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IBM Spectrum Virtualize for Public Cloud on AWS Implementation Guide

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IBM Spectrum Virtualize for Public Cloud on AWS Implementation Guide

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

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Preface

IBM® Spectrum Virtualize is a key member of the IBM Spectrum™ Storage portfolio. It is a highly flexible storage solution that enables rapid deployment of block storage services for new and traditional workloads, whether on-premises, off-premises, or a combination of both.

The initial release of IBM Spectrum Virtualize™ for Public Cloud is now available on Amazon Web Services (AWS). This IBM Redpaper™ publication gives a broad understanding of the IBM Spectrum Virtualize for Public Cloud on AWS architecture, and provides planning and implementation details of the common use cases for this new product.

This publication helps storage and networking administrators plan, implement, install, modify, and configure the IBM Spectrum Virtualize for Public Cloud on AWS offering. It also provides a detailed description of troubleshooting tips.

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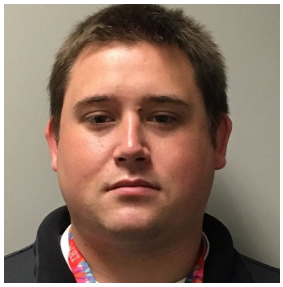

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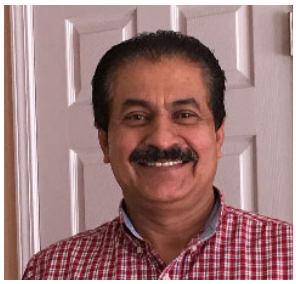

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1

Introduction

This chapter describes the IBM Spectrum Virtualize product that is implemented in a cloud environment, which is referred to as IBM Spectrum Virtualize for Public Cloud. A brief overview of the technology that is behind the product introduces the drivers and business values of using IBM Spectrum Virtualize in the context of public cloud services. It also describes how the solution works from a high-level perspective.

This publication describes IBM Spectrum Virtualize for Public Cloud V8.3.

In this chapter, the following topics are described:

- Introduction to IBM Spectrum Virtualize for Public Cloud
- IBM Spectrum Virtualize for Public Cloud
- IBM Spectrum Virtualize for Public Cloud on AWS

1.1 Introduction to IBM Spectrum Virtualize for Public Cloud

Companies are currently undergoing a digital transformation, and making architecture decisions that determine how their businesses are going to operate in the next couple of years. They recognize the value of delivering services by using the cloud, and many of them are already using public clouds to some degree. The role of the cloud is maturing and it is more often being considered as a platform for innovation and business value. The cloud is a key enabler to drive transformation and innovation for IT agility and new capabilities.

Nevertheless, one of the challenges for these organizations is how to integrate those public cloud capabilities with the existing back- nd. Organizations want to retain flexibility without introducing new complexity or requiring significant new capital investment.

Cloud integration can occur between different endpoints (cloud-to-cloud, on-premises to off-premises, or cloud to non-cloud) and at different levels within the cloud stack: infrastructure layer, service layer and, for example, at the application layer or at the management one. Within the infrastructure as a service (IaaS) domain, storage layer integration is often the most attractive approach for ease of migration and replication of heterogeneous resources and data consistency.

In this sense, coming from the IBM Spectrum Storage™ family, IBM Spectrum Virtualize for Public Cloud supports clients in their IT architectural transformation and migration towards the cloud service model, enabling hybrid cloud strategies or, for a cloud-native workload, providing the benefits of familiar and sophisticated storage functions on public cloud data centers, enhancing the existing cloud offering.

Running on-premises, IBM Spectrum Virtualize software supports capacity that is built into storage systems, and capacity in over 400 different storage systems from IBM and other vendors. This wide range of storage support means that the solution can be used with practically any storage in a data center today and integrated with its counterpart IBM Spectrum Virtualize for Public Cloud, which supports Amazon Web Services (AWS) Elastic Block Store (EBS) and its various options, which are detailed in Chapter 3, “Architecture of the solution” on page 23 and Chapter 4, “Planning and preparation for the IBM Spectrum Virtualize for Public Cloud on AWS deployment” on page 37.

Note on the Storwize rebranding: On 02/11/2020 IBM rebranded IBM Storwize storage systems as IBM FlashSystem, so for example IBM Storwize V5030 is now called IBM FlashSystem 5030. This book been updated to use the new terminology., but you might still see the “Storwize” name in some of the links.

1.2 IBM Spectrum Virtualize for Public Cloud

Designed for SDS environments, IBM Spectrum Virtualize for Public Cloud represents a solution for public cloud implementations, and includes technologies that both complement and enhance public cloud offering capabilities.

For example, traditional practices that provide data replication simply by copying storage at one facility to largely identical storage at another facility are not an option for public cloud. Also, using conventional software to replicate data imposes unnecessary loads on application servers. More detailed use cases are analyzed in Chapter 2, “Typical use cases for IBM Spectrum Virtualize for Public Cloud” on page 9.

IBM Spectrum Virtualize for Public Cloud delivers a powerful solution for the deployment of IBM Spectrum Virtualize software in public clouds. This new capability provides a monthly license to deploy and use IBM Spectrum Virtualize for Public Cloud on AWS to enable hybrid cloud solutions, which offer the ability to transfer data between on-premises data centers by using any IBM Spectrum Virtualize -based appliance and multiple cloud environments.

With a deployment that is designed for the cloud, IBM Spectrum Virtualize for Public Cloud can be deployed in cloud data centers around the world where, after provisioning the infrastructure, an installation script automatically installs the software.

1.2.1 Primers of storage virtualization and software-defined storage

The term *virtualization* is used widely in IT and applied to many of the associated technologies. Its usage in storage products and solutions is no exception. IBM defines storage virtualization in the following manner:

- Storage virtualization is a technology that makes one set of resources resemble another set of resources, preferably with more wanted characteristics.
- It is a logical representation of resources that is not constrained by physical limitations and hides part of the complexity. It also adds or integrates new functions with existing services and can be nested or applied to multiple layers of a system.

The aggregation of volumes into storage pools enables you to better manage capacity, performance, and multiple tiers for the workloads. IBM Spectrum Virtualize for Public Cloud provides virtualization only at the disk layer (block-based) of the I/O stack, and for this reason is referred to as *block-level virtualization*, or the block aggregation layer. For the sake of clarity, the block-level volumes that are provided by the cloud are exposed as target volumes, and are seen by IBM Spectrum Virtualize as a managed disk (MDisk).

These MDisks are then aggregated into a storage pool, sometimes referred to as a managed disk group (mdiskgrp). IBM Spectrum Virtualize then creates logical volumes (referred to as volumes or VDisks) that are striped across all of the MDisks inside of their assigned pool.

The virtualization terminology is included into the wider concept of SDS, an approach to data storage in which the programming that controls storage-related tasks is decoupled from the physical storage hardware. This separation allows SDS solutions to be placed over any existing storage systems or, more generally, installed on any commodity x86 hardware and hypervisor.

Shifting to a higher level in the IT stack allows for a deeper integration and response to application requirements for storage performance and capabilities. SDS solutions offer a full suite of storage services (equivalent to traditional hardware systems) and federation of multiple persistent storage resources: internal disk, cloud, other external storage systems, or cloud and object platforms.

In general, SDS technology uses the following concepts:

- A shared-nothing architecture (or in some cases a partial or fully shared architecture) with no single point of failure and nondisruptive upgrades.
- Scale-up or scale-out mode: Add building blocks for a predictable increase in capacity, performance, and resiliency.
- Multiple classes of service: File-based, object-based, block-based, and auxiliary and storage support service. SDS solutions may also be integrated together into a hybrid or composite SDS solution.

- High availability (HA) and disaster recovery (DR): Able to tolerate levels of availability and durability as self-healing and adjusting.
- Lower total cost of ownership (TCO): Lower the TCO for those workloads that can use SDS.

1.2.2 Benefits of IBM Spectrum Virtualize for Public Cloud

IBM Spectrum Virtualize for Public Cloud offers a powerful value proposition for enterprise and cloud users who are searching for more flexible and agile ways to deploy block storage on cloud. Using standard Intel servers, IBM Spectrum Virtualize for Public Cloud can be easily added to existing cloud infrastructures to deliver more features and functions, which enhance the storage offering that is available on the public cloud catalog. The benefits of deploying IBM Spectrum Virtualize for Public Cloud are two-fold:

- Public cloud storage offering enhancement: IBM Spectrum Virtualize for Public Cloud enhances the public cloud catalog by increasing standard storage, and offering capabilities and features that decrease specific limitations:
  - Snapshots: A volume's snapshots occur on high-tier storage with no options for a lower-end storage tier. Using IBM Spectrum Virtualize, the administrator has more granular control, which enables a production volume to have a snapshot that is stored on lower-end storage.
  - Volume size: Most cloud storage providers have a maximum volume size (typically a few terabytes) that can be provided by a few nodes. At the time of writing, IBM Spectrum Virtualize allows for up to 256 TB and up to 20,000 host connections.
  - Native storage-based replication: Replication features are natively supported, but are typically limited to specific data center pairs and a predefined minimum recovery point objective (RPO). They are accessible only when the primary volume is down. IBM Spectrum Virtualize provides greater flexibility in storage replication to allow for user-defined RPO and replication between any other system running IBM Spectrum Virtualize.
- New features for public cloud storage offering: IBM Spectrum Virtualize for Public Cloud introduces to the public cloud catalog new storage capabilities. Those features are available on SAN Volume Controller and IBM Spectrum Virtualize, but are not available by default. These additional features that are provided on public cloud are related to hybrid cloud scenarios and its support to foster all those solutions for improved hybrid architectures:
  - Replication or migration of data between on-premises storage and public cloud storage: In a heterogeneous environment, replication consistency is achieved through storage-based replica peer cloud storage with primary storage on-premises. Due to standardization of the storage service model and inability to move its own storage to a cloud data center, the storage-based replica is achievable only by involving an SDS solution on-premises.

    In this sense, IBM Spectrum Virtualize for Public Cloud offers data replication between the FlashSystem family, SAN Volume Controller, or VersaStack and Public Cloud and extends replication to all types of supported virtualized storage on-premises. Working together, IBM Spectrum Virtualize and IBM Spectrum Virtualize for Public Cloud support synchronous and asynchronous mirroring between the cloud and on-premises for more than 400 different storage systems from a wide variety of vendors. In addition, they support other services, such as IBM FlashCopy® and IBM Easy Tier®.
  - DR strategies between on-premises and public cloud data centers as alternative DR solutions: One of the reasons to replicate is to have a copy of the data from which to restart operations in case of an emergency. IBM Spectrum Virtualize for Public Cloud

enables DR for virtual and physical environments, thus adding new possibilities compared to the software replicators in use today that handle virtual infrastructure only.

– Benefit from familiar, sophisticated storage functions in the cloud to implement reverse mirroring: IBM Spectrum Virtualize enables the possibility to reverse data replication to offload from a cloud provider back to on-premises or to another cloud provider.

IBM Spectrum Virtualize, both on-premises and on cloud, provides a data strategy that is independent of the choice of infrastructure, which delivers tightly integrated functions and consistent management across heterogeneous storage and cloud storage. The software layer that is provided by IBM Spectrum Virtualize on-premises or in the cloud can provide a significant business advantage by delivering more services faster and more efficiently, enabling real-time business insights and supporting more customer interaction.

Capabilities such as rapid, flexible provisioning; simplified configuration changes; nondisruptive movement of data among tiers of storage; and a single user interface helps make the storage infrastructure (and the hybrid cloud) simpler, more cost-effective, and easier to manage.

1.2.3 Features of IBM Spectrum Virtualize for Public Cloud

IBM Spectrum Virtualize for Public Cloud helps make cloud storage volumes (block-level) more effective by including functions that are not natively available on the public cloud catalogs and that are traditionally deployed within disk array systems in the on-premises environment. For this reason, IBM Spectrum Virtualize for Public Cloud improves and expands the existing capabilities of the cloud offering.

Table 1-1 summarizes the IBM Spectrum Virtualize for Public Cloud features and benefits.

Table 1-1 IBM Spectrum Virtualize for Public Cloud features and benefits

Feature	Benefits
Single point of control for cloud storage resources.	► Designed to increased management efficiency. ► Designed to help support application availability.
Pools the capacity of multiple storage volumes.	► Helps overcome the volume size limitations. ► Helps manage storage as a resource to meet business requirements, and not just as a set of independent volumes. ► Helps an administrator to better deploy storage as required beyond traditional “islands”. ► Can help to increase the use of storage assets. ► Insulate applications from maintenance or changes to a storage volume offering.
Clustered pairs of servers that are configured as IBM Spectrum Virtualize for Public Cloud engines.	► Use of cloud-catalog Intel servers foundation. ► Designed to avoid single point of hardware failures.
Manages tiered storage	► Helps to balance performance needs against infrastructures costs in a tiered storage environment. ► Automated policy-driven control to put data in the right place at the right time automatically among different storage tiers or classes.

Feature	Benefits
Easy-to-use IBM FlashSystem family management interface	► A single interface for storage configuration, management, and service tasks regardless of the configuration that is available from the public cloud portal. ► Helps administrators use storage assets and volumes more efficiently. ► IBM Spectrum Control™ Insights and IBM Spectrum Protect™ provide more capabilities to manage capacity and performance.
Dynamic data migration	► Migrate data among volumes or LUNs without taking applications that use that data offline. ► Manage and scale storage capacity without disrupting applications.
Advanced network-based copy services	► Copy data across multiple storage systems with IBM FlashCopy. ► Copy data across metropolitan and global distances as needed to create high-availability storage solutions between multiple data centers.
Thin provisioning and snapshot replication	► Reduce volume requirements by using storage only when data changes. ► Improve storage administrator productivity through automated on-demand storage provisioning. ► Snapshots are available on lower-tier storage volumes.
IBM Spectrum Protect Snapshot application-aware snapshots	► Performs near-instant application-aware snapshot backups, with minimal performance impact for IBM DB2®, Oracle, SAP, Microsoft SQL Server, and Microsoft Exchange. ► Provides advanced, granular restoration of Microsoft Exchange data.
Native IP replication	► Embedded compress replication traffic for WAN optimization. ► Reduces network costs or speed replication cycles, improving the accuracy of remote data.
IBM Spectrum Connect Cloud Storage Management	► Manages container storage in Kubernetes.

Note: The following features are not supported in the first IBM Spectrum Virtualize for Public Cloud release:

- Stretched cluster
- IBM HyperSwap®
- IBM Real-time Compression™
- Data deduplication
- Encryption
- Data reduction
- Unmap
- Cloud backup
- Hot spare node

Some of these features are planned for future releases and will be prioritized for implementation based on customer feedback.

1.3 IBM Spectrum Virtualize for Public Cloud on AWS

The initial release of IBM Spectrum Virtualize for Public Cloud is available on AWS. Block virtualization further uses public cloud infrastructure for various types of workload deployments whether it is new or traditional. The following features are supported on the AWS infrastructure:

- Data replication with any IBM Spectrum Virtualize product and between public clouds
- FlashCopy snapshots in the cloud
- Common Management: IBM Spectrum Virtualize GUI
- Deployment in any AWS region
- Encryption at rest by using EBS encrypted volumes
- Data redundancy with volume mirroring
- Automated block-level storage tiering by using Easy Tier
- Scale on demand by thin provisioning volumes and paying for AWS storage as you grow

The AWS infrastructure is an established platform for today's computing needs. By deploying the IBM Spectrum Virtualize for Public Cloud platform, the features of IBM Spectrum Virtualize further enrich the capabilities of the cloud infrastructure. Figure 1-1 shows the general layout of IBM Spectrum Virtualize for Public Cloud on AWS.

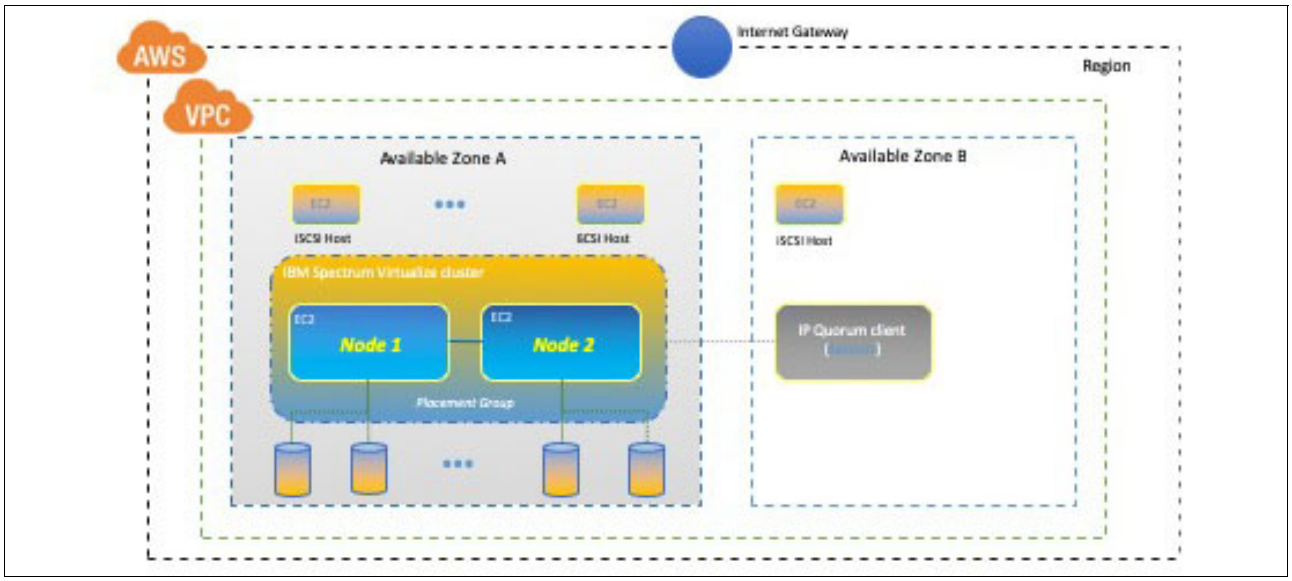

Figure 1-1 High-level architecture of IBM Spectrum Virtualize for Public Cloud on AWS

In AWS, the EBS storage is directly attached to the IBM Spectrum Virtualize node instances that compose a single node pair (or I/O group) that provides a shared storage pool that is used by IBM Spectrum Virtualize. IBM Spectrum Virtualize supports the following Amazon EBS types:

- General Purpose solid-state drive (SSD) (gp2)
- Provisioned IOPS SSD (io1)
- Throughput Optimized hard disk drive (HDD) (st1)

2

Typical use cases for IBM Spectrum Virtualize for Public Cloud

This chapter covers four use cases for IBM Spectrum Virtualize for Public Cloud.

In this chapter, the following topics are described:

- Deploying whole IT services in the public cloud
- Disaster recovery
- IBM FlashCopy in the public cloud
- Workload relocation into the public cloud

2.1 Deploying whole IT services in the public cloud

Companies are approaching and using public cloud services from multiple angles. Users that are rewriting and modernizing applications for cloud complement those users that are looking to move to cloud-only new services or to extend existing IT into a hybrid model to address quickly changing capacity and scalability requirements. There are different delivery models for public cloud, such as software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS). The workload deployment is composed of two major use cases, as shown in Figure 2-1:

- *Hybrid cloud*: The integration between the off-premises public cloud services with an existing on-premises IT environment.
- *Cloud-native*: The full application's stack is moved to cloud as SaaS, PaaS, IaaS, or as a combination of the three delivery models.

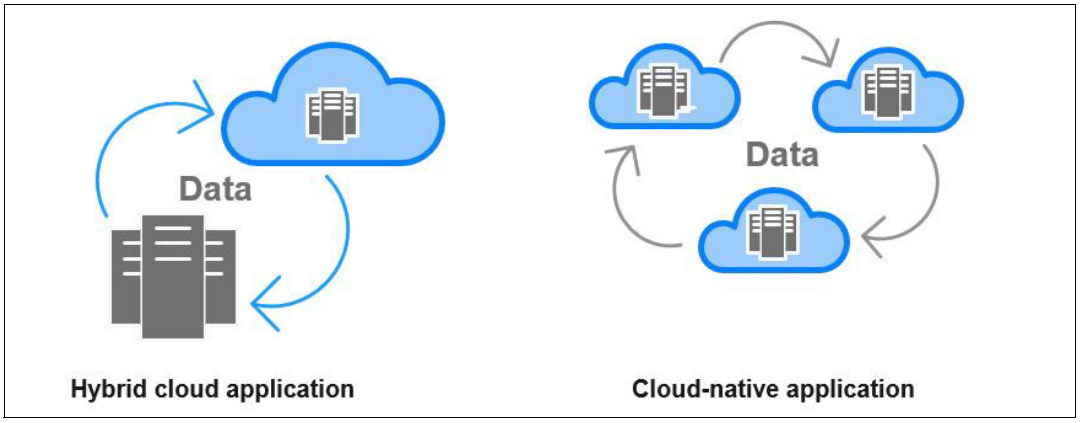

Figure 2-1 The two major deployment models for public cloud

Cloud-native implementations (that is, whole IT services that are deployed in the public cloud) are composed of several use cases, all with the lowest common denominator of having a full application deployment in the public cloud data centers. The technical details, final architecture, and roles and responsibilities depend on SaaS, PaaS, or IaaS usage. Within the IaaS domain, the transparency of cloud services is the highest because the user's visibility (and responsibility) into the application stack is much deeper compared to the other delivery models. Conversely, the *burden* for its deployment is higher because all the components must be designed from the server up. At the time of writing, IBM Spectrum Virtualize for Public Cloud is framed only within the IaaS cloud delivery model so that the user can interact with their storage environment as they did on-premises, which provides more granular control over performance.

2.1.1 Business justification

A workload or an application that is stand-alone, with few on-premises dependencies, relatively undemanding of I/O performance (low-latency and low response time and high IOPS), and that is not processing highly regulated data, represents a good fit for a cloud-native deployment. The drivers that motivate businesses towards cloud-native deployment span from capital expenditure and operating expenditure reduction, better resource management and controls against hidden or *shadow* IT resources, more flexibility and scalability, and improved flow in delivering IT service due to the global footprint of the cloud data centers.

At its core, the cloud environment is highly focused on standardization and automation. Therefore, the full spectrum of features and customization that are available in a typical on-premises or outsourcing deployment might not be natively available in the cloud catalog.

Nevertheless, the client does not lose performance and capabilities when deploying a cloud-native application. In this context, the storage virtualization with IBM Spectrum Virtualize for Public Cloud enables the IT staff to maintain the existing technical capabilities and skills to deploy, run, and manage highly available and highly reliable cloud-native applications in a public cloud. In this context, the IBM Spectrum Virtualize for Public Cloud acts as a bridge between the standardized cloud delivery model and the enterprise assets that the client uses in their traditional IT environment.

In a hybrid multicloud environment, the orchestration of the infrastructure requires multiple entities that are tightly integrated with each other and smartly respond to administrator or user needs, and that is where a software-defined environment (SDE) has an important role in the overall orchestration. Integration between service delivery, management, orchestration, automation, and hardware systems is becoming a requirement to support the emergence of SDEs. For SDEs to provide their benefits, they must understand and manage all the components of the infrastructure, including storage, and that makes software-defined storage (SDS) more relevant and important.

The capability of collecting the information from storage systems and providing a simplified multicloud deployment across IBM Storage systems is provided by IBM Spectrum Connect. IBM Spectrum Virtualize for Public Cloud on Amazon Web Services (AWS) and IBM Spectrum Connect integrate vRealize Orchestrator with vRealize Automation, which takes the service around infrastructure beyond orchestration. By integrating the Advanced Service Designer feature of vRealize Automation with vRealize Orchestrator, an organization can offer anything as a service (XaaS) to its users. Using the XaaS feature of vRealize Automation, IBM Spectrum Virtualize Storage System and IBM Spectrum Virtualize for Public Cloud on AWS can be delivered as SaaS in a multicloud environment, whether it is deployed in private cloud or a public cloud multicloud environment.

2.1.2 Highly available deployment models

The architecture is directly responsible for an application's reliability and availability if there is component failure (either hardware and software). When an application is fully hosted on cloud, the cloud data center becomes the primary site (production site). Cloud deployment does not guarantee 100% uptime, that the backups are available by default, or that the application is automatically replicated between different sites. These security, availability, and recovery features are often not the client's responsibility if the service is delivered by the SaaS model, are partially the user's responsibility in the PaaS model, and are *entirely* the client's responsibility in the IaaS model.

Having reliable cloud deployments means that the service provider must meet the required service level agreement (SLA), which guarantees service availability and uptime. Companies that use a public cloud IaaS can meet required SLAs either by implementing highly available solutions and duplicating the infrastructure in the same data center or in two data centers to maintain business continuity in case of failures. If business continuity is not enough to reach the requirements of the SLA, then disaster recovery (DR) implementations, which split the application among multiple cloud data centers (usually with a distance of at least 300 Km) prevent failure in a major disaster in the organization's main campus.

The highly available deployment models for an application that is fully deployed on public cloud are summarized as follows:

- *Highly available cloud deployment on a single primary site*: All the solution's components are duplicated (or more) within the same data center. This solution continues to function because there are not single points of failure (SPOF), but it does not function if the data center is unavailable.
- *Highly available cloud deployment on multi-site*: The architecture is split among multiple cloud data centers either within the same campus to mitigate the failure of an entire datacenter, or spread globally to recover the solution if there is a major disaster that affects the campus.

Highly available cloud deployment on a single primary site

When fully moving an application to a cloud IaaS that is the primary site for service delivery, a reasonable approach is implementing at least a highly available architecture. Each component (servers, network components, and storage) is redundant to avoid SPOF.

Within the single primary site deployment, storage is usually deployed as native cloud storage. Using the public cloud catalog storage, users can take advantage of the intrinsic availability (and SLAs) of the storage service, which is Amazon Elastic Block Store (EBS) volumes types in this case.

When IBM Spectrum Virtualize for Public Cloud is deployed as clustered pair of Elastic Compute Cloud (EC2) instances, it mediates between the cloud block storage and the workload hosts. In the specific context of single-site deployment, IBM Spectrum Virtualize for Public Cloud supports extra features that enhance the public cloud block-storage offering. At the storage level, IBM Spectrum Virtualize for Public Cloud resolves some limitations due to the standardized model of public cloud providers: a maximum number of LUNs per host, a maximum volume size, and poor granularity in the choice of tiers for storage snapshots.

IBM Spectrum Virtualize for Public Cloud also provides a new view for the storage management other than the cloud portal. It is a high-level view of the storage infrastructure and some limited specific operations at the volume level (such as volume size, IOPS tuning, and snapshot space increase). What is not provided is a holistic view of the storage from the application perspective.

For more information about the benefits of an IBM Spectrum Virtualize for Public Cloud single site deployment, see Table 2-1.

Table 2-1 Benefits of IBM Spectrum Virtualize for Public Cloud single site deployment

Feature	Benefits
Single point of control for cloud storage resources.	► Designed to increase management efficiency and to help to support application availability.
Pools the capacity of multiple storage volumes.	► Helps to overcome volume size limitations. ► Helps to manage storage as a resource to meet business requirements, and not just as a set of independent volumes. ► Helps administrator to better deploy storage as required beyond traditional "islands". ► Can help to increase the use of storage assets. ► Insulate applications from maintenance or changes to a storage volume offering.

Feature	Benefits
Manages tiered storage.	► Helps to balance performance needs against infrastructures costs in a tiered storage environment. ► Automated policy-driven control to put data in the right place at the right time automatically among different storage tiers and classes.
Easy-to-use IBM FlashSystem family management interface.	► Has a single interface for storage configuration, management, and service tasks regardless of the configuration that is available from the public cloud portal. ► Helps administrators use storage assets and volumes more efficiently. ► Has IBM Spectrum Control Insights and IBM Spectrum Protect for extra capabilities to manage capacity and performance.
Dynamic data migration.	► Migrates data among volumes and LUNs without taking applications that use that data offline. ► Manages and scales storage capacity without disrupting applications.
Advanced network-based copy services.	► Copy data across multiple storage systems with IBM FlashCopy. ► Copy data across metropolitan and global distances as needed to create high-availability storage solutions between multiple data centers.
Thin provisioning and snapshot replication.	► Reduces volume requirements by using storage only when data changes. ► Improves storage administrator productivity through automated on-demand storage provisioning. ► Snapshots are available on lower tier storage volumes.
IBM Spectrum Protect Snapshot application-aware snapshots.	► Perform near-instant and application-aware snapshot backups, with minimal performance impact for IBM Db2®, Oracle, SAP, VMware, Microsoft SQL Server, and Microsoft Exchange. ► Provide advanced and granular restoration of Microsoft Exchange data.
Third-party native integration	► Integration with VMware vRealize.

Highly available cloud deployment on multiple sites

When the application architecture spans over multiple data centers, it can tolerate the failure of the entire primary data center by switching to the secondary data center. The primary and secondary data centers can be deployed as:

- *Active-active*: The secondary site is always running and synchronously aligned with the primary site.
- *Active-passive:* The secondary site is either always running but asynchronously replicated (with a specific recovery point objective (RPO)) or running only for specific situations, such as acting as a recovery site or test environment. Storage is always active and available for data replication.

The active-passive configuration is usually the best fit for many cloud use cases, including DR, as shown in 2.2, “Disaster recovery” on page 14. The ability to provision compute resources on demand in a few minutes with just the storage that is provisioned and aligned with a specific RPO is a huge driver for a cost-effective DR infrastructure, and lowers the total cost of ownership (TCO).

The replication among multiple cloud data centers is no different from the traditional approach except for the number of available tools in the cloud. Although existing solutions based on hypervisor or application-layer replication such as VMware, Veeam, and Zerto are available in the public cloud, if the environment is heterogeneous (virtual servers, bare metal servers, multiple hypervisors, and so on), storage-based replication is still the preferable approach.

Active-passive asynchronous mirroring that uses Global Mirror with Change Volumes (GMCV) provides a minimum RPO of 2 minutes (the Change Volume (CV) cycle period ranges is 1 minute - 1 day, and a best practice is setting the cycle period to be half of the RPO), and can replicate a heterogeneous environment.

2.2 Disaster recovery

Since 2018, customers have been harnessing and securing proliferating data in their environment and infrastructure workloads have the highest increase in the adoption of DR.

Technology is just one crucial piece of a DR solution, and not the one that dictates the overall approach.

The section describes DR approach and benefits of IBM Spectrum Virtualize for Public Cloud on AWS.

A DR strategy is the predominant aspect of an overall resiliency solution because it determines what classes of physical events the solution can address, sets the requirements in terms of distance, and sets constraints on technology.

2.2.1 Business justification

Table 2-2 shows the drivers and the challenges of having a DR solution on cloud and what capabilities IBM Spectrum Virtualize for Public Cloud provides in these areas.

Table 2-2 Drivers, challenges, and capabilities that are provided by IBM Spectrum Virtualize for Public Cloud

Adoption drivers	Challenges	IBM Spectrum Virtualize for IBM Public Cloud capabilities
The promise of reduced operational expenditures and capital expenditures	► Hidden costs. ► Availability of data when needed.	► Optimized for Cloud Block Storage ► IBM Easy Tier solution to optimize the most valuable storage usage, which maximizes Cloud Block Storage performance ► Thin provisioning to control the storage provisioning ► Snapshots feature for backup and DR solution ► HA clusters architecture

Adoption drivers	Challenges	IBM Spectrum Virtualize for IBM Public Cloud capabilities
Bridging technologies from on-premises to cloud	► Disparate Infrastructure: How can my on-premises production data be readily available in the cloud in a disaster?	► Any to any replication ► Supporting over 400 different storage devices (on-premises), including iSCSI on-premises and when deployed in cloud
Using the cloud for backup and DR	► Covering virtual and physical environments. ► Solutions to meet a range of RPO/RTO needs.	► A storage-based, serverless replication with options for low RPO/RTO: – Global Mirror for Asynchronous replication with an RPO close to “0” – Metro Mirror for Synchronous replication – GMCVs for Asynchronous replication with a tunable RPO

At the time of writing, IBM Spectrum Virtualize for Public Cloud has the following features that are related to DR:

- Can be implemented at any location in AWS Cloud and can be installed by using AWS Marketplace.
- Is deployed on an Amazon EC2 instance.
- Offers data replication with the FlashSystem family, V9000, SAN Volume Controller, or VersaStack and public cloud.
- Supports two node clusters in AWS Cloud.
- Offers data services for Amazon EBS.
- Offers common management with the IBM Spectrum Virtualize GUI with full admin access and a dedicated instance.
- No incoming data transfer cost.
- Replicates between two AWS Cloud locations.
- Replicates between on-premises and AWS Cloud running IBM Spectrum Virtualize on-premises and IBM Spectrum Virtualize for Public Cloud on AWS.

2.2.2 Two common DR scenarios with IBM Spectrum Virtualize for Public Cloud

Here are two of the most common scenarios that can be implemented with IBM Spectrum Virtualize for Public Cloud:

- IBM Spectrum Virtualize Hybrid Cloud DR for “Any to Any”
- IBM Spectrum Virtualize for Public Cloud solution on AWS Cloud DR, as shown in Figure 2-2

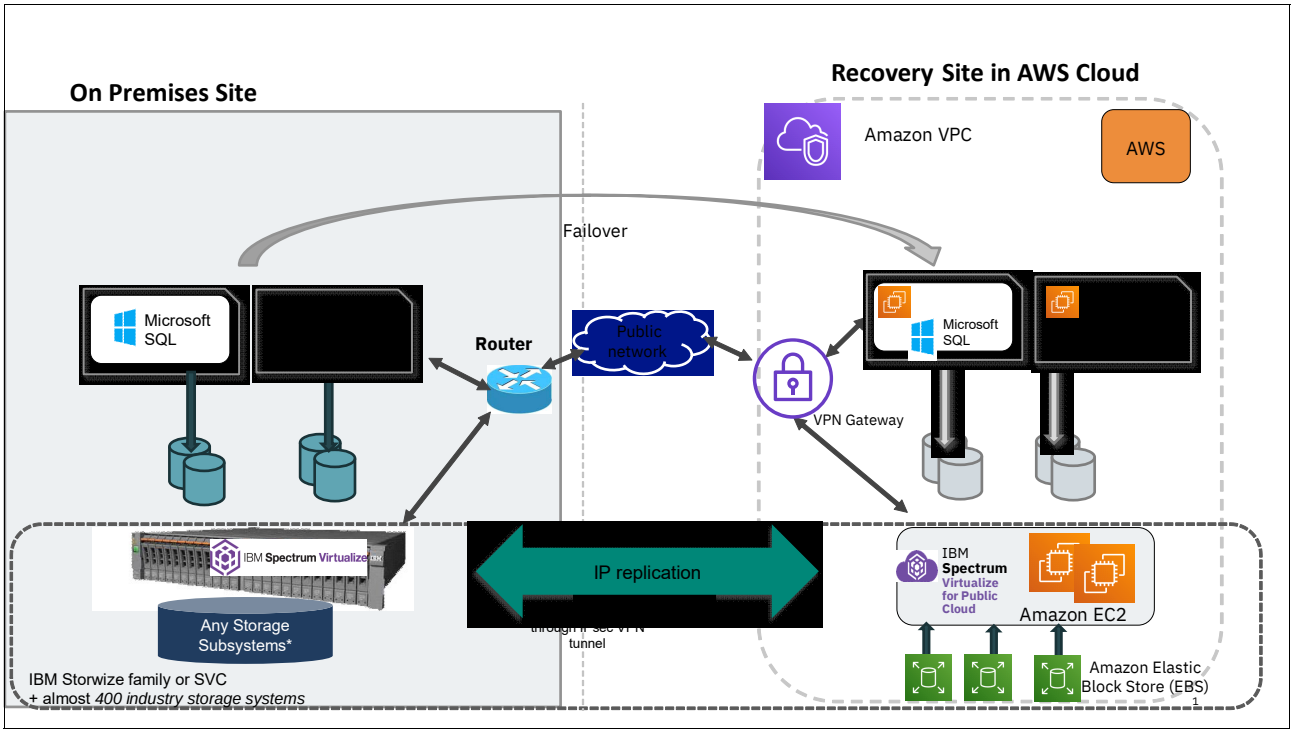

Figure 2-2 IBM Spectrum Virtualize for Public Cloud on AWS Cloud DR solution

As shown in Figure 2-2, a customer can deploy a storage replication infrastructure in a public cloud by using IBM Spectrum Virtualize for Public Cloud.

