WHITE PAPER
Software-Defined Storage IzumoFS with Cisco UCS and Cisco UCS Director Solutions

Introduction

While the data handled by companies has an average growth rate of over 50% per annum, growth of HDDs' capacities have slowed down. Still, the needs to process large amounts of data at high speed and in real time has never been higher. To solve the problem, IzumoFS - Next Generation Software Defined Storage - provides an optimal solution in combination with Cisco Unified Computing System (Cisco UCS). The solution realizes a distributed storage with scalability and fault-tolerance.

IzumoFS - Cisco UCS Software Storage Solution

IzumoBASE and Cisco are going to collaborate by integrating IzumoFS with Cisco UCS Server to provide the best storage solution in the market.

IzumoFS consists of a Pure P2P architecture that doesn't require any gateway, connector or even metadata node. The installation process is simple and fast, as it requires only 2 steps and less than 60 seconds. IzumoFS provides high usability by simplifying configurations as much as possible. With the combination of such usability and inline deduplication for data capacity compression, IzumoFS brings down storage TCO drastically.

On the other hand, Cisco UCS series, including Cisco UCS Manager and Cisco UCS Director, provides a centralized, superior hardware management and provisioning systems. In addition, Cisco UCS is constantly introducing novel technologies that offer the latest hardware technology and manageability at all time. As an optimal way to catch up with the evolution of Cisco UCS, IzumoFS has a node replacement feature, which enables users to renew hardware easily with minimal overhead. It allows users to benefit from newest advantages of Cisco UCS at any time.

The key benefit of IzumoFS -- Cisco UCS integration for customers are:

- Construct enterprise scale-out NAS with Cisco UCS
- Easy storage management by simple IzumoFS UI
- Flexible hardware management by Cisco UCS manager
- Seamless hardware replacement by IzumoFS's Node Replacement to upgrade Cisco UCS..

This white paper outlines the result of compatibility test between IzumoFS and

Cisco UCS. Also, as an appendix, it describes a configuration example of Cisco UCS Director integration feature (under development).

IzumoFS Architecture and Features

IzumoFS runs on CentOS or RHEL and serves a huge virtual single storage pool. IzumoFS supports SMB / NFS / iSCSI protocols without any gateway, connector. Clients do not need to install any client applications. IzumoFS realizes a flexible, high-performance and cost-efficient scale-out NAS with comfort.

Other key features are

- Next generation security with distribution scheme that uses secret sharing (a user can choose between performance-oriented replication and security-oriented secret sharing scheme as a distribution policy for each volume).
- Real-time Active to Active disaster recovery by wide-area inter-site clustering.
- Inline deduplication that enables high efficiency in capacity and higher cache hit rate.
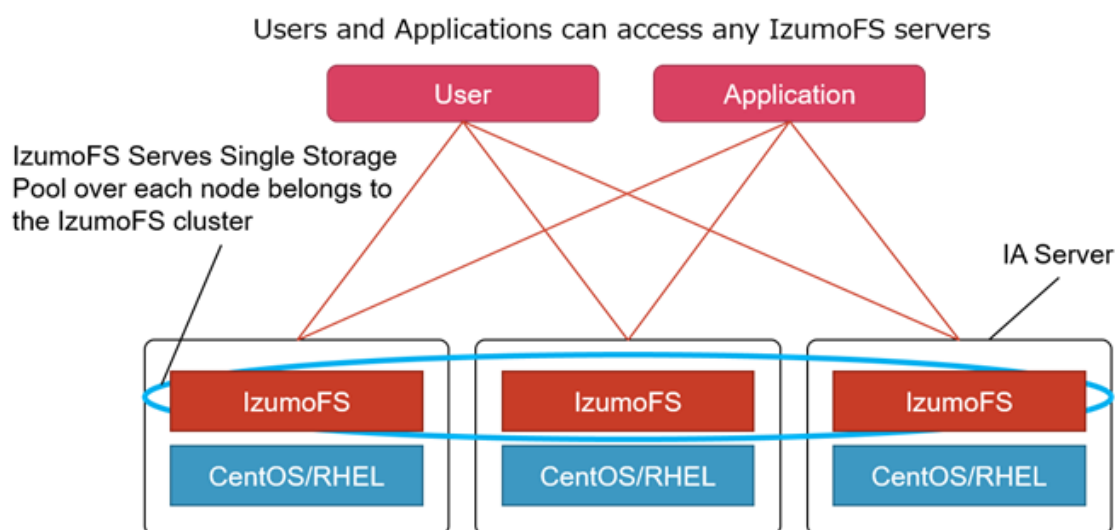

Figure 1 General diagram of IzumoFS cluster and its storage pool

As shown in Figure 1, IzumoFS has an extremely simplified architecture. A user can use all features of IzumoFS by simply launching the IzumoFS service installed on each IA server. Internal core components of IzumoFS are the following three components, which users do not have to recognize in normal operation:

IzumoFS
IzumoFS provides access through SMB / NFS / iSCSI protocol and manages block data and metadata. It Serves a virtual storage pool in cooperation with IzumoDB.

