Cloud Object Storage in your IBM cloud account

Give the service instance a name and choose either lite or standard plan. In our case we chose a lite plan and the instance name given was redbooks-pvs-Decano (you can specify a different name to match your lab or id and ignore the lite plan warnings if present) as shown on picture Figure 2-4.

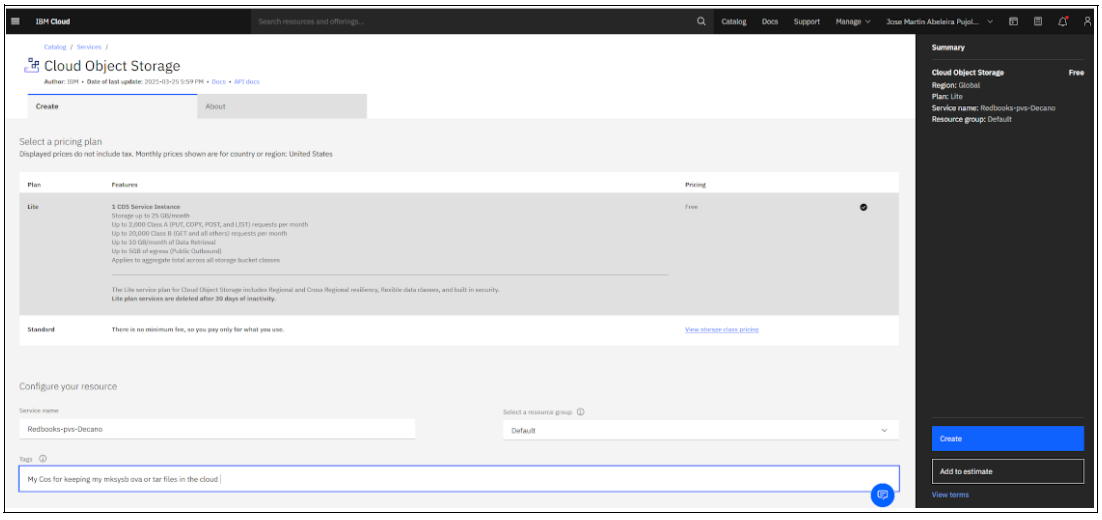


Figure 2-4 Create your COS bucket

You can also check on the pricing depending on how much data you will need to store.Click create and you will be automatically be redirected to your new instance as shown on Figure 2-5.

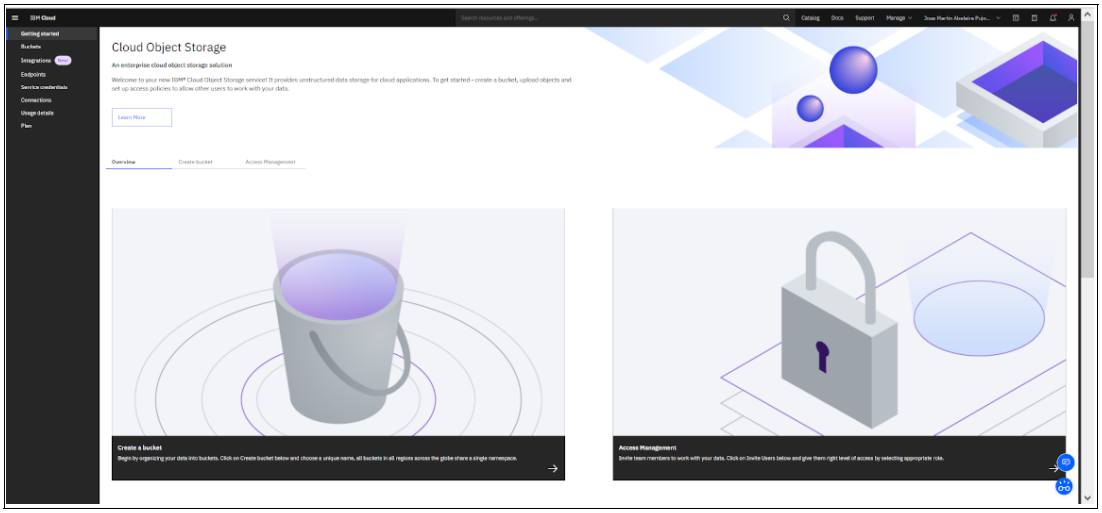


Figure 2-5 Using your bucket, or setting up security

The next step is to create a bucket to store data, choose a name of the bucket with correct permissions as shown in Figure 2-6.

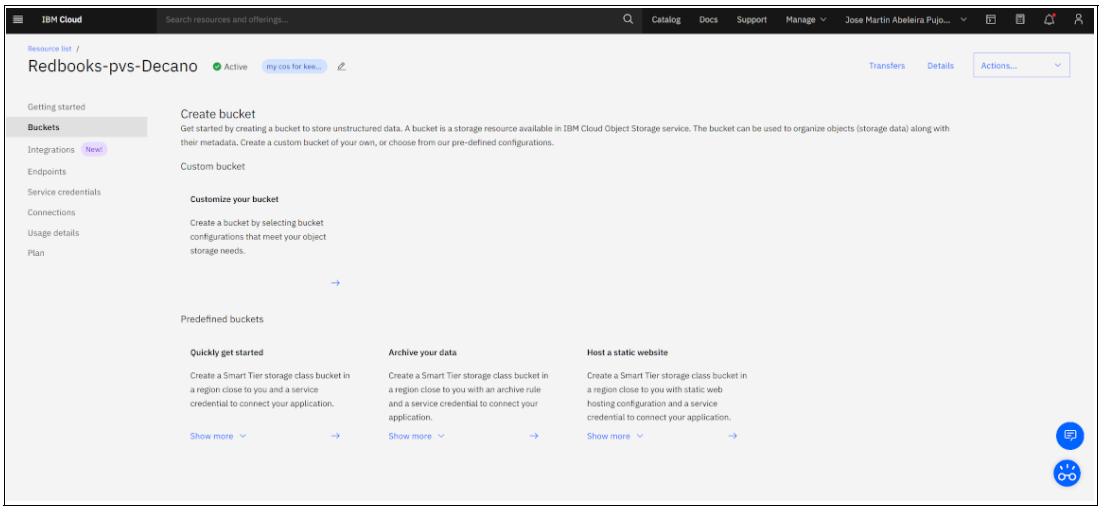


Figure 2-6 Working with your COS, to create a bucket

Select customize your bucket, give it a name (here we used “gpc-decano-store”), selected“regional”, location= “eu-gb” and storage class “Vault” (you can specify a different name and region to match your needs). Refer to Figure 2-7 on page 31.

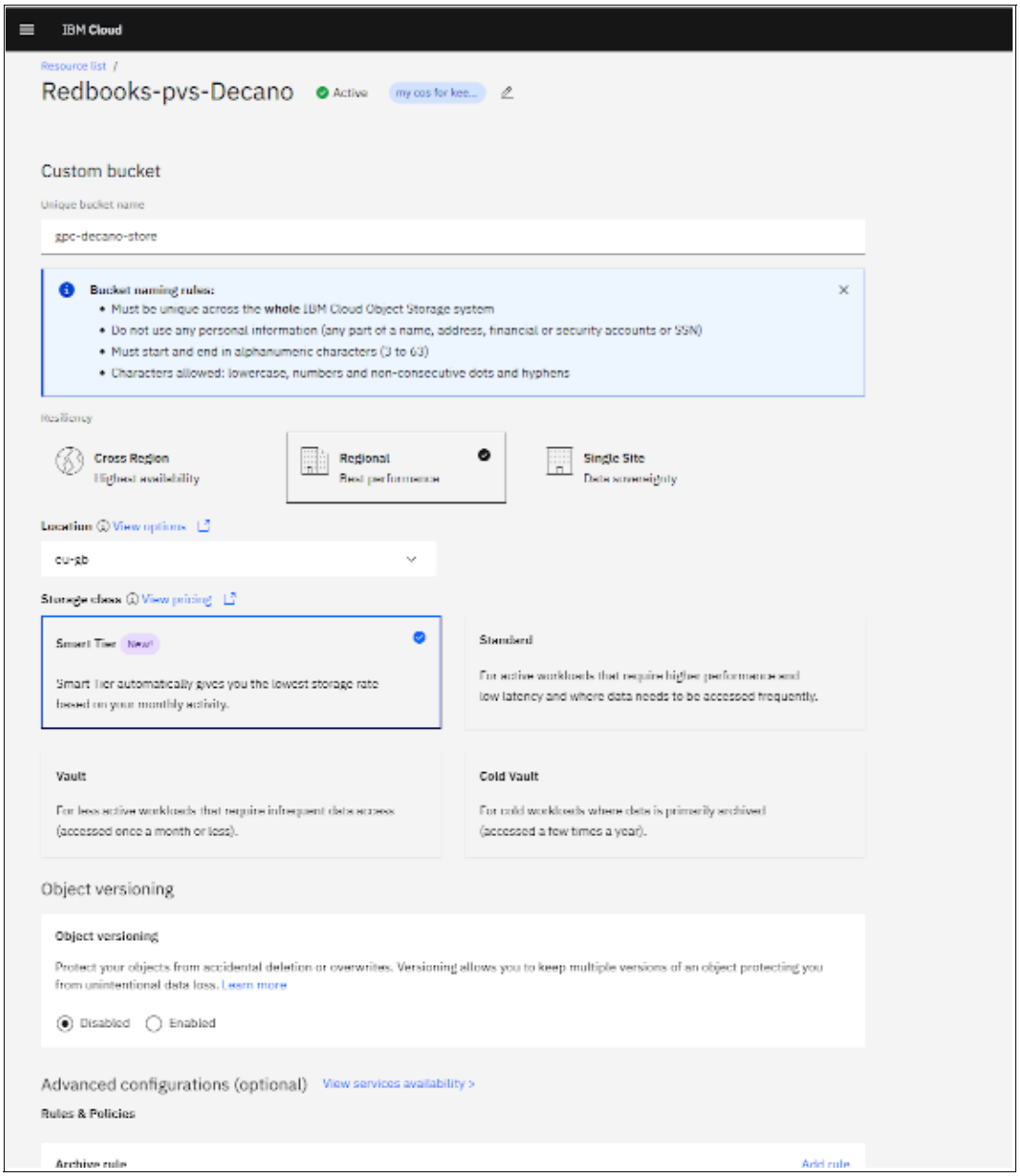


Figure 2-7 Customizing COS bucket details

When you are finished, click create. Check under the Buckets tab that it has been created as shown in Figure 2-8 on page 32.

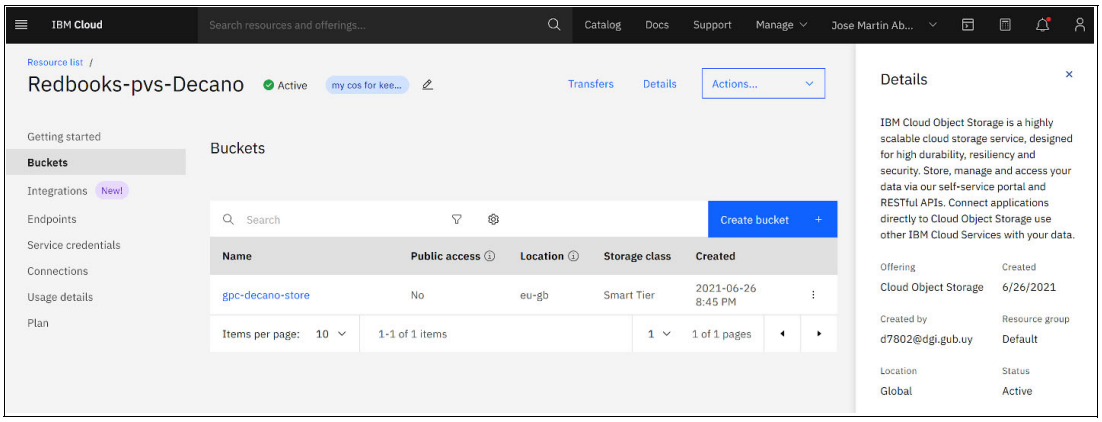


Figure 2-8 Verify your bucket configuration

After creation of the bucket go to create Service Credentials, which will provide necessary information to connect an application to Object storage on the left hand side menu as shown in Figure 2-9.

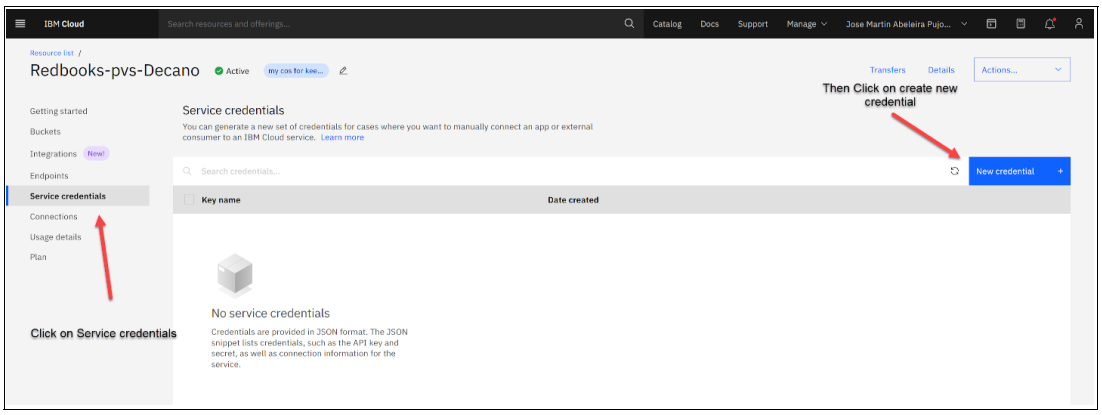


Figure 2-9 Create Service credentials for your bucket

Select “New credential + “on the top right hand side (note that selection locations can vary based on your window sizes). Fill in the pop-up with a credential name (in this case “Service credentials-hugo-vasco”), assign role as “Manager”. Optionally toggle “Include HMAC Credential” to On under advanced options if you will use NFS (out of scope in this lab) before clicking Add. Refer to Figure 2-10 on page 33.

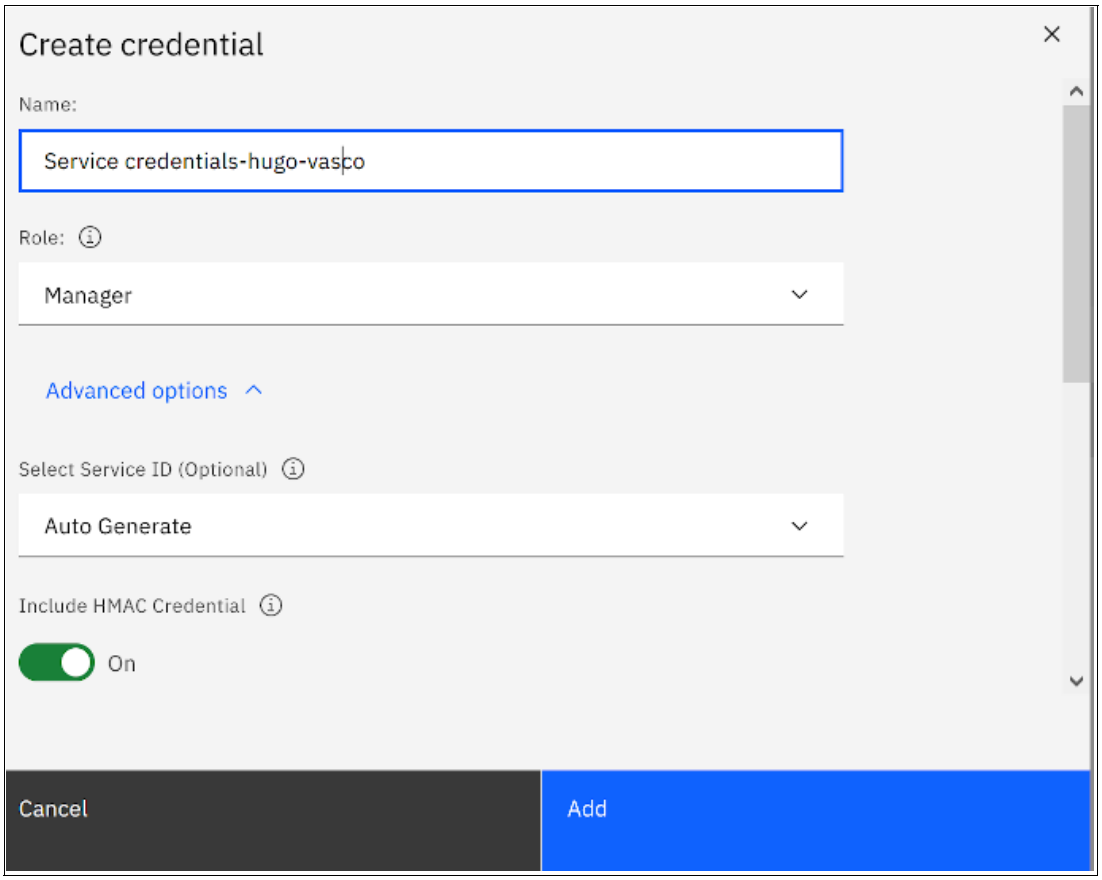


Figure 2-10 COS Create credential

Figure 2-11 shows the new Service Credential created. Click the down arrow by the credential name to view the credentials.

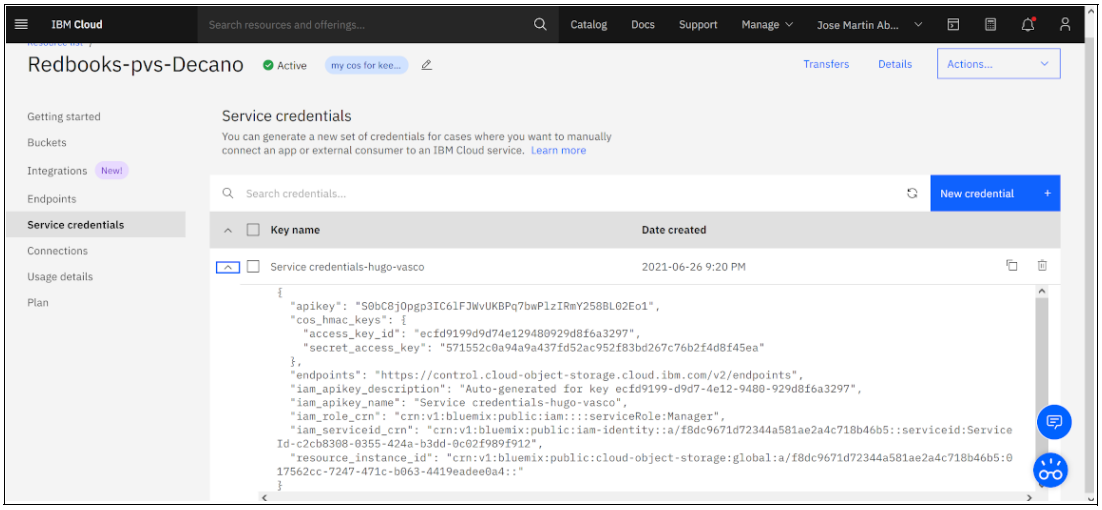


Figure 2-11 COS list Service Credential Details

You can start uploading any file using the Aspera connect which is a built in feature. You can set Aspera as your default for any uploads. For more information about configuring Aspera high speed transfer in IBM Cloud, refer to the following website:

https://cloud.ibm.com/docs/services/cloud-object-storage/iam?topic=cloud-object-storage-aspera

Installing Aspera Client on your machine

This step is optional if using pre-loaded mksysb, tar or ova file.

What is IBM Aspera Connect?

Aspera Connect is a file transfer browser plug-in that allows web applications to take advantage of fast-enhanced transfers. It can be used to initiate downloads and uploads, display file selection dialogs, and handle drag and drop events.

You need to install the IBM Aspera Connect client on your machine. Refer to Figure 2-12.

The following link provides the instructions:

https://downloads.asperasoft.com/connect2/?_ga=2.198106671.1294498643.1587399103-940898264.1586790978

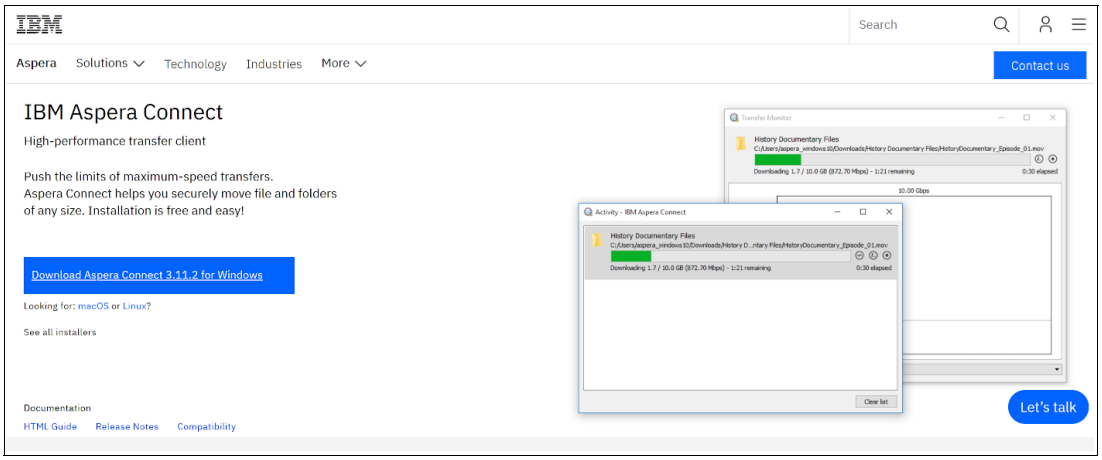


Figure 2-12 IBM Aspera Connect - COS installation

Tip: Follow Aspera instructions for installation as your machine environment can be different on your device. Additional screen captures and step by step instructions have not been included in this document.

Copying Image of AIX VM to Cloud Object Store Bucket

This step is optional if using a pre-loaded mksysb. The next step is to transfer the mksysb image saved on our machine to the Cloud Object Storage we created earlier.

We will use the bucket (here named “gpc-decano-store”) to store the mksysb file (for example, aix_7.2_TL5.SP1.mksysb).

You can drag and drop the mksysb file or click upload to select the file as shown in Figure 2-13 on page 35.

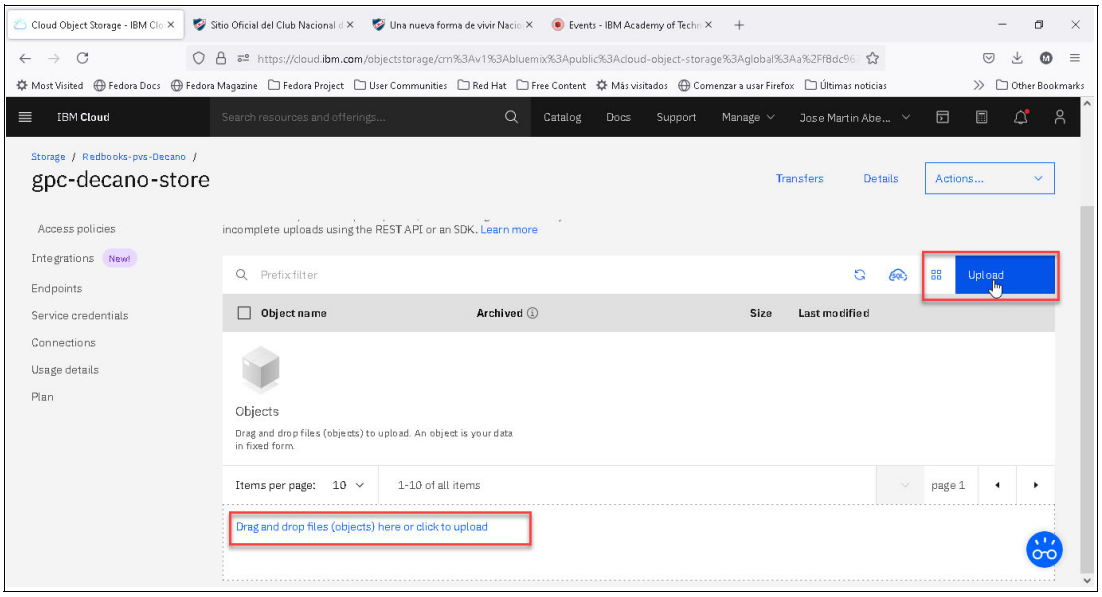


Figure 2-13 COS file upload window

Click Aspera transfers provides information about active and completed transfers as shown in Figure 2-14, including completion status, start and estimated end times, and actual end times.

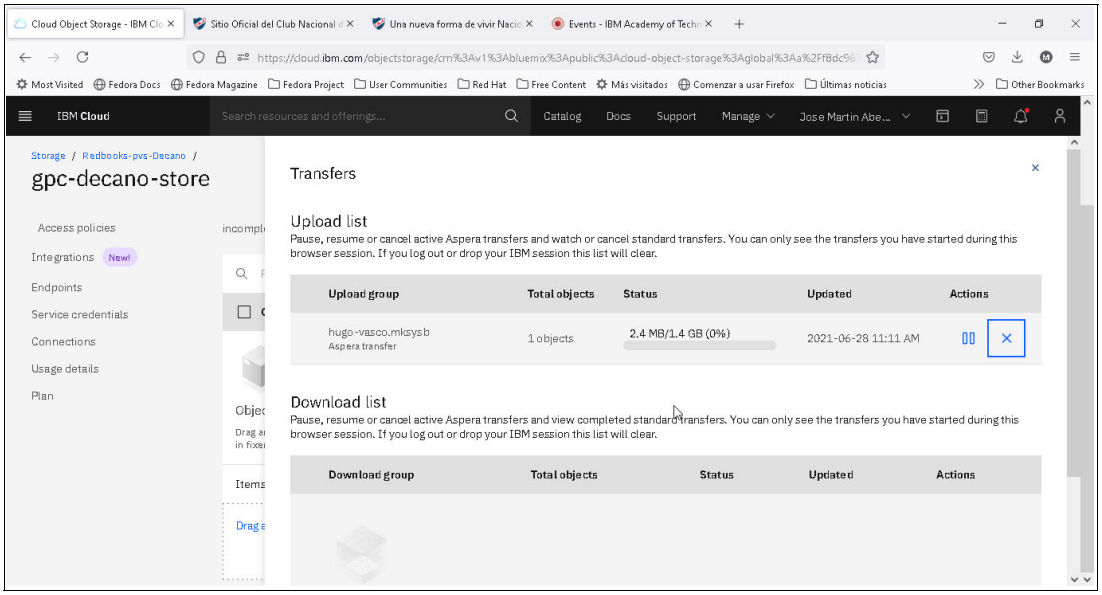


Figure 2-14 COS to Aspera transfer details

Depending on your network bandwidth, uploading the mksysb can take from a few minutes to a few hours. Refer to Figure 2-15 on page 36.

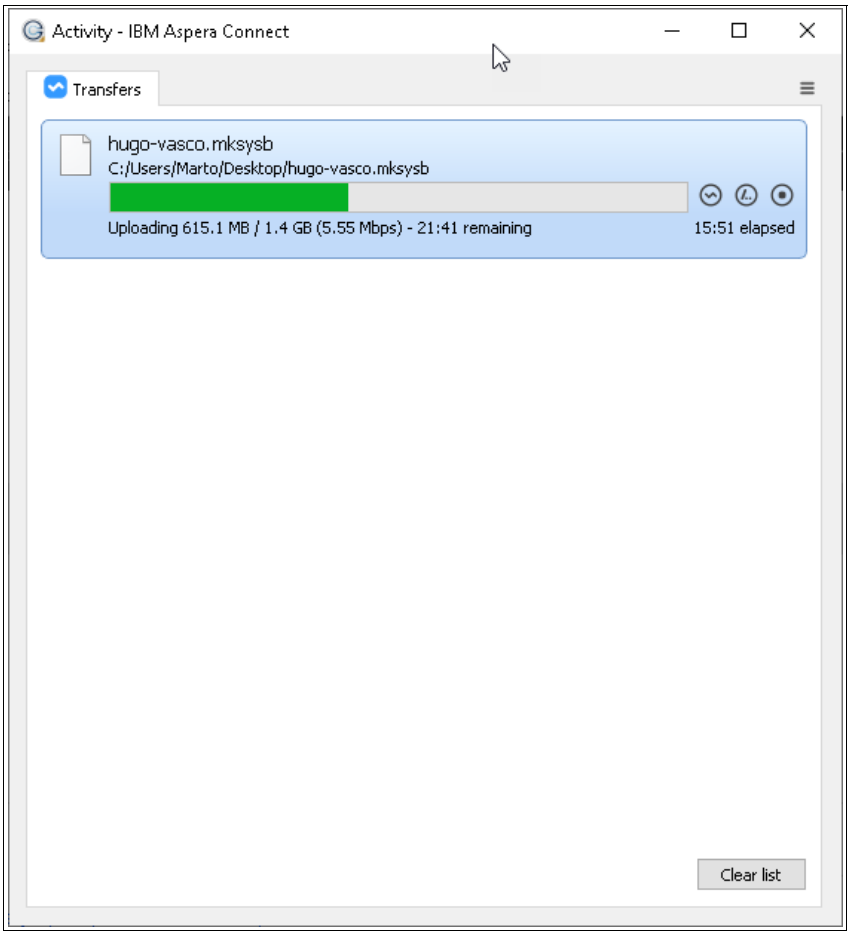


Figure 2-15 Aspera client COS upload progress window

Note: You can gzip the mksysb to reduce time for the transfer.If your internet speeds are slow and the estimated time to complete the transfer is long.

If you had it, or you already loaded an image, you can access a preloaded mksysb.

You can look at your uploaded files inventory by selecting Objects on the left hand menu, select the object you are interested in and select Object details for an overview or lifecycle information about the right hand side as shown in Figure 2-16 on page 37.

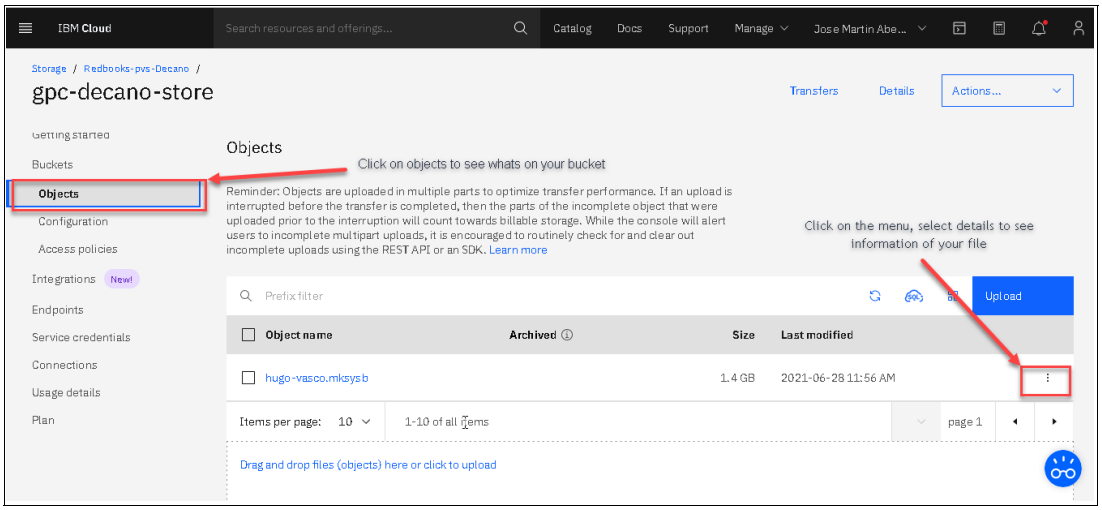


Figure 2-16 Listing uploaded Objects in your bucket

Tip: Try to upload a small file to check everything works before uploading the mksysb.

Figure 2-17 shows the COS object detailed information pane.

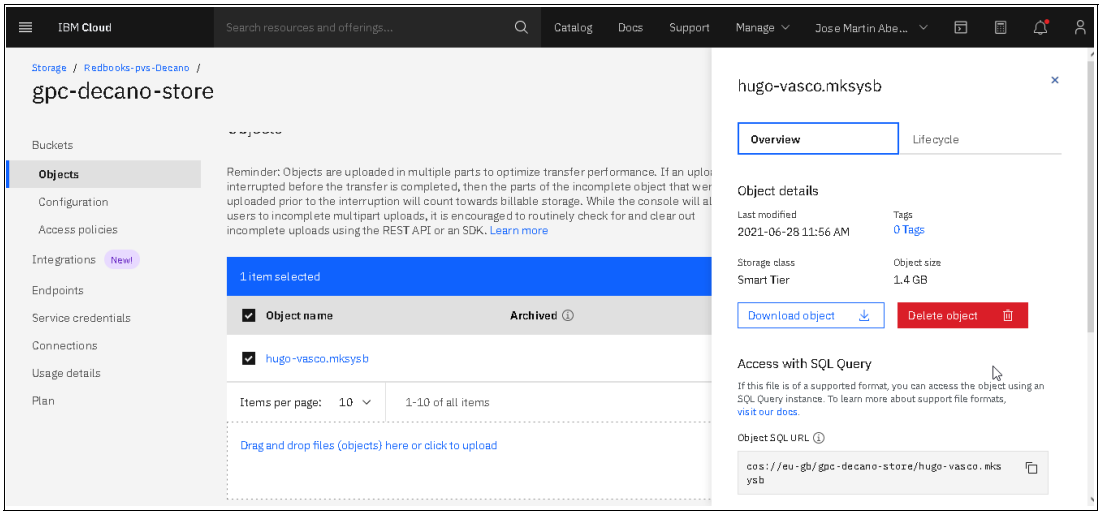


Figure 2-17 COS object detailed information

Import Image from Cloud Object Storage Bucket to PSVS

Now we will need to import the mksysb to our Power Systems Virtual Server instance. There are several methods / options to access an IBM Cloud Object Storage Bucket to/from a Power Systems Virtual Server like using IBM COS CLI, or Minio Client, rclone, using s3 FSNFS, and so on. Review prerequisites of each option/method depending on the platform you want to access your storage bucket from (Linux x86, Windows, MacOS, Linux pp64 ...).

More details and prerequisites of each method are at the following URLs:

- IBM COS CLI

  https://cloud.ibm.com/docs/cloud-object-storage?topic=cloud-object-storage-cli-plugin-ic-cos-cli

- AWS CLI

  https://cloud.ibm.com/docs/services/cloud-object-storage?topic=cloud-object-storage-aws-cli

- S3fs

  https://cloud.ibm.com/docs/services/cloud-object-storage?topic=cloud-object-storage-s3fs

- Minio Client

  https://cloud.ibm.com/docs/services/cloud-object-storage?topic=cloud-object-storage-minio

- Rclone

  https://cloud.ibm.com/docs/services/cloud-object-storage?topic=cloud-object-storage-rclone

You can be productive with the command line in most environments with IBM Cloud Object Storage and cURL. This is what we will be using in this lab.More details about usage of curl to access an IBM COS Bucket can be found at the following website:

https://cloud.ibm.com/docs/services/cloud-object-storage?topic=cloud-object-storage-curl

Recall that we have already have information about Service credentials and Endpoints for our COS when we created it. We need to capture some details for these and set them as environment variables in our Power Systems Virtual Server instance.

From the IBM Cloud Resource list menu, select Storage, then select the COS you created (e.g.named here Cloud Object Storage Redbooks-pvs-Decano), select the bucket you created (for example, named here gpc-decano-store) and finally select Configuration as shown in Figure 2-18.

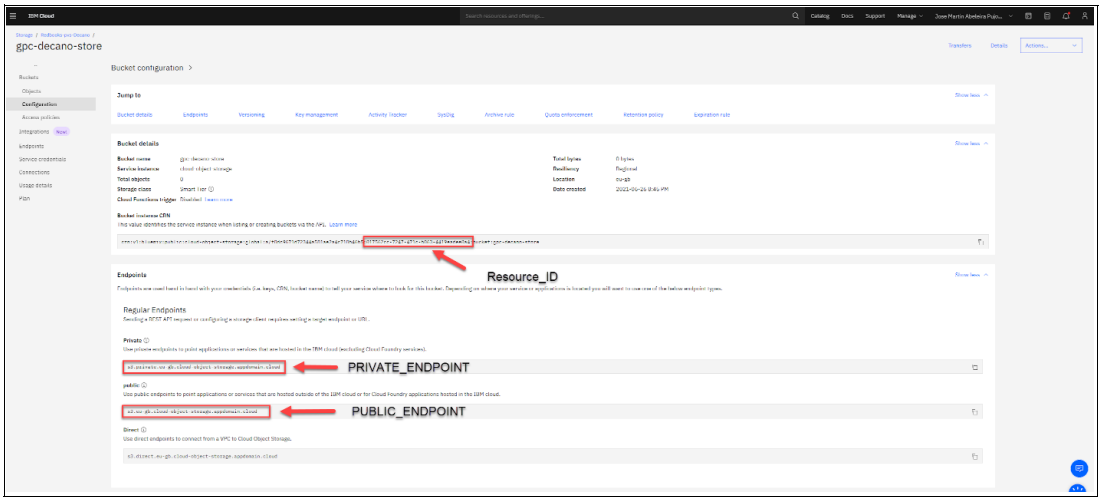


Figure 2-18 Take note of the resource ID

Make note of the information you need to save: the bucket resource ID and endpoints highlighted in RED on the configuration:

```
RESOURCE_ID="017562cc-7247-471c-b063-4419eadee0a4"
PRIVATE_ENDPOINT="s3.private.eu-gb.cloud-object-storage.appdomain.cloud"
PUBLIC_ENDPOINT="s3.eu-gb.cloud-object-storage.appdomain.cloud"
```

You also need the COS API key from the Service credentials tab as shown in Figure 2-19.

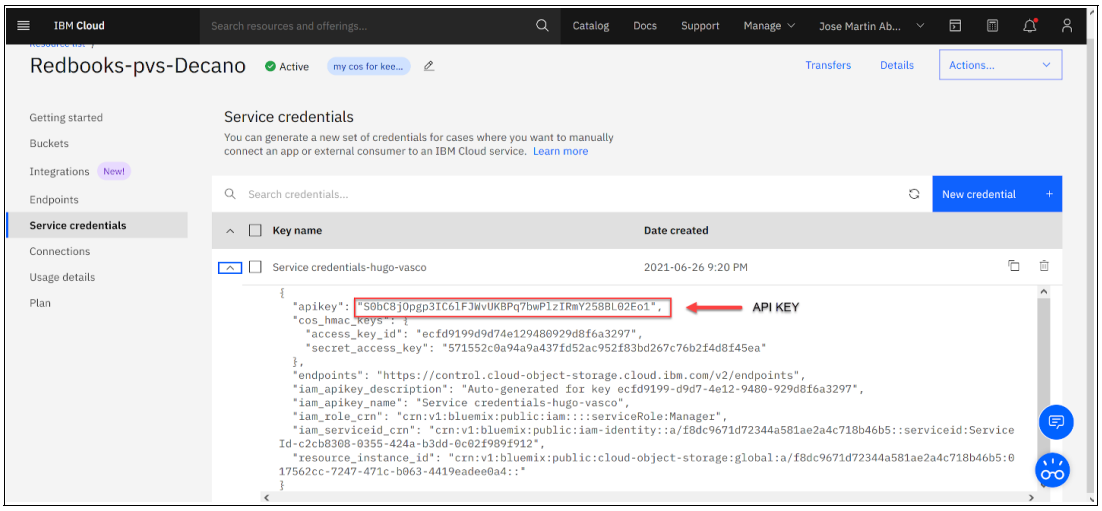


Figure 2-19 Get the API key from the bucket credentials

```
APIKEY="S0bC8jOpgp3IC6lFJWvUKBPq7bwPlzIRmY258BL02Eo1"
```

You are now ready to go to your Power Systems Virtual Server instance and set the data collected as environment variables. Go to Resource list Services select the Power Systems Virtual Server (here named Power Systems Virtual Server - LON04) and log into the instance you created (here hugo-vasco-aix-oncloud) through opening the console or by way of ssh as root and the password, using the external IP address.

After logged in, set the environment variables as shown in Example 2-1.

Example 2-1 Set environment variables for COS object access

```
#export RESOURCE_ID="017562cc-7247-471c-b063-4419eadee0a4"
# export PRIVATE_ENDPOINT="s3.private.eu-gb.cloud-object-storage.appdomain.cloud"
# export PUBLIC_ENDPOINT="s3.eu-gb.cloud-object-storage.appdomain.cloud"
# export APIKEY="S0bC8jOpgp3IC6lFJWvUKBPq7bwPlzIRmY258BL02Eo1"
```

The next step is to issue from the same login, the **cURL** command to request your own IAM Access token as shown in Example 2-2.

Example 2-2 Get COS Access token

```
# clear
# curl -X "POST" "https://iam.cloud.ibm.com/identity/token" \-H 'Accept:
application/json' \-H 'Content-Type: application/x-www-form-urlencoded'
\--data-urlencode "apikey=$APIKEY" \--data-urlencode "response_type=cloud_iam"
\--data-urlencode "grant_type=urn:ibm:params:oauth:grant-type:apikey" | python -m
json.tool | grep access_token
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  1805  100  1670  100   135   3939    318 --:--:-- --:--:-- --:--:--  4626
    "access_token":
"eyJraWQiOiIyMDIxMDYxOTE4MzciLCJhbGciOiJSUzI1NiJ9.eyJpYW1faWQiOiJpYWOtU2VydmljZUlk
LWMyY2I4MzA4LTAzNTUtNDIOYS1iM2RkLTBjMDJmOTg5ZjkxMiIsImlkIjoiaWFtLVNlcnZpY2VJZC1jMm
NiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJyZWFsbWlkIjoiaWFtIiwianRpIjoiMzg2
MjBhMjAtNDQwNyOOMDhhLThlNzItNGRiZDk5ZTBlM2ZiIiwiaWRlbnRpZmllciI6IlNlcnZpY2VJZC1jMm
```

```
NiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJuYW1lIjoiU2VydmljZSBjcmVkZW5OaWFs
cy1odWdvLXZhc2NvIiwic3ViIjoiU2VydmljZUlkLWMyY2I4MzA4LTAzNTUtNDIOYS1iM2RkLTBjMDJmOT
g5ZjkxMiIsInN1Yl9OeXBlIjoiU2VydmljZUlkIiwiYXVOaG4iOnsic3ViIjoiaWFtLVNlcnZpY2VJZC1j
MmNiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJpYW1faWQiOiJpYWOtaWFtLVNlcnZpY2
VJZC1jMmNiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJzdWJfdHlwZSI6IlNlcnZpY2VJ
ZCIsIm5hbWUiOiJTZXJ2aWNlIGNyZWRlbnRpYWxzLWh1Z28tdmFzY28ifSwiYWNjb3VudCI6eyJib3VuZG
FyeSI6Imdsb2JhbCIsInZhbGlkIjpOcnVlLCJic3MiOiJmOGRjOTY3MWQ3MjMONGE1ODFhZTJhNGM3MThi
NDZiNSIsImZyb3plbiI6dHJ1ZXOsImlhdCI6MTYyNDkwMTU2NywiZXhwIjoxNjIOOTA1MTY3LCJpc3MiOi
JodHRwczovL2lhbS5jbG91ZC5pYmOuY29tL2lkZW5OaXR5IiwiZ3JhbnRfdHlwZSI6InVybjppYmO6cGFy
YW1zOm9hdXRoOmdyYW5OLXR5cGU6YXBpa2V5Iiwic2NvcGUiOiJpYmOgb3BlbmlkIiwiY2xpZW5OX2lkIj
oiZGVmYXVsdCIsImFjciI6MSwiYW1yIjpbInB3ZCJdfQ.iCwazq26V5A3ydMnH1DYerBgLh2UPl_4Nooec
N-DWBb9jf8q6mA_Xn3ZQ8Pn2TWyz4uLGyqDNSWg7A8M-wL8YQLtsLLTfaB3qz6gOhXup7dsODEOXPmRIxj
oLqR1O7xx3PBfPGsob7BcRSdNHHCHcjW8UA3a3dqOg4knDTyULMSfNiyB2AHaBrH38oq_ViakIBB9c_r1I
ObfcXQKhrlJfszjZhsx7qseOIfYcDCXdRxoOjx9On6CrbwCReZjNxwtEj2GdrLDGhp6gfmntPf3TrOOpea
fi9IXyiq3fo4TeYZg1gDwgzrsg3yqLX1I3OcURfSuRpHWzqXBUjvaMA_Ogw",
```

And set to a new variable named ACCESS_TOKEN (your token will be different) as shown in Example 2-3.

Example 2-3 Set the variable name

```
# export
ACCESS_TOKEN="eyJraWQiOiIyMDIxMDYxOTE4MzciLCJhbGciOiJSUzI1NiJ9.eyJpYW1faWQiOiJpYWO
tU2VydmljZUlkLWMyY2I4MzA4LTAzNTUtNDIOYS1iM2RkLTBjMDJmOTg5ZjkxMiIsImlkIjoiaWFtLVNlc
nZpY2VJZC1jMmNiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJyZWFsbWlkIjoiaWFtIiw
ianRpIjoiMzg2MjBhMjAtNDQwNyOOMDhhLThlNzItNGRiZDk5ZTBlM2ZiIiwiaWRlbnRpZmllciI6IlNlc
nZpY2VJZC1jMmNiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJuYW1lIjoiU2VydmljZSB
jcmVkZW5OaWFscy1odWdvLXZhc2NvIiwic3ViIjoiU2VydmljZUlkLWMyY2I4MzA4LTAzNTUtNDIOYS1iM
2RkLTBjMDJmOTg5ZjkxMiIsInN1Yl9OeXBlIjoiU2VydmljZUlkIiwiYXVOaG4iOnsic3ViIjoiaWFtLVN
lcnZpY2VJZC1jMmNiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJpYW1faWQiOiJpYWOta
WFtLVNlcnZpY2VJZC1jMmNiODMwOCOwMzU1LTQyNGEtYjNkZCOwYzAyZjk4OWY5MTIiLCJzdWJfdHlwZSI
6IlNlcnZpY2VJZCIsIm5hbWUiOiJTZXJ2aWNlIGNyZWRlbnRpYWxzLWh1Z28tdmFzY28ifSwiYWNjb3Vud
CI6eyJib3VuZGFyeSI6Imdsb2JhbCIsInZhbGlkIjpOcnVlLCJic3MiOiJmOGRjOTY3MWQ3MjMONGE1ODF
hZTJhNGM3MThiNDZiNSIsImZyb3plbiI6dHJ1ZXOsImlhdCI6MTYyNDkwMTU2NywiZXhwIjoxNjIOOTA1M
TY3LCJpc3MiOiJodHRwczovL2lhbS5jbG91ZC5pYmOuY29tL2lkZW5OaXR5IiwiZ3JhbnRfdHlwZSI6InV
ybjppYmO6cGFyYW1zOm9hdXRoOmdyYW5OLXR5cGU6YXBpa2V5Iiwic2NvcGUiOiJpYmOgb3BlbmlkIiwiY
2xpZW5OX2lkIjoiZGVmYXVsdCIsImFjciI6MSwiYW1yIjpbInB3ZCJdfQ.iCwazq26V5A3ydMnH1DYerBg
Lh2UPl_4NooecN-DWBb9jf8q6mA_Xn3ZQ8Pn2TWyz4uLGyqDNSWg7A8M-wL8YQLtsLLTfaB3qz6gOhXup7
dsODEOXPmRIxjoLqR1O7xx3PBfPGsob7BcRSdNHHCHcjW8UA3a3dqOg4knDTyULMSfNiyB2AHaBrH38oq_
ViakIBB9c_r1IObfcXQKhrlJfszjZhsx7qseOIfYcDCXdRxoOjx9On6CrbwCReZjNxwtEj2GdrLDGhp6gf
mntPf3TrOOpeafi9IXyiq3fo4TeYZg1gDwgzrsg3yqLX1I3OcURfSuRpHWzqXBUjvaMA_Ogw"
```

Finally, use a second **cURL** command as shown in Example 2-4 to access the mksysb in the COS bucket and copy it over to /tmp on your Power Systems Virtual Server instance.

Example 2-4 Access the mksysb in the COS bucket

```
# curl -O "https://$PUBLIC_ENDPOINT/gpc-decano-store/hugo-vasco.mksysb" -H
"Authorization: Bearer $ACCESS_TOKEN"
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 1475M  100 1475M    0     0  22.6M      0  0:01:05  0:01:05 --:--:-- 20.8M
#
# ls -lrt *.mksysb
-rw-r--r--    1 root     system   1547110400 Jun 28 15:53 hugo-vasco.mksysb
```

Note: First check that you have enough space in /tmp using the **df** command and increase it if needed.

it is important to direct (>) the output to a file (in this case to a file named hugo-vasco.mksysb, which is the same name as the mksysb we are copying from the Cloud Object Store bucket named gpc-decano-store). The resulting copied file (~1.5 GB).

2.1.4 Restore mksysb image onto Power Systems Virtual Server

Now we need to add additional disk, to restore the mksysb. Determine the size of disk required as per the original VM as shown in Example 2-5. For this book we added 60 GB of additional disk from the Power Systems Virtual Server Instance as shown in Figure 2-20.

Example 2-5 Check mksysb file, and available disks

```
# ls -lrt *.mksysb
-rw-r--r--    1 root     system   1547110400 Jun 28 15:53 hugo-vasco.mksysb
# lspv
hdisk0          00fa00d6b552f41b                    rootvg          active
```

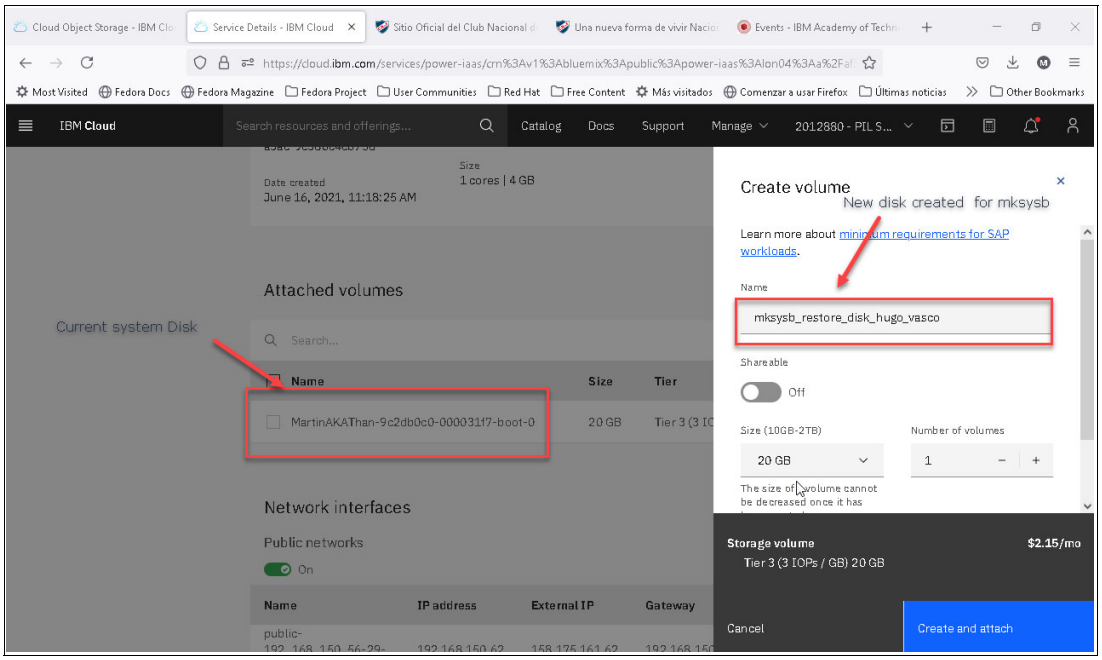


Figure 2-20 Add disk for restoring the mksysb

If you are not sure what hdisks you have already, use the **lspv** command. **Bootinfo -s hdiskx** will give you the size of that disk. if you want to estimate the size of the new disk you are creating for the mksysb (besides looking on the on-premises machine), run the command on the mksysb file as shown in Example 2-6.

Example 2-6 Check disk size from saved mksysb

```
# restore -qf /tmp/hugo-vasco.mksysb ./bosinst.data
x ./bosinst.data
# grep -p target_disk_data bosinst.data
target_disk_data:
        PVID = 00c44f8745265c7b
```

```
PHYSICAL_LOCATION = U9080.M9S.1044F87-V13-C2-T1-L8200000000000000
      CONNECTION = vscsi0//820000000000
      LOCATION =
      SIZE_MB = 10240
      HDISKNAME = hdisk0
```

You can check the new disk is attached by clicking the VM instance and check from the command line as shown in Example 2-7.

Example 2-7 List available disks with newly added

```
# lspv
hdisk0          00fa00d6b552f41b                    rootvg          active
# cfgmgr
# lspv
hdisk0          00fa00d6b552f41b                    rootvg          active
hdisk1          none                                None
```

After adding the disk, you see it in the machine, check that the new disk is bootable. You can do it after restoring it.

The newly added disk is hdisk1, and as you can see it is available for use as it is not assigned to any vg as shown in Figure 2-21.

Tip: It can take a while to show the disk in the system even when it says it is done fast, so do not panic and wait a few minutes and run **`cfgmgr`**, and **`lspv`** again.