Here are the details of this scenario:

- Primary storage is in the customer’s physical data center. The customer has an on-premises IBM Spectrum Virtualize solution that is installed.
- Auxiliary storage sits on the DR site, which can be an IBM Spectrum Virtualize cluster running in the public cloud.
- The virtual IBM Spectrum Virtualize cluster manages the storage that is provided by an Amazon EBS volume.

A replication partnership that uses GMCVs is established between an on-premises IBM Spectrum Virtualize cluster or FlashSystem solution and the virtual IBM Spectrum Virtualize cluster to provide DR.

When talking about DR, understand that IBM Spectrum Virtualize for Public Cloud is an important piece of a more complex solution that has some prerequisites considerations and best practices that must be applied.

Note: To see an example of a simple implementation of a DR solution, including IBM FlashSystem and IBM Spectrum Virtualize for Public Cloud, see 5.5, “Configuring a site-to-site virtual private network IPSec tunnel for hybrid cloud connectivity in AWS Cloud” on page 78.

2.3 IBM FlashCopy in the public cloud

The IBM FlashCopy function in IBM Spectrum Virtualize can perform a *point-in-time (PiT) copy* of one or more volumes. You can use FlashCopy to help you solve critical and challenging business needs that require duplication of data of your source volume. Volumes can remain online and active while you create consistent copies of the data sets. Because the copy is performed at the block level, it operates below the host operating system and its cache. Therefore, the copy is not apparent to the host unless it is mapped.

2.3.1 Business justification

The business applications for FlashCopy are wide-ranging. Common use cases for FlashCopy include, but are not limited to, the following examples:

- Rapidly creating consistent backups of dynamically changing data.
- Rapidly creating consistent copies of production data to facilitate data movement or migration between hosts.
- Rapidly creating copies of production data sets for application development and testing.
- Rapidly creating copies of production data sets for auditing purposes and data mining.
- Rapidly creating copies of production data sets for quality assurance.
- Rapidly creating copies of replication targets for testing data integrity.

Regardless of your business needs, FlashCopy with IBM Spectrum Virtualize is flexible and offers a broad feature set, which makes it applicable to many scenarios.

2.3.2 FlashCopy mapping

The association between the source volume and the target volume is defined by a *FlashCopy mapping*. The FlashCopy mapping can have three different *types*, four *attributes*, and seven different *states*.

FlashCopy in the GUI can be one of the three types:

- Snapshot: Sometimes referred to as *nocopy*. A PiT copy of a volume without a background copy of the data from the source volume to the target. Only the changed blocks on the source volume are copied. The target copy cannot be used without an active link to the source, which is achieved by setting the copy and clean rate to zero.
- Clone: Sometimes referred to as *full copy*. A PiT copy of a volume with a background copy of the data from the source volume to the target. All blocks from the source volume are copied to the target volume. The target copy becomes a usable independent volume, which is achieved with a copy and clean rate greater than zero and an autodelete flag, so no cleanup is necessary after the background copy is finished.

- Backup: Sometimes referred to as *incremental*. A backup FlashCopy mapping consists of a PiT full copy of a source volume, plus periodic increments or “deltas” of data that changed between two points in time. This is a mapping where the copy and clean rates are greater than zero, no autodelete flag is set, and you use an incremental flag to preserve the bitmaps between activations so that only the deltas since the last “backup” must be copied.

The FlashCopy mapping has four property attributes (*clean rate*, *copy rate*, *autodelete*, *and incremental*) and seven different states. The *actions* users can perform on a FlashCopy mapping are:

- Create: Define a source and a target, and set the properties of the mapping.
- Prepare: The system must be prepared before a FlashCopy copy starts. It basically flushes the cache and makes it “transparent” for a short time so that no data is lost.
- Start: The FlashCopy mapping is started and the copy begins immediately. The target volume is immediately accessible.
- Stop: The FlashCopy mapping is stopped (either by the system or by the user). Depending on the state of the mapping, the target volume is usable or not.
- Modify: Some properties of the FlashCopy mapping can be modified after creation.
- Delete: Delete the FlashCopy mapping. This does not delete any of the volumes (source or target) from the mapping.

The source and target volumes must be the same size. The minimum granularity that IBM Spectrum Virtualize supports for FlashCopy is an entire volume. It is not possible to use FlashCopy to copy only part of a volume.

Important: As with any PiT copy technology, you are bound by operating system and application requirements for interdependent data and the restriction to an entire volume.

The source and target volumes must belong to the same IBM Spectrum Virtualize system, but they do not have to be in the same I/O group or storage pool.

Volumes that are members of a FlashCopy mapping cannot have their sizes increased or decreased while they are members of the FlashCopy mapping.

All FlashCopy operations occur on FlashCopy mappings. FlashCopy does not alter source volumes. Multiple operations can occur at the same time on multiple FlashCopy mappings by using *consistency groups*.

2.3.3 Consistency groups

To overcome the issue of dependent writes across volumes and create a consistent image of the client data, perform a FlashCopy operation on multiple volumes as an atomic operation. To accomplish this task, IBM Spectrum Virtualize supports the concept of *consistency groups*. Consistency groups preserve PiT data consistency across multiple volumes for applications that include related data that spans multiple volumes. For these volumes, consistency groups maintain the integrity of the FlashCopy by ensuring that *dependent writes* are run in the application’s intended sequence.

FlashCopy mappings can be part of a consistency group even if there is only one mapping in the consistency group. If a FlashCopy mapping is not part of any consistency group, it is referred to as *stand-alone*.

2.3.4 Crash-consistent copy and host considerations

FlashCopy consistency groups do not provide application consistency. They only ensure volume points-in-time are consistent between volumes.

Because FlashCopy is at the block level, you must understand the interaction between your application and the host operating system. From a logical standpoint, it is easiest to think of these objects as “layers” that sit on top of one another. The application is the topmost layer, and beneath it is the operating system layer.

Both of these layers have various levels and methods of caching data to provide better speed. Because the IBM SAN Volume Controller and FlashCopy sit below these layers, *they are unaware of the cache at the application or operating system layers.*

To ensure the integrity of the copy that is made, it is necessary to flush the host operating system and application cache for any outstanding reads or writes before the FlashCopy operation is performed. Failing to flush the host operating system and application cache produces what is referred to as a *crash-consistent* copy.

The resulting copy requires the same type of recovery procedure, such as log replay and file system checks, that is required following a host crash. FlashCopy copies that are crash-consistent often can be used after the file system and application recovery procedures.

Various operating systems and applications provide facilities to stop I/O operations and ensure that all data is flushed from the host cache. If these facilities are available, they can be used to prepare a FlashCopy operation. When this type of facility is unavailable, the host cache must be flushed manually by quiescing the application and unmounting the file system or drives.

The target volumes are overwritten with a complete image of the source volumes. Before the FlashCopy mappings are started, it is important that any data that is held on the host operating system (or application) caches for the target volumes is discarded. The easiest way to ensure that no data is held in these caches is to unmount the target volumes before the FlashCopy operation starts.

Best practice: From a practical standpoint, when you have an application that is backed by a database and you want to make a FlashCopy of that application’s data, it is sufficient in most cases to use the write-suspend method that is available in most modern databases because the database maintains strict control over I/O.

This method is as opposed to flushing data from both the application and the backing database, which is always the suggested method because it is safer. However, this method can be used when facilities do not exist or your environment includes time sensitivity.

2.4 Workload relocation into the public cloud

In this section, a use case for IBM Spectrum Virtualize for Public Cloud is illustrated where an entire workload segment is migrated from a client’s enterprise into the cloud. Although the process for relocating a workload into the cloud by using IBM Spectrum Virtualize can use only Remote Copy, there are other mechanisms that can accomplish this task.

2.4.1 Business justification

All the drivers that motivate businesses to use virtualization technologies makes deploying services into the cloud even more compelling because the cost of idle resources is further absorbed by the cloud provider. However, certain limitations in regulatory or process controls may prevent a business from moving all workloads and application services into the cloud.

An ideal case with regards to a hybrid cloud solution is the relocation of a specific segment of the environment that is well suited, such as development. Another might be a specific application group that does not require either the regulatory isolation or low response time integration with on-premises applications.

Although performance might be a factor, it should not be assumed that cloud deployments automatically create a diminished performance. Depending on the location of the cloud service data center and the intended audience for the migrated service, the performance can conceivably be superior to on-premises pre-migration.

In summary, moving a workload into the cloud might provide similar functions with better economies due to scaling of physical resources in the cloud provider. Moreover, the cost of services in the cloud is structured, measurable, and predictable.

2.4.2 Data migration

There are multiple methods for performing data migrations to the cloud. Here are three general approaches:

- IBM Spectrum Virtualize Remote Copy
- Host-side mirroring (Storage vMotion or IBM AIX® Logical Volume Manager mirroring)
- Appliance-based data transfer, such as IBM Aspera® or IBM Transparent Data Migration Facility

The first method was described in 2.3, “IBM FlashCopy in the public cloud” on page 17, and is essentially the same process as DR. The only difference is that instead of a persistent replication, after the initial synchronization is complete, the goal is to schedule the cutover of the application onto the compute nodes in the cloud environment that is attached to the IBM Spectrum Virtualize storage.

Host-side mirroring requires the server to have concurrent access to both local and remote storage, which is not feasible. Also, because the object is to relocate the workload (both compute and storage) into the cloud environment, that task is more easily accomplished by replicating the storage and, after it is synchronized, bringing up the server in the cloud environment and making the appropriate adjustments to the server for use in the cloud.

The second method is largely impractical because it requires the host to access both source and target simultaneously, and the practical impediments to creating an iSCSI (the only connection method currently available for IBM Spectrum Virtualize in the Public Cloud) connection from on-premises host systems into the cloud are beyond the scope of this use case. Traditional VMware Storage vMotion is similar, but again requires the target storage to be visible through iSCSI to the existing host.

The third method entails the use of third-party software and or hardware to move the data from one environment to another one. The general idea is that the target system has an operating system and some empty storage that is provisioned to it that acts as a landing pad for data that is on the source system. Going into detail about these methods is also outside the scope of this document, but the process is no different between an on-premises to cloud migration as it is to an on-premises to on-premises migration.

Table 2-3 shows the migration methods.

Table 2-3 Migration methods

Migration method	Best suited operating system	Pros versus cons
Remote Copy	Stand-alone Windows, Linux, or VMWare (any version)	Simple versus limited scope
Host Mirror	VMWare vSphere 5.1 or higher	Simple versus limited scope
Appliance	N/A	Flexible versus cost and complexity

2.4.3 Host provisioning

In addition to the replication of data, it is necessary for compute nodes and networking to be provisioned within the cloud provider upon which to run the relocated workload. Currently, in the AWS Cloud the EC2 compute nodes are available with storage that is provisioned to the EC2 compute instance by using an iSCSI connection.

2.4.4 Implementation considerations

The following list describes implementation considerations for the workload relocation into the public cloud use case:

- Naming conventions: This is an important consideration in the manageability of a standard on-premises IBM Spectrum Virtualize environment, but given the multiple layers of virtualization in a cloud implementation, maintaining a consistent and meaningful naming convention for all objects (managed disks (MDisks), volumes, FlashCopy mappings, Remote Copy relationships, hosts, and host clusters) is necessary.
- Monitoring integration: Integration into IBM Spectrum Control or some other performance monitoring framework is useful for maintaining metrics for reporting or troubleshooting. IBM Spectrum Control is well suited for managing IBM Spectrum Virtualize environments.
- Planning and scheduling: Regardless of the method that is chosen, gather as much information ahead of time as possible: File system information, application custodians, full impact analysis of related systems, and so on.
- Be sure to ensure a solid backout: If inter-related systems or other circumstances require rolling back the application servers to on-premises, plan the migration to ensure as little difficulty as possible in the roll-back, which might mean keeping zoning in the library (even if it is not in the active configuration), and not destroying source volumes for a certain period.

3

Architecture of the solution

This chapter provides a technical overview of the Amazon Web Services (AWS) environment regarding IBM Spectrum Virtualize for Public Cloud deployment. Furthermore, it provides functional definitions of the solution components and how they interact and interrelate.

In this chapter, the following topics are described:

- Amazon Web Services
- IBM Spectrum Virtualize
- Solution architecture

3.1 Amazon Web Services

AWS delivers infrastructure as a service (IaaS) in the form of virtual private clouds (VPCs) within which network, compute and storage resources are housed. Resources such as Elastic Compute Cloud (EC2) and Elastic Block Store (EBS), as shown in Figure 3-1. IBM Spectrum Virtualize nodes are built on EC2 instances and virtualize EBS volumes that are provisioned to those nodes, providing advanced capacity savings functions, and replication and point-in-time (PiT) copy services over a block virtualization layer through a user interface that is familiar to IBM Spectrum Virtualize clients.

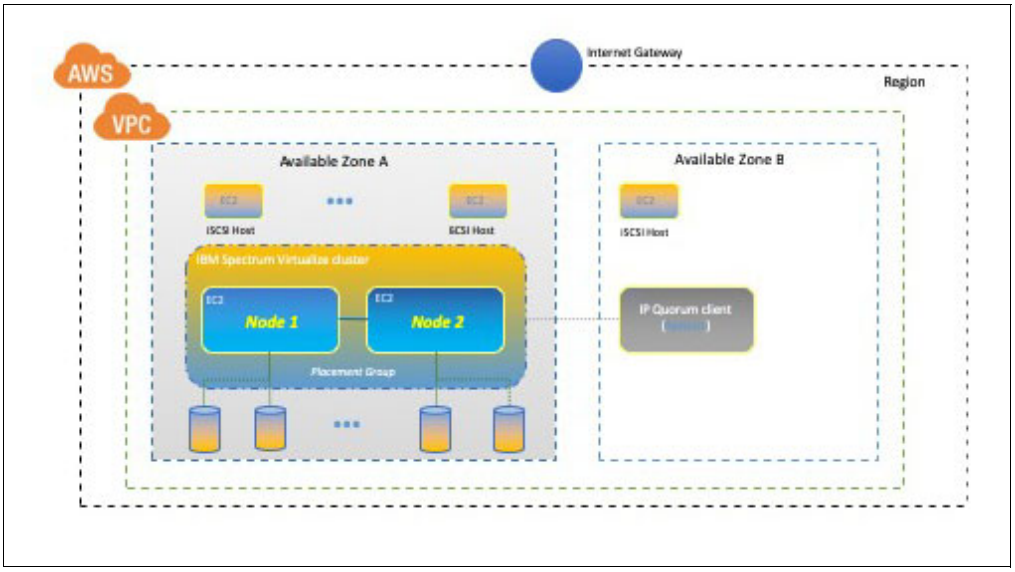

Figure 3-1 Architectural overview of high-level AWS components

For more information about the common components in AWS, see Table 3-1.

Table 3-1 Definition of terminology in AWS

Item	Definition
Elastic Compute Cloud (EC2)	A service that you can use to start virtual machine (VM) instances in various operating systems.
Elastic Block Store (EBS)	Persistent block storage volumes that are used with Amazon EC2 (as opposed to the more common Simple Storage Service (S3)).
Availability zones	Distinct locations that are insulation from failures.
Virtual private cloud (VPC)	Virtual network in your own logically isolated area within the AWS Cloud. It is populated by infrastructure, platform, and application services that share common security and interconnection.
CloudFormation Template	Creates and configures AWS resources and discovers dependencies.

Item	Definition
Amazon Machine Images (AMI)	Template that contains a software configuration (for example, an operating system, an application server, and applications).
Simple Storage Service (S3)	Storage for the internet. You can use Amazon S3 to store and retrieve any amount of data at any time, from anywhere on the web.

3.2 IBM Spectrum Virtualize

IBM Spectrum Virtualize is a software-enabled storage virtualization engine that provides a single point of control for storage resources within the data centers. IBM Spectrum Virtualize is a core software engine of established and IBM storage virtualization solutions, such as IBM SAN Volume Controller and all versions of the IBM FlashSystem family of products.. This technology is now available in AWS, providing increased flexibility in data center infrastructure and cloud systems. This section describes the components of IBM Spectrum Virtualize as they are deployed in the cloud.

3.2.1 Nodes

IBM Spectrum Virtualize software is installed on EC2 instances that are provisioned in AWS. Each EC2 is called a *node*. The node provides the virtualization for a set of volumes, cache, and copy services functions. The nodes are deployed in pairs (*I/O groups*) and 1 - 4 pairs make up a *clustered system*. At the time of writing, IBM Spectrum Virtualize for Public Cloud on AWS is limited to a single I/O group, but there are plans to quickly expand to four I/O groups.

One of the nodes within the system is assigned the role of the *configuration node*. The configuration node manages the configuration activity for the system and owns the cluster IP address that is used to access the management GUI and command-line interface (CLI) connections. If this node fails, the system chooses a new node to become the configuration node.

Because the active nodes are installed in pairs, each node maintains cache coherence with its partner to provide seamless failover functions and fault tolerance, which are described in greater detail in 3.2.2, “I/O groups” on page 25.

3.2.2 I/O groups

A specific *volume* is always presented to a host server or cluster by a single I/O group in the system. When a host server performs I/O to one of its volumes, all the I/Os for a specific volume are directed to one specific I/O group in the system. Under normal conditions, the I/Os for that specific volume are always processed by the same node within the I/O group. This node is referred to as the *preferred node* for this specific volume. When the preferred node receives a write into its cache, that write is mirrored to the partner node before the write is acknowledged back to the host. Reads are serviced by the preferred node. For more information, see 3.2.7, “Cache” on page 28.

Both nodes of an I/O group act as the preferred node for their own specific subset of the total number of volumes that the I/O group presents to the host servers. However, both nodes also act as failover nodes for their respective partner node within the I/O group. Therefore, a node takes over the I/O workload from its partner node, if required. For this reason, it is mandatory for servers that are connected to use multipath drivers to handle these failover situations.

If required, host servers can be mapped to more than one I/O group within the IBM Spectrum Virtualize system. Therefore, they can access volumes from separate I/O groups. You can move volumes between I/O groups to redistribute the load between the I/O groups. Modifying the I/O group that services the volume can be done concurrently with I/O operations if the host supports nondisruptive volume moves and is zoned to support access to the target I/O group.

It also requires a rescan at the host level to ensure that the multipathing driver is notified that the allocation of the preferred node changed, and the ports by which the volume is accessed changed. This modification can be done in the situation where one pair of nodes becomes overused.

3.2.3 System

The current IBM Spectrum Virtualize for Public Cloud on AWS system or clustered system consists of one I/O group with plans to support more soon. Certain configuration limitations are then set for the individual system. For example, at the time of writing, the maximum number of volumes that is supported per system is 10000, and the maximum managed disks (MDisks) that are supported is ~28 PIB (pebibytes) or 32 PB (petabytes) per system. The current AWS implementation is optimized around 16 EBS volumes and the largest single EBS volume on AWS is 16384 GiB.

All configuration, monitoring, and service tasks are performed at the system level. Configuration settings are replicated to all nodes in the system. To facilitate these tasks, a management IP address is set for the system.

Note: The management IP is also referred to as the system or cluster IP and is active on the configuration node. Each node in the system is also assigned a service IP to allow for individually interacting with the node directly.

A process is provided to back up the system configuration data onto disk so that it can be restored if there is a disaster. This method does not back up application data. Only the IBM Spectrum Virtualize system configuration information is backed up.

For the purposes of remote data mirroring, two or more systems must form a *partnership* before relationships between mirrored volumes are created.

For more information about the maximum configurations that apply to the system, I/O group, and nodes, see V8.2.1.x Configuration Limits and Restrictions for IBM Storwize V7000 and V7000F.

3.2.4 MDisks

IBM Spectrum Virtualize for Public Cloud on AWS views the EBS volumes that are presented to the EC2 instance nodes by AWS as several disks or LUNs, which are known as *MDisks*. Because IBM Spectrum Virtualize does not attempt to provide recovery from physical failures within the back-end controllers, an MDisk often is typically provisioned from a RAID array and you assume that the EBS volumes are suitably protected and redundant.

However, the application servers do not see the MDisks. Rather, they see several logical disks, which are known as *virtual disks* or *volumes*, which are presented by the I/O groups through the LAN (iSCSI) to the servers. The MDisks are placed into storage pools where they are divided into extents that are used to create the *virtual disks* or *volumes*.

For more information about the total storage capacity that is manageable per system regarding the selection of extents, see V8.2.1.x Configuration Limits and Restrictions for IBM Storwize V7000 and V7000F.

MDisks that are presented to IBM Spectrum Virtualize can have the following modes of operation:

- Unmanaged MDisk

  An MDisk is reported as unmanaged when it is not a member of any storage pool. An unmanaged MDisk is not associated with any volumes and has no metadata that is stored on it. IBM Spectrum Virtualize does not write to an MDisk that is in unmanaged mode, except when it attempts to change the mode of the MDisk to one of the other modes.

- Managed MDisk

  Managed MDisks are members of a storage pool and they contribute extents to the storage pool. This mode is the most common and normal mode for an MDisk.

3.2.5 Storage pool

A *storage pool or MDisk group* is a collection of MDisks that provides the pool of storage from which volumes are provisioned. The size of these pools can be changed (expanded or shrunk) nondisruptively by adding or removing MDisks without taking the storage pool or the volumes offline. At any point, an MDisk can be a member in one storage pool only.

Each MDisk in the storage pool is divided into extents. The size of the extent is selected by the administrator when the storage pool is created and cannot be changed later, although there are ways to address this with volume mirroring (see 3.2.6, “Volumes” on page 27). The size of the extent can be 16 MiB (mebibyte) - 8192 MiB, with the default being 1024 MiB.

It is a best practice to use the same extent size for all storage pools in a system. This approach is a prerequisite for supporting volume migration between two storage pools. If the storage pool extent sizes are not the same, you must use volume mirroring to copy volumes between pools.

3.2.6 Volumes

Volumes are logical disks that are presented to the host or application servers by IBM Spectrum Virtualize. The hosts cannot see the MDisks; they can see only the logical volumes that are created from combining extents from a storage pool.

An IBM Spectrum Virtualize for Public Cloud on AWS volume is allocated one extent in turn from each MDisk in the storage pool. This process continues until the space that is required for the volume is satisfied.

It is also possible to supply a list of MDisks to use. This is the default volume type. There are other volume types that are supported by the IBM Spectrum Virtualize product, but the default or striped volume is the only one relevant for AWS implementations.

3.2.7 Cache

The primary benefit of storage cache is to improve I/O response time. Reads and writes to a magnetic disk drive experience seek and latency time at the drive level, which can result in 1 ms - 10 ms of response time (for an enterprise-class disk).

IBM Spectrum Virtualize provides a flexible cache model, and the node's memory can be used as read or write cache. The cache management algorithms allow for improved performance of many types of underlying disk technologies. The IBM Spectrum Virtualize capability to manage in the background the destaging operations that are incurred by writes (in addition to still supporting full data integrity) helps the IBM Spectrum Virtualize capability to achieve good database performance.

The cache is separated into two layers: upper cache and lower cache.

Figure 3-2 shows the separation of the upper and lower cache.

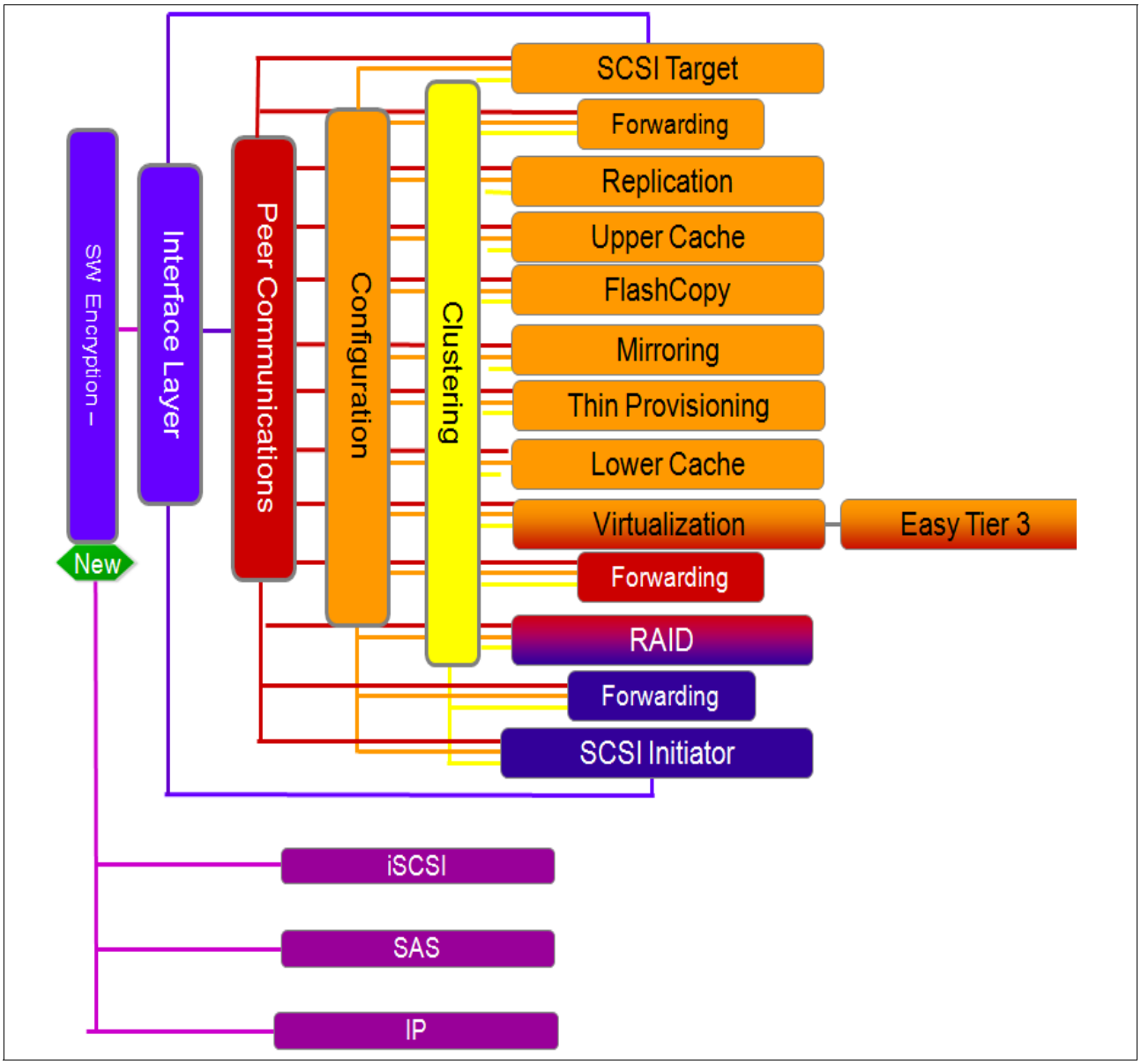

Figure 3-2 Separation of upper and lower cache

The upper cache delivers fast write response times to the host by being as high up in the I/O stack as possible. The lower cache works to help ensure that cache between nodes are in sync, pre-fetches data for an increased read cache hit ratio on sequential workloads, and optimizes the destaging of I/O to the backing storage controllers.

Combined, the two levels of cache also deliver the following functions:

- Pins data when the LUN goes offline.
- Provides enhanced statistics for IBM Spectrum Control or IBM Storage Insights, and maintains compatibility with an earlier version.
- Provides trace data for debugging.
- Reports media errors.
- Resynchronizes cache correctly and provides the atomic write function.
- Ensures that other partitions continue operation when one partition becomes 100% full of pinned data.
- Supports fast-write (two-way and one-way), flush-through, and write-through.
- Integrates with T3 recovery procedures.
- Supports two-way operations.
- Supports none, read-only, and read/write as user-exposed caching policies.
- Supports flush-when-idle.
- Supports expanding cache as more memory becomes available to the platform.
- Supports credit throttling to avoid I/O skew and offer fairness and balanced I/O between the two nodes of the I/O group.
- Enables switching of the preferred node without needing to move volumes between I/O groups.

3.2.8 IBM Easy Tier

IBM Easy Tier is a performance function that automatically migrates or moves extents of a volume to or from one MDisk storage tier to another MDisk storage tier. IBM Spectrum Virtualize code can support a three-tier implementation.

Easy Tier monitors the host I/O activity and latency on the extents of all volumes with the Easy Tier function, which is turned on in a multitier storage pool over a 24-hour period.

Next, it creates an extent migration plan that is based on this activity, and then dynamically moves high-activity or hot extents to a higher disk tier within the storage pool. It also moves extents whose activity dropped off or cooled down from the high-tier MDisks back to a lower-tiered MDisk. The condition for hot extents is frequent small block (64 Kb or less) reads.

Easy Tier: The Easy Tier function can be turned on or off at the storage pool and volume level.

The automatic load-balancing (*auto-rebalance*) function is enabled by default on each volume and cannot be turned off by using the GUI. This load-balancing feature is not considered the same as the Easy Tier function, but it uses the same principles. Auto-balance evens the load for a pool across MDisks. Therefore, even the addition of new MDisks, or having MDisks of different sizes within a pool, does not adversely affect the performance.

The Easy Tier function can make it more appropriate to use smaller storage pool extent sizes. The usage statistics file can be offloaded from the IBM Spectrum Virtualize nodes. Then, you can use the IBM Storage Advisor Tool (STAT) to create a summary report. STAT is available on the web at no initial cost at IBM Storage Tier Advisor.

3.2.9 Hosts

Volumes can be mapped to a *host* to allow access for a specific server to a set of volumes. A host within the IBM Spectrum Virtualize is a collection of iSCSI-qualified names (IQNs) that are defined on the specific server.

The iSCSI software in IBM Spectrum Virtualize supports IP address failover when a node is shut down or restarted. As a result, a node failover (when a node is restarted) can be handled without having a multipath driver that is installed on the iSCSI-attached server. An iSCSI-attached server can reconnect after the node shutdown to the original target IP address, which is now presented by the partner node. However, to protect the server against link failures in the network, you need a multipath driver. As a result, it is a best practice to implement multipathing on all hosts that are attached to IBM Spectrum Virtualize systems.

3.2.10 Host cluster

A *host cluster* is a host object in IBM Spectrum Virtualize. A host cluster is a combination of two or more servers that is connected to IBM Spectrum Virtualize through an iSCSI connection. A host cluster object can see the same set of volumes, so volumes can be mapped to a host cluster to allow all hosts to have a common mapping.

3.2.11 iSCSI

The *iSCSI function* is a software function that is provided by the IBM Spectrum Virtualize code. IBM introduced software capabilities to allow the underlying virtualized storage to attach to IBM Spectrum Virtualize by using the iSCSI protocol.

The major functions of iSCSI include encapsulation and the reliable delivery of Command Descriptor Block (CDB) transactions between initiators and targets through the IP network, especially over a potentially unreliable IP network.

Every iSCSI node in the network must have an iSCSI name and address as described here:

- An *iSCSI name* is a location-independent, permanent identifier for an iSCSI node. An iSCSI node has one iSCSI name, which stays constant for the life of the node. The terms *initiator name* and *target name* also refer to an iSCSI name.
- An *iSCSI address* specifies the iSCSI name and location of an iSCSI node. The address consists of a host name or IP address, a TCP port number (for the target), and the iSCSI name of the node. An iSCSI node can have any number of addresses, which can change at any time, particularly if they are assigned by way of Dynamic Host Configuration Protocol (DHCP). An IBM Spectrum Virtualize node represents an iSCSI node and provides statically allocated IP addresses.

3.2.12 IP replication

IP replication allows data replication between IBM Spectrum Virtualize family members. IP replication uses IP-based ports of the cluster nodes.

The configuration of the system is straightforward and IBM FlashSystem family systems normally find each other in the network and can be selected from the GUI.

IP replication includes *Bridgeworks SANSlide* network optimization technology and is available at no additional charge. Remember, Remote Mirror is a chargeable option, but the price does not change with IP replication. Existing Remote Mirror users have access to the function at no additional charge.

IP connections that are used for replication can have long latency (the time to transmit a signal from one end to the other), which can be caused by distance or by many “hops” between switches and other appliances in the network. Traditional replication solutions transmit data, wait for a response, and then transmit more data, which can result in network utilization as low as 20% (based on IBM measurements). In addition, this scenario gets worse the longer the latency.

Bridgeworks SANSlide technology, which is integrated with the IBM FlashSystem family, requires no separate appliances and so requires no additional cost or configuration steps. It uses artificial intelligence (AI) technology to transmit multiple data streams in parallel, adjusting automatically to changing network environments and workloads.

Bridgeworks SANSlide improves network bandwidth utilization up to 3x. Therefore, customers can deploy a less costly network infrastructure, or take advantage of faster data transfer to speed replication cycles, improve remote data currency, and enjoy faster recovery.

3.2.13 Synchronous or asynchronous remote copy

The general application of remote copy seeks to maintain two copies of data. Often, the two copies are separated by distance, but not always. The remote copy can be maintained in either synchronous or asynchronous modes. With IBM Spectrum Virtualize, Metro Mirror and Global Mirror are the IBM branded terms for the functions that are synchronous remote copy and asynchronous remote copy.

Synchronous remote copy ensures that updates are committed at both the primary and the secondary volumes before the application considers the updates complete. Therefore, the secondary volume is fully up to date if it is needed in a failover. However, the application is fully exposed to the latency and bandwidth limitations of the communication link to the secondary volume. In a truly remote situation, this extra latency can have a significant adverse effect on application performance at the primary site.

Special configuration guidelines exist for SAN fabrics and IP networks that are used for data replication. There must be considerations with regards the distance and available bandwidth of the intersite links.

A function of Global Mirror for low bandwidth was introduced in IBM Spectrum Virtualize. It uses Change Volumes (CVs) that are associated with the primary and secondary volumes. These CVs are used to record changes to the primary volume that are transmitted to the remote volume on an interval that i specified by the cycle period.

When a successful transfer of changes from the master CV to the auxiliary volume is achieved within a cycle period, a snapshot is taken at the remote site from the auxiliary volume onto the auxiliary CV to preserve a consistent state and a freeze time is recorded. This function is enabled by setting the *Global Mirror cycling mode*. Figure 3-3 shows an example of this function where you can see the association between volumes and CVs.

