PROPHETSTOR

Making Software-Defined Storage a Reality

ProphetStor Federator Software-Defined Storage

White Paper

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Background

Rapid data growth and longer retention times are increasing the storage burden on data centers, as IT departments work to accommodate increasingly diverse types of storage including big data, system logs, and audio and video data, among others.

This has forced IT departments into undertaking expensive migrations or unplanned storage array acquisitions as systems reach their capacity faster than expected. Compounded with shrinking budgets, IT departments need to be more creative in storage planning.

Unfortunately, the functionalities of specialized storage hardware are locked down, necessitating new requisitions when existing storage cannot meet the needs of new applications.

Storage has to change to meet these challenges with higher efficiency and better agility.

Introducing Federator Software-Defined Storage

ProphetStor Federator Software-Defined Storage (SDS) provides the core functions of storage discovery, abstraction, pooling, classification, and provisioning.

Federator SDS enables multiple pools of physical storage (block, file, and object), abstracted as virtual storage pools, to work together in a coordinated manner for data storage, access, migration, and management. Federator recognizes the built-in functionalities of individual storage resources, and uses them to define storage on demand, matching the requirements of storage requests.

Federator SDS provides a complete software-defined storage solution that includes Federator Server, which is the SDS controller, and Federator Storage Hypervisor, which serves as the default backend storage.

The following diagram provides an overview of the Federator SDS system:

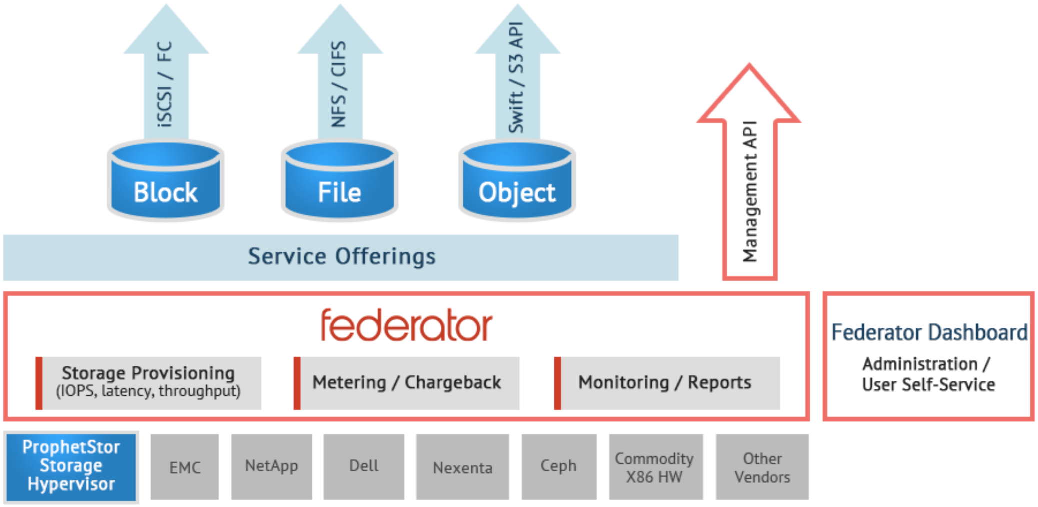


Figure 1: ProphetStor Federator SDS Overview

Product Highlights

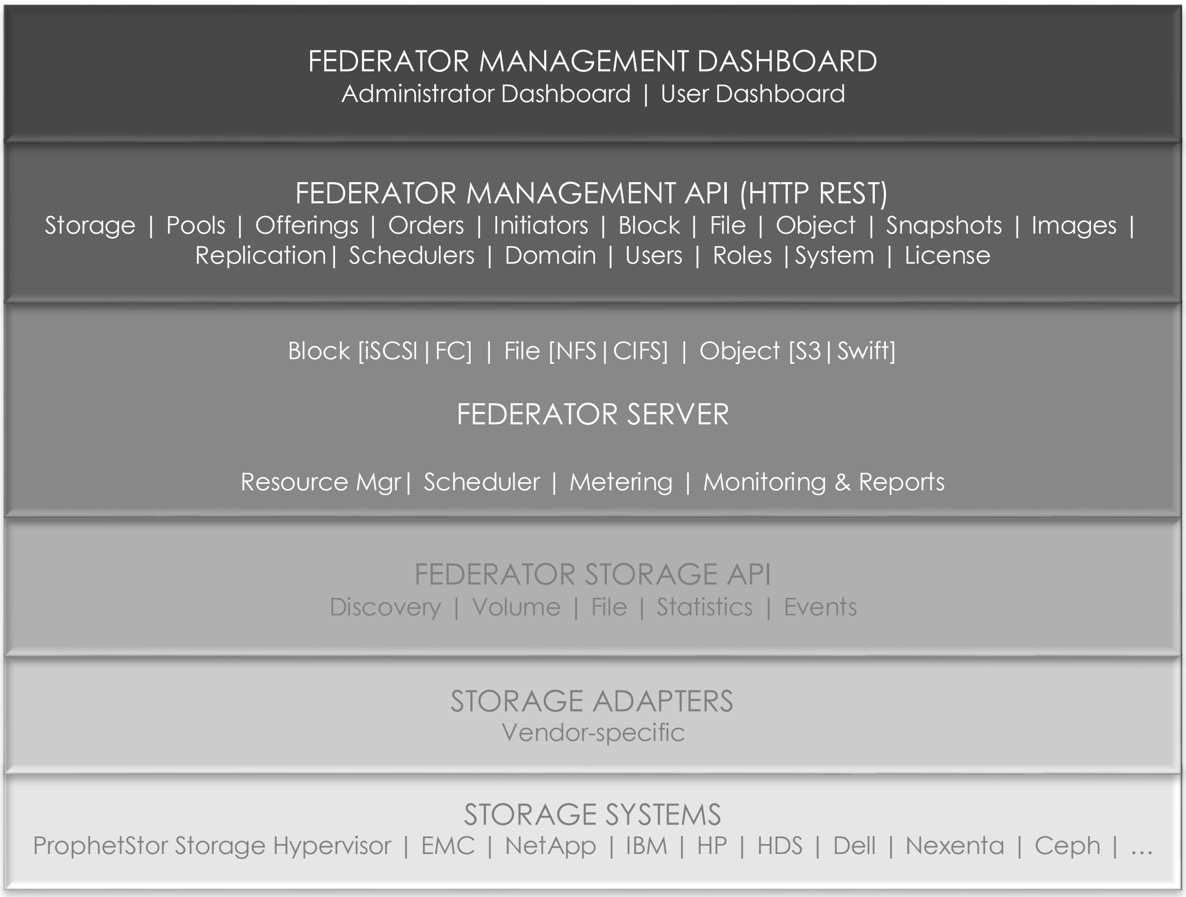
ProphetStor Federator SDS offers industry-leading features, including the following:

- Automatic discovery of storage systems and abstraction of physical resources into virtual pools
- Support for enterprise storage arrays and commodity storage hardware
- Classification of storage pools by their capabilities and performance
- Dynamic monitoring and scheduling of resources to deliver storage requests
- Automatic storage provisioning based on pool groups and IOPS service offerings
- Support for block and file storage through iSCSI, FC, NFS, and CIFS protocols*
- Support for object storage using Swift API and AWS S3 API*
- Open HTTP REST APIs, including the following:
    - Storage API to allow development of adaptors for other storage systems
    - Management API for software-defined storage control
- Built for OpenStack, enabling storage services with unified management for storage systems
- ProphetStor Storage Hypervisor as the default backend storage

*Note that Federator currently supports iSCSI block storage, with support for other storage types in future releases.