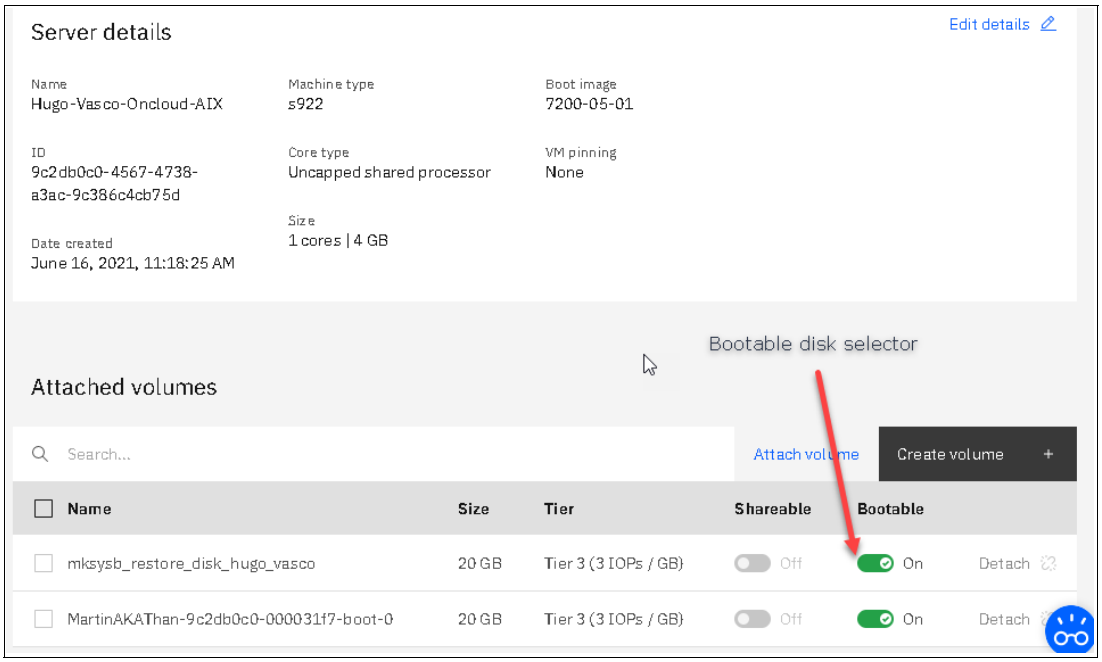


Figure 2-21 List newly added disk

You now restore the mksysb using the alternate disk mksysb (alt_disk_mksysb) method. Run the command **`alt_disk_mksysb`** or smitty alt_install as shown in Example 2-8 on page 43.

```
# /usr/sbin/alt_disk_mksysb -d 'hdisk1' -m '/tmp/hugo-vasco.mksysb' -P'all'
```

Example 2-8 Smitty alt_install

```
Install mksysb on an Alternate Disk

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                      [Entry Fields]
* Target Disk(s) to install                          [hdisk1]                +
* Device or image name                               [/tmp/hugo-vasco.mksys> +
  Phase to execute                                    all                    +
  image.data file                                    []                       /
  Customization script                               []                       /
  Set bootlist to boot from this disk
  on next reboot?                                     yes                    +
  Reboot when complete?                               no                     +
  Verbose output?                                     no                     +
  Debug output?                                       no                     +
  resolv.conf file                                   []                       /
  Use system alt_disk_install boot image?             no                     +
    Instead of the boot image from the mksysb.


F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

After completion of the restore check the bootlist to make sure when we reboot the OS it will boot from the new volume.

Validate the new VM and clean up

You need to validate the new VM and proceed to clean up.

Reboot the VM

After the reboot, login into the same Power Systems Virtual Server Instance (same external IP address previously used that was defined) and check the disk of the new VM.

Instead of login in as root, log in with the new credentials that do not exist in the stock AIX image as a quick test that you indeed have restored a different image, so you need to use the root password or any user of the on-premises machine.

Important: Remember, you need to know the passwords from the original on-premises machine, the public keys you were using to access from the external ips wont work because you're now using "other" machine setup

You can then detach the original or helper disk by logging in as root (if not root) and running **`exportvg`** and **`rmdev`**.

We will now remove the boot disk flag on the disk we will be detaching by going to Storage Volumes and editing the disk by clicking the bootable switch as shown in Figure 2-21 on page 42.

You can now detach the disk, by selecting the virtual server instances and click the instance, then click Manage existing volumes and de-select the disk you want to detach.

You can optionally delete other components of the PVS but we encourage you to look around and get more familiar with the GUI and various options available from the IBM Power Systems Virtual Server IBM Cloud offering before shutting down.

To delete your virtual instance altogether, click the trash can on the upper right hand side, click DELETE at the prompt to confirm. It can take several minutes for the deletion process to conclude. Refresh the table (and your browser) to verify the VM is no longer present.

2.2 Backup and migrate alternative

A key question for AIX/Linux/IBM i (Power Systems servers in general) clients looking to take advantage of the benefits of IBM Power Systems Virtual Server is: how do I move my existing workloads to Power Systems Virtual Server? At the highest level, the process for most clients involves performing a save on-premises, transferring the save to Power Systems Virtual Server and performing a restore.

For clients using Power Virtualization Center (PowerVC), the move to Power Systems Virtual Server involves using PowerVC to capture an Open Virtualization Appliance (OVA) image of the AIX workload and transferring the OVA to Power Systems Virtual Server.

The goal of this subchapter is to provide step-by-step instructions for moving an AIX/Linux workload to Power Systems Virtual Server using one of the most popular methods.

Although the techniques described here can be used to move at least an initial save of a specific application, going into specific database or application requirements or synchronizing the data after a migration is beyond the scope of this document.

Migration by way of PowerVC OVA In this case we will show how to migrate the entire logical partition (LPAR) and its associated disk(s) by using PowerVC's capability to capture the LPAR in an OVA.

Restriction: Having a fully operational PowerVC environment is a prerequisite for this approach.

We already described, how to create an system backup and upload it to COS or upload it using ssh earlier on this chapter on 2.1.4, "Restore mksysb image onto Power Systems Virtual Server" on page 41.

2.2.1 Backup migrate using OVA formatted image

Currently available their are several ways to obtain an OVA image, both paid and open source projects. And transferring your image and deploying it in IBM Cloud it s a simple few steps process

OVA file create from PowerVC

Access the CLI of your PowerVC Server using ssh.

PowerVC images available in your environment are shown in Example 2-9.

Example 2-9 List ova images available in PowerVC

```
# powervc-image list
+--------------------+--------------------------------------+--------+---------+------+--------------+--------------+-----------+-----------+
```

```
| Name              | ID                                   | Status | Volumes | Size | Description | Architecture | OS Distro | Exportable |
+-------------------+--------------------------------------+--------+---------+------+-------------+--------------+-----------+------------+
| rhel4ova_capture_2 | 3dbe8f82-ade5-473e-85dd-cc3d18a3b87e | active | 1       | 22 |             | ppc64le      | rhel      | True       |
+-------------------+--------------------------------------+--------+---------+------+-------------+--------------+-----------+------------+
```

Export an Image in the command line to create OVA file as shown in Example 2-10.

Example 2-10 Exporting ova image

```
# powervc-image export --image rhel4ova_capture_2
Created temporary staging directory /var/opt/ibm/powervc/imgstaging/tmpolKRMe
Found image with ID '3dbe8f82-ade5-473e-85dd-cc3d18a3b87e' and name 'rhel4ova_capture_2'.
The export directory and the staging directory are on the same file system. Double image size space is required.
Using the image name 'rhel4ova_capture_2' for the default OVA name.
Register temporary file-copy volume driver.
Registered temporary driver PVC-Lite-File_tmpolKRMe servicing location /var/opt/ibm/powervc/imgstaging/tmpolKRMe
Cloning 'Image rhel4ova_capture_2 volume 1' into temporary volume 'Image_rhel4ova_capture_2_volume_1_tmpolKRMe'.
The size to clone is 22 GiBs..Done cloning.
Warning: Some stale scsi device paths were detected. If an error is encountered, consider running with --debug option
to see device path messages and/or running the 'cleanup' subcommand to attempt cleanup of these stale devices that
could prevent discovery of newly attached volumes.
Migrate volume data for 'Image_rhel4ova_capture_2_volume_1_tmpolKRMe' from 'FS92OO' to the target storage template
'PVC-Lite-File_tmpolKRMe base template'.
Attaching volume...

Copying Image_rhel4ova_capture_2_volume_1 [1OO%] Rate: 233.11 MiB-per-S, ETA: O:OO:OO [H:MM:SS]
Detaching volume and finalizing metadata...
Copy complete after waiting O:O1:41 [H:MM:SS]

GiBs remaining to copy for image: O
Creating image package with 1 volumes.
Creating OVF: /var/opt/ibm/powervc/imgstaging/tmpolKRMe/rhel4ova_capture_2.ovf
Creation of OVF completed.
Adding OVF to OVA /var/opt/ibm/powervc/ova/rhel4ova_capture_2.ova
Adding volume 'Image_rhel4ova_capture_2_volume_1' to OVA.
Exported OVA /var/opt/ibm/powervc/ova/rhel4ova_capture_2.ova size: 22.OO GiB
Cleaning up Lite-Volume export resources...
De-register the temporary file driver 'PVC-Lite-File_tmpolKRMe'.
Cleaning up the temporary staging directory...
Time spent: O:O3:28 [H:MM:SS]
Successfully finished creating image package /var/opt/ibm/powervc/ova/rhel4ova_capture_2.ova
```

Gzip your OVA file just created is located in the following directory:

```
# cd /var/opt/ibm/powervc/ova/rhel4ova_capture_2.ova
# gzip rhel4ova_capture_2.ova
```

You have completed the process. You can proceed to uploading your image to your Bucket as shown in “Copying Image of AIX VM to Cloud Object Store Bucket” on page 34.

OVA file creation using pvsadm command line on Linux PPCle

This example uses a ppc64 Red Hat Enterprise Linux system running kvm.

As pre-requisites, you need a valid qcow2 image. For example a downloaded KVM guest image from Red Hat Enterprise Linux.

Attention: Make sure you have more than 60 GB available in /tmp (default) or any other file system (need to specified when running command).

In order to get pvsadm installed, follow these steps:

1. install this packages.

```
# yum -y install qemu-img.ppc64le cloud-utils-growpart.noarch
```

2. Install pvsadm.

Go to the release page in GitHub https://github.com/ppc64le-cloud/pvsadm/releases/.

3. Select the desired version, and then package built, for example using **wget**:

```
# wget
https://github.com/ppc64le-cloud/pvsadm/releases/download/v0.1.2/pvsadm-linux-ppc6
4le.tar.gz
```

4. Now, with the file downloaded, extract the tar file.

```
# tar -zxvf pvsadm-linux-ppc64le.tar.gz
pvsadm
```

5. Move it to a directory in your Path (or you can run it with the path).

```
# mv pvsadm /usr/bin/
```

6. You can now use the **pvsadm** command in your system.

```
# pvsadm -h
```

Power Systems Virtual Server projects deliver flexible compute capacity for Power Systems workloads.

Integrated with the IBM Cloud platform for on-demand provisioning.

This is a tool built for the Power Systems Virtual Server helps managing and maintaining the resources easily.

7. Using **pvsadm** to create ova file.

```
# pvsadm image qcow2ova --image-name rhel-84-07202021 --image-url
./rhel-8.4-ppc64le-kvm.qcow2 \
> --image-dist rhel --rhn-user <RHELsubscritionUser> --rhn-password
<subscriptionpassword>
```

Attention: This command might fail if you do not have **growpart** installed. To fix it run:

```
#yum install cloud-utils-growpart -y
```

8. Output of the successful command shows the root password.

Successfully converted Qcow2 image to OVA format is found at /root/rhel-84-07202021.ova.gz.

OS root password: <rootpassword>.

9. Display created image

```
# ls *ova*
rhel-84-07202021.ova.gz
```

OVA upload to Cloud Object Storage using pvsadm

Pre-requests need a API KEY find steps in the following link

https://cloud.ibm.com/docs/account?topic=account-userapikey#create_user_key)

Or refer to 2.1.3, “Creating an instance of IBM Cloud Object Storage in IBM Cloud” on page 28.

```
export IBMCLOUD_API_KEY="$yourkey"
# pvsadm image upload --bucket redbookbucket -f rhel-84-07202021.ova.gz
--cos-instance-name cos-2q --bucket-region us-south
```

3

IBM Power Systems Virtual Server in the IBM Cloud network

This chapter covers the different Hybrid Cloud networking use cases for setting up private network between on-premises and IBM Power Systems Virtual Server and provide guidance on production and non-production networking scenarios.

This chapter contains the following topics related to Power Systems Virtual Server networking:

3.1 Introduction to IBM Power Systems Virtual Server virtual private network connectivity

A key client requirement for the IBM Power Systems Virtual Server (PowerVS) is the ability to connect to cloud-based workloads from an on-premises environment. It is not recommended to create PowerVS workloads with a public IP address for security reasons. Clients need the capability for multiple users and multiple on-premises systems to connect securely over private network to workloads in PowerVS.

This section covers the different Hybrid Cloud networking use cases for setting up private network between on-premises and PowerVS, and provides guidance for production and non-production networking scenarios.

IBM Power Systems Virtual Servers are co-located in IBM cloud data centers with their own dedicated infrastructure, and they are connected to IBM Cloud Infrastructure as a Service (IaaS) by way of Direct Link Connect (DLC). PowerVS being co-located, they are also referred to as COLO location or just COLO. This connection is illustrated in Figure 3-1.

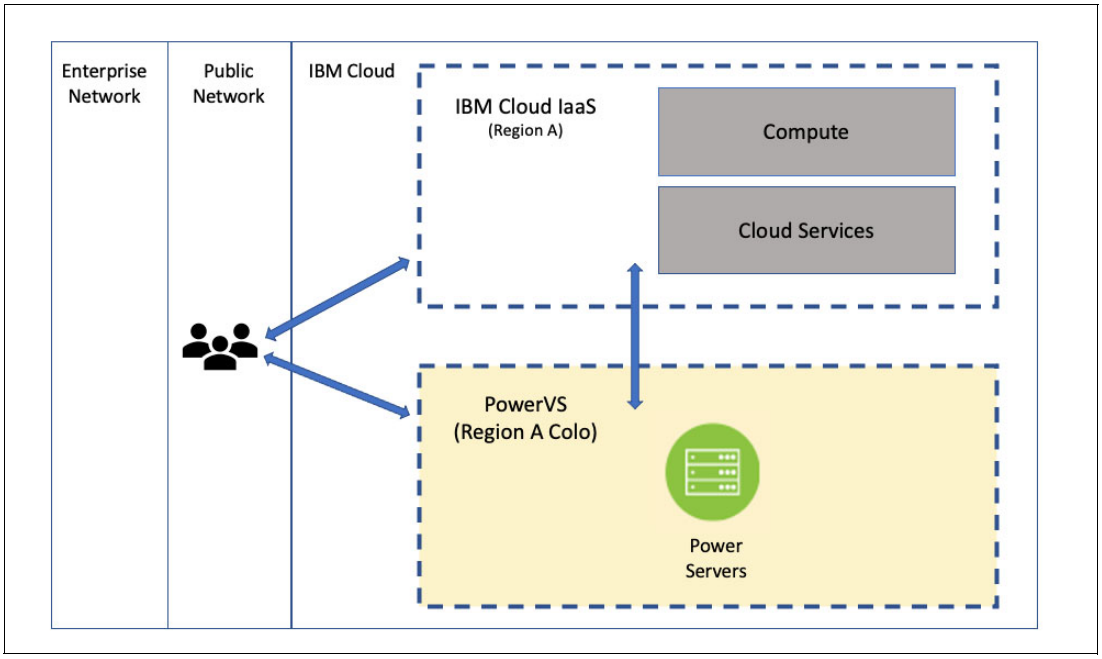


Figure 3-1 An over-simplified illustration of the IBM Cloud IaaS and PowerVS connection

Direct Link Connect enables a key client benefit where workloads running on IBM Power Systems Virtual Server can integrate with x86-based workloads running in IBM Cloud for a single multiplatform business solution. For example:

- An Oracle database running in AIX in Power Systems Virtual Server connecting to a Linux application server in an x86 Virtual Server Instance (VSI).
- A core banking application in IBM i connecting to a point-of-sale application in a VMware-based x86 VSI.

IBM Power Systems Virtual Server offering includes a highly available up to 10 Gigabits per second (Gbps) when using Direct Link Connect 2.0 to IBM Cloud services at no cost for each client per data center. For more details about DLC, how to order DLC and a tutorial on Integrating x86 workloads with PowerVS, see the following links:

- https://cloud.ibm.com/docs/power-iaas?topic=power-iaas-ordering-direct-link-connect
- https://cloud.ibm.com/docs/power-iaas?topic=power-iaas-ibm-power-systems-virtual-server-integration-with-x86-based-workloads

3.2 PowerVS network overview

There are broadly three ways clients can configure connections from on-premises to PowerVS location and other locations as shown in Figure 3-2.

1. On-premises to PowerVS by way of IBM Cloud IaaS.

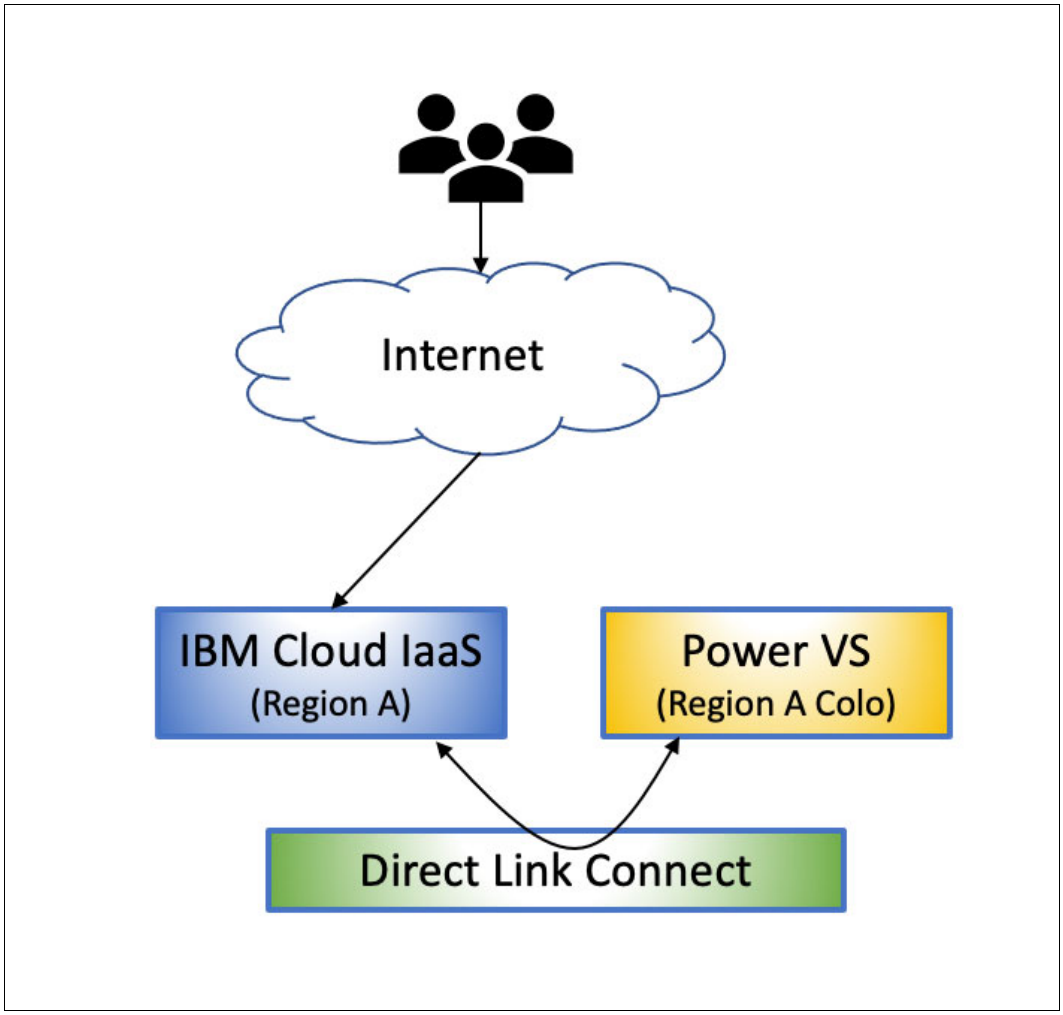


Figure 3-2 On-premises to PowerVS by way of IBM Cloud IaaS

2. On-premises to PowerVS directly as shown in Figure 3-3 on page 52.

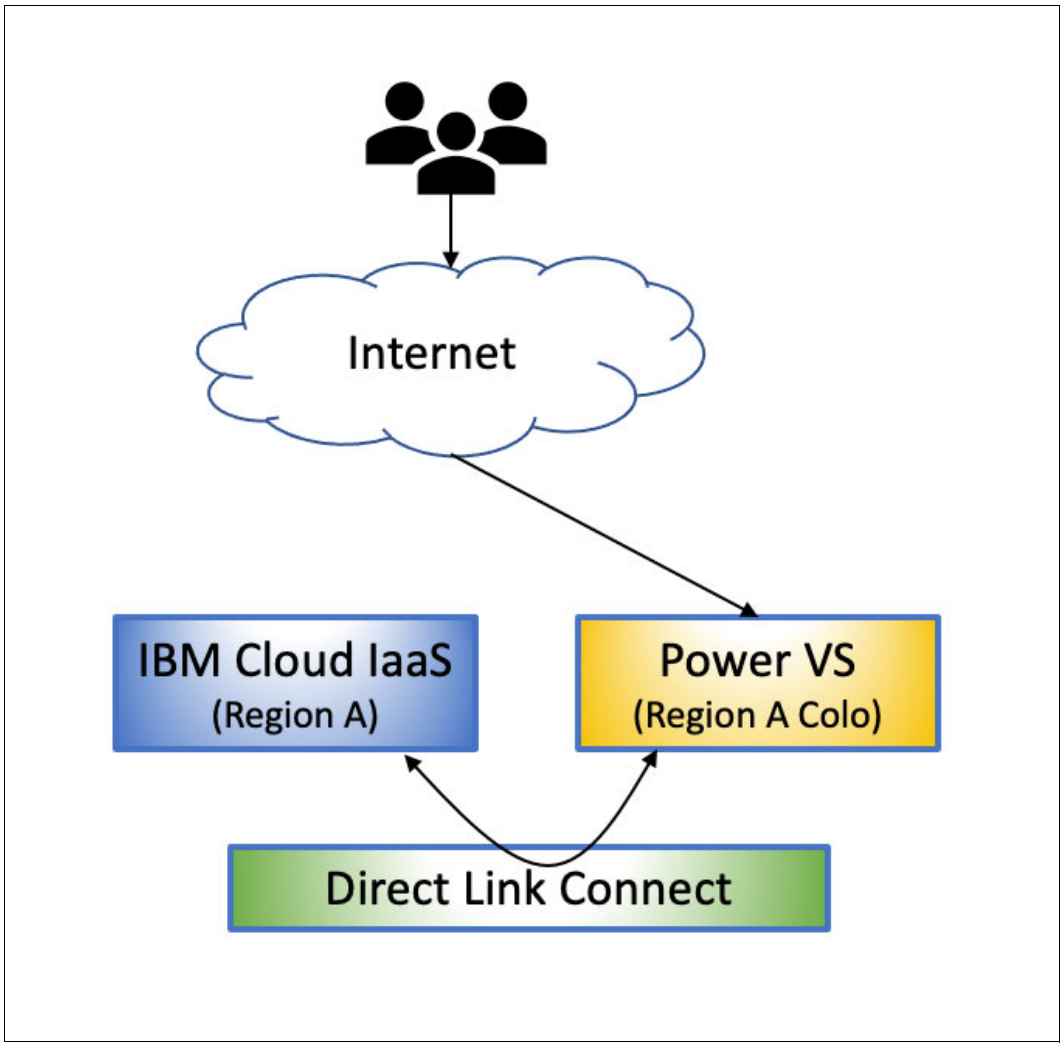


Figure 3-3 On-premises to PowerVS directly

3. On-premises to PowerVS (multiple COLOs) as shown in Figure 3-4 on page 53.

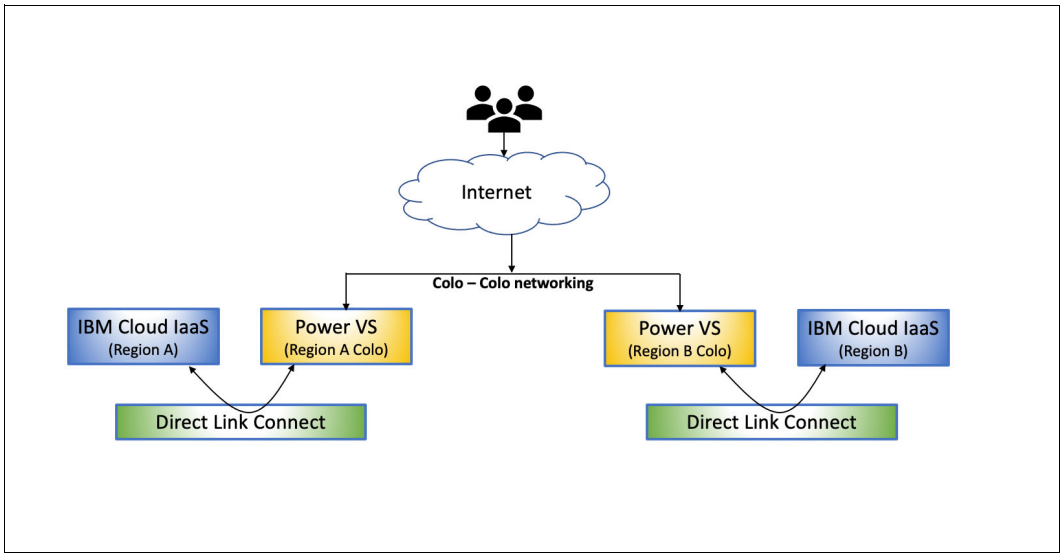


Figure 3-4 On-premises to PowerVS (multiple COLOs)

3.3 PowerVS network scenarios

There are multiple ways clients can create a private network connection between on-premises and PowerVS. Based on the networking technology used, network hops required, network latency, network session and stability considerations, networking scenarios can be classified as:

- Non-production/Proof-of-Concept (POC) Production.
- Production.

3.4 Non-production proof of concept (POC) scenarios

Non-Production/Proof of Concept (POC) environments can utilize a number of configurations. Configuration include:

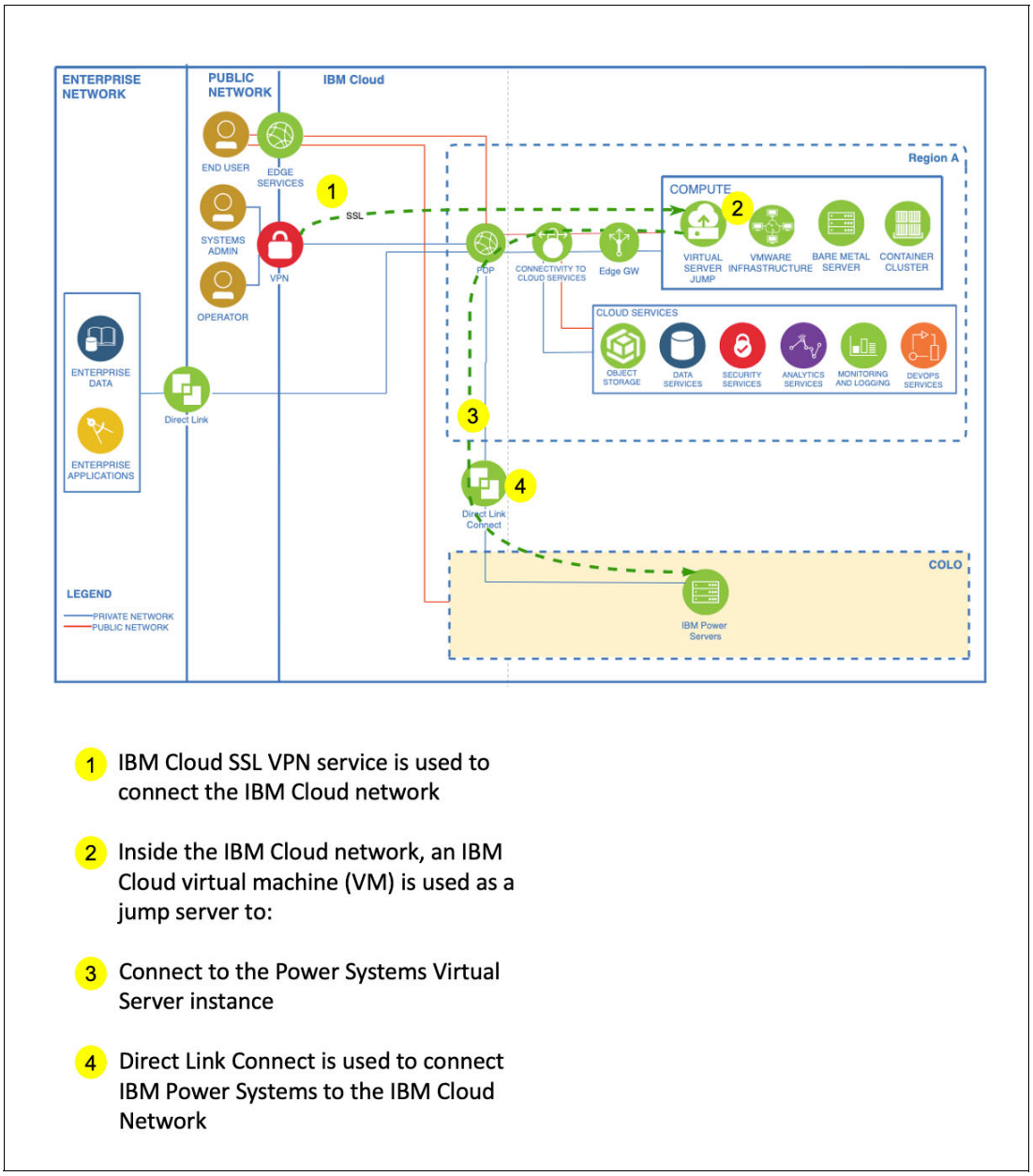
- Private Connection using SSL + Jump Host + Direct Link Connect.
- Private Connection using IPsec Virtual Private Networking (VPN) + Direct Link + Edge Gateway.

3.4.1 Private Connection using SSL + Jump Host + Direct Link Connect

This scenario is used for environment management and test/dev use cases from the public network. It is not recommended for production workloads.

A jump server must be used because it is not possible to use a VPN connection to directly connect to the Power Systems Virtual Server instance (at the time this publication was written).

Reference architecture is shown in Figure 3-5 on page 54.



1. IBM Cloud SSL VPN service is used to connect the IBM Cloud network
2. Inside the IBM Cloud network, an IBM Cloud virtual machine (VM) is used as a jump server to:
3. Connect to the Power Systems Virtual Server instance
4. Direct Link Connect is used to connect IBM Power Systems to the IBM Cloud Network

Figure 3-5 Private Connection using SSL + Jump Host + Direct Link Connect

It is a two step process:

1. Private access to a jump server/host (windows/Linux VM on the IBM Cloud side).
2. After logged into the jump host, you can connect to the PowerVS environment over the direct link connect between PowerVS and IBM Cloud.

The direct link connect between PowerVS and IBM Cloud has to be established by way of a ticket. More details about Direct Link Connect for Power Systems Virtual Servers is available at:

https://cloud.ibm.com/docs/power-iaas?topic=power-iaas-ordering-direct-link-connect

In addition, you cannot connect directly to the PowerVS environment from on-premises in this setup. You must access the jump host first and initiate the second connection to the PowerVS

environment. That initial access to the IBM Cloud classic private environment is done through the no cost SSL VPN client (IBM Cloud SSL VPN service).

Review enabling the SSL VPN access at the following links:

- Enabling SSL VPN access:

  https://cloud.ibm.com/docs/iaas-vpn/set-up-ipsec-vpn.html#enable-user-vpn-access

- Using an SSL VPN:

  https://cloud.ibm.com/docs/iaas-vpn?topic=iaas-vpn-using-ssl-vpn

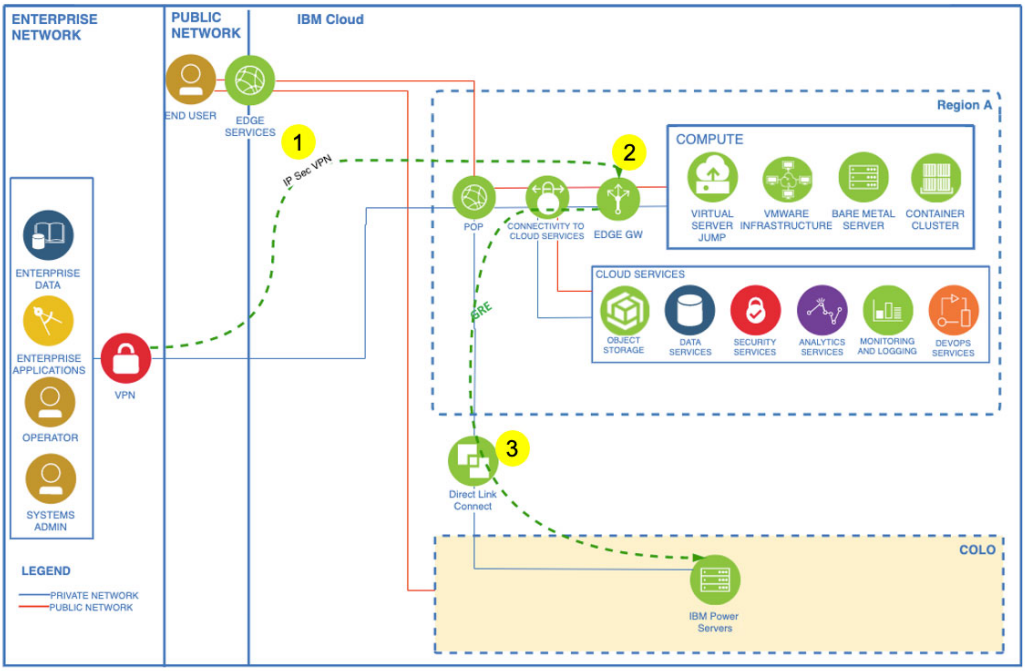
Access and download the no cost SSL clients at the following links:

- https://www.ibm.com/cloud/vpn-access
- https://cloud.ibm.com/docs/iaas-vpn?topic=iaas-vpn-standalone-vpn-clients

3.4.2 Private Connection using IPsec Virtual Private Networking (VPN) + Direct Link + Edge Gateway

In this scenario, a user can have a dedicated & direct access to the Power environment through an IPsec VPN setup between on-premises and a client owned gateway appliance setup in IBM Cloud and a DLC setup PowerVS and the IBM Cloud.

Reference architecture is shown in Figure 3-6 on page 56.



1 IPSEC VPN is setup between On-premises and IBM Cloud Classic.

2 Inside the IBM Cloud network, an Edge Gateway device is used to connect to the Power Systems Virtual Instance.

3 Direct Link Connect is used to connect IBM Power Systems to the IBM Cloud Network

GRE tunnel setup may be necessary for this setup to facilitate connectivity from PowerVS back to the enterprise.

Figure 3-6 Private Connection using IPsec Virtual Private Networking (VPN) + Direct Link + Edge Gateway

In this setup PowerVS is directly reachable from on-premises. A Virtual Router Appliance (VRA or Edge GW) is needed in IBM Cloud because it is not possible to use a VPN connection to directly connect to the Power Systems Virtual Server instance (at the time this publication was written). Client also need the same VRA to access both IBM Cloud resources and PowerVS.

There are various configuration caveats needed to facilitate the connection. For example, because IBM will not advertise the on-premises subnets over the DLC between PowerVS and Cloud, various mechanisms are leveraged to ensure traffic from PowerVS to on-premises including:

- GRE setup between the Edge GW and the PowerVS router/firewall (IBM Managed). This way, Edge GW in IBM Cloud will be set up as the next hop for any traffic intended for on-premises subnets from PowerVS. This set up requires a support ticket with PowerVS support (by way of the cloud console). See more at this link for the IBM Power Systems Virtual Server Virtual Private Network Connectivity:

https://cloud.ibm.com/media/docs/downloads/power-iaas-tutorials/PowerVS_VPN_Tutorial_v1.pdf). This is the preferred option.

- NAT on the Edge GW appliance in IBM Cloud. The Edge GW can *mediate* traffic between on-premises subnets and PowerVS subnet. This works since PowerVS only sends traffic to IBM Cloud subnets (portable subnets) that can be translated to on premises address. This only works well if there just a few on-premises IP/subnets or traffic is only initiated from the PowerVS.

3.5 Production scenarios

Production environments can utilize a number of configurations. Configuration include:

- Private Connection using Direct Link + Edge GW + Direct Link Connect.
- Private Connection using Megaport + Direct Link Connect (On-premises to IBM Cloud PowerVS COLO).
- Private Connection using Megaport - Multi COLO, Multi-Region.
- Private Connection using IBM backbone - Multi COLO.

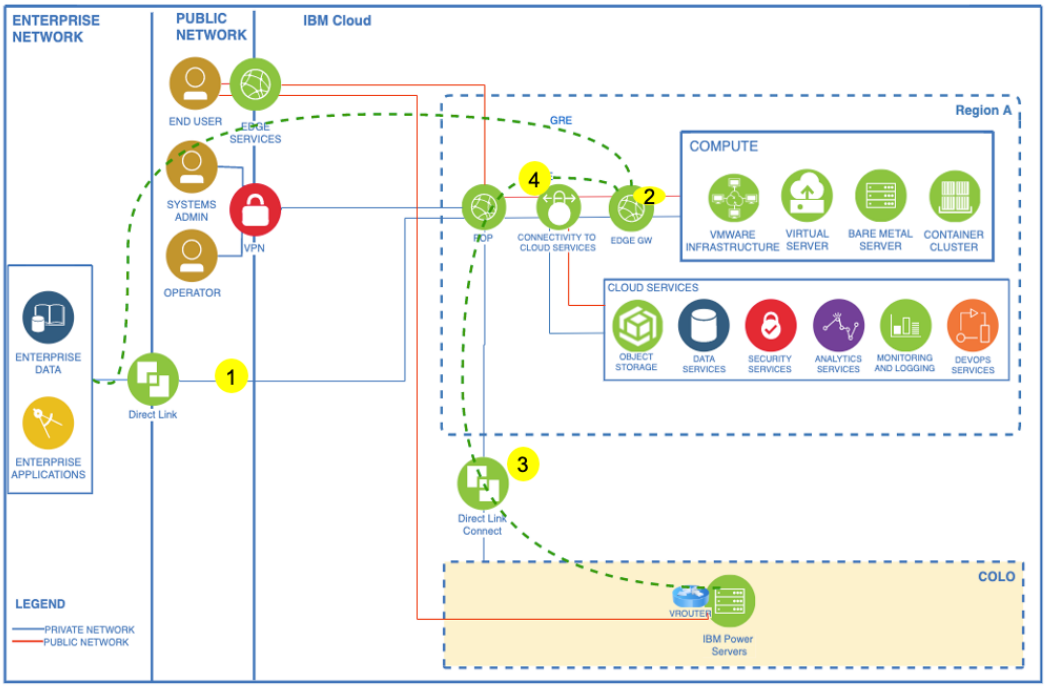
3.5.1 Private Connection using Direct Link + Edge GW + Direct Link Connect

Use this scenario for enterprise connectivity when private dedicated high speed access through IBM Cloud is preferred and Client wants to support workloads in IBM Cloud and PowerVS environments. Direct Link option needed to provide private connectivity to IBM Cloud. Useful for routing BYOIP addresses through IBM Cloud leveraging GRE tunnels.

A Direct Link setup (Connect/Exchange/Dedicated) between On premises and IBM Cloud (typically terminates on client owned gateway appliance) & a direct link connection (DLC) setup between PowerVS and the IBM Cloud Network.

GRE Tunnelling is needed in most configurations because IBM Cloud Network does not advertise on-premises subnets over Direct Link and for Bring Your Own IP (BYOIP) considerations.

The reference architecture is shown in Figure 3-7 on page 58.



1 Direct Link is used to connect the enterprise to the IBM Cloud network.

2 Inside the IBM Cloud network, an Edge Gateway device is used to connect to the Power Systems Virtual Instance. An Edge Gateway must be used to control routing between IBM Cloud and the COLO where IBM Power Systems resides

3 Direct Link Connect is used to connect IBM Power Systems to the IBM Cloud Network

4 GRE Service is configured on the IBM Power Server Network to establish a GRE Tunnel enabling BYOIP to the Power Server environment.

Figure 3-7 Private Connection using Direct Link + Edge GW + Direct Link Connect

As you can see there is a GRE tunnel is built over the Direct Link Setup between IBM Cloud and On premises. There is also a GRE Tunnel setup over the Direct Link Connect between PowerVS and IBM Cloud.

There are various configuration caveats needed to facilitate the connection. For example, because IBM will not advertise the on premise subnets over the Direct Link between PowerVS and Cloud, various mechanisms are leveraged to ensure traffic from PowerVS to on premises including:

- GRE setup between the Edge GW and the PowerVS router/firewall (IBM Managed). This way, Edge GW in IBM Cloud will be setup as the next hop for any traffic intended for on

premises subnets from PowerVS. This set up requires a support ticket with PowerVS support (by way of the cloud console). See more at this link for the IBM Power Systems Virtual Server Virtual Private Network Connectivity: https://cloud.ibm.com/media/docs/downloads/power-iaas-tutorials/PowerVS_VPN_Tutorial_v1.pdf). This is the preferred option.

- NAT on the Edge GW appliance in IBM Cloud. The Edge GW can *mediate* traffic between on premises subnets and PowerVS subnet. This works since PowerVS only sends traffic to IBM Cloud subnets (portable subnets) that can be translated to on premises address. This only works well if there just a few on premises subnets or traffic is only initiated from the PowerVS.

3.5.2 Private Connection using Megaport + Direct Link Connect (On-premises to IBM Cloud PowerVS COLO)

In this scenario the client desires a secure low latency direct connection between the on-premises and the PowerVS COLO using Megaport a third party communication provider.

Usage case scenario for:

- Private & dedicated High speed, high bandwidth, low latency, direct connection to PowerVS environment.
- Replication from enterprise to PowerVS.

The client is responsible for *last mile* connectivity between the on-premises and IBM Cloud datacenter. The ordering process requires the client to order a Direct Link Connection with Megaport to obtain a Service Key which is required to order/provision Megaport VXC.

In this setup, client engages Megaport to facilitate the connectivity to the PowerVS environment:

https://cloud.ibm.com/docs/dl?topic=dl-megaport

The reference architecture is shown in Figure 3-8 on page 60.

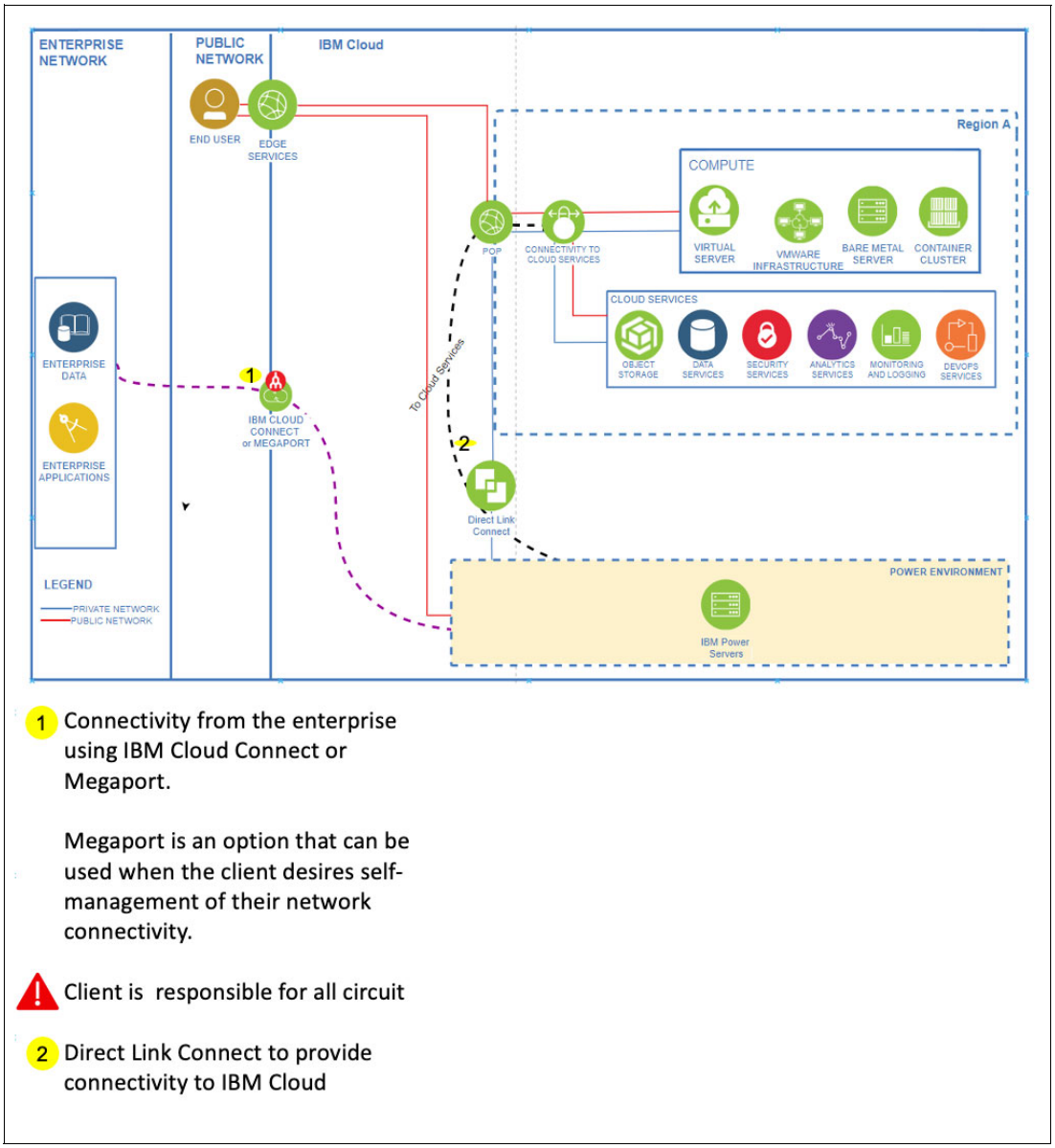


Figure 3-8 Private Connection with Megaport + Direct Link Connect (On-premises to IBM Cloud PowerVS COLO)

IBM Cloud Connect is used when the client desires a fully managed service for connectivity between COLOs. However, IBM Network Services can also provide this as a service with IBM Cloud Connect. IBM Cloud Connect service is an IBM Network service wrapped around the Megaport connectivity.

Follow the process here before engaging Megaport for this service:

https://cloud.ibm.com/docs/power-iaas?topic=power-iaas-configuring-power#connecting-megaport

3.5.3 Private Connection using Megaport - Multi COLO, multi-region

In this scenario the client desires connectivity between two sites over the IBM Cloud backbone. Because the PowerVS subnets cannot be advertised over the cloud backbone, GRE tunnels are necessary to facilitate the routing between the two locations.

Usage case scenario for:

- IBM Power Systems deployed to more than one COLO and connectivity is required between the two.
- Replication between IBM sites Production and DR systems in IBM Cloud over the IBM Backbone.

The client is responsible for *last mile* connectivity between the on-premises and IBM Cloud datacenter. The ordering process requires the client to order a Direct Link Connection with Megaport to obtain a Service Key which is required to order/provision Megaport VXC.

In this setup, client engages Megaport to facilitate the connectivity to the PowerVS environment:

https://cloud.ibm.com/docs/dl?topic=dl-megaport

The reference architecture is shown in Figure 3-9 on page 62.

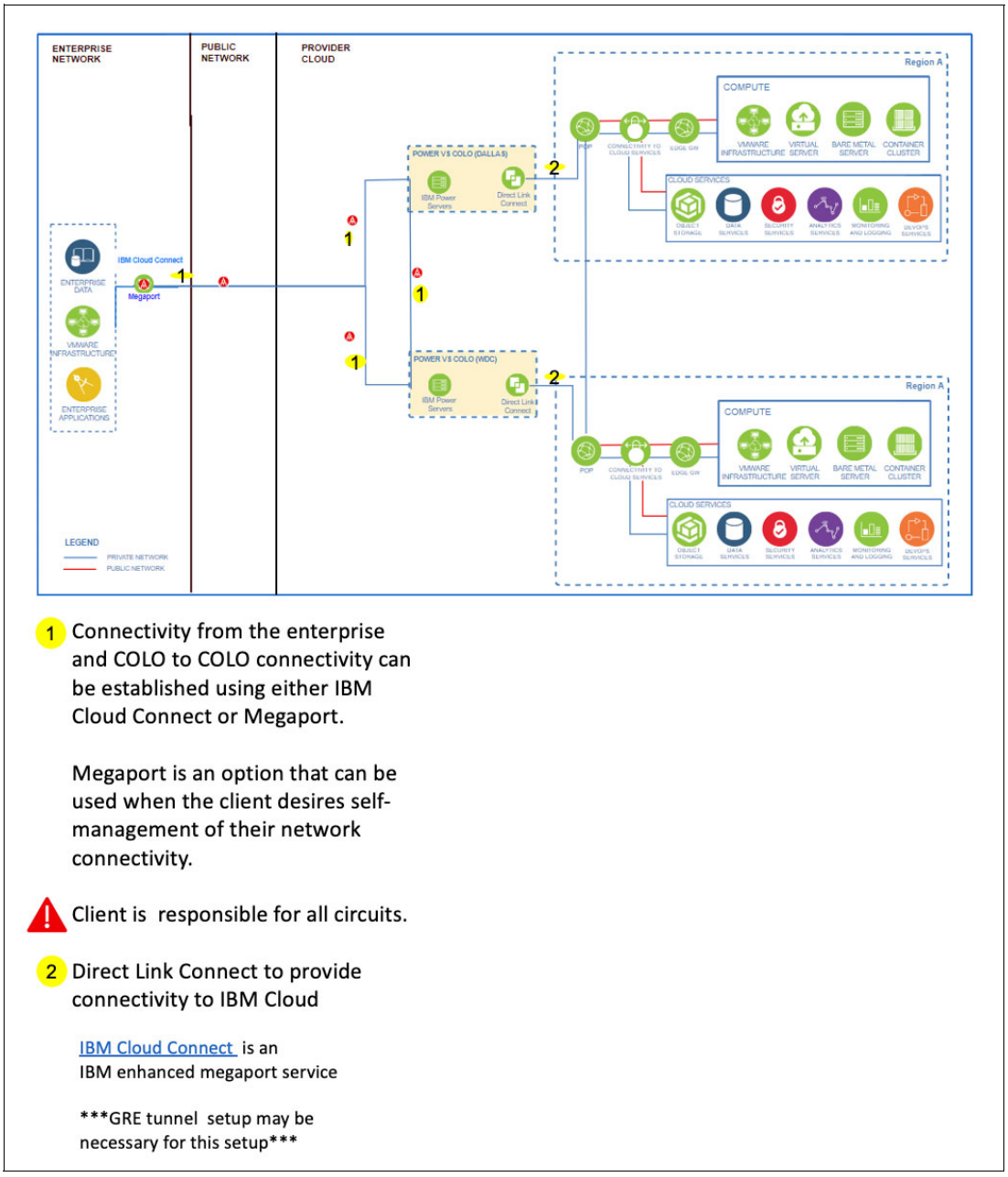


Figure 3-9 Private Connection using Megaport - Multi COLO, Multi-Region

3.5.4 Private Connection using IBM backbone - Multi COLO

In this scenario the client desires connectivity between two sites over the IBM Cloud backbone. Because the PowerVS subnets cannot be advertised over the cloud backbone, GRE tunnels are necessary to facilitate the routing between the two locations.

Usage case scenario for:

- IBM Power Systems deployed to more than one COLO and connectivity is required between the two.
- Replication between IBM sites Production and DR systems in IBM Cloud over the IBM Backbone.

The reference architecture is shown in Figure 3-10.

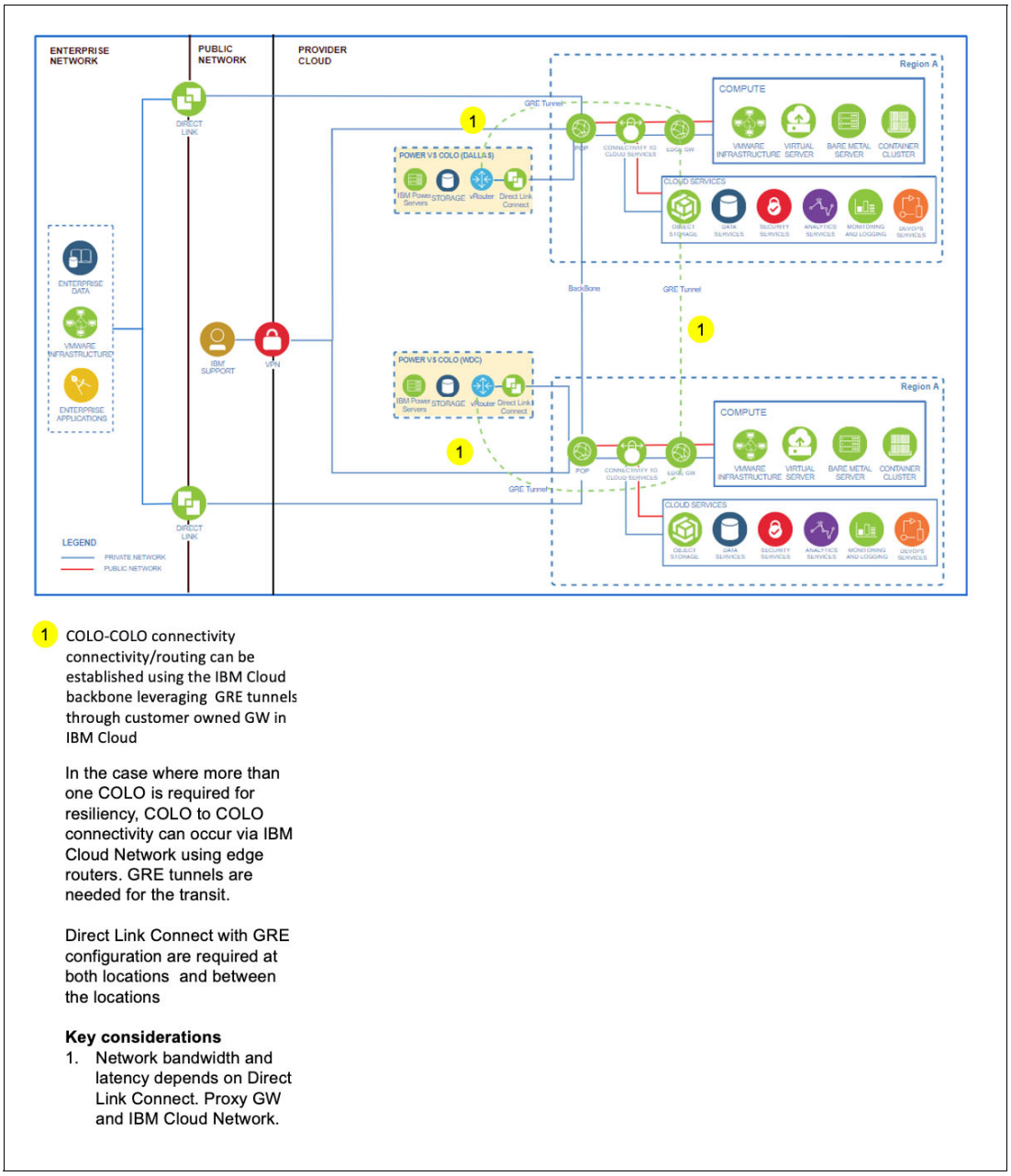


Figure 3-10 Private Connection using IBM backbone - Multi COLO

The following are necessary:

1. Client owned Gateways (ATT router/Juniper VSRX/FortiGate/BYOGW) at each site.
2. GRE tunnel from Powers to the Gateway at each location.
3. GRE tunnel between Gateway at site A to Gateway at Site B.

Note: in this scenario, it is assumed that the Enterprise is connecting to IBM Cloud by way of a Direct Link Setup as shown on the diagram. However, ISPEC VPN to each site can also be an option depending on required bandwidth and use cases.

3.6 IBM Cloud connections

You can use IBM Cloud connections to connect your Power Systems Virtual Server instances to IBM Cloud resources on IBM Cloud classic network and Virtual Private Cloud (VPC) infrastructures. IBM Cloud connection creates a Direct Link (2.0) Connect instance to connect your Power Systems Virtual Server instances to the IBM Cloud resources within your account. For cross-account connectivity, use IBM Transit Gateway to interconnect your Power Systems Virtual Server to the IBM Cloud classic and Virtual Private Cloud (VPC) infrastructures. The speed and reliability of the Direct Link connection extends your Power Systems Virtual Server network to the IBM Cloud network and offers more consistent and higher-throughput connectivity, while keeping network traffic within the IBM Cloud.

Important: You can have a maximum of two IBM Cloud (Power Systems Virtual Server Direct Link Connect) per account per Power Systems Virtual Server data center. To create a Power Systems Virtual Server IBM Cloud you must have the required access to create the connections.

Support for Power Systems Virtual Server workspaces with IBM Cloud connections

Power Systems Virtual Server supports multiple workspaces from the same account. However, any given IBM Cloud connection can be used by only one workspace. If you want to configure a setup with multiple workspaces for the same account and if you want these workspaces to share an IBM Cloud connection, open an IBM Support case.

Getting started with IBM Cloud Transit Gateway

Use IBM Cloud Transit Gateway to interconnect IBM Cloud classic and Virtual Private Cloud (VPC) infrastructures worldwide, keeping traffic within the IBM Cloud network. With IBM Cloud Transit Gateway, organizations can define and control communication between resources on the IBM Cloud network, providing dynamic scalability, high availability, and private, in-transit data between IBM Cloud data centers. Transit gateways are commonly implemented to support hybrid workloads, frequent data transfers, private workloads, or to ease administration of the IBM Cloud environment.

3.6.1 Creating IBM Cloud connections with Transit Gateway

In this scenario, we demonstrate the necessary steps to configure Cloud Connection with Transit Gateway to establish the communication between one Power Systems Virtual Server environment, classic infrastructure environment and VPC environment as shown in Figure 3-11 on page 65.

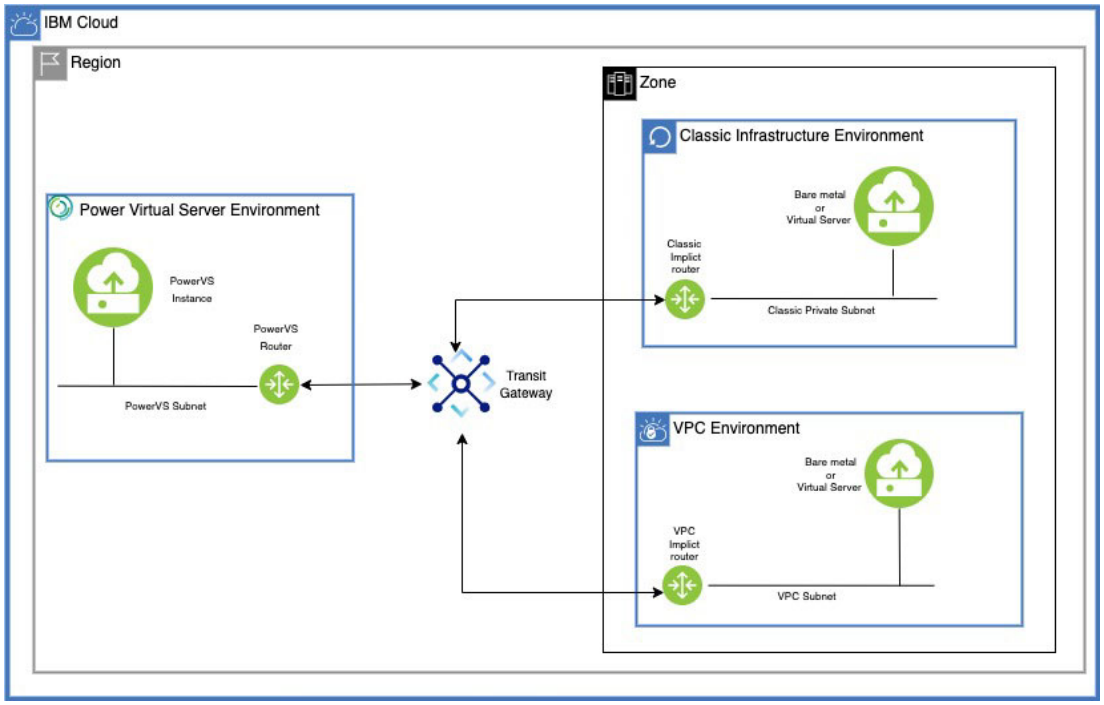


Figure 3-11 PowerVS Cloud Connection with Transit Gateway

To create an IBM Cloud connection, complete the following steps:

1. Go to the Power Systems Virtual Server user interface and click Cloud connection as shown in Figure 3-12.

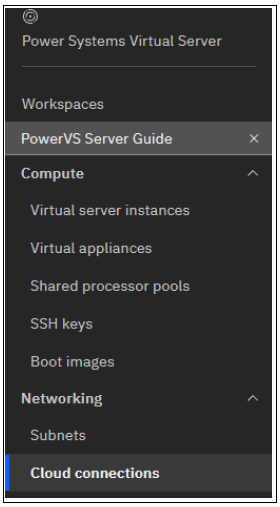


Figure 3-12 Selecting Cloud connection

2. On the Cloud connections page, click Create connection as shown in Figure 3-13 on page 66.

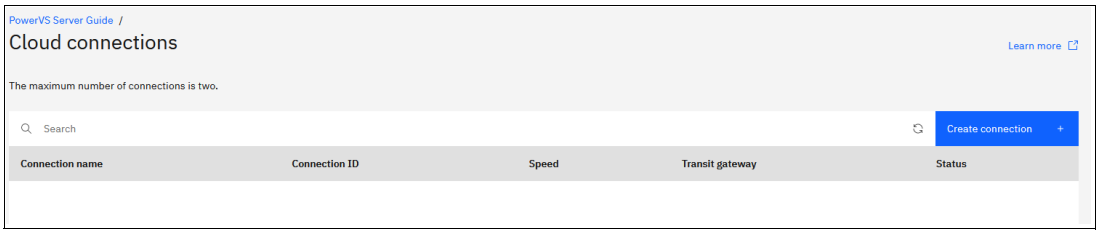


Figure 3-13 Creating connection

3. Specify a connection name and select a connection speed as shown in Figure 3-14.

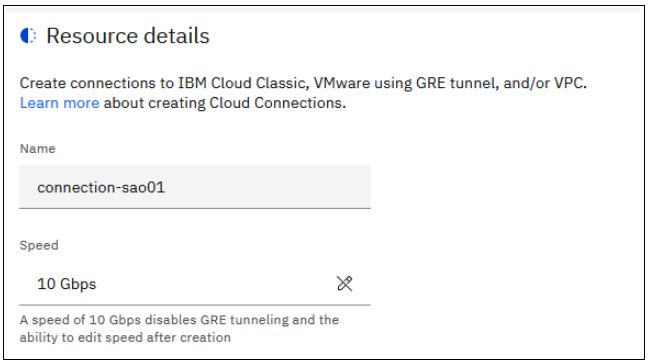


Figure 3-14 Specify connection name and connection speed

Follow these guidelines for setting the speed:

- Maximum connection speed is 10 Gbps.
- You can select 10 Gbps speed only when you are creating a new connection.
- If you select 10 Gbps as the required speed, the GRE tunneling option is disabled.
- You cannot modify a Cloud connection with 10 Gbps to be GRE capable by reducing the speed.
- You cannot modify the speed of an IBM Cloud connection when the speed is set to 10 Gbps at the time of creation.

4. Select *Enable global* routing if you need access to other data centers outside your Power Systems Virtual Server region as shown in Figure 3-15 on page 67. For example, you can use global routing to share workloads between dispersed IBM Cloud resources, such as Dallas to Tokyo, or Dallas to Frankfurt. If you want to enable IBM Transit Gateway for the Cloud connection, then global routing option is not required. And select *Enable IBM Transit Gateway* to interconnect your Power Systems Virtual Server to the IBM Cloud classic and Virtual Private Cloud (VPC) infrastructures and to keep traffic within IBM Cloud. IBM Cloud Transit Gateway connects the private networks, such as classic, VPC, and Direct Link. IBM Cloud Transit Gateway is currently available in WDC04, DAL12, LON04, LON06, FRA04, FRA05, SAO01, SYD04, TOK04, TOR01, MON01, SYD05, OSA21, and DAL13 data centers.

Figure 3-15 Enabling global routing and Transit Gateway

5. In the Virtual connections window as shown in Figure 3-16, you can establish a connection between multiple Power Systems Virtual Server workspaces across different data centers by using an IBM Cloud Transit Gateway. You can create virtual connections that are directly attached to the Direct Link gateway, or you can choose to connect an IBM Cloud Transit Gateway and then create a connection from it to your networks (VPC, classic). You must create an IBM Cloud Transit Gateway to enable virtual connections. Select the virtual connections check box to continue. This setting is required if you selected the Enable IBM Transit Gateway check box in the previous step.

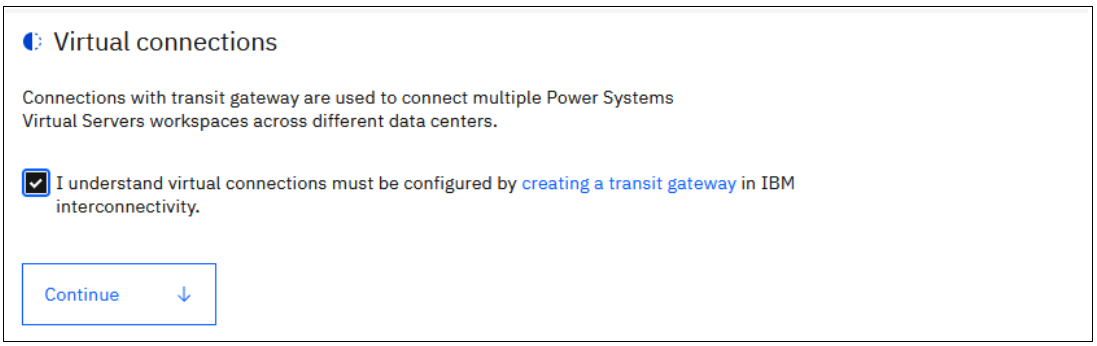


Figure 3-16 Virtual connection selection

Getting started with IBM Cloud Transit Gateway

Use IBM Cloud Transit Gateway to interconnect IBM Cloud classic and Virtual Private Cloud (VPC) infrastructures worldwide, keeping traffic within the IBM Cloud network. With IBM Cloud Transit Gateway, organizations can define and control communication between resources on the IBM Cloud network, providing dynamic scalability, high availability, and private, in-transit data between IBM Cloud data centers. Transit gateways are commonly implemented to support hybrid workloads, frequent data transfers, private workloads, or to ease administration of the IBM Cloud environment.

With IBM Cloud Transit Gateway, you can connect:

- VPCs in the same region (local routing.
- VPCs in different regions (global routing).
- VPCs to your IBM Cloud classic infrastructure.
- Networks using a Generic Routing Encapsulation (GRE) tunnel.
- On-premises networks using Direct Link (2.0) to your IBM Cloud networks.
- Power Systems Virtual Server.
- IBM Cloud classic.

Click *creating a transit gateway* and a window opens as shown in Figure 3-17.

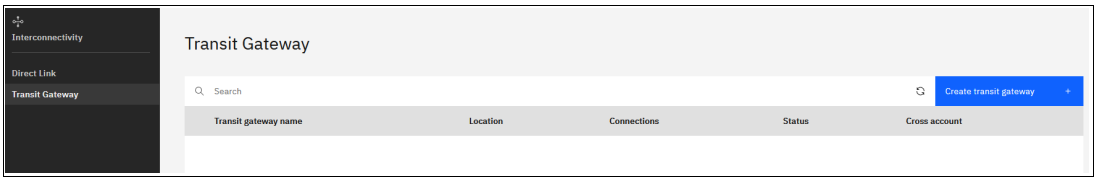


Figure 3-17 Creating a Transit Gateway

Next chose a transit gateway name, resource group, and region as shown in Figure 3-18.

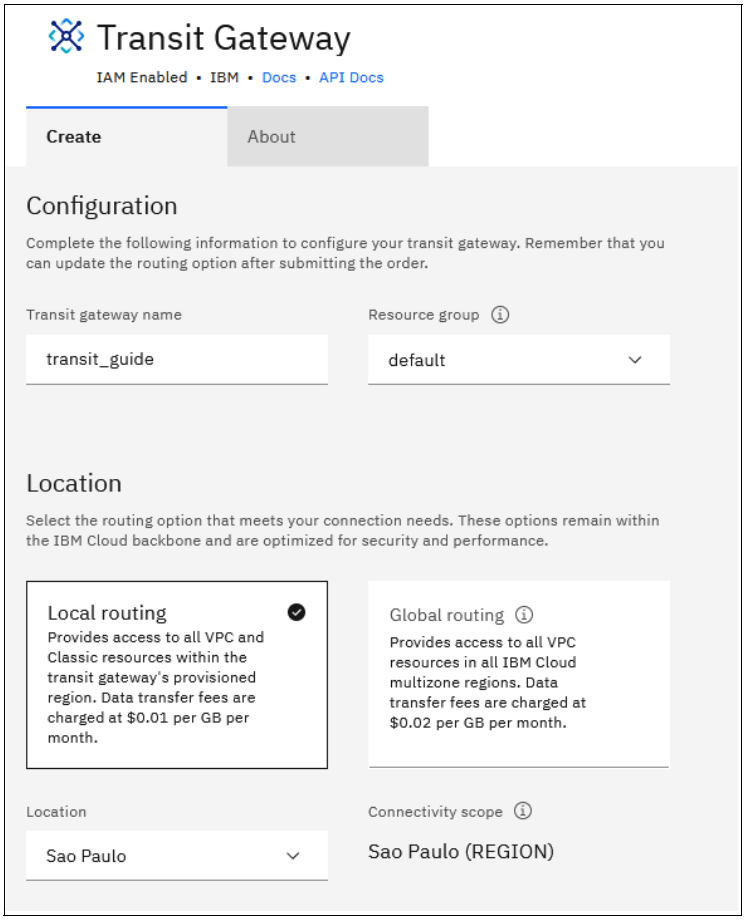


Figure 3-18 Creating a Transit Gateway

Click create and the transit appears as available as shown in Figure 3-19.

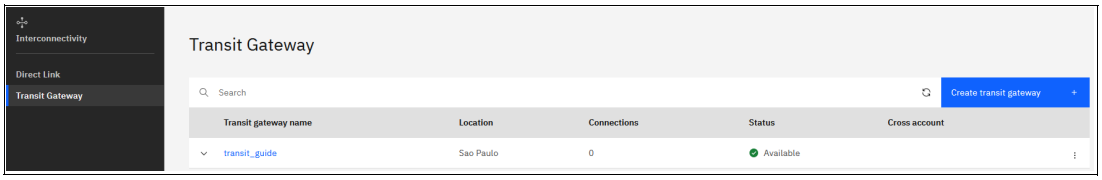


Figure 3-19 Check transit Gateway

6. In the Subnets section, click Attach existing to attach an existing subnet to the connection as shown in Figure 3-20 on page 69. A GRE tunnel requires that a connection be attached

to a subnet. You can create a new subnet. If you enable IBM Cloud Transit Gateway, you can configure the GRE tunnel by using the IBM Cloud Transit Gateway interface. The table in this topic lists all the subnets that are attached to the IBM Cloud connection.

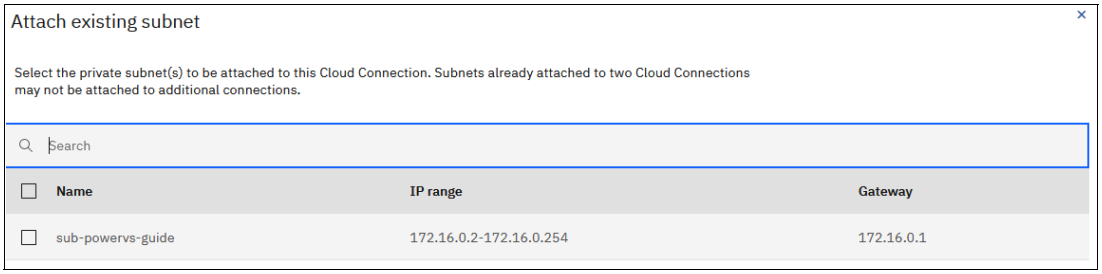


Figure 3-20 Selecting subnet

7. Review the summary and the terms and conditions. Then, click Create to create an IBM Cloud connection as shown in Figure 3-21.

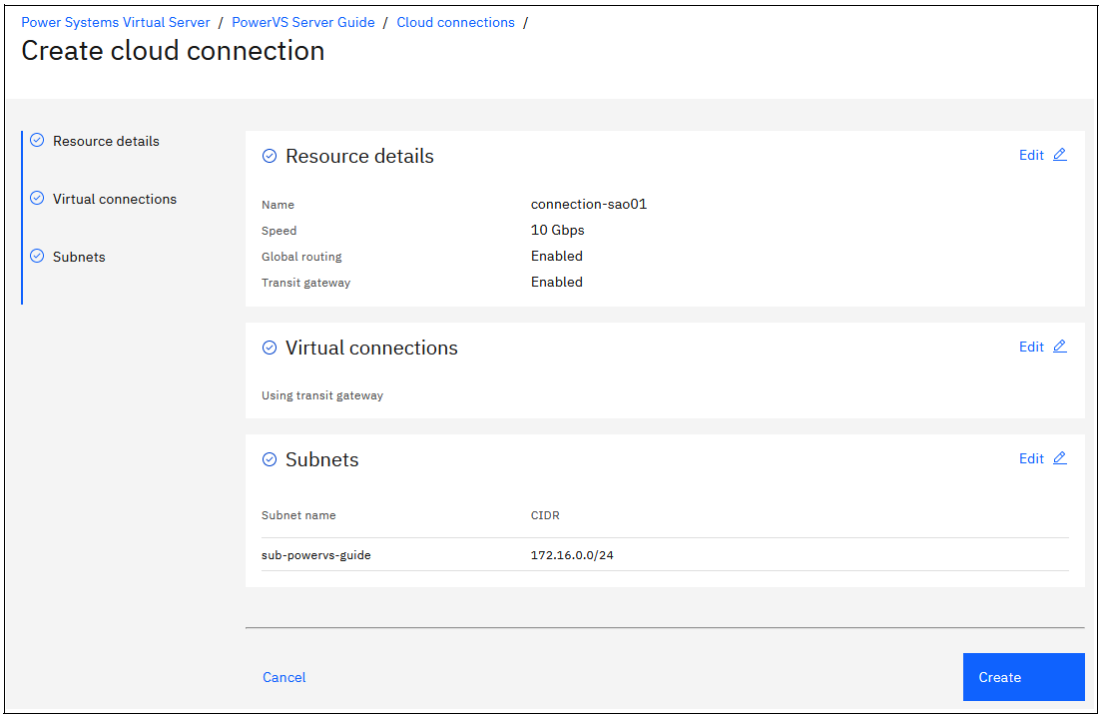


Figure 3-21 Review the summary

After click create and the cloud connection is available as shown in Figure 3-22.

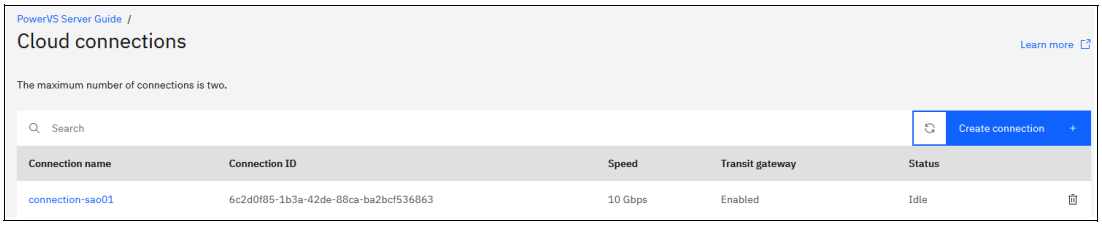


Figure 3-22 Checking Cloud connection

Check the cloud connect details as shown in Figure 3-23 on page 70.

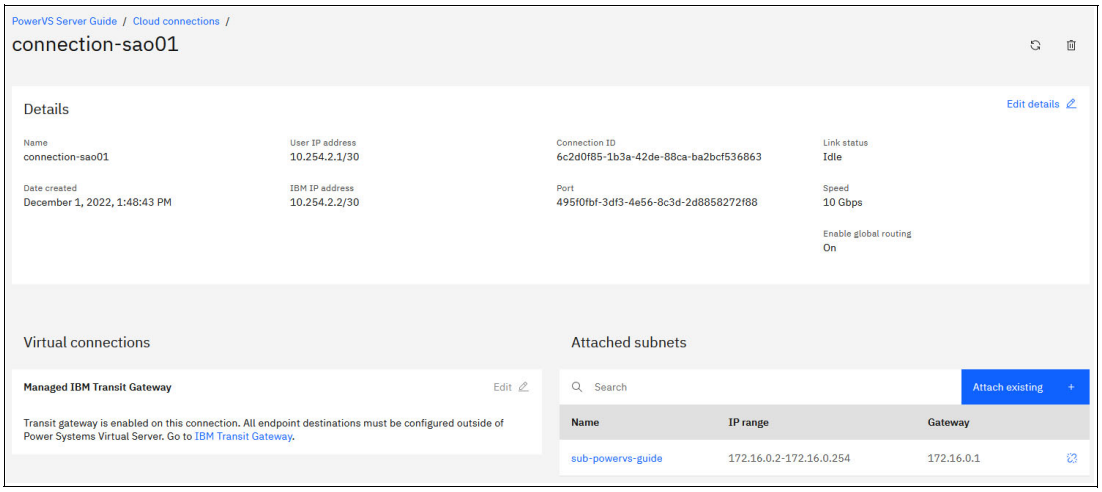


Figure 3-23 Check the cloud connection details

At this point, return to the previously configured transit gateway as shown in Figure 3-24.

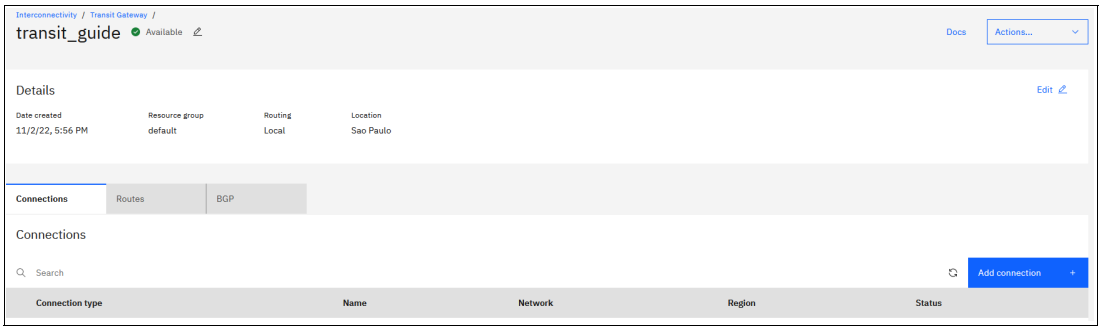


Figure 3-24 Transit gateway

We make the following connections:

- PowerVS Environment.
- VPC Environment.
- Classic Environment.

To add a PowerVS Environment click add → for Network connection select Direct Link → select the link in Existing direct links and choose your connection name in Connection Name as shown in Figure 3-25.

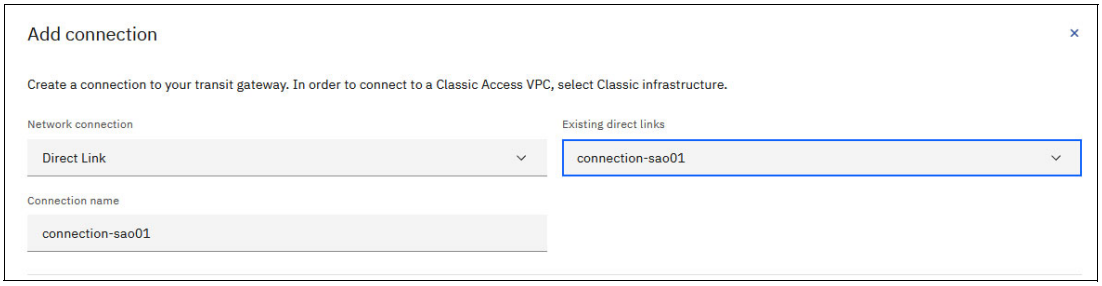


Figure 3-25 Adding PowerVS Connection to Transit Gateway

When finished the status appears as attached as shown in Figure 3-26 on page 71.

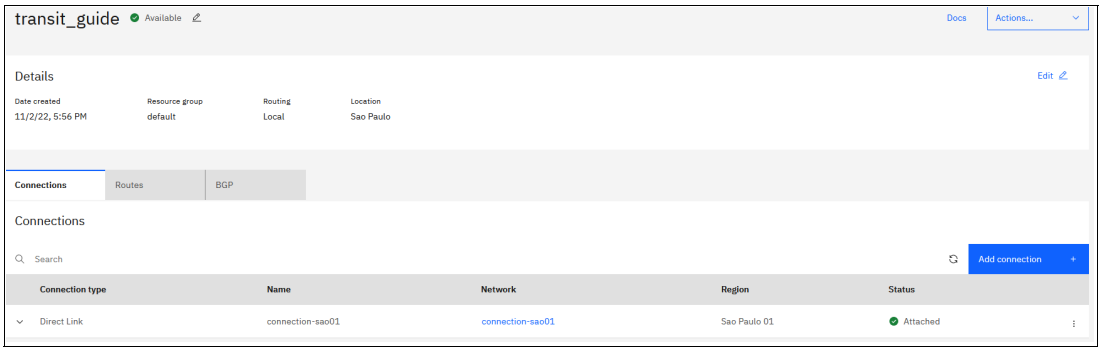


Figure 3-26 PowerVS Connection attached to Transit Gateway

To add a VPC Environment, click add → for Network connection select VPC → select the Region → select the Available connection and give the connection name as shown in Figure 3-27.

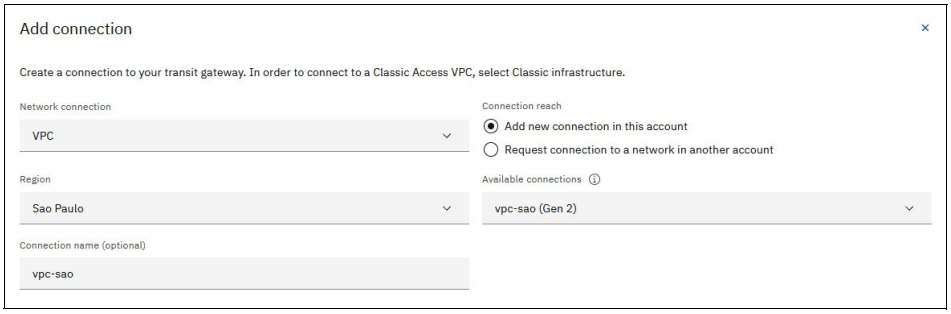


Figure 3-27 Adding VPC Connection to Transit Gateway

To add a Classic Environment click add → for Network connection select Classic Infrastructure and give the connection name as shown in Figure 3-28.

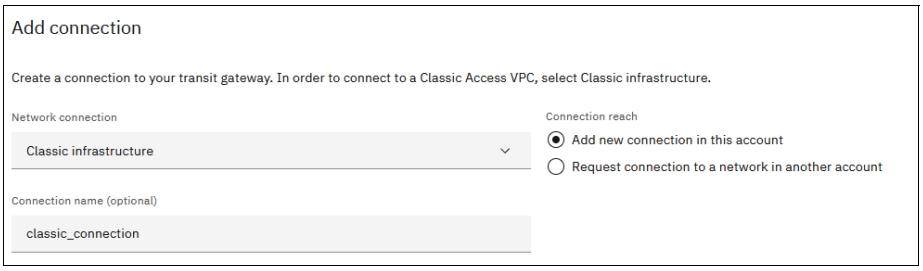


Figure 3-28 Adding Classic Connection to Transit Gateway

At the end you see all connections with status attached as shown in Figure 3-29 on page 72.

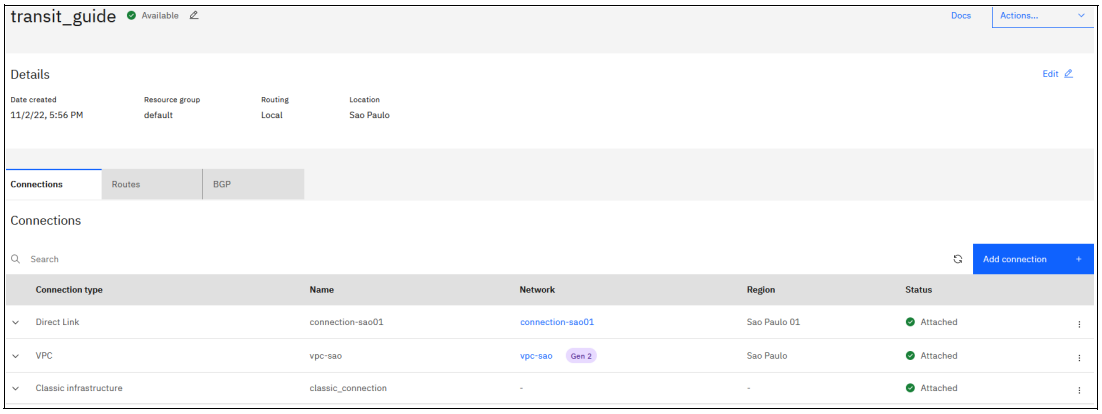


Figure 3-29 Connections established at the transit gateway

Now click Routes → click Generate report so that the routes are generated as shown in Figure 3-30.

Figure 3-30 Routes Generate report

Click BGP to check the generated BGP routes as shown in Figure 3-31.

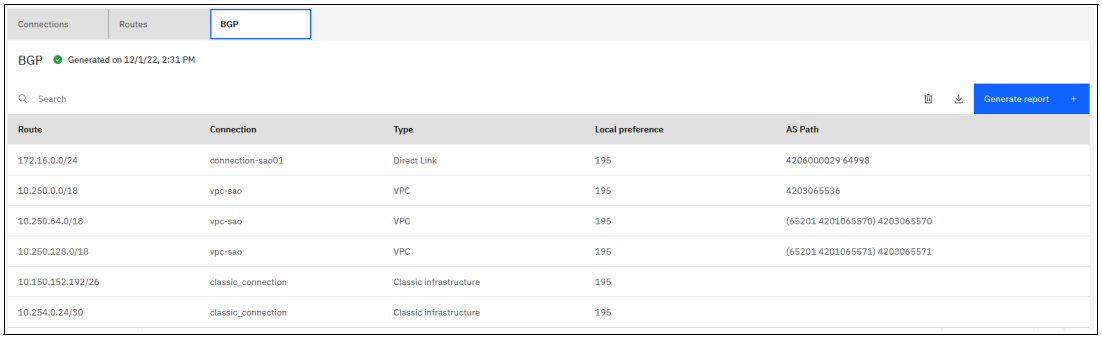


Figure 3-31 BGP generate report

Check the environment connectivity

- Check the Virtual Server Instance for VPC as shown in Figure 3-32 on page 73.

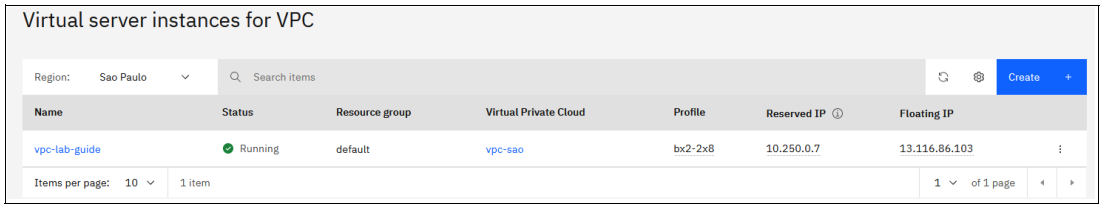


Figure 3-32 Virtual Server Instance for VPC

- Check the Virtual Server Instance for Classic Infrastructure as shown in Figure 3-33.

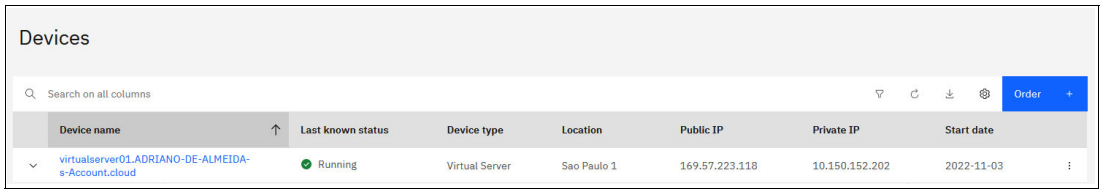


Figure 3-33 Virtual Server Instance for Classic Infrastructure

- Check the Power Virtual Server Instance as shown in Figure 3-34.

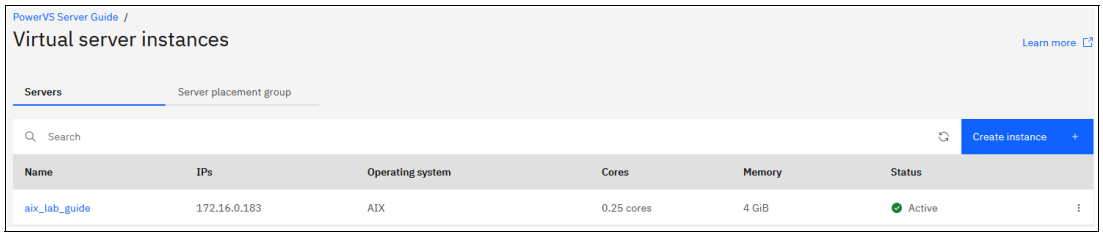


Figure 3-34 Power Virtual Server Instance

- The Classic to PowerVS environment communication is shown in Figure 3-35.