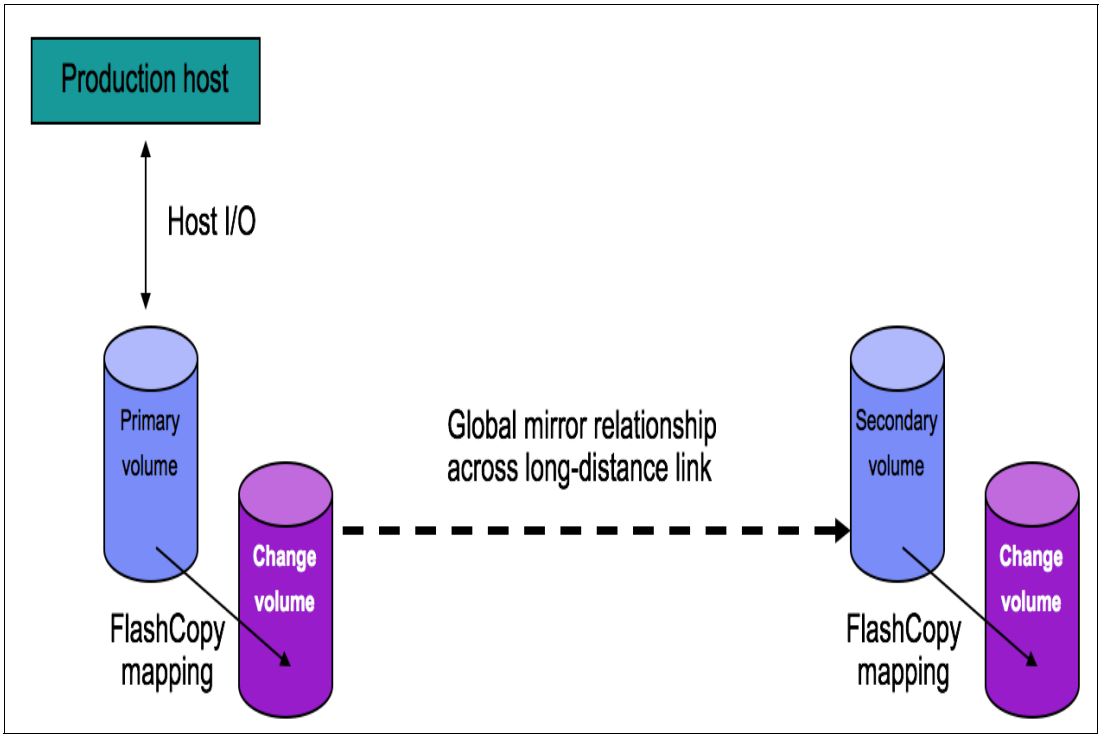

Figure 3-3 Global Mirror cycling mode

3.2.14 IBM FlashCopy

FlashCopy is sometimes described as an instance of a time-zero (T0) copy or a PiT copy technology.

FlashCopy can be performed on multiple source and target volumes. FlashCopy permits the management operations to be coordinated so that a common single PiT is chosen for copying target volumes from their respective source volumes.

With IBM Spectrum Virtualize, multiple target volumes can undergo FlashCopy from the same source volume. This capability can be used to create images from separate PiTs for the source volume, and to create multiple images from a source volume at a common PiT. Source and target volumes can be thin-provisioned volumes.

Reverse FlashCopy enables target volumes to become restore points for the source volume without breaking the FlashCopy relationship, and without waiting for the original copy operation to complete. IBM Spectrum Virtualize supports multiple targets, and has multiple rollback points.

Most clients aim to integrate the FlashCopy feature for PiT copies and quick recovery of their applications and databases. An IBM solution to this is provided by IBM Spectrum Protect, which is described in What can IBM Spectrum Protect do for your business?

For a use case for using FlashCopy with IBM Spectrum Virtualize for Public Cloud, see 2.3, “IBM FlashCopy in the public cloud” on page 17.

3.3 Solution architecture

This section describes the solution architecture.

3.3.1 Overview

As shown in Figure 3-1 on page 24, the IBM Spectrum Virtualize for Public Cloud environment is contained in a set of networks in a VPC, the IBM Spectrum Virtualize Cluster is on EC2 nodes, the Bastion and IP quorums are on EC2 nodes, and the second IP quorum is in another availability zone for redundancy. In Figure 3-4, those components are placed into the larger context of the solution as built for this document. In support of replication connectivity and the Transparent Cloud Tiering (TCT) function, internet access and a site-to-site IPSec tunnel were added to the configuration. The site-to-site tunnel also provides an alternative method for managing the environment versus using Bastion as a port-forwarder for the IBM Spectrum Virtualize GUI (which is not recommended from a security standpoint) or the complex process of setting up a *client virtual private network (VPN) Endpoint* in AWS (which requires configuring a certificate authority, and then either transferring certificates to the AWS Certificate Manager or integrating Active Directory for authentication).

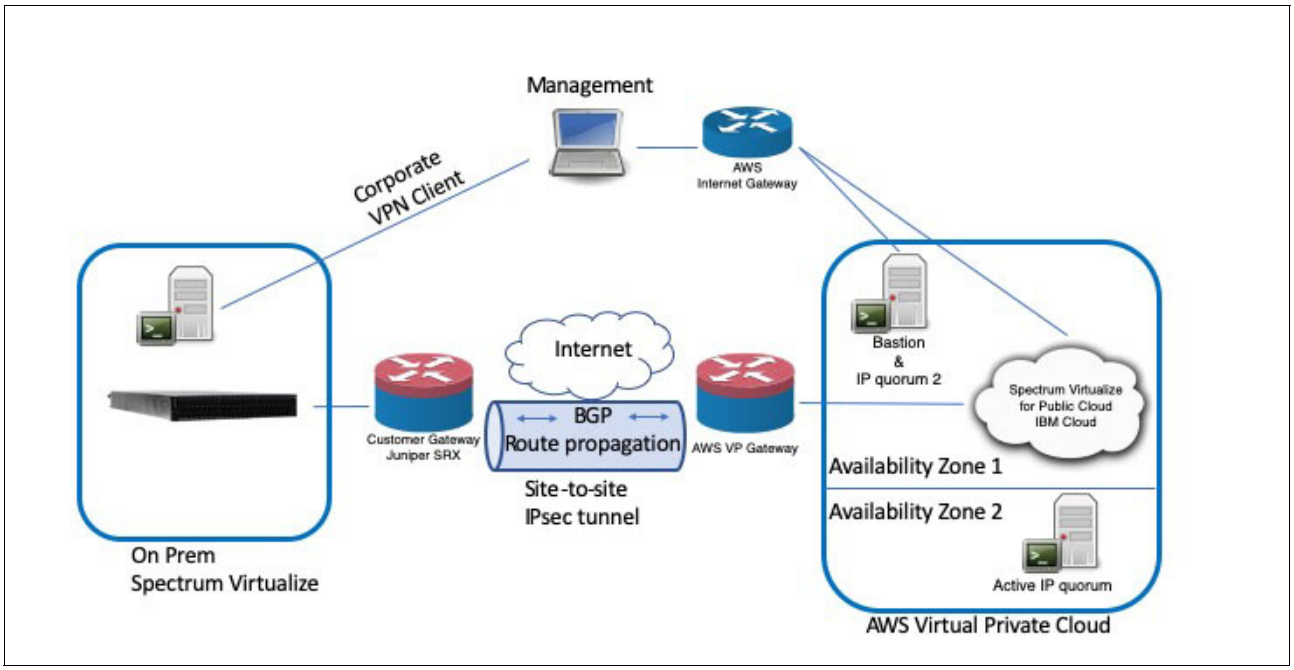

Figure 3-4 Connectivity between on-premises and Amazon AWS and management connections

3.3.2 Objective

The design of the solution for this publication was intended to illustrate two key features of IBM Spectrum Virtualize for Public Cloud: Easy Tier and replication.

Easy Tier

Easy Tier with thin provisioning provides a compelling business justification for using IBM Spectrum Virtualize in Public Cloud, especially for AWS. With thin provisioning, capacity and performance can be extended for Amazon EBS volumes, allowing applications to achieve the same level of performance but with lower cost than without IBM Spectrum Virtualize. For the purposes of this illustration, two out of the four available EBS types are blended into a single Easy Tier pool. For the enterprise or nearline tier, *st1* is used and the flash tier is made up of *gp2* volumes. Table 3-2 shows a comparison of the four available types of Amazon EBS volumes.

Table 3-2 Amazon EBS storage types

Items	**Solid-state drives (SSDs)**		**Hard disk drives (HDD)**	
Volume type	General-purpose SSD (gp2)*.	Provisioned IOPS SSD (io1).	Throughput-optimized HDD (st1).	Cold HDD (sc1).
Description	General-purpose SSD volume that balances price and performance for a wide variety of workloads.	Highest-performance SSD volume for mission-critical low-latency or high-throughput workloads.	Low-cost HDD volume that is designed for frequently accessed, throughput-intensive workloads.	Lowest cost HDD volume that is designed for less frequently accessed workloads.
Use cases	► Recommended for most workloads. ► System boot volumes. ► Virtual desktops. ► Low-latency interactive apps. ► Development and test environments.	► Critical business applications that require sustained IOPS performance, or more than 16,000 IOPS or 250 MiBps of throughput per volume. ► Large database workloads, such as: – MongoDB – Cassandra – Microsoft SQL Server	► Streaming workloads requiring consistent, fast throughput at a low price. ► Big data. ► Data warehouses. ► Log processing. ► Cannot be a boot volume.	► Throughput-oriented storage for large volumes of data that is infrequently accessed. ► Scenarios where the lowest storage cost is important. ► Cannot be a boot volume.
API name	gp2	io1	st1	sc1

Replication

Data mobility is firmly established as a foundational use case for block storage virtualization and the cornerstone of the IBM Spectrum Virtualize product. Replication between on-premises and AWS is the use case for the network diagram in Figure 3-4 on page 33.

3.3.3 Considerations

Here are the most important considerations when implementing this solution:

- Use only the first three categories (and not the *sc1* class storage due to the high latency of that storage class).
- Due to the nature of EBS storage provisioning to EC2 instances, any single EBS volume is provisioned only to one of the two IBM Spectrum Virtualize nodes. *However,* the forwarding layer within the IBM Spectrum Virtualize software uses the custom tags that are attached to the EBS volumes to provide seamless handling of failover events.
- To ensure seamless handling of failover events, there is a 16 EBS volume limit per I/O group or IBM Spectrum Virtualize node pair.
- The Cloud Formation Template (CFT) that governs the installation of IBM Spectrum Virtualize for Public Cloud on AWS currently implements the Bastion host and IP quorum server in the same availability zone for installations requesting a new VPC, and installations into an existing VPC allows the installer to choose a different availability zone for the Bastion and IP quorum server. In installations that include the creation of a VPC, it is a best practice that an extra subnet is provisioned in a different availability zone and a secondary IP quorum server is started in that subnet and made the active quorum device.

4

Planning and preparation for the IBM Spectrum Virtualize for Public Cloud on AWS deployment

This chapter describes the planning considerations for implementing an IBM Spectrum Virtualize for Public Cloud on Amazon Web Services (AWS) deployment solution.

In this chapter, the following topics are described:

- Introduction
- General planning introduction
- Requirements and limitations
- Amazon Web Services resources
- Network and security
- Storage performance optimization

4.1 Introduction

This chapter describes the planning and preparation steps to provision network, server, and storage components on AWS, which are required for installing IBM Spectrum Virtualize for Public Cloud on AWS.

Background information about the AWS cloud networking architecture and storage offerings is also described to help the reader who is unfamiliar with the AWS cloud plan for the IBM Spectrum Virtualize for Public Cloud placement into the larger context of an application environment.

4.2 General planning introduction

To achieve the most benefit from IBM Spectrum Virtualize for Public Cloud on AWS, preinstallation planning must include several important steps.

4.2.1 Prerequisites for AWS

Before you install IBM Spectrum Virtualize for Public Cloud software from the AWS Marketplace, ensure that you complete the following tasks on the AWS site:

1. Sign up for AWS.
2. Create an AWS Identity and Access Management (IAM) administrator profile.
3. Assign the appropriate rules for installation and usage.
4. Create a key pair.

You can use the default AWS administrator profile to install the IBM Spectrum Virtualize for Public Cloud software or you can create an installer user profile that includes only the required permissions for deploying the software. Creating a second user for monitoring only is a best practice. To create those two extra users, you must complete the following steps:

1. Create an appropriate user profile for the installer and the monitoring user.
2. Create one user for installation and one for monitoring, and assign the appropriate user profile.

Creating an AWS user profile

To create an installer user profile, complete these steps:

1. Log on to the AWS Management Console with the AWS default administrator profile.
2. Select **Services** in the upper left and click **IAM** to open the Identity and Access Management console.
3. In the **Navigation** pane, select **Policies** → **Create policy**.
4. Click the **JSON** tab and add the JSON content that is shown in Example 4-1.

Example 4-1 User profile for an installer user

```
{
   "Version": "2012-10-17",
   "Statement": [
       {
           "Sid": "VisualEditor0",
           "Effect": "Allow",
           "Action": [
```

```
                "aws-marketplace:ViewSubscriptions",
                "aws-marketplace:Unsubscribe",
                "aws-marketplace:StartBuild",
                "aws-marketplace:ListBuilds",
                "aws-marketplace:Subscribe",
                "iam:CreateInstanceProfile",
                "cloudformation:CreateUploadBucket",
                "sns:DeleteTopic",
                "iam:RemoveRoleFromInstanceProfile",
                "iam:CreateRole",
                "cloudformation:UpdateTerminationProtection",
                "s3:CreateBucket",
                "sns:ListTopics",
                "sns:Unsubscribe",
                "iam:PutRolePolicy",
                "iam:AddRoleToInstanceProfile",
                "iam:PassRole",
                "cloudformation:DescribeStackEvents",
                "ssm:DescribeParameters",
                "iam:DeleteRolePolicy",
                "cloudformation:UpdateStack",
                "sns:Subscribe",
                "s3:DeleteObject",
                "s3:DeleteBucket",
                "cloudformation:ListStackResources",
                "iam:DeleteInstanceProfile",
                "iam:GetRole",
                "cloudformation:ListStacks",
                "iam:GetInstanceProfile",
                "sns:GetTopicAttributes",
                "cloudformation:DescribeStackResources",
                "sns:CreateTopic",
                "iam:ListRoles",
                "iam:DeleteRole",
                "ssm:GetParameters",
                "iam:ListInstanceProfiles",
                "cloudformation:GetTemplateSummary",
                "cloudformation:DescribeStacks",
                "s3:PutObject",
                "s3:GetObject",
                "cloudformation:GetStackPolicy",
                "s3:ListAllMyBuckets",
                "cloudformation:CreateStack",
                "cloudformation:GetTemplate",
                "cloudformation:DeleteStack",
                "ec2:*",
                "cloudformation:ListChangeSets"
            ],
            "Resource": "*"
        }
    ]
}
```

5. Click **Review Policy** and add a name for the policy, such as `SV_install_policy`.
6. Click **Create Policy**.

To create a user profile with limited permissions, do the same steps but use the JSON content that is shown in Example 4-2 when you create the customized policy.

Example 4-2 User profile for a monitoring user

```
{
   "Version": "2012-10-17",
   "Statement": [
       {
           "Sid": "VisualEditor0",
           "Effect": "Allow",
           "Action": [
               "ec2:RebootInstances",
               "iam:GetRole",
               "ec2:Describe*",
               "ec2:StartInstances",
               "iam:ListRoleTags",
               "iam:ListAttachedRolePolicies",
               "iam:ListRoles",
               "iam:ListPolicies",
               "ec2:StopInstances",
               "iam:ListRolePolicies",
               "iam:ListInstanceProfiles",
               "iam:GetRolePolicy",
               "ec2:Get*"
           ],
           "Resource": "*"
       }
   ]
}
```

7. Click **Review Policy** and add a name for the policy, such as `SV_monitor_policy`. Click **Create Policy**.

Creating an AWS user and assigning the appropriate profile

To creating two new users for installation and monitoring, complete the following steps twice:

1. Log on to the AWS Management Console with the AWS default administrator profile.
2. Select **Services** in the upper left and click IAM to open the Identity and Access Management console.
3. In the **Navigation** pane, select **Users** → **Add user**.
4. Enter a name and password, and ensure that you select AWS Management Console access for the **Access type**. Click **Next: Permissions**.
5. Select **Attach existing policies directly** and select the new policy that you created in “Creating an AWS user profile” on page 38. Click **Next: Tags**.
6. Ensure that you add a tag that includes the email address for the installer user profile.

A successful login that uses the new user ID requires the login link that is provided by the AWS email, which must be manually sent during the creation process.

Because these steps might change, see IBM Knowledge Center for any new or changed information.

4.2.2 Prerequisites for IBM Spectrum Virtualize for Public Cloud

The IBM Spectrum Virtualize for Public Cloud on AWS software is a Buy Your Own License (BYOL) offering in AWS Marketplace. During the deployment, the installation template verifies the proof of entitlement that indicates that a valid license is purchased from IBM. If the proof of entitlement is not present, the installation fails. To obtain the license and proof of entitlement for the software, complete these steps:

1. Go to the IBM Passport Advantage® website to obtain a license and proof of entitlement for the software.
2. On the website, follow the directions to enter your IBM customer number and the maximum number of terabytes of virtual storage to provision with your systems.

4.3 Requirements and limitations

The installation is available on AWS Marketplace and uses AWS CloudFormation service to simplify provisioning of AWS resources. The IBM Spectrum Virtualize for Public Cloud installation provides two templates to provision and configure the required AWS services. One template installs the software on a new virtual private cloud (VPC) and the other template is used for installations on an existing VPC.

When the installation template is started from AWS Marketplace, the user is prompted to provide information, such as a customer ID for the entitlement check. For more information, see IBM Knowledge Center.

IBM Spectrum Virtualize for Public Cloud on AWS provides the following set of storage functions, which are similar to the ones that are provided by IBM Spectrum Virtualize for on-premises installations:

- IP-based Copy Services are available for the following three types of replication:
  - Global Mirror
  - Metro Mirror
  - Global Mirror with Change Volumes (GMVC)
- Replication is possible between:
  - On-premises SAN Volume Controller, IBM FlashSystem, or IBM Spectrum Virtualize as software only on Bare Metal Servers to AWS Cloud
  - IBM Spectrum Virtualize for Public Cloud on AWS instances that are deployed into two different availability zones
- FlashCopy, IBM Easy Tier, and thin pro.visioning are supported by IBM Spectrum Virtualize for Public Cloud on AWS.

There are some limitations that are related to scalability:

- Two nodes per cluster only.
- IPv4 only (no IPv6).
- Sixteen Elastic Block Store (EBS) volumes per I/O group.
- The general maximum Amazon EBS Volume size is 16 TiB.

Multiple Availability Zones are supported only through a separate Global Mirror instance of IBM Spectrum Virtualize for Public Cloud.

There are some unsupported features in this release:

- Stretched Cluster
- HyperSwap
- Real-time Compression
- Data Reduction Pools
- Deduplication
- IBM Spectrum Virtualize native encryption
- Hot Spare Node (not applicable to cloud)
- DRAID and encrypted DRAID (not applicable to cloud)
- N_Port ID virtualization (NPIV) (not applicable to cloud)
- SCSI Unmap for host and back end

Note: IBM Spectrum Virtualize for Public Cloud on AWS is configured by the AWS time server by using underlying operating system methods. Changing the time server or setting a static time is not a best practice and might cause difficulties. For more information about the AWS time server, see Setting the Time for Your Linux Instance.

Configuration requirement: The EBS volumes and the Elastic Compute Cloud (EC2) instance to which it attaches must be in the same Availability Zone.

Configuration best practice: The EC2 instance acting as the IP quorum should be in another Availability Zone in the same VPC.

For more information, see IBM Knowledge Center.

4.4 Amazon Web Services resources

Multiple resources are required for IBM Spectrum Virtualize for Public Cloud on AWS. Each IBM Spectrum Virtualize node requires one EC2 server instance. A single EC2 instance is required for the IP quorum device. Amazon EBS storage devices are used as IBM Spectrum Virtualize managed disks (MDisks).

After the CloudFormation template completes the installation, the result is a fully configured 2-node cluster in a private network with two MDisks. In addition, the installation process performs the following tasks:

- Validate the entitlement for an IBM Spectrum Virtualize for Public Cloud purchase (the client provides a customer number).
- Configure all IPs (cluster IP, service IPs, node IPs, and iSCSI port IPs).
- Configure NTP and DNS with AWS internal servers.

The security rules are automatically configured according to AWS requirements:

- For access to services that are provided by the IBM Spectrum Virtualize for Public Cloud system (web GUI, SSH, and iSCSI).
- For IBM Spectrum Virtualize inter-node communication, including network failover (IP).
- For IBM Spectrum Virtualize for Public Cloud to manage EBS.
- One IP quorum client is configured on a third EC2 instance (a Bastion host).

At least 11 IP addresses are required for a single IBM Spectrum Virtualize for Public Cloud on AWS installation in an existing VPC:

- Two node IP addresses per node
- Two port IP addresses per node
- One service IP address per node
- One IBM Spectrum Virtualize for Public Cloud on AWS cluster IP address

4.4.1 Amazon EC2 instances

The network bandwidth, the number of vCPUs, and the amount of memory are determined by instance type. The AWS instances (C5.4xlarge, C5.9xlarge, and C5.18xlarge) are the available options in the first release. The technical specifications are shown on Table 4-1. Dedicated Hosts mode is not supported for the first release.

Table 4-1 Amazon AWS EC2 on-demand resources

EC2 instance	vCPU	Memory (GiB)	Dedicated EBS bandwidth (Mbps)	Network performance (Gbps)
c5.4xlarge	16	32	3.500	Up to 10
c5.9xlarge	36	72	7.000	10
c5.18xlarge	72	144	14.000	25

Note: These specifications were valid at the time of writing (May 2019).

For more information about available Amazon EC2 instances and pricing, see the following resources:

- Amazon EC2 Instances Types
- Amazon EC2 Pricing

Note: Selection of the EC2 instances should be done carefully because there is no EC2 node exchange or upgrade process in place. A mix of different EC2 instances in the same IBM Spectrum Virtualize cluster is not supported in the first release. Migration to a different hardware platform can be done by replication to a new cluster.

4.4.2 Amazon Elastic Block Store

All Amazon EBS volume types are designed for 99.999% availability. They fall into two categories:

- Solid-state drive (SSD)-based volumes that are optimized for transactional workloads with a small I/O size. The dominant performance attribute is IOPS.
- Hard disk drive (HDD)-based volumes that are optimized for streaming workloads, which are measured in MiBps.

Different volume types are available for Amazon EBS. They differ in performance characteristics, as shown in Table 4-2.

Table 4-2 EBC volume types

Item	SSDs		HDDs	
Volume type	General-purpose SSD	Provisioned IOPS SSD	Throughput-optimized HDD	Cold HDD
API name	gp2	io1	st1	sc1
Max IOPS / volume	16,000	64,000	500	250
Max throughput / volume in MiBps	250	1,000	500	250

Recommended EBS volume types are:

- General-purpose SDSD (gp2)
- Provisioned IOPS SSD (io1)
- Cold HDD (st1)

All volume types appear as “Enterprise Disks” tier in IBM Spectrum Virtualize for Public Cloud and the tier level should be adapted afterward according to their capabilities.

General-purpose SSD (gp2) volumes are the default volume type for EBS volumes that are created from the console. The gp2 volumes have a throughput limit of 128 MiBps - 250 MiBps depending on volume size. These volumes earn I/O credits at the baseline performance rate of 3 IOPS per GiB of volume size. For example, a 100 GiB gp2 volume has a baseline performance of 300 IOPS. When a volume below 1 TiB size requires more than the baseline performance I/O level, it draws on I/O credits in the credit balance to burst to the required performance level. For more about the EBS volume types, the I/O credits, and pricing, see the following resources:

- Amazon EBS Volume Types
- Amazon EBS Pricing

4.4.3 Amazon Web Services cost estimation

THe AWS cost depends on multiple factors:

- Bandwidth
- Virtual CPUs and memory
- Storage capacity and performance
- Duration of usage

Amazon Total Cost of Ownership (TCO) helps with AWS cost estimation.

4.5 Network and security

AWS uses a *shared responsibility model* where AWS provides a global secure infrastructure and services. AWS customers are responsible for protecting the confidentiality, integrity, and availability of their data in the cloud, and fulfillment of specific business requirements. Careful planning is required for the network environment to fulfill future scalability and performance requirements.

Important: Involve the customer network architect and the AWS architect in the early phases of planning to ensure a successful implementation.

For more information about how AWS keeps your data safe and how AWS meets compliance requirements, see AWS Cloud Security.

For more information about Amazon Security best practices, see *AWS Security Best Practices*.

4.5.1 Data security

Data security and protection can be achieved by encrypting the following types of data:

- Data in motion
- Data in use
- Data at rest

Native encryption is not supported by IBM Spectrum Virtualize for Public Cloud on AWS in the first release. However, Amazon EBS volumes can be ordered as encrypted or non-encrypted. Usage of unencrypted and Amazon EBS volumes that are encrypted with the “(default) aws/ebs” Master key are supported. Amazon EBS volumes that are encrypted with the AWS “Adminkey” are not supported. These “Adminkey” encrypted volumes generate an error and fail when a user attempts to add them to a pool.

The data-at-rest encryption occurs on the servers that host EC2 instances running the IBM Spectrum Virtualize nodes, providing encryption of data as it moves between EC2 instances and the encrypted EBS volumes. For more information, see the following resources:

- Amazon EBS features
- AWS Identity and Access Management

AWS has a full range of security IaaS. Software installation and system management must be integrated under that infrastructure consistently and securely. There are three different user types with the appropriate IAM roles that are required for successful installation and system management, as described in the following sections.

Installer

To install the IBM Spectrum Virtualize for Public Cloud from AWS marketplace, an Installer user profile should be predefined manually in the AWS IAM service. Any user can be used as the Installer if the user meets the minimum privileges of the Installer profile. There are six service-related permissions that are needed to deploy an IBM Spectrum Virtualize for Public Cloud cluster on the AWS cloud.

User

A user profile can be defined based on your own IT security policy. However, it is a best practice to limit the permissions of these users to actions that they complete as part of their daily work.

IP quorum management

IP quorum management requires permissions to access quorum-related actions.

For more information about planning an installation on AWS, see IBM Knowledge Center.

4.6 Storage performance optimization

IBM Spectrum Virtualize for Public Cloud assigns workloads to MDisks according to their physical capabilities. Those capabilities must be set manually for external MDisks like Amazon EBS volumes.

Easy Tier is a solution that you can use to optimize the most valuable storage usage and maximize Cloud Block Storage performance. Those settings are used on Easy Tier for hot extent relocation and optimal performance. By selecting the appropriate tier for the EBS volume, IBM Spectrum Virtualize may use the back-end MDisk according to its capabilities, and not underdrive or overdrive the volume.

By default, all MDisks appear in IBM Spectrum Virtualize for Public Cloud on AWS as “Enterprise” tier with the “default” **easytierload** (medium), as shown in Example 4-4.

Example 4-3 Verifying the current MDisk tier settings

```
IBM_IBM Spectrum_Virtualize:REDBOOKS-SV4PC:superuser>lsmdisk 0 | grep tier
tier tier_enterprise
easy_tier_load
IBM_IBM Spectrum_Virtualize:REDBOOKS-SV4PC:superuser>I
```

The assignment to the appropriate Easy Tier level that is shown in Table 4-3 is a best practice, and must be adjusted manually by using the **chmdisk -tier -easytierload** command.

Table 4-3 AWS assignment to Easy Tier level

Drive	AWS volume type	Easy Tier level	easytierload command flag
Provisioned IOPS SSD	io1	tier0_flash	**high**
General-purpose SSD	gp2	tier1_flash	**low**
Throughput-optimized HDD	st1	tier_nearline	**low**

In Example 4-4, you assign an Amazon EBS gp2 volume to the appropriate IBM Spectrum Virtualize for Public Cloud storage tier. Finally, you verify the tier level by running the **lsmdisk** command.

Example 4-4 Changing the MDisk tier level settings

```
IBM_IBM Spectrum_Virtualize:REDBOOKS-SV4PC:superuser>chmdisk -tier tier1_flash
-easytierload low 0
IBM_IBM Spectrum_Virtualize:REDBOOKS-SV4PC:superuser>lsmdisk 0 | grep tier
tier tier1_flash
easy_tier_load low
IBM_IBM Spectrum_Virtualize:REDBOOKS-SV4PC:superuser>
```

5

Implementation

This chapter describes how to implement an IBM Spectrum Virtualize for Public Cloud on Amazon Web Services (AWS) environment and provides detailed instructions about the following topics:

- Implementing IBM Spectrum Virtualize for Public Cloud on Amazon Web Services
- Logging in to IBM Spectrum Virtualize for Public Cloud on AWS
- Configuring the cloud quorum
- Configuring the back-end storage
- Configuring a site-to-site virtual private network IPSec tunnel for hybrid cloud connectivity in AWS Cloud
- Configuring replication from on-premises IBM Spectrum Virtualize to IBM Spectrum Virtualize for Public Cloud on AWS

5.1 Implementing IBM Spectrum Virtualize for Public Cloud on Amazon Web Services

This section contains instruction for implementing IBM Spectrum Virtualize for Public Cloud on AWS. The IBM Spectrum Virtualize for Public Cloud on AWS implementation starts from the following assumption: The required IBM Spectrum Virtualize Licenses are bought and you have access to IBM Passport Advantage.

Designed for software-defined environments (SDEs), IBM Spectrum Virtualize for Public Cloud on AWS represents a solution for public cloud implementations, and includes technologies that complement and enhance public cloud offering capabilities.

IBM Spectrum Virtualize for Public Cloud on AWS provides for the deployment of IBM Spectrum Virtualize software in public clouds in Amazon Cloud. IBM Spectrum Virtualize for Public Cloud on AWS provides a monthly license to deploy and use IBM Spectrum Virtualize for Public Cloud on AWS to enable hybrid cloud solutions, offering the ability to have storage as service in a multicloud environment.

Table 5-1 shows IBM Spectrum Virtualize for Public Cloud on AWS at a glance on Amazon Cloud.

Table 5-1 IBM Spectrum Virtualize for Public Cloud on AWS at a glance

Items	On AWS
Storage supported	Amazon Cloud Elastic Block Store (EBS)
Licensing approach	Simple, flat cost per managed terabyte and monthly licensing
Platform	IBM Spectrum Virtualize for Public Cloud on AWS installed on an Elastic Compute Cloud (EC2) instance

5.1.1 Installing IBM Spectrum Virtualize for Public Cloud on AWS

The IBM Spectrum Virtualize for Public Cloud installation uses AWS CloudFormation templates that simplify provisioning and management on AWS. These templates are available on AWS Marketplace and simplify the provisioning and installation process.

Ensure that all prerequisites are complete before you install the IBM Spectrum Virtualize for Public Cloud software from AWS Marketplace (https://aws.amazon.com/marketplace).

Note: Before installing IBM Spectrum Virtualize for Public Cloud on AWS, make sure that you have the key pair (`ssh_key`) defined and accessible after installation. This key is used to access the Bastion host and any other EC2 instances that are created and other key-based authentication.

To install the IBM Spectrum Virtualize for Public Cloud software, complete these steps:

1. Go to the IBM Spectrum Virtualize for Public Cloud BYOL Marketplace Offering (or just search for “IBM Spectrum Virtualize” on the AWS marketplace.

   If you have not done so, log in to with your AWS account, as shown in Figure 5-1.

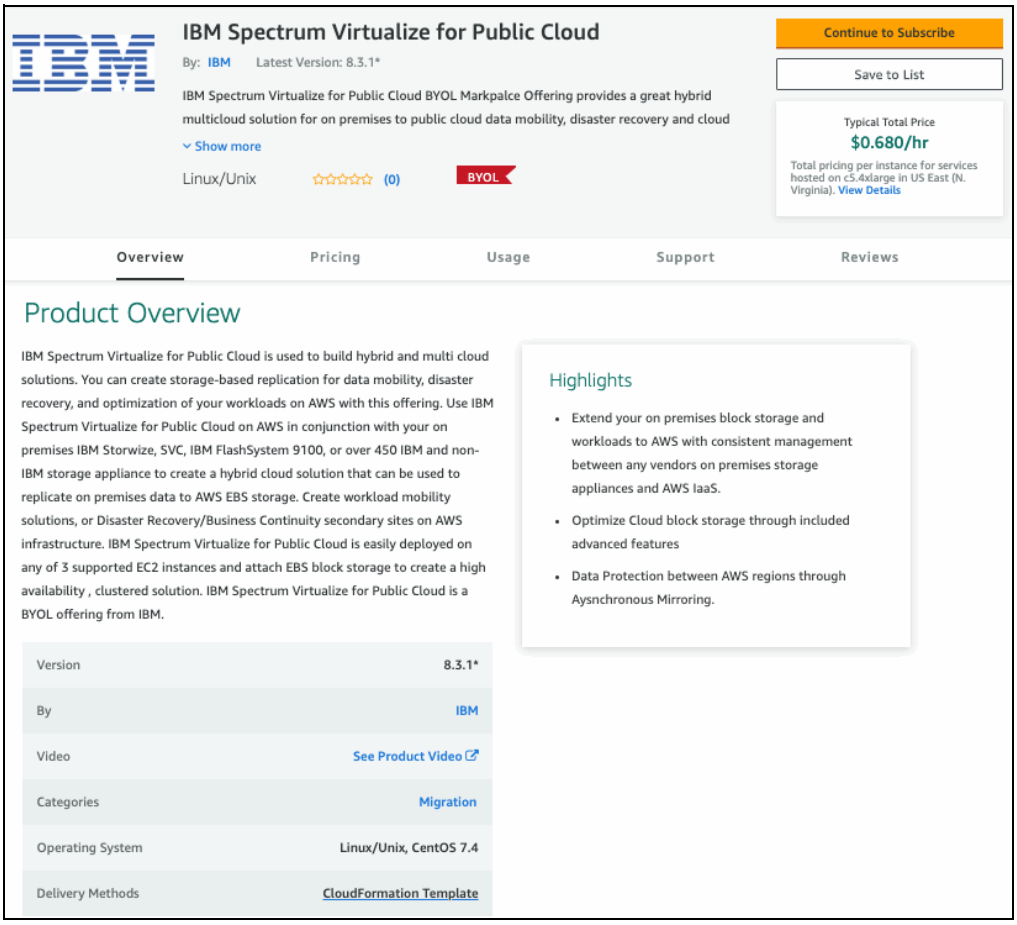

Figure 5-1 IBM Spectrum Virtualize for Public Cloud AWS Marketplace page

2. Scroll down from the **Overview** section to **Pricing** or select it from the menu items at the top of the Marketplace page, and input or validate the following information for your installation:
   - **Region**
   - **Fulfillment Option** (using an existing virtual private cloud (VPC) or a new VPC)
   - **EC2 Instance type** (The current default is c5.4xlarge.)

AWS Marketplace provides a dynamic pricing display based on your selections. If you are satisfied with your selections, click the **Continue to Subscribe** link in the upper right corner of the page and follow the instructions, as shown in Figure 5-2.