IzumoDB

IzumoDB acts as a distributed object store and it handles inter-node communication over RPC.

IzumoFS API

IzumoFS provides its own management API. It will mainly be used by the management console on web ? that runs on all nodes ? and a freely installable CLI console. All nodes can be managed and automated from any single node.

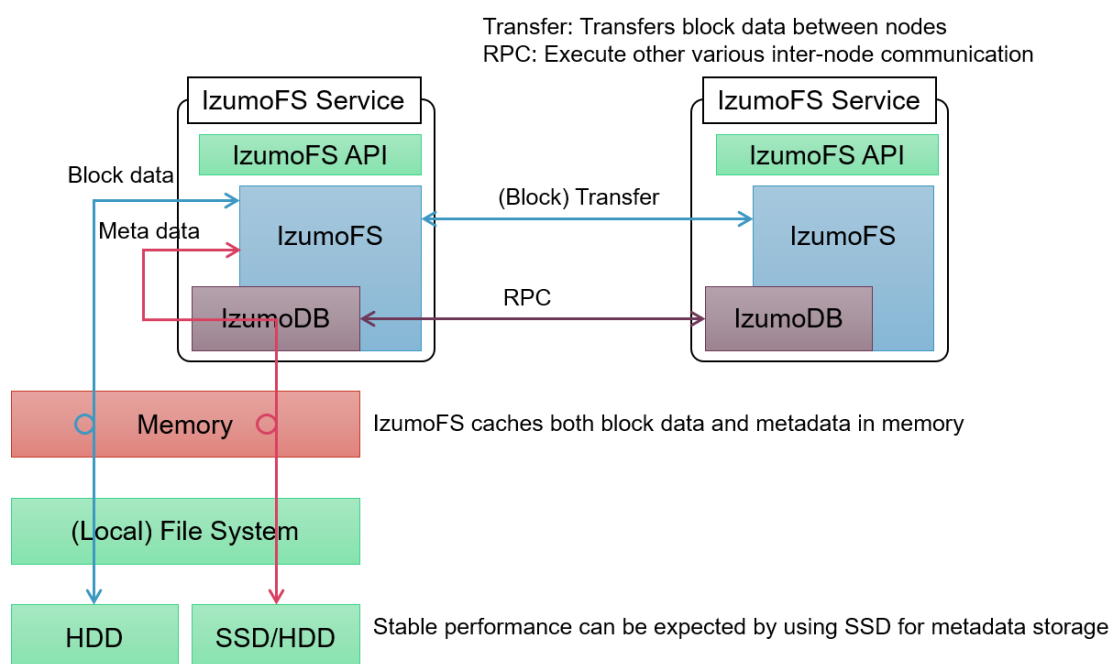Figure 2 shows how these IzumoFS components and hardware interwork.

Figure 2 General diagram of IzumoFS core components and its mutual behavior

IzumoFS uses RAID at physical layer of nodes to maintain availability of disks. Therefore, IzumoFS does not manage individual disks. In terms of performance, it is essential to assign separate RAID groups for block data and metadata. Although not mandatory, we also recommend metadata be stored on SSDs.

Cisco UCS Server

Cisco UCS (Unified Computing System) is an advanced server solution from Cisco. These days, each layer of infrastructures -- such as application, server, network, and storage -- operates in various environments including cloud, physical and virtual environments. Managing those components is becoming more complicated than ever. Cisco UCS integrates these diverse environments and provides a system that responds to the needs of flexible and rapid changes in the IT environment.

Cisco UCS Manager exists as a major software for achieving superior manageability of Cisco UCS. Cisco UCS Fabric Interconnect integrates and monitors both Cisco UCS blade servers and rack-mount servers.