```
[root@virtualserver01 ~]# ping 172.16.0.183
PING 172.16.0.183 (172.16.0.183) 56(84) bytes of data.
64 bytes from 172.16.0.183: icmp_seq=1 ttl=248 time=0.701 ms
64 bytes from 172.16.0.183: icmp_seq=2 ttl=248 time=0.474 ms
^C
--- 172.16.0.183 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 999ms
rtt min/avg/max/mdev = 0.474/0.587/0.701/0.116 ms
[root@virtualserver01 ~]# ssh root@172.16.0.183
The authenticity of host '172.16.0.183 (172.16.0.183)' can't be established.
RSA key fingerprint is SHA256:HQbvpicrs9CFHiTlZhraZOUZ/JXjNXQ2fWG34dIS1XY.
RSA key fingerprint is MD5:88:fa:5a:65:38:af:e1:bd:89:53:ca:42:28:68:63:5d.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '172.16.0.183' (RSA) to the list of known hosts.
root@172.16.0.183's password:
Last login: Thu Dec  1 14:48:12 CST 2022 on /dev/pts/0 from 10.250.0.7
*******************************************************************************
*                                                                             *
*                                                                             *
*  Welcome to AIX Version 7.2!                                                *
*                                                                             *
*                                                                             *
*  Please see the README file in /usr/lpp/bos for information pertinent to    *
*  this release of the AIX Operating System.                                  *
*                                                                             *
*                                                                             *
*******************************************************************************
#
```

Figure 3-35 Classic to PowerVS environment communication

- PowerVS to Classic communication is shown in Figure 3-36 on page 74.

```
[root@virtualserver01 ~]# ssh root@172.16.0.183
root@172.16.0.183's password:
Last login: Thu Dec  1 14:51:52 CST 2022 on /dev/pts/1 from 10.150.152.202
*******************************************************************************
*                                                                             *
*                                                                             *
*  Welcome to AIX Version 7.2!                                                *
*                                                                             *
*                                                                             *
*  Please see the README file in /usr/lpp/bos for information pertinent to    *
*  this release of the AIX Operating System.                                  *
*                                                                             *
*                                                                             *
*******************************************************************************
# ping 10.150.152.202
PING 10.150.152.202 (10.150.152.202): 56 data bytes
64 bytes from 10.150.152.202: icmp_seq=0 ttl=57 time=0 ms
64 bytes from 10.150.152.202: icmp_seq=1 ttl=57 time=0 ms
64 bytes from 10.150.152.202: icmp_seq=2 ttl=57 time=0 ms
^C
--- 10.150.152.202 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
#
```

Figure 3-36 PowerVS to Classic communication

- VPC to PowerVS communication is shown in Figure 3-37.

```
[root@vpc-lab-guide ~]# ping 172.16.0.183
PING 172.16.0.183 (172.16.0.183) 56(84) bytes of data.
64 bytes from 172.16.0.183: icmp_seq=1 ttl=247 time=0.452 ms
64 bytes from 172.16.0.183: icmp_seq=2 ttl=247 time=0.573 ms
^C
--- 172.16.0.183 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 999ms
rtt min/avg/max/mdev = 0.452/0.512/0.573/0.064 ms
[root@vpc-lab-guide ~]# ssh root@172.16.0.183
The authenticity of host '172.16.0.183 (172.16.0.183)' can't be established.
RSA key fingerprint is SHA256:HQbvpicrs9CFHiTlZhraZOUZ/JXjNXQ2fWG34dIS1XY.
RSA key fingerprint is MD5:88:fa:5a:65:38:af:e1:bd:89:53:ca:42:28:68:63:5d.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '172.16.0.183' (RSA) to the list of known hosts.
root@172.16.0.183's password:
Last login: Thu Dec  1 14:12:34 CST 2022 on /dev/vty0
*******************************************************************************
*                                                                             *
*                                                                             *
*  Welcome to AIX Version 7.2!                                                *
*                                                                             *
*                                                                             *
*  Please see the README file in /usr/lpp/bos for information pertinent to    *
*  this release of the AIX Operating System.                                  *
*                                                                             *
*                                                                             *
*******************************************************************************
#
```

Figure 3-37 VPC to PowerVS communication

- PowerVS to VPC communication is shown in Figure 3-38.

```
[root@vpc-lab-guide ~]# ssh root@172.16.0.183
root@172.16.0.183's password:
Last login: Thu Dec  1 14:47:14 CST 2022 on /dev/pts/0 from 10.250.0.7
*******************************************************************************
*                                                                             *
*                                                                             *
*  Welcome to AIX Version 7.2!                                                *
*                                                                             *
*                                                                             *
*  Please see the README file in /usr/lpp/bos for information pertinent to    *
*  this release of the AIX Operating System.                                  *
*                                                                             *
*                                                                             *
*******************************************************************************
# ping 10.250.0.7
PING 10.250.0.7 (10.250.0.7): 56 data bytes
64 bytes from 10.250.0.7: icmp_seq=0 ttl=57 time=0 ms
64 bytes from 10.250.0.7: icmp_seq=1 ttl=57 time=0 ms
64 bytes from 10.250.0.7: icmp_seq=2 ttl=57 time=0 ms
64 bytes from 10.250.0.7: icmp_seq=3 ttl=57 time=0 ms
^C
--- 10.250.0.7 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
#
```

Figure 3-38 PowerVS to VPC communication

- Classic to VPC communication is shown in Figure 3-39.

```
[root@virtualserver01 ~]# ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.150.152.202  netmask 255.255.255.192  broadcast 10.150.152.255
        inet6 fe80::42d:ceff:fe65:3bbc  prefixlen 64  scopeid 0x20<link>
        ether 06:2d:ce:65:3b:bc  txqueuelen 1000  (Ethernet)
        RX packets 723039  bytes 193405153 (184.4 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 672768  bytes 60682034 (57.8 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 169.57.223.118  netmask 255.255.255.240  broadcast 169.57.223.127
        inet6 fe80::436:90ff:fef6:e9ca  prefixlen 64  scopeid 0x20<link>
        ether 06:36:90:f6:e9:ca  txqueuelen 1000  (Ethernet)
        RX packets 5262769  bytes 405235327 (386.4 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 2756028  bytes 443995711 (423.4 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

[root@virtualserver01 ~]# ping 172.16.0.183
PING 172.16.0.183 (172.16.0.183) 56(84) bytes of data.
64 bytes from 172.16.0.183: icmp_seq=1 ttl=248 time=0.865 ms
64 bytes from 172.16.0.183: icmp_seq=2 ttl=248 time=0.388 ms
64 bytes from 172.16.0.183: icmp_seq=3 ttl=248 time=0.368 ms
^C
--- 172.16.0.183 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 0.368/0.540/0.865/0.230 ms
[root@virtualserver01 ~]#
```

Figure 3-39 Classic to VPC communication

- VPC to Classic communication is shown in Figure 3-40.

```
# ifconfig -a
en0: flags=1e084863,814c0<UP,BROADCAST,NOTRAILERS,RUNNING,SIMPLEX,MULTICAST,GROUPRT,64BIT,CHECKSUM_OFFLOAD(ACTIVE),LARGESEND,CHAIN>
        inet 172.16.0.183 netmask 0xffffff00 broadcast 172.16.0.255
         tcp_sendspace 262144 tcp_recvspace 262144 rfc1323 1
en1: flags=1e084863,814c0<UP,BROADCAST,NOTRAILERS,RUNNING,SIMPLEX,MULTICAST,GROUPRT,64BIT,CHECKSUM_OFFLOAD(ACTIVE),LARGESEND,CHAIN>
        inet6 fe80::a801:46ff:fee3:4db4/64
         tcp_sendspace 262144 tcp_recvspace 262144 rfc1323 1
sit0: flags=8100041<UP,RUNNING,LINK0>
        inet6 ::/96
lo0: flags=e08084b,c0<UP,BROADCAST,LOOPBACK,RUNNING,SIMPLEX,MULTICAST,GROUPRT,64BIT,LARGESEND,CHAIN>
        inet 127.0.0.1 netmask 0xff000000 broadcast 127.255.255.255
        inet6 ::1%1/128
         tcp_sendspace 131072 tcp_recvspace 131072 rfc1323 1
# ping 10.150.152.202
PING 10.150.152.202 (10.150.152.202): 56 data bytes
64 bytes from 10.150.152.202: icmp_seq=0 ttl=57 time=0 ms
64 bytes from 10.150.152.202: icmp_seq=1 ttl=57 time=0 ms
```

Figure 3-40 VPC to Classic communication

4

Recommendations for IBM AIX and Linux deployments on IBM Power Systems Virtual Server

This chapter walks you through navigating in IBM Power Systems Virtual Server environment on IBM Cloud for AIX and Linux.

The content in this chapter is derived from actual experiences while deploying and managing workloads on-premises and in the Cloud with the IBM Power Systems Virtual Server.

This chapter provides the following:

4.1 Hints and tips for AIX and Linux

The hints and tips that are gathered here are from actual problem experiences. After reading this chapter, you will be familiar with the process of VNC console, SSH tunneling, console by way of the LAN adapter, and take snapshots on AIX and Linux instances.

4.1.1 Pre-configurations using VNC console

This section shows how to connect to an AIX or Linux VM after deploying your system. In this case we selected the MonoGambetta-RearServer.

1. From the dashboard, **Open console**. In the IBM Power Systems Virtual Server for AIX/Linux a way to access the console is by running the VNC as shown in Figure 4-1.

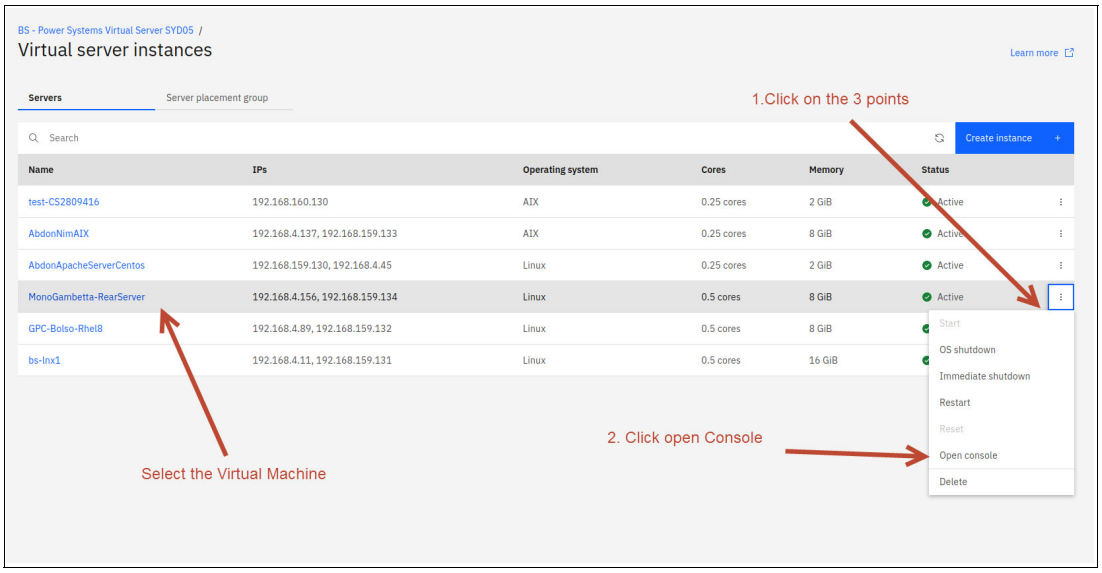


Figure 4-1 Opening console on PowerVS for AIX/Linux

2. After a new window opens to access by way of the web console the default credentials for the initial login, user profile root and password empty (in the AIX machines cases, any user created in Linux cases). This example uses the Linux user shubbert previously created using ssh, as shown in Figure 4-2 on page 79.

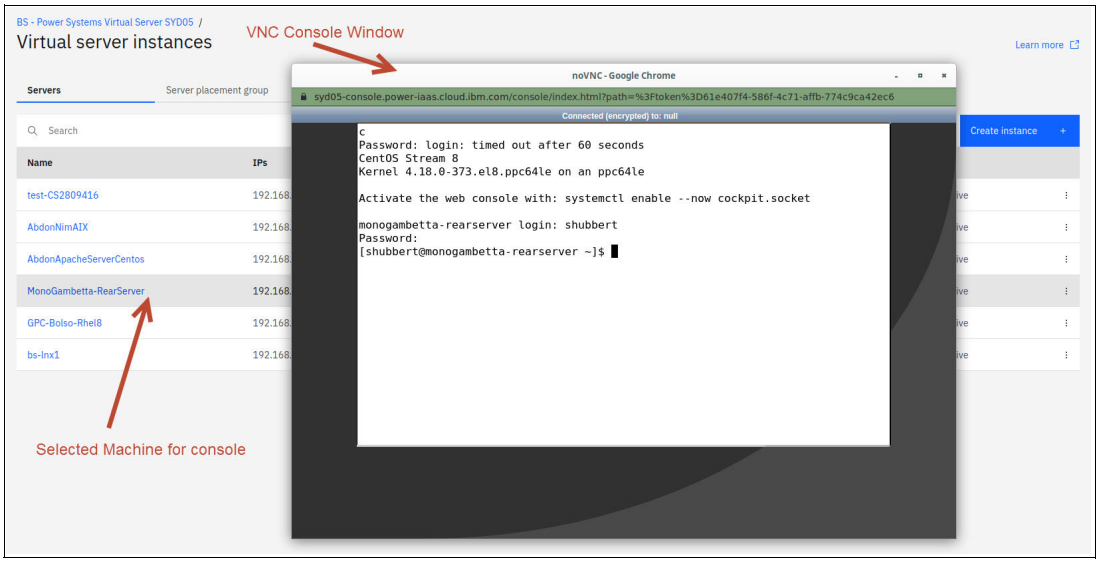


Figure 4-2 Opened console for IBM AIX/Linux on PowerVS

3. If login with root on AIX machines, you need to change the password. Add a new one for user profile root as shown in Figure 4-3.

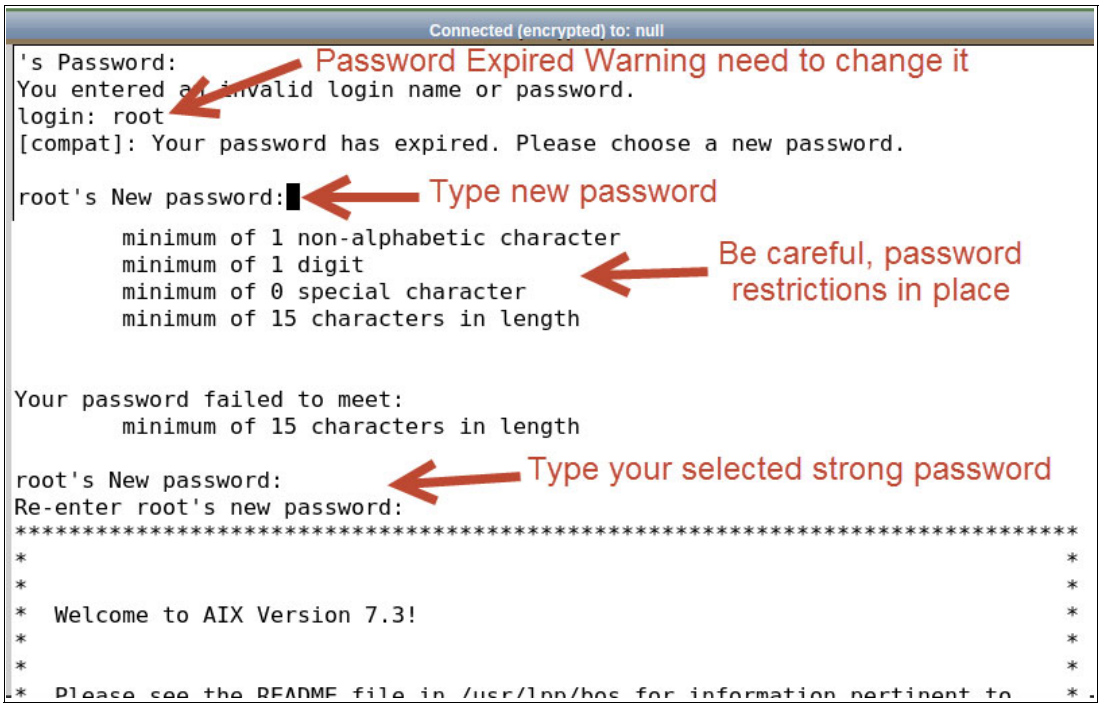


Figure 4-3 Change root´s password

4. Carry on accepting the software agreements, if needed.
5. Then the shell login is displayed by VNC.

4.1.2 Remote access to AIX or Linux Services by tunneling

The public IP address blocks most ports. As a result, you need to use SSH tunneling or configure your certificates and use SSL to allow your service to connect over public IP.

Before you use an SSH tunnel, you must create a user profile in the Virtual Machine (keep using shubbert as user and monoGambetta-RearServer as Virtual Machine).

In the following steps, you can see the procedure to be able to access through SSH tunneling:

1. Open a PuTTY terminal and create a session using the public IP as shown in Figure 4-4.

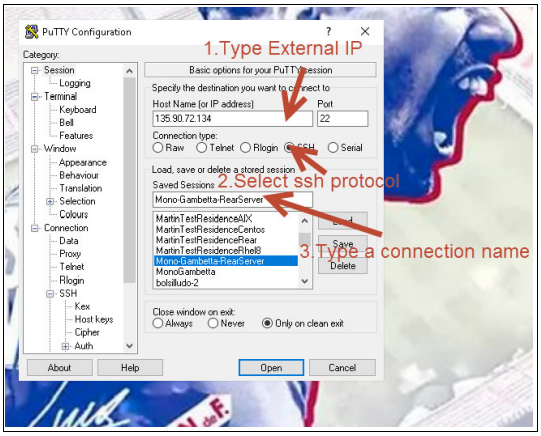


Figure 4-4 Set PuTTY terminal

a. The ports required to configure PuTTY are described in Table 4-1. For this scenario, we forwarded http and mysql port just for testing purposes.

Table 4-1 Ports required to setup on PuTTY

Source port	Destination	Source port	Destination
80	localhost:80	80	localhost:80
3306	localhost:3306	3306	localhost:3306

b. Setup the source port and destination as shown in Figure 4-5 on page 81.

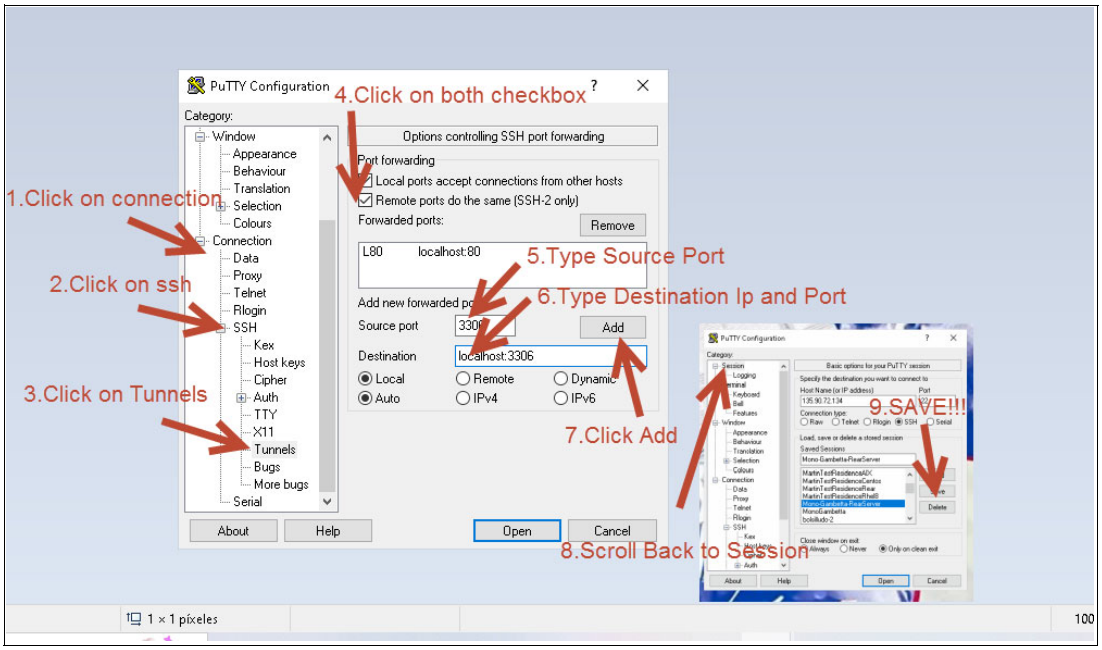


Figure 4-5 Set the source ports on PuTTY

Note: Steps 5, 6, and 7 are repeated for each value cited in Table 4-1 on page 80.

a. Go back to Session on Category at left hand at PuTTY, and Click Save to keep changes.

a. Click **Open** at session in PuTTY and click **Yes** to trust this host and connection.

a. New window terminal is opened, type root and password already changed, and click Enter. Then the tunneling is ready. Hold the terminal opened as shown in Figure 4-6 on page 82.

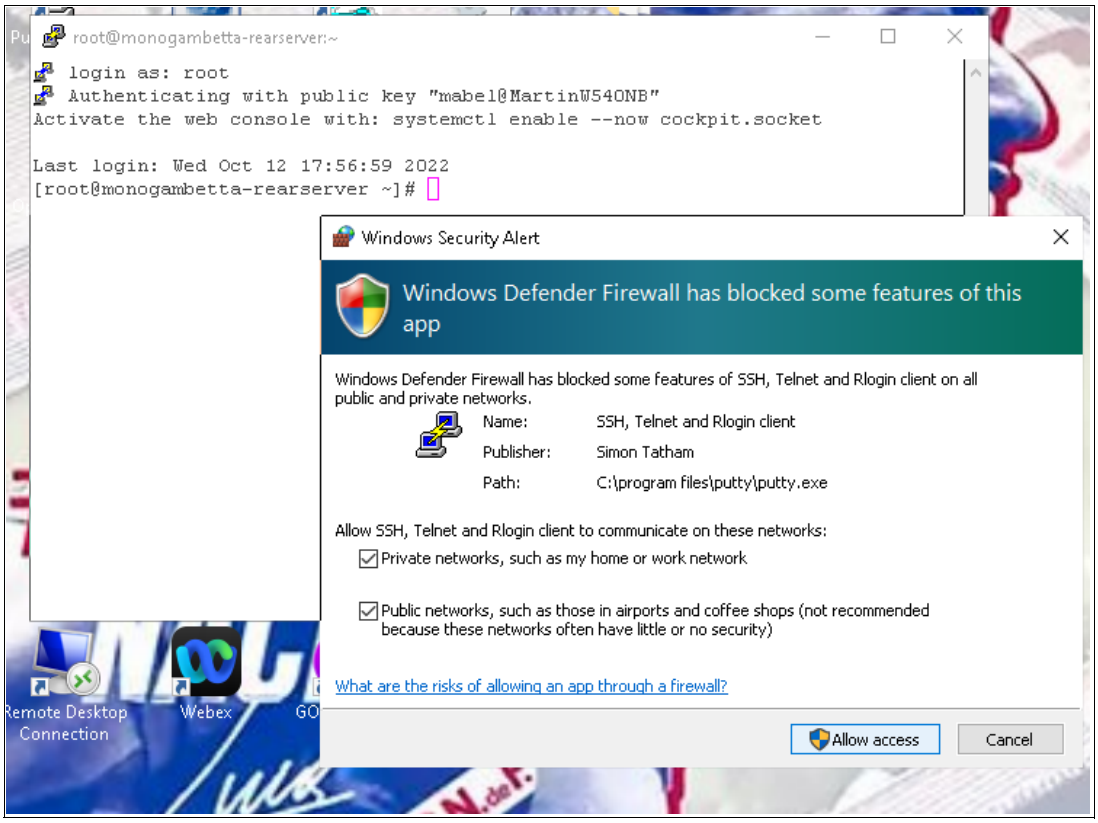


Figure 4-6 PuTTY login for root

Important: The tunneling done using PuTTY is for a Windows system. If everything is OK as shown in Figure 4-6, you get a warning from your windows firewall that services are starting on your machine (the ones forwarded). If you use another operating system such as Linux or Mac system, the SSH tunneling to allow ACS to connect over the External IP is different, refer to `Using SSH tunneling to permit ACS to connect over the public IP`.

2. We connected to our web server, and our mysql server, through our SSH tunnels as shown in Figure 4-7 on page 83.

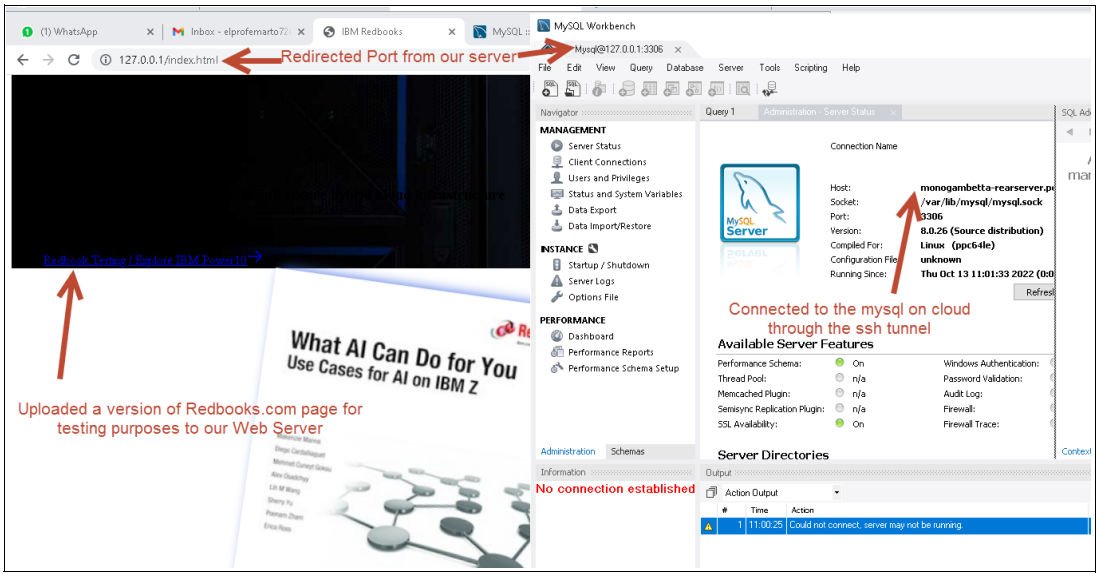


Figure 4-7 SSH tunneling access to apps

Important: For this scenario, ports 3306 and 80 are chosen as the source port numbers. This value has been configured in PuTTY. Do not change the source port numbers. When telnetting, avoid making the source port the same as the destination.

4.2 Using snapshots on AIX and Linux instances

Snapshots is a resource to create a checkpoint in IBM i VMs for a possible future rollback. It uses copy-on-write technics to minimize snapshot time to near zero, allowing the VM to be restored really fast.

To ensure data integrity we need to perform a disk stage on IBM i to save data cached in memory.

Snapshots are useful on change management tasks:

- Before performing an OS upgrade.
- Before installing PTFs.
- Before making changes to system values.
- Before updating application programs.

Remember: Snapshot is not a backup mechanism. It cannot use one snapshot in a different system to the source instance, you cannot move snapshot data to other medium and you cannot mount snapshots on a new system as done with PowerHA SystemMirror for backup purposes.

4.2.1 Taking snapshots

Snapshots can only be taken from the command line using APIs or IBM Cloud CLI. You need some IBM Cloud CLI knowledge to perform this task.

Installing and using IBM Cloud CLI

You will learn how to install the IBM Cloud CLI on Windows. For further information refer to the official IBM Cloud online documentation: Getting started with the IBM Cloud CLI.

For Windows, some functions are not supported unless you are running Windows 10 Pro.

- Open a PowerShell window as Administrator and run the command as shown in Example 4-1.

Example 4-1 Run the install command