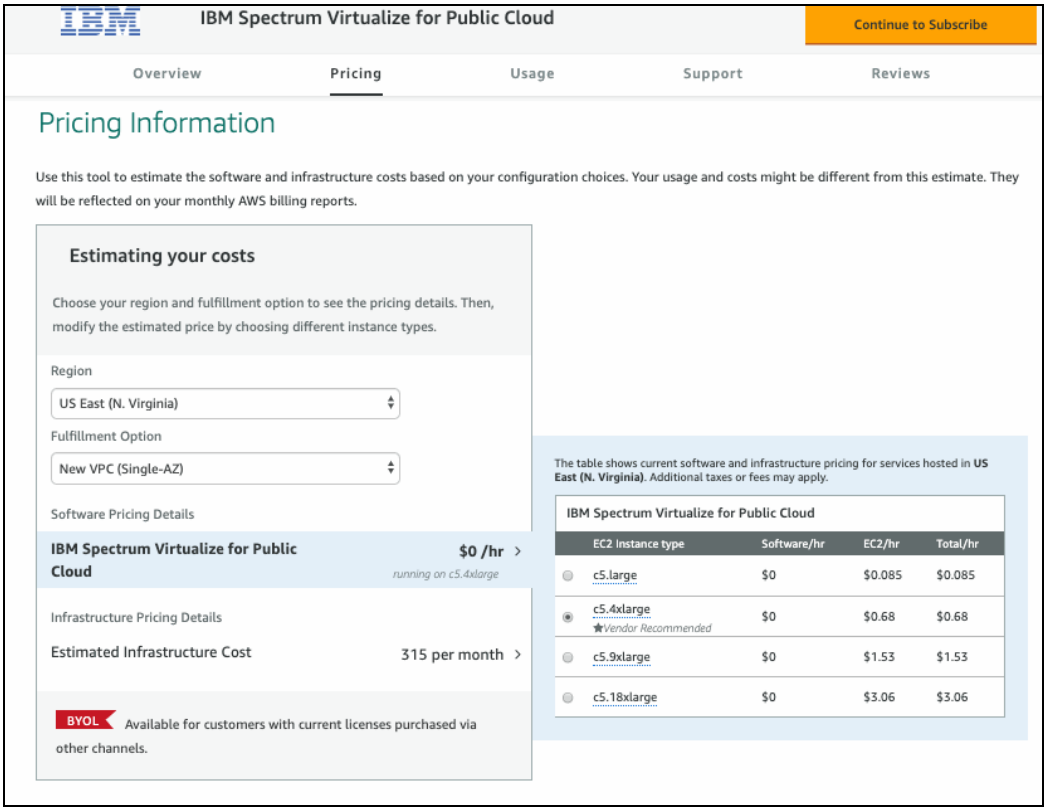

Figure 5-2 IBM Spectrum Virtualize for Public Cloud on AWS Marketplace Pricing Summary

3. The Terms and Conditions window opens and shows the Product information, as shown in Figure 5-3. After you are satisfied with what you see, click **Continue to Configuration**.

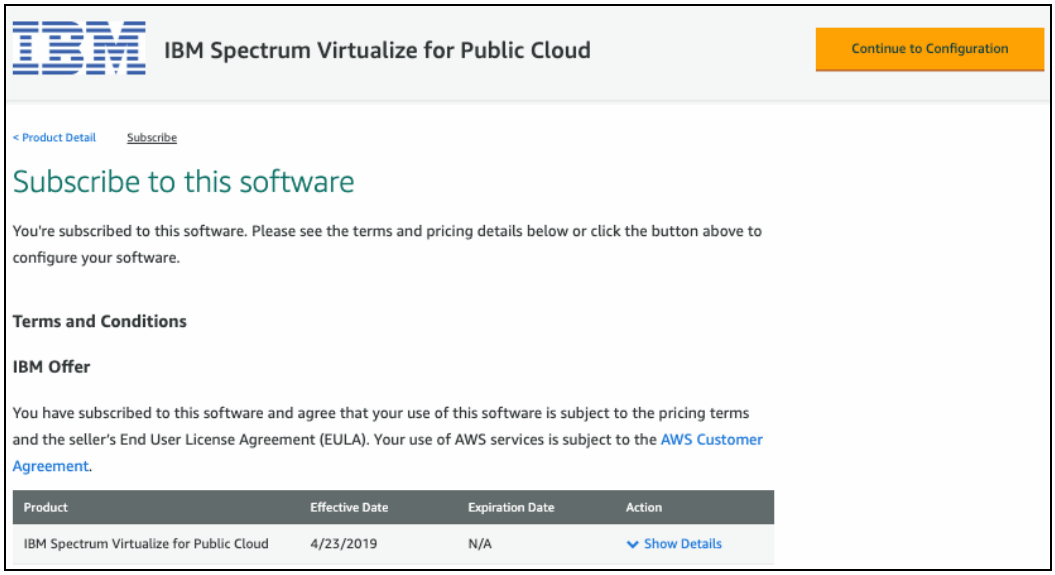

Figure 5-3 IBM Spectrum Virtualize for Public Cloud AWS Marketplace Terms and Conditions

4. Now, specify whether a New VPC is wanted or if you want to deploy into an existing VPC. In this example, we choose a new VPC, which carries the reminder that only a single Availability Zone is provided by default, so the Bastion host and the initial IP quorum are placed in the same Availability Zone as the IBM Spectrum Virtualize nodes. We elaborate on the significance of this setup and the steps to remediate it by adding another subnet in a different Availability Zone, starting a private network-only EC2 instance into that new Availability Zone, and installing the IP quorum application on that server. There is also an opportunity to change the software version if others are available, and change the region of AWS for the deployment. After all the options are finalized, click **Continue to Launch**, as shown in Figure 5-4.

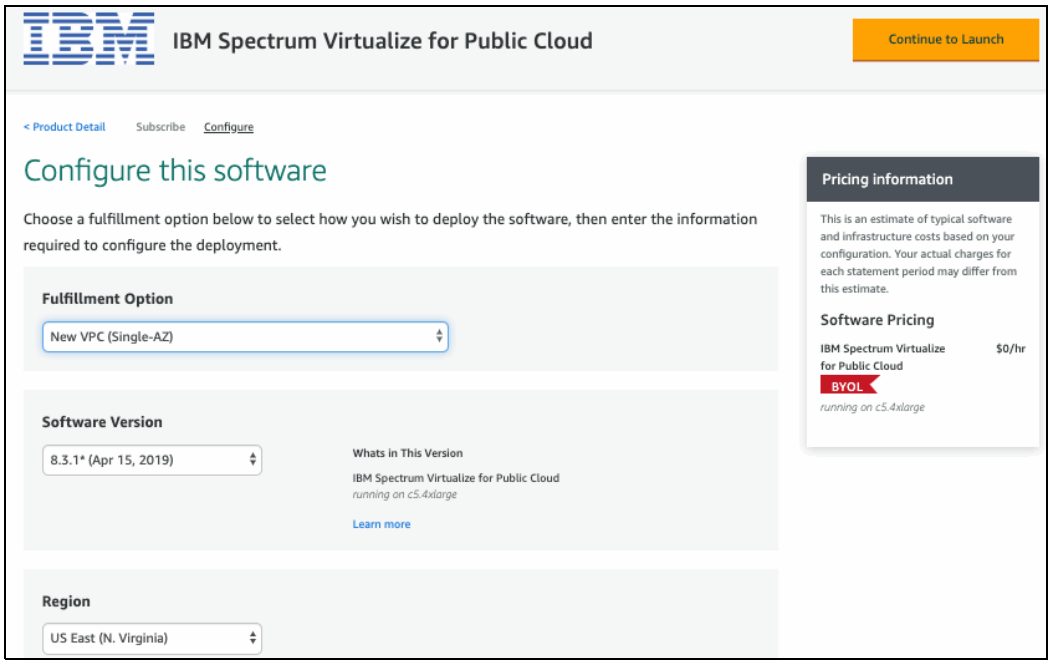

Figure 5-4 Continue to Launch

5. The CloudFormation template opens, which automates the rest of the installation after some key parameters are input. The default action is the launch of the CloudFormation process, so click **Launch**, as shown in Figure 5-5.

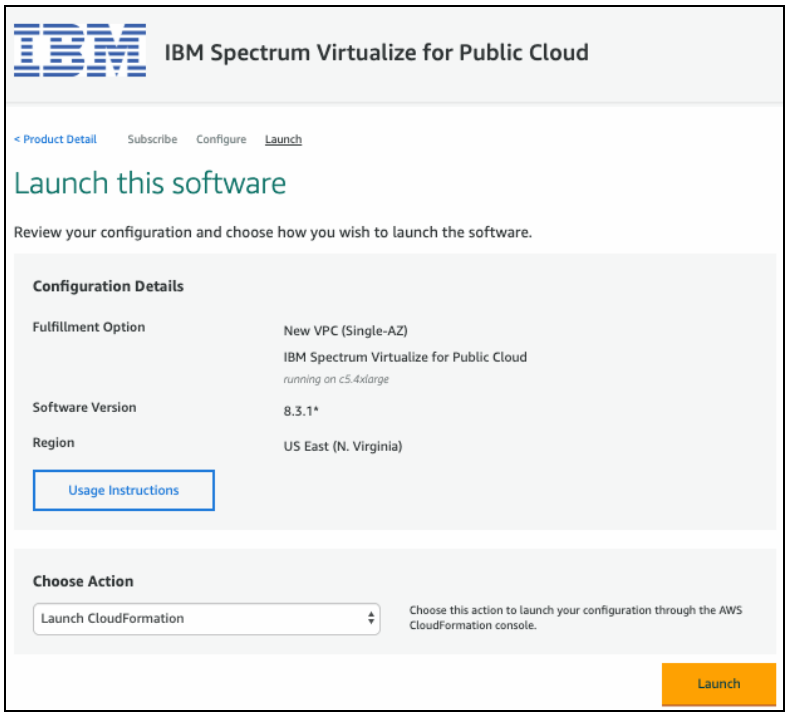

Figure 5-5 Launching the CloudFormation templates

6. Next is the stack creation process. Use the defaults and do not change the Amazon Simple Storage Service (S3) URL. This template location is provided by IBM Spectrum Virtualize for Public Cloud and contains critical information for installation automation. Click **Next**, as shown in Figure 5-6.

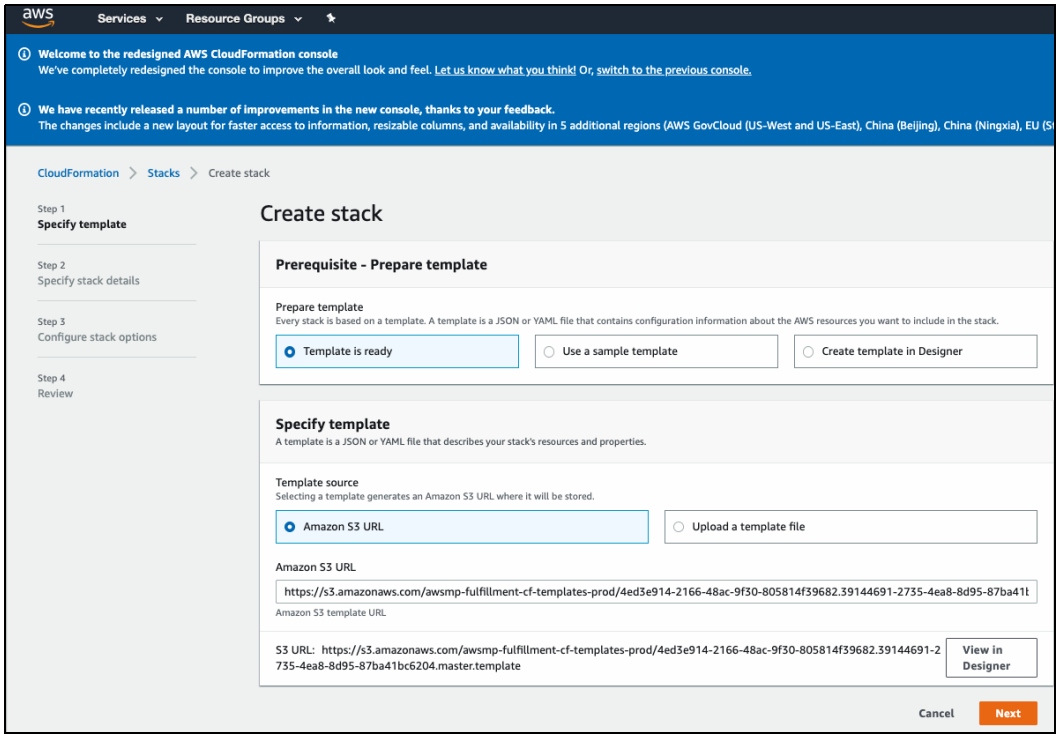

Figure 5-6 Starting the CloudFormation stack creation

7. Provide the stack name that will be the basis of the IBM Spectrum Virtualize cluster or system name. Specify the availability zone and modify the network parameters as needed. The default for the whole VPC is 10.0.0.0/16 or 10.0.0.0-10.0.255.255. The default settings are perfectly functional for public and private clouds, especially in a new VPC. For more information, see Figure 5-7.

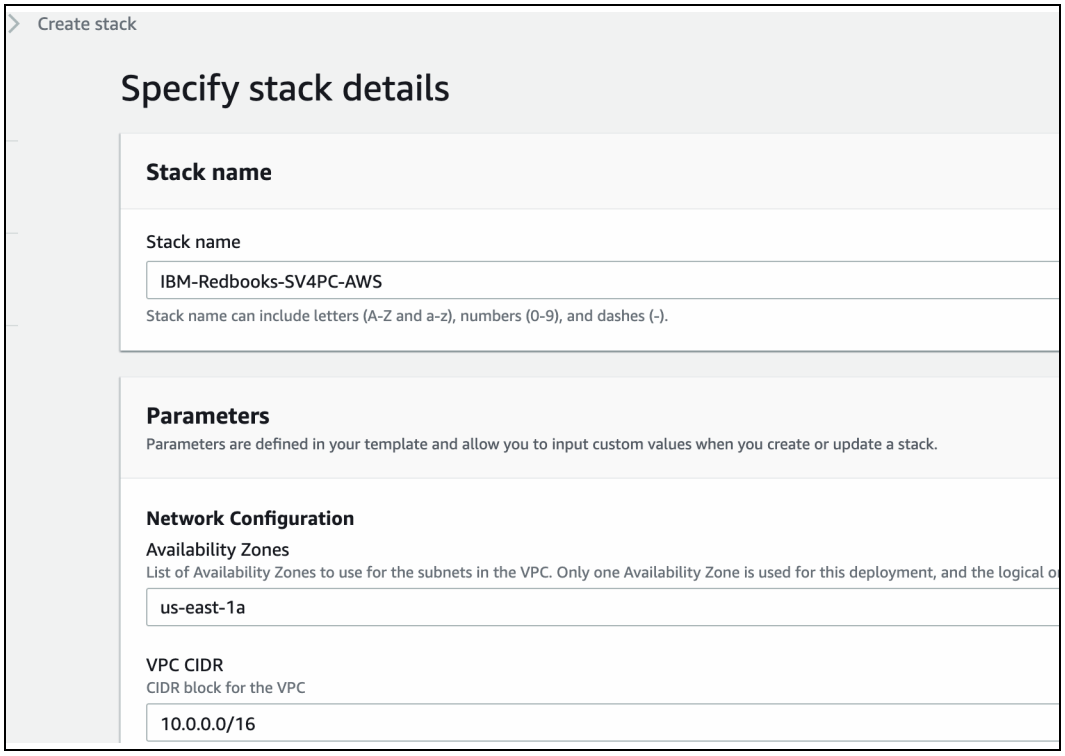

Figure 5-7 CloudFormation Stack: Name

8. Set the access filter as needed. For this example, we did not restrict which IPs were allowed to access `sv_cloud`. There is an opportunity to change the EC2 server size for the IBM Spectrum Virtualize nodes and the Bastion host, as shown in Figure 5-8.

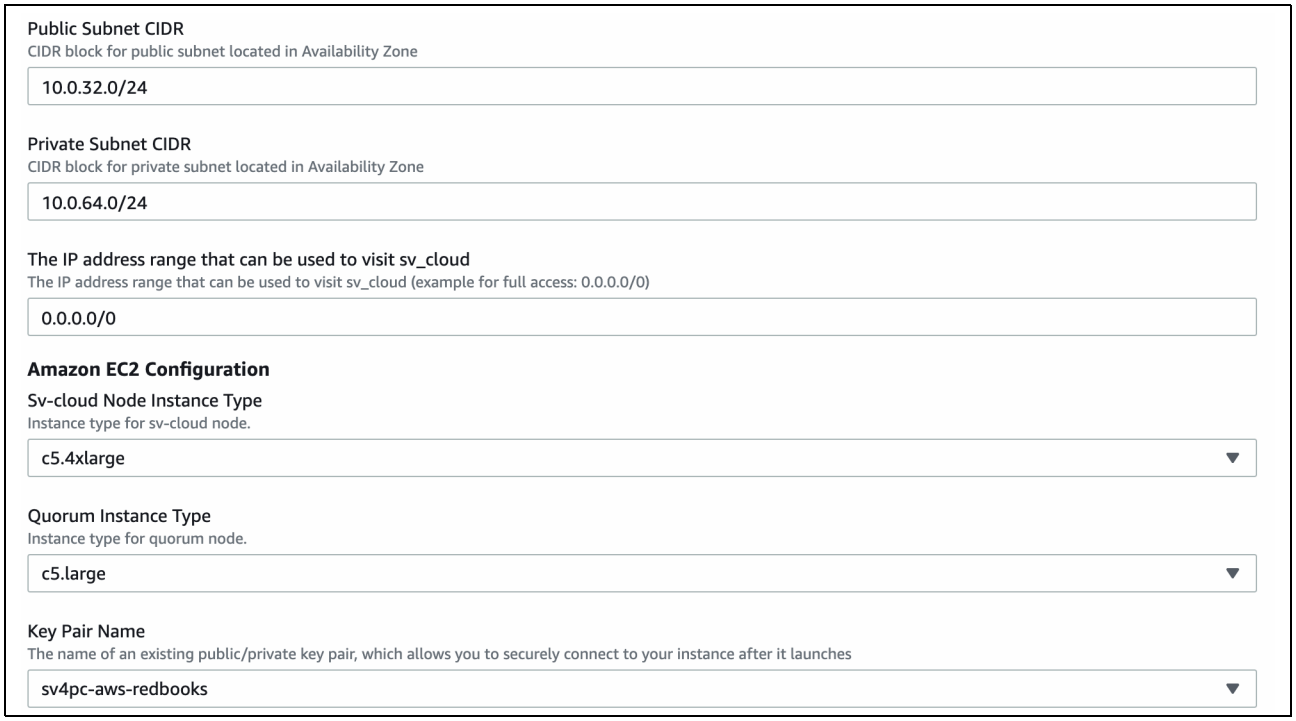

Figure 5-8 Access filter configuration

9. Finally, in the configuration page that is shown in Figure 5-9, specify the size of the two EBS gp2 volumes that are put into a pool as part of the cluster creation.

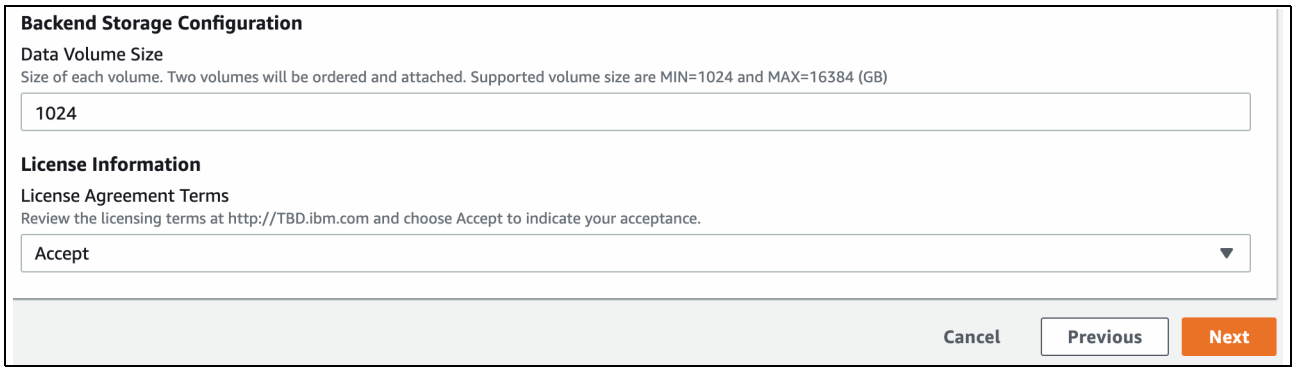

Figure 5-9 CloudFormation Stack: Initial EBS gp2 volume size

10. Next is the summary and acknowledgment page. This page has two steps. Review your selections and edit them if necessary, as shown in Figure 5-10 and Figure 5-11.

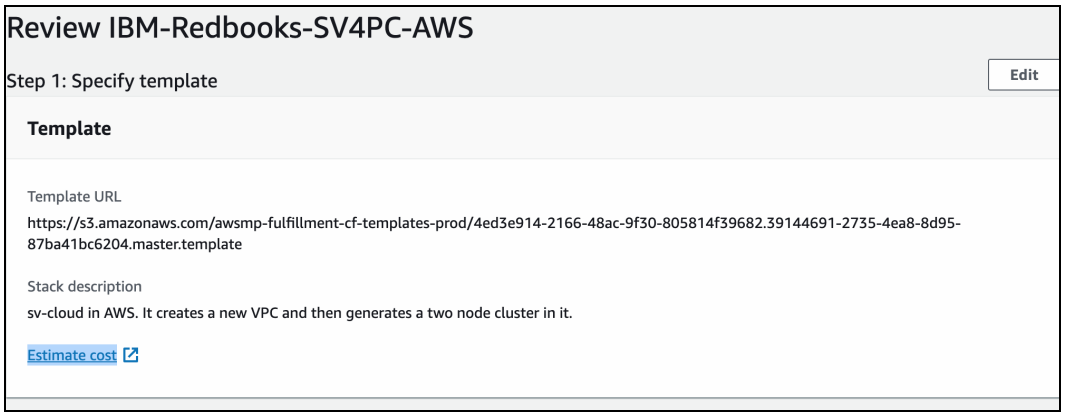

Figure 5-10 CloudFormation Stack: Use the default template

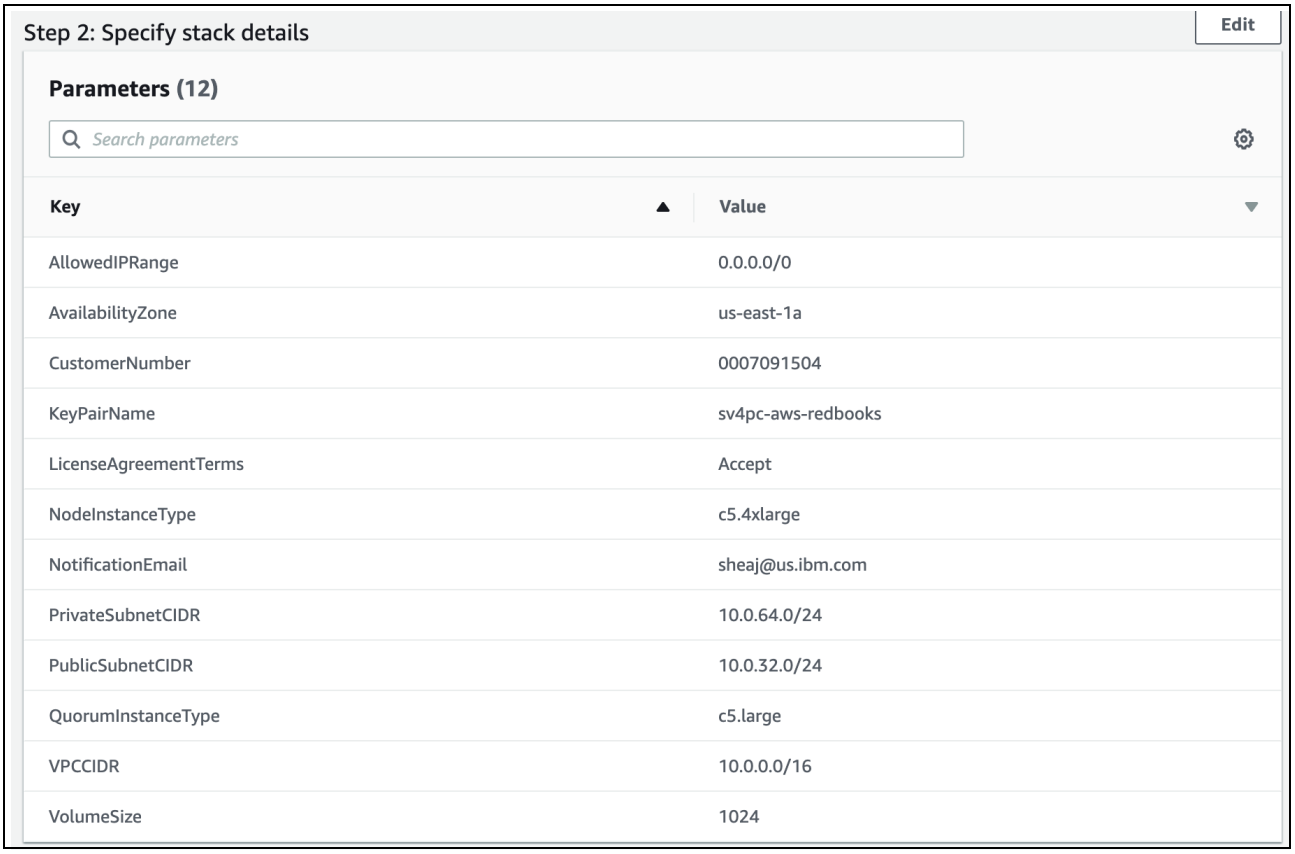

Figure 5-11 CloudFormation Stack: Review the selections

11. After you review your selections, click **Create Stack**, as shown in Figure 5-12.

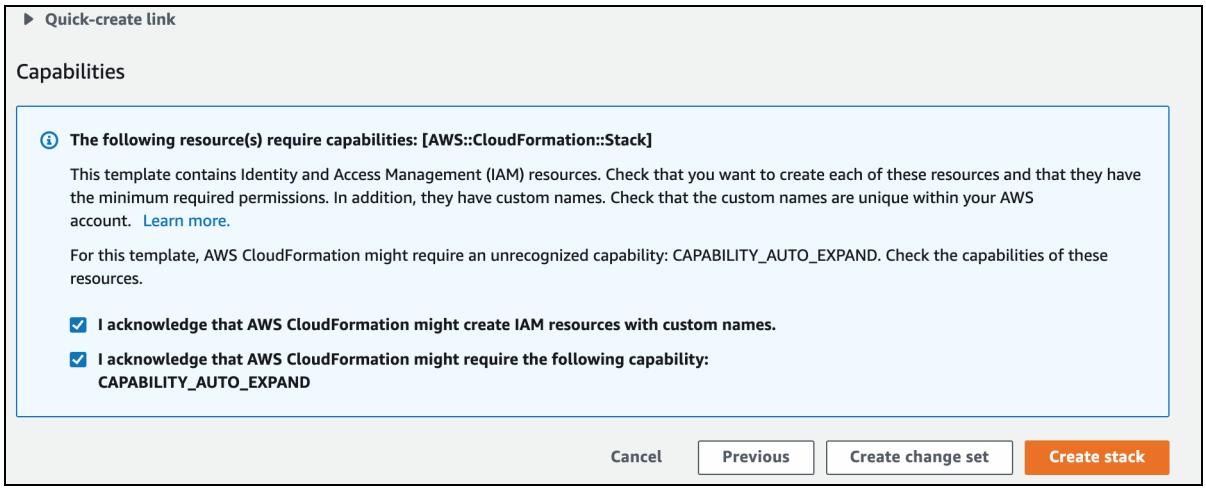

Figure 5-12 CloudFormation Stack: Create the stack

12. The stack creation process takes about 20 minutes for new VPCs and 15 minutes for existing VPCs. Progress can be monitored by going to the AWS console and selecting **CloudFormation** → **Stacks**, and then clicking the **Events** tab. After the stack and associated WorkloadStack reaches `CREATE_COMPLETE`, the environment is ready for interaction, as shown in Figure 5-13.

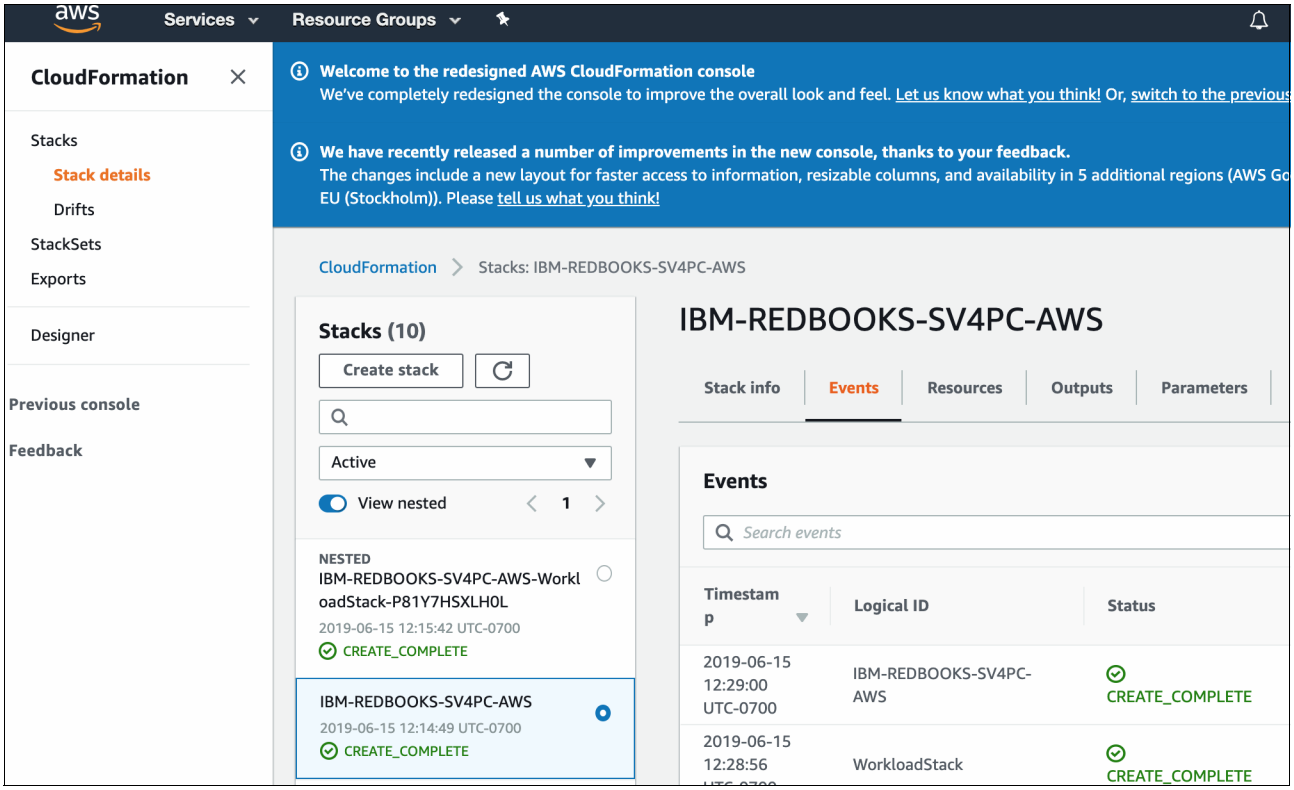

Figure 5-13 CloudFormation Stack: Creation complete

13. In this same view, you can view important IP address information by clicking the Outputs tab, as shown in Table 5-2.

Table 5-2 Output of CloudFormation auto-provisioning after AWS finishes stack creation

Name	IP address	Description
IBMSVClusterIP	10.0.64.246	IBM Spectrum Virtualize Cloud Cluster IP
IBMSVNode1Port1NodeIP	10.0.64.26	IBM Spectrum Virtualize Node1 Port1 Node IP
IBMSVNode1Port2NodeIP	10.0.64.9	IBM Spectrum Virtualize Node1 Port2 Node IP
IBMSVNode1PortIP1	10.0.64.239	IBM Spectrum Virtualize Node1 Port IP1
IBMSVNode1PortIP2	10.0.64.239	IBM Spectrum Virtualize Node1 Port IP2
IBMSVNode1ServiceIP	10.0.64.100	IBM Spectrum Virtualize Node1 Service IP
IBMSVNode2Port1NodeIP	10.0.64.50	IBM Spectrum Virtualize Node2 Port1 Node IP
IBMSVNode2Port2NodeIP	10.0.64.122	IBM Spectrum Virtualize Node2 Port2 Node IP
IBMSVNode2PortIP1	10.0.64.57	IBM Spectrum Virtualize Node2 Port IP1
IBMSVNode2PortIP2	10.0.64.57	IBM Spectrum Virtualize Node2 Port IP2
IBMSVNode2ServiceIP	10.0.64.177	IBM Spectrum Virtualize Node2 Service IP
IBMSVQuorumClientEC2IP	10.0.32.105	IBM Spectrum Virtualize Quorum Client EC2 Private IP
IBMSVVersion	8.3.0.0	IBM Spectrum Virtualize Cloud version

5.2 Logging in to IBM Spectrum Virtualize for Public Cloud on AWS

When the creation of CloudFormation is complete, you can log in to IBM Spectrum Virtualize for Public Cloud for further configuration. Because this is the only server with an externally exposed address, it has the following functions:

- The SSH jump host
- GUI proxy
- Cloud Call Home gateway
- SMTP gateway (optionally)
- Remote Support Proxy (RSP) server (optionally)
- Storage Insights DataCollector host (optionally)

5.2.1 Using SSH to access the Bastion host

Use the AWS console to access the list of EC2 instances and look for an instance that starts with your stack name and ends in `IBM-SV-QuorumNode`. Above it are the two IBM Spectrum Virtualize nodes. Select the QuorumNode instance or Bastion host and look for the IPv4 Public IP in the Description tab, as shown in Figure 5-14.

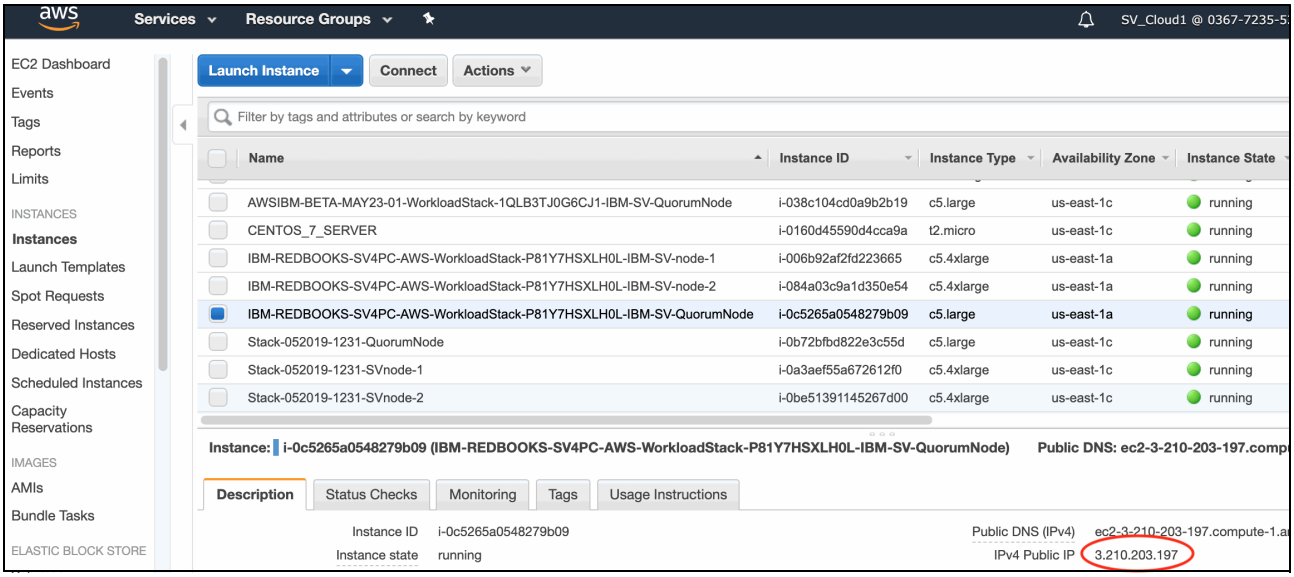

Figure 5-14 Public IP of QuorumNode (Bastion host)

Using the IP address, run **ssh** to access the Bastion host. Figure 5-15 shows the output.

```
Jacksons-MacBook-Pro:~ sheaj$ ssh -i ~/.ssh/sv4pc-aws-
redbooks.pem centos@3.210.203.197
The authenticity of host '3.210.203.197 (3.210.203.197)' can't be
established.
ECDSA key fingerprint is
SHA256:oI25L8cwai/X5wYlyywf5Wj3DjUgMRtY1cup+UWYcms.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '3.210.203.197' (ECDSA) to the list of
known hosts.

################## Welcome to sv-cloud world! ###################
# Try 'ssh cluster' to login to sv-cloud cluster.              #
# Try 'ssh node1(or node2)' to login to sv-cloud node, enjoy:) #
################################################################

[centos@svpc-bastion ~]$
```

Figure 5-15 Running ssh to access the Bastion host

5.2.2 Configuring the Bastion host

To configure the Bastion host, complete the actions in the following sections.