Exploring the Federator Architecture

The Federator architecture provides a complete software-defined storage framework that is both flexible and extensible. The following diagram shows the Federator SDS architecture:



FEDERATOR MANAGEMENT DASHBOARD
Administrator Dashboard | User Dashboard

FEDERATOR MANAGEMENT API (HTTP REST)
Storage | Pools | Offerings | Orders | Initiators | Block | File | Object | Snapshots | Images | Replication| Schedulers | Domain | Users | Roles |System | License

Block [iSCSI|FC] | File [NFS|CIFS] | Object [S3|Swift]
FEDERATOR SERVER
Resource Mgr| Scheduler | Metering | Monitoring & Reports

FEDERATOR STORAGE API
Discovery | Volume | File | Statistics | Events

STORAGE ADAPTERS
Vendor-specific

STORAGE SYSTEMS
ProphetStor Storage Hypervisor | EMC | NetApp | IBM | HP | HDS | Dell | Nexenta | Ceph | ...

Figure 2: ProphetStor Federator SDS Architecture

Storage Systems

Federator supports multi-vendor heterogeneous storage that includes the Federator Storage Hypervisor running on standardized x86 hardware, purpose-built arrays from leading vendors, and software storage appliances from Nexenta and Ceph.

Storage Adapters

ProphetStor offers adapters for storage systems from NetApp, Nexenta, Ceph, and FalconStor, supporting both automatic and manual discovery of storage systems in the deployed physical infrastructure. Discovered storage systems can then be selectively registered into Federator as storage resources.

ProphetStor continues to develop adapters for other storage systems, and works with storage vendors to help extract the greatest value from associated systems.

Federator Storage API

The Federator Storage API allows third-party vendors to independently develop storage adapters that plug into the Federator platform. The comprehensive API greatly simplifies development, and includes the following classes and functions:

- Discovery Class — Provides functions for storage system and resource discovery
- Volume functions — Performs CRUD operations, as well as advanced operations such as snapshots and rollbacks
- Object Class — Performs account, container, and object management
- Events and Statistics — Enables monitoring, alerts, and reporting

Refer to the Federator Storage API for additional development details and tips on how to use the library.

Exploring the Federator Server

Federator Server provides block, file and object storage controls for unified storage management, with support for iSCSI block storage (additional storage types to be supported in the future).

Understanding the Federator Resource Manager

The Federator Resource Manager queries discovered storage systems to determine the storage pools and associated characteristics. Administrators can then selectively import storage pools that are abstracted into virtual storage pools.

Federator further allows administrators to create Storage Service Offerings (SSO) for user self-provisioning.