```
[Net.ServicePointManager]::SecurityProtocol = "Tls12, Tls11, Tls, Ssl3";
iex(New-Object
Net.WebClient).DownloadString('https://raw.githubusercontent.com/IBM-Cloud/ibm-clo
ud-developer-tools/master/windows-installer/idt-win-installer.ps1')
```

This process can take some minutes. Wait until the end and restart the system.

- On a command window run the command as shown in Example 4-2 to check if setup succeed.

Example 4-2 Check ibmcloud cli setup process

```
ibmcloud dev help
```

If you can see the help means you can continue.

- Now you need to connect to your account as shown in Example 4-3 and continue installing the plugins.

Example 4-3 Logon to your account

```
ibmcloud login
```

- Now you see the system asking for your account using email and then your password.
- When you have more than one account, you need to select the one you will use and the region using the item number on your window.
- To install the required plug-in to work with Power Systems Virtual Server, run the command as shown in Example 4-4.

Example 4-4 Install Power IaaS plug-in

```
ibmcloud plugin install power-iaas
```

- Click y when asked to continue with setup process.
- Now list the available services as shown in Example 4-5.

Example 4-5 List available services

```
ibmcloud pi service-list
```

Example 4-6 shows the list of available services.

Example 4-6 List the available services

```
C:\Users\martin>ibmcloud pi service-list
Listing services under account PIL Support as user martin@abeleira.uy...
ID
Name
```

```
crn:v1:bluemix:public:power-iaas:syd05:a/af339adbfd124f99a5cea8271bf030cc:86ae0e84
-1dd4-40a9-9901-b44e811de9d2::   BS - Power Systems Virtual Server SYD05
```

- Target the service by entering the command **ibmcloud pi service-target <crn>** as shown in Example 4-7.

Example 4-7 Target the service to use

```
C:\Users\martin>ibmcloud pi service-target
crn:v1:bluemix:public:power-iaas:syd05:a/af339adbfd124f99a5cea8271bf030cc:86ae0e84
-1dd4-40a9-9901-b44e811de9d2::
Targeting service
crn:v1:bluemix:public:power-iaas:syd05:a/af339adbfd124f99a5cea8271bf030cc:86ae0e84
-1dd4-40a9-9901-b44e811de9d2::...
```

- To list the available instances, run the command as shown in Example 4-8.

Example 4-8 List instances

```
C:\Users\martin>ibmcloud pi ins
Listing instances under account PIL Support as user martin@abeleira.uy...
ID                                   Name                      Path
b841d73d-d89f-417b-8524-276cc56b230f   morro-garcia-AIXNfs
/pcloud/v1/cloud-instances/20b08814cda14b62a71fa685a36b9f9b/pvm-instances/b841d73d-d89f-417b-8524-276cc56b230f
5269d87b-152b-4879-8614-86d1155030d0   test-CS2809416
/pcloud/v1/cloud-instances/20b08814cda14b62a71fa685a36b9f9b/pvm-instances/5269d87b-152b-4879-8614-86d1155030d0
e0dc7b4a-f9f2-4aea-af24-c5a42aea6b76   AbdonNimAIX
/pcloud/v1/cloud-instances/20b08814cda14b62a71fa685a36b9f9b/pvm-instances/e0dc7b4a-f9f2-4aea-af24-c5a42aea6b76
56dd3f79-fbf4-411c-97e7-3361bb5bcd37   AbdonApacheServerCentos
/pcloud/v1/cloud-instances/20b08814cda14b62a71fa685a36b9f9b/pvm-instances/56dd3f79-fbf4-411c-97e7-3361bb5bcd37
2168c2e3-5268-46dd-bcfc-e2b1369f2787   MonoGambetta-RearServer
/pcloud/v1/cloud-instances/20b08814cda14b62a71fa685a36b9f9b/pvm-instances/2168c2e3-5268-46dd-bcfc-e2b1369f2787
d9d66851-7239-4a7f-a115-ebe4120a883f   GPC-Bolso-Rhel8
/pcloud/v1/cloud-instances/20b08814cda14b62a71fa685a36b9f9b/pvm-instances/d9d66851-7239-4a7f-a115-ebe4120a883f
01c96c47-fb5e-46a0-99e6-416f8882bd9d   bs-lnx1
/pcloud/v1/cloud-instances/20b08814cda14b62a71fa685a36b9f9b/pvm-instances/01c96c47-fb5e-46a0-99e6-416f8882bd9d
```

- With this list you can copy the instance ID you need to freeze using snapshot.
- Now you need to go back to the console or terminal session and perform a stop of the database (in this example mysql) as shown in Example 4-9.

Example 4-9 Perform a disk stage and quiesce database

```
[root@monogambetta-server]# systemctl stop mysqld
```

- This action needs to be performed on any server running database services, or transactional services that might be affected during the snapshot, before running the snapshot command.
- After your data is written to disk and transactions are held in memory continue with your task on ibmcloud cli and take the snapshot. You use the **ibmcloud pi snapshot-create** command targeting your VM instance and choose a name to identify the snapshot. Refer to Example 4-10.

Example 4-10 Take the snapshot using ibmcloud cli

```
C:\Users\martin>ibmcloud pi snapshot-create 2168c2e3-5268-46dd-bcfc-e2b1369f2787
--name MonoGambetta-snap
Creating snapshot for instance 2168c2e3-5268-46dd-bcfc-e2b1369f2787 under account
PIL Support as user martin@abeleira.uy...
OK
Snapshot MonoGambetta-snap with ID of cea0a4d9-5e29-4527-bd34-fa81c9e3944a has
started.
```

- To list the snapshot use the command **ibmcloud pi snaps**. You see the snapshot state next to the Instance ID and Snapshot ID. Wait for the available status.
- When the status is available, resume database activity as shown in Example 4-11.

Example 4-11 Resume database activity

```
[root@monogambetta-server]# systemctl start mysqld
```

- To restore the snapshot you need to power-off your VM instance.
- The command to restore the snapshot data is **ibmcloud pi snapshot-restore <instance_id> --snapshot <snapshot_id>** as shown in Example 4-12.

Example 4-12 Restoring the snapshot