Enabling GUI access

Run **ssh** to access the Bastion host by using the `ssh-key` that you specified during the installation, as shown in Example 5-1.

Example 5-1 SSH connection to the Bastion host to enable GUI access to the IBM Spectrum Virtualize instance

```
[centos@svpc-bastion~]$ enable-sv-cloud-management-gui
```

Note: Port forwarding of port 8443, which is needed for GUI access, is disabled by default. For added security, you should enable it.

Configuring the Remote Support Proxy server

An *RSP* is a server that can be deployed to use the remote support assistance features that are offered in the IBM Spectrum Virtualize software. This section describes how to install the RSP server and configure the proxy in IBM Spectrum Virtualize to enable remote support connections into the cluster.

For the purposes of this book, assume that a separate virtual server is created in the environment that has access to both the public network and the private network, including routes to the subnet in which IBM Spectrum Virtualize is running. Additionally, for this guide, assume that the virtual server that is deployed is Red Hat Linux 7.x.

Complete the following steps:

1. Get the RSP software from your product support page. At the time of writing, this code is under the Others category, as shown in Figure 5-16.

Figure 5-16 Downloading code from the product support page

2. After the code is downloaded to the administrators laptop, you must upload the file to the server in which the proxy will be installed. To do so, run the **scp** command. You also must install the `redhat-lsb` package if it is not already installed. When the file is uploaded to the server and all prerequisite packages are installed, you can proceed with the installation, as shown in Example 5-2 on page 61.

Example 5-2 Installing the Remote Support Proxy

```
[root@itso-dal10-sv-rsp ~]# chmod +x
supportcenter_proxy-installer-rpm-1.3.2.1-b1501.rhel7.x86_64.bin
[root@itso-dal10-sv-rsp ~]#
./supportcenter_proxy-installer-rpm-1.3.2.1-b1501.rhel7.x86_64.bin
Starting installer, please wait...
```

Tip: In order for the installation to succeed, make sure that the required packages are installed. On Red Hat systems, install the packages `redhat-lsb` and `bzip2`. On SUSE systems, install the package `insserv`.

3. When the installer is started, you see the International License Agreement for Non-Warranted Programs. To complete the installation, enter `1` to accept the license agreement and complete the installation.
4. When the installation completes, you must configure the proxy server to listen for connections. You can do this by editing the configuration file `supportcenter/proxy.conf`, which is in the `/etc` directory. The minimum modification that is required is to edit the fields `ListenInterface` and `ListenPort`. By default, the file has “?” as the value for both of them.
5. To complete the configuration, specify `ListenInterface` with the interface name in Linux that has access to the IBM Spectrum Virtualize clusters. You can discover this name by running the **`ifconfig`** command, and identifying the interface that accesses the AWS Cloud private network. Additionally, set `ListenPort` to the TCP port number to listen on for remote support requests. A sample configuration file is shown in Example 5-3.

Tip: Note the internal address of the Bastion host. In Example 5-3, it is 10.0.32.86. We could have gotten it from the same AWS console view where we got the public IP, but it is useful to be able to find it from `ifconfig` on the server. The internal IP is used for a number of configuration items on the IBM Spectrum Virtualize system. Also, note the port that is specified for `ListenPort` of the remote proxy because it will be needed later in EasySetup for Support Proxy.

Example 5-3 Sample proxy configuration

```
[centos@svpc-bastion ~]$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.32.86 netmask 255.255.224.0  broadcast 10.93.4.127
        inet6 fe80::490:fbff:fed6:7120  prefixlen 64  scopeid 0x20<link>
        ether 06:90:fb:d6:71:20  txqueuelen 1000  (Ethernet)
        RX packets 58690  bytes 59492454 (56.7 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 15492  bytes 2239603 (2.1 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 1  (Local Loopback)
        RX packets 46  bytes 2693 (2.6 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 46  bytes 2693 (2.6 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

[root@itso-dal10-sv-rsp ~]# cat /etc/supportcenter/proxy.conf
```

```
# Configuration file for remote support proxy 1.3

# Mandatory configuration

# Network interface and port that the storage system will connect to
ListenInterface eth0
ListenPort 8988

#Remote support for SVC and Storwize systems on the following front servers
ServerAddress1 129.33.206.139
ServerPort1 443
ServerAddress2 204.146.30.139
ServerPort2 443

# Optional configuration

# Network interface (lo for local) for status queries
# StatusInterface ?
# StatusPort ?

# HTTP proxy for connecting to the Internet
# HTTPProxyHost ?
# HTTPProxyPort ?
# Optional authentication data for HTTP proxy
# HTTPProxyUser ?
# HTTPProxyPassword ?

# External logger (default is none)
# Logger /usr/share/supportcenter/syslog-logger

# Restricted user
# User nobody

# Log file
# LogFile /var/log/supportcenter_proxy.log

# Optional debug messages for troubleshooting
# DebugLog No

# Control IPv4/IPv6 usage
# UseIPv4 yes
# UseIPv6 yes
# UseIPv6LinkLocalAddress no
```

6. When the service is configured, you must start the service so that the server can start listening for requests. Optionally, you can also configure the service to start on system start. To start the service, run either the **service** or **systemctl** command. To make the service start on system start, run the **chkconfig** command. Both of these processes are shown in Example 5-4.

Example 5-4 Starting the service

```
[root@itso-dal10-sv-rsp ~]# service supportcenter_proxy start
Starting IBM remote support proxy:                         [  OK  ]
[root@itso-dal10-sv-rsp ~]# chkconfig supportcenter_proxy on
```

7. When the service starts, you are ready to configure IBM Spectrum Virtualize to use the proxy to initiate remote support requests.

5.2.3 Logging in to the IBM Spectrum Virtualize for Public Cloud cluster and completing the installation

When the installation is complete, you can log in to the IBM Spectrum Virtualize for Public Cloud on AWS cluster through the WebGUI, as shown in Figure 5-17 by using the Bastion public IP address as a proxy after the **`enable-sv-cloud-management-gui`** command is run on the Bastion host. Complete the following steps:

1. With the proxy enabled, open a browser to the Bastion public IP, and append the port ID (:8443) to access the IBM Spectrum Virtualize WebGUI. In our example, it was `https://3.210.203.197:8443`.

Figure 5-17 Logging in to WebGUI

2. You are redirected to the Welcome window. Click **Next**, as shown in Figure 5-18.

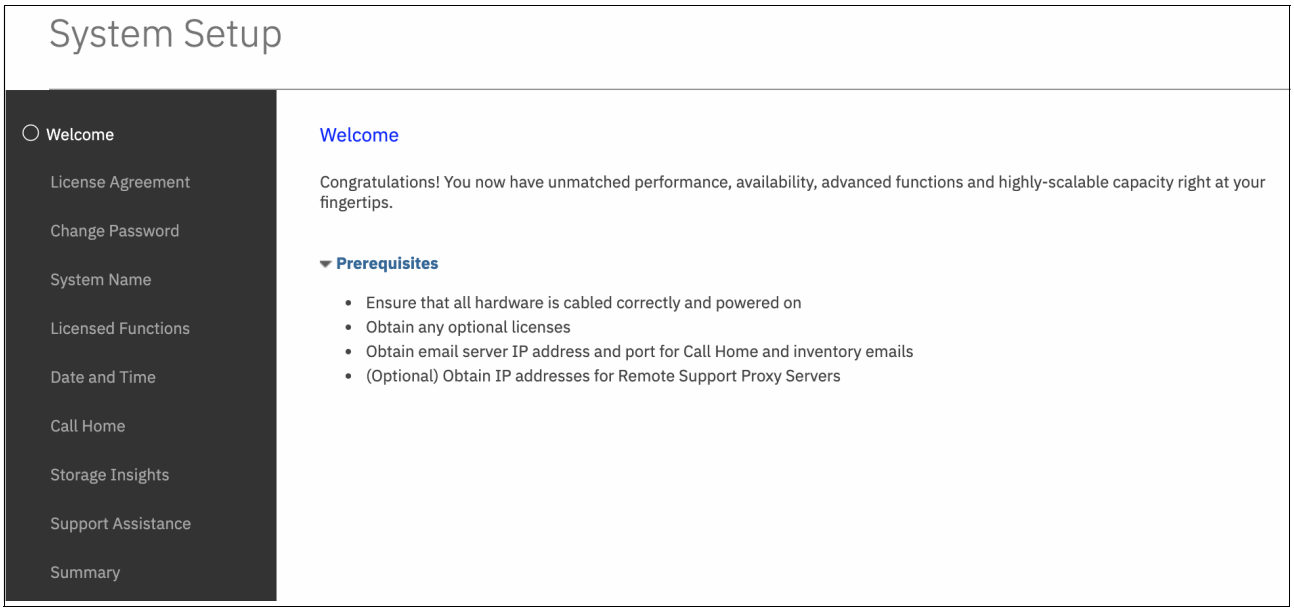

Figure 5-18 EasySetup: Welcome window

3. You are redirected to the Change Password window, as shown in Figure 5-19. Change your password, and then click **Apply** and **Next** to open the next window.

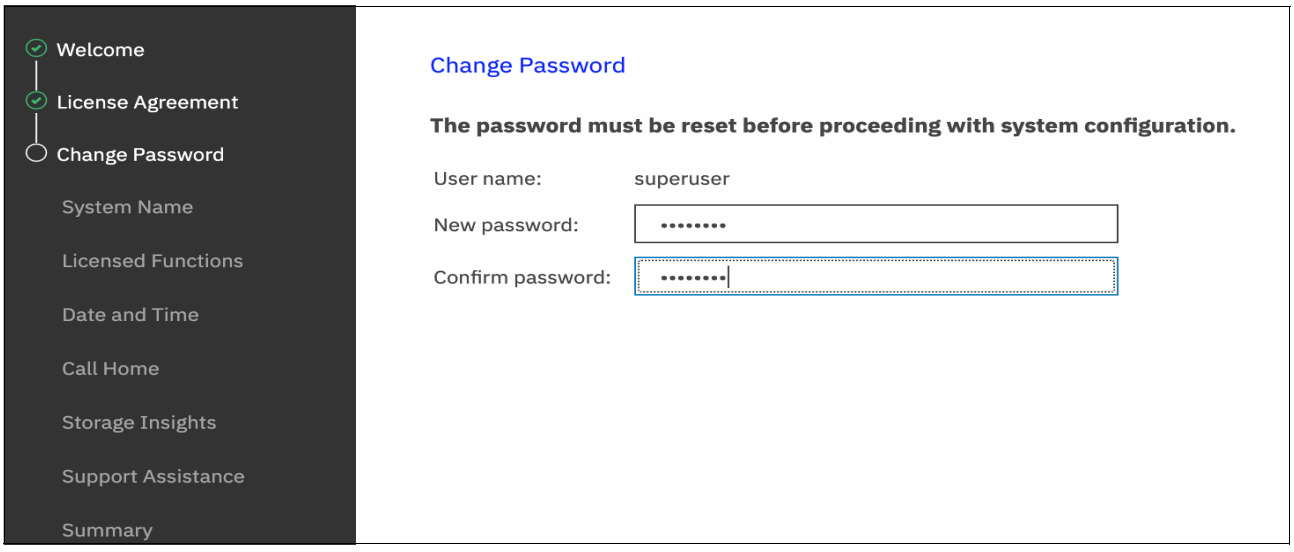

Figure 5-19 Easy Setup: Change Password

4. You can change your cluster name, which defaults to the stack ID name and -WorkloadStack-{stack unique identifier}. As a best practice, trim the unique identifier at the end, as shown in Figure 5-20. Click **Apply** and **Next** to open the next one.

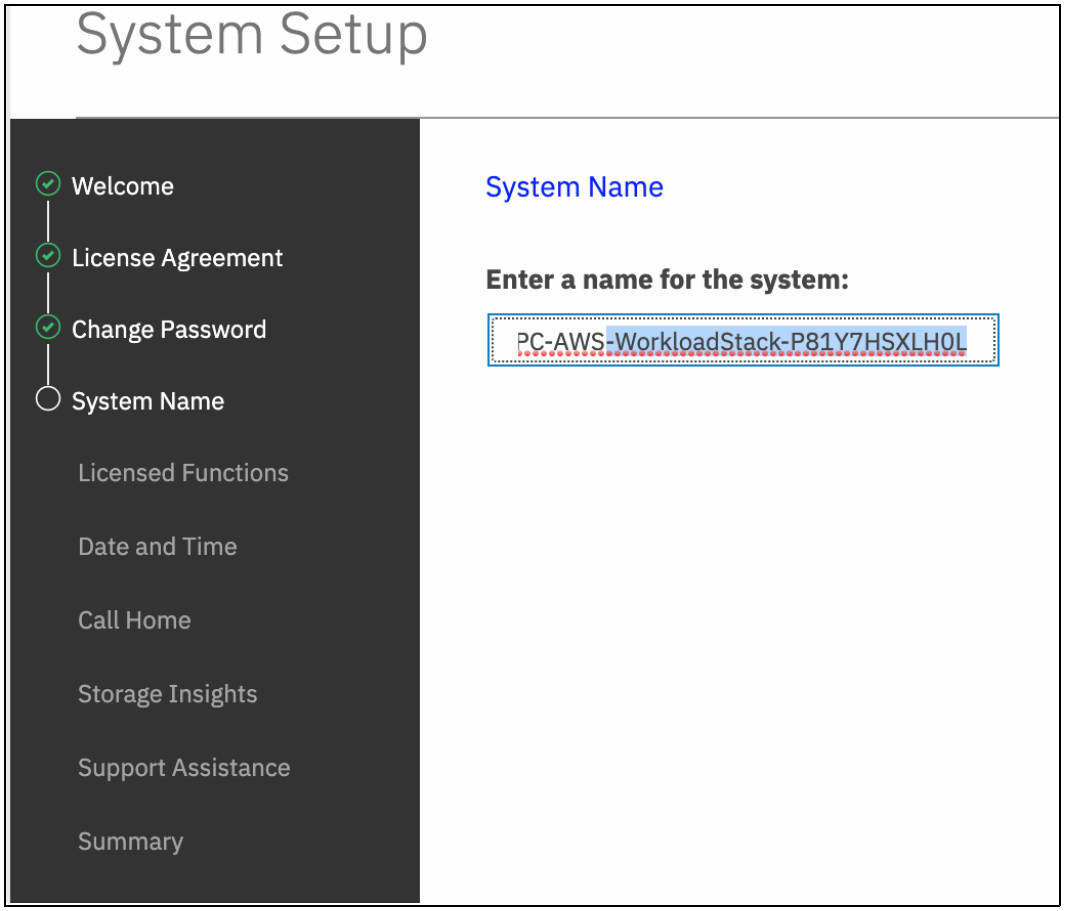

Figure 5-20 EasySetup: Trimming the system name

5. Insert your capacity license in accordance with your IBM agreement, as shown in Figure 5-21. Click **Apply** and **Next** to open the next window.

Note: An IBM Spectrum Virtualize for Public Cloud license uses simple TiB values instead of Storage Capacity Units, which keeps the licensing model simple and still realizes economic benefits through thin provisioning and IBM Easy Tier by allowing for overallocation of the EBS volumes that are purchased and allowing for the use of fewer expensive high-performance EBS volumes and cheaper low-performance volumes.

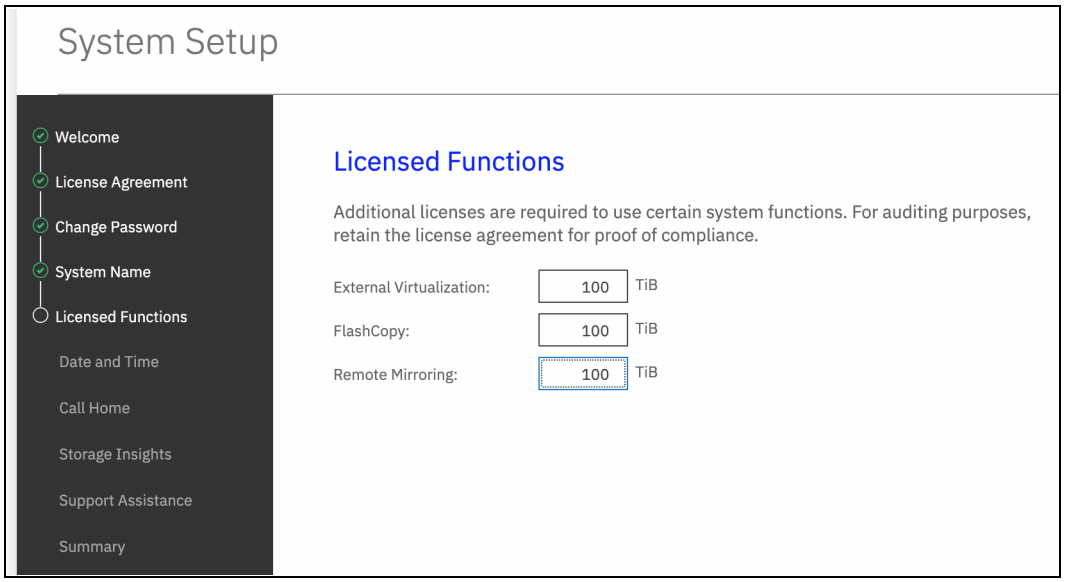

Figure 5-21 EasySetup: Licensed Functions

6. You do not need to set the Date and Time because it is controlled by AWS. IBM Spectrum Virtualize for Public Cloud on AWS is configured by the AWS time server by using underlying operating system methods. Changing the time server or setting a static time is not recommended and might cause difficulties. For more information about the AWS time server, see Setting the Time for Your Linux Instance.

   Make sure that the time zone is set. For ease of troubleshooting across multiple time zones, it is a best practice to use GMT or UTC+0, as in Figure 5-22 on page 67.

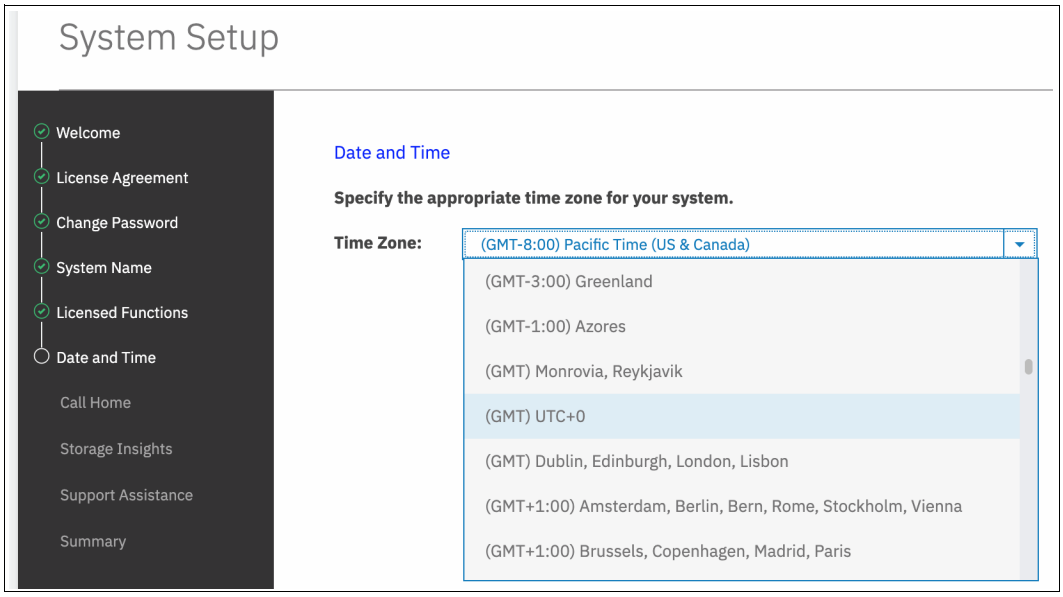

Figure 5-22 EasySetup: Time Zone

7. IBM Spectrum Virtualize for Public Cloud on AWS is preconfigured with Cloud Call Home that uses the Bastion host as a gateway. When the EasySetup process enters the Call Home configuration, Cloud Call Home verifies the connection to the support center, as shown in Figure 5-23.

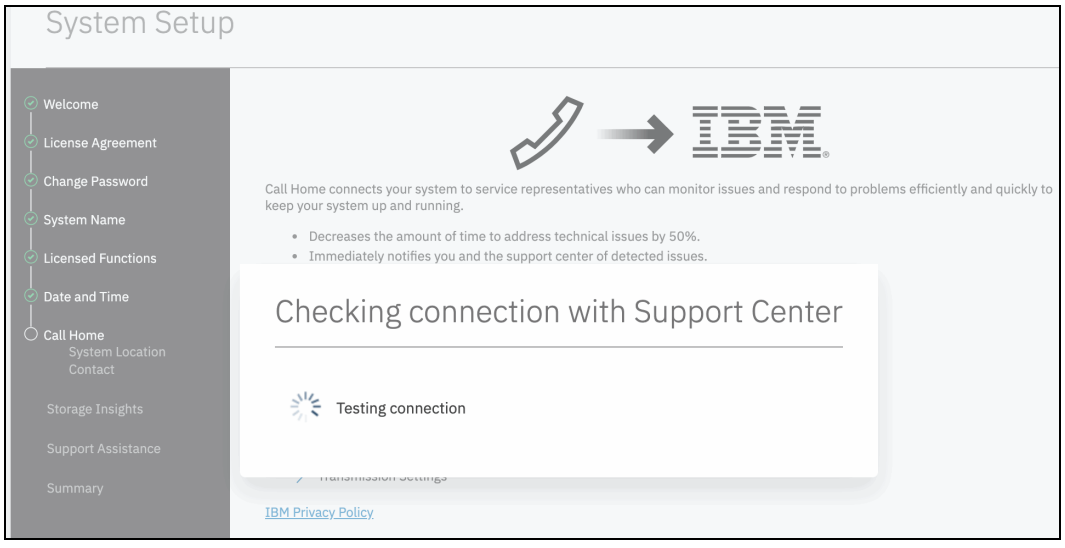

Figure 5-23 EasySetup: Cloud Call Home verification

8. This verification should succeed, as shown in Figure 5-24, which is the System Location window.

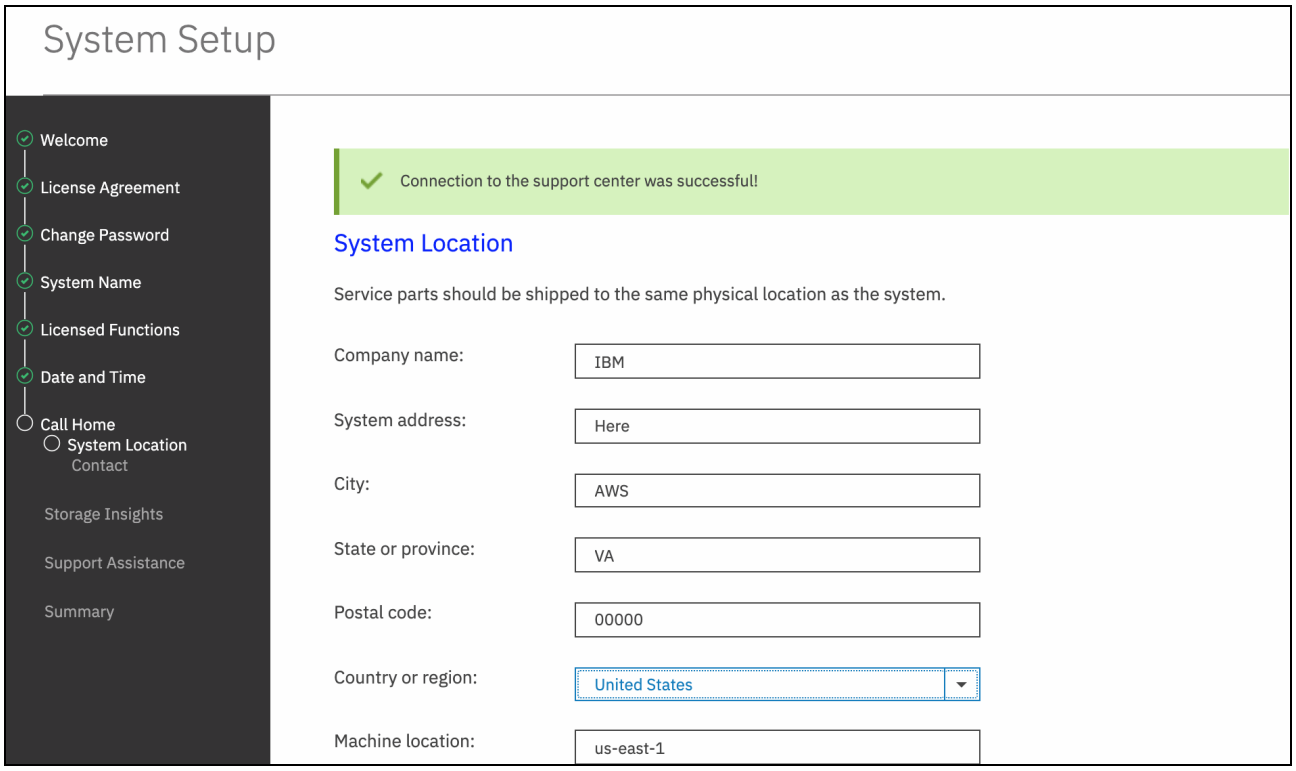

Figure 5-24 EasySetup: Successful Cloud Call Home and System Location information

9. Finish the Call Home configuration by entering the contact information, as shown in Figure 5-25.

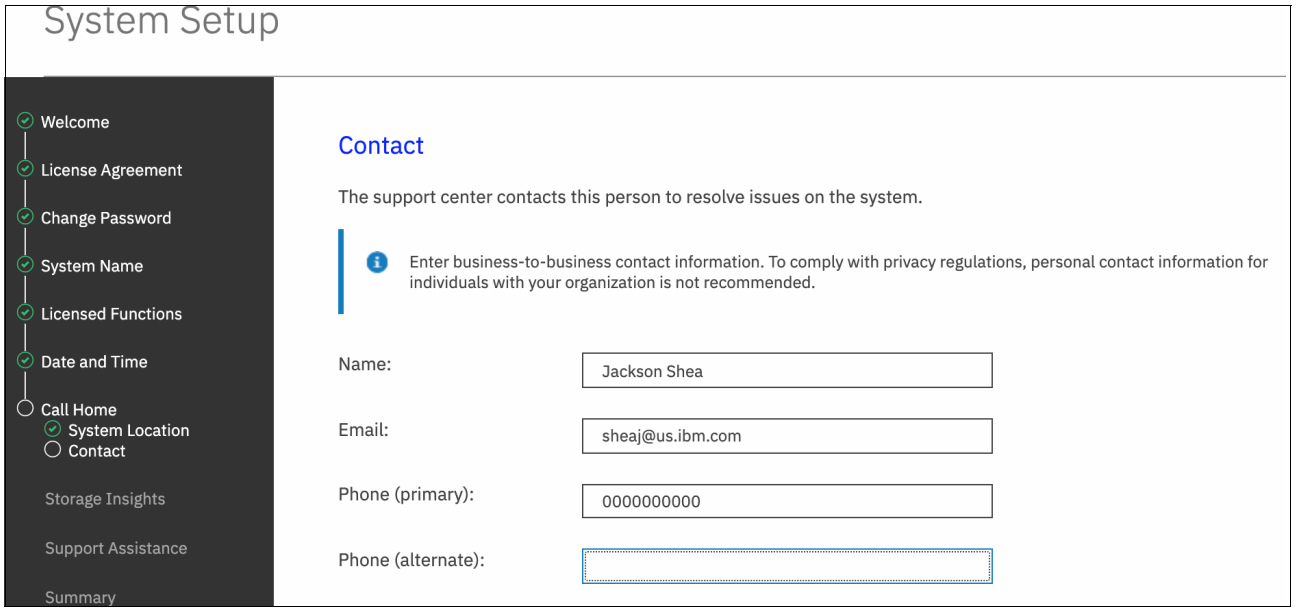

Figure 5-25 EasySetup: Contact information

10. Next is the IBM Storage Insights configuration, which you do not have to do during EasySetup. It requires registering for a no-charge account and installation of a DataCollector, which can be installed on the Bastion host. Figure 5-26 shows the IBM Storage Insights configuration window. Skip this step for now.

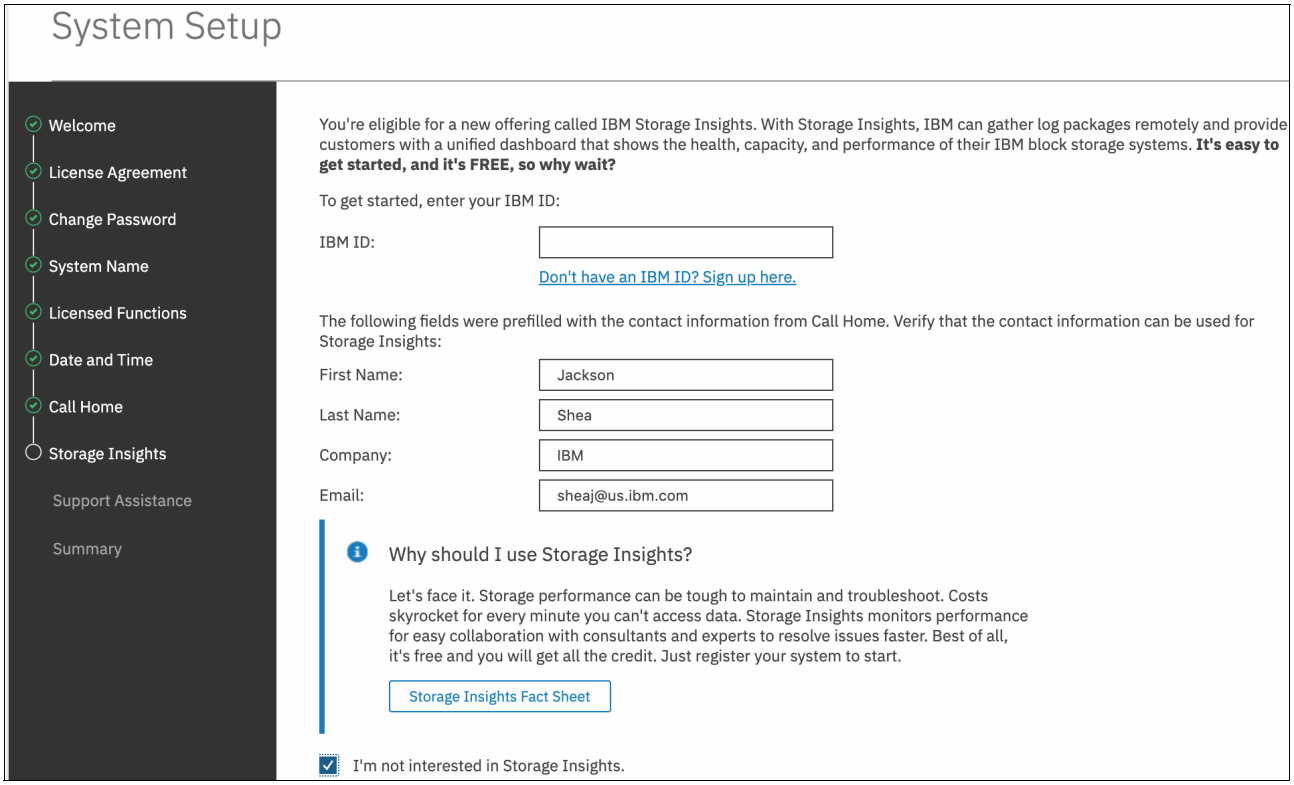

Figure 5-26 EasySetup: IBM Storage Insights

11. Configure your RSP, as shown in Figure 5-27.

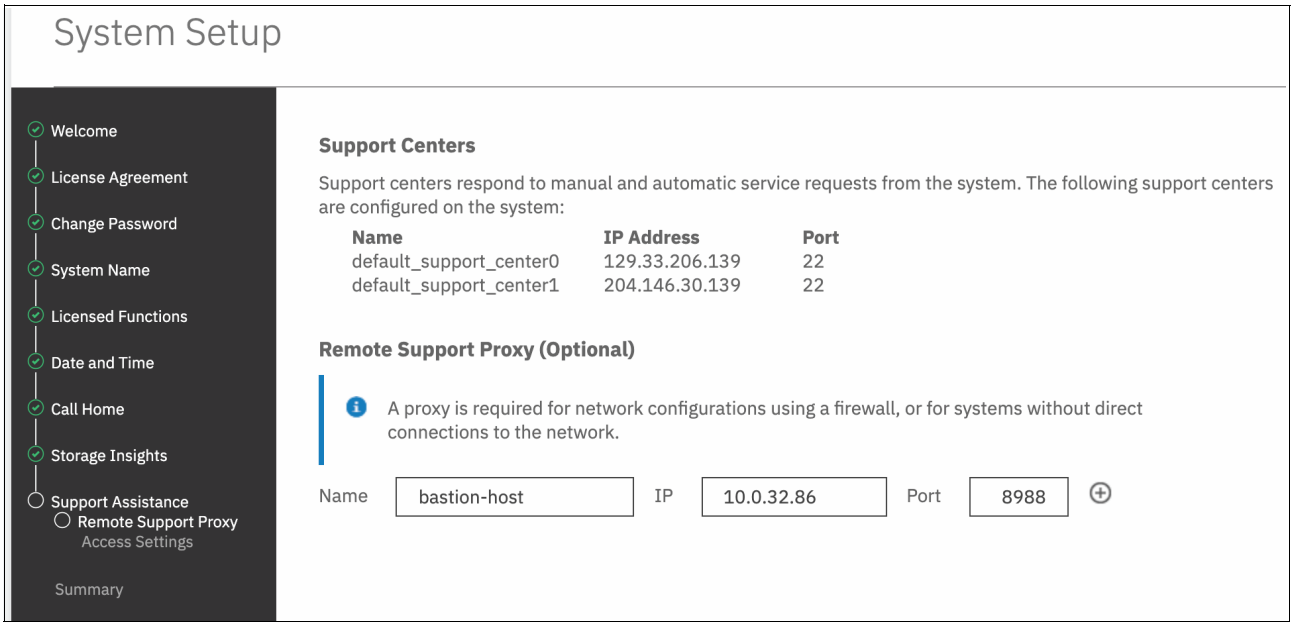

Figure 5-27 EasySetup: Remote Support Proxy

Note: This step assumes that you have deployed an RSP. Again, the Bastion host is a logical choice. Note the internal IP address of the Bastion host and the `ListenPort` that was specified in 5.2.2, “Configuring the Bastion host” on page 60.