OpenStack with Federator IOPS Provisioned Offerings

Storage pools scheduled through IOPS Storage Service Offering

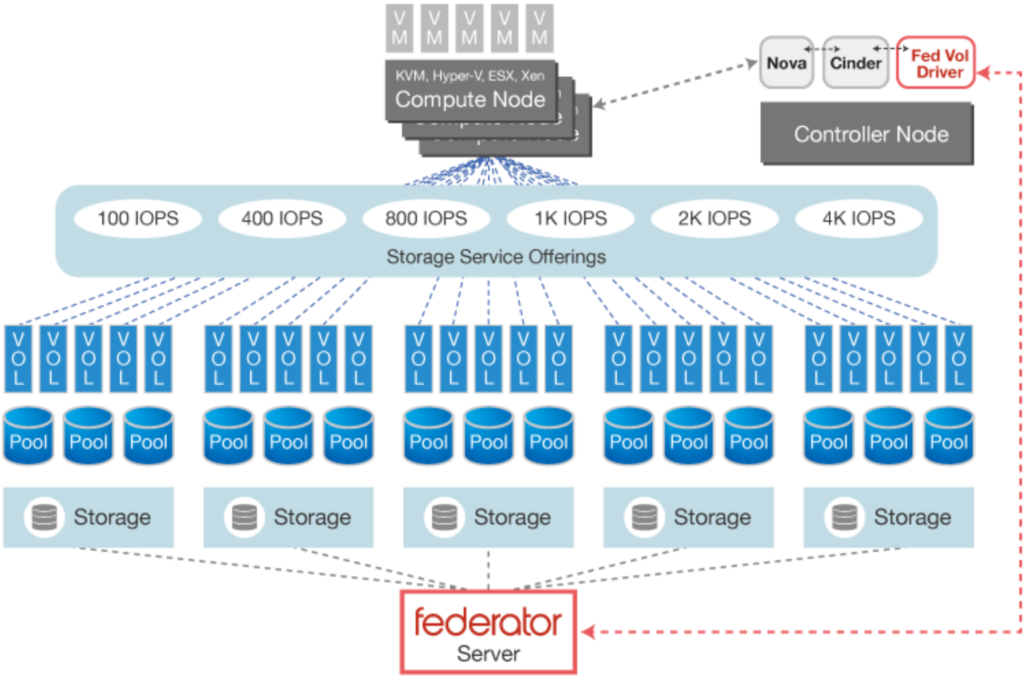


Figure 3: Storage Service Offerings Scheduling

The Federator scheduler uses the order requests to dynamically qualify pools that meet the offering requirements, and designates a pool for service delivery. Federator offers two types of service offerings:

- IOPS (I/O per second) offerings
- Pool offerings

IOPS Offerings

IOPS offerings allow users to provision storage for I/O sensitive applications such as databases. Administrators create an IOPS offering by specifying the IOPS rate (up to 4000 IOPS), in addition to the storage characteristics of a service offering. Administrators can create multiple IOPS offerings, as required, allowing users to select the most appropriate IOPS rate for their applications.

Pool Offerings

Pool offerings allow administrators to group storage pools that have similar performance characteristics and capabilities together as an SSO. For example, administrators can group similar storage pools that span multiple storage systems, or group pools from a specific vendor storage system.

IOPS and Pool Provisioning

Users can request an IOPS or pool offering, together with the storage size. Federator dynamically selects a storage pool that can accommodate the requested storage IOPS (if appropriate) and storage size, creates the volume, and reserves the amount of IOPS in the pool (in the case of IOPS offerings).

Note that the actual realized IOPS might vary from the specified value depending on the application workload, network bandwidth, and other environmental factors.

Understanding the Federator Management Dashboard

The Metering, Monitoring, and Reporting modules provide an overview of the storage resources managed by Federator. Administrators and users can view and manage this information using a web-based Management Dashboard that provides the following views:

- Administrator View—Offers administration functions such as storage discovery, pool import, offerings creation, user management, resource monitoring, and more.

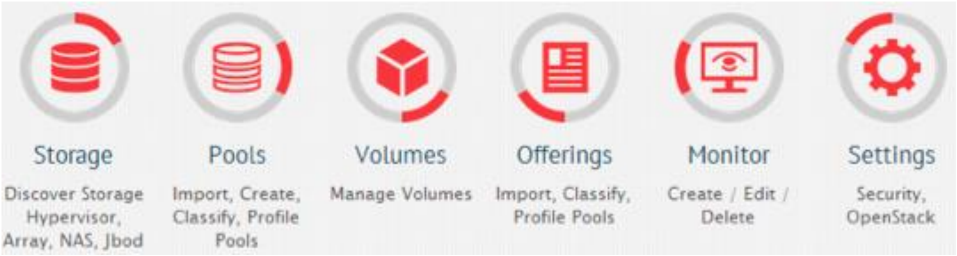

Storage
Discover Storage Hypervisor, Array, NAS, Jbod
Pools
Import, Create, Classify, Profile Pools
Volumes
Manage Volumes
Offerings
Import, Classify, Profile Pools
Monitor
Create / Edit / Delete
Settings
Security, OpenStack

Figure 4: Administrator View

User View—Allows users to provision storage, by creating a volume for example, based on the SSO created by administrators. Users can also manage their storage and perform operations such as snapshots and rollbacks.

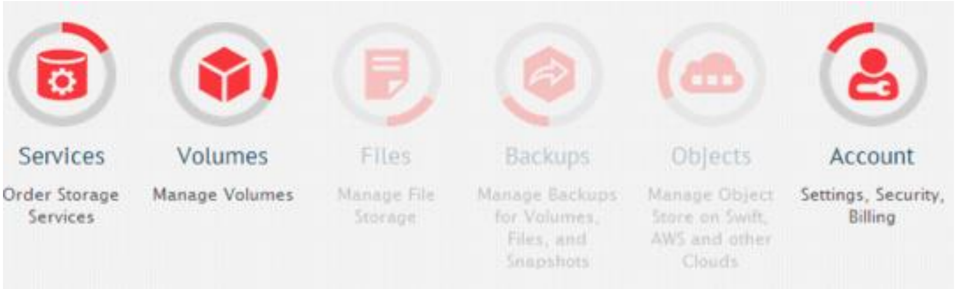

Services
Order Storage Services
Volumes
Manage Volumes
Files
Manage File Storage
Backups
Manage Backups for Volumes, Files, and Snapshots
Objects
Manage Object Store on Swift, AWS and other Clouds
Account
Settings, Security, Billing