```
C:\Users\martin>ibmcloud pi snapshot-restore 2168c2e3-5268-46dd-bcfc-e2b1369f2787
--snapshot cea0a4d9-5e29-4527-bd34-fa81c9e3944a
Restoring snapshot for instance 2168c2e3-5268-46dd-bcfc-e2b1369f2787 under account
PIL Support as user martin@abeleira.uy...
OK
Restoring snapshot cea0a4d9-5e29-4527-bd34-fa81c9e3944a has started.
```

- You can get the restore operation status using the **ibmcloud pi snaps** command.
- After the snapshot is restored start the VM instance.

5

Migration and deployment to Cloud with IBM Power Systems Virtual Server

In this chapter we describe how to deploy and migrate AIX and Linux operation system to IBM Power Systems Virtual Server.

The following topics are discussed:

5.1 Power Systems Virtual Server workspace and instance

Before you create a virtual server, you must understand the difference in terminology between a *Power Systems Virtual **workspace*** and a *Power Systems Virtual Server **instance***.

Think® of the Power Systems Virtual Server **workspace** as a container for all Power Systems Virtual Server **instances** at a specific geographic region. The Power Systems Virtual Server **workspace** is available from the **Resource list** in the Power Systems Virtual Server user interface. The **workspace** can contain multiple Power Systems Virtual Server **instances**. For example, you can have two Power Systems Virtual Server **workspaces**, one in Dallas, Texas, and another in Washington, D.C. Each service can contain multiple Power Systems Virtual Server **instances**.

5.1.1 Creating a Power Systems Virtual Server workspace

To create and configure an IBM Power Systems Virtual Server, complete the following steps:

1. Log in to the IBM Cloud catalog with your IBM Cloud account credentials.
2. In the catalog's search box, type Power Systems Virtual Server and click WorkSpace for Power Systems Virtual Server as shown on Figure 5-1.

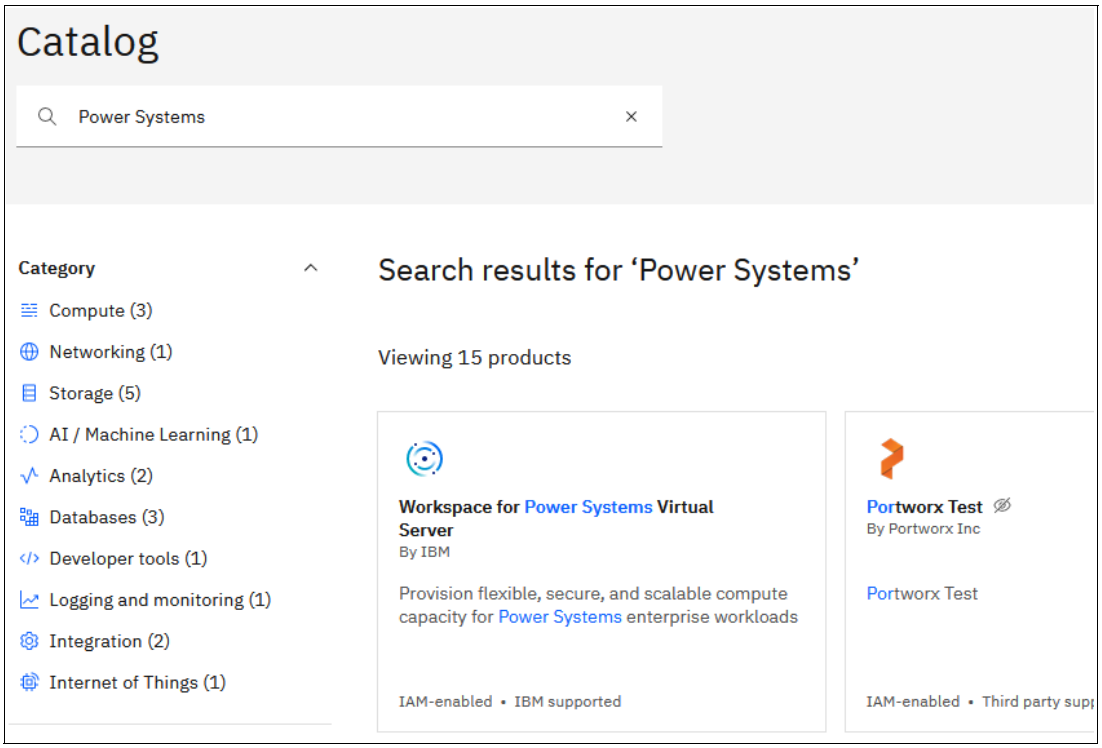


Figure 5-1 Searching for IBM Power System Virtual Server on IBM Cloud catalog

3. Click workspace, then click Create as shown in Figure 5-2.

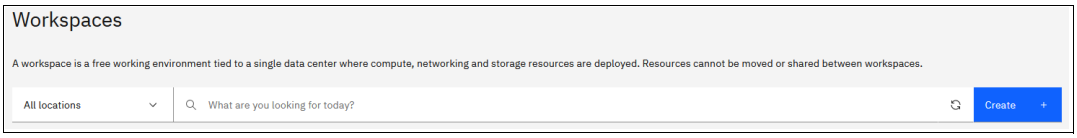


Figure 5-2 Selecting IBM Power Systems Virtual Server region

4. Specify a name for your workspace, select your resource group, select your Region and then click Create as shown in Figure 5-3.

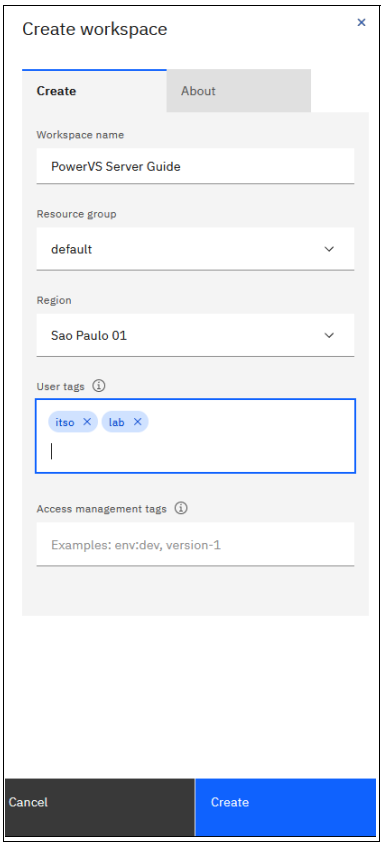


Figure 5-3 Creating the Power Systems Virtual Server workspace

5. From the Resource List, select your Power Systems Virtual Server workspace under compute as shown in Figure 5-4.

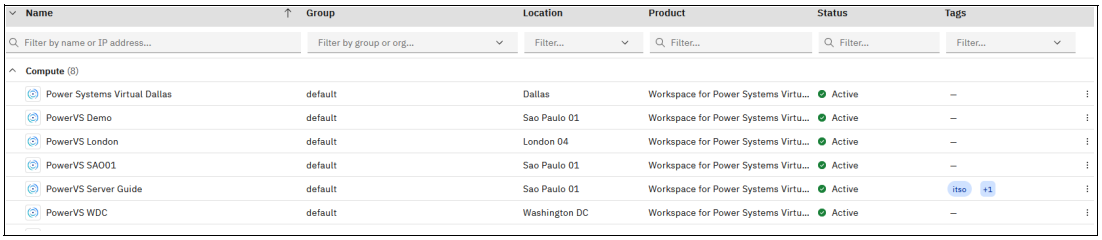


Figure 5-4 IBM Cloud Resource List

5.1.2 Networking VLANs and subnets

This section shows a summary of the configuration connectivity to Power Systems Virtual Server and the configuration and addition of a private network subnet.

The Virtual LAN (VLAN) on the IBM Power Systems Infrastructure network, provides an enterprise-grade private network with full isolation and security. Each VLAN is Public or Private, and is assigned to a specific data center for a specific IBM Cloud Account.

Each VLAN is associated with a single Subnet, for example:

- Public VLAN (only one per region).
  - Public Subnet.
- Private VLAN.
  - Private Subnet.

A Public Subnet is the quickest and simplest way to connect to a IBM Power Systems Virtual Server instance. The public network is protected by a firewall and only the following network protocols are allowed:

- SSH (port 22).
- HTTPS (port 443).
- Ping (ICMP).
- IBM i 5250 console emulation with SSL (port 992).

A Private Subnet is required for the connection of your virtual instances with systems outside of the IBM data centers. This subnet is an internal network that can be used to connect individual IBM Power Systems Virtual Servers with each other.

If you want to separate different types of network traffic in your landscape, you can order more subnets (and their respective VLANs).

Keep in mind that the additional VLANs and subnets lead to traffic segregation, not increased performance; the increased performance is gained when additional VLANs and Subnets are associated to a host. When multiple network interfaces are used, two performance increases are possible depending on the use case:

- Bonding of the network interfaces, creating a network path with the network throughput of both interfaces.
- Traffic segregation using two networks, then isolating high volumes of traffic to a specific network which avoids a single network becoming a bottleneck. For example, a network for storage I/O only.

With IBM Power Virtual Server as an example, a single threaded Linux network interface can reach 100% CPU Thread utilization even though the performance limits of the network path itself are still not reached. Additional network interfaces attached to another VLAN and Subnet will therefore increase performance.

By default, your server has a Private IP address. If you use public subnets, a public IP address is assigned in addition.

Configuring and adding a private network subnet

You can configure a private network subnet when you create a IBM Power Systems Virtual Server. You must give your subnet a Name and specify a Classless inter-domain routing (CIDR). When you specify a CIDR, the Gateway, IP range, and DNS server are automatically populated. You must use CIDR notation when you choose the IP ranges for your private network subnet. CIDR notation is defined in RFC 1518 and RFC 1519.

For example, 192.168.100.14/24 represents the IPv4 address, 192.168.100.14, and its associated routing prefix 192.168.100.0, or equivalently, its subnet mask 255.255.255.0 (which has 24 leading 1-bits).

Important: The first IP address is always reserved for the gateway in all data centers. The second and third IP addresses are reserved for gateway high-availability (HA) in only the WDC04 colo. The subnet address and subnet broadcast address are reserved in both colos.

Attention: You must not use an IP range outside of the ranges that are defined by RFC 1918 (10.0.0.0/8, 172.16.0.0/12, or 192.168.0.0/16) for a subnet. The instances that are attached to that subnet might not be able to reach parts of the public internet.

To create a subnet in the new Power Systems Virtual Server service click Create Subnet as shown in Figure 5-5.

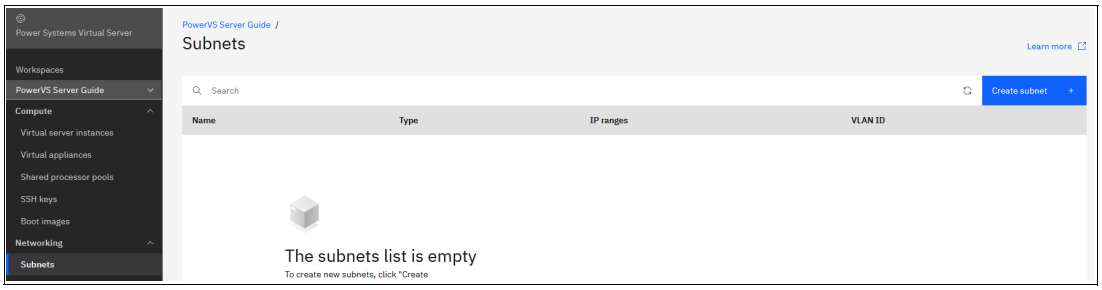


Figure 5-5 Creating new Subnet

Then fill the name and CIDR of the new subnet as shown in Figure 5-6.

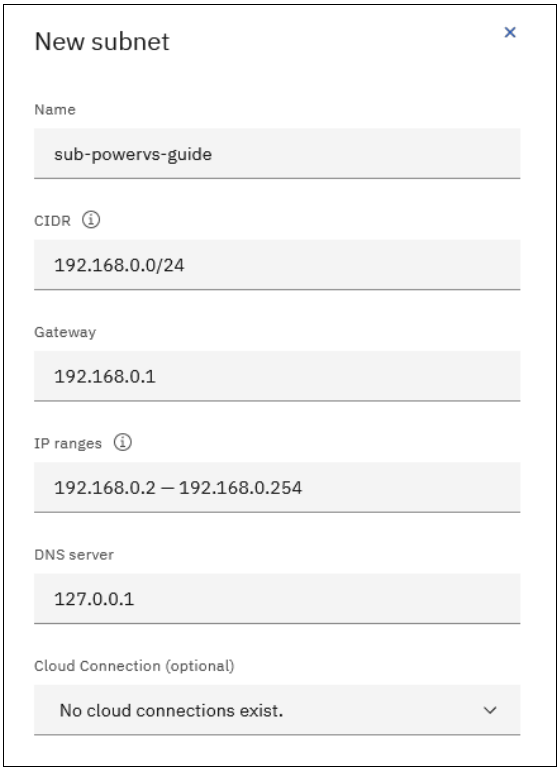


Figure 5-6 Creating new Subnet

After creating the subnet, check their details as shown in Figure 5-7 on page 92.

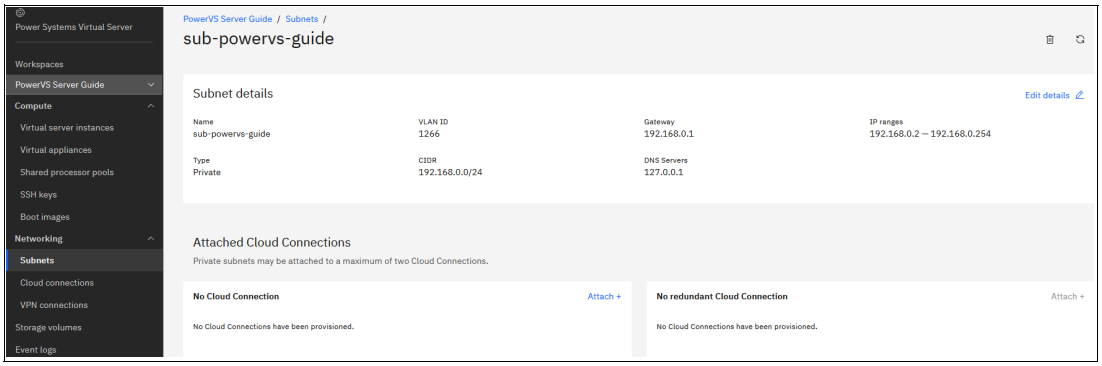


Figure 5-7 Checking subnet details

5.2 Deploy an AIX Power Systems Virtual Server

To begin, complete all of the fields under the Virtual servers section. If you select more than one instance, you are presented with additional options.

1. Click Create instance under Virtual server instances as shown in Figure 5-8.

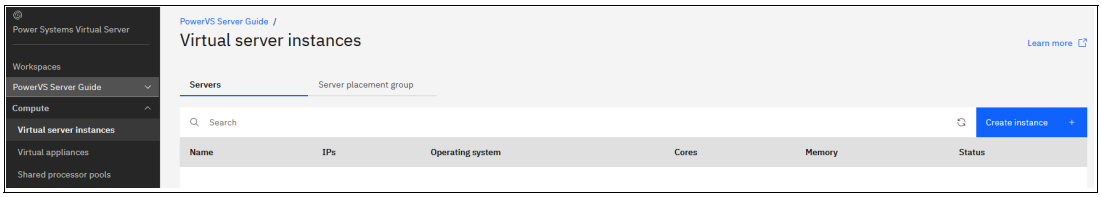


Figure 5-8 Creating a instance

2. Next chose the instance name and specify the number of instances to be created as shown in Figure 5-9.

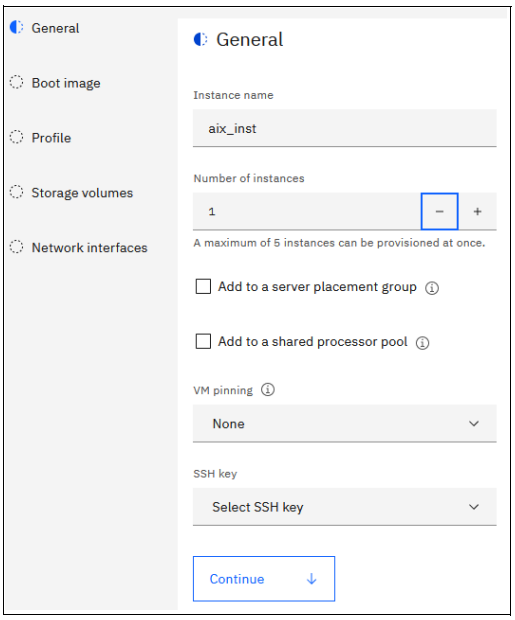


Figure 5-9 Choosing the Instance name, number of instances and VM pinning options

- Placement groups provide control over the host on which a VM is placed. The host is determined by the group's collocation policy, different server or same server. Use a "Different server" placement group to build high availability within a data center.
- Shared processor pools can be used to split cores between a set of virtual server instances, reduce licensing costs, or both.
- Number of Instances.

If you choose the Machine type as E880 or E980, you can choose anti-affinity policy with maximum of 2 VM instances as shown in Figure 5-10.

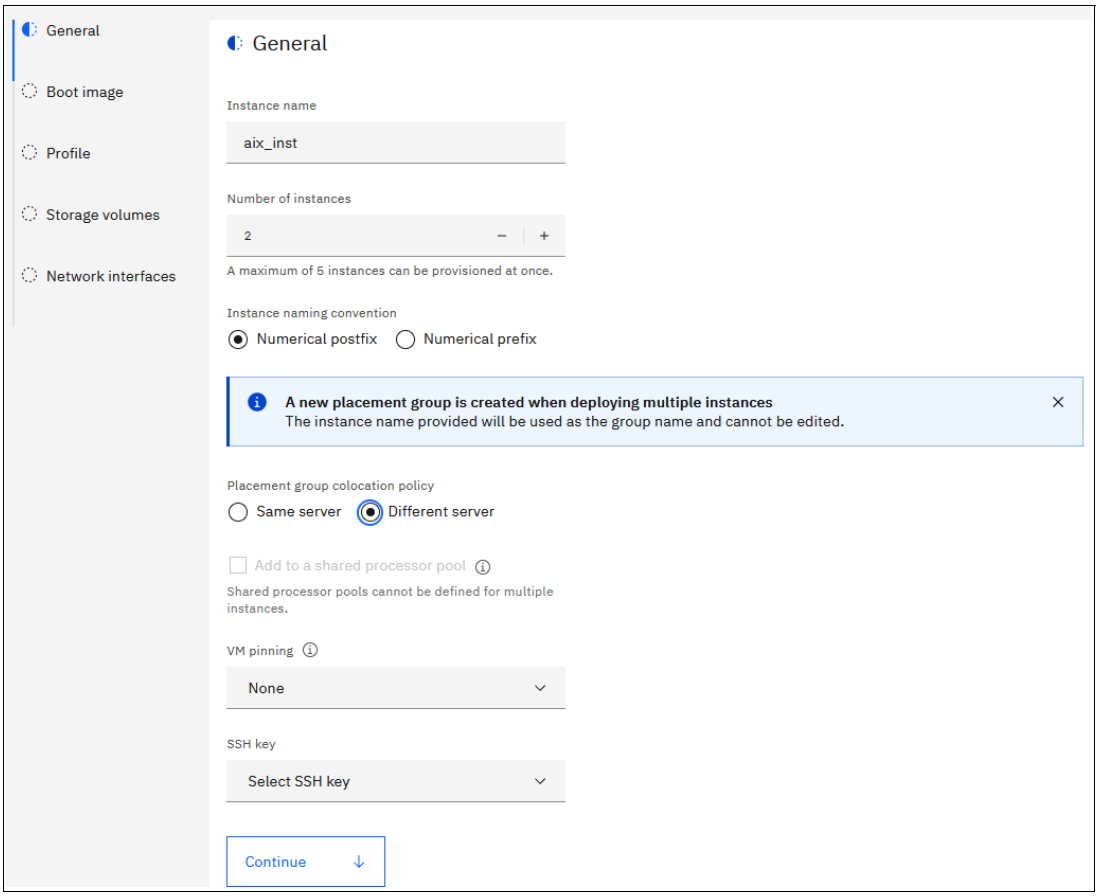


Figure 5-10 Selecting number of instances

If you specify more than one instance, you can select the following naming conventions and colo rules:

- Different Server

Select this option to host each instance on a different server. You can use this option if you are concerned about a single-server outage that might affect all Power Systems Virtual Server instances.

- Same Server

Select this option to host each instance on a different server.

- Numerical prefix

Select this option to add numbers before the name of the virtual server. If, for example, the first Power Systems Virtual Server name is Austin the next name for the virtual instance is 1Austin.

- Numerical postfix

Select this option to add numbers after the name of the virtual server. If, for example, the first Power Systems Virtual Server name is Austin the next name for the virtual instance is Austin1.

- VM pinning

Select this option to pin your virtual machine. You can choose either a soft or hard pinning policy. When you soft pin a VM for high availability, PowerVC automatically migrates the VM back to the original host after the host is back to its operating state. If the VM has a licensing restriction with the host, the hard pin option restricts the movement of the VM during remote restart, automated remote restart, DRO, and live partition migration. The default pinning policy is none.

3. Choose an existing SSH key or create one to securely connect to your Power Systems Virtual Server as shown in Figure 5-11.

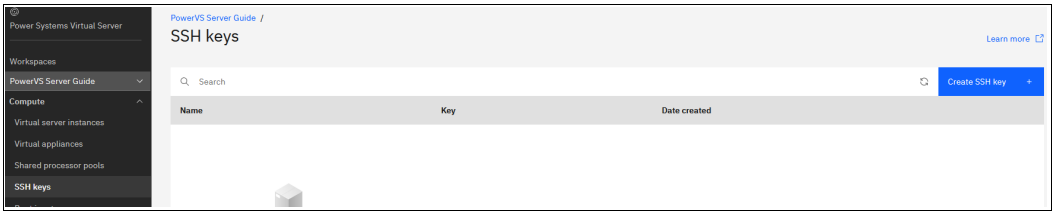


Figure 5-11 Creating the SSH Key

To create a new SSH key click Create SSH and put your Key name and public key as shown in Figure 5-12.

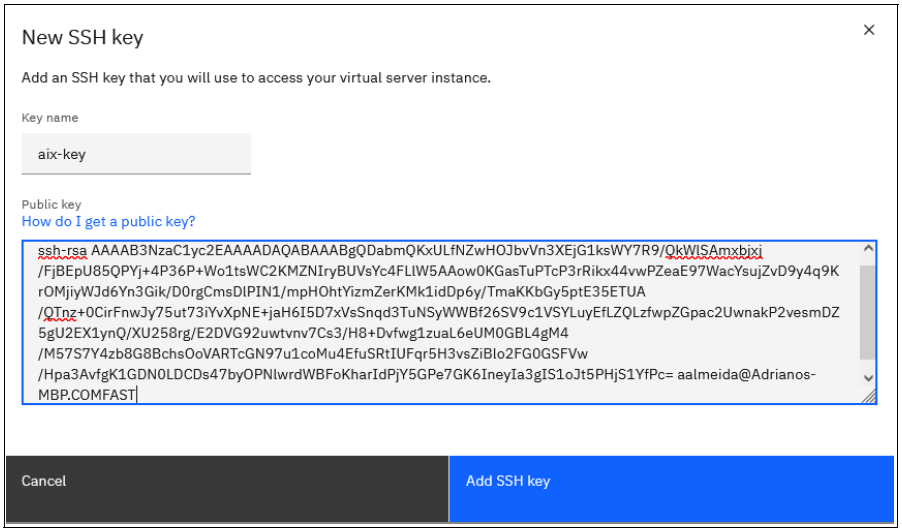


Figure 5-12 Creating a new SSH Key

After created the SSH key, select it as shown in Figure 5-13 on page 95.

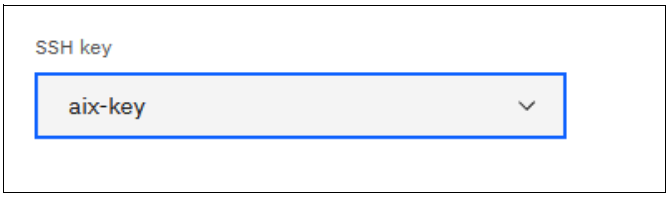


Figure 5-13 Selecting the SSH Key

4. Select the boot image completing the fields as instructed by your organization. When you select Boot image, the Power Systems Virtual Server user interface allows you to select boot images from a group of stock images or the list of stock images in your catalog. You must select a storage type for stock images as shown in Figure 5-14.

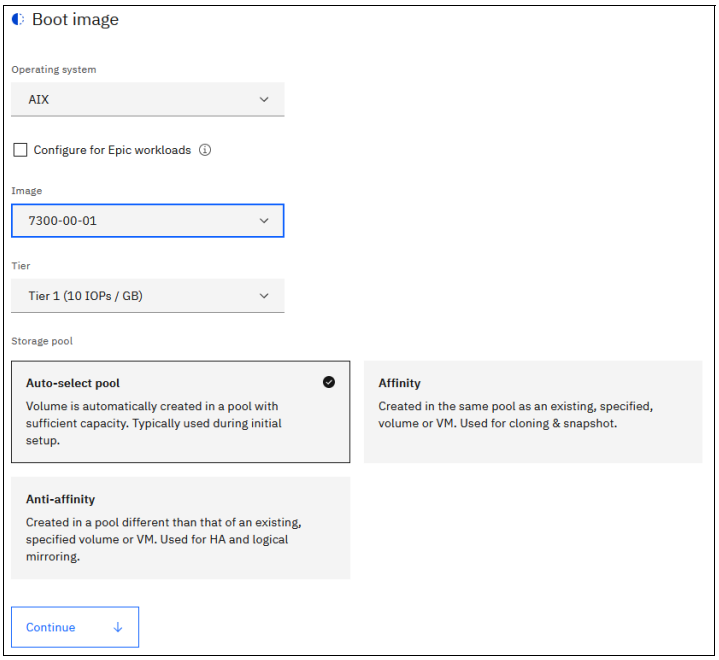


Figure 5-14 Selecting Boot Image

- Storage tiers

For each Power Systems Virtual Server instance, you must select a storage tier - Tier 1 or Tier 3. The storage tiers in Power Systems Virtual Server are based on I/O operations per second (IOPS). It means that the performance of your storage volumes is limited to the maximum number of IOPS based on volume size and storage tier. Although, the exact numbers might change over time, the Tier 3 storage is currently set to 3 IOPS/GB, and the Tier 1 storage is currently set to 10 IOPS/GB. For example, a 100 GB Tier 3 storage volume can receive up to 300 IOPs, and a 100 GB Tier 1 storage volume can receive up to 1000 IOPS.

5. Select your machine type, the number of cores, the amount of memory (GB) and whether you want a dedicated processor, uncapped shared processor, or capped shared processor as shown in Figure 5-15 on page 96.

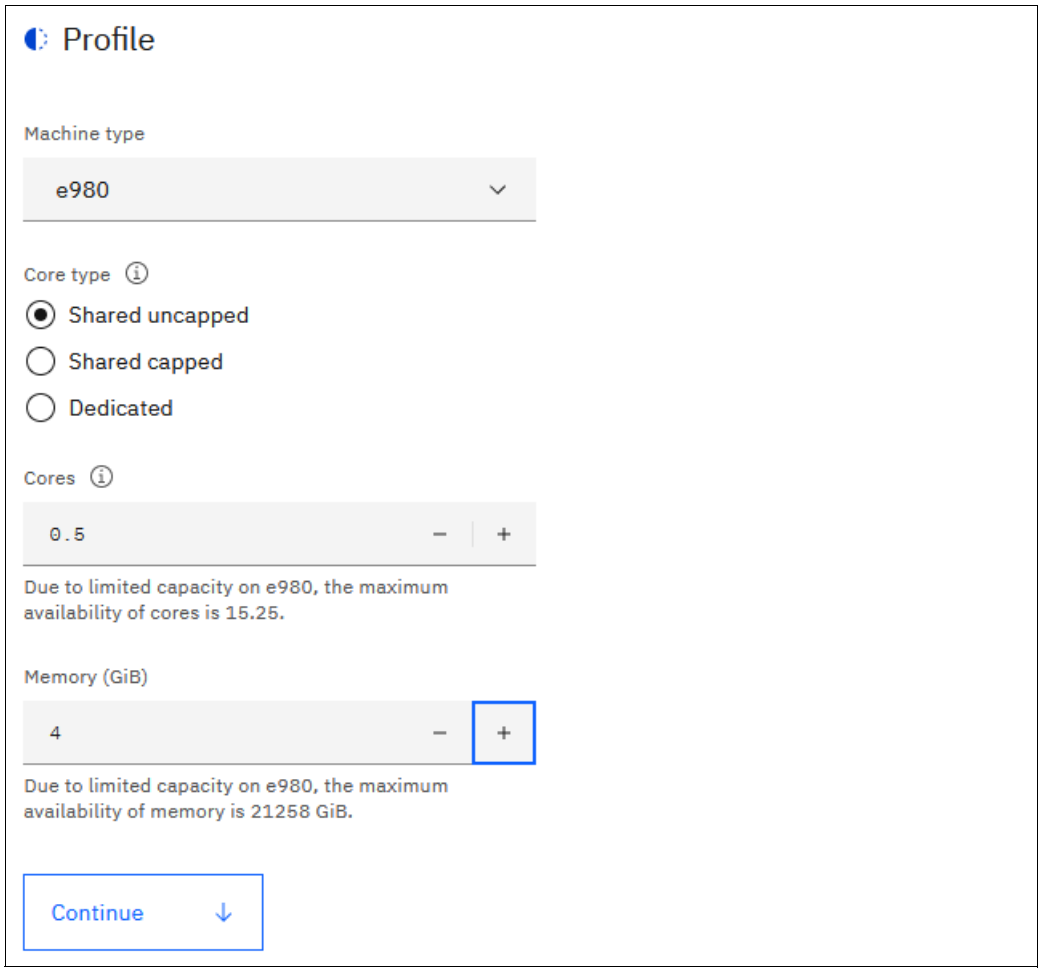


Figure 5-15 Configuring the IBM Power Systems Virtual Server Profile

- Machine type

Specify the machine type. The machine type that you select determines the number of cores and memory that is available. For more information about hardware specifications, see E880 (Dallas and Washington only), S922, and E980 (Data centers other than Dallas and Washington).

- Cores

There is a core-to-vCPU ratio of 1:1. For shared processors, fractional cores round up to the nearest whole number. For example, 1.25 cores equals 2 vCPUs.

- Memory

Select the amount of memory for the Power Systems Virtual Server. If you choose to use more than 64 GBs of memory per core, you are charged a higher price. For example, when you choose one core with 128 GBs of memory, you are charged the regular price for the first 64 GBs. After the first 64 GBs (64 - 128 GBs), you are charged a higher price.

6. Optional you can either create a new data volume or attach an existing one that you defined in your IBM Cloud account.

- To create a new volume on Storage volume click Storage volumes as shown in Figure 5-16 on page 97.

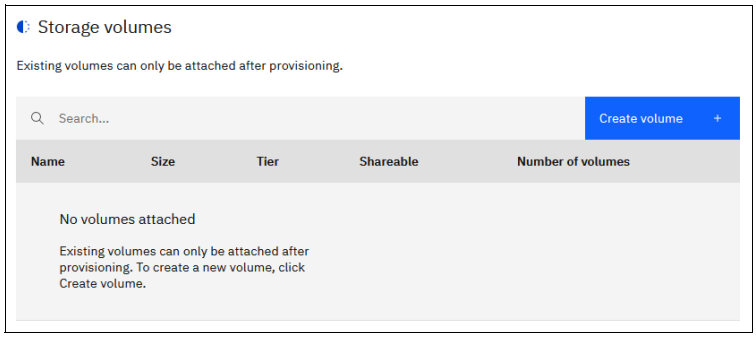


Figure 5-16 Adding a new storage volume

On the new storage to be added write the name, chose if it will be sharable, the size and quantity as shown in Figure 5-17.

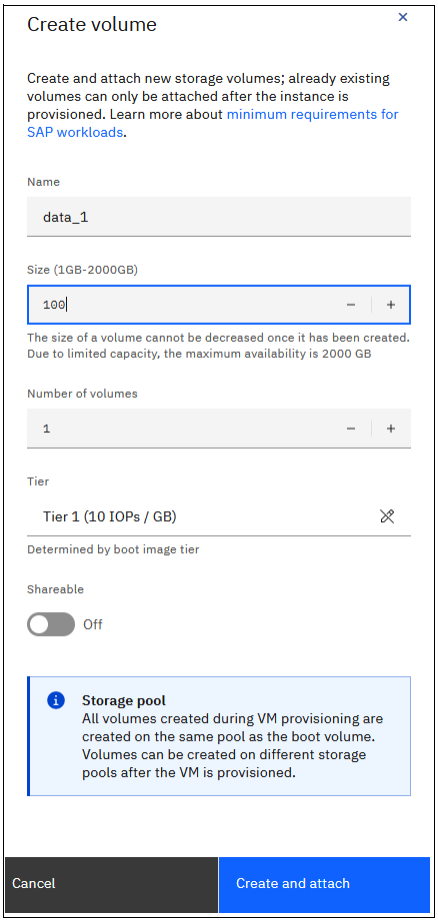


Figure 5-17 Adding a new storage volume

The disk select to be created is shown in Figure 5-18 on page 98.

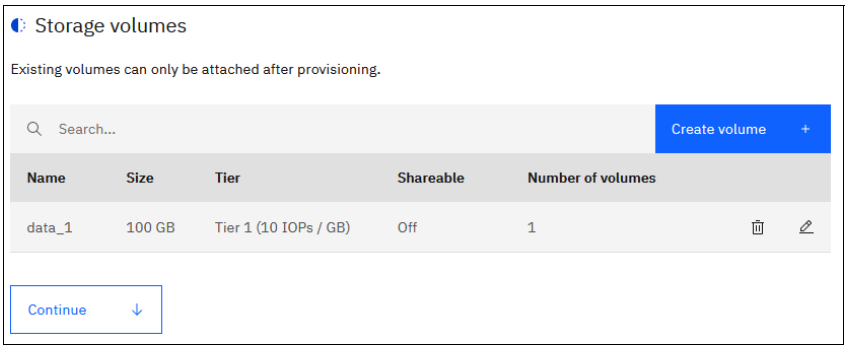


Figure 5-18 Attached storage volume

7. Next select the Network Interfaces as shown in Figure 5-19.

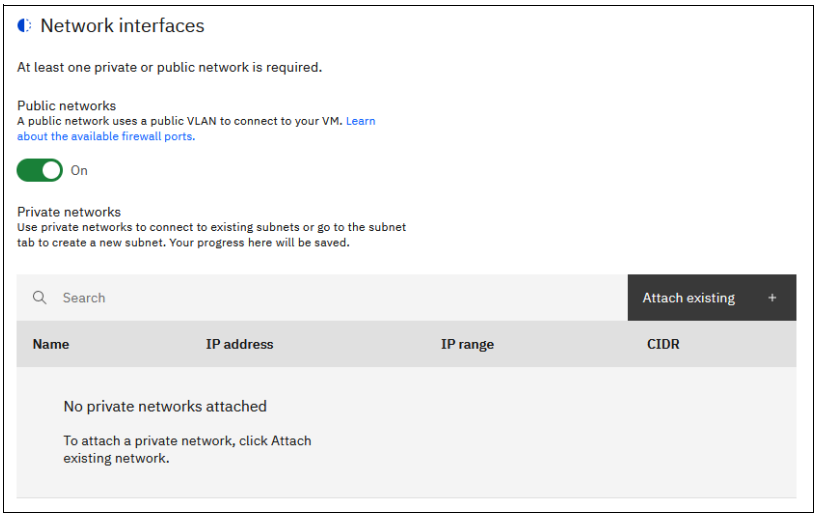


Figure 5-19 Attaching existing Network

- Public Networks

Select this option to use an IBM-provided public network. There is a cost that is associated with selecting this option.

- Private Networks

Click Add to identify a new private network for the virtual server. If you already added a private network, you can select it from the list as shown in Figure 5-20.

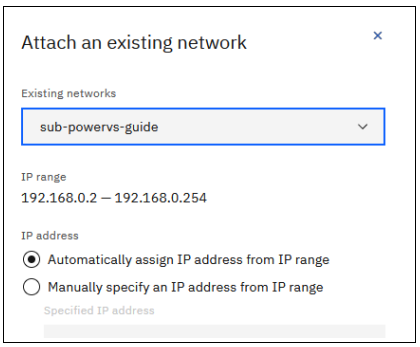


Figure 5-20 Attaching an existing network

After selecting the networks, it is listed as shown i n Figure 5-21.

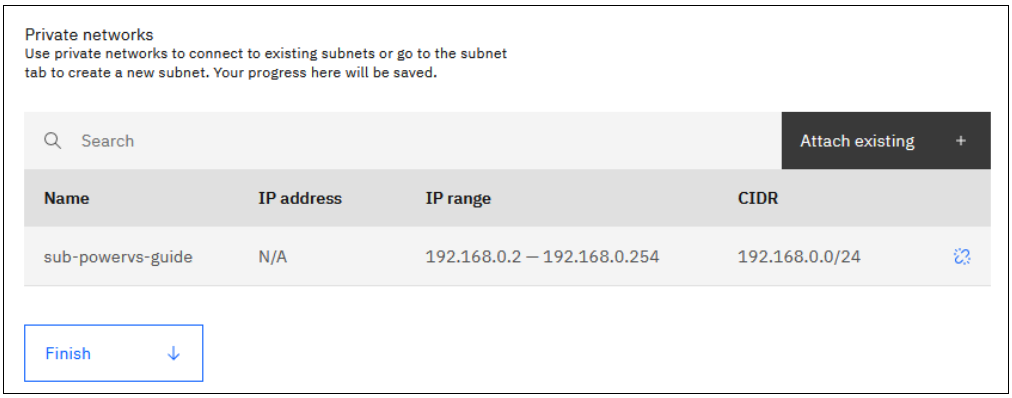


Figure 5-21 Listing Networking Selected

8. To create the IBM Power Systems Virtual Server select “I agree to the Terms an Conditions” then click Create Instance as shown in Figure 5-22 on page 100.

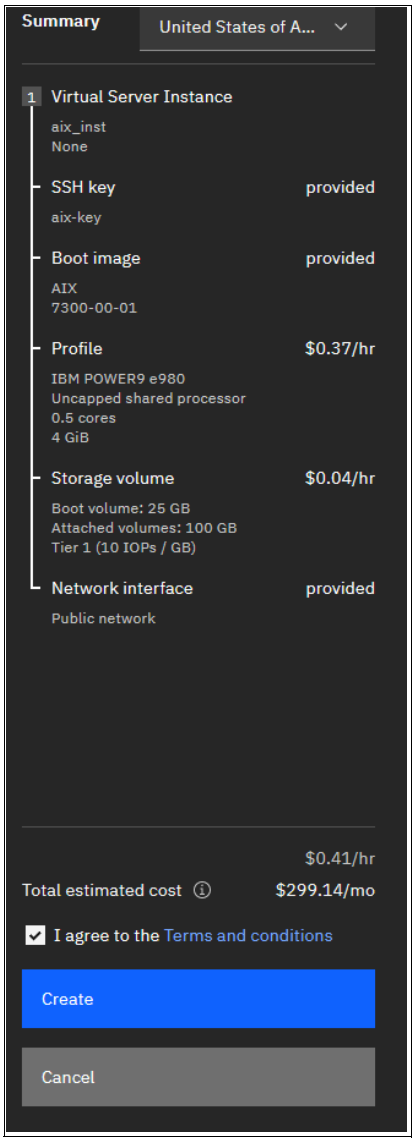


Figure 5-22 Creating IBM Power Systems Virtual Server

In the resource list, the IBM Power Systems Virtual Server new instance is listed as shown in Figure 5-23.

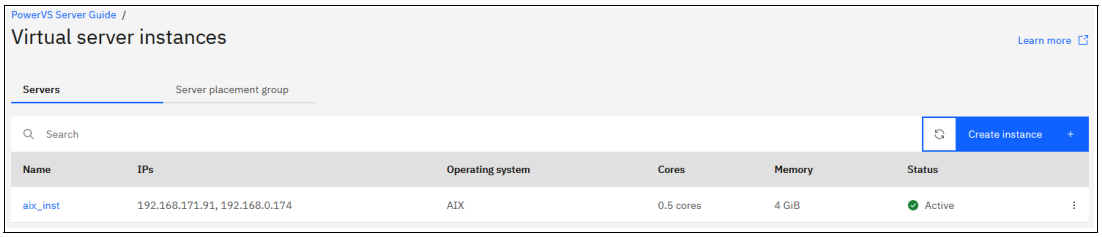


Figure 5-23 IBM Power Systems Virtual Server instance

Click IBM Power System Virtual aix_inst to check details as shown in Figure 5-24 on page 101.

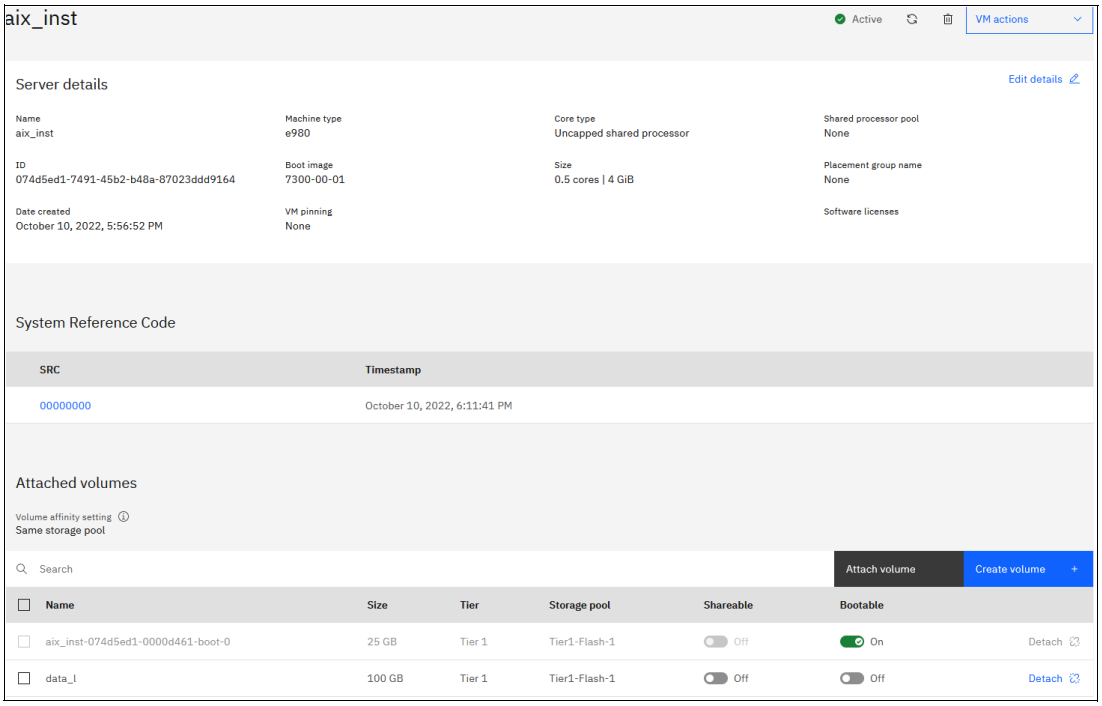


Figure 5-24 Server detail

Click menu. The open console is as shown in Figure 5-25.

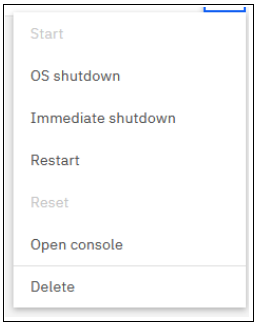


Figure 5-25 Virtual Server instance operation menu

Then the console is opened as shown in Figure 5-26 on page 102.

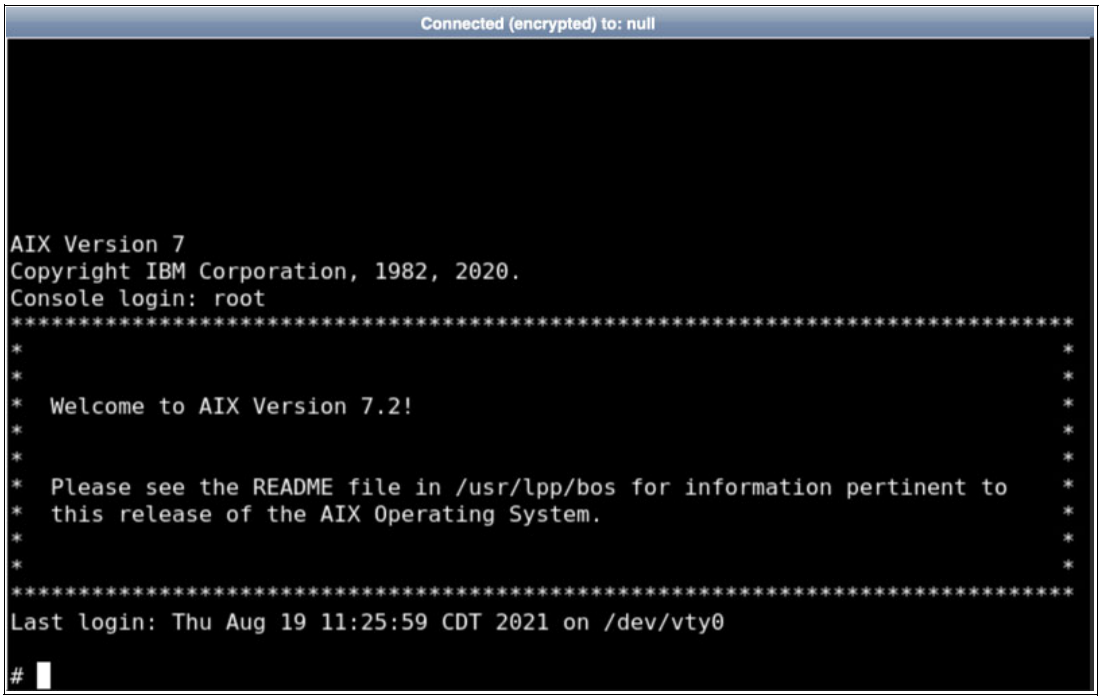


Figure 5-26 Virtual Server console

5.3 Migrating AIX by way of PowerVC OVA file to a Power Systems Virtual Server

You can bring your own customized AIX operating system (OS) image to deploy within a IBM Power Systems Virtual Server.

Note: You cannot transfer an OS license from an on-premises system to a Power Systems Virtual Server. The license cost is factored into the overall hourly billing rate.

The basic steps that are involved in deploying an instance by using a custom image are:

1. Create the custom image.
2. Store the image in your Cloud Object Storage account.
3. Point the Power Systems Virtual Server console to the image in the Cloud Object Storage and deploy the Virtual Server instance.

Using PowerVC to capture and import an OVA image

If you have deployed PowerVC in your on-premises environment, you can use it to capture any supported LPAR and create an OVA image. After you create the OVA image, upload it to your Cloud Object Storage account and import it into the Power Systems Virtual Server environment.

The following link contains information details how to export an image to an OVA package:

https://www.ibm.com/docs/en/powervc/2.0.2?topic=SSXK2N_2.0.2/com.ibm.powervc.standard.help.doc/powervc_export_image_hmc.html

Using create_ova command on AIX 7.2 to create OVA image

The create_ova command is used to create a single-volume raw disk image and to export contents of a raw disk image to a compatible OVA package format. The OVA package can be imported into any IBM Power Virtualization Center (PowerVC) environment that contains a supported storage device. You can also import the OVA package into any cloud service that supports the Open Virtualization Format (OVF) packaging standard. The imported OVA package can be deployed as a virtual machine.

The following link contains information details how to create OVA image using AIX 7.2:

https://www.ibm.com/docs/en/aix/7.2?topic=c-create-ova-command

What is IBM Cloud Object Storage?

Cloud object storage is a format for storing unstructured data in the cloud. Object storage is considered a good fit for the cloud because it is elastic, flexible and it can more easily scale into multiple petabytes to support unlimited data growth. The architecture stores and manages data as objects compared to block storage, which handles data as blocks, and logical volumes and file storage which store data in hierarchical files.

IBM Cloud Object Storage (ICOS) makes it possible to store practically limitless amounts of data, simply and cost effectively. It is commonly used for data archiving and backup; for web and mobile applications; and as scalable, persistent storage for analytics. Flexible storage class tiers with a policy-based archive let you effectively manage costs while meeting data access needs. The integrated IBM Aspera high-speed data transfer option makes it easy to transfer data to and from IBM Cloud Object Storage, and query-in-place functionality allows you to run analytics directly on your data.

Creating an instance of IBM Cloud Object Storage in IBM Cloud

Login to the IBM cloud console, go to the Catalog and search for the Object Storage.

Give the service instance a name and choose either lite or standard plan. In our case we chose a Standard Plan and the instance name given was *COS PowerVS* as shown in Figure 5-27 on page 104.

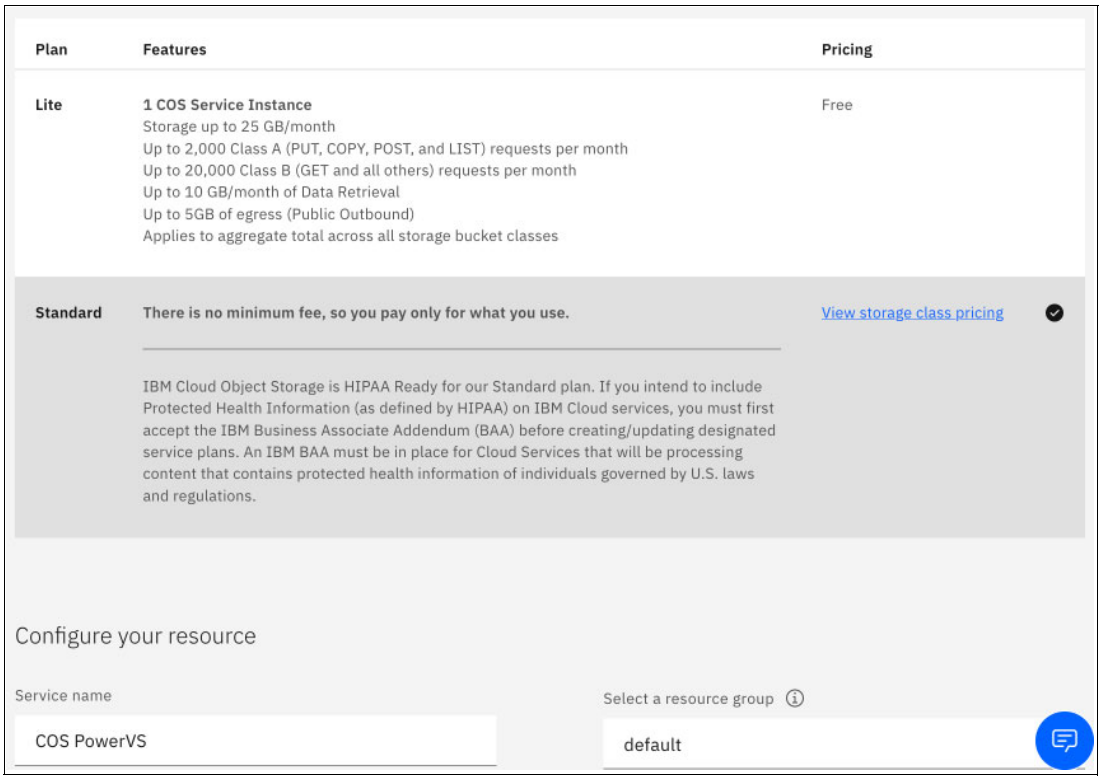


Figure 5-27 Creating an instance of IBM Cloud Object Storage

After creating the instance, you are automatically redirected to the new instance as shown in Figure 5-28.

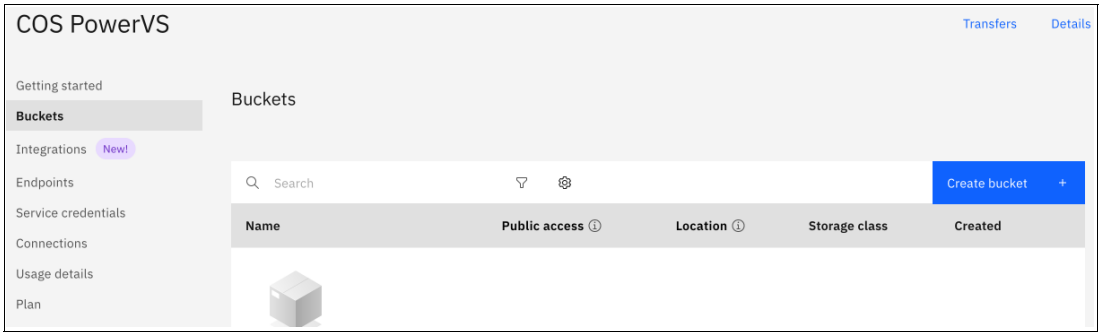


Figure 5-28 IBM Cloud Object Storage

The next step is to create a bucket to store data, choose a name of the bucket with the correct permissions as shown in Figure 5-29 on page 105.

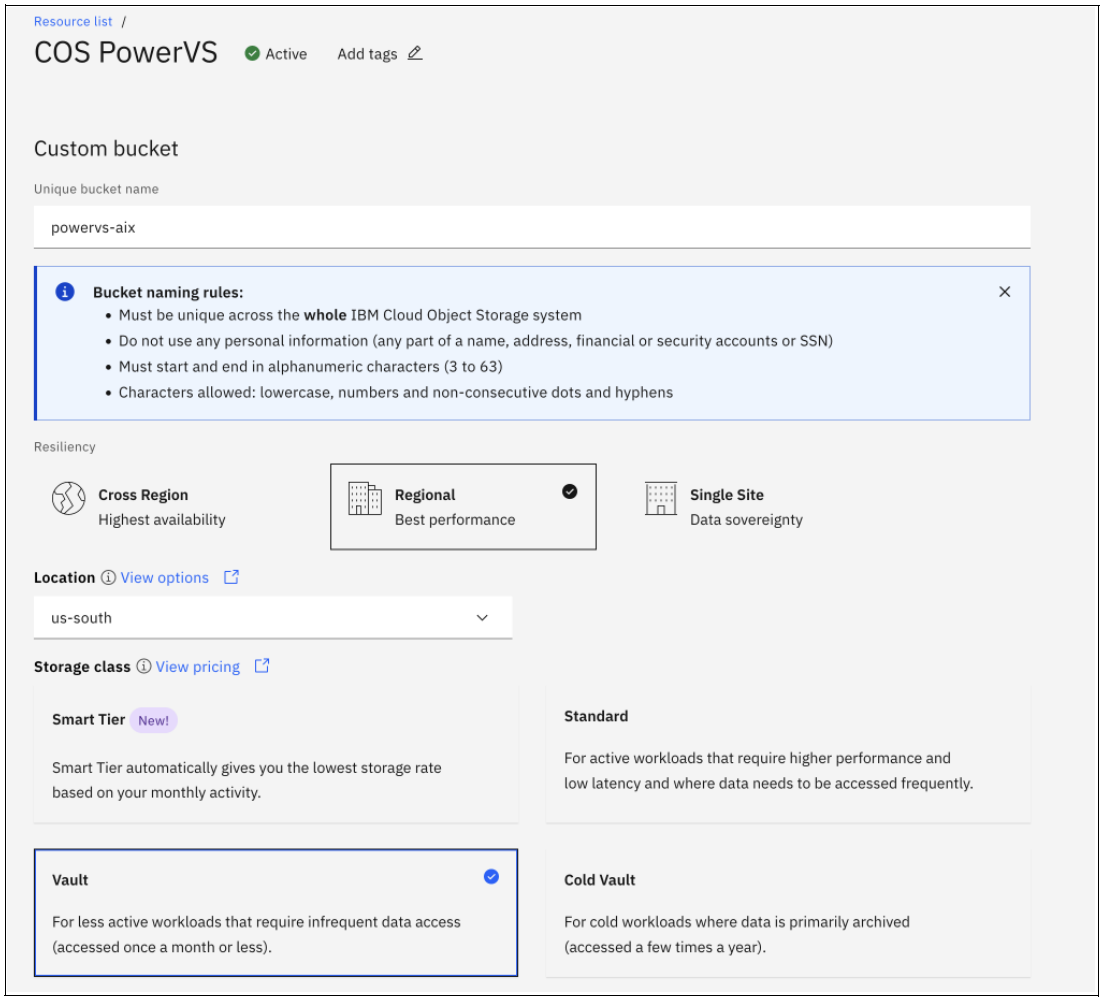


Figure 5-29 Creating a bucket

After creating the bucket, it is listed on *COS PowerVS* service instance IBM Cloud Object Storage as shown in Figure 5-30.

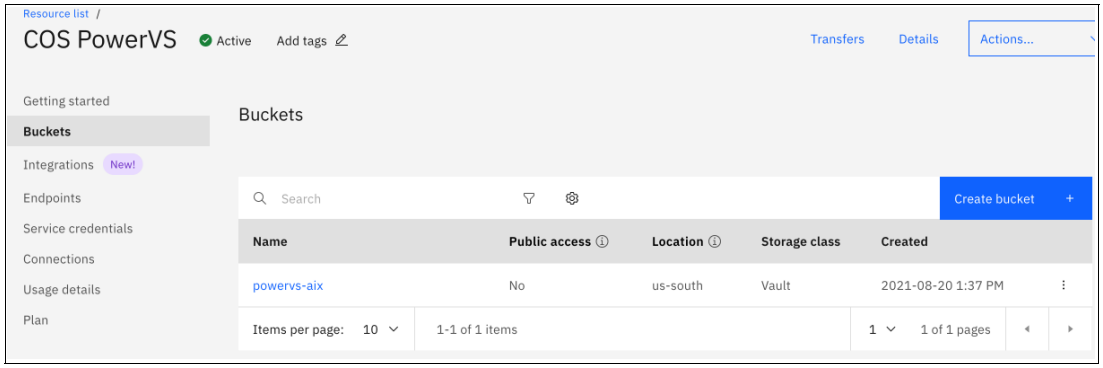


Figure 5-30 Listing buckets

After the creation of the bucket, you need to create Service Credentials, which provide necessary information to connect an application to Object storage.

Select Service credentials and then click New credential as shown in Figure 5-31 on page 106.

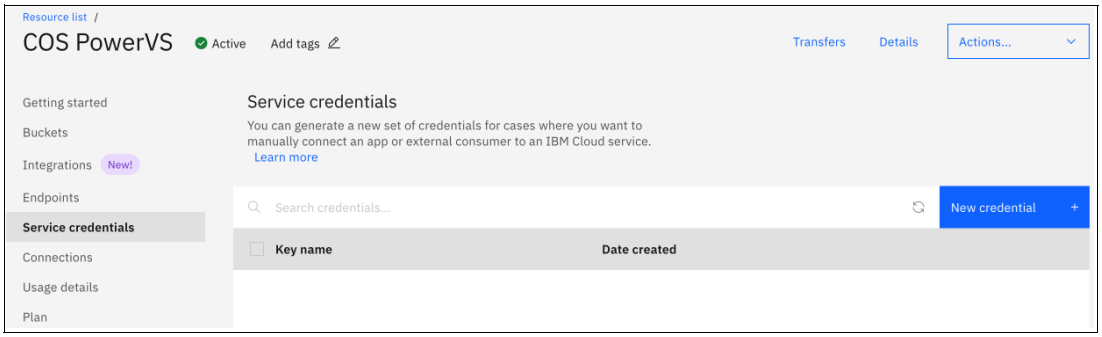


Figure 5-31 Creating New credential

Give the service credential name, choose the Role, and enable the Include HMAC Credential as shown in Figure 5-32.

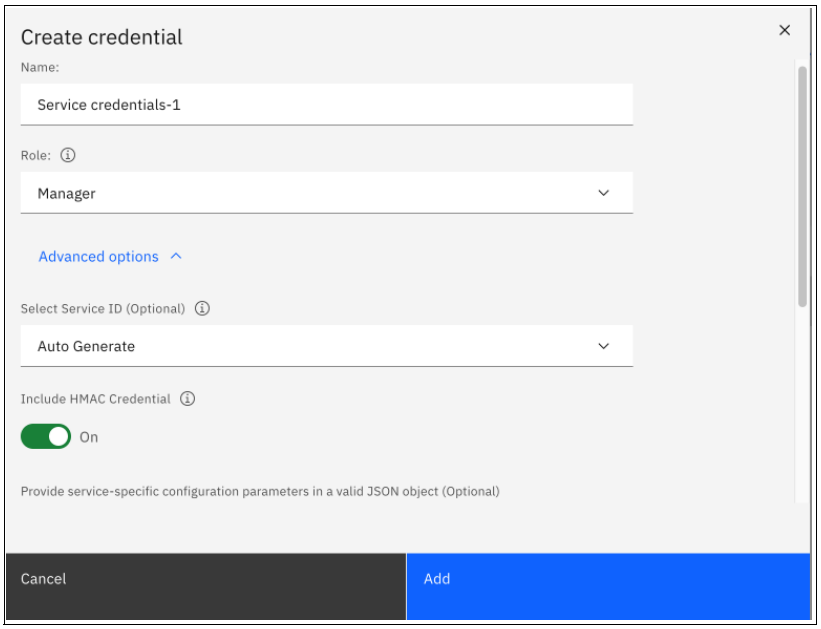


Figure 5-32 Creating New credential

Figure 5-33 shows the new service Credential created.

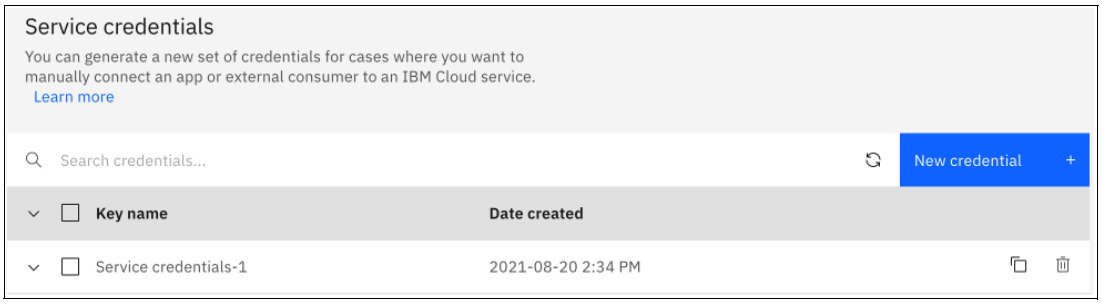


Figure 5-33 New service credential

Figure 5-34 on page 107 shows the new created service Credential.

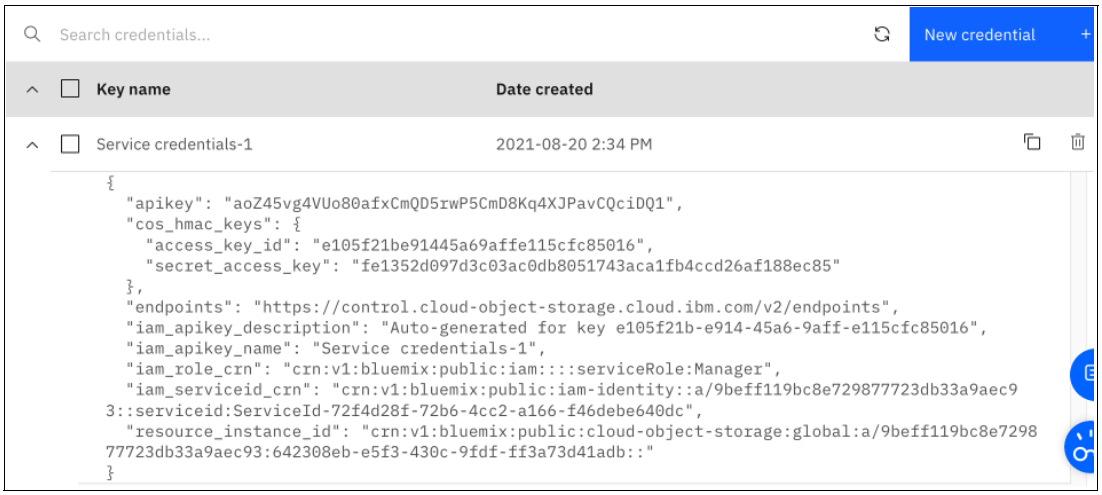


Figure 5-34 New service Credential

You can now start uploading any ova file using the Aspera connect which is a built in feature.

Note: You can either set Aspera as your default for any uploads. The following link provides more information about configuring Aspera high speed transfer in the IBM Cloud:

https://cloud.ibm.com/docs/services/cloud-object-storage/iam?topic=cloud-object-storage-aspera

To upload the ova image to the IBM Cloud Object Storage, click Upload as shown in Figure 5-35.

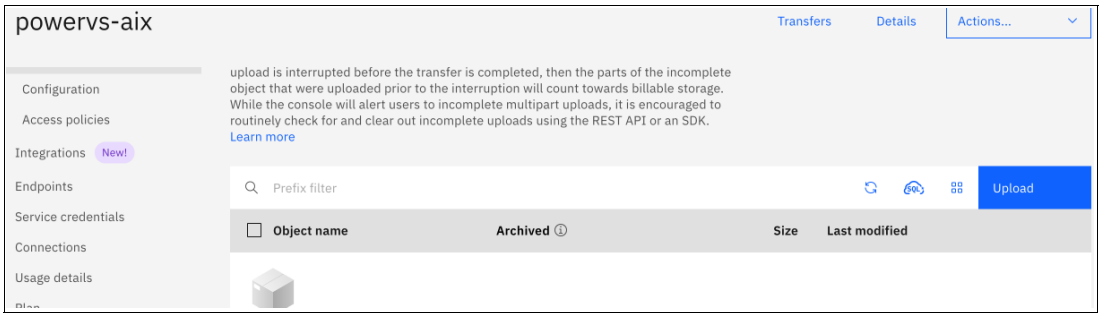


Figure 5-35 Uploading a file to a bucket

When you click upload and select files, you see a window as shown in Figure 5-36 on page 108.

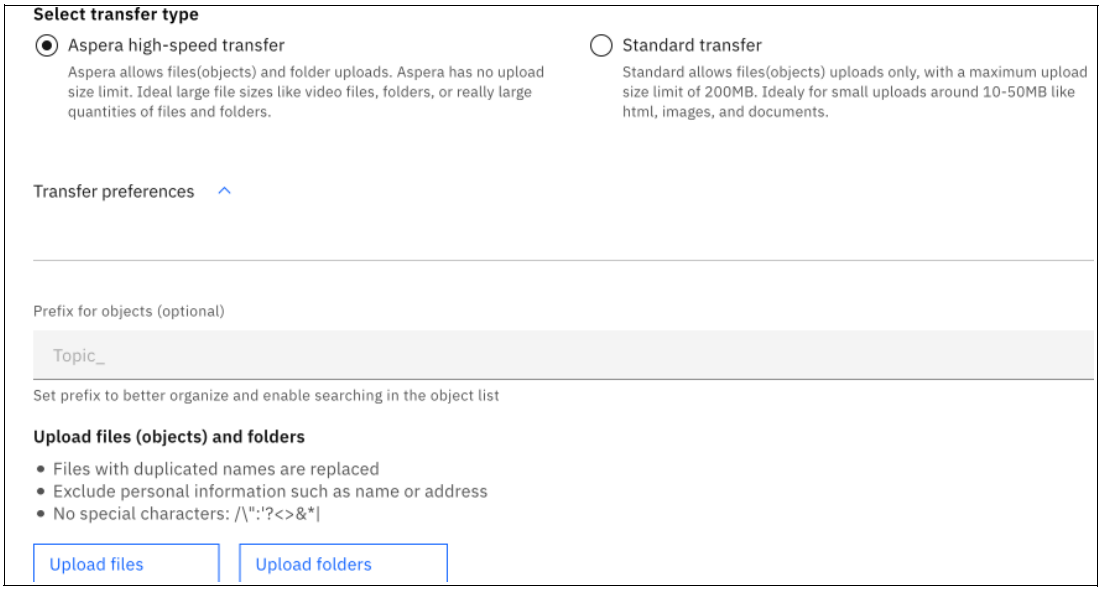


Figure 5-36 Uploanding file using Aspera

Click Upload files to browse your notebook folder. Choose a file and start the upload. You can see the file transfer on you UI as shown in Figure 5-37.

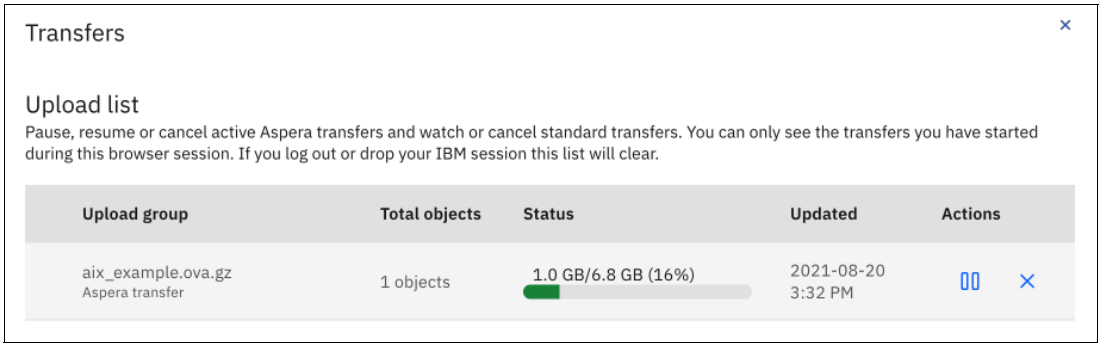


Figure 5-37 Transfer file to bucket

You can check the file in the bucket as shown in Figure 5-38.

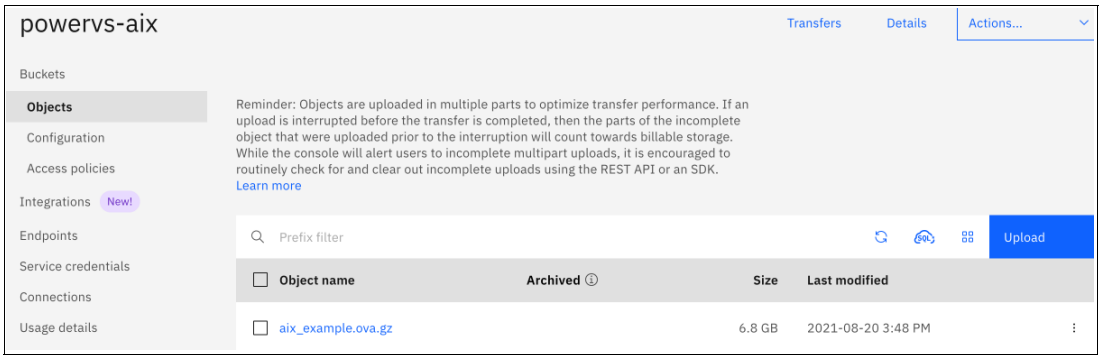


Figure 5-38 Checking the file in the bucket

Now you import the ova file to our PowerVS instance.

Go to Resource list → Services → select this case PowerVS Server Guide, and select on boot images tab as shown in Figure 5-39.

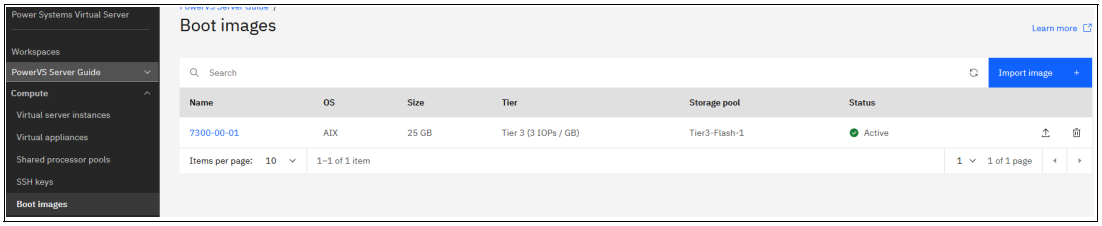


Figure 5-39 Selection Boot Images tab

Before you import the image, you need to have the following information:

- Storage type (Tier 1 or Tier 3).
- Region.
- Image filename.
- Bucket name.
- Cloud Object Storage access key -- select Menu icon → Resource list → Storage → Cloud Storage Object name → Service credentials → View credentials. Copy the access_key_id.
- Cloud Object Storage secret key -- select Menu icon → Resource list → Storage → Cloud Storage Object name → Service credentials → View credentials. Copy the secret_access_key.

Now click Import Image. You see a window to import a new boot image. Fill in the catalog-image-name, Storage type, Region, Image filename, bucket name and storage access key and secret key as shown in Figure 5-40 on page 110.

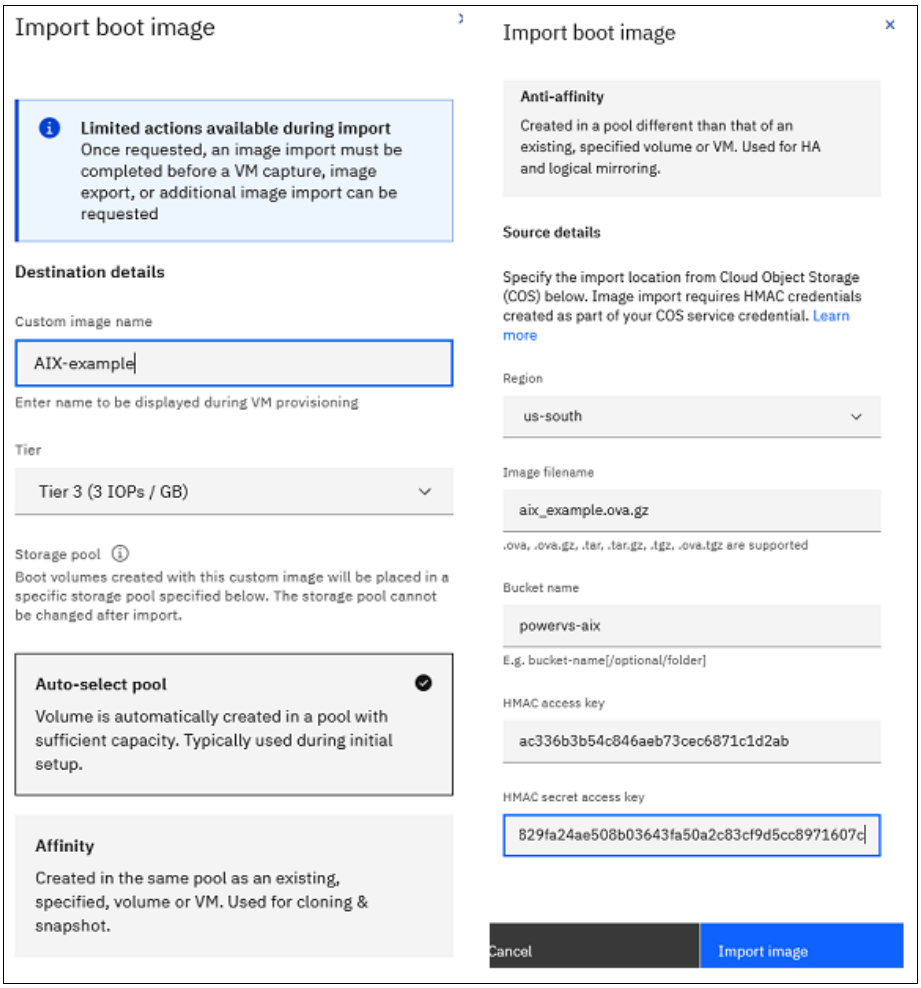


Figure 5-40 Importing Boot Image

After the image is imported, use this image to deploy a new AIX virtual Machine. Select Virtual server instance and click create instance. Fill in the require Name and make sure you see the imported image as shown in Figure 5-41.

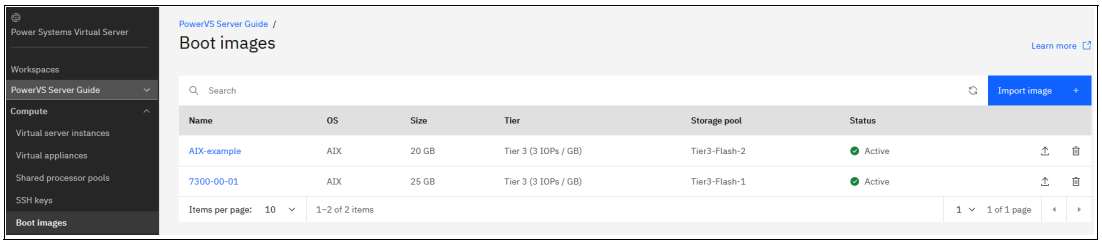


Figure 5-41 Listing Boot Images

After the image is imported, use this image to deploy a new AIX virtual Machine. Select Virtual server instance and click create instance. Fill in the require Name and make sure you see the imported image shown in Figure 5-42 on page 111.

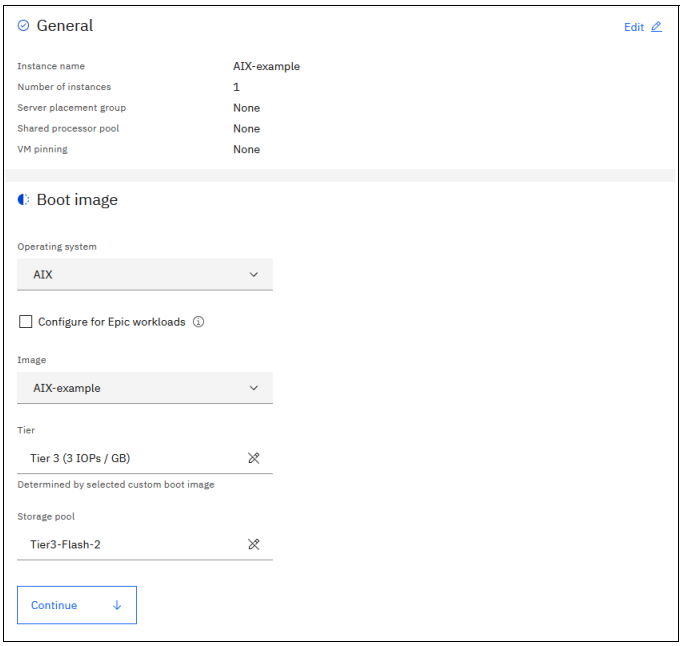


Figure 5-42 Creating a new AIX virtual machine

We can check the VSI created as shown in Figure 5-43.

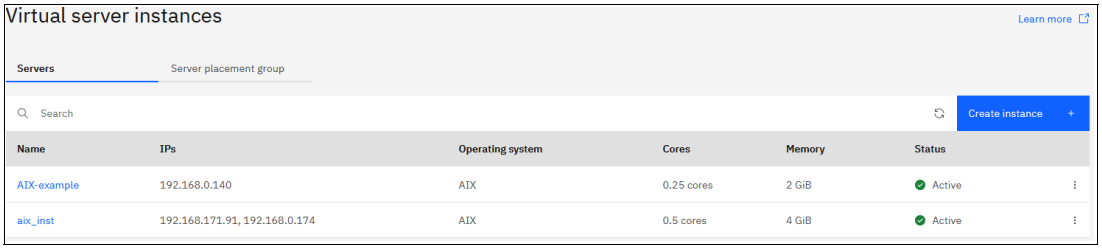


Figure 5-43 Listing Virtual Instances

Connecting to VSI, check the AIX image file restored as shown in Figure 5-44.

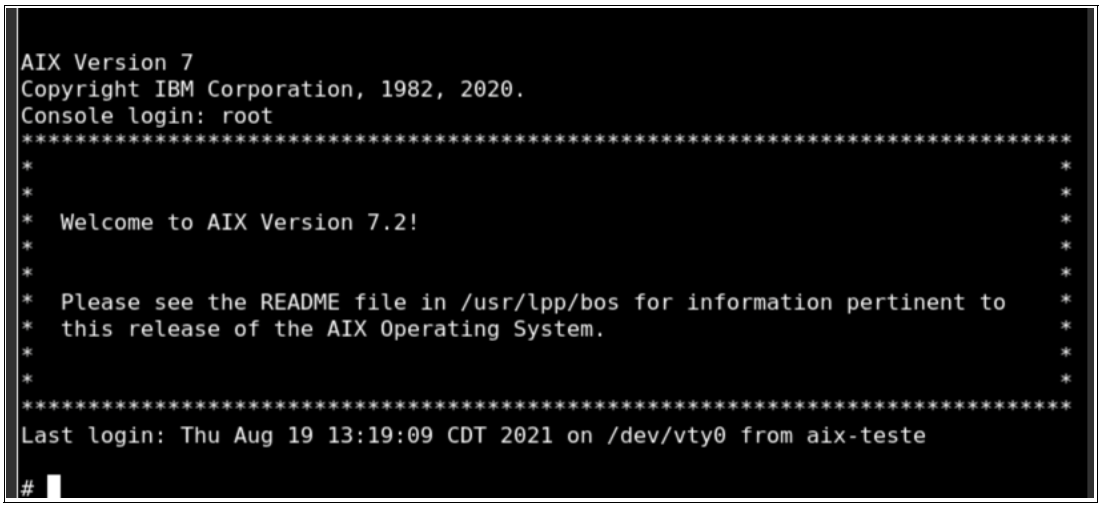


Figure 5-44 AIX image ova file restored

5.4 Migrating AIX by way of a mksysb system backup to a Power Systems Virtual Server

In this section, we perform a system migration from an on-premises system to a Power VS Instance using the mksysb approach.

After we have the mksysb image collected from an on-promises system, upload the mksysb to your Cloud Object Storage bucket using Aspera on the bucket *powervs-aix* created as shown in Figure 5-45.

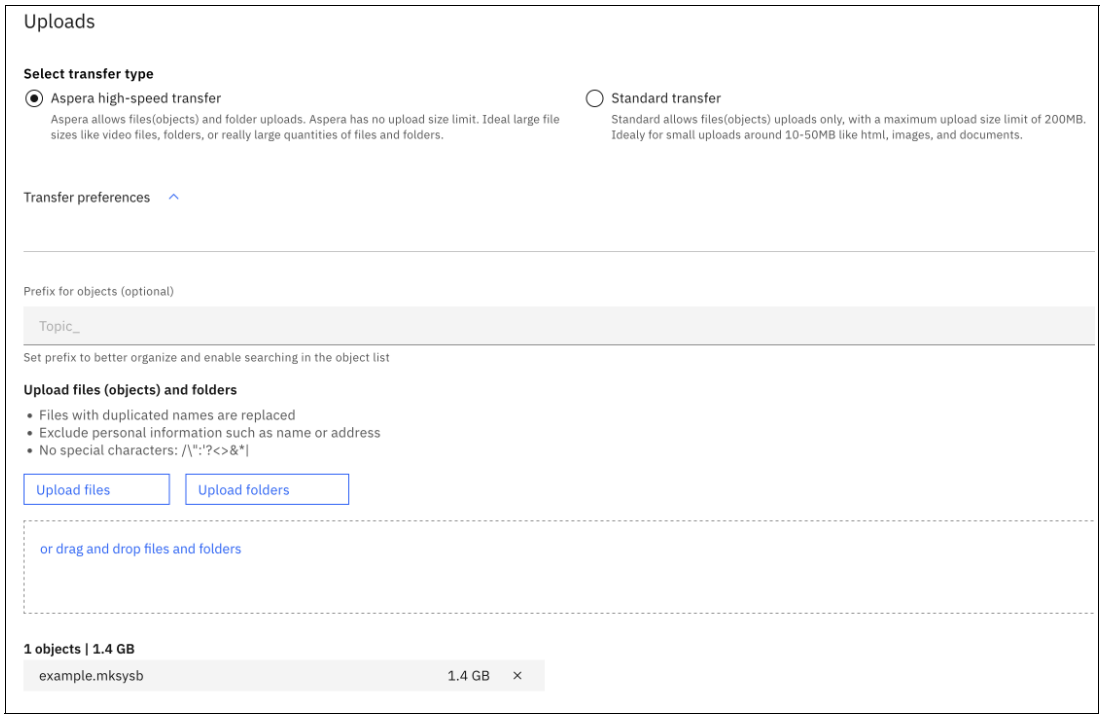


Figure 5-45 Uploading the mksysb image

Click Upload files to browse your notebook folder, choose a file, and start the upload. You can see the file transfer on you UI as shown in Figure 5-46.

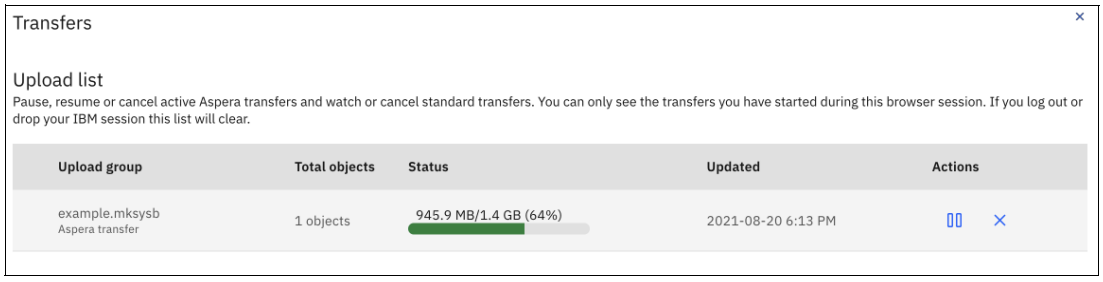


Figure 5-46 Uploading the mksysb image

You can check the file in the bucket as shown in Figure 5-47 on page 113.

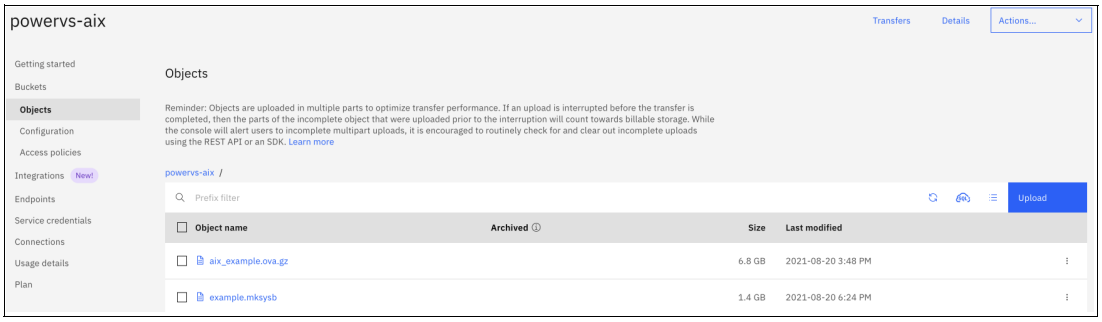


Figure 5-47 Listing files in the bucket

Now create a virtual server in PowerVS to restore the mksysb image.

1. Click Create Instance and give the instance name as shown in Figure 5-48.

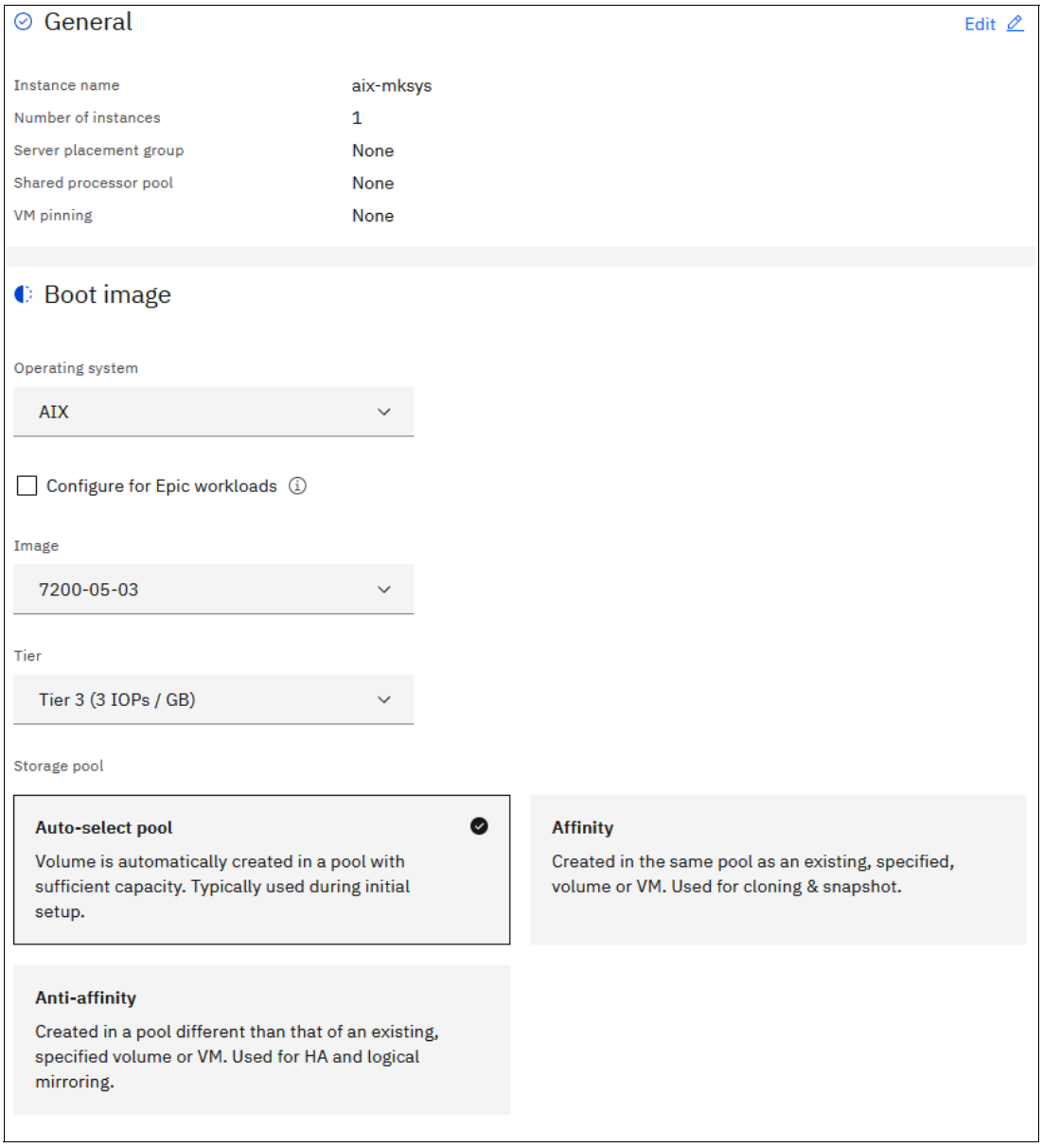


Figure 5-48 Creating a new VSI

2. Select a reasonable machine type, CPU and memory configuration as shown in Figure 5-49.

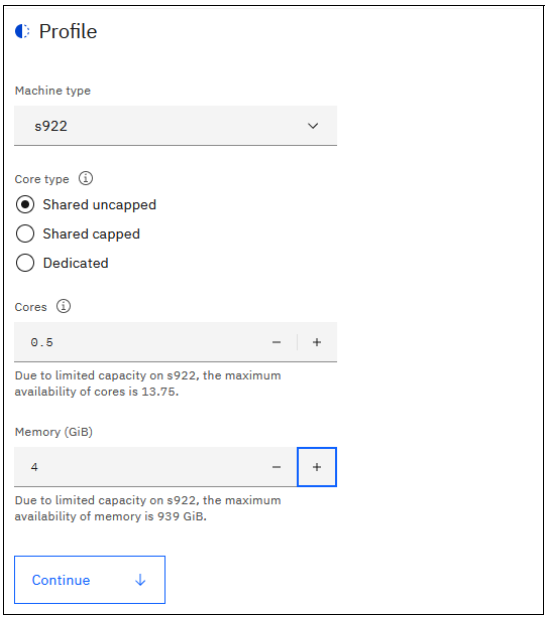


Figure 5-49 Selecting CPU and Memory for a new VSI

3. Enable the public network. This is to enable access to install the AWS CLI tools from the Internet and to allow access to the external COS endpoint. The public connection is likely to be disabled after install. Refer to Figure 5-50.

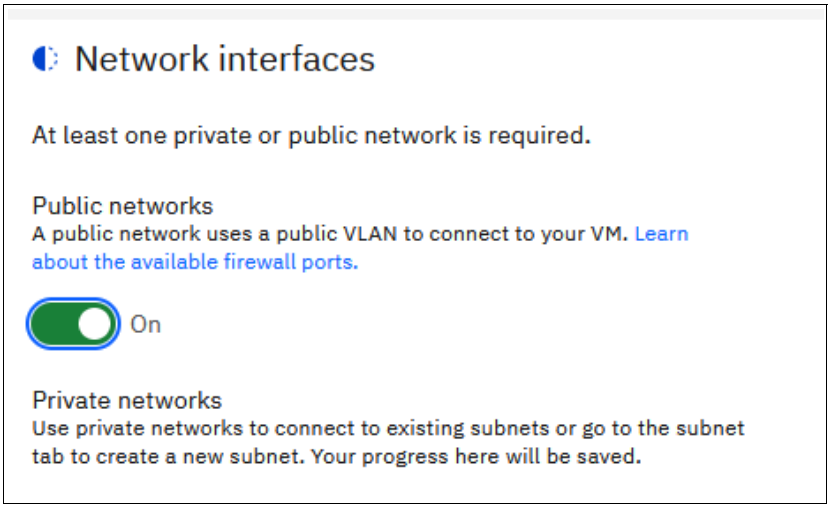


Figure 5-50 Enabling public network

4. Agree to the terms and conditions and click Create Instance as shown in Figure 5-51 on page 115.

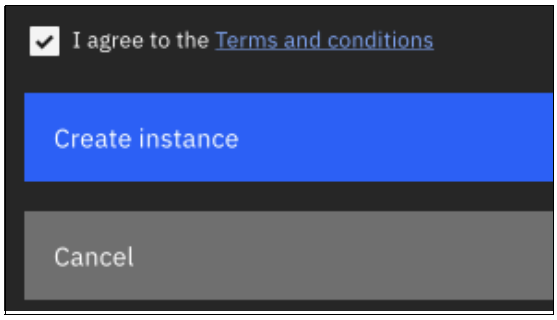


Figure 5-51 Creating a VSI Instance

5. When the Virtual Server Instance creation is completed, open the console into the instance by selecting VM Actions, click Open Console, and select open console as shown in Figure 5-52.

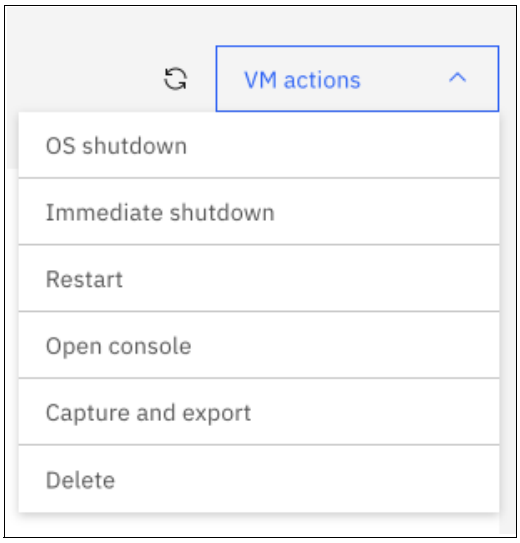


Figure 5-52 Selecting Open Console

6. Login as root and set the root password as shown in Figure 5-53 on page 116.