12. Figure 5-28 shows a summary of your configuration. Your cluster setup is complete.

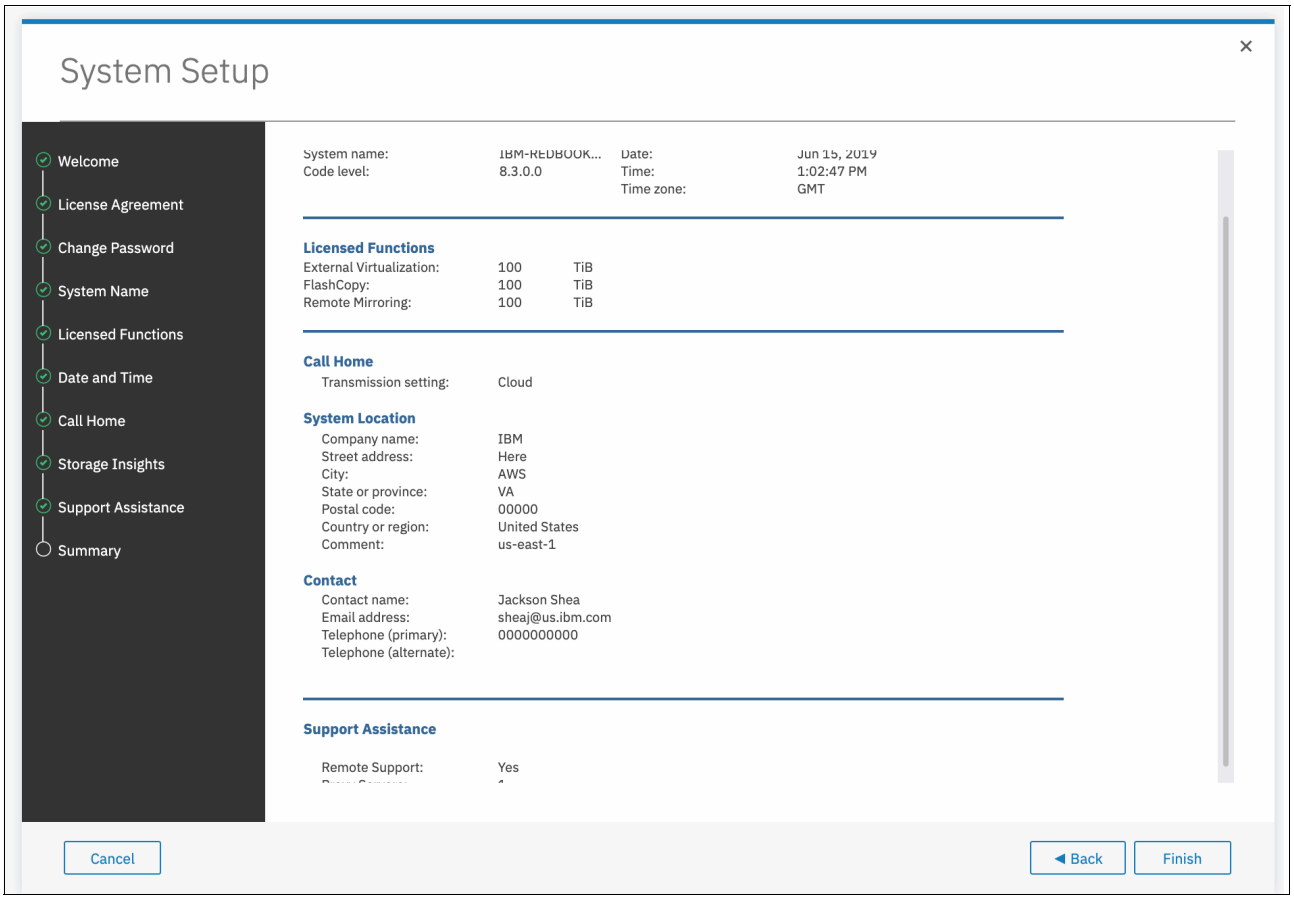

Figure 5-28 EasySetup: Summary

Note: Call Home is set up with Cloud Call Home. However, email notification is useful for event notification and can be set up after the EasySetup process is done. The Bastion host runs an SMTP service and can be used as the email gateway.

5.3 Configuring the cloud quorum

IP quorum applications are used in Ethernet networks to resolve failure scenarios when half the nodes on the system become unavailable. These applications determine which nodes can continue processing host operations and avoids a split-brain scenario where both halves attempt to service independently I/O, which causes corruption. As part of the installation of IBM Spectrum Virtualize for Public Cloud on AWS, a Bastion host is provisioned and the IP quorum application is installed and configured on this instance. This Bastion host operates as the IP quorum and the network gateway for the configuration.

Note: An IP quorum is configured during the installation. You configure an extra IP quorum only if you want to enhance the fault tolerance by putting the active one in a different Availability Zone for installations into new VPCs.

There are strict requirements on the IP network with using IP quorum applications. All IP quorum applications must be reconfigured and redeployed to hosts when certain aspects of the system configuration change. These aspects include adding or removing a node from the system or when node service IP addresses are changed.

Other examples include changing the system certificate or experiencing an Ethernet connectivity issue.

An Ethernet connectivity issue prevents an IP quorum application from accessing a node that is still online.

If an IP application is offline, it must be reconfigured because the system configuration changed.

To view the state of an IP quorum application in the management GUI, select **Settings** → **System** → **IP Quorum**, as shown Figure 5-29.

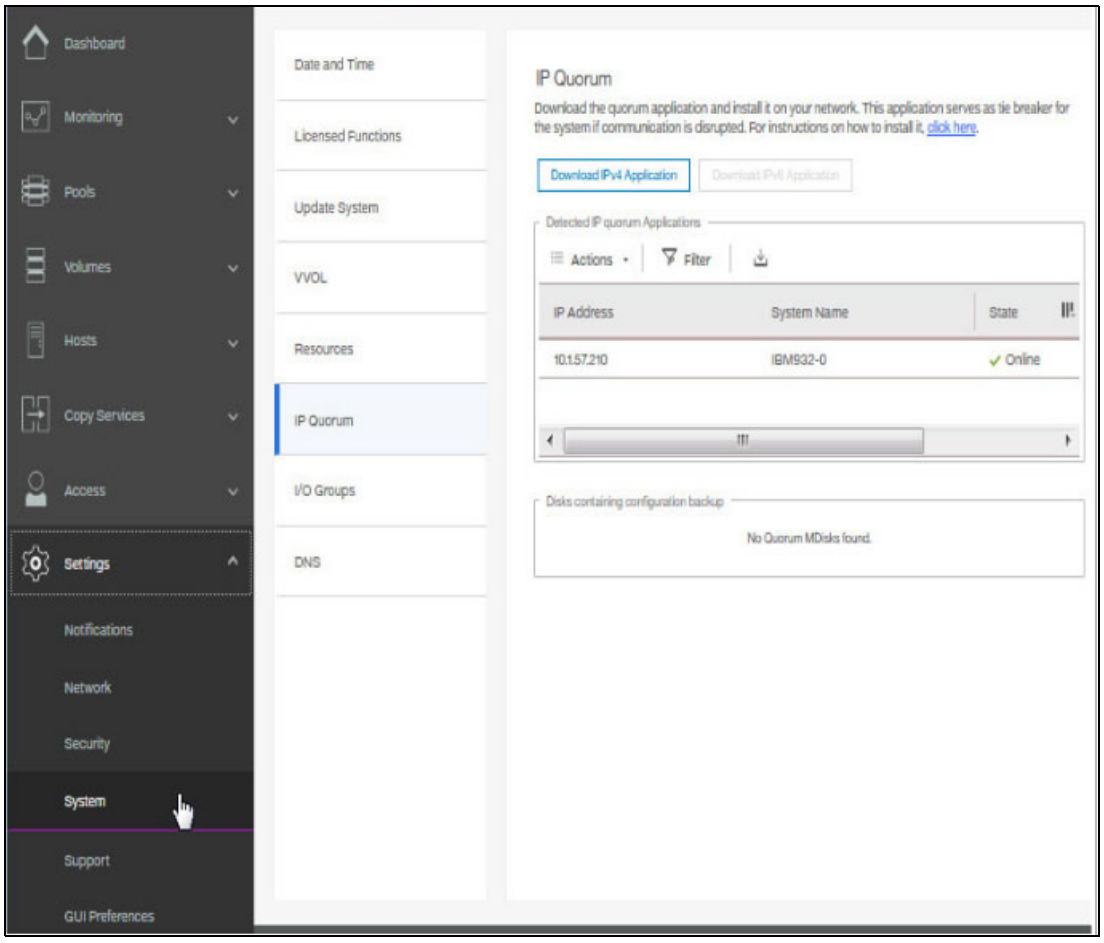

Figure 5-29 IP quorum example from the GUI

Even with IP quorum applications on an EC2 instance, quorum disks are required on each node in the system to contain backups of the configuration and recovery information. On-EC2 instances where IBM Spectrum Virtualize connectivity with its nontraditional back-end storage connectivity, the quorum disks cannot be on external storage or internal disk as in SAN Controller Volume or FlashSystem systems. Therefore, they are automatically allocated on the EC2 instance boot device for each IBM Spectrum Virtualize node.

The IBM Spectrum Virtualize command **`lsquorum`** shows only the IP quorum.

The maximum number of IP quorum applications that can be deployed is five. Applications can be deployed on multiple hosts to provide redundancy.

For stable quorum resolutions, an IP network must provide the following requirements:

- Connectivity from the servers that are running an IP quorum application to the service IP addresses of all nodes.
- The network must also deal with the possible security implications of exposing the service IP addresses because this connectivity can also be used to access the service assistant interface if the IP network security is configured incorrectly.
- Port 1260 is used by IP quorum applications to communicate from the hosts to all nodes.
- The maximum round-trip delay must not exceed 80 milliseconds (ms), which means 40 ms each direction.
- A minimum bandwidth of 2 MBps is guaranteed for node-to-quorum traffic.

IBM Knowledge Center describes the IP quorum configuration.

Note: The current Cloud Formation Template (CFT) for new VPCs deploys the Bastion host (which houses the initial IP quorum device) into the same Availability Zone as the IBM Spectrum Virtualize nodes. If deploying into an existing VPC, it is possible to place that Bastion host on a subnet that is in a different Availability Zone from the IBM Spectrum Virtualize nodes.

However, if you are deploying into a new VPC that is created as part of the IBM Spectrum Virtualize installation process, it is a best practice that you create a new subnet in that VPC that belongs to a different Availability Zone. Then, start a new secure EC2 instance by using only a private interface in that new subnet with no direct access from the internet. Then, you deploy an IP quorum application on that server and restart the one on the Bastion host so that the secure, redundant IP quorum is the active quorum device.

In summary, here are the steps for deploying a second IP quorum server with a new VPC:

1. Create a subnet within the VPC in a different Availability Zone than the IBM Spectrum Virtualize nodes and Bastion host.
2. Start a new EC2 instance. You can use the Amazon Linux Amazon Machine Images (AMI) 2018.03.0 image from the quick start because it has Java preinstalled. The default type of t2.micro is suitable but do *not* select **Review and Launch**.
3. Click **Next: Configure Instance Details** and select the correct VPC and subnet that you created in step 1. Leave **Public IP** disabled for added security and use an existing security group (same as the Bastion host).
4. Click **Review and Launch** to review the configuration and then click **Launch**.
5. Select the keypair that was used during the creation of the cluster because the keypair is needed to access the new EC2 instance.
6. After the instance is provisioned, run the **scp** command on the private key that is used to access the Bastion host over *to* the Bastion host.
7. Run **ssh** to access the Bastion host and run **scp** to transfer the `ip_quorum.jar` file from the Bastion host over to the new EC2 instance by using the private key:

   ```
   scp -i ~/.ssh/privkey.pem /usr/local/bin/ip_quorum.jar ec2-user@{new EC2 IP}:
   ```

8. Run **ssh** to access the new EC2 instance and test the ip_quorum service:

   ```
   java -jar ~/ip_quorum.jar
   ```

9. Set up the quorum as a service or install a cronjob to ensure that it is always running.
10. Exit the new EC2 instance and restart the `ip_quorum` service on the Bastion host:

    ```
    systemctl restart ip-quorum
    ```

5.4 Configuring the back-end storage

IBM Spectrum Virtualize for Public Cloud on AWS uses the back-end storage that is provided by AWS Cloud EBS as external MDisks. As part of the initial default installation, two gp2 EBS volumes are allocated and put into a pool on the IBM Spectrum Virtualize cluster (Figure 5-30). If more or even different storage is want, complete the following steps.

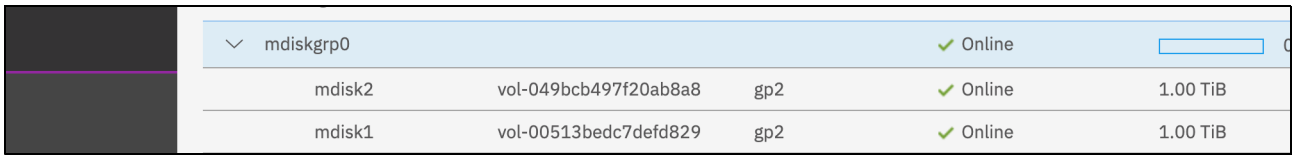

Figure 5-30 Default EBS gp2 volumes that are specified during CloudFormation template configuration

1. To order back-end storage, log in to the AWS Console.
2. Sign in to the AWS Console, click **Services** in the upper left corner of browser window, and then click **EC2**.
3. Under Resources, click **Volumes**. In the window that opens, you can create volumes and view current volumes.

> **Note:** The AWS CloudFormation template provides two gp2 EBS volumes of a size that is specified during the CloudFormation template configuration for use with your IBM Spectrum Virtualize cluster.
>
> Either before adding EBS volumes to a storage pool or as a part of the assignment process, be sure to follow the recommendation for properly aligning the EBS volume type to IBM Spectrum Virtualize performance expectations in accordance with Table 4-2 on page 44.

4. To create a volume, click **Create Volume** in upper left of the window.

5. Select the volume type and size of the volume that is required, as shown in Figure 5-31.

> **Note:** When you create an EBS volume, ensure that you choose the same Availability Zone as the IBM Spectrum Virtualize for Public Cloud on AWS instance.

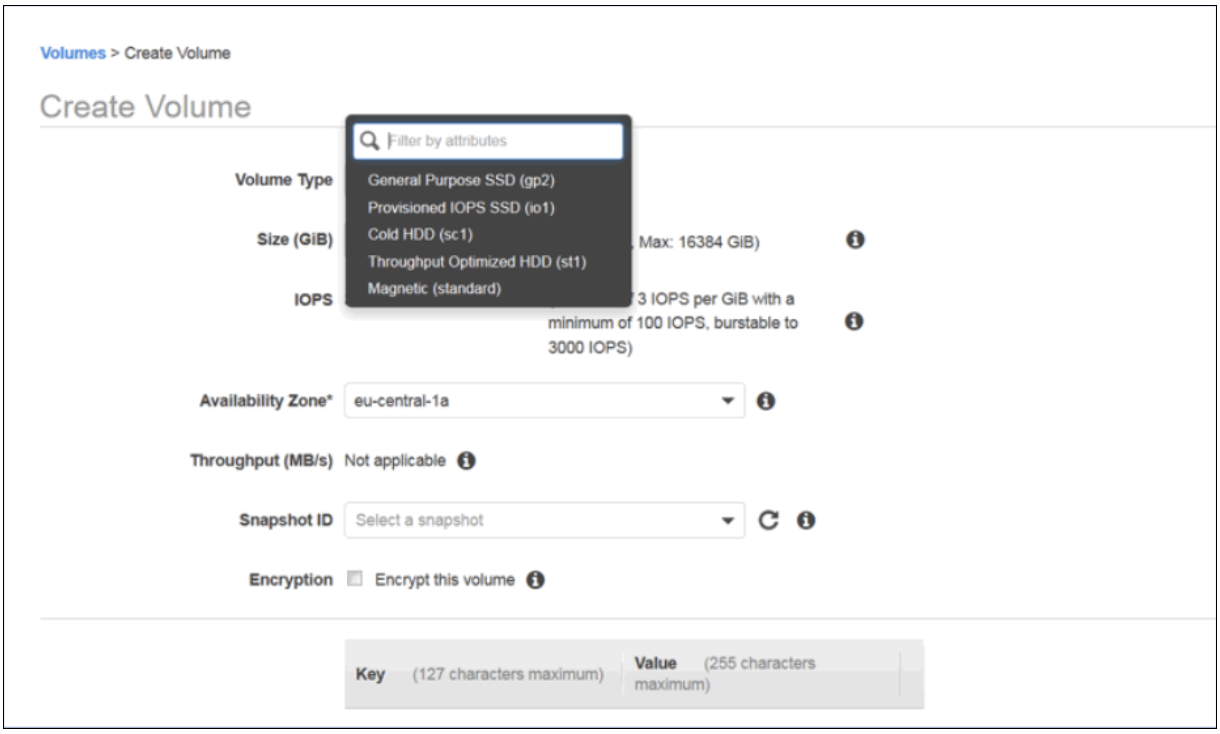

Figure 5-31 EBS: Create Volume on the AWS Console

Volumes that are created are viewable on the AWS Console in the **EBS volumes** section, and they should have a status of *Available*.

As shown in Figure 5-32, there are two pools that are created on IBM Spectrum Virtualize for Public Cloud on AWS and each pool has one MDisk assigned, which is the EBS external storage that is purchased on AWS Cloud.

6. To create pool on IBM Spectrum Virtualize for Public Cloud on AWS, log in to the IBM Spectrum Virtualize for Public Cloud on AWS GUI and select **Pools** → **Create Pool**.

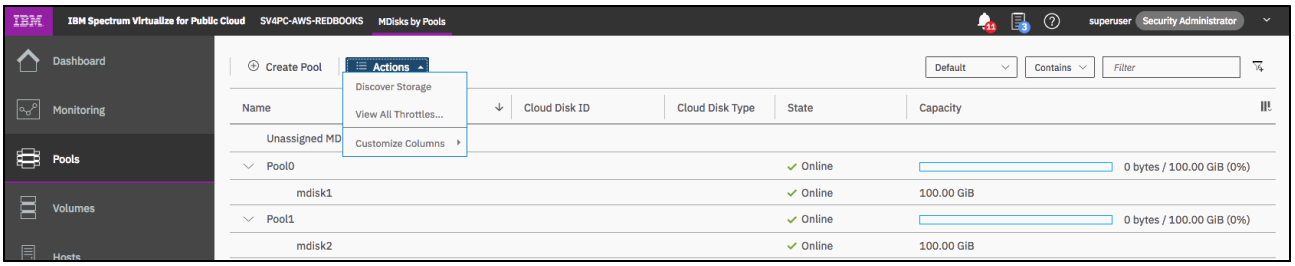

Figure 5-32 Pool creation

7. After the pool is created, select **Action** → **Discover Storage**, as shown in Figure 5-32 on page 75. The EBS volumes that were purchased on AWS Cloud and are free and unused are visible under Unassigned MDisk. To cross-verify that the correct volume is added to the pool, check to see whether the EBS Volume ID is the same volume ID that is seen on the AWS Cloud console.
8. Add storage in the form of MDisks to the pool. There can only be 16 MDisks per I/O group.
9. Now, you can create a VDisk and assign the volume for host access by using iSCSI.

5.4.1 Configuring an IBM Spectrum Virtualize volume

In this section, you create a volume by using the pool that was created with the EBS volumes or MDisks. Volumes can be fully allocated or thinly provisioned (space-efficient). The default pre-allocation that is indicated by the command-line interface (CLI) below Example 5-5 is 2% (specified by the real size (rsize)). You have 98% of the capacity for the volumes that is available in the pool for other volumes until this volume claims it.

Example 5-5 Thinly provisioned (space-efficient) volume creation by using the CLI

```
svctask mkvdisk -autoexpand -grainsize 256 -mdiskgrp 2 -name thin-test -rsize 2%
-size 32212254720 -unit b -warning 80%
```

Figure 5-33 shows thinly provisioned (space-efficient) volume creation by using the GUI.

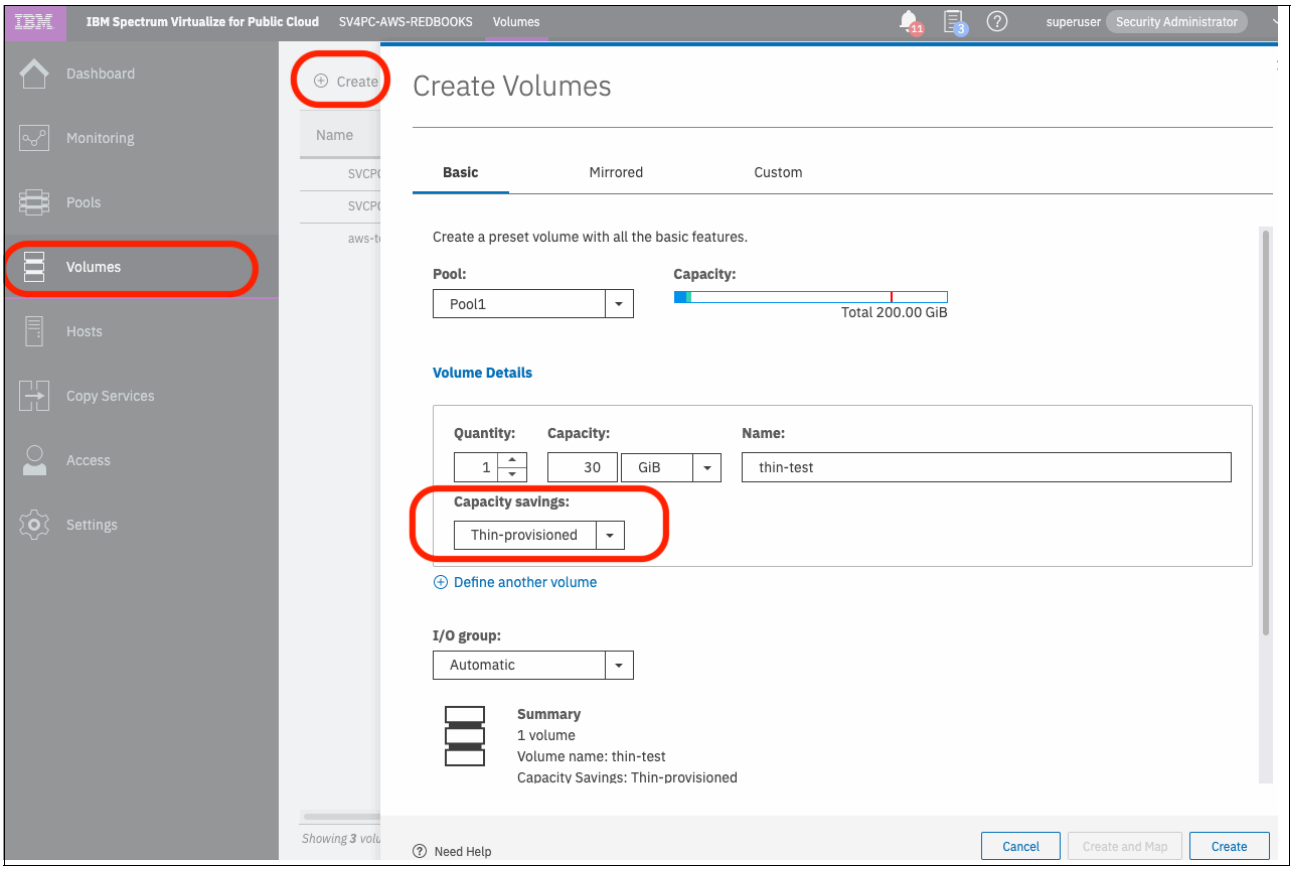

Figure 5-33 Thinly provisioned (space-efficient) volume creation with the GUI

Thinly provisioned volumes allow users the ability to over-provision the EBS volumes and therefore reduce the overall operational cost in AWS.

5.4.2 Configuring the host and volume mapping

To use the volume that you created, you must map it to a host object. The host object represents a single Bare Metal Server on your cloud account and its iSCSI-qualified identifier (IQN), which is similar to a worldwide port name (WWPN) for an FC host.

To create a host object, you must collect its IQN. The place and the procedure to collect the IQN from can vary with each operating system. For the appropriate steps for an operating system, see the documentation for it.

When you create your host object and map your volume, depending on what operating system you using, you must install the iSCSI initiator and run some specific operations to use your mapped volumes with the hosts.

Linux host

Install the Linux software iSCSI initiator. The initiator software on RHEL systems is packaged as `iscsi-initiator-utils`, and the suggested version is 6.2.0.873-35 or later. The initiator software on SUSE Linux Enterprise Server systems is packaged as `open-iscsi`, and the suggested version is 6.2.0.873-33.2 or later.

According to IBM Knowledge Center, set the IQN; target discovery; and authentication, and enable multipathing for the Linux hosts.

After creating the host object and mapping VDisks to it, on the IBM Spectrum Virtualize cluster, scan for the disks on the host by using the specific iSCSI command, just like an anon-premises IBM Spectrum Virtualize Cluster.

Check the **`multipath`** output (run **`multipath -ll`**) to ensure that your VDisks are attached correctly through the multipath tool. A typical output of a VDisk should be like in Example 5-6.

Example 5-6 Linux multipath -ll output example

```
mpathch (3600507680181820bc800000000000009) dm-1 IBM     ,2145
size=500G features='1 queue_if_no_path' hwhandler='0' wp=rw
|-+- policy='round-robin 0' prio=50 status=active
| |- 26:0:0:5 sdf  8:80   active ready running
| `- 27:0:0:5 sdl  8:176  active ready running
`-+- policy='round-robin 0' prio=10 status=enabled
  |- 28:0:0:5 sdr  65:16  active ready running
  `- 29:0:0:5 sdx  65:112 active ready running
```

Windows host

The software iSCSI initiator is built in to the system on Windows 2008 and later. Access the iSCSI initiator either from the **Control Panel** or search from the **Start** menu.

Discover the iSCSI target either by using **Send Targets** or by using iSNS. For more information, see IBM Knowledge Center.

Connect to the discovered targets, as demonstrated in IBM Knowledge Center IBM Knowledge Center.

Now, the mapped volumes are visible to Windows disk management services. The system volumes can be initialized, formatted, and mounted. You can view the details of the discovered disks by using the Windows Command Prompt. An example output is shown in Example 5-7.

Example 5-7 Diskpart command example

```
DISKPART> list disk
 Disk ###  Status      Size     Free     Dyn  Gpt
 --------  ----------  -------  -------  ---  ---
 Disk 0    Online       149 GB    78 GB   *
 Disk 1    Online       149 GB    78 GB   *
 Disk 2    Online       565 MB   565 MB
 Disk 3    Online       337 MB   337 MB
DISKPART> select disk 2
Disk 2 is now the selected disk.
DISKPART> detail disk
IBM      2145             SCSI Disk Device
Disk ID: 00000000
Type   : iSCSI
Bus    : 0
Target : 2
LUN ID : 0
There are no volumes.
```

5.5 Configuring a site-to-site virtual private network IPSec tunnel for hybrid cloud connectivity in AWS Cloud

This section describes how to configure hybrid cloud connectivity between the AWS Cloud and the on-premises environment. This section also describes the lab setup and the steps to configure the site-to-site IPSec tunnel for communication between AWS Cloud and the on-premises site.

The virtual private network (VPN) IPSec site-to-site tunnel creates a secure communication network between the AWS Cloud infrastructure and on-premises infrastructure. Network communication between the private subnets is controlled by the access control list (ACL) that is populated when you create the VPN IPSec site-to-site tunnel.

AWS configuration for the VPN IPSec tunnel

This section describes the steps that are required at the VPC level in AWS Cloud for establishing the IPSec tunnel.

1. Create a customer gateway: Log into the AWS console with resource provisioning privileges, select **Services** at the upper left, and then **VPC**. Select **Virtual Private Network (VPN)** in the pane on the left. Click the customer gateways and input the required details.
2. Create the virtual private gateways: Click the **Virtual private gateways** section in the VPC and configure the required details.
3. Attach a virtual private gateway to the VPC.

4. Create a site-to-site VPN connection in AWS Console: Select the virtual private gateway and customer gateway parameters. Attach the virtual private gateway to the VPC in AWS.
5. After the site-to-site connection is complete, a configuration file is generated for the end-to-end point. This step creates two tunnels in the VPC, and the same configuration file is used for the configuration at the other end of the tunnel.

5.6 Configuring replication from on-premises IBM Spectrum Virtualize to IBM Spectrum Virtualize for Public Cloud on AWS

This section describes how to configure replication from an on-premises solution that could be a FlashSystem or SAN Volume Controller system to an IBM Spectrum Virtualize for Public Cloud on AWS solution.

Our example uses a FlashSystem system in the on-premises data center and a two-node IBM Spectrum Virtualize for Public Cloud on AWS as a DR storage solution.

This scenario uses IBM Spectrum Virtualize Global Mirror with Change Volume (GMCV) to replicate the data from the on-premises data center to AWS Cloud.

This implementation starts with the assumption that the IP connectivity between the on-premises data center and AWS Cloud is established through a Multiprotocol Label Switching (MPLS) or VPN connection. Because there are multiple ways to implement the IP connectivity, this section does not consider that specific configuration. For more information, contact your organizations's network technical specialist.

To configure the GMCV, complete the following steps:

1. Configure your IBM Spectrum Virtualize Private IP ports so that they are enabled for remote copy. This configuration is required on both sites, as shown in Figure 5-34.

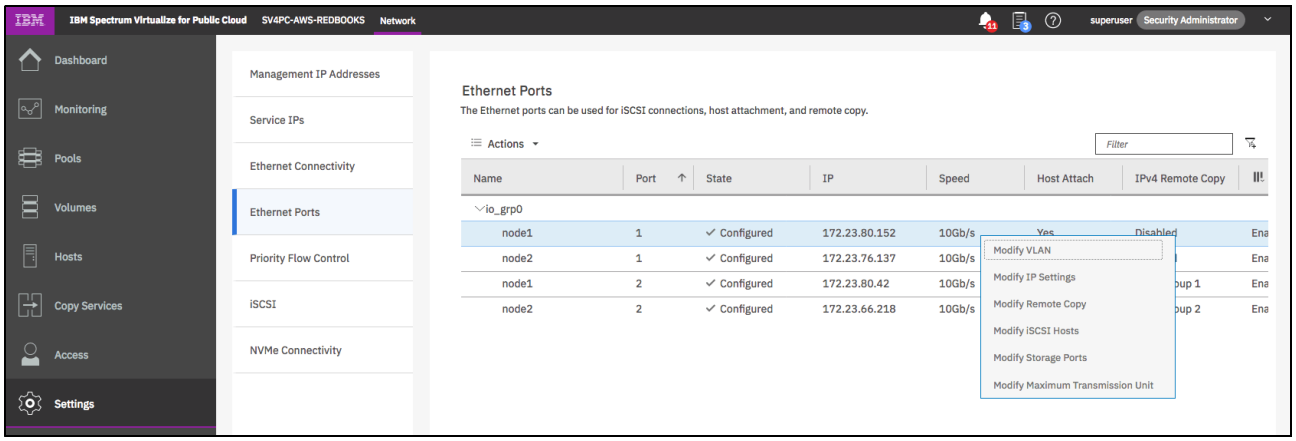

Figure 5-34 Remote copy IP port example

a. You are redirected to choose which copy group to use, as shown in Figure 5-35.

Figure 5-35 Group 1 configuration example

b. Repeat steps 1 on page 79 and a for all of the IP ports that you want to configure, and you end up with a similar configuration as shown in Figure 5-36.

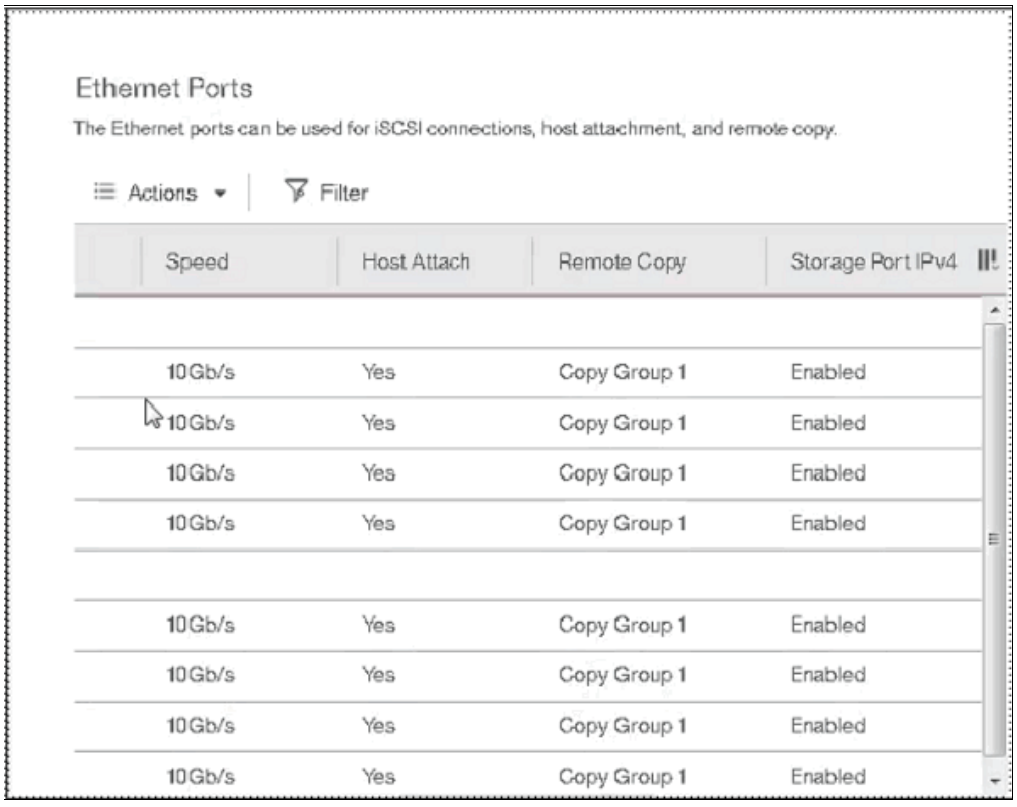

Figure 5-36 IBM Spectrum Virtualize configuration complete

c. Run the same configuration for the on-premises FlashSystem storage system or SAN Volume Controller, as shown in Figure 5-37 and Figure 5-38.

Note: It is important to understand what versions of IBM Spectrum Virtualize software are supported. For supported and interoperability versions, see IBM Spectrum Virtualize Family of Products Inter-System Metro Mirror and Global Mirror Compatibility Cross Reference.