Cisco UCS Manager manages all information of servers by Service Profiles. Service Profilescan be flexibly associated with servers by Cisco UCS Manager. This achieves rapid provisioning which is required for fast moving IT environment. It eliminates needs for administrators to perform troublesome setting tasks on individual servers. Operation efficiency will greatly increase with tasks that previously required a lot of man-hours, such as introducing a large number of servers at once.
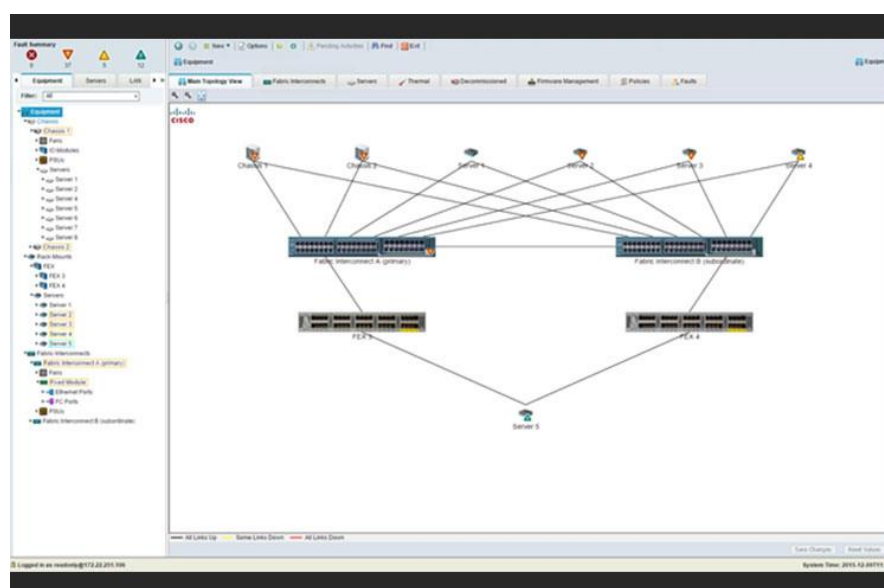
Solution Use Cases

IzumoFS - Cisco UCS Software Storage Solution realizes an optimal infrastructure with SMB / NFS / iSCSI protocol and modern environments like cloud computing and inter-site clustering. The following are examples of solution use cases:

Scale-Out NAS

- Available and extensible scale-out NAS
- Start from minimal of 3 servers and scale as data grows
- Extremely simple operation with Pure P2P architecture
- Flexible operation depending on data size
- Allow up to 2 server failures at any moment

Cloud
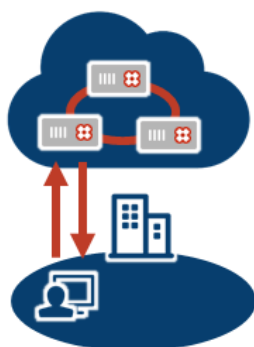
- Seamless migration from existing environment by supporting SMB / NFS / iSCSI protocol
- Super secure cloud service with Secret Sharing Scheme
- Seamless hardware upgrade by Node Replacement feature
- No worries for future data migration tasks (Node Replacement feature enables graceful upgrade on each hardware)

Inter-site Clustering
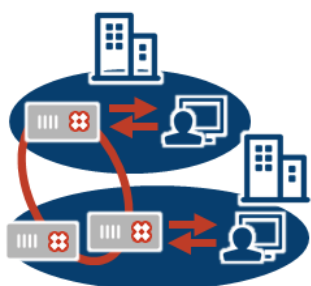
- Centralized data management on distributed environment
- Servers on each site are Active - Active
- Data will be synced to each site periodically
- A user can choose to access the closest server to get maximum performance
- Frequently accessed data will be cached automatically to the closest site

IzumoFS - Cisco UCS Compatibility Testing

IzumoBASE and Cisco did a series of Interoperability Verification Testing (IVT) between IzumoFS and Cisco UCS C240 M4 Rack mount servers.The IVT includes installation, functionality testing, and resilience testing. IVT assures the solution behaves as expected in the environment and configuration described below.

Environments and Diagrams

The IzumoFS cluster in testing environment consists of four IzumoFS nodes. It is the recommended configuration to use secret sharing as a redundancy policy. As a best practice in terms of performance and ease of maintenance, OS, metadata and block data are stored in separate RAID groups. Detailed network and hardware diagrams and specs of the nodes are illustrated below.
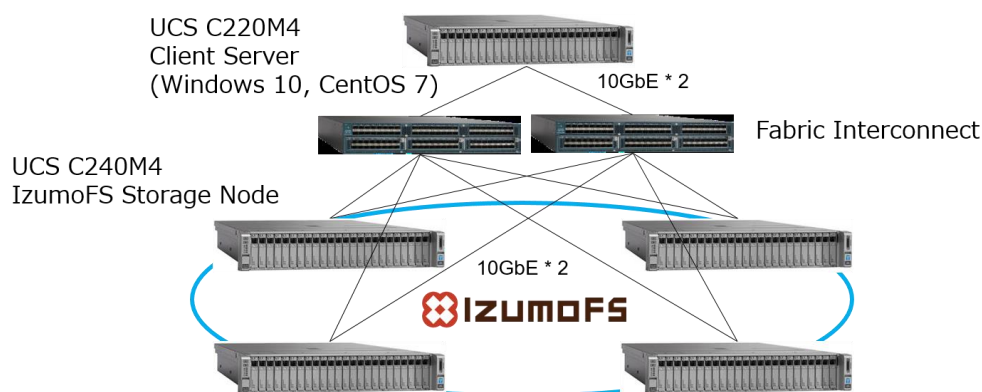