```
You entered an invalid login name or password.
login: root
*******************************************************************************
*                                                                             *
*                                                                             *
*  Welcome to AIX Version 7.2!                                                *
*                                                                             *
*                                                                             *
*  Please see the README file in /usr/lpp/bos for information pertinent to    *
*  this release of the AIX Operating System.                                  *
*                                                                             *
*                                                                             *
*******************************************************************************

# passwd
Changing password for "root"
root's New password:
Re-enter root's new password:
#
```

Figure 5-53 Access console and changing root password

7. Login using SSH on the assigned public IP address as shown in Figure 5-54.

Network interfaces

Public networks

On

Extra steps required.

Name	IP address	External IP	Gateway	MAC address	VLAN ID	CIDR
public-192_168_172_208-29-VLAN_2054	192.168.172.210	169.57.212.210	192.168.172.209	fa:c5:fb:ef:a0:20	2054	192.168.172.208/29

Figure 5-54 Check public IP address

8. Access the VSI from public IP address as shown in Figure 5-55.

```
aalmeida — ssh root@169.57.212.210 — 130×27
Last login: Fri Aug 20 11:10:58 on ttys000
aalmeida@Adrianos-MBP ~ % ssh root@169.57.212.210
The authenticity of host '169.57.212.210 (169.57.212.210)' can't be established.
RSA key fingerprint is SHA256:6jJWpFCIDjbKcKU1pb362bqQvKQ8mRFJmEjO2eT4AsQ.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '169.57.212.210' (RSA) to the list of known hosts.
root@169.57.212.210's password:
Last login: Fri Aug 20 18:37:30 CDT 2021 on /dev/vty0
*******************************************************************************
*                                                                             *
*                                                                             *
*  Welcome to AIX Version 7.2!                                                *
*                                                                             *
*                                                                             *
*  Please see the README file in /usr/lpp/bos for information pertinent to    *
*  this release of the AIX Operating System.                                  *
*                                                                             *
*                                                                             *
*******************************************************************************
#
```

Figure 5-55 Access the VSI from public IP address

9. Now add a staging volume copying the mksysb image:
   a. Click VSI in the Cloud GUI and find the Attached Volumes section. Click Create Volume as shown in Figure 5-56.

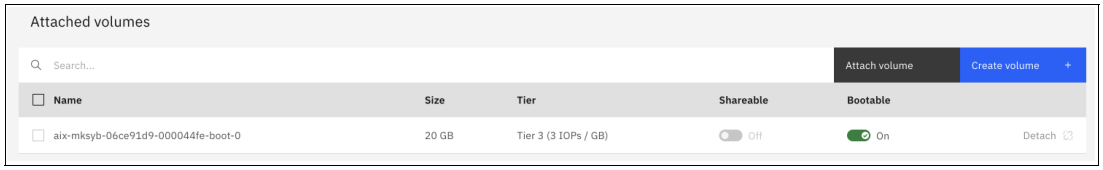


Figure 5-56 Creating a new volume

   b. Name your volume and check the size is enough to contain the mksysb file. Then click Create and Attach as shown in Figure 5-57.

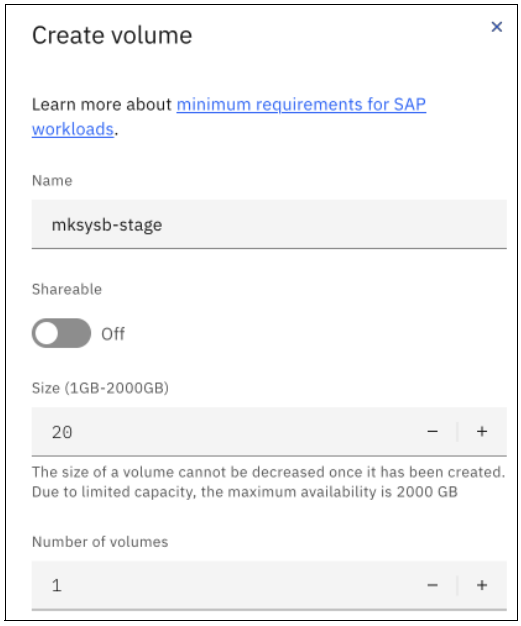


Figure 5-57 Creating a new volume

10. From the ssh console, run **cfgmgr** and the new volume is available as shown in Figure 5-58.

```
# cfgmgr
# lspv
hdisk0          00fa00d6b552f41b                    rootvg          active
hdisk1          none                                None
#
```

Figure 5-58 Recognize the new disk

11. Create a staging volume group and a file system on the new disk, and mount it as shown in Figure 5-59 on page 118.

```
# mkvg -y stagevg -f hdisk1
stagevg
# crfs -v jfs2 -g stagevg -m /stage -A yes -a size=10G
File system created successfully.
10485236 kilobytes total disk space.
New File System size is 20971520
# mount -a
mount: /dev/hd1 on /home: Device busy
mount: /dev/hd11admin on /admin: Device busy
mount: /proc on /proc: Device busy
mount: /dev/hd10opt on /opt: Device busy
mount: /dev/livedump on /var/adm/ras/livedump: Device busy
mount: /dev/repo00 on /usr/sys/inst.images: Device busy
#
```

Figure 5-59 Creating staging volume group

12. Install the AWS CLI tools to retrieve the mksys from IBM Cloud Object Storage:

    a. Increase the size of the /opt filesystem to make space for the tools as shown in Figure 5-60.

```
# chfs -a size=+2G /opt
Filesystem size changed to 4980736
#
```

Figure 5-60 Increasing /opt filesystem

    b. Run the cloud_setup script to install a series of opensource packages that are dependencies for the aws-cli tools as shown in Figure 5-61.

```
# /usr/samples/nim/cloud_setup
Initializing resources ...


Checking for resource group yum...done

Checking for resource group python...done
Installing filesets ...

Checking /opt space requirement...done
Setting up Update Process
Resolving Dependencies
--> Running transaction check
---> Package python.ppc 0:2.7.15-3 will be updated
--> Processing Dependency: python = 2.7.15-3 for package: python-devel-2.7.15-3.ppc
--> Processing Dependency: python = 2.7.15-3 for package: python-tools-2.7.15-3.ppc
---> Package python.ppc 0:2.7.18-3 will be an update
--> Processing Dependency: readline >= 8.0 for package: python-2.7.18-3.ppc
--> Processing Dependency: gdbm >= 1.18.1 for package: python-2.7.18-3.ppc
--> Processing Dependency: db >= 5.3.28 for package: python-2.7.18-3.ppc
--> Processing Dependency: libgcc >= 8.3.0 for package: python-2.7.18-3.ppc
--> Processing Dependency: ncurses >= 6.2 for package: python-2.7.18-3.ppc
--> Processing Dependency: gettext >= 0.19.8.1 for package: python-2.7.18-3.ppc
--> Processing Dependency: bzip2 >= 1.0.8 for package: python-2.7.18-3.ppc
--> Processing Dependency: libstdc++ >= 8.3.0 for package: python-2.7.18-3.ppc
--> Processing Dependency: sqlite >= 3.32.3 for package: python-2.7.18-3.ppc
--> Processing Dependency: expat >= 2.2.9 for package: python-2.7.18-3.ppc
```

Figure 5-61 Running cloud_setup script

    c. Install the awscli tools as shown in Figure 5-62 on page 119.

```
# pip install awscli
Collecting awscli
  Downloading https://files.pythonhosted.org/packages/aa/24/e098cf5ce28a764bca174e88f4ccb70754e9f049c9bf986e582aedcb7420/awscli-1.
19.112-py2.py3-none-any.whl (3.6MB)
    100% |################################| 3.6MB 1.5MB/s
Collecting colorama<0.4.4,>=0.2.5 (from awscli)
  Downloading https://files.pythonhosted.org/packages/c9/dc/45cdef1b4d119eb96316b3117e6d5708a08029992b2fee2c143c7a0a5cc5/colorama-
0.4.3-py2.py3-none-any.whl
Collecting botocore==1.20.112 (from awscli)
  Downloading https://files.pythonhosted.org/packages/c7/ea/11c3beca131920f552602b98d7ba9fc5b46bee6a59cbd48a95a85cbb8f41/botocore-
1.20.112-py2.py3-none-any.whl (7.7MB)
    100% |################################| 7.7MB 217kB/s
Collecting s3transfer<0.5.0,>=0.4.0 (from awscli)
  Downloading https://files.pythonhosted.org/packages/63/d0/693477c688348654ddc21dcdce0817653a294aa43f41771084c25e7ff9c7/s3transfe
r-0.4.2-py2.py3-none-any.whl (79kB)
    100% |################################| 81kB 408kB/s
Requirement already satisfied: PyYAML<5.5,>=3.10 in /opt/freeware/lib/python2.7/site-packages (from awscli) (3.11)
Collecting rsa<=4.5.0,>=3.1.2; python_version == "2.7" (from awscli)
  Downloading https://files.pythonhosted.org/packages/26/f8/8127fdda0294f044121d20aac7785feb810e159098447967a6103dedfb96/rsa-4.5-p
y2.py3-none-any.whl
Collecting docutils<0.16,>=0.10 (from awscli)
  Downloading https://files.pythonhosted.org/packages/3a/dc/bf2b15d1fa15a6f7a9e77a61b74ecbbae7258558fcda8ffc9a6638a6b327/docutils-
0.15.2-py2-none-any.whl (548kB)
    100% |################################| 552kB 279kB/s
Collecting urllib3<1.27,>=1.25.4 (from botocore==1.20.112->awscli)
  Downloading https://files.pythonhosted.org/packages/5f/64/43575537846896abac0b15c3e5ac678d787a4021e906703f1766bfb8ea11/urllib3-1
.26.6-py2.py3-none-any.whl (138kB)
```

Figure 5-62 Installing awscli tools

d. Use **`aws configure`** command to setup the connection to the IBM Cloud Object Storage. You need to copy the access keys from the defined Service Credentials as shown in Figure 5-63.

```
# /opt/freeware/bin/aws configure
AWS Access Key ID [None]: e105f21be91445a69affe115cfc85016
AWS Secret Access Key [None]: fe1352d097d3c03ac0db8051743aca1fb4ccd26af188ec85
Default region name [None]: us-south
Default output format [None]: json
#
```

Figure 5-63 Configure connecting to the IBM Cloud Object Storage

e. Then use aws to copy the mksysb from your bucket into the stage file system:

- From the bucket created to collect the public endpoint as shown in Figure 5-64.

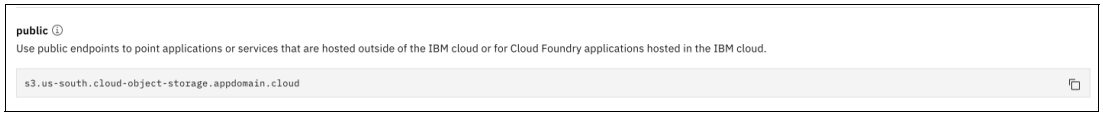


Figure 5-64 Collecting public endpoint from powervs-aix bucket

- List the objects in the bucket *powervs-aix* as shown in Figure 5-65.

```
# /opt/freeware/bin/aws --endpoint-url https://s3.us-south.cloud-object-storage.appdomain.cloud s3 ls s3://powervs-aix
2021-08-20 13:48:41 7248571595 aix_example.ova.gz
2021-08-20 16:24:21 1553971200 example.mksysb
```

Figure 5-65 Listing objects in the bucket powervs-aix

- Copy the example.mksyb file from powervs-aix bucket to the /stage file system as shown in Figure 5-66.

```
# /opt/freeware/bin/aws --endpoint-url https://s3.us-south.cloud-object-storage.appdomain.cloud s3 cp s3://powervs-aix/example.mksysb /stage
download: s3://powervs-aix/example.mksysb to stage/example.mksysb
#
```

Figure 5-66 Copying file from bucket to the filesystem

13. Add a new root volume to restore the mksysb:

- Change to the /stage directory and restore the image.data file from the mksysb to check the original disk information as shown in Figure 5-67 on page 120.

```
# ls -la
total 3035464
drwxr-xr-x    3 root     system          256 Aug 20 22:15 .
drwxr-xr-x   23 root     system         4096 Aug 20 21:38 ..
-rw-r--r--    1 root     system   1553971200 Aug 20 16:24 example.mksysb
drwxr-xr-x    2 root     system          256 Aug 20 20:52 lost+found
# restore -xqvf ./example.mksysb ./image.data
New volume on ./example.mksysb:
 Cluster 51200 bytes (100 blocks).
    Volume number 1
    Date of backup: Wed Apr  7 15:21:59 CDT 2021
    Files backed up by name
    User root
x        11619 ./image.data
    total size: 11619
    files restored: 1
#
```

Figure 5-67 Restore the image.data file

- **cat** out or otherwise search the image.data file to find the source_disk_data section as shown in Figure 5-68. You can see the original system had a single 20 GB root volume.

```
source_disk_data:
        PVID= 00cb7d127bec6bf7
        PHYSICAL_LOCATION= U8286.42A.06B7D12-V12-C6-T1-W5005076802233416-L0
        CONNECTION= fscsi1//5005076802233416,0
        LOCATION= C6-T1-01
        SIZE_MB= 20480
        HDISKNAME= hdisk0
```

Figure 5-68 Checking the disk sizing from image backup

14. Now, from the GUI, create a new volume that is large enough to deploy the mksysb as shown in Figure 5-69.

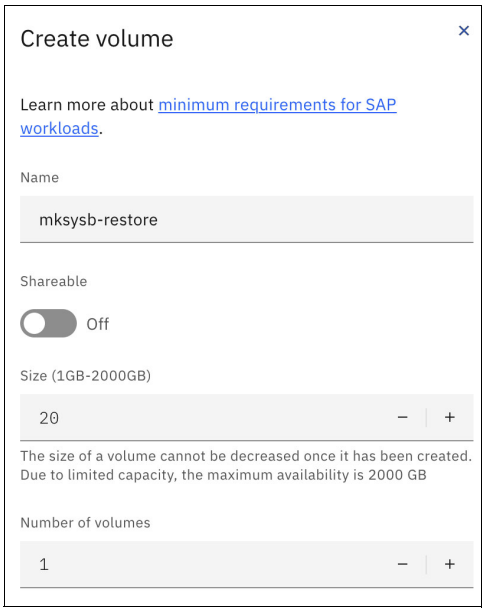


Figure 5-69 Creating new volume

15. After the volume is created, click Storage volumes in the left column, and then click Edit for your new volume as shown in Figure 5-70.

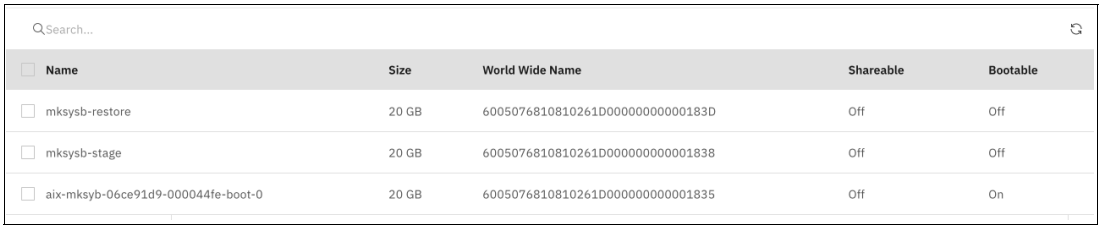


Figure 5-70 Listing Storage Volumes

16. You need to set the Bootable option for the restore volume to on as shown in Figure 5-71.

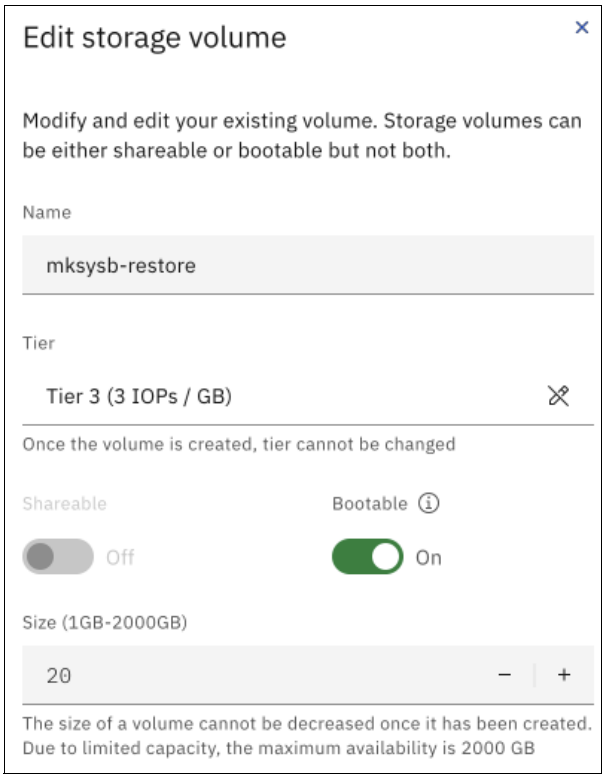


Figure 5-71 Changing storage volume to bootable

17. Now, return to the console and run **cfgmgr** to discover the new volume. You can confirm the size with **bootinfo -s** as shown in Figure 5-72.

```
# cfgmgr
# lspv
hdisk0          00fa00d6b552f41b                    rootvg          active
hdisk1          00cbc6e06666ae03                    stagevg         active
hdisk2          none                                None
# bootinfo -s hdisk2
20480
#
```

Figure 5-72 checking the size of the new disk

18. Restore the mksysb with alt_disk_mksysb:

- Use alt_disk_mksysb to restore your mksysb onto the new disk. This step can take some time, 20-30 minutes as shown in Figure 5-73.

```
# alt_disk_mksysb -c /dev/vty0 -d hdisk2 -m /stage/example.mksysb
Restoring /image.data from mksysb image.
Checking disk sizes.
Creating cloned rootvg volume group and associated logical volumes.

Warning: The original logical volume name fslv00 has been changed
to fslv00a on the alternate disk.  This change was necessary to avoid
logical volume naming conflicts.
Creating logical volume alt_hd5.
Creating logical volume alt_hd6.
Creating logical volume alt_hd8.
Creating logical volume alt_hd4.
Creating logical volume alt_hd2.
Creating logical volume alt_hd9var.
Creating logical volume alt_hd3.
Creating logical volume alt_hd1.
Creating logical volume alt_hd10opt.
Creating logical volume alt_hd11admin.
Creating logical volume alt_lg_dumplv.
Creating logical volume alt_livedump.
Creating logical volume alt_fslv00a.
Creating /alt_inst/ file system.
Creating /alt_inst/admin file system.
Creating /alt_inst/home file system.
Creating /alt_inst/opt file system.
Creating /alt_inst/stage file system.
Creating /alt_inst/tmp file system.
Creating /alt_inst/usr file system.
Creating /alt_inst/var file system.
Creating /alt_inst/var/adm/ras/livedump file system.
Restoring mksysb image to alternate disk(s).
```

Figure 5-73 Running alt_disk_mksysb

- If the restore completes without errors, the bootlist is automatically set to point to the restored root volume as shown in Figure 5-74.