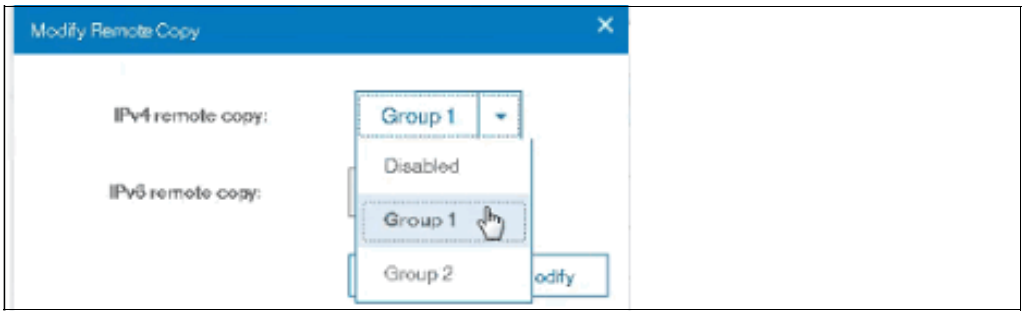

Figure 5-37 On-premises copy group example

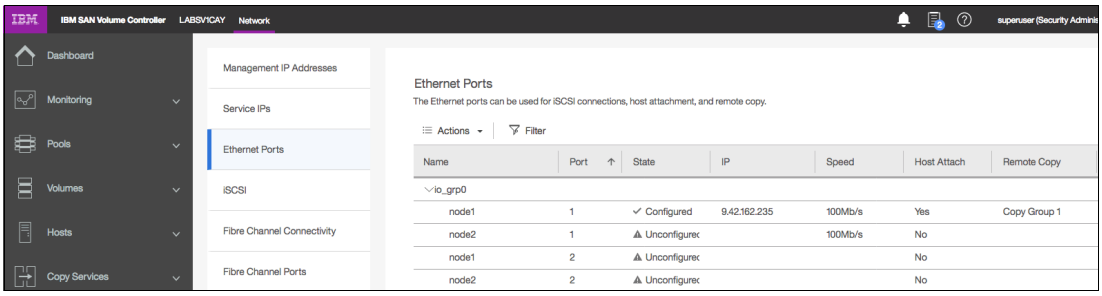

Figure 5-38 On-premises configuration completion example

2. Create a cluster partnership between the on-premises data center and IBM Spectrum Virtualize for Public Cloud on AWS from the on-premises GUI, as shown in Figure 5-39.

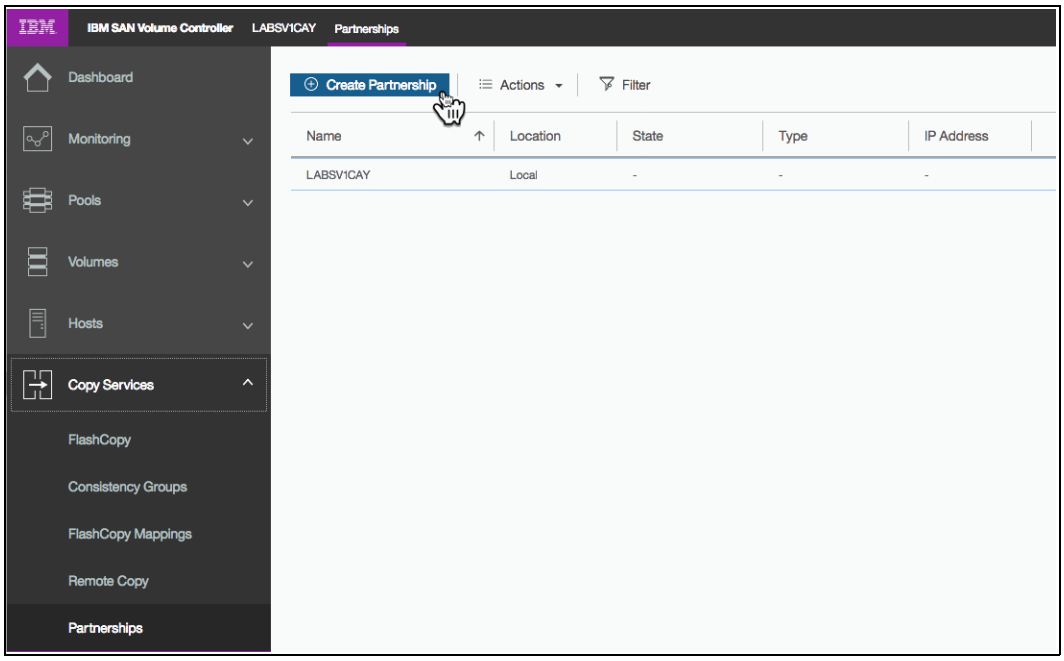

Figure 5-39 Create Partnership setup example

3. Complete the partnership creation from on-premises, as shown in Figure 5-40.

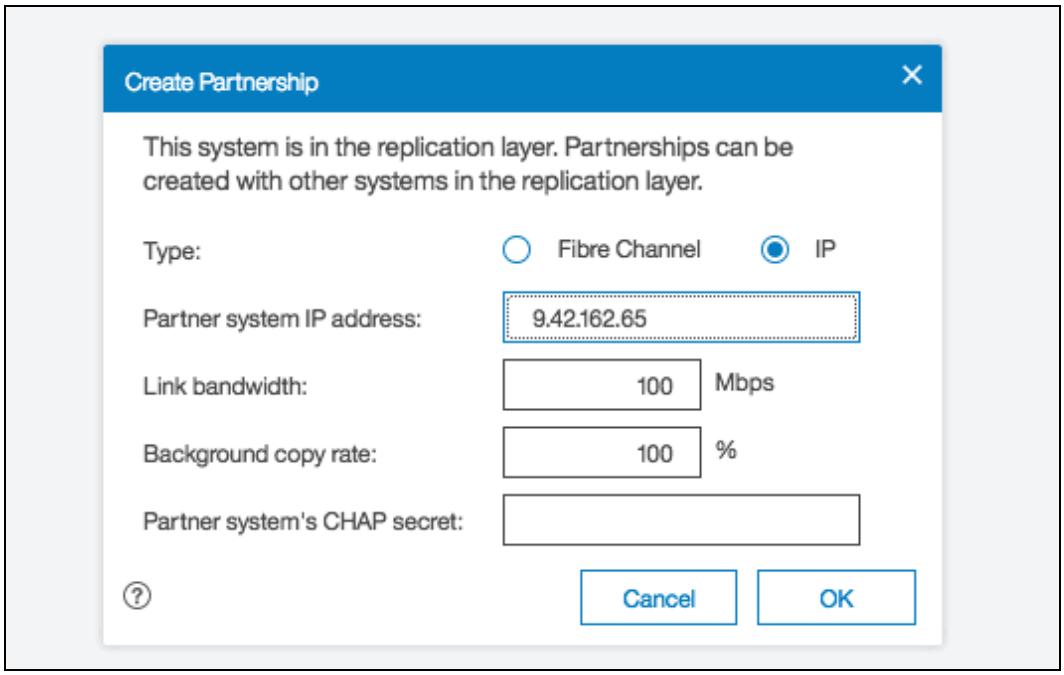

Figure 5-40 Inserting an IP address example

4. As you can see in Figure 5-41, the partnership is partially complete. You must complete the partnership in the IBM Spectrum Virtualize on-premises GUI.

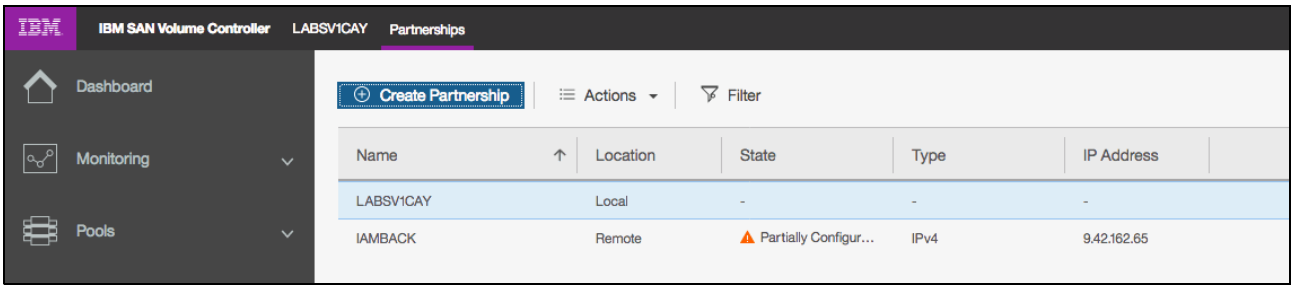

Figure 5-41 Partnership partially configured

5. Complete the partnership configuration in the IBM Spectrum Virtualize on-premises GUI, as shown in Figure 5-42 and Figure 5-43 on page 84.

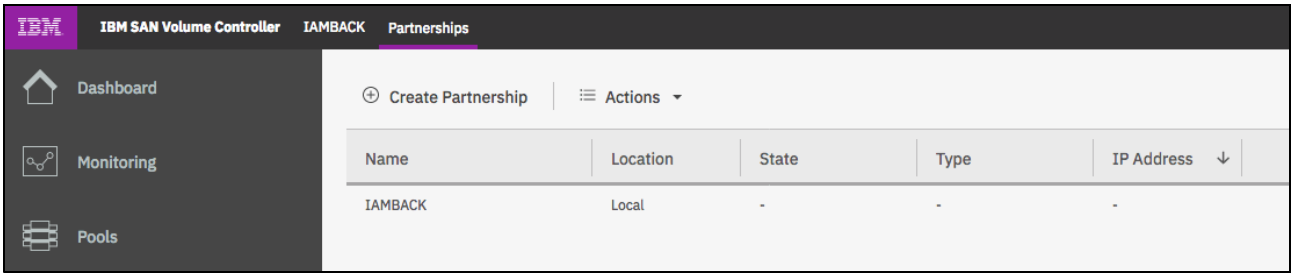

Figure 5-42 Create partnership example

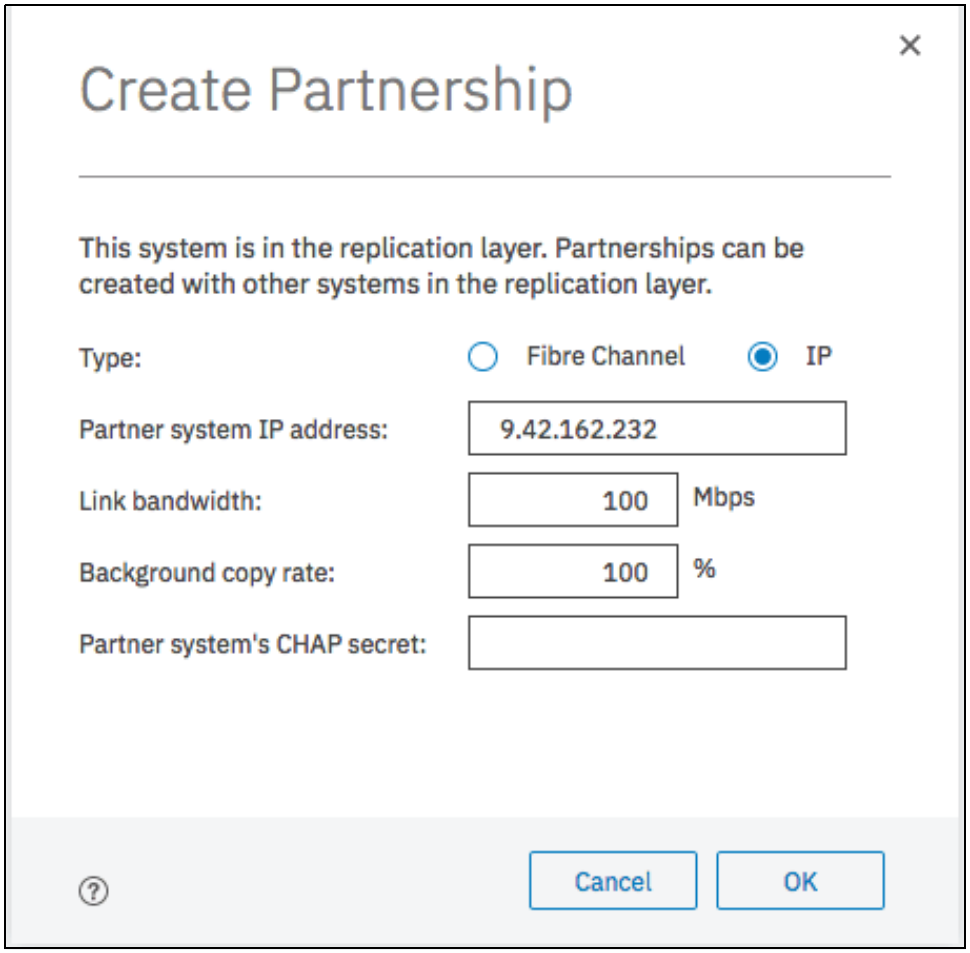

Figure 5-43 Partnership example

6. Now, your partnership is fully configured, as shown in Figure 5-44.

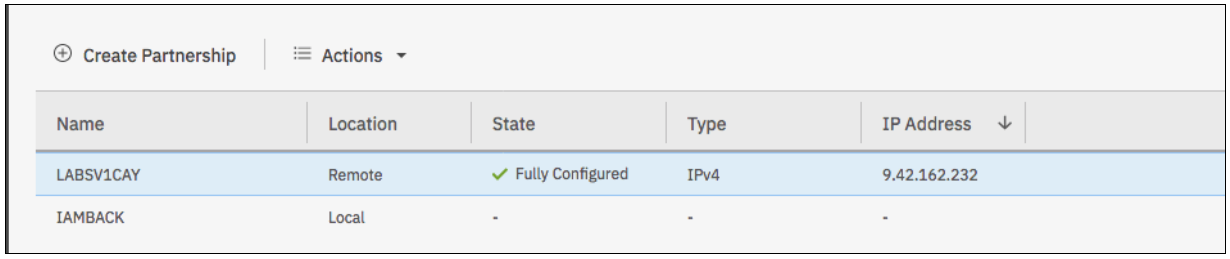

Figure 5-44 Fully configured example

Note: The connection might take a few seconds to synchronize, but double-clicking **Partnership** reveals the confirmed status of the partnership quicker.

7. In our example, we have an on-premises 100 GiB volume with its Change Volume (CV) that must be replicated to a 100 GiB volume in the AWS Cloud instance that is defined in our IBM Spectrum Virtualize for Public Cloud installation. The on-premises volumes are thin-provisioned, but this is not a specific requirement. It is just a choice. The CV can be thin-provisioned or fully provisioned, regardless of whether the master or auxiliary volume is thin-provisioned or space-efficient.

   The CV must store only the changes that accumulated during the cycle period, so it should use real capacity when possible, as shown in Figure 5-45.

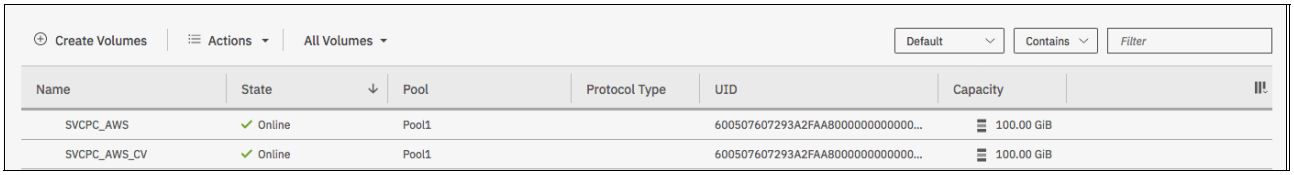

Figure 5-45 Volumes example

8. Create a volume remote copy relationship for a GMCV from the on-premises data center, as shown in Figure 5-46.

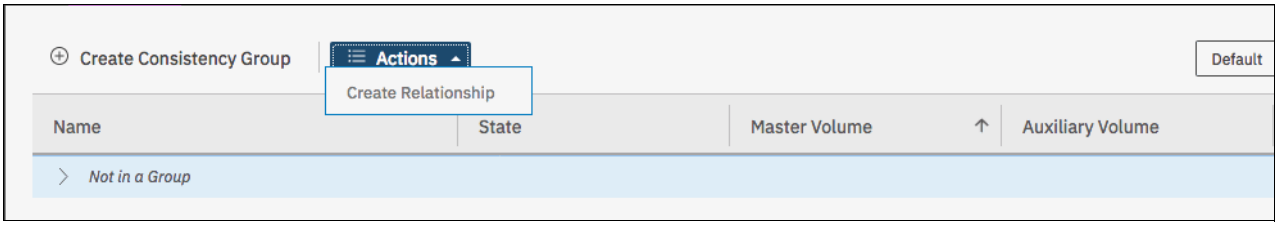

Figure 5-46 Creating a relationship

9. Select the type of relationship, as shown in Figure 5-47.

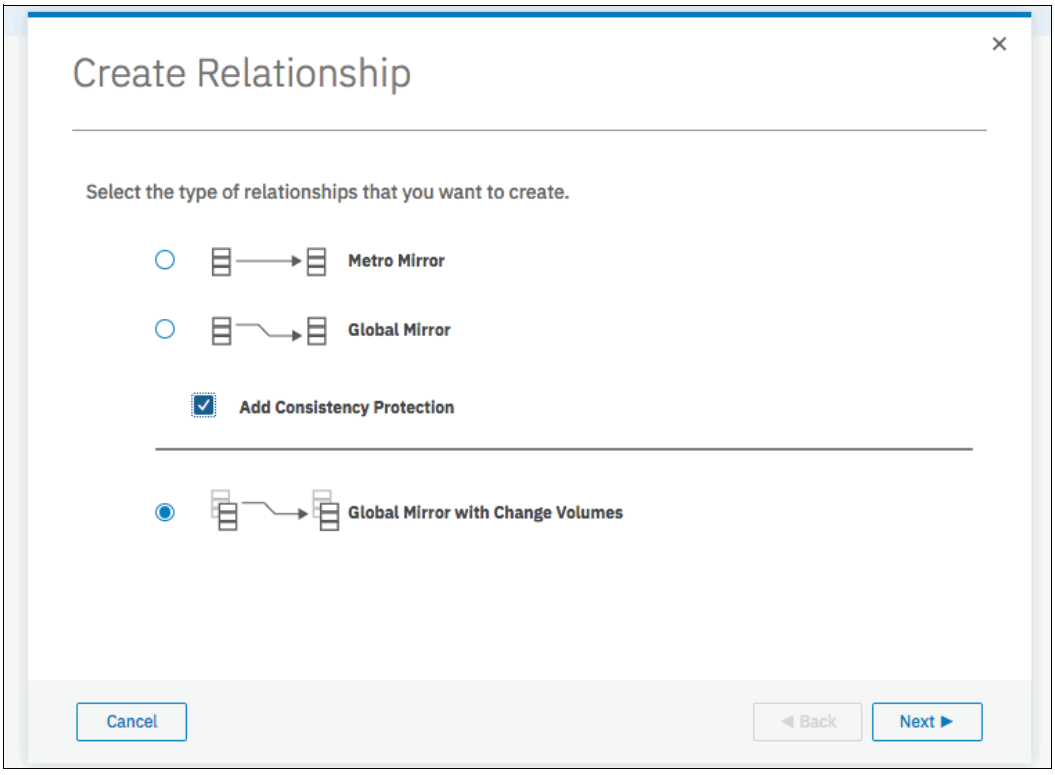

Figure 5-47 Global Mirroring with Change Volumes example

10. Select the remote system, as shown in Figure 5-48 on page 87, and select the volumes that must be in the relationship, as shown in Figure 5-49 on page 87.

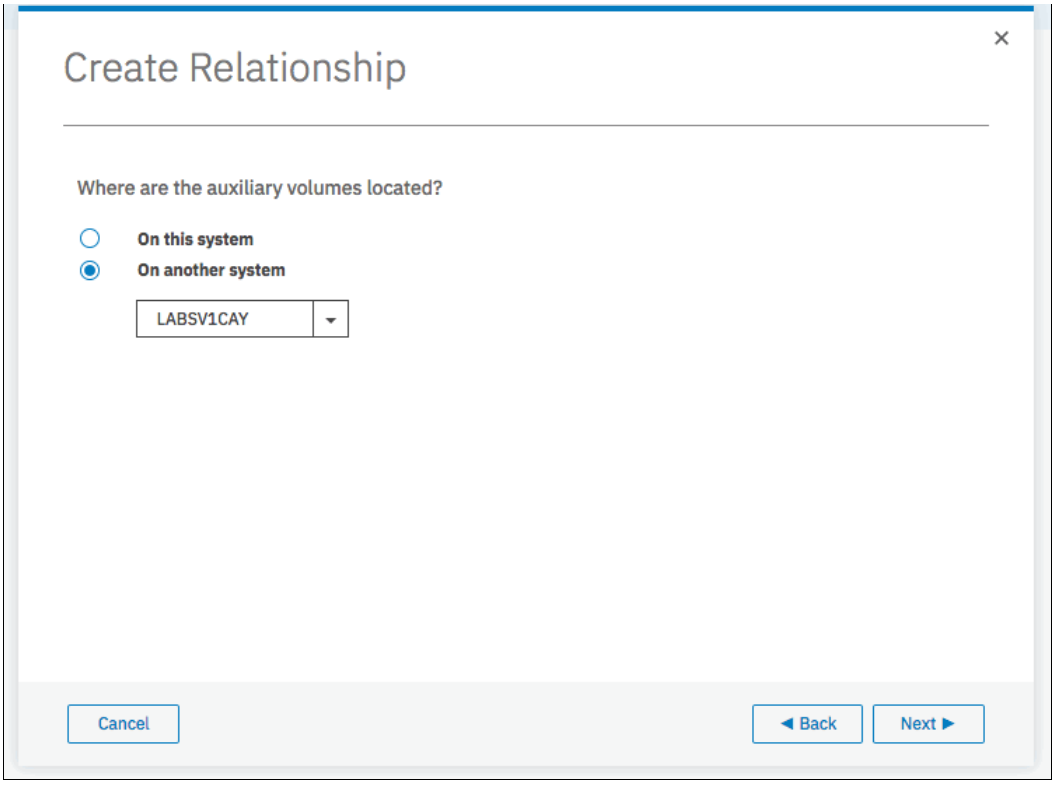

Figure 5-48 Remote system

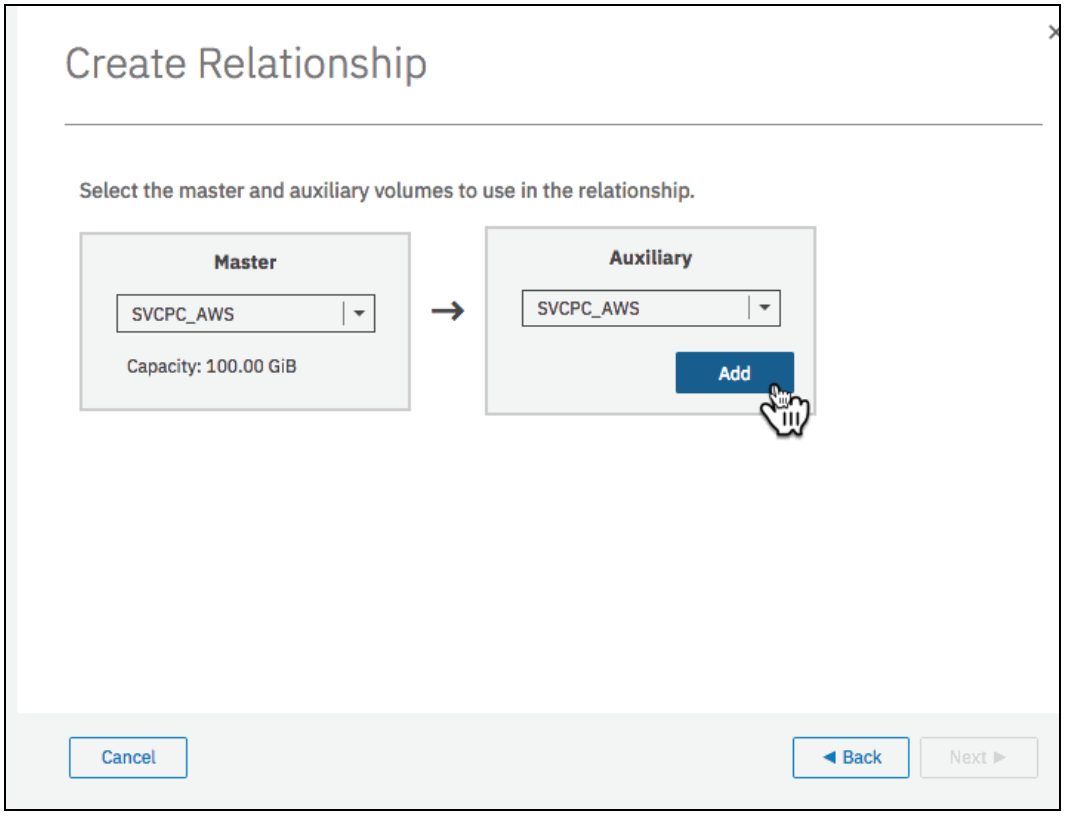

Figure 5-49 Master and auxiliary volumes example

11. In our example, we select **No, do not add a master change volume**, as shown in Figure 5-50. They are added later.

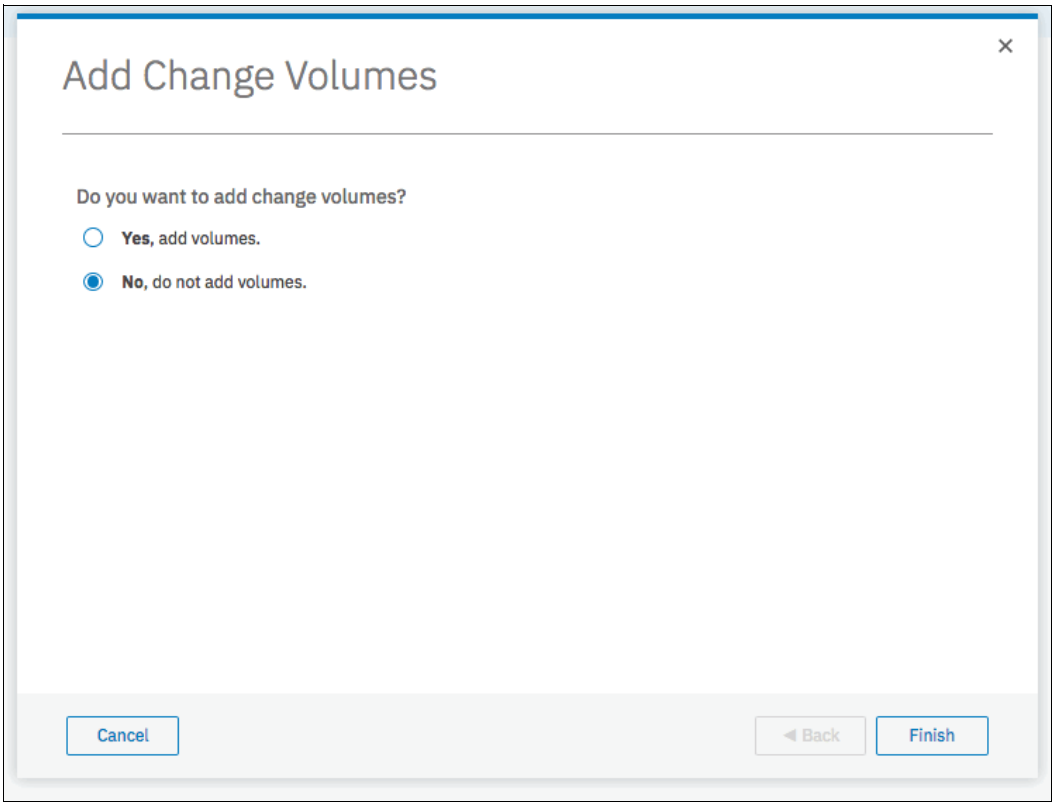

Figure 5-50 Do not add change volume example

12. We select **No, do not start copying**, as shown in Figure 5-51 on page 89.

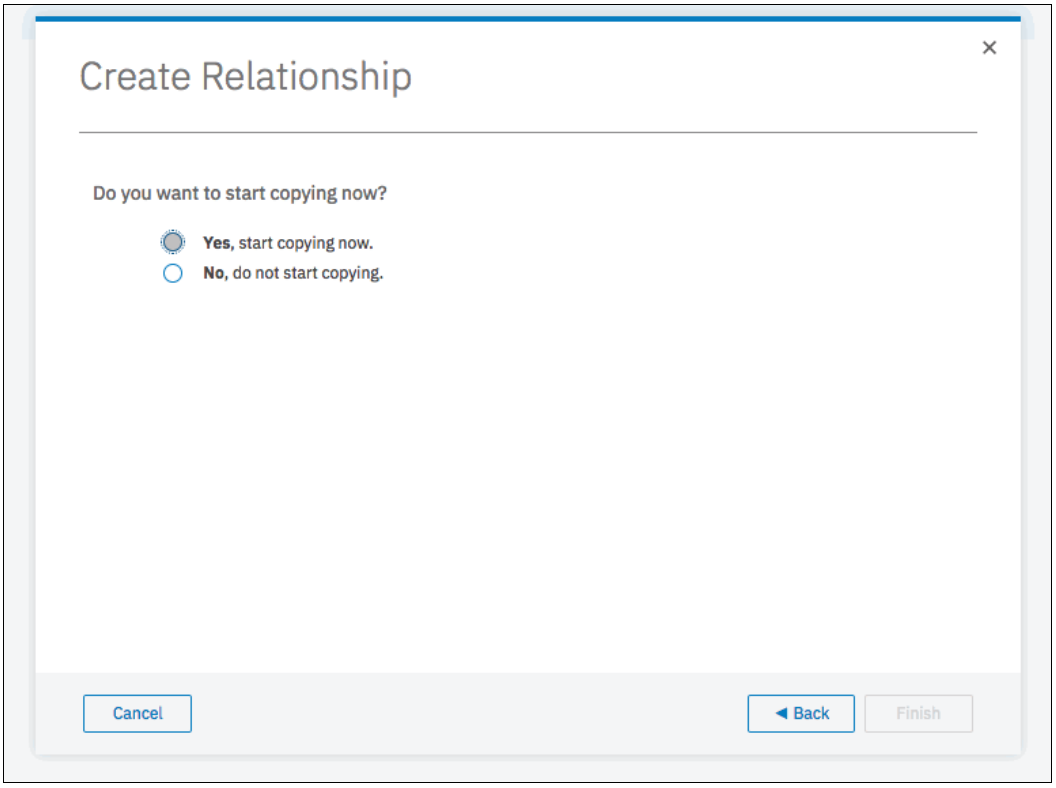

Figure 5-51 Do not start relationship example

13. Edit the relationship and set the **Cycling Mode** and **Cycling Period**.
14. Add the CV volumes to your relationship on both sides, as shown in Figure 5-52, Figure 5-53 on page 90, and Figure 5-54 on page 90.

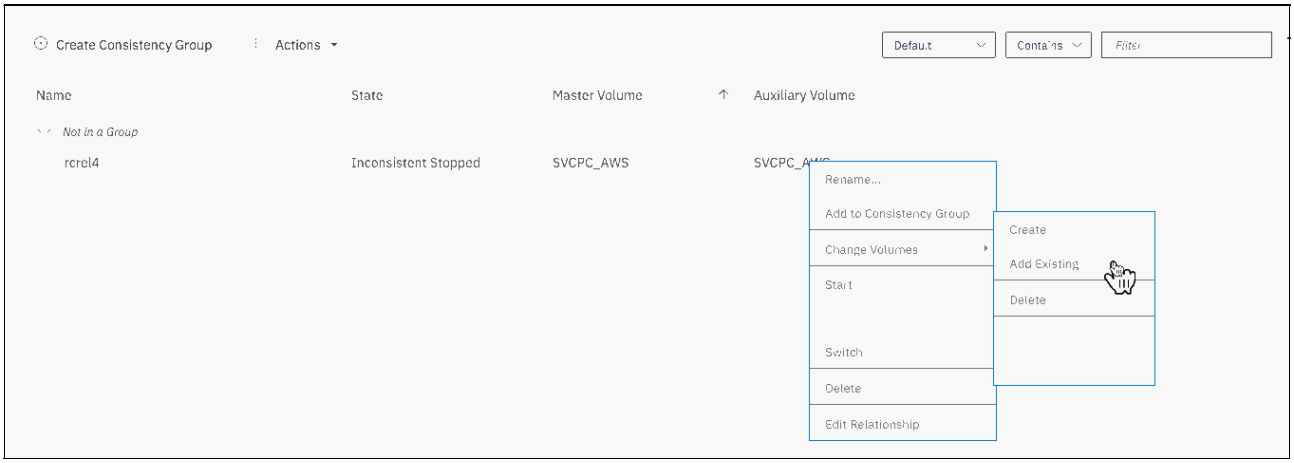

Figure 5-52 Adding a change volume from the on-premises site

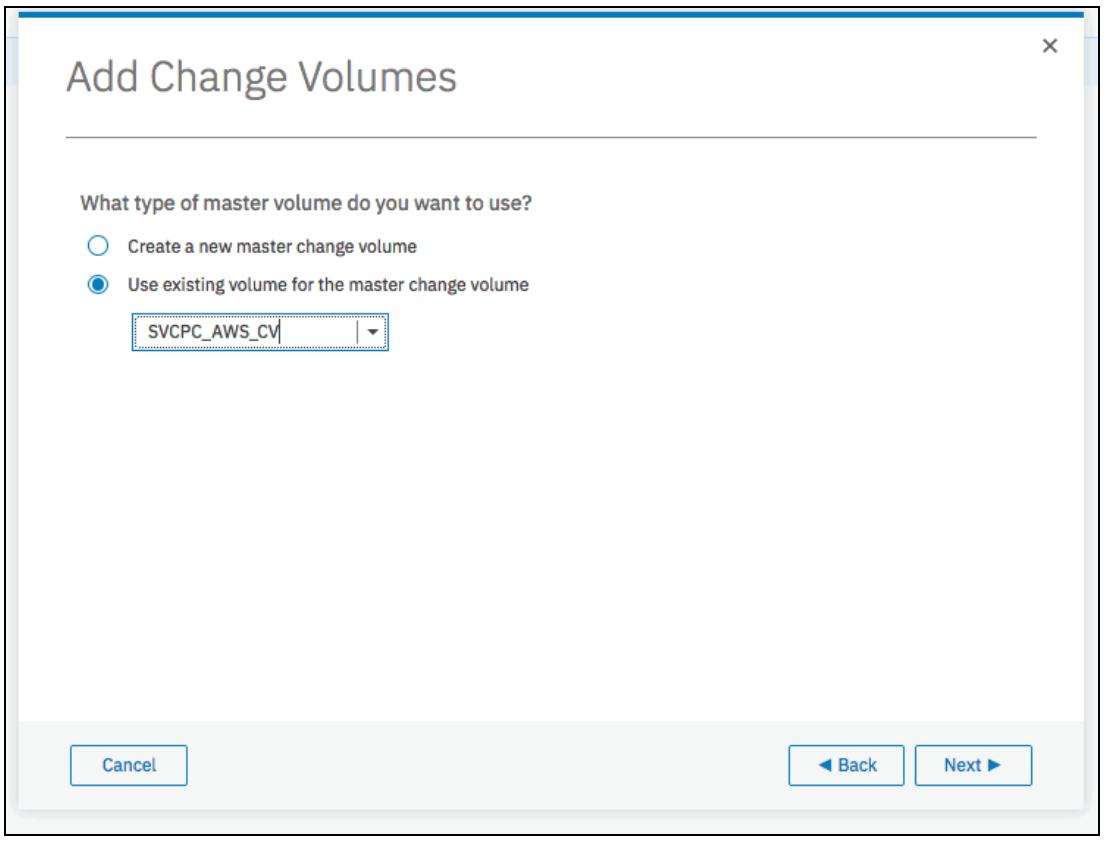

Figure 5-53 Selecting the change volume from the on-premises site

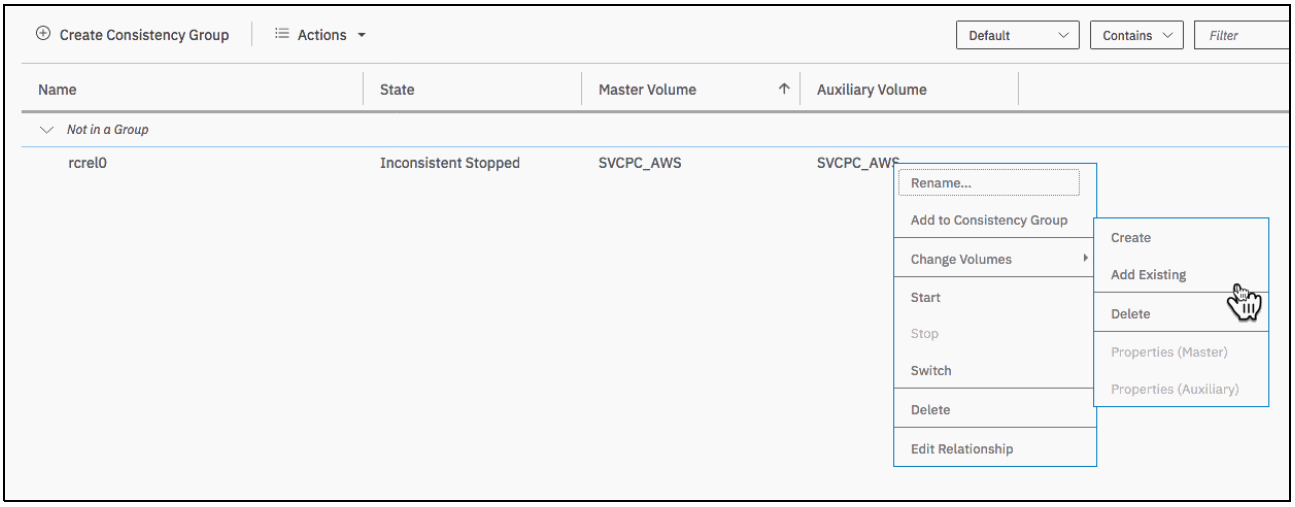

Figure 5-54 Adding the change volume to the AWS Cloud site

15. Now, start your relationship from the on-premises site, as shown in Figure 5-55 on page 91.

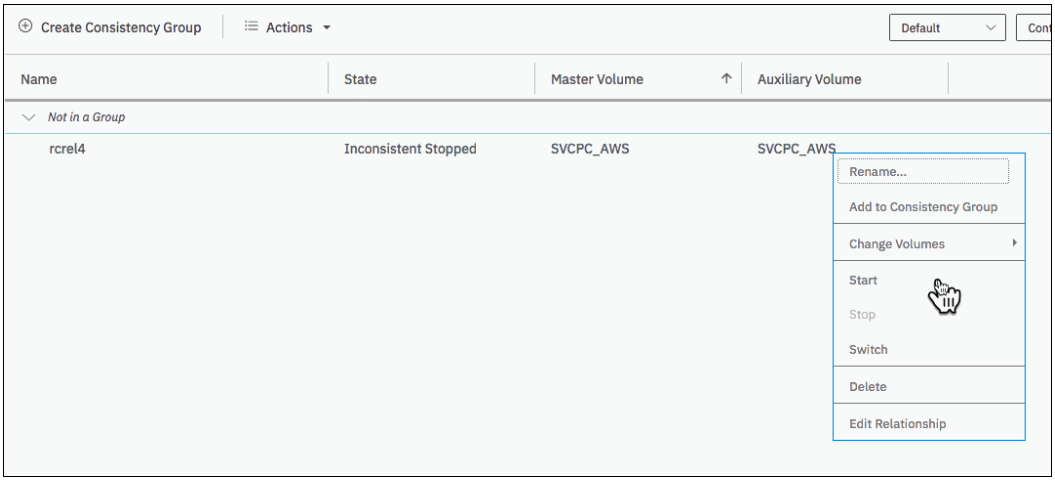

Figure 5-55 Starting the relationship

16. Now, you can create a GM consistency group and add your relationship to it, as shown in Figure 5-56 and Figure 5-57 on page 92.