Figure 5: User View

Federator Management API

The Federator Management API provides a programmatic interface to manage the Federator platform and associated resources. The HTTP REST API includes functions for storage discovery, pool import, offering creation, service order management, and storage operations.

The Management API allows developers to integrate Federator with third-party applications, and offers the opportunity to build new data services using the Federator platform.

Exploring ProphetStor Storage Hypervisor

ProphetStor Storage Hypervisor transforms x86 commodity hardware into storage servers providing a broad range of enterprise-grade features including the following:

- Data protection with mirroring, striping, striped mirroring, along with additional RAID levels
- Self-healing
- Snapshot and rollback
- Multi-level cache

ProphetStor Storage Hypervisor supports the iSCSI block storage protocol (with support for Fibre Channel in the future), and offers the following supported functions:

- Volume Create/Delete
- Volume Attach/Detach
- Snapshot Create/Delete
- Create Volume from Snapshot
- Get Volume Statistics
- Copy Image to Volume
- Copy Volume to Image
- Clone Volume
- Extend Volume
- Volume Rollback

Exploring OpenStack Integration

Unlike other storage systems that try to redefine themselves to adapt to OpenStack, Federator is built for OpenStack from the ground up, providing seamless integration with its components. Specifically, Federator integrates with the following OpenStack projects: Cinder, Nova, and Horizon.

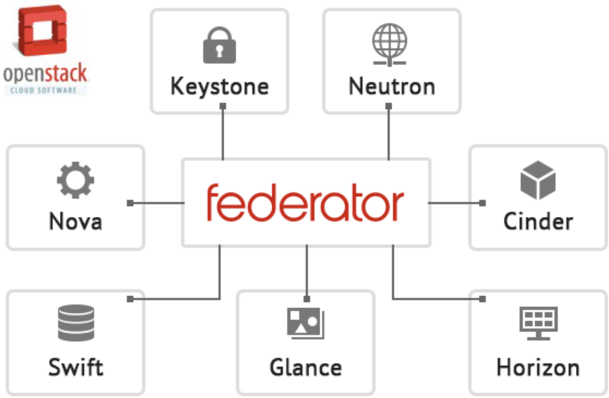


Figure 6: OpenStack Integration

Cinder

Federator provides the *Federator Volume Driver for Cinder* that allows storage to be plugged into the OpenStack cloud platform for storage federation. *Federator Volume Driver* extends Cinder by providing advanced storage operations such as snapshot rollback, and unifies data operations across block, file, and object storage.

Nova

Federator integrates with Nova through Cinder, providing both persistent volumes for virtual machines across federated storage, and unified operations across Cinder volumes.

Horizon

The Federator extension for Horizon exposes administrator-defined storage service offerings on the dashboard, available for users to request when creating volumes. Service offering details, such as thin provisioning capability and IOPS performance, are available allowing users to select the appropriate type of storage for an application.

Summary

In most cases, software-defined storage solutions offered by many vendors are little more than spot-solutions or solutions for existing problems unique to the vendor. ProphetStor Federator Software-Defined Storage, in contrast, supports heterogeneous, multi-vendor storage, making it possible for data center administrators to pool storage resources from different arrays and abstract them into virtual pools that can be provisioned automatically.

In addition, ProphetStor Storage Hypervisor, running on commodity x86 hardware, allows IT managers to easily add low-cost storage with enterprise-grade features and performance, helping to keep spending in line with current budgets.

ProphetStor Federator is designed to provide flexibility, intelligence, and standardization while, at the same time, offering freedom of choice to storage decision makers.

We Define

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