```
Changing logical volume names in volume group descriptor area.
Fixing LV control blocks...
forced unmount of /alt_inst/var/adm/ras/livedump
forced unmount of /alt_inst/var/adm/ras/livedump
forced unmount of /alt_inst/var
forced unmount of /alt_inst/var
forced unmount of /alt_inst/usr
forced unmount of /alt_inst/usr
forced unmount of /alt_inst/tmp
forced unmount of /alt_inst/tmp
forced unmount of /alt_inst/stage
forced unmount of /alt_inst/stage
forced unmount of /alt_inst/opt
forced unmount of /alt_inst/opt
forced unmount of /alt_inst/home
forced unmount of /alt_inst/home
forced unmount of /alt_inst/admin
forced unmount of /alt_inst/admin
forced unmount of /alt_inst
forced unmount of /alt_inst
Fixing file system superblocks...
Bootlist is set to the boot disk: hdisk2 blv=hd5
#
```

Figure 5-74 Bootlist automatically set to point to the restored root volume

19. Boot from new boot volume with restored mksysb:

- Return to the GUI and open a console (Click Open Console) as shown in Figure 5-75 on page 123.

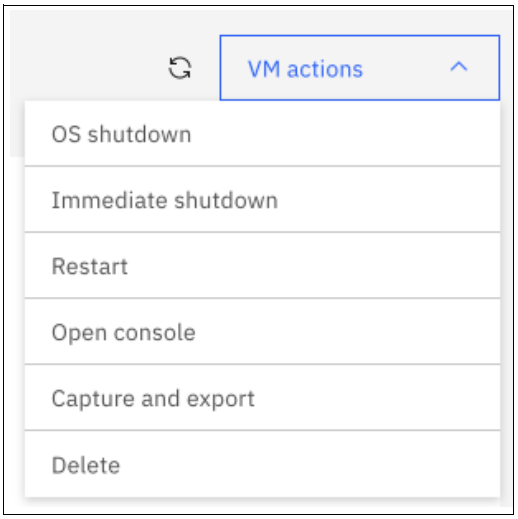


Figure 5-75 Open console

- Then reboot your VSI. This can take some time as devices must be recreated in the restored environment. You notice at least one reboot during this process. If the console closes while you are waiting, just open it again. Refer to Figure 5-76.

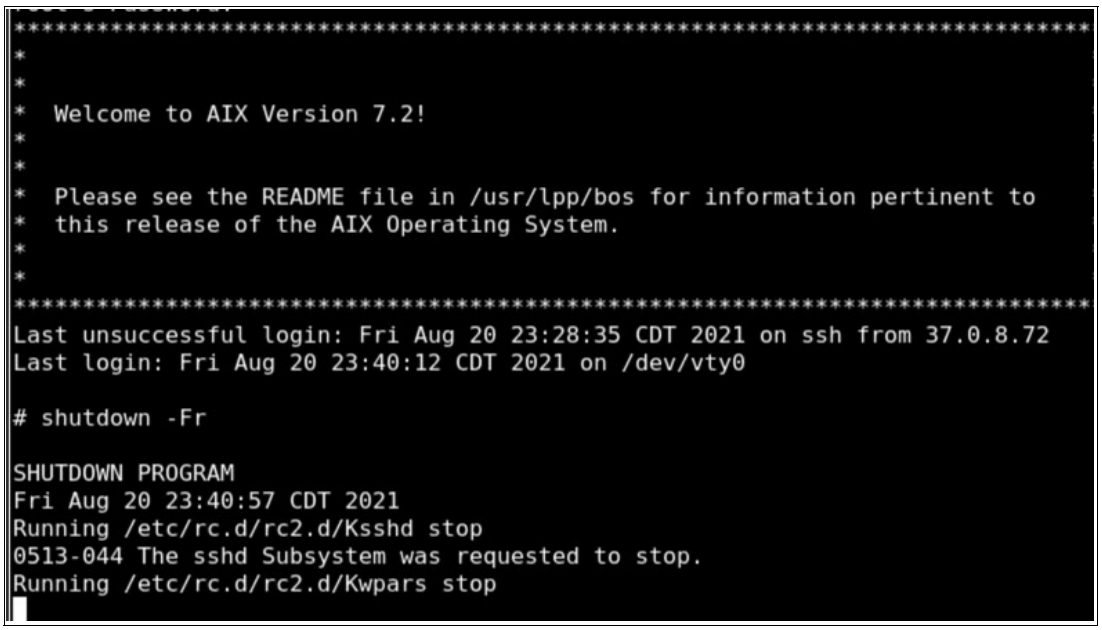


Figure 5-76 Reboot VSI

- After about 25 minutes, when the system is back up, set the terminal type to vt100. Then choose the option for Tasks Complete – Exit to Login. Refer to Figure 5-77 on page 124.

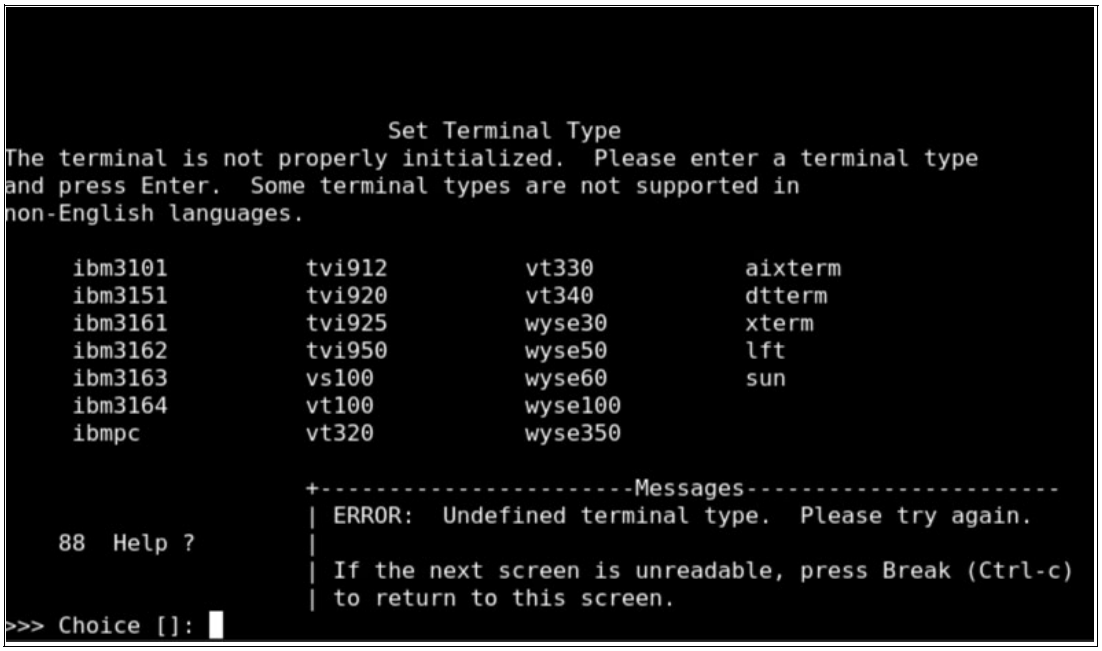


Figure 5-77 Setting terminal

- Then login as root as shown in Figure 5-78.

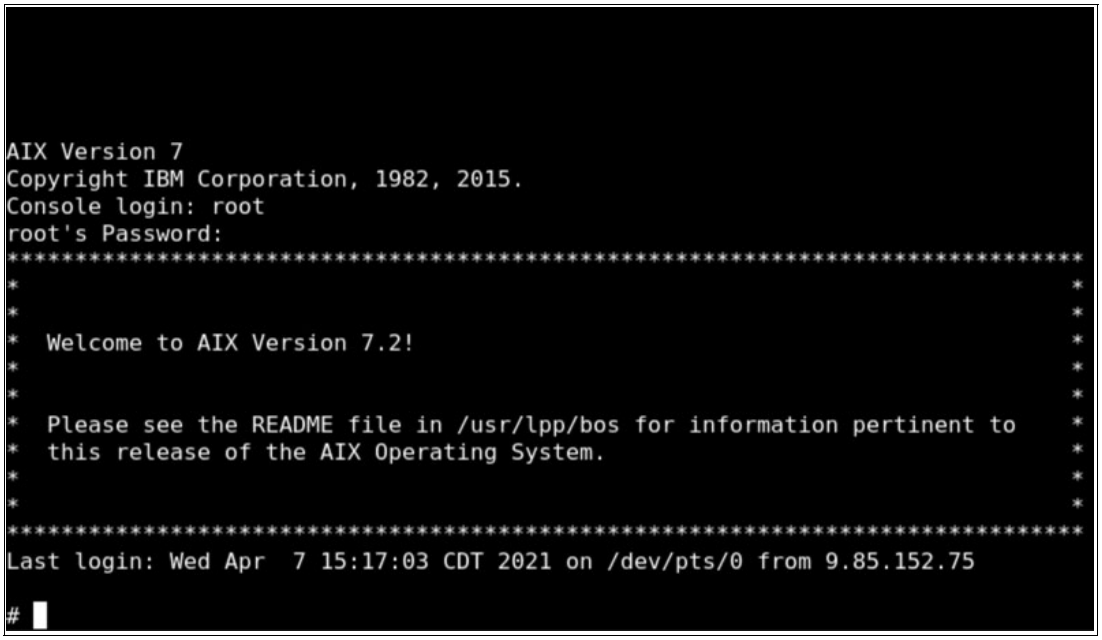


Figure 5-78 Logging on restored image

5.5 Deploy a Linux Power Systems Virtual Server

You can use Power Systems Virtual Server workspace to deploy a generic Linux virtual machine (VM).

You must obtain the subscription for Linux directly from the vendor. After you deploy your Linux VM, you must log in to the VM and register it with the Linux vendor's satellite server. To reach the Linux vendor satellite servers (where you can register and obtain packages and fixes), you must attach a public network to your VM.

Linux-Client supplied subscription

When you are provisioning a VM, select Linux-Client **supplied subscription** for your operating system (the OS filename for Linux-Client supplied subscription starts with Linux-RHEL or Linux-SUSE). The Power Systems Virtual Server workspace provides few Linux stock images for SAP HANA and SAP NetWeaver applications. You can also bring your own Linux image (OVA format) and subscription.

Using SUSE Linux Enterprise Server within the Power Systems Virtual Server

You can use Power Systems Virtual Server to deploy a generic Linux virtual machine (VM). When you are provisioning a VM, select Linux – Client supplied subscription for your operating system. Power Systems Virtual Server provides few Linux stock images for SAP HANA and SAP NetWeaver applications. You can also bring your own Linux image (OVA format) and subscription. Power Systems Virtual Server now supports Linux (Red Hat Enterprise Linux and SUSE Linux Enterprise Server) stock images for non-SAP applications. The following versions of Linux are supported:

- SUSE Linux Enterprise Server 12 - Minimum level: SP4 + Kernel 4.12.14-95.54.1.
- SUSE Linux Enterprise Server 15 - Minimum level: SP1 + kernel 4.12.14-197.45-default.

Using Red Hat Enterprise Linux within the Power Systems Virtual Server

You can use the Power Systems Virtual Server to deploy a generic Red Hat Enterprise Linux virtual machine (VM). When you are provisioning a VM, select Linux – Client supplied subscription for your operating system. The Power Systems Virtual Server provides few Linux stock images for SAP HANA and SAP NetWeaver applications. You can also bring your own Linux image (OVA format) and subscription. Power Systems Virtual Server now supports Linux (Red Hat Enterprise Linux and SUSE Linux Enterprise Server) stock images for non-SAP applications as shown in Figure 5-79 on page 126. The following versions of Linux are supported:

- Red Hat Enterprise Linux 8.1.
- Red Hat Enterprise Linux 8.2.
- Red Hat Enterprise Linux 8.3.
- Red Hat Enterprise Linux 8.4.
- Red Hat Enterprise Linux 8.6.

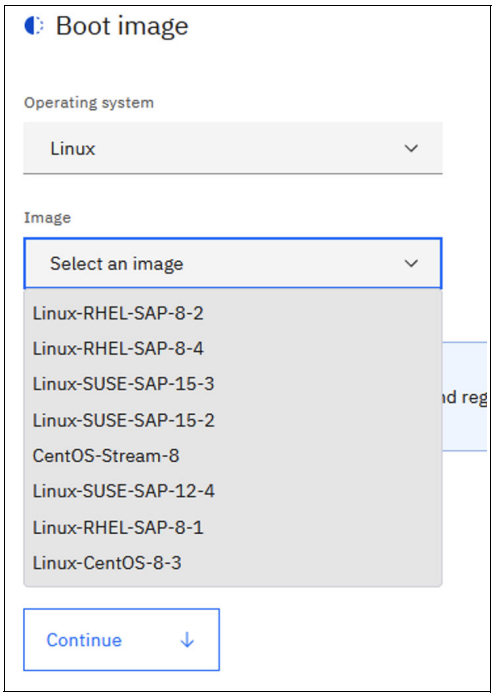


Figure 5-79 Listing Linux client supplied

Full Linux subscription for Power Systems Virtual Servers

You can also bring your own Linux image (OVA format) and subscription. Power Systems Virtual Server also supports Linux (Red Hat Enterprise Linux and SUSE Linux Enterprise Server) stock images for non-SAP applications by using **full Linux subscription**.

Full Linux subscription provides Red Hat Enterprise Linux) and SUSE Linux Enterprise Server stock images that can be used for SAP and non-SAP applications.

Power Systems Virtual Server provides three versions of stock images for each operating system (OS). You can also use the full Linux subscription feature to get OS interim fixes and updates for Power servers that are hosted on the IBM satellite server within the IBM Cloud environment. Extra charges apply if you use the activation keys in the IBM Cloud Satellite to receive the interim fixes.

Full Linux subscription is supported on the following OS versions as shown in Figure 5-80 on page 127.

SUSE Linux Enterprise Server:

- SUSE Linux Enterprise Server 15 SP2 (SAP only).
- SUSE Linux Enterprise Server 15 SP3 (General and SAP).
- SUSE Linux Enterprise Server 15 SP4 (General).

Red Hat Enterprise Linux:

- Red Hat Enterprise Linux 8.4 (General and SAP).
- Red Hat Enterprise Linux 8.6 (General).

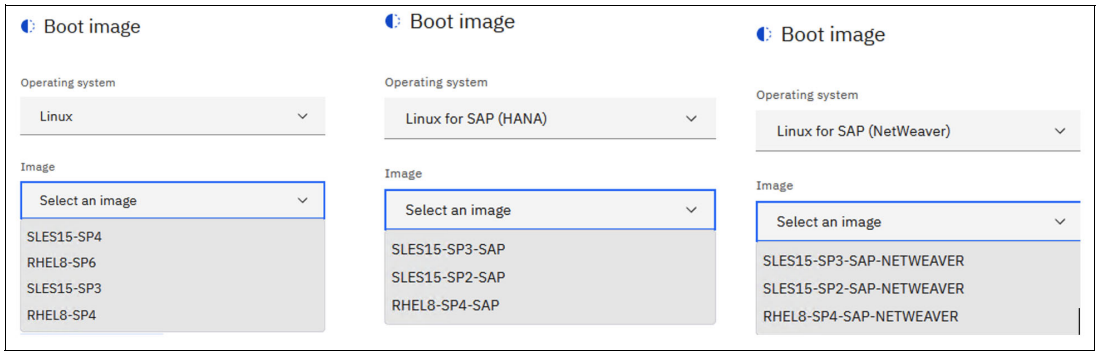


Figure 5-80 Listing full Linux subscription

5.5.1 Deploying a Linux virtual machine

To begin, complete all of the fields under the Virtual servers section. If you select more than one instance, you are presented with additional options.

1. Click Create instance bottom under Virtual server instances as shown in Figure 5-81.

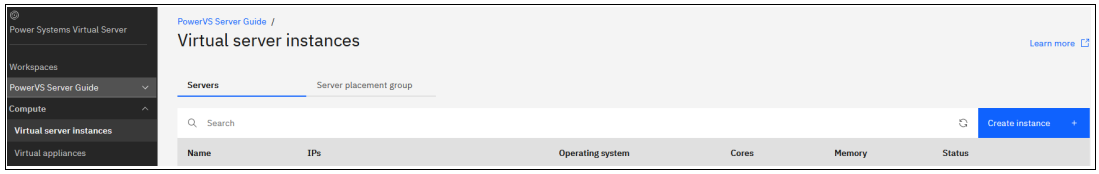


Figure 5-81 Creating a instance

2. Next chose the instance name and specify the number of instances to be created as shown in Figure 5-82.

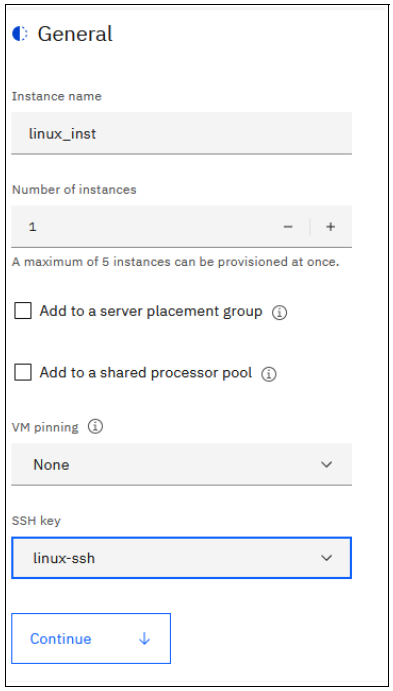


Figure 5-82 Defining instance name and number of instances

3. Select the boot image completing the fields as instructed by your organization. When you select Boot image, the Power Systems Virtual Server user interface allows you to select boot images from a group of stock images or the list of stock images in your catalog. You must select a storage type for stock images as shown in Figure 5-83.

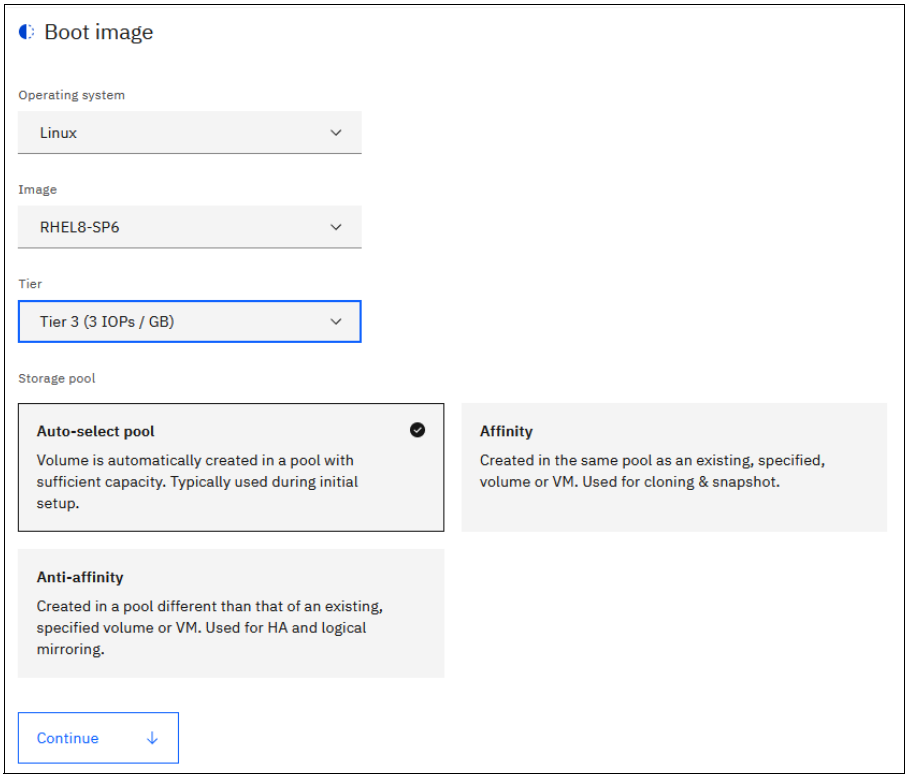


Figure 5-83 Selecting boot image

4. Select your Machine type, the number of Cores, the amount of Memory (GB) and whether you want a Dedicated processor, Uncapped shared processor, or Capped shared processor as shown in Figure 5-84 on page 129.

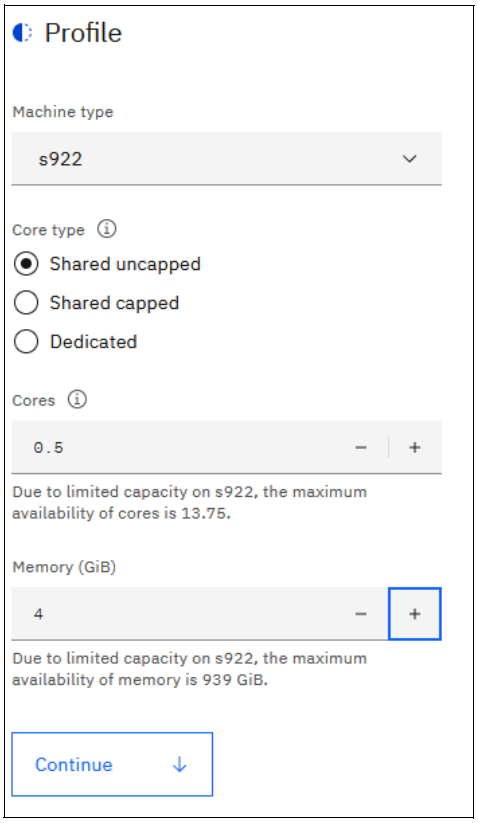


Figure 5-84 Configuring the IBM Power Systems Virtual Server Profile

5. Optional: you can either create a new data volume or attach an existing one that you defined in your IBM Cloud account.

To create a new volume on the Storage volume click Create volume as shown in Figure 5-85.

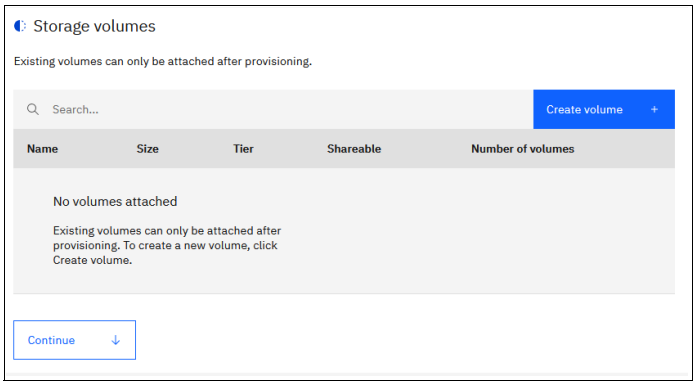


Figure 5-85 Creating a new volume

On the new storage to be added put the name, chose if it will be sharable, the size and quantity as shown in Figure 5-86 on page 130.

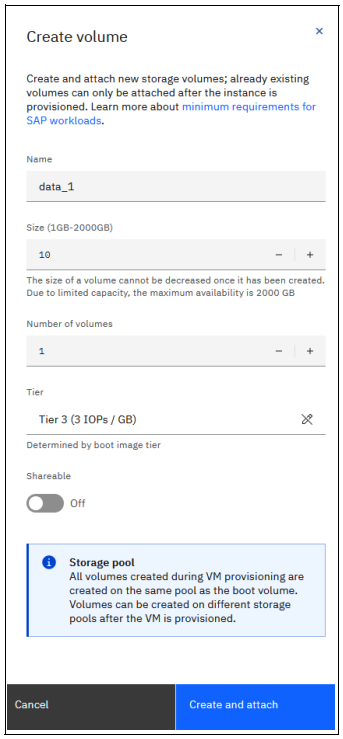


Figure 5-86 Creating a new volume

The selected disk to be created is shown in Figure 5-87.

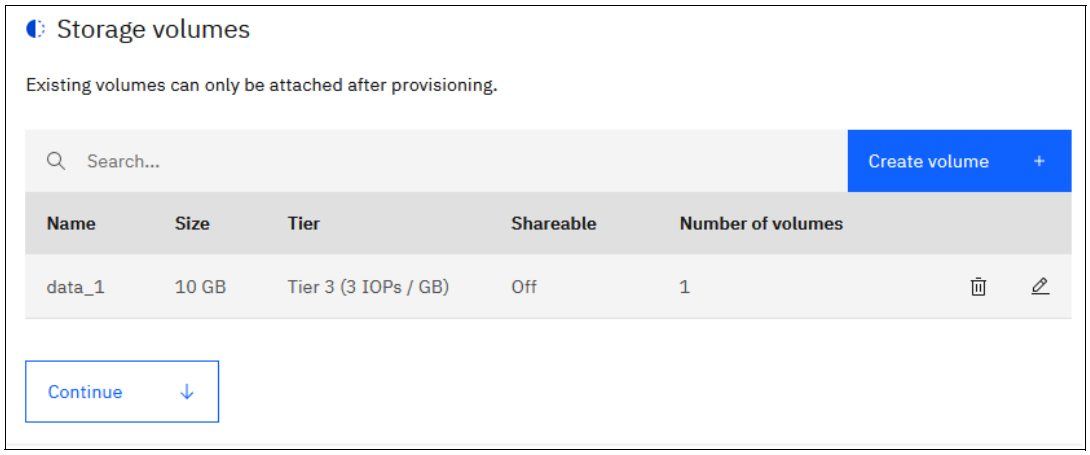


Figure 5-87 Attacked storage volume

6. Next select Network Interfaces as shown in Figure 5-88 on page 131.

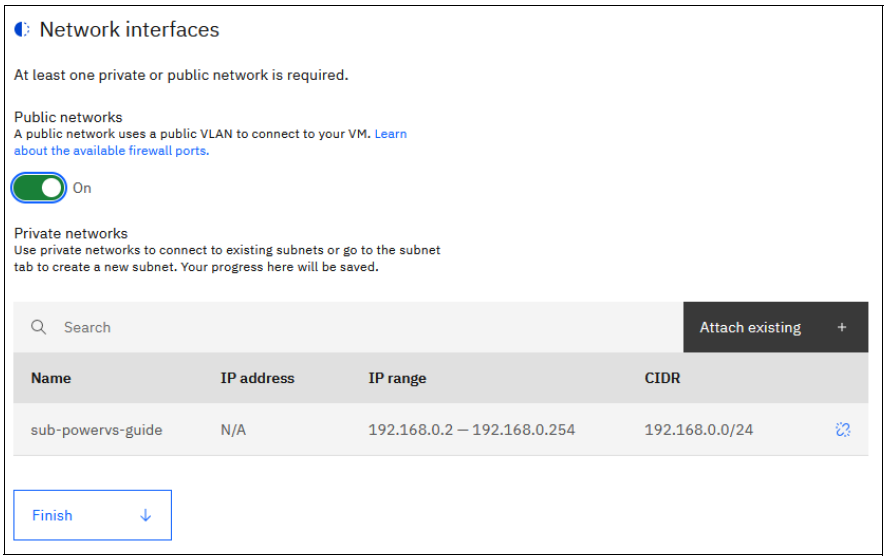


Figure 5-88 Listing selected network

7. To create the IBM Power Systems Virtual Server select “I agree to the Terms an Conditions” then click Create Instance as shown in Figure 5-89.

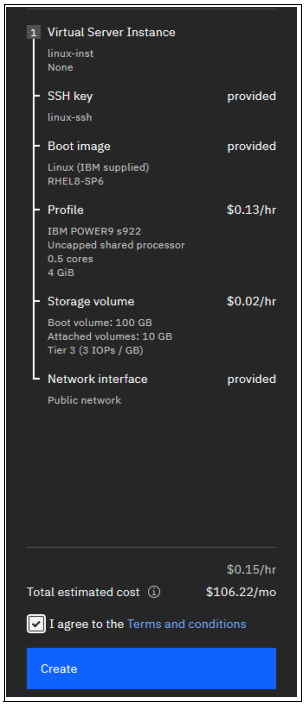


Figure 5-89 Creating IBM Power Systems Virtual Server

In the resource list, the IBM Power Systems Virtual Server new instance is listed as shown in Figure 5-90 on page 132.

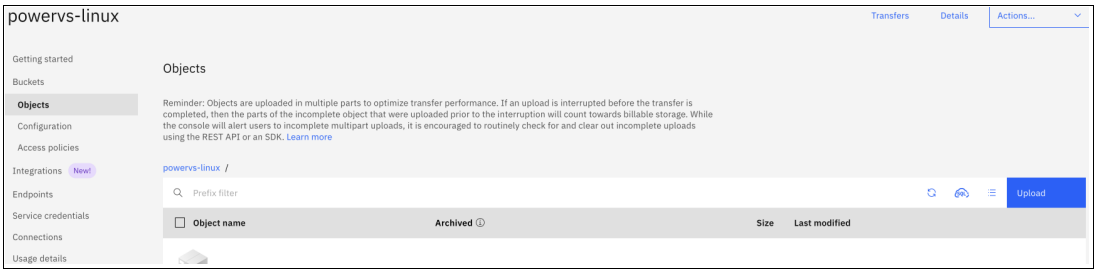


Figure 5-90 IBM Power Systems Virtual Server instance

Click the new IBM Power System Virtual *linux_inst*, it is possible to check its details as shown in Figure 5-91.

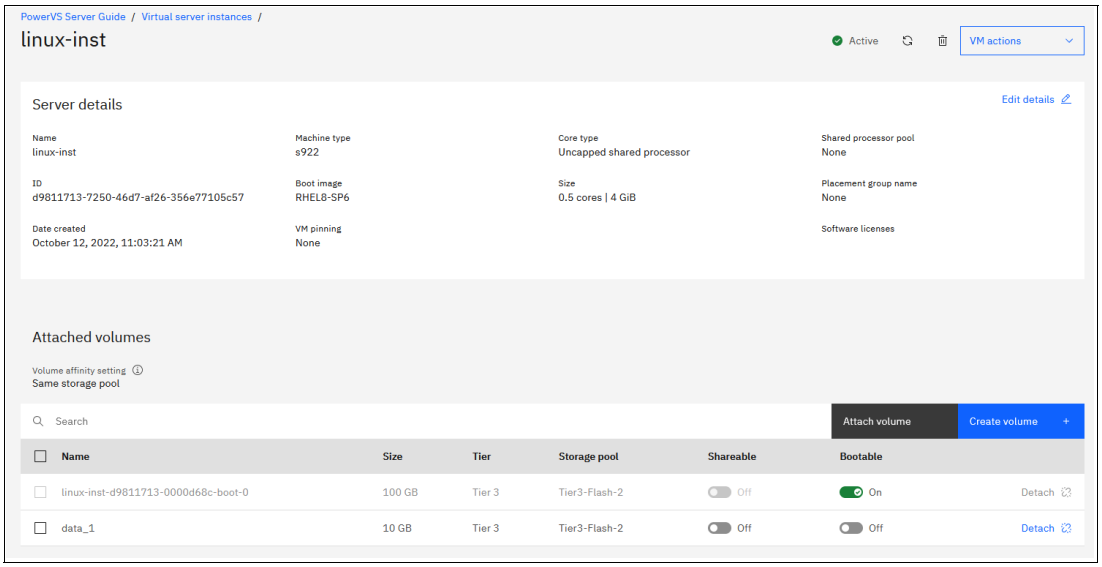


Figure 5-91 Server detail

Click VM actions to open a console as shown in Figure 5-92.

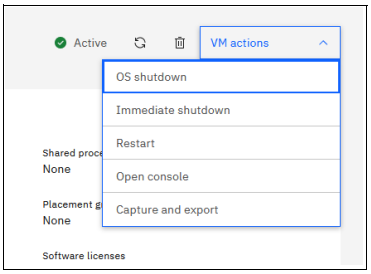


Figure 5-92 Virtual Server instance operation menu

Then the console opens as shown in Figure 5-93 on page 133.

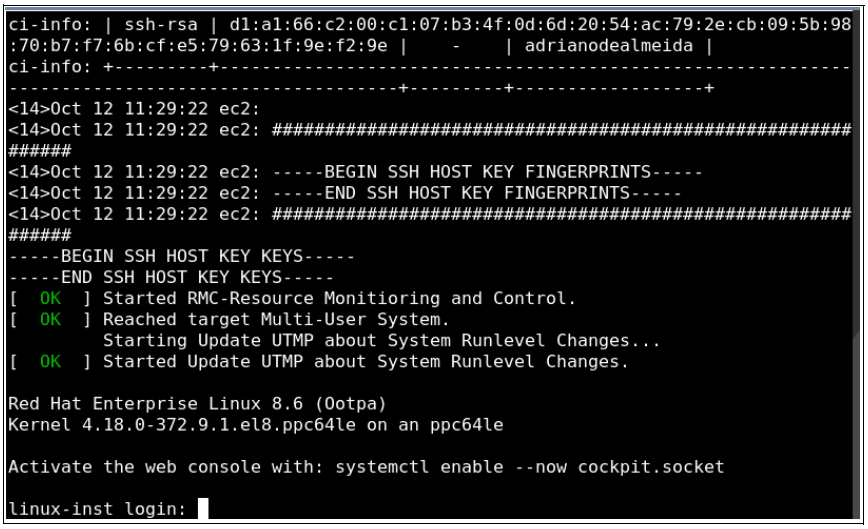


Figure 5-93 Virtual Server console

5.6 Migration Linux by way of the PowerVC OVA file to the Power Systems Virtual Server

You can bring your own customized Linux operating system (OS) image to deploy within a IBM Power Systems Virtual Server.

The basic steps that are involved in deploying an instance by using a custom image are:

1. Create the custom image.
2. Store the image in your Cloud Object Storage account.
3. Point the Power Systems Virtual Server console to the image in the Cloud Object Storage and deploy the Virtual Server instance.

5.6.1 Using PowerVC to capture and import an OVA image

If you've deployed PowerVC in your on-premises environment, you can use it to capture any supported LPAR and create an OVA image. After you create the OVA image, upload it to your Cloud Object Storage account and import it into the Power Systems Virtual Server environment.

5.6.2 Creating an instance of IBM Cloud Object Storage in IBM Cloud

The next step is to create a bucket to store data in the previous instance of instance of IBM Cloud Object Storage *“COS PowerVS”*, choose a name of the bucket with correct permissions as shown in Figure 5-94 on page 134.

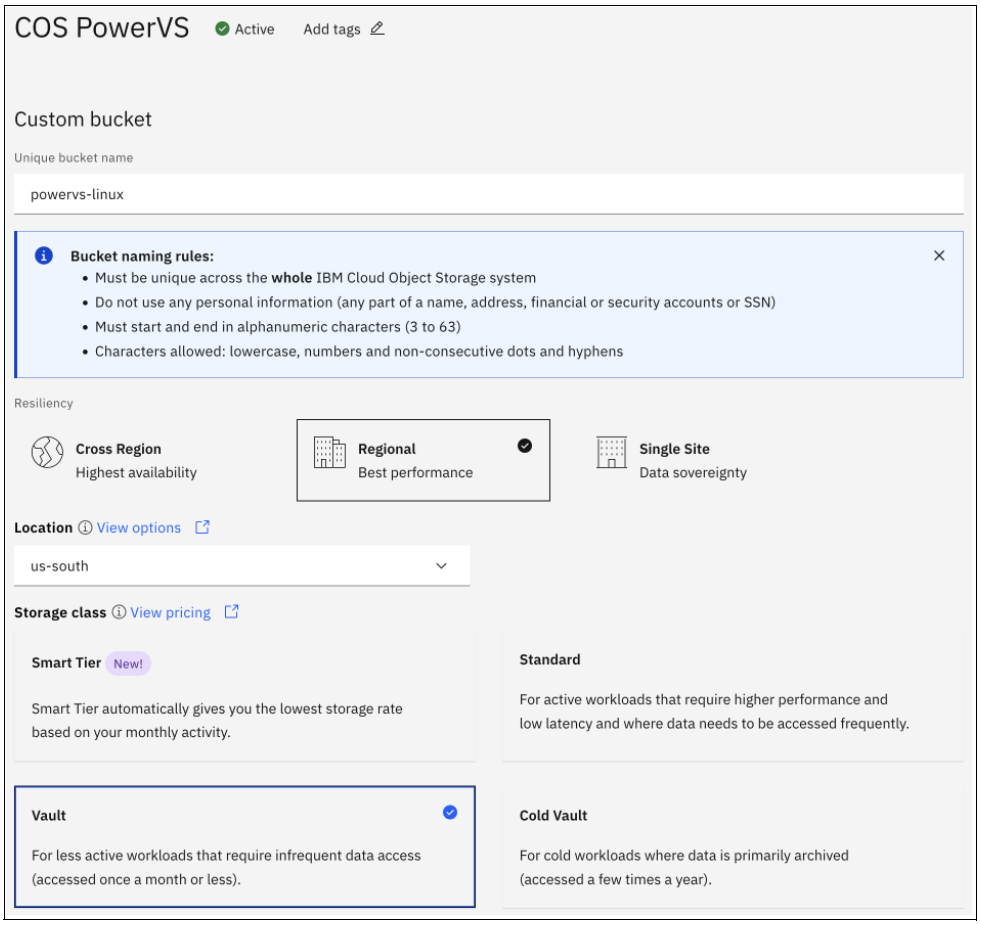


Figure 5-94 Creating a bucket

After creating the bucket, it is listed in the *COS PowerVS* service instance IBM Cloud Object Storage as shown in Figure 5-95.

Figure 5-95 Listing buckets

For Service Credentials, use the same created before as described in “Creating an instance of IBM Cloud Object Storage in IBM Cloud” on page 103.

You can now start uploading any ova file using the Aspera connect which is built in feature. To upload the ova image to the IBM Cloud Object Storage, click Upload as shown in Figure 5-96 on page 135.

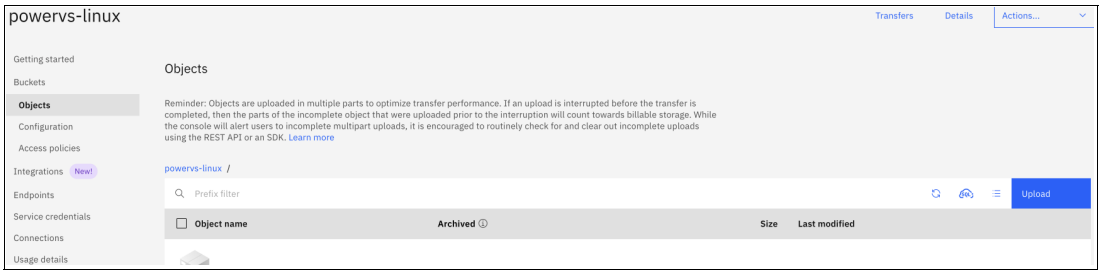


Figure 5-96 Uploanding a file to a bucket

When you click Upload and select files, you see a window as shown in Figure 5-97.

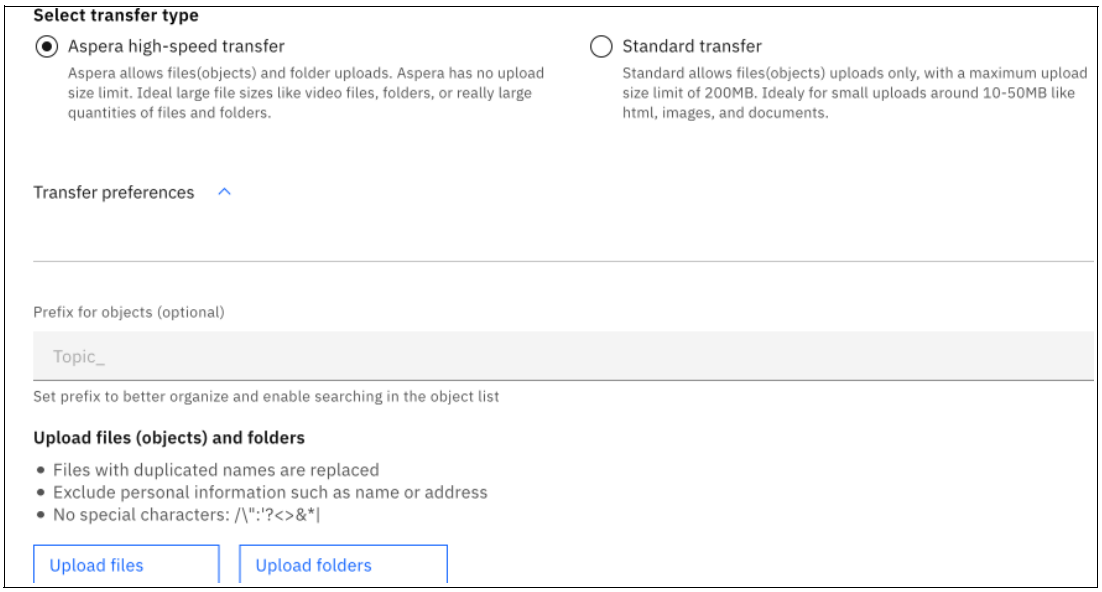


Figure 5-97 Transfer file by way of Aspera

Click Upload files and this action browses your notebook folder. Choose a file and start the upload. You can see the file transfer in the UI as shown in Figure 5-98.

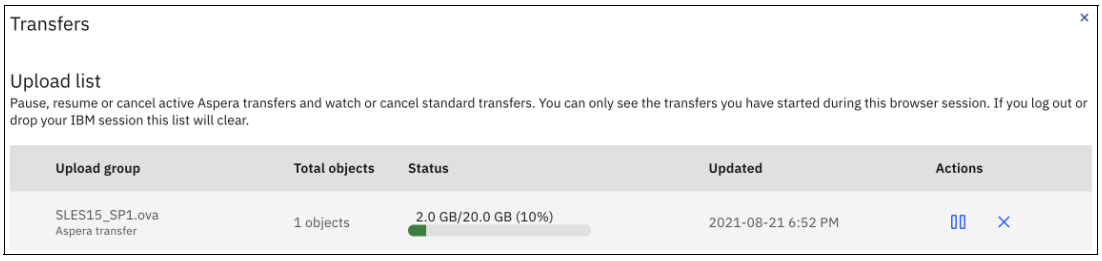


Figure 5-98 Transfer file to bucket

You can check the file in the bucket as shown in Figure 5-99 on page 136.

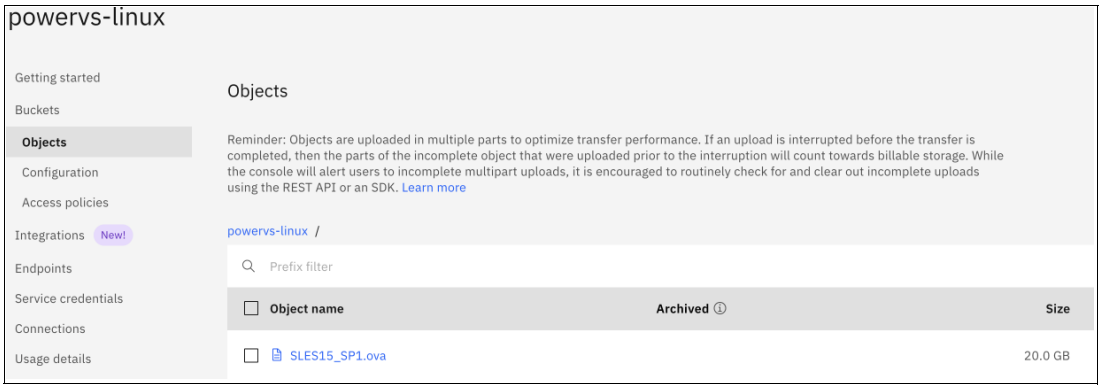


Figure 5-99 Check files in the bucket

Now import the ova file to your PowerVS instance. Go to Resource list → Services → Select e PowerVS Server Guide → Select the boot images tab as shown in Figure 5-100.

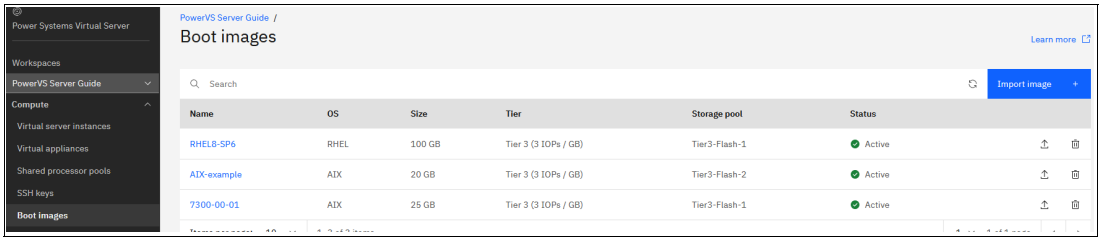


Figure 5-100 Selection Boot Images tab

Before you import the image, you need the following information:

- Storage type (Tier 1 or Tier 3).
- Region.
- Image filename.
- Bucket name.
- Cloud Object Storage access key -- select Menu icon → Resource list → Storage → Cloud Storage Object name → Service credentials → View credentials. Copy the access_key_id.
- Cloud Object Storage secret key -- select Menu icon → Resource list → Storage → Cloud Storage Object name → Service credentials → View credentials. Copy the secret_access_key.

Now click Import Image. You see a window to import a new boot image. Fill in the catalog-image-name, Storage type, Region, Image filename, bucket name and storage access key and secret key as shown in Figure 5-101 on page 137.

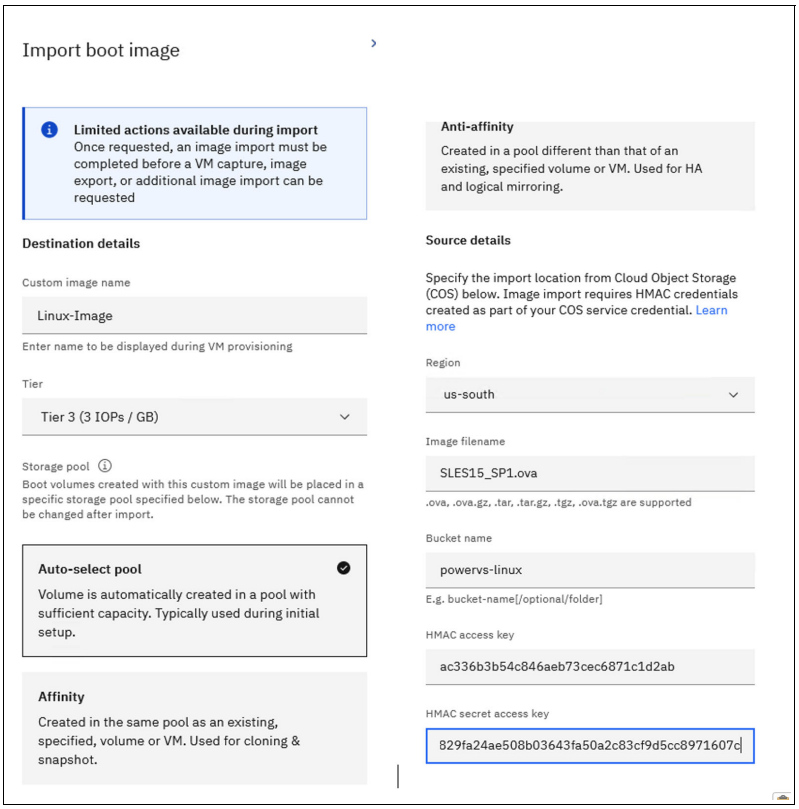


Figure 5-101 Importing boot image

Check the bootimages after the file has been imported as shown in Figure 5-102.

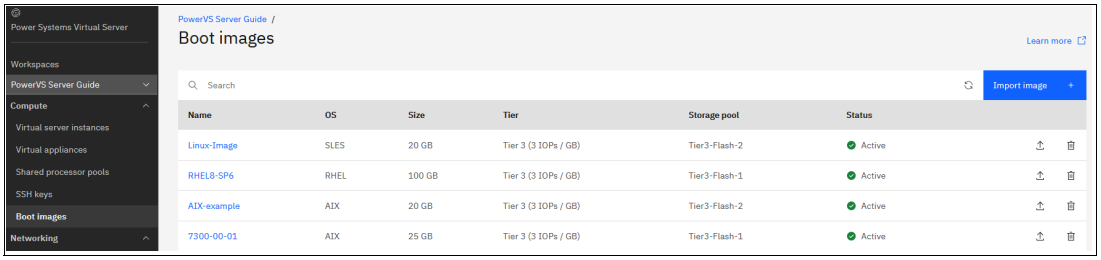


Figure 5-102 Listing boot images

After the image is imported, we will use this image to deploy a new Linux virtual machine. Select Virtual server instance and click create instance. Fill in the require Name and check you see the imported image as shown in Figure 5-103 on page 138.

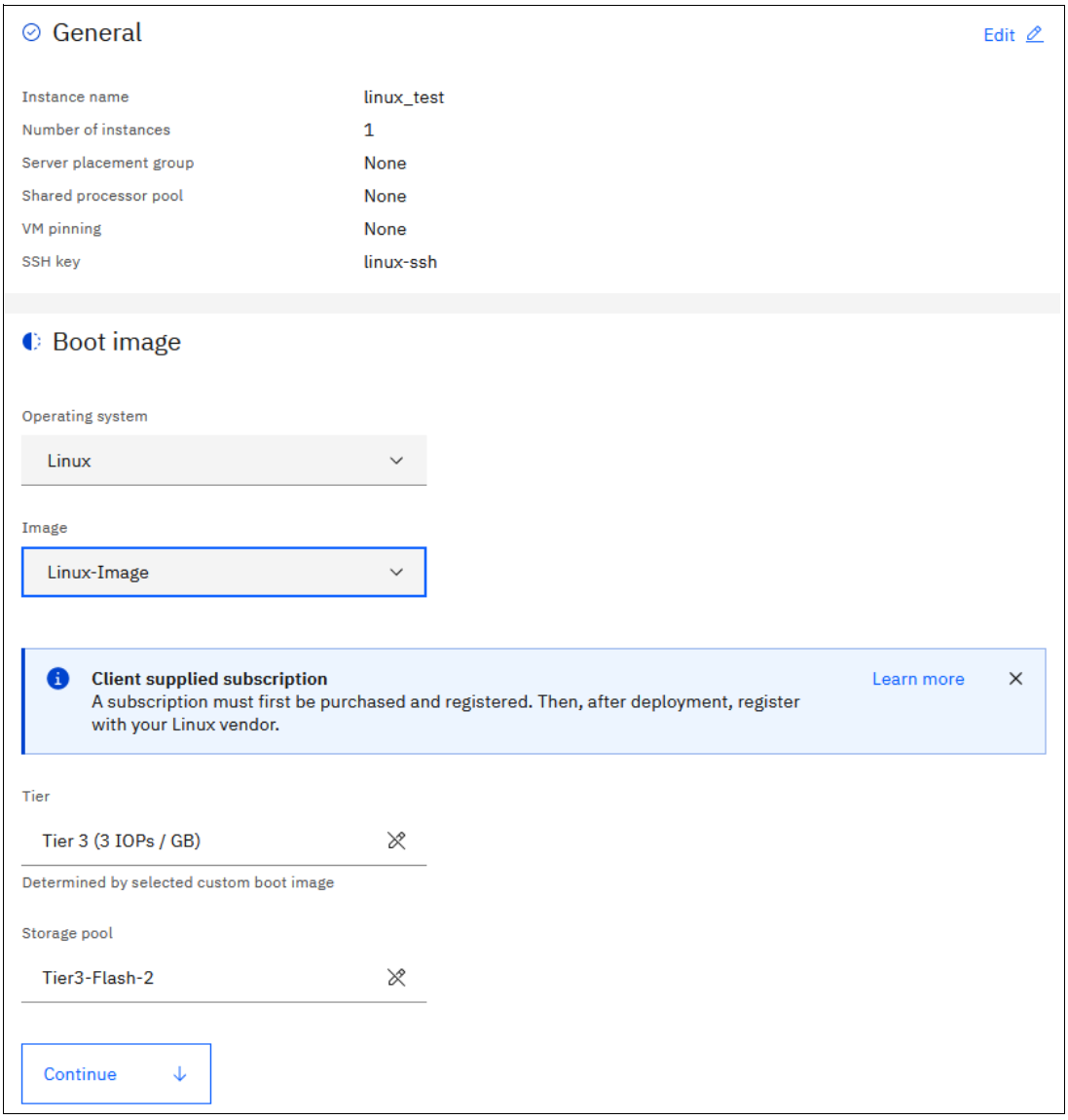


Figure 5-103 Creating a new Linux virtual machine

After creating the virtual machine, list it on the Virtual Server Instances as shown in Figure 5-104.

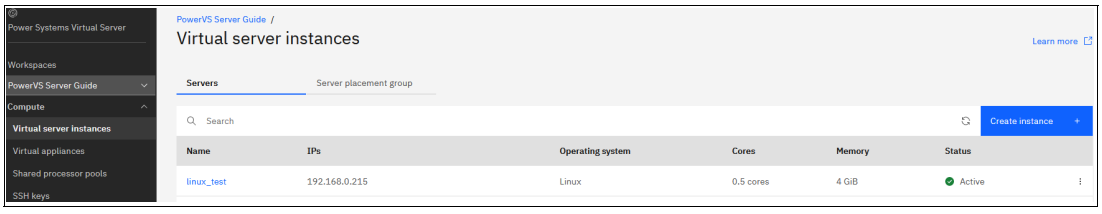


Figure 5-104 Listing VSI

Figure 5-105 on page 139 shows the restored Linux OVA image.

Figure 5-105 Restored Linux OVA image

5.7 IBM Power Virtual Server certified profiles for SAP HANA

IBM and SAP continue a collaboration since the early 1970s in multiple areas, including hardware, software, cloud, services, and finance. They are now collaborating to run SAP HANA-based applications on IBM Power Systems Virtual Servers.

Power Systems Virtual Server is a Power Systems enterprise infrastructure as a service (IaaS) offering. Power Systems Virtual Servers are physically located with low-latency connectivity to the IBM Cloud Infrastructure. This infrastructure design enables Power Systems Virtual Servers to maintain key enterprise software certification and support as its architecture is identical to certified on-premises infrastructure.

The IBM Power Systems Virtual Servers offering is ideal for practically all SAP HANA use case scenarios. You can use your servers for mission critical workloads, as your test environment, or your business continuity disaster recovery (BCDR) site. All SAP HANA-based products are supported on Power Systems Virtual.

Understanding IBM Power Virtual Server profile names

The IBM Power Virtual Server for SAP HANA have profile names that are contextual and sequential. There are multiple families of profiles for SAP HANA, each with associated with the required Service Level Agreements (SLAs):

- **np1** = Non-product development for testing or development use only. Not intended for production deployments; not supported or certified by SAP production.
- **umh1** = Ultra Memory HANA for OLTP that use 1:240 as the cpu:memory ratio.
- **mh1** = High Memory for OLAP that use 1:180 as the cpu:memory ratio.
- **bh1** = Balanced for OLAP that use 1:100 as the cpu:memory ratio.
- **ch1** = Compute Intensive for OLAP that use 1:50 as the cpu:memory ratio.

For more details about profiles certified for on IBM Power System Virtual Server see the SAP Note 2947579 - SAP HANA on IBM Power Systems Virtual Servers:

https://launchpad.support.sap.com/#/notes/2947579

Figure 5-106 shows the profiles certified for SAP HANA available for IBM Power Systems Virtual Server.

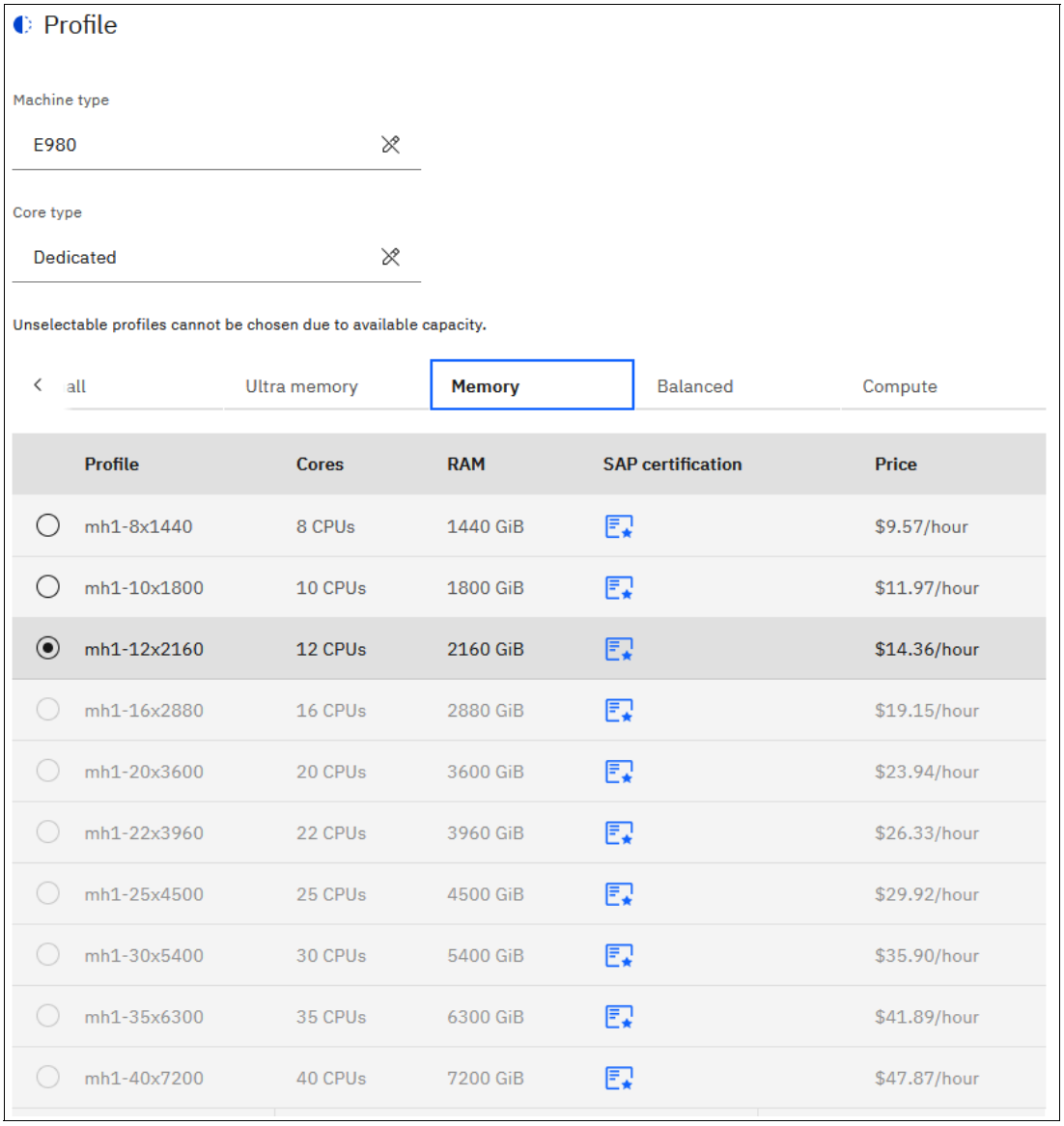


Figure 5-106 Checking SAP HANA profiles for VSI

5.8 IBM Power Systems Virtual Server certified profiles for SAP NetWeaver

IBM Power Systems Virtual Servers are available with fully adjustable CPU cores and memory (RAM GB). It is permitted to define a custom size of the IBM Power Systems Virtual Server to use for SAP NetWeaver, in accordance with existing SAP NetWeaver or SAP AnyDB for IBM Power Systems best practices and guidance from SAP.

Therefore, no profile names are used to define running SAP NetWeaver or SAP AnyDB that uses IBM Power Virtual Servers.

For SAP applications the following virtual server configurations are supported. Given SAP NetWeaver instance sizing is flexible, it must follow the standard SAP sizing guidelines by using SAPS benchmarks as shown in Table 5-1.

Table 5-1 SAP benchmarks

Power Systems type	SAPS per CPU core	SAPS per CPU thread (using SMT-8)
S922	5,570	696.25
E980	6,000	750

For more information, see SAP Note 2855850 - SAP Applications on IBM Power Systems Virtual Servers:

https://launchpad.support.sap.com/#/notes/2855850

Figure 5-107 shows the example of creating an SAP NetWeaver VSI.

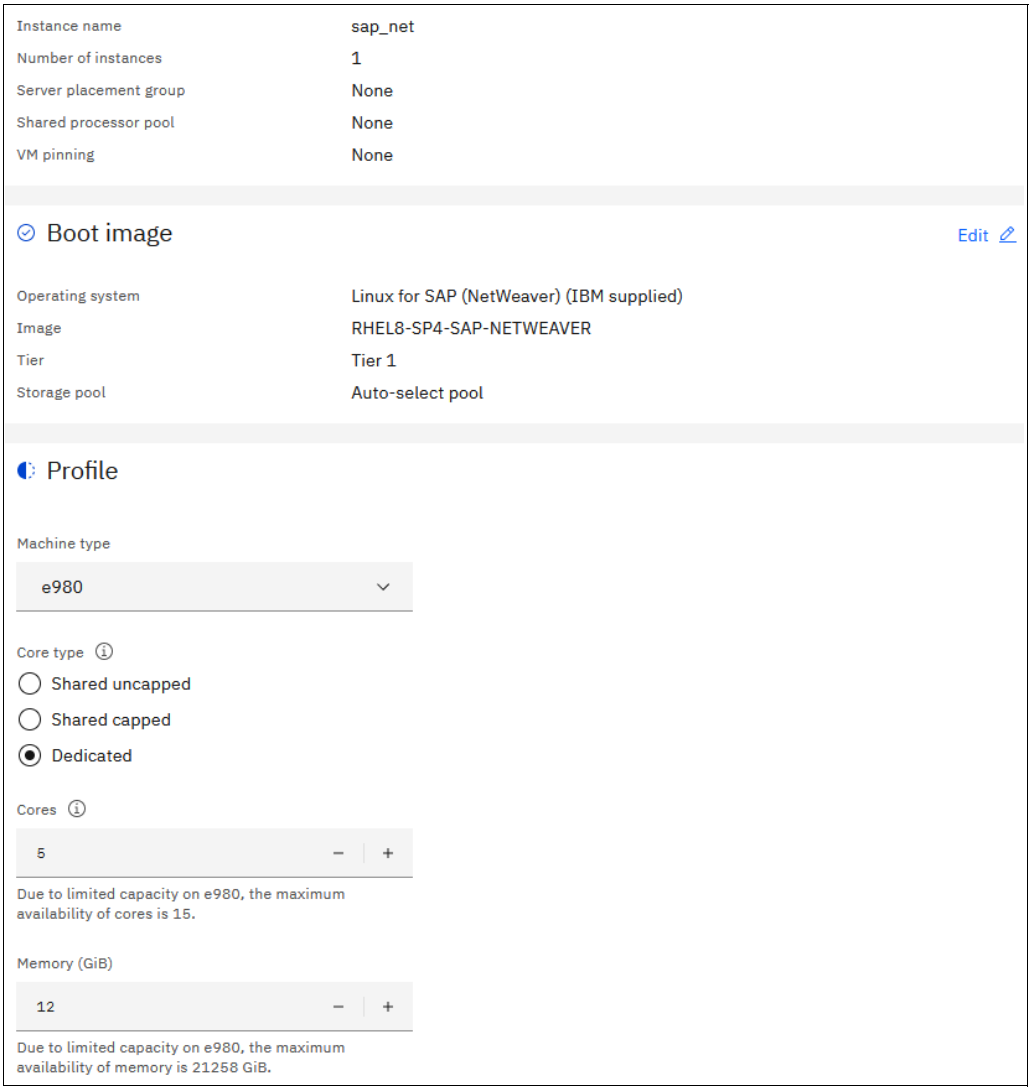


Figure 5-107 SAP NetWeaver VSI

6

Reference architectural decisions to migrate IBM AIX or Linux on-premises to IBM Power Systems Virtual Server

This chapter provides a sample describing the considerations, architectural decisions, issue or problem statements, assumptions, motivations, alternatives, and implications to migrate IBM AIX or Linux workloads from on-premises to off-premises- IBM Power Systems Virtual Server on IBM Cloud.

This chapter contains the following:

6.1 Introduction

The main goal of this section is to let you know what are the considerations from architectural point of view before to migrate IBM AIX/Linux on-premises workloads to off-premises. Here we describe one of most common methods used to migrate IBM AIX/Linux environments to the cloud currently, we will assumption an hypothetical scope based on real customers experiences, it also functional and non- functional requirements. Then an overview of an architecture diagram.

Note: If you need to understand customer's current IBM AIX/Linux systems, refer to `Discovery and inventory Questions`.

6.2 Hypothetical case overview

Supposing that a customer has signed an agreement with IBM to move ten IBM AIX/Linux virtual machines located in La Paz - Bolivia named LPZ01 and LPZ02 to IBM Power Systems Virtual Server on IBM Cloud in SAO01 and SAO04, both in Sao Paulo, Brazil. As per the agreement signed with the customer, all IBM AIX/Linux virtual machines will be moved "as is", with operating system release 7.2. There is no transformation included in this project, except the operating system upgrade to 7.3. There exist four productions IBM AIX/Linux virtual machines, moreover one development VM and one archive VM, and four disaster recovery VMs that are duplicated to SAO04; this environment includes storage, backups in IBM Cloud Object Storage (COS), internal network including firewalls and Jump server for the IBM AIX/Linux virtual machines access management. Additionally this scope includes a third-party vendor logical replication solution between source and target replicating across different zones in IBM Cloud. Refer to Figure 6-1.

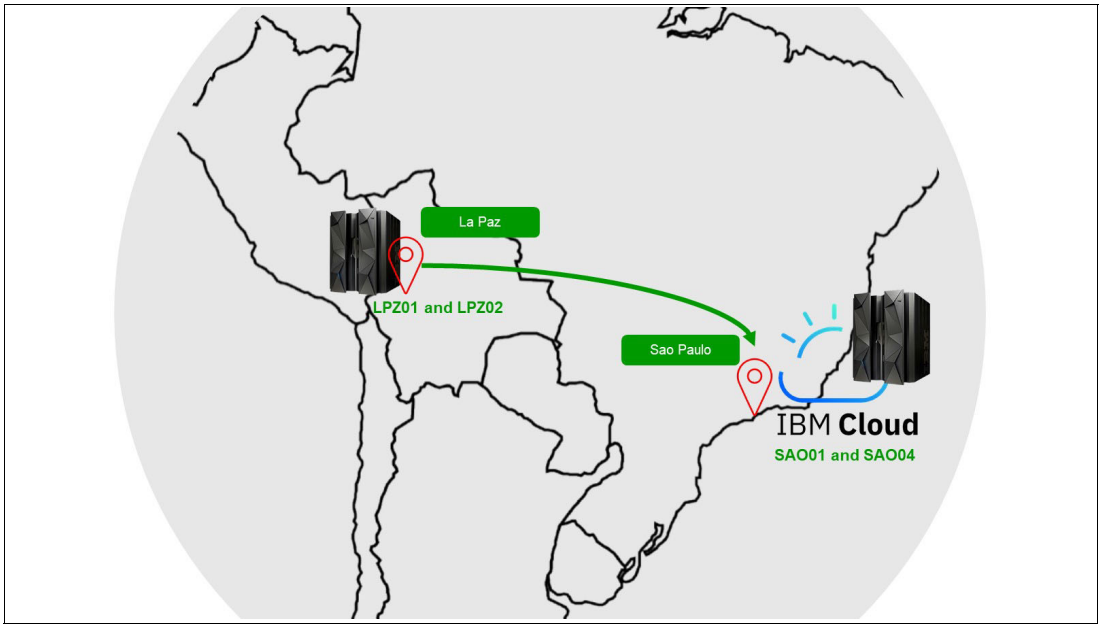


Figure 6-1 Migrating IBM AIX/Linux VMs from La Paz (on-premises) to Sao Paulo (off-premises)

Note: Bolivia and Brazil are in the same continent (South America) that is why this hypothetical case described both countries, La Paz and Sao Paulo cities are across 3000 kilometers. For further information about multizone regions refer to Locations for resource deployment.

6.2.1 Scope

The assumption about this scope is to migrate all ten IBM AIX/Linux virtual machines from two Data Centers LPZ01 (source) and LPZ02 (target) managed by customer in La Paz, Bolivia to the IBM Cloud Data Center in SAO01 (source) and SAO04 (target). Development and archive VMs currently residing in La Paz-Bolivia data center to be migrated to IBM Cloud utilizing ICOS (IBM Cloud Object Storage) backup and subsequently restored to the target VM in IBM PowerVS on IBM Cloud. About the IBM AIX/Linux productions VMs currently residing on LPZ01 will be migrated using ICOS backup and logical replication method as shown in chapter 2.1.1, “Migration of an AIX image Using Cloud Object Storage” on page 26.

Note: Commonly you need a maintenance contract, activation key of the logical replication, installation and configuration done by the third-party vendor solution.

After the IBM AIX/Linux VMs are active, the data is restored to the target location and the connectivity from La Paz data center is established using IBM AIX/Linux Access Client Solution (ACS). After validated, customer’s applications is configured the application functions in the environment, moreover, tests of each virtual machine is done and the overall function for each environment. IBM provides to customer the temporary technical information such as: IP addresses, DNS names, VM temporary name, and so on; required to be in position to perform the tests without any incidence on existing IBM AIX/Linux production environments established in La Paz Bolivia.

It is customer’s responsibility to administrate their applications and user ID management.

After migration IBM can run the appropriate security scan for each IBM AIX/Linux environment based on existing customer’s security policy and provide the results to customer for evaluation.

Multiple teams are involved in the transition and steady state support of the environment including IBM Cloud connect for Network, Cloud Object Storage, IBM PowerVS, IBM AIX/Linux support team, customer’s application team, and third party vendor software team support for logical replication.

Image catalogs are created out of objects that are backed up by using optical devices. These catalogs must be restored on the IBM Power Systems Virtual Server instance by using some of the migration strategies, using ICOS and NFS server.

Infrastructure considerations

The technical infrastructure architecture and design consist in deploying several zones in IBM Cloud in Sao Paulo. In addition to the IBM Power Systems Virtual Servers zone named *“Power Colo”* (contraction of Power Collocation), a creation of a Front-End zone where is deployed Jump servers for users’ access and some other function such as a Proxy for accessing the IBM Cloud Object Storage services. Those services are hosted in a Bare Metal server. A cluster of firewalls is deployed in the Front-End zone within the SAO01 site. In SAO04 a Standalone firewall is deployed.

Functional requirements

The solution must satisfy functional and non-functional requirements in a way that best balances competing stakeholders' concerns and must take constraints into account.

Table 6-1 shows the functional requirements.

Table 6-1 Functional requirements

Requirement	Description
Management services for IBM AIX/Linux.	Support for IBM AIX/Linux operating systems.
Provide backup services.	IBM Cloud Object Storage is used as backup-services.
Provide multi-site HA solution.	Multi-site infrastructure to be provide in Sao Paulo (dual-sites).
Dual sites high availability.	The use of any third-party vendor solution on logical replication to establishing disaster recovery between SAO01 and SAO04.
Provide fault tolerant LAN infrastructure in IBM Cloud.	Provide Network connectivity for application and servers.
Data replication between IBM Cloud and customer data center.	By using a logical replication solution for replicating data for the more for IBM AIX/Linux for replicating data for the move of application.
Provide traffic isolation and segmentation.	The use of Jump servers and traffic filtering on IBM Cloud.
Provide WAN connectivity.	Customer provides WAN circuit and the POP network infrastructure; IBM provides the termination endpoint in Sao Paulo.

Non-functional requirements

In the following lines we described non-functional requirements:

- IBM Cloud portal access for IBM AIX/Linux virtual machines provisioning.
- Tools for alert monitoring and reporting (IBM AIX/Linux).
- Traffic bandwidth in IBM Cloud infrastructure will not exceed 1 Gpbs.
- Traffic bandwidth for replication limited to 500 Mbps. Internet will be used for preserving production traffic.
- Local network redundancy to be provided in primary IBM Cloud site (SAO01): firewall cluster in High Availability, dual ports connectivity.
- Manageability access for customer's users to be provided by means of Jump servers.

6.2.2 Architectural decisions

Architectural decisions help to communicate why the solution architecture is the way it is, across the scope of the solution. There is more than one conceivable arrangement choice to a given architectural issue. This incorporates components and their connections, choice of innovation, allotting usefulness to different components, making situation choices for components facilitated inside different infrastructure nodes and so on. The choices can have diverse costs related with them, the degree they fulfill different prerequisites and can show distinctive ways of adjusting competing stakeholders' concerns. Enabled architects to:

- Formally archive the basic choices that they make in their creation of the arrangement.
- Get it and concur why the arrangement looks the way it does.

In summary, architectural decisions resides on:

- Make express the method of reasoning and defense of the choices made.
- Offer assistance guarantee the arrangement fulfills both functional and non-functional prerequisites and on the off chance that it does not, offer assistance making it unequivocal to the partners.
- Avoid superfluous adjust all through the arrangement conveyance lifecycle.

Table 6-2, Table 6-3 on page 148, Table 6-4 on page 149, and Table 6-5 on page 150 describe some examples decisions regarding lift and shift an IBM AIX/Linux VMs from the architectural perspective about:

- Infrastructure.
- Migration.
- Servers.
- Networking.

Table 6-2 Infrastructure - Front End accounts

Architectural decision	Front End accounts used for accessibility and provision of some services.
Problem statement	Providing a way for accessing the target Power VS which are moved from customer's data centers to IBM Cloud - Sao Paulo in a dual site configuration.
Assumptions	Customer provides the WAN connectivity up to the network PoP Equinix[1] next to the data center.
Motivation	Standard design for this type of solution.
Alternatives	None alternatives.
Decision	Deploy Front-End account and services.
Justifications	For accessibility of the PowerVS, there is a need for a front-end zone. There are some services provided here, such as the control of network traffic (firewalls), a relay environment for accessing the target IBM AIX/Linux images and a Proxy for IBM COS access.
Implications	Deploy WAN access and replication method for moving the existing data in the target environment.
Derived requirements	► Providing Firewall services for VPN access and filtering of traffic. ► Providing IBM COS services for Backup. ► Providing WAN network connectivity for customer's users and application connectivity. ► Providing Bare Metal servers to hosts relay applications and Proxy.

[1] For further details about Equinix refer to America Data Centers.

Note: Using Equinix you can get a Direct Link to classic and from there reach IBM Power Systems Virtual Server over Direct Link Connect. Or from Equinix, get a cross connect to Megaport and connect to IBM Power Systems Virtual Server directly.

Important: Before you begin, determine the location connection to IBM Cloud by verifying your collocation provider's or service provider's capabilities to reach the Meet-Me Room and cross-connect into IBM Cloud, refer to `Ordering IBM Cloud Direct Link Dedicated`.

By the other side, for example, on SAO01, the location type and Meet-Me Room (MMR) Operator, is DC and Digital Realty (Ascenty), and SAO04 DC(AZ1) and ODATA.

In this hypothetical case to lift and shift IBM AIX/Linux VMs from Bolivia to Brazil, it is possible to establish the connection from Bolivia to SAO01. For example, to do this you need to contract directly with a Carrier that has capacity and presence in any *Ascenty* data center. The solution might be LAN-to-LAN + Cross Connection Fiber Optic + IBM DirectLink 1 G or 10 G.

For the LAN-to-LAN link, but IBM needs to directly contract the carriers for the private LAN-to-LAN circuits. For example, a list with the Carriers and the location of the Ascenty data centers are as follows: ALGAR TELECOM, ALOO TELECOM, AMERICANET, ANGOLA CABLES, BRDIGITAL, LUMEN, COGENT, SEABORN, CLARO - PRIMESYS - EMBRATEL, Durand / Tavola, HOSTFIBER, MEGATELECOM, MUNDIVOX, NETELL, NEUTRONA NETWORKS, NOVVACORE TELECOMUNICAÇÕES, OI MOVEL, Seaborn, SILICA NETWORKS, VIVO, VOGEL, WCS TELECOM.

Further information about Digital Realty (Ascenty) and ODATA, see `Ascenty` and `ODATA`.

Table 6-3 Infrastructure - Dual site

Architectural decision	Dual site infrastructure has been required for High availability purpose.
Problem statement	In case of major outage, customer's users are able to connect on backup site (use of DNS for servers translation; secondary site has a different TCP IP address).
Assumptions	Two sites are used for the solution: one in SAO01 and the other one in SAO04 (in a different zone).
Motivation	Infrastructure recovery in case of major outage.
Alternatives	There is not alternatives
Decision	Deploy dual site solution in an IBM Cloud Multi-Zone Region (Sao Paulo).
Justifications	In case of primary site major outage, the main goal is to restart part of the application and services in the secondary site.
Implications	Deploy a secondary site in addition to the Production environment.

Architectural decision	Dual site infrastructure has been required for High availability purpose.
Derived requirements	► Providing WAN network connectivity to secondary site for customer's users and application connectivity. ► Duplicate part of the primary infrastructure in backup site.

Table 6-4 Migration strategy and backup

Architectural decision	IBM Cloud Object Storage backup will be used for migrating IBM AIX/Linux VMs to SAO01 and SAO04.
Problem statement	Back-up and data replication between client datacenter and IBM Cloud target infrastructure. There is no ATL or VTS (Automatic Tape Library) available to perform Save/Restore which is a traditional migration method for IBM AIX/Linux O.S.
Assumptions	The use of IBM Cloud Object Storage for the migration is one of the available method for moving workload to IBM Power Systems Virtual Server in IBM Cloud.
Motivation	The use of IBM Cloud Object Storage to move IBM AIX/Linux workloads to SAO01 and SAO04.
Alternatives	1. The use of IBM Cloud Object Storage for migration 2. The use of Master Data Management (MDS) device for the migration. 3. Transferring IBM AIX/Linux image OVA file to IBM Cloud Storage using IBM Power Virtualization Center.
Decision	In this case IBM Cloud Object Storage will be used.
Justifications	Master Data Management has been excluded due to the delay for taking backups data on 1 Gpbs interface. Customer do not have a virtualization by PowerVC.
Implications	Network connectivity will include VPN WAN connectivity and Proxy in Front-End account
Derived requirements	Deploy Proxy in Front-End zones and VPN access from client on IBM Cloud. Bucket are needed to create on IBM Cloud Object Storage for the data move. Needs additional storage for the IBM Cloud Object Storage backup for in the source IBM AIX/Linux VM.

Table 6-5 Networking - IBM Cloud Direct Link Dedicated on Classic

Architectural decision	WAN direct link connectivity to be redundant: one primary and one secondary link.
Problem statement	WAN access connectivity to be recovered in case of primary link outage.
Assumptions	WAN part is customer's responsibility, IBM Cloud will provide dual circuit connectivity on diverse physical devices.
Motivation	Maintain connectivity with customer's corporate network.
Alternatives	Doubling the WAN connectivity: a redundant connectivity in SAO01 and a redundant connectivity in SAO04.
Decision	Provide redundant connectivity in SAO01 and use the IBM Cloud backbone for Inter-site communications.
Justifications	The provided service level will be consistent and there is the option to connect the IBM Cloud site using VPN.
Implications	Sao Paulo site to site connectivity to be deployed.
Derived requirements	Deploy GRE and Direct link connectivity for Front-End zones communications.

IBM Cloud Direct Link Dedicated is a single-tenant product as shown in Table 6-5. It offers a dedicated port that is perfect for banks, insurance companies or anyone with strict compliance policies. Create a fiber cross-connection through a network service provider (NSP) in an IBM Cloud network Point of Presence (PoP). Our engineers facilitate end-to-end connectivity with your selected NSP, and you have access to your cloud infrastructure in the local IBM Cloud data center. The NSP runs last-mile links directly between a router on your network and an IBM Cloud router. As with all of the Direct Link products, you can add global routing that enables private network traffic to all IBM Cloud locations. For more information, see IBM Cloud Direct Link provides fast, secure and reliable performance for hybrid workloads.

Note: IBM Cloud Direct Link is available in these offerings:

IBM Cloud Direct Link on Classic:

- Direct Link Connect on Classic.
- Direct Link Dedicated on Classic.
- Direct Link Exchange on Classic.
- Direct Link Dedicate Hosting on Classic.

IBM Direct Link 2.0:

- Direct Link Connect.
- Direct Link Dedicated.

To know which Direct Link solution to order, see Getting started with IBM Cloud Direct Link on Classic and Getting started with IBM Cloud Direct Link (2.0).

Important: The tables show decisions *just as an examples* can vary according the customer, scenario, third-party vendor applications, in-house applications, region, networking, etc. Do not guarantee the journey to the cloud just consider as possible guidelines. A certified Architect for IBM AIX/Linux creates decisions regarding the scenario faced.

6.2.3 Architectural diagram

Figure 6-2 shows a detailed overview for IBM Cloud in Sao Paulo delineating the physical division of different zones.

These zones are confined from each other by the physical switches which is an activity controlled by firewalls. The given infrastructure is a dual site infrastructure:

1. SAO01 is where the IBM AIX/Linux production runs, it comprises in two sub-zones:
   - The first one named Client Front End Account, there you can see Jump Servers and services such as IBM Cloud firewalls and proxy. The two zones communicate by the internal IBM Cloud network backbone.
   - The second one named Power Colo where IBM PowerVS resides.
2. SAO04 is for disaster recovery purposing in case of SAO01 outage.

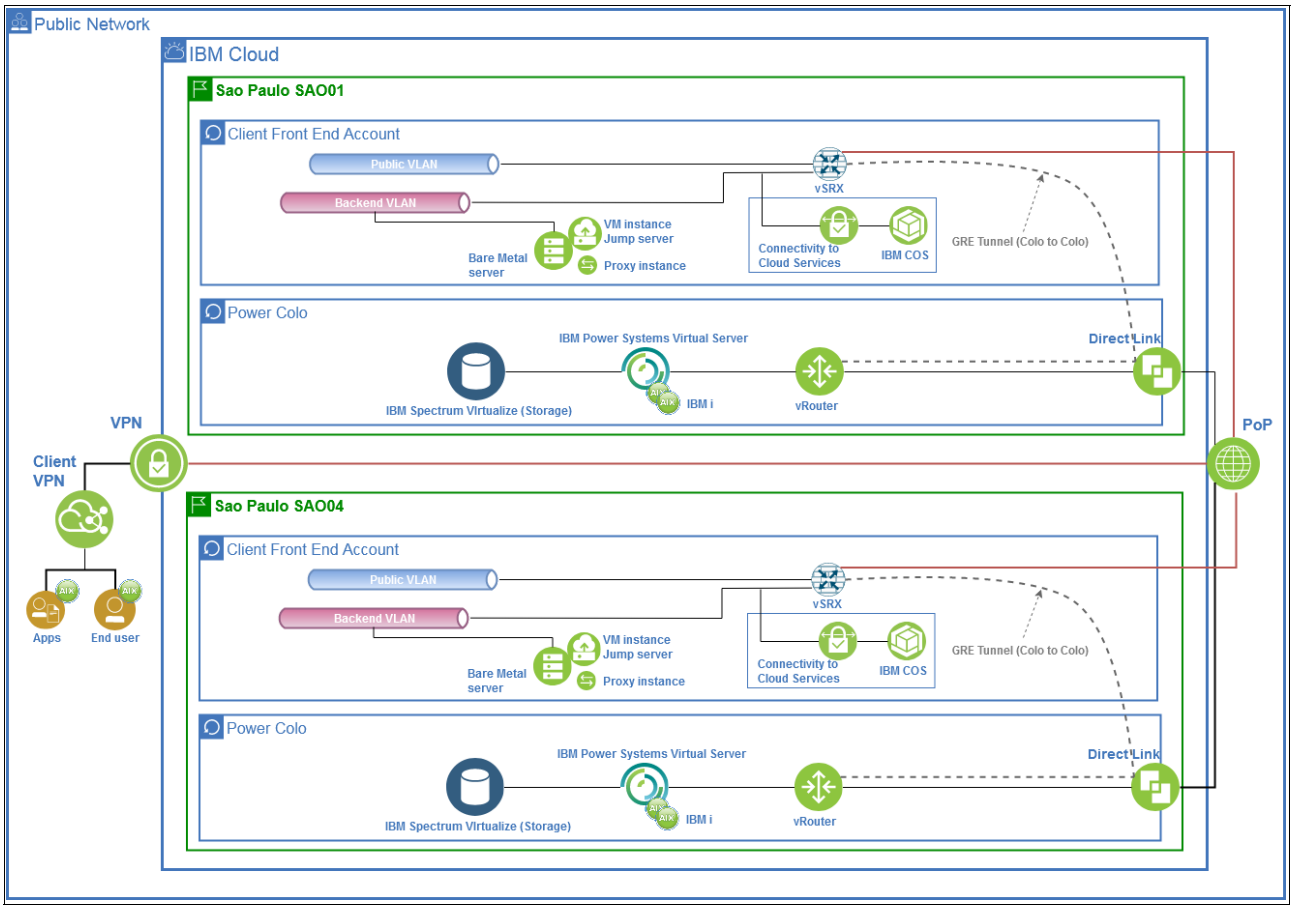


Figure 6-2 Sample - Architectural diagram of IBM AIX/Linux on IBM PowerVS

Note: The Architecture can also consider the following points:

- The System Context Diagram (SCD) that provides the networking environment and the IBM AIX/Linux VMs and servers, in addition identifies the interfaces between entities.
- An Operational Model to describe at a high level of abstraction specifying how the components of the application are organized and connected, where they will be located and hosted, and what business requirements the application will resolve.
- The backup and recovery strategy regarding that the backups will be save in IBM COS if backups are less than 2 TB to be a viable solution the save to IBM COS
- The strategy on how the IBM AIX/Linux data will be replicated across zones in IBM Cloud, using PowerHA for IBM AIX/Linux.
- For more information about Architectural decisions, see Architectural Thinking.

A

Global Replication Services solution using IBM Power Systems Virtual Server

This appendix describes how to build a replication solution using Power Systems Virtual Server including use cases and examples that you can apply in your deployments.

This appendix contains the following sections:

Solution overview

IBM Power Systems clients run mission critical workloads. To ensure business continuity during uncertain conditions, you need a secure, highly available and disaster recovery solution. Planning such an environment is complex and requires large capital expenditures to configure compute, capacity and advance network and storage requirements.

IBM Power Systems Virtual Server cloud now brings a Global Replication Services solution which provide the replication capability to your workloads by maintaining the benchmarks for Recovery Point Objective (RTO) and Recovery Time Objective (RTO) as shown in Figure A-1.

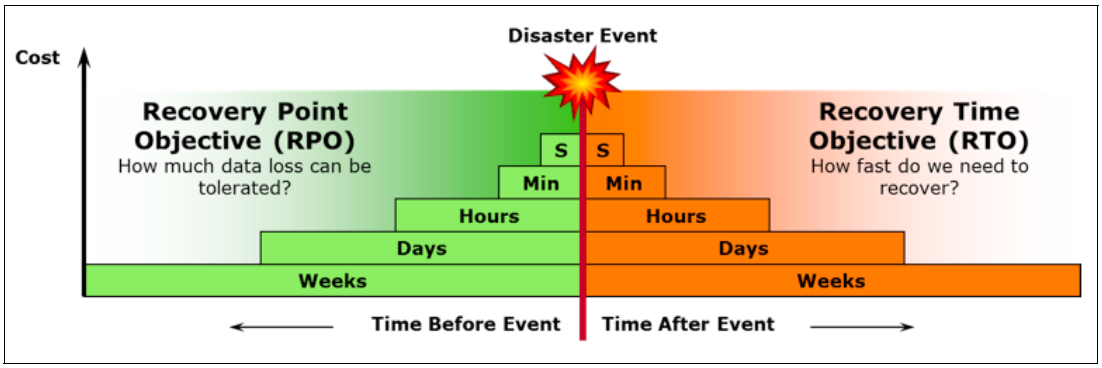


Figure A-1 Recovery time graphics

Global Replication Services (GRS) is based on well-known industry standards IBM Storwize® Global Mirror Change Volume Asynchronous replication technology. IBM PowerVS Global Replication Services solution exposes cloud API/CLI to create and manage replication enabled volumes.

The benefits of GRS on Power Systems Virtual Server include the following:

- Maintain a consistent and recoverable copy of the data at the remote site, created with minimal impact to applications at your local site.
- Efficiently synchronize the local and remote sites with support for failover and failback modes, helping to reduce the time that is required to switch back to the local site after a planned or unplanned outage.
- Replicate more data in less time to remote locations.
- Maintain redundant data centers in distant geographies for rapid recovery from disasters.
- Eliminate costly dedicated networks for replication and avoid bandwidth upgrades.

Feature is currently enabled in two data centers: DAL12 and WDC06 as shown in Figure A-2 on page 155.

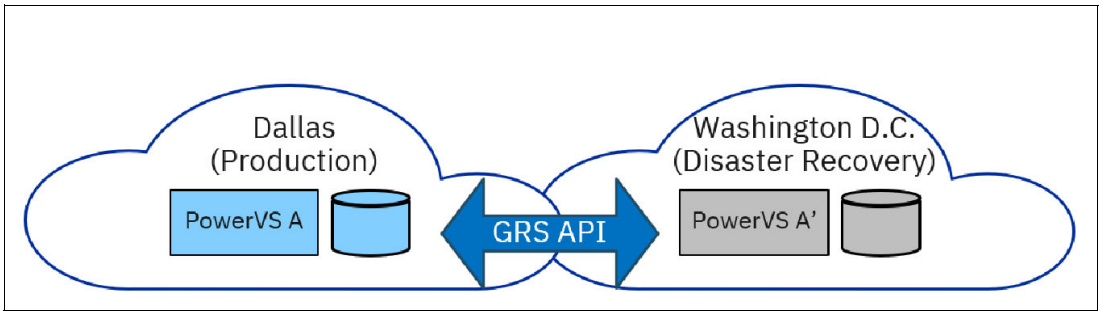


Figure A-2 Data centers diagram

This section focuses on how to use the new GRS API/CLI to build the disaster recovery solution:

- Setting up replication from scratch.
- Setting up replication using existing volumes.

A.1 Setup for Global Replication Services

The data centers for IBM Power Systems Virtual Server are setup to have all the required configuration needed to offer replication capabilities as shown in Figure A-3.

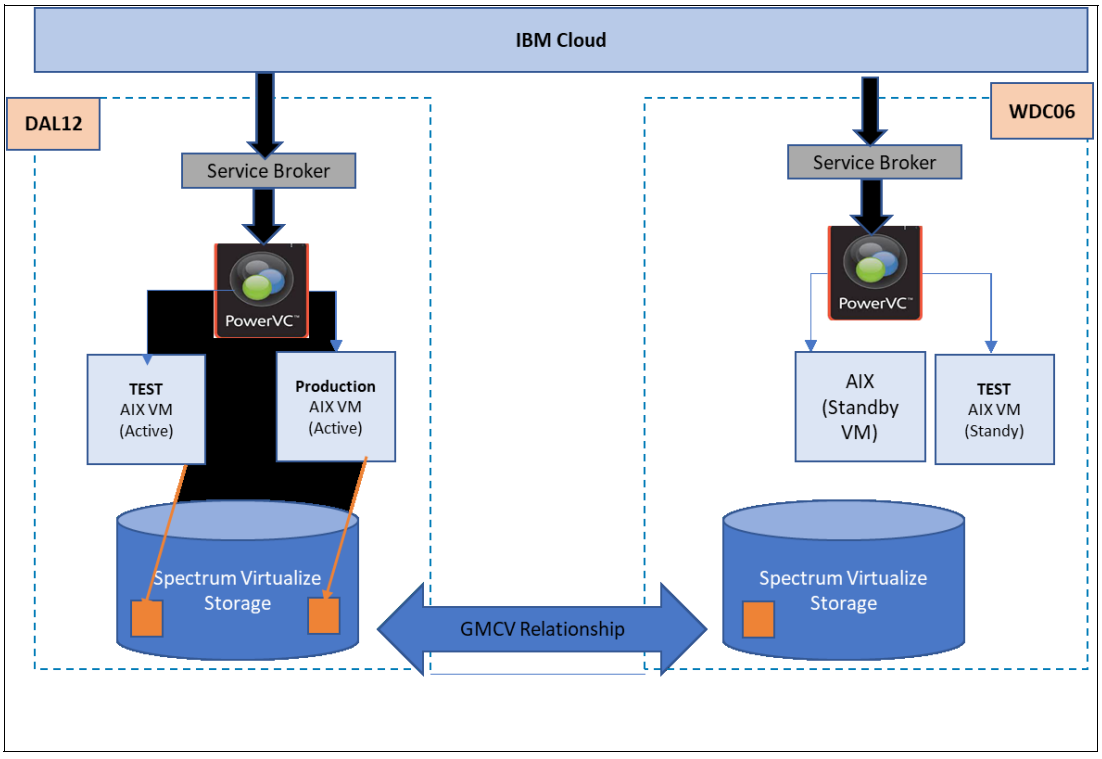


Figure A-3 IBM Cloud solution diagram

Supported storage controllers Tier1/Tier3 will pre-configured to use IBM Storwize Global Mirror Change volume (GMCV) replications. Global Replication Services provide the replication at the storage level by making use of GMCV asynchronous replication technology. In this case the first (initial) sync copies the entire data from master to auxiliary, going forward

only the delta changes are synchronized with the periodic interval of 500 seconds. Which means the maximum RPO will be ~15 min.

On every replicated volumes creation, 4 copies of volumes are created across 2 sites as shown in Figure A-4:

1. Master volume on site1.
2. Master change volume on site1, to store the delta changes.
3. Auxiliary volume on site2.
4. Auxiliary change volume on site2, to update the delta changes.

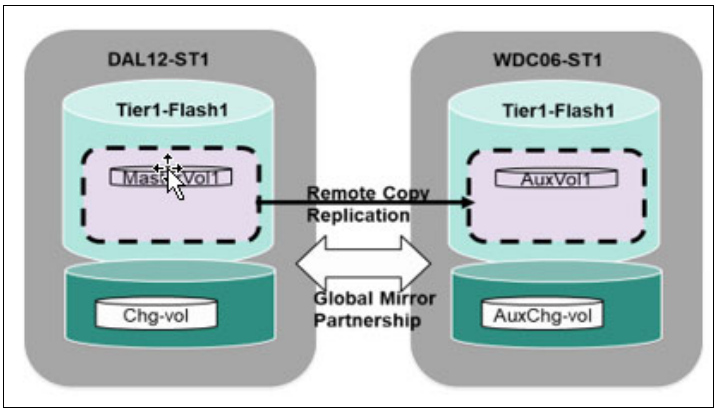


Figure A-4 Volume diagram, remote consistency group

The solution It uses remote copy consistency group to ensure that the data spread across multiple volumes are consistent while it is copied across remote site. Also, it helps to switch the replication direction during the time of planned and un-planned disaster. GRS API/CLI can be used to create and manage replicated volumes and consistency groups.

IBM Power System Virtual Server has DAL12/WDC06 data centers enabled to use Global Replication Services APIs.

Which means if you are using DAL12 as a primary site, you have auxiliary volumes created on WDC06. And if you are using WDC06 as a primary site, you have auxiliary volumes created on DAL12. Site where volumes are created or enabled for replication is the primary site.

After you have the volumes replicated at both primary and secondary, you can use certain “Disaster recovery workflow” on page 157 to start the standby VM using the replicated volumes.

DR location sites

Identify the replication enabled Sites, using the PowerVS disaster recovery location CLI. Figure A-5 on page 157 shows that dal12 and wdc06 are active replication sites.

```
CLI:  ibmcloud pi drl --all-regions --json
```

```
21:04 $ ibmcloud pi drl --all-regions --json
{
    "disasterRecoveryLocations": [
        {
            "location": "dal12",
            "replicationSites": [
                {
                    "isActive": true,
                    "location": "wdc06"
                }
            ]
        },
        {
            "location": "wdc06",
            "replicationSites": [
                {
                    "isActive": true,
                    "location": "dal12"
                }
            ]
        }
    ]
}
```

Figure A-5 Ibmcloud CLI drl list example

Create Power Virtual Service Instances on both replications enabled sites. After you create these service instances, you can list these instances to find the CRNs using the following command on the CLI:

```
CLI: ibmcloud pi service-list
```

Disaster recovery workflow

As an example, consider an AIX VM running an Oracle database application workload on DAL12 data center serving as primary site, and you need to enable global replication for the data volumes to recover the Oracle database. Refer to Figure A-6 on page 158.

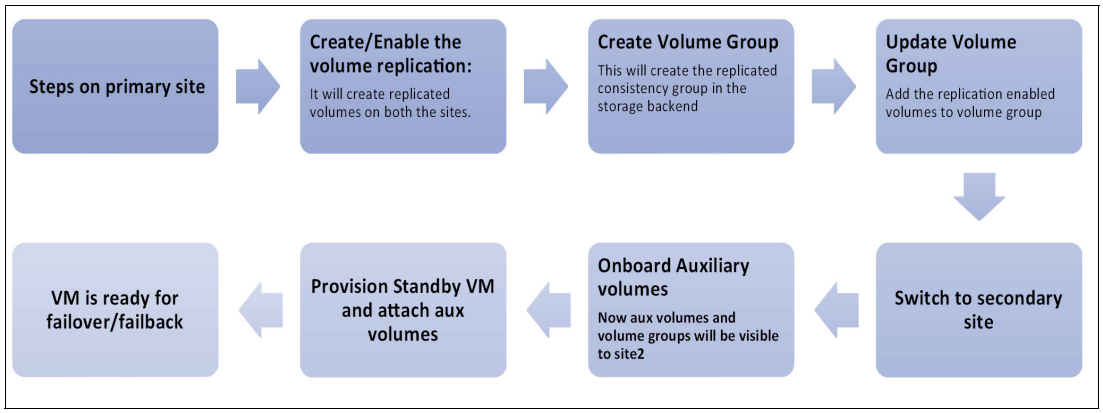


Figure A-6 Disaster Recovery (DR) data center configuration

Figure A-7 shows the steps to enable the replication for your application workload running on the primary site and make it ready to trigger failover and failback.

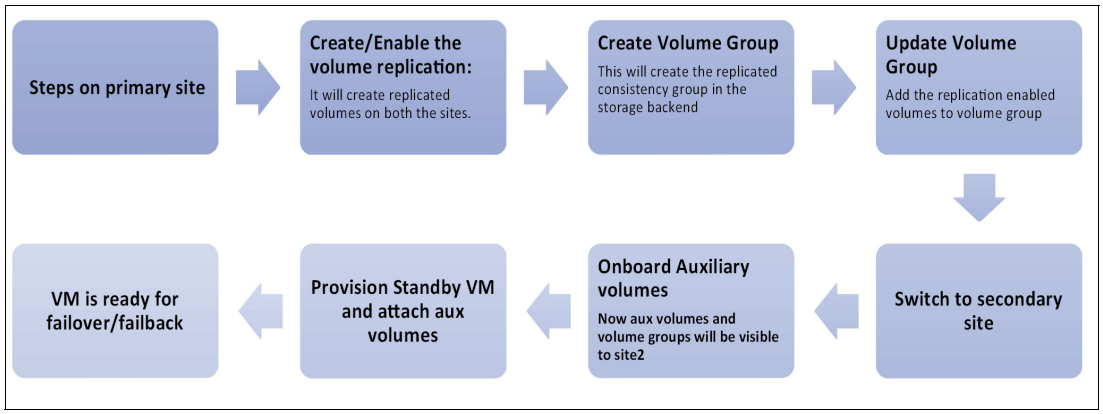


Figure A-7 DR recovery workflow diagram

Create and enable volume replication

The first step is to have replication enabled volumes for the VM which needs to be protected due to a disaster recovery scenario. You can either create a new replication enabled volumes, or you can convert existing volumes to replication enabled. When the volume is replication enabled, it creates an auxiliary mirror volume on remote storage controllers and creates replication relationships.

Figure A-8 on page 159 shows an AIX VM with volumes (vol1, vol2, and vol3), and after enabling replication, it creates aux_vol1, aux_vol2 and aux_vol3 on the secondary storage. These volumes are not visible and managed by the service broker workspace.

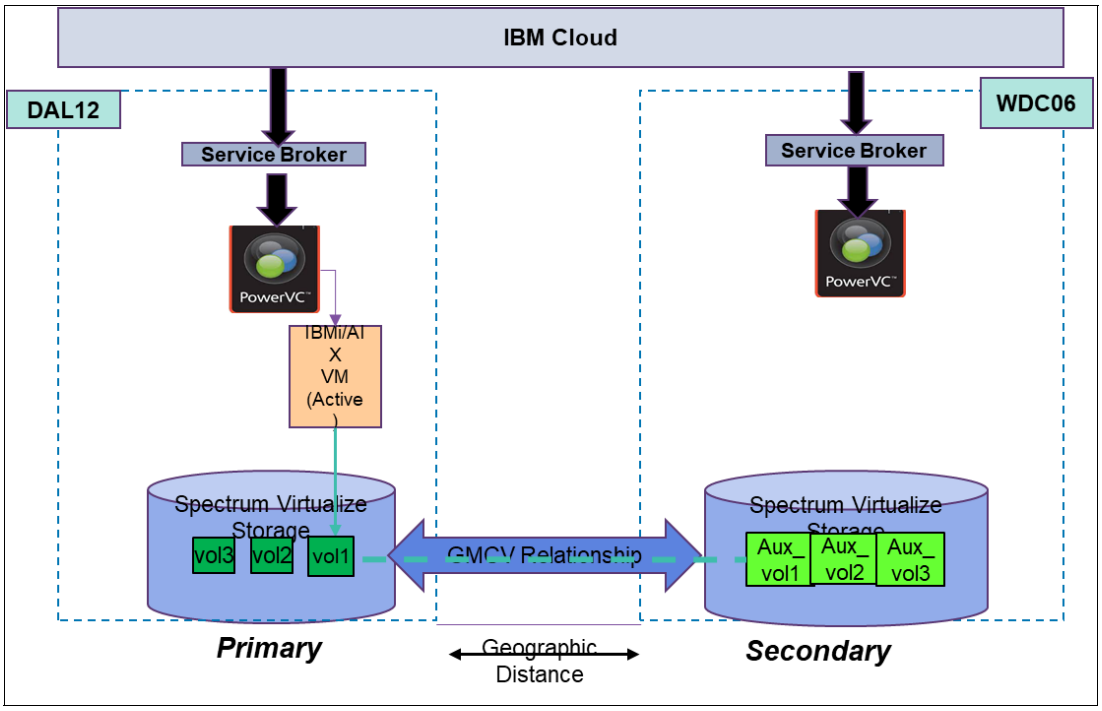


Figure A-8 Replicated volume creation diagram

Create a new replication enabled volume

A new option, replication Enabled, has been added for creating a replication enabled volume as shown in Figure A-9:

```
CLI: ibmcloud pi volc testVol1 --size 1 --replication-enabled –type tier1
```

```
15:08 $ ibmcloud pi volc testVol1 --size 1  --type tier1 --json --replication-enabled
{
    "bootable": false,
    "creationDate": "2022-11-22T09:40:50.610Z",
    "diskType": "tier1",
    "lastUpdateDate": "0001-01-01T00:00:00.000Z",
    "name": "testVol1",
    "pvmInstanceIDs": [],
    "replicationEnabled": true,
    "shareable": false,
    "size": 1,
    "state": "creating",
    "volumeID": "afd07003-a61a-45ca-97d1-4f910272306d",
    "volumePool": "Tier1-Flash-3",
    "volumeType": "Tier1-Flash-3-DR"
}
```

Figure A-9 Ibmcloud create replication enabled Volume

Convert existing volumes to replication enabled volumes

You can convert existing volumes to replication enabled provided the given volume pool supports replication capability as shown in Figure A-10 on page 160:

CLI: ibmcloud pi vola testVol2--replication-enabled=true

```
15:24 $ ibmcloud pi vola testVol2 --replication-enabled
Performing action on volume testVol2 under account Power IaaS Lite - Staging
OK
Action on Volume ID testVol2 successful.
```

Figure A-10 Ibmcloud CLI list replicated volumes

Check replication properties of the volume

Get the volume details and check the replicationEnabled field. If it is true, then volume is replication enabled otherwise it is not as shown in Figure A-11:

`CLI: ibmcloud pi vol testVol1 --json`

```
15:28 $ ibmcloud pi vol testVol1 --json
{
    "auxVolumeName": "aux_volume-testVol1-afd07003-a61a1210664",
    "auxiliary": false,
    "bootable": false,
    "creationDate": "2022-11-22T09:40:50.000Z",
    "diskType": "tier1",
    "lastUpdateDate": "2022-11-22T09:40:56.000Z",
    "masterVolumeName": "volume-testVol1-afd07003-a61a",
    "mirroringState": "consistent_copying",
    "name": "testVol1",
    "primaryRole": "master",
    "pvmInstanceIDs": [],
    "replicationEnabled": true,
    "replicationStatus": "enabled",
    "replicationType": "global",
    "shareable": false,
    "size": 1,
    "state": "available",
    "volumeID": "afd07003-a61a-45ca-97d1-4f910272306d",
    "volumePool": "Tier1-Flash-3",
    "volumeType": "Tier1-Flash-3-DR",
    "wwn": "60050768108081F7D0000000000484B9"
}
```

Figure A-11 Ibmcloud export replicated volumes list to json

- *auxVolumeName, masterVolumeName: Names of auxiliary and master volume created at the storage host level.*
- *auxiliary: Boolean property which tells if the volume referred is master or auxiliary. If false means that this is master volume, else it is the auxiliary volume.*
- *primaryRole: Shows the role of the volume, is primaryRole is master means the volume at the given site is playing the role of master.*
- *replicationStatus: Shows the replication status of the volume. If enabled means volume is enabled for replication and is active.*
- mirroringState: It is the replication relationship state. If consistent_copying means the replication data is in sync.

Create and update the volume group

The next step is to create a volume group and add the replication enabled volumes to the volume group. This creates a remote replication consistency group at both primary and

remote storage backend. This process stores the consistent copy for the volumes. When the volume group is created it assigns the primary role as master. Figure A-12 shows a VolumeGroup which creates an RCCG and adds vol1, vol2 and vol3.

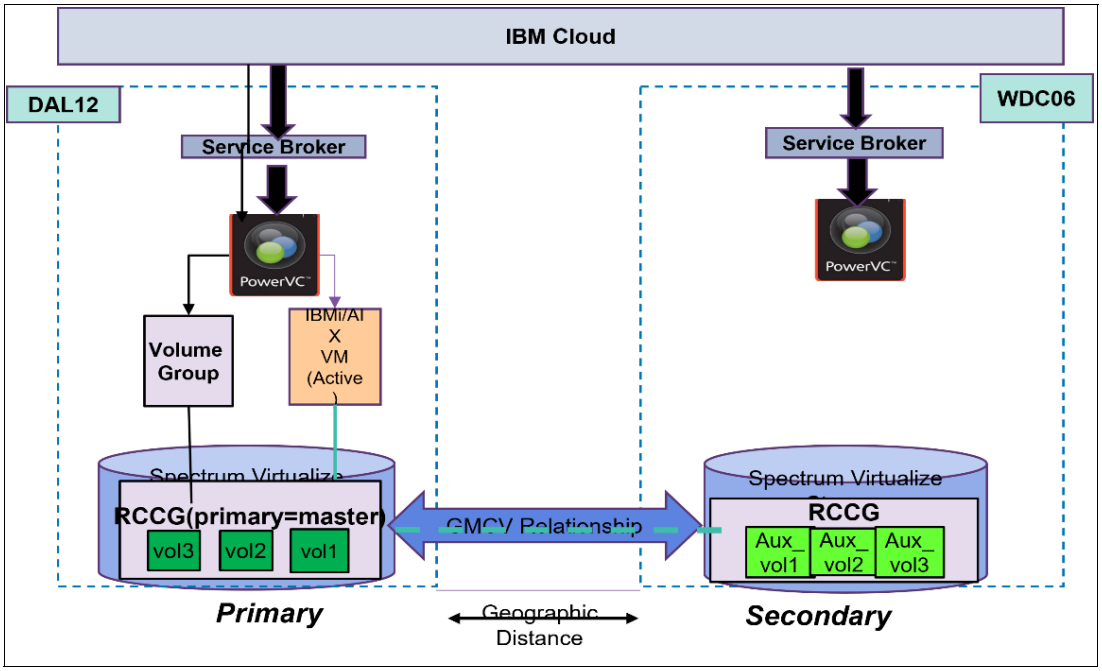


Figure A-12 Create and update a volume group

Create a volume group

Figure A-13 shows the CLI can be used to create a volume-group and add replication enabled volumes. You can only add replication enabled volumes to a volume group. If a non-replication volume is added to a volume group, it fails.

```
13:53 $ ibmcloud pi vgc --volume-group-name testVolGrp --member-volume-ids
afd07003-a61a-45ca-97d1-4f910272306d,7a9f1ca6-acec-4578-a65c-5e45f893a4a2 --json
{
   "id": "5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca",
   "name": "testVolGrp",
   "status": "available"
}
```

Figure A-13 Ibmcloud create volume group from CLI

- member-volume-ids is a space separated list of volume ids which should be part of the volume-group.
- All volumes ids must belong to same storage host(volumepool), otherwise VG creation fails.
- At least one volume is mandatory to create a volume-group.
- A volume can only be part of a single volume-group at a time. If the same volume is added to another volume group, it fails.

Get a volume group properties

You can check the volume group basic properties using the CLI as shown in Figure A-14 on page 162. These values are retrieved from the database so this CLI is used to retrieve the static properties like name and volumeIDs.

```
16:36 $ ibmcloud pi vg 5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca --long --json
{
    "consistencyGroupName": "rccg-5bbe-189ca",
    "id": "5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca",
    "name": "testVolGrp",
    "replicationStatus": "enabled",
    "status": "available",
    "statusDescription": {
        "errors": []
    },
    "volumeIDs": [
        "7a9f1ca6-acec-4578-a65c-5e45f893a4a2",
        "afd07003-a61a-45ca-97d1-4f910272306d"
    ]
}
```

Figure A-14 Ibmcloud CLI get volume properties

- ***consistencyGroupName****: Shows the name of the replication consistency group which is created at the storage level. This field remains the same for a replication consistency group across two sites*.
- ***volumeIDs****: Shows the list of volumeIDs which are part of volume-group.*
- ***statusDescription****: This field is populated if there are any failure while adding the volumes to volume-group.*
- ***status:*** *Shows the volume-group status. Status available means it is active. Possible values are available, error, updating, and creating*.
- ***replicationStatus:*** *Show the replication consistency group, and the replication is enabled.*
- When volume is part of volume group. You can see two new fields group_id and consistencyGroupName in the volume group details.

Figure A-15 on page 163 shows the retrieved properties.

```
13:47 $ ibmcloud pi vol testVol2 --json
{
    "auxVolumeName": "aux_volume-testVol2-7a9f1ca6-acec1210664",
    "auxiliary": false,
    "bootable": false,
    "consistencyGroupName": "rccg-5bbe-189ca",
    "creationDate": "2022-11-22T09:54:28.000Z",
    "diskType": "tier1",
    "groupID": "5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca",
    "lastUpdateDate": "2022-12-01T07:40:17.000Z",
    "masterVolumeName": "volume-testVol2-7a9f1ca6-acec",
    "mirroringState": "consistent_copying",
    "name": "testVol2",
    "primaryRole": "master",
    "pvmInstanceIDs": [
        "f31bf07d-da37-4848-bd4c-b6e64db036cc"
    ],
    "replicationEnabled": true,
    "replicationStatus": "enabled",
    "replicationType": "global",
    "shareable": false,
    "size": 1,
    "state": "in-use",
    "volumeID": "7a9f1ca6-acec-4578-a65c-5e45f893a4a2",
    "volumePool": "Tier1-Flash-3",
    "volumeType": "Tier1-Flash-3-DR",
    "wwn": "60050768108081F7D0000000000484BB"
}
```

Figure A-15 Ibmcloud export volume properties to json

Get volume-group storage details

The get volume group storage details CLI retrieves the live consistency group information from the storage backend. So, if you need the exact consistency group state and role, then use this CLI (refer to Figure A-16):

`CLI : ibmcloud pi vgsd 5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca --json`

```
14:05 $ ibmcloud pi vgsd 5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca  --json
{
    "consistencyGroupName": "rccg-5bbe-189ca",
    "cyclePeriodSeconds": 500,
    "cyclingMode": "multi",
    "numOfvols": 2,
    "primaryRole": "master",
    "remoteCopyRelationshipNames": [
        "rcrel4",
        "rcrel6"
    ],
    "replicationType": "global",
    "state": "consistent_copying"
}
```

Figure A-16 Ibmcloud get volume storage details json formatted

– ***state:*** Shows the live consistency group state. Possible consistency group states are: -consistent_copying, inconsistent_copying, inconsistent_stopped, idling, idling_disconnected, inconsistent_disconnected.

Get volume-group relationship details

To know more granular information for the volume group with respect to remoteRelationships, freezeTime, and copy progress, use the following CLI (refer to Figure A-17):

```
CLI : ibmcloud pi vgrcr 5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca --json
```

```
00:15 $ ibmcloud pi vgrcr 5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca --json
{
    "id": "5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca",
    "remoteCopyRelationships": [
        {
            "auxChangedVolumeName": "chg_aux_volume-testVol2-7a9f1ca6-acec1210664",
            "auxVolumeName": "aux_volume-testVol2-7a9f1ca6-acec1210664",
            "consistencyGroupName": "rccg-5bbe-189ca",
            "copyType": "global",
            "cyclingMode": "multi",
            "freezeTime": "2022-12-02T18:34:18.000Z",
            "masterChangedVolumeName": "chg_volume-testVol2-7a9f1ca6-acec",
            "masterVolumeName": "volume-testVol2-7a9f1ca6-acec",
            "name": "rcrel4",
            "primaryRole": "master",
            "progress": 100,
            "remoteCopyID": "36",
            "state": "consistent_copying"
        },
        {
            "auxChangedVolumeName": "chg_aux_volume-testVol1-afd07003-a61a1210664",
            "auxVolumeName": "aux_volume-testVol1-afd07003-a61a1210664",
            "consistencyGroupName": "rccg-5bbe-189ca",
            "copyType": "global",
            "cyclingMode": "multi",
            "freezeTime": "2022-12-02T18:34:18.000Z",
            "masterChangedVolumeName": "chg_volume-testVol1-afd07003-a61a",
            "masterVolumeName": "volume-testVol1-afd07003-a61a",
            "name": "rcrel6",
            "primaryRole": "master",
            "progress": 100,
            "remoteCopyID": "70",
            "state": "consistent_copying"
        }
    ]
}
```

Figure A-17 Get volume relationship details

– ***remoteCopyrelationships:*** *Shows the relationship details for each replicated volume which are part of volume group.*

– ***freezeTime:*** *Indicates the time YY/MM/DD/HH/MM format when the last sync happened. This parameter is used to monitor the RPO.*

– ***progress:*** *Shows the relationship progress.*

After you have the volume group created and it is in consistent copying state, which means your volume data is copied to the secondary site and is ready for replication.

Switch to the secondary site (WDC06)

Now you must move to the secondary site to perform the remaining steps. Set the service target of the CLI environment to wdc06 Power System Virtual Server instances as follows:

```
CLI: ibmcloud pi st crn:v1:bluemix:public:power-iaas:wdc06:a/
2bb3df23c0d14ebe921397bd8aa2555a:56ee5081-f4cf-4d19-8bd6-4fdaa60c9999::
```

Onboard auxiliary volumes

Although auxiliary volumes are in the storage host of the secondary site, still these volumes are not managed by the current Power Systems Virtual Server workspace. You need to onboard the auxiliary volume so it can be managed and accessed by the cloud user. The onboard operation requires a source CRN to validate if the remote user has required permissions to access the auxiliary volumes based on the owner of the paired primary volumes and can onboard the auxiliary volumes. If the user does not have valid permissions, the onboard operation fails with an authentication error. Refer to Figure A-18.

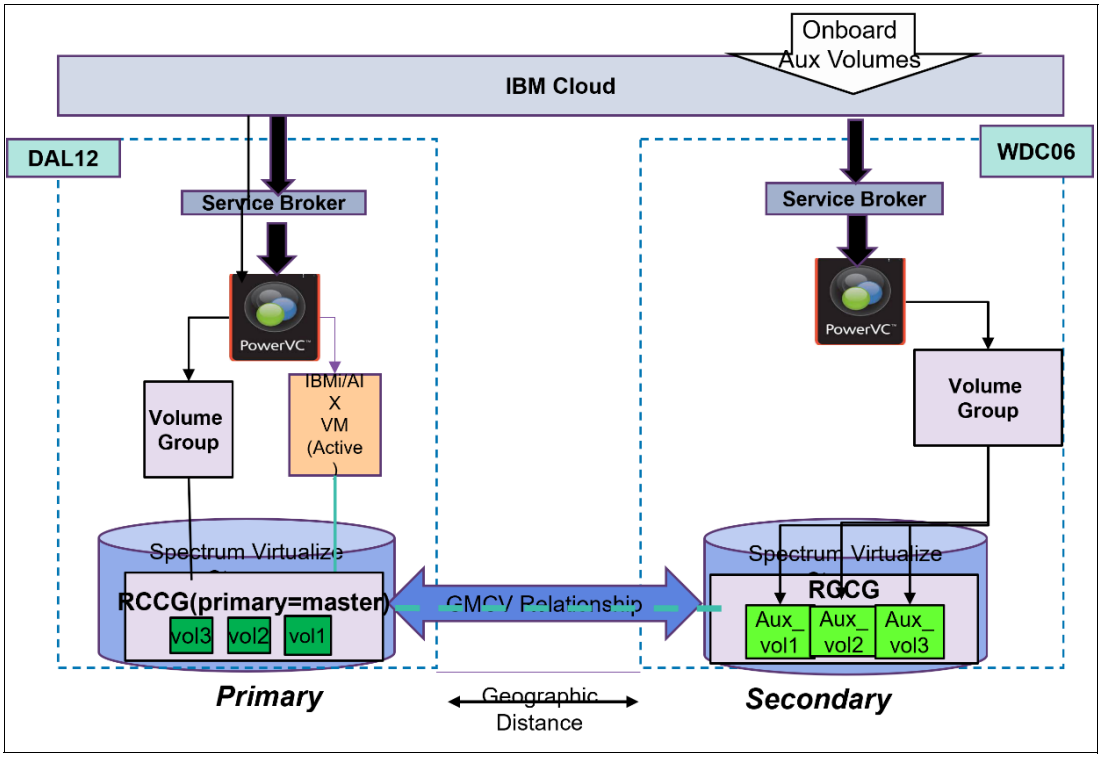


Figure A-18 Onboard auxiliary volumes

As a part of the onboard auxiliary volume operation, the required volume IDs are created to manage the existing auxiliary volumes. If the auxiliary volumes are part of the consistency group, the onboard operation also creates the volume-group IDs to manage the existing consistency group.

Onboard auxiliary volume with the CLI

You can use the following command in the command line interface (CLI) to trigger the onboard operation. It returns the onboard UUID, which can be used to monitor the progress of the onboarding task progress running in the background.

The following command creates an onboarding job testOnboarding to onboard two auxiliary volumes for the given source-crn (refer to Figure A-19 on page 166):

```
CLI : ibmcloud pi voloc --source-crn crn:v1: bluemix:public:power-iaas:dal10:
2bb3df23c0d14ebe921397bd8aa2555a:56ee5081-f4cf-4d19-8bd6-4fdaa60c8888::
--description testOnboarding  --auxiliary-volume
"aux_volume-testVol1-afd07003-a61a1210664 recoveryVol1" --auxiliary-volume "
aux_volume-testVol2-7a9f1ca6-acec1210664 recoveryVol2"
```

```
Creating volume onboarding under account Power IaaS Lite

ID            fd501768-4100-4127-b2b6-af9c0f099186
Description   testOnboarding
```

Figure A-19 Ibmcloud onboard volume

Check onboard progress

The onboard operation returns the onboarding UUID which can be used to check the status of the onboarding operation. The onboarding operation is an asynchronous operation that can take some time which depends upon the number of volumes.

Figure A-20 shows the command to check the status of the onboard operation.

```
12:49 $ ibmcloud pi volo fd501768-4100-4127-b2b6-af9c0f099186 --jso
{
    "description": "testOnboarding",
    "id": "fd501768-4100-4127-b2b6-af9c0f099186",
    "inputVolumes": [
        "aux_volume-testVol1-afd07003-a61a1210664",
        "aux_volume-testVol2-7a9f1ca6-acec1210664"
    ],
    "status": "SUCCESS",
    "creationTimestamp": "2022-11-24T06:39:47.000Z",
    "progress": 100,
    "results": {
        "onboardedVolumes": [
            "aux_volume-testVol2-7a9f1ca6-acec1210664",
            "aux_volume-testVol1-afd07003-a61a1210664"
        ],
        "volumeOnboardingFailures": []
    }
}
```

Figure A-20 Ibmcloud check onboard status

- **Status:** Show the status for onboard. SUCCESS/FAILURE.
- **Results:** Returns the onboarded auxiliary volumes.

On completion of the onboard operation, you can check the auxiliary volumes using the volume list or you can retrieve the volume details using the volume name. Volume IDs and group ID for the master-aux volume pair are different on the primary and the secondary sites. However, you can check other fields such as *masterVolumeName*, *auxVolumeName*, and *consistencyGroupName*.

Figure A-21 on page 167 and Figure A-22 on page 167 shows the volume and the volume-group details created after the onboard operation.

```
[06:47 $ ibmcloud pi vol 920b667f-5c7a-4001-ba43-fe9a3ae602b9 --json
{
    "auxVolumeName": "aux_volume-testVol2-7a9f1ca6-acec1210664",
    "auxiliary": true,
    "bootable": false,
    "consistencyGroupName": "rccg-5bbe-189ca",
    "creationDate": "2022-11-24T06:40:22.000Z",
    "diskType": "tier1",
    "groupID": "96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3",
    "lastUpdateDate": "2022-11-29T01:14:22.000Z",
    "masterVolumeName": "volume-testVol2-7a9f1ca6-acec",
    "mirroringState": "consistent_copying",
    "name": "recoveryVol2",
    "primaryRole": "master",
    "pvmInstanceIDs": [],
    "replicationEnabled": true,
    "replicationStatus": "disabled",
    "replicationType": "global",
    "shareable": false,
    "size": 1,
    "state": "available",
    "volumeID": "920b667f-5c7a-4001-ba43-fe9a3ae602b9",
    "volumePool": "Tier1-Flash-1",
    "volumeType": "Tier1-Flash-1-DR",
    "wwn": "600507640081028970000000000029E04"
}
```

Figure A-21 Ibmcloud list volume information

```
[06:12 $ ibmcloud pi vg 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3 --long --json
{
    "consistencyGroupName": "rccg-5bbe-189ca",
    "id": "96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3",
    "name": "rccg-5bbe-189ca",
    "replicationStatus": "enabled",
    "status": "available",
    "statusDescription": {
        "errors": []
    },
    "volumeIDs": [
        "920b667f-5c7a-4001-ba43-fe9a3ae602b9",
        "ba147c20-578a-4ae1-8a94-252b6bbcd9cb"
    ]
}
```

Figure A-22 Ibmcloud list volume information json format

Deploy the standby VM on the secondary site

After onboarding the auxiliary volumes and volume group on the secondary site, provision a standby VM on the secondary site and attach the auxiliary volumes as shown in Figure A-23 on page 168. Keep the VM off and only use it in case of a disaster. The auxiliary volumes are read/write protected. Note that at this time only a primary site can perform I/O on it. When the primary site is down, the consistency group is stopped by allowing read permission, then only read/write operations are allowed on the auxiliary volumes.

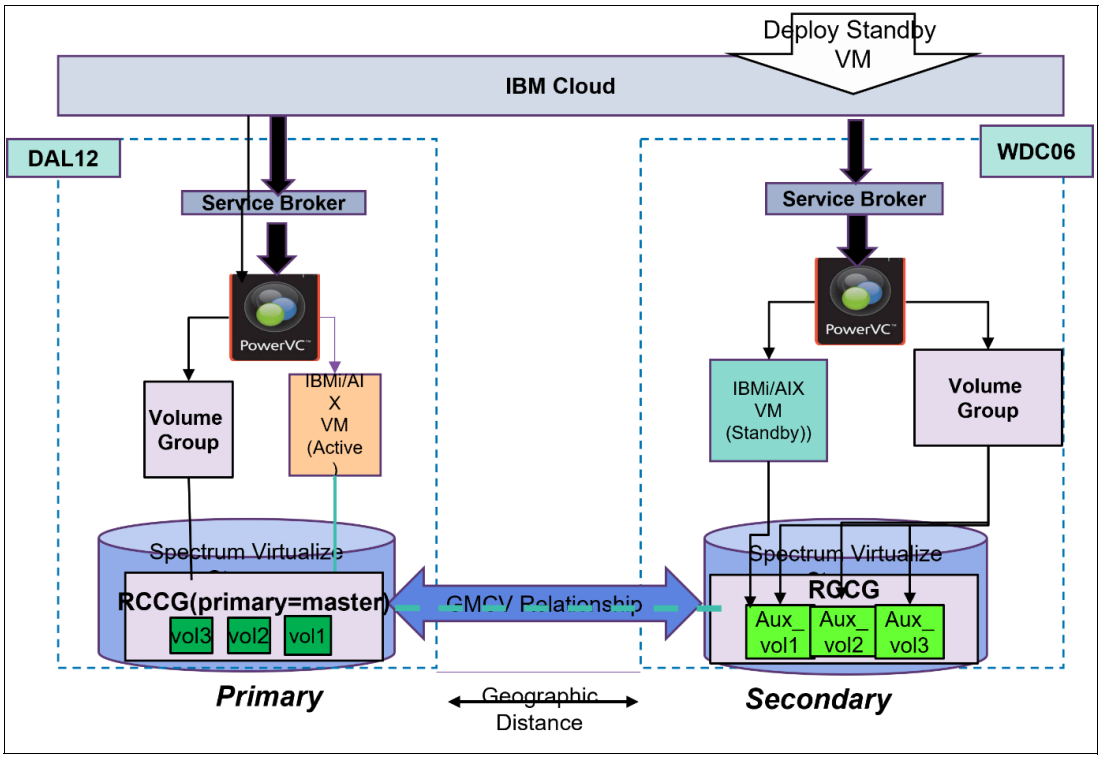


Figure A-23 Deploy machine on remote site

You can use the existing commands to provision and attach volumes. Refer to the following documentation:

https://cloud.ibm.com/docs/power-iaas-cli-plugin?topic=power-iaas-cli-plugin-power-iaas-cli-reference#ibmcloud-pi-instance-create
https://cloud.ibm.com/docs/power-iaas-cli-plugin?topic=power-iaas-cli-plugin-power-iaas-cli-reference#ibmcloud-pi-volume-attach

Failover and failback

In case of disaster (primary site failure, or storage failure) as shown in Figure A-24 on page 169, you lose access to the storage volumes, and these are marked with an *ERROR*. The replication relationship is disconnected, and the consistency group is move to *consistent-disconnected*. The volume group primary role is assigned as blank.

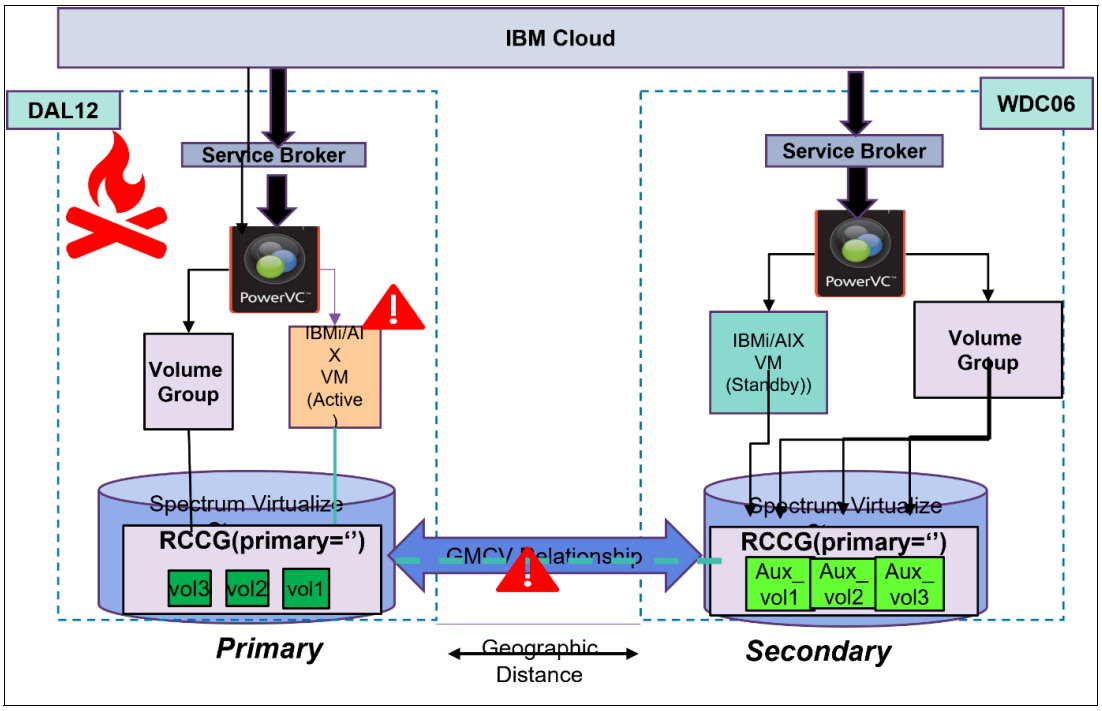


Figure A-24 Failover and failback diagram

In this situation no new replication operations are allowed, as replication is broken. You can only access existing workloads by powering on the standby VM and auxiliary replication volumes from the secondary site after giving then read access:

- Access auxiliary volumes on primary site failure.
- Failover or switch volume group role to secondary
- Failback to primary site.

Access auxiliary volumes on site failure

To allow read/write I/O on auxiliary volumes in case of a primary site failure, stop the volume group with the command **`--allow-read-access`** as shown in Figure A-25

```
[06:56 $ ibmcloud pi vgsp 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3  --allow-read-access=true
Performing stop action on volume group 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3 under account
OK
Stop request on volume group 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3 has been accepted.
```

Figure A-25 Ibmcloud CLI failover and failback

After stopping the volume group, RCCG moves into *Idling* state and the replication status is disabled as shown in Figure A-26 on page 170.

```
06:56 $ ibmcloud pi vgsd 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3 --json


{
    "consistencyGroupName": "rccg-5bbe-189ca",
    "cyclePeriodSeconds": 500,
    "cyclingMode": "multi",
    "numOfvols": 2,
    "remoteCopyRelationshipNames": [
        "rcrel4",
        "rcrel6"
    ],
    "replicationType": "global",
    "state": "idling",
    "sync": "out_of_sync"
}
```

Figure A-26 Ibmcloud failover and failback json output

Now you can power-on the standby VM and run the required instructions to access your application configured on the auxiliary volumes.

Failover or switch volume group role to auxiliary

When the primary site is recovered, the consistency group can be started to restart the replication. You can start the volume group to switch the role to auxiliary to change the replication direction from secondary to primary. This allows the auxiliary volume delta changes to be copied to the master volumes to be synchronized. Refer to Figure A-27.

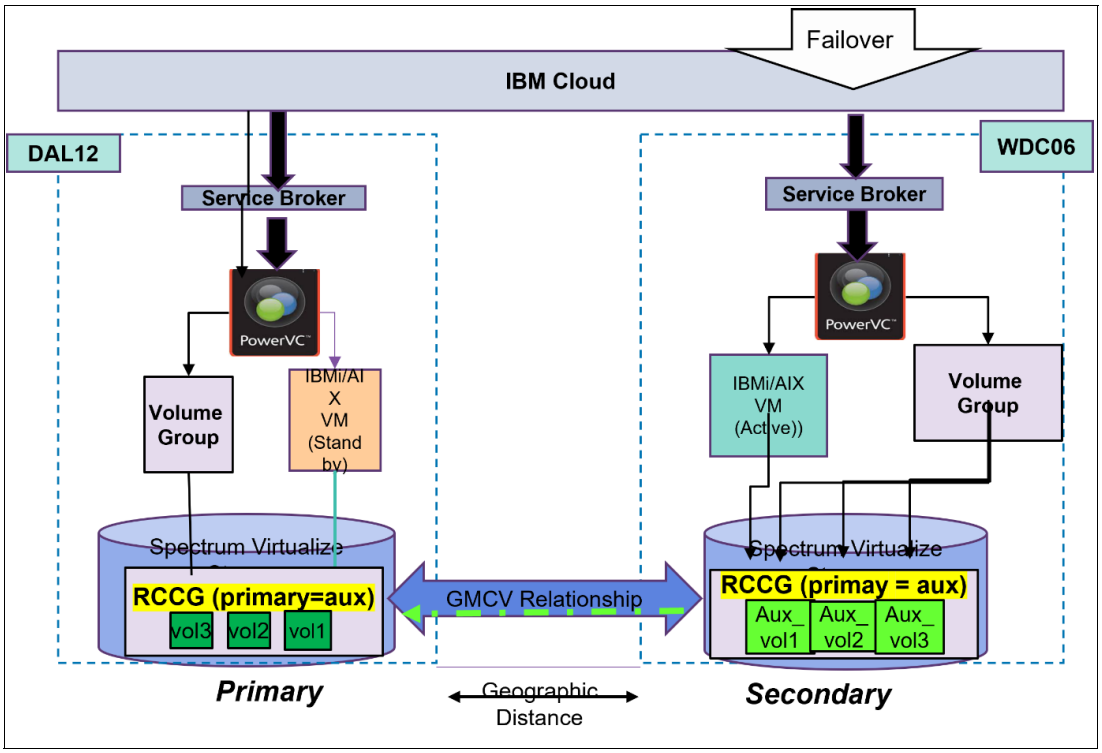


Figure A-27 Failover diagram

Figure A-28 on page 171 shows the command which can be used to start the volume group and Figure A-29 on page 171 shows the switched role to auxiliary.

```
07:03 $ ibmcloud pi vgst 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3  --source auxiliary
Performing start action on volume group 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3 under account


OK
Start request on volume group 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3 has been accepted.
```

Figure A-28 Ibmcloud CLI start volume

```
07:04 $ ibmcloud pi vgsd 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3 --json


{
    "consistencyGroupName": "rccg-5bbe-189ca",
    "cyclePeriodSeconds": 500,
    "cyclingMode": "multi",
    "numOfvols": 2,
    "primaryRole": "aux",
    "remoteCopyRelationshipNames": [
        "rcrel4",
        "rcrel6"
    ],
    "replicationType": "global",
    "state": "consistent_copying"
}
```

Figure A-29 ibmcloud role switched

Failback to primary site

To switch back the volume group to the primary site, use the same volume group start command without –source option. Refer to Figure A-28.

A.2 Disabling the replication

Disabling the replication means deleting the auxiliary volume from the remote site. Before disabling the replication, check that the replication is not associated with any group. Since there are two sites, follow the procedure for disabling the replication illustrated in the next section.

Remove the volumes from volume-group from the primary site

If the volume is a part of any volume-group then remove the volume from its associated volume-group with the following command (Figure A-30):

```
CLI: ibmcloud pi vgu  5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca
--remove-member-volume-ids afd07003-a61a-45ca-97d1-4f910272306d
```

```
00:16 $ ibmcloud pi vgu  5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca
--remove-member-volume-ids afd07003-a61a-45ca-97d1-4f910272306d
Updating volume group 5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca under account
OK
Volume group 5bbe734a-7ec6-4f0a-a34e-8bd45fc189ca update request was accepted.
```

Figure A-30 Ibmcloud remove volume group from primary site

Disable the replication of a volume

When you disable the volume replication, this removes the replication relationship and delete the auxiliary volume from the storage backend. Use the following command (Figure A-31):

```
CLI: ibmcloud pi vola  afd07003-a61a-45ca-97d1-4f910272306d
–replication_enabled=False
```

```
$ ibmcloud pi vola afd07003-a61a-45ca-97d1-4f910272306d --replication-enabled=False
Performing action on volume afd07003-a61a-45ca-97d1-4f910272306d under account Power
OK
Action on Volume ID afd07003-a61a-45ca-97d1-4f910272306d successful.
```

Figure A-31 Ibmcloud disable the replication of a volume

This is an asynchronous process, hence check the volume-details to make sure that volume replication is disabled as shown in Figure A-32.

```
$ ibmcloud pi vol afd07003-a61a-45ca-97d1-4f910272306d --json
{
    "bootable": false,
    "creationDate": "2022-11-22T09:40:50.000Z",
    "diskType": "tier1",
    "lastUpdateDate": "2022-12-02T19:43:08.000Z",
    "name": "testVol1",
    "pvmInstanceIDs": [],
    "replicationEnabled":false
    "shareable": false,
    "size": 1,
    "state": "available",
    "volumeID": "afd07003-a61a-45ca-97d1-4f910272306d",
    "volumePool": "Tier1-Flash-3",
    "volumeType": "Tier1-Flash-3",
    "wwn": "60050768108081F7D000000000484B9"
}
```

Figure A-32 Check replication disable

Remove the volumes from volume-group from Secondary Site

Update the volume-group of the secondary site to remove the volumes from it:

```
CLI: ibmcloud pi vgu 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3
--remove-member-volume-ids ba147c20-578a-4ae1-8a94-252b6bbcd9cb
```

If the volume-group is empty, then you can delete the volume-group:

```
CLI: ibmcloud pi vgd 96e037e3-9efd-4d6d-90cf-d1f6cc76d6c3
```

Delete the auxiliary volume from secondary site

Finally delete the auxiliary volume reference from the secondary site with the following command:

```
CLI: ibmcloud pi vold  afd07003-a61a-45ca-97d1-4f910272306d
```

If the auxiliary volume is not deleted from secondary site, then this volume moves to an ERROR state as a part of out-of-band periodic check interval of 24 hours, as these volumes no longer exists in the storage backend.

Billing and charging

You are charged from the location where you create a replication-enabled volume. There are no charges for the auxiliary volume from the remote site.

The volume of size X GB is charged based on following two components:

- The master volume is charged 2x size based on its Tier under the existing part numbers for Tier 1 and Tier 3.
- Replication capability cost is charged $Y/GB under a new part number GLOBAL_REPLICATION_STORAGE_GIGABYTE_HOURS that is independent of volume tier.

Upon a site failure due to a catastrophe, metering is not available from the failed site. The auxiliary volumes are charged from remote site for its 2x size based on its tier. There is no replication capability cost for any replication-enabled volume.

Troubleshooting

This section provides some problem determinations procedures.

Can I start and stop a volume-group in any site?

Yes, you can start and stop it from any site. But it is recommended to use the primary site for all the volume operations and perform operations on the auxiliary volume on the secondary site only during failover.

Volume-group replication status is not in sync across two sites

Check the storage-details of the volume-group to check the actual replication status of volume-group, not the volume-group details.

The start and stop operation on the volume-group updates the replication status of the volume-group on the site from where the start and the stop operations are performed but it does not update the replication status of the corresponding volume-group on the other site.

How to check the failures if an update on the volume-group fails?

Updates on the volume-group are a asynchronous operations. You have to check the volume-group details to check its results. If there is any error during the update operation then the *statusDescription(errors)* field provides the error details from the last failed operation.

Update on volume-group is not working as its status is in error state

You can perform a reset operation on the volume-group. This action does not make any change in the replication status but sets its status to *available* so that updates can be performed on the volume-group.

This action does not clear the *errors* field from the volume-group. The next successful update operation resets this field.

How to check who is playing the primary role for a volume-group?

Retrieve the storage-details of a volume-group and check the *primaryRole* field. A *master* value indicates that master volumes are playing the primary role.

What If I forget to onboard a few volumes of a volume-group?

You can create one more onboarding operation with the required volume list. Onboarding operation onboards new volumes with an existing volume-group.

Can I add more volumes to a volume-group after the onboarding operation?

Yes, you can. Add volumes to the volume-group on the primary site and then onboard the volumes on the secondary site.

What if I delete the volume from one site, but not from the other site?

The replicated volume that is managed on its corresponding remote site moves to an error state in an interval of 24 hours. Any operation on this replicated volume fails except a delete operation and sets the volume in error state.

You must delete the volumes from the primary site. Otherwise master volumes are charged when you delete the auxiliary volume but fail to delete the master volume.

References

- IBM Power System Virtual Servers API Reference

https://cloud.ibm.com/apidocs/power-cloud

- IBM Power System Virtual Servers CLI Reference

https://cloud.ibm.com/docs/power-iaas-cli-plugin?topic=power-iaas-cli-plugin-power-iaas-cli-reference

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

IBM Redbooks

The following IBM Redbooks publications provide additional information about the topic in this document. Note that some publications referenced in this list might be available in softcopy only.

- *IBM Power Systems Virtual Server Guide for IBM i*, SG24-8513

You can search for, view, download or order these documents and other Redbooks, Redpapers, Web Docs, draft and additional materials, at the following website:

ibm.com/redbooks

Online resources

These websites are also relevant as further information sources:

- Global Replication Service Solution Using IBM Power Virtual Server

  https://www.ibm.com/cloud/blog/a-global-replication-service-solution-using-ibm-power-virtual-server
- IBM Support portal

  https://www.ibm.com/support/home/
- Power Systems Virtual Server FAQ

  https://cloud.ibm.com/docs/power-iaas?topic=power-iaas-power-iaas-faqs
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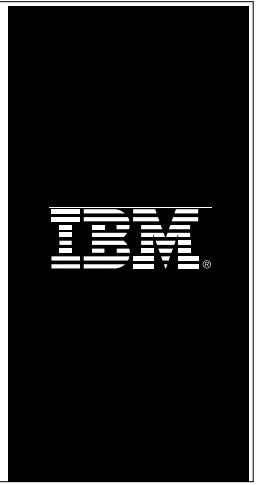

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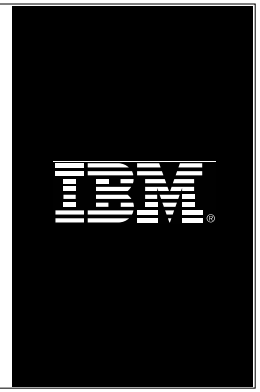

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