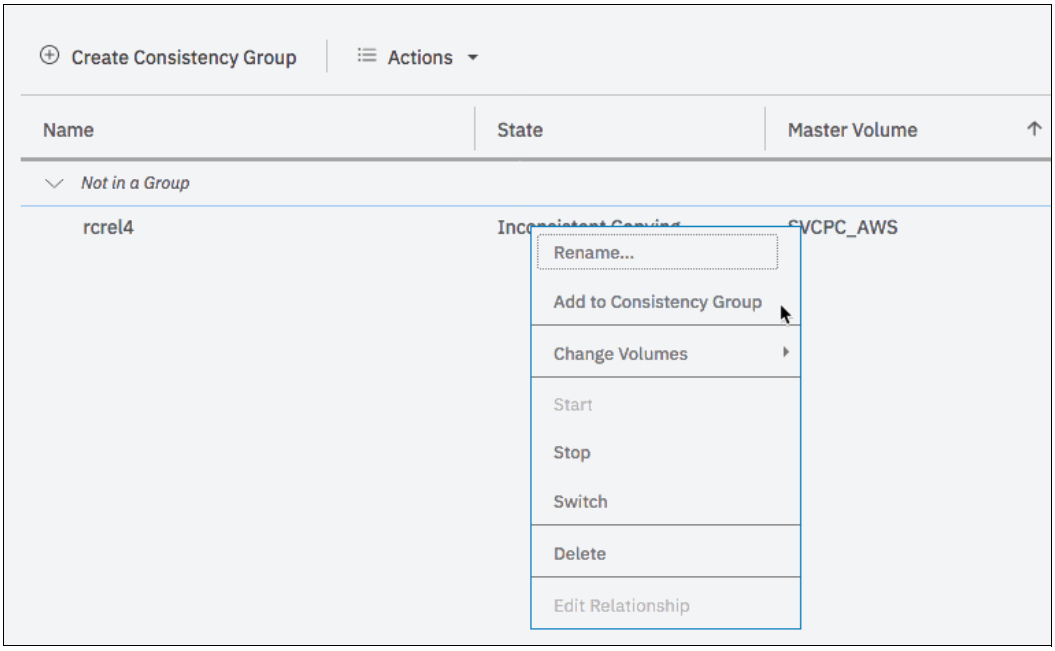

Figure 5-56 Adding a consistency group

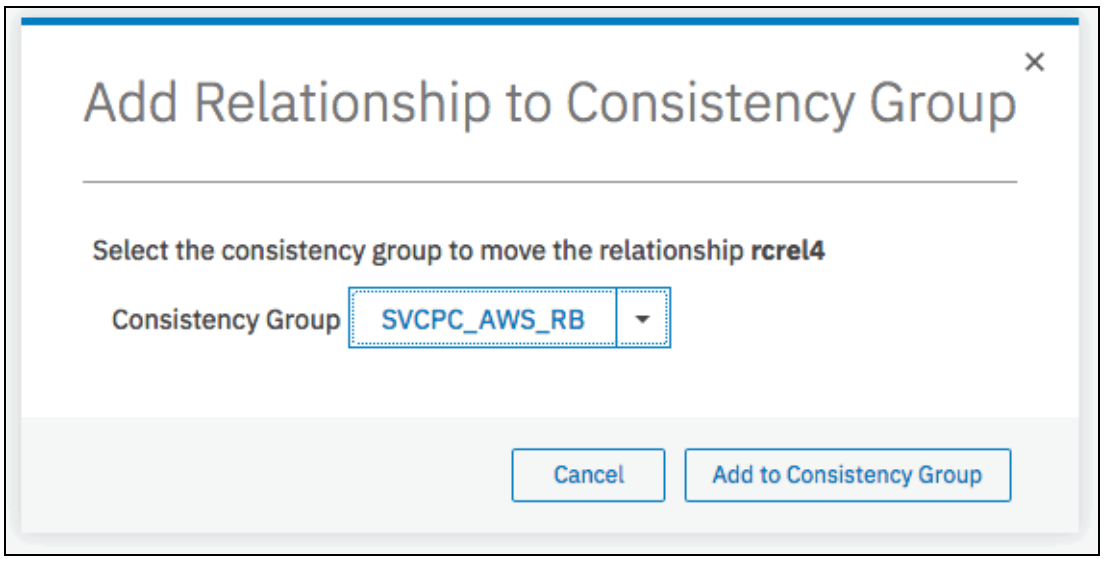

Figure 5-57 Add Relationship to Consistency Group

17. Now you can see the status of your consistency group, as shown in Figure 5-58 and Figure 5-59.

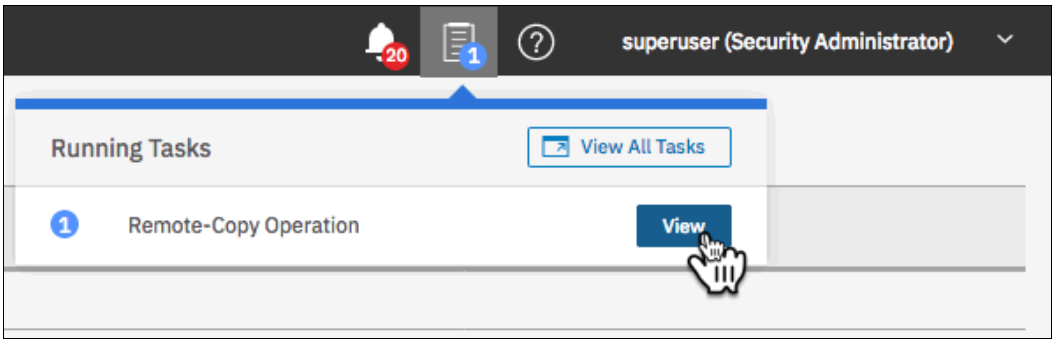

Figure 5-58 Consistency group status

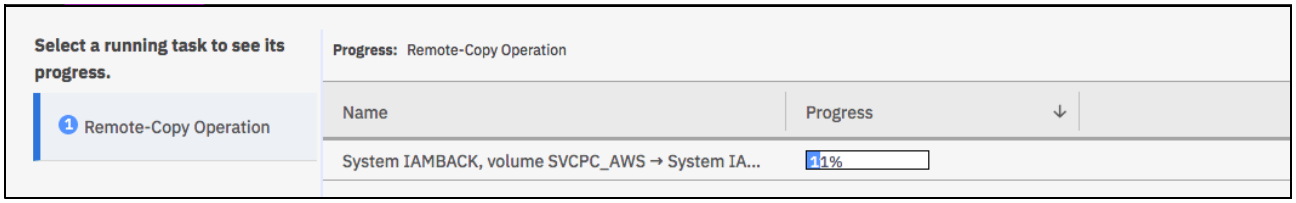

Figure 5-59 Copying status

In our example, we show the status by using the IBM Spectrum Virtualize for AWS Cloud GUI.

When the copy approaches completion, the CV algorithm starts to prepare a freeze time in accordance with the cycling windows. When your copy reaches 100%, a FlashCopy is taken from the auxiliary volume to the auxiliary-CV to be used in case of real disaster or DR test. At 100%, the status is *consistent copying*.

What we have described is just an example of how to configure a GMCV relationship from an on-premises solution to an IBM Spectrum Virtualize for Public Cloud on AWS solution. It can be valuable to configure a snapshot (FlashCopy) of your GMCV auxiliary volume to be used for DR testing or other purposes.

The previous steps were completed by using the GUI, but they can also be done by using the CLI.

For more information about how to manage FlashSystem, IBM Spectrum Virtualize, or SAN Volume Controller copy functions, see the following publications:

- *Implementing the IBM Storwize V7000 with IBM Spectrum Virtualize V8.2.1*, SG24-7938
- *IBM System Storage SAN Volume Controller and Storwize V7000 Best Practices and Performance Guidelines*, SG24-7521
- *Implementing the IBM System Storage SAN Volume Controller with IBM Spectrum Virtualize V8.1*, SG24-7933

6

Supporting the solution

This chapter provides guidance about how support for this solution is put together. This solution is made up of two basic support segments:

- Amazon Web Services (AWS)
- IBM Storage support teams.

It is important to understand who to contact if a problem occurs.

In this chapter, the following topics are described:

- Who to call for support
- Working with AWS support

6.1 Who to call for support

The IBM Spectrum Virtualize for Public Cloud on AWS solution is composed of several components, much like the traditional storage offerings. However, when deployed in the public cloud on AWS, IBM Spectrum Virtualize is simply an application running in a stack on AWS Cloud. So, to ensure that your level of support matches the level that is required to support your application, see AWS Support to see the various levels of support that are available to an AWS user.

In this solution, the cloud provider is responsible for providing the infrastructure, network components, storage, support, and assistance for this solution. The cloud user or any involved third parties are responsible for deploying and configuring the solution from the network layer up to the operating system, and the software that is installed. IBM Systems Support is responsible for providing support and assistance with the IBM Spectrum Virtualize application.

The solution is composed of multiple parties with different roles and responsibilities. For this reason, it is a best practice in such cross-functional projects and processes to clarify roles and responsibilities by using a workflow definition that handles tasks and problems when they arise. In this sense, a responsibility assignment matrix, also known as *a RACI matrix*, describes the participation by various roles in completing tasks or deliverables for a project or business process. (RACI stands for *Responsible (R)*, *Accountable (A)*, *Consulted (C)*, and *Informed (I)*.

The RACI matrix is specific for each solution deployment: How the cloud service is provided, who the final user is, who are the multiple parties that are involved, and so on. To help create a workflow for handling problems when they arise, use Table 6-1 as an example of an RACI matrix.

Table 6-1 Simplified workflow definition based on an RACI matrix

Situation	Client	Cloud provider	IBM Spectrum Virtualize
IBM Spectrum Virtualize error 2030.	Informed	Consulted	Responsible
Managed disk (MDisk) is offline.	Informed	Responsible	Accountable
Network port is down.	Informed	Responsible	Consulted
Configuration question.	Responsible	Consulted	Accountable

In situations where the cloud provider is responsible or accountable, the client should collect as much detail about the problem that is known and open a ticket with the cloud provider. In the situations where IBM Spectrum Virtualize is responsible or accountable, the client should collect as much detail about the problem and diagnostic data surrounding the event and open a Problem Management Record (PMR) with IBM. In situations where the client is responsible, it is up to the client to be as detailed as possible in any requests or questions that are raised to the cloud provider, IBM Spectrum Virtualize, or any other third party that is involved in the support.

6.2 Working with AWS support

AWS is a service that provisions the infrastructure, network, operating systems, and back-end storage that is used in this solution. AWS support is responsible for helping resolve problems and answer questions for products and services that are acquired through the AWS Marketplace Console.

The AWS support team is engaged by opening a case that provides support for any related problems and questions if the IBM Spectrum Virtualize Software cannot run successfully.

Figure 6-1 shows where you can open a case in the AWS Marketplace support center.

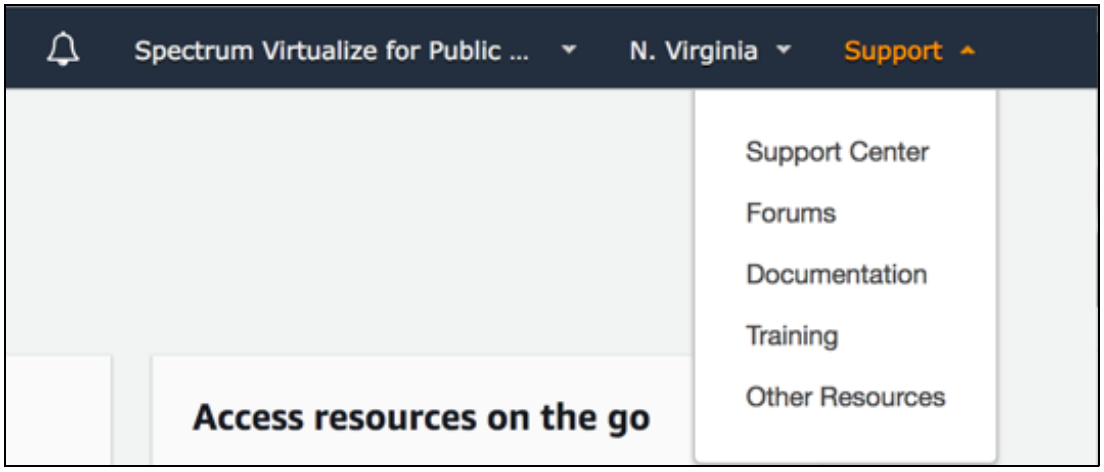

Figure 6-1 Accessing the support center by using the AWS Marketplace Console

In this page, you can create a case, as shown in Figure 6-2.

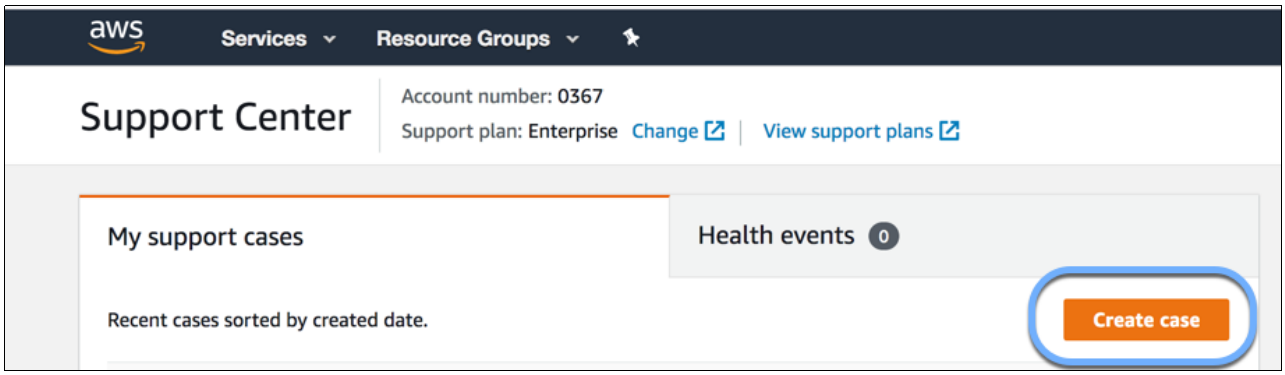

Figure 6-2 Create a case by using the AWS Support Center

There are three types of cases that can be open with AWS Support. Our focus is on technical support, as shown in Figure 6-3.

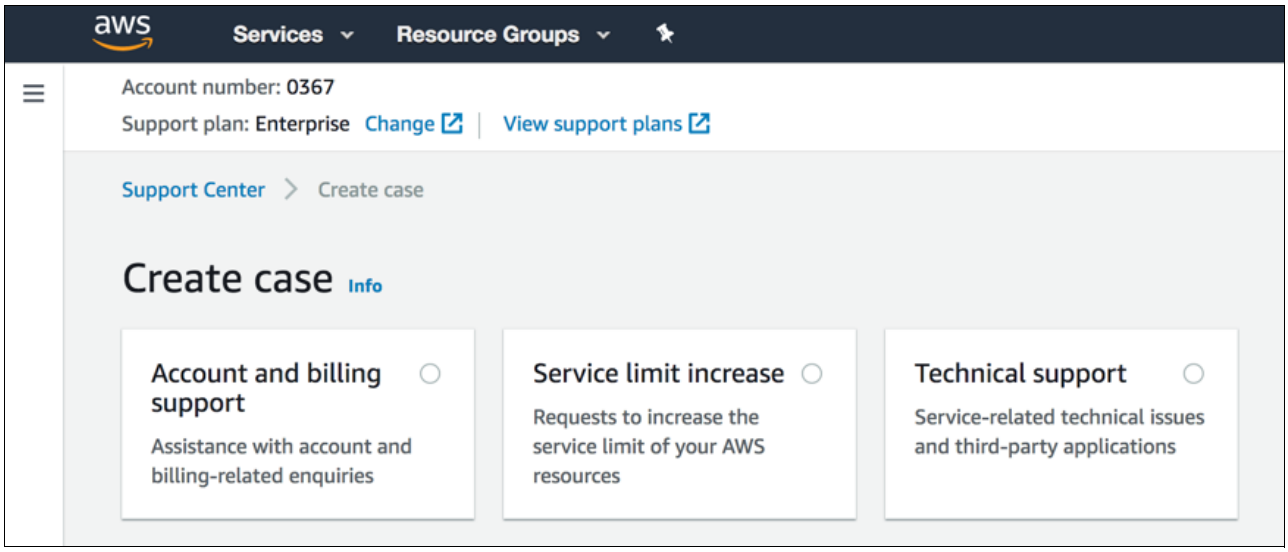

Figure 6-3 Type of cases that can be opened with AWS Support Center

In this page, you see a form to complete regarding the problem, as shown in Figure 6-4.

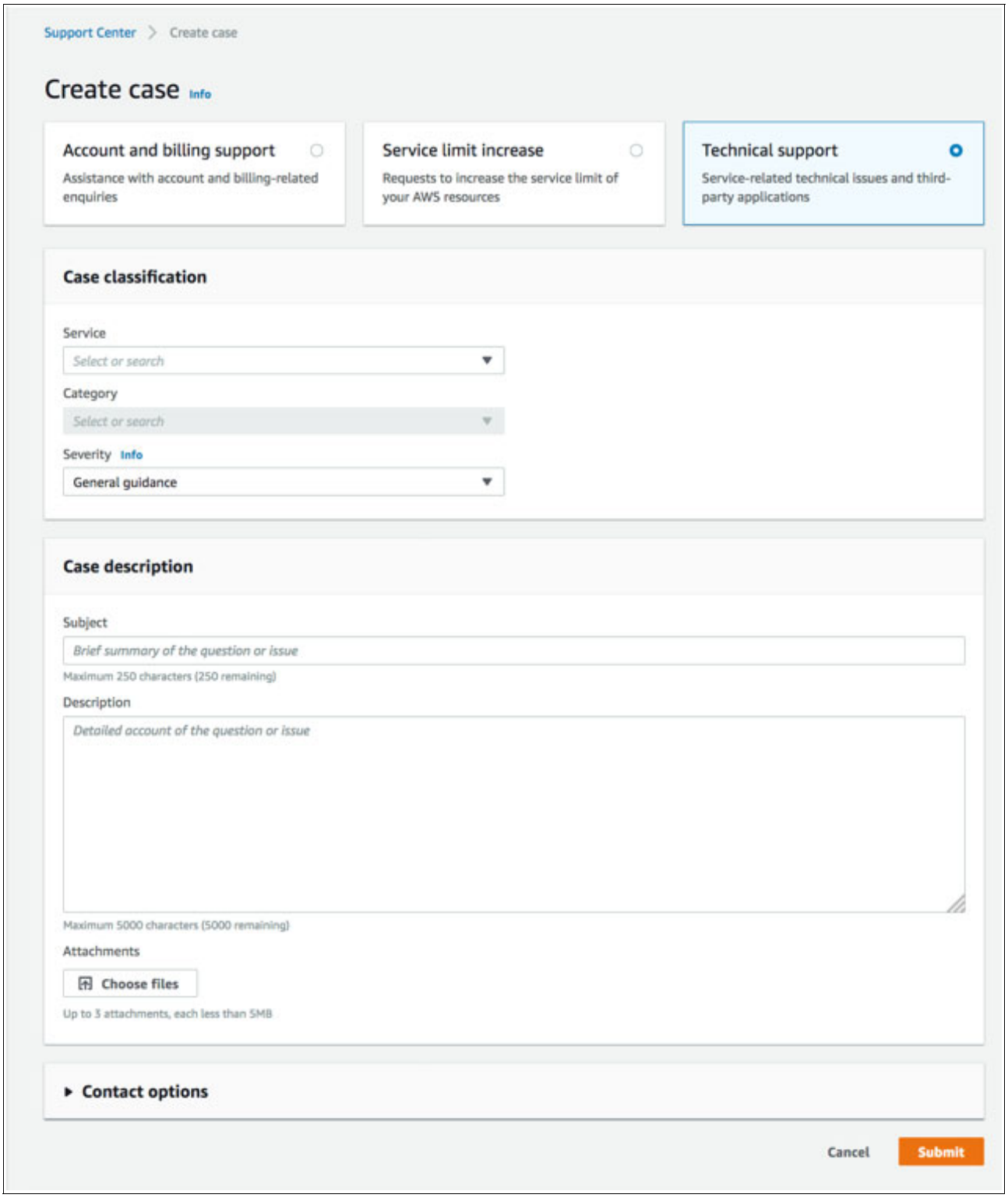

Figure 6-4 Submitting a case

After adding your case subject and description, you have three options to engage with AWS support, as shown in Figure 6-5.

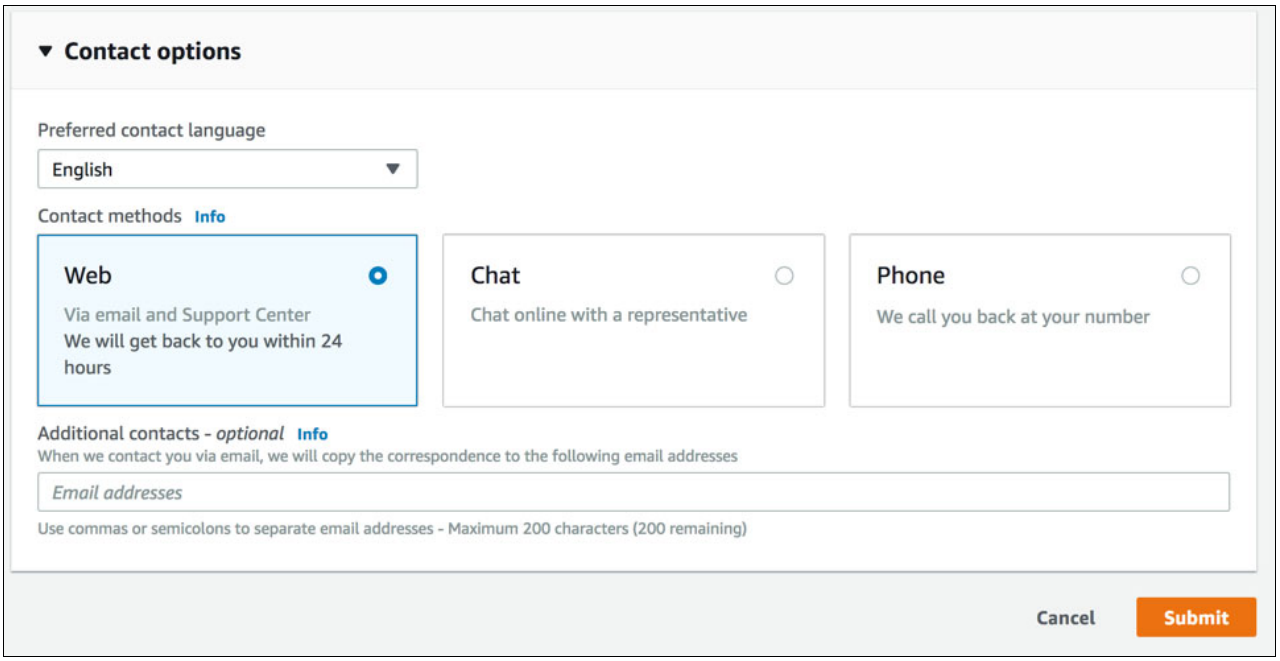

Figure 6-5 Options for engaging with AWS support

If a technical issue cannot be resolved through a chat with a representative from AWS support, you can check the status of the case in the **My support cases** tab, as shown in Figure 6-6. An email is sent to the master account and to all the customer representative accounts that are assigned to the ticket or entitled to receive it. The accuracy of email addresses must be verified in advance for the correct functioning of email notifications.

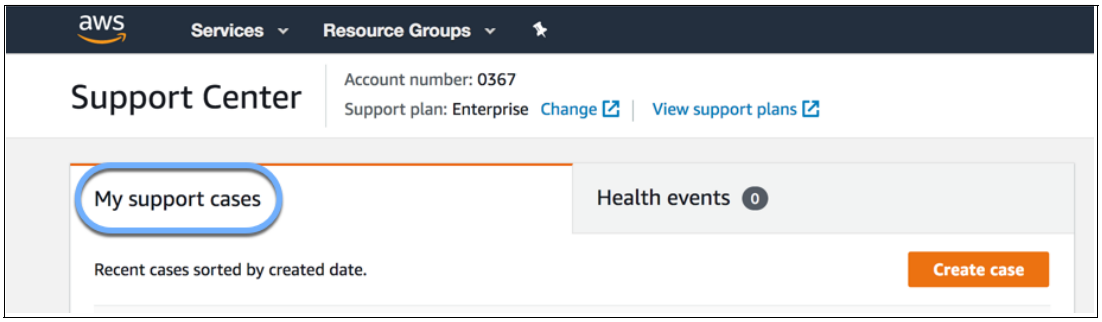

Figure 6-6 Checking the existing support cases in AWS Support Center

The **Case history** page shows a list of existing and previous cases, as shown in Figure 6-7 on page 101.

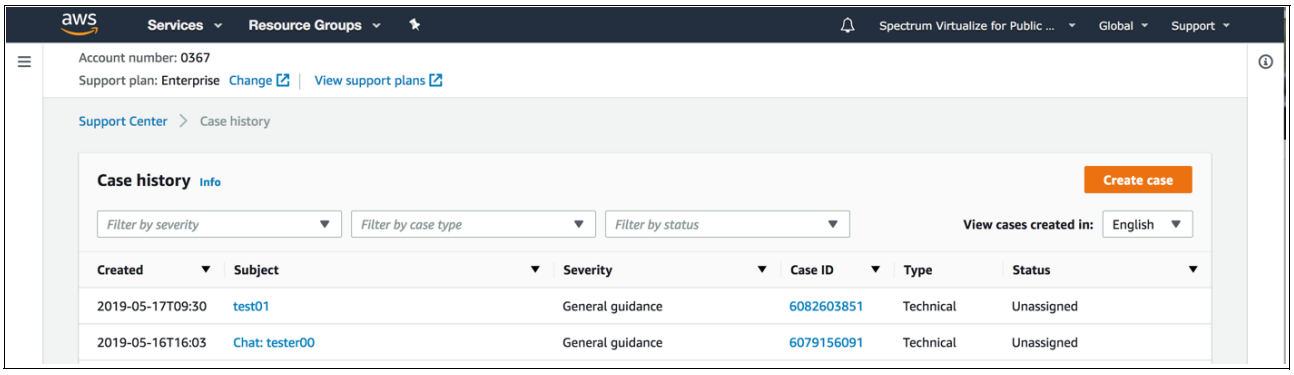

Figure 6-7 List of existing cases

In this window, an individual case can be selected by clicking the case subject or the case ID. When viewing an existing case, you can review the status, submit an update to the cases, and mark a case as resolved, as shown in Figure 6-8 to progress with the support interaction.

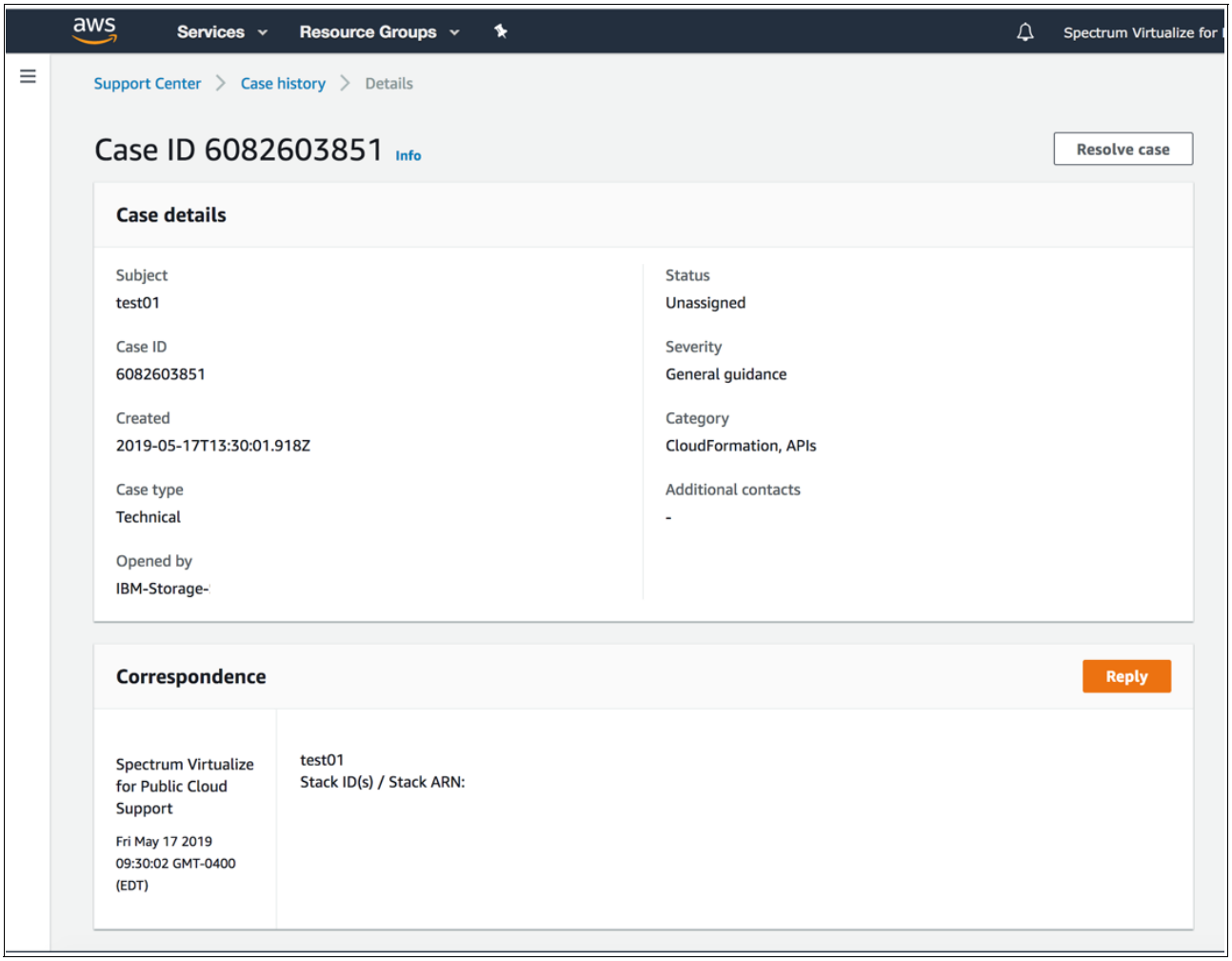

Figure 6-8 Reviewing a specific case

Related publications

The publications that are listed in this section are considered suitable for a more detailed description of the topics that are covered in this paper.

IBM Redbooks

The following IBM Redbooks publications provide more information about the topics in this document. Some publications that are referenced in this list might be available in softcopy only.

- *IBM System Storage SAN Volume Controller and Storwize V7000 Best Practices and Performance Guidelines*, SG24-7521
- *Implementing IBM Spectrum Virtualize for Public Cloud Version 8.3*, REDP-5466
- *Implementing the IBM Storwize V7000 with IBM Spectrum Virtualize V8.2.1*, SG24-7938
- *Implementing the IBM System Storage SAN Volume Controller with IBM Spectrum Virtualize V8.1*, SG24-7933

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- Amazon Total Cost of Ownership (TCO) Calculator:

  https://aws.amazon.com/tco-calculator/
- Amazon Web Services (AWS) pricing:

  https://aws.amazon.com/ec2/pricing/on-demand/
- IBM FlashCopy solution:

  https://www.ibm.com/us-en/marketplace/data-protection-and-recovery
- IBM replication interoperability matrix:

  https://www-01.ibm.com/support/docview.wss?uid=ssg1S1003646
- IBM Spectrum Virtualize 8.2.1 configuration limits page:

  https://www-01.ibm.com/support/docview.wss?uid=ibm10741421
- IBM Storage Advisor Tool (STAT):

  http://www.ibm.com/support/docview.wss?uid=ssg1S4000935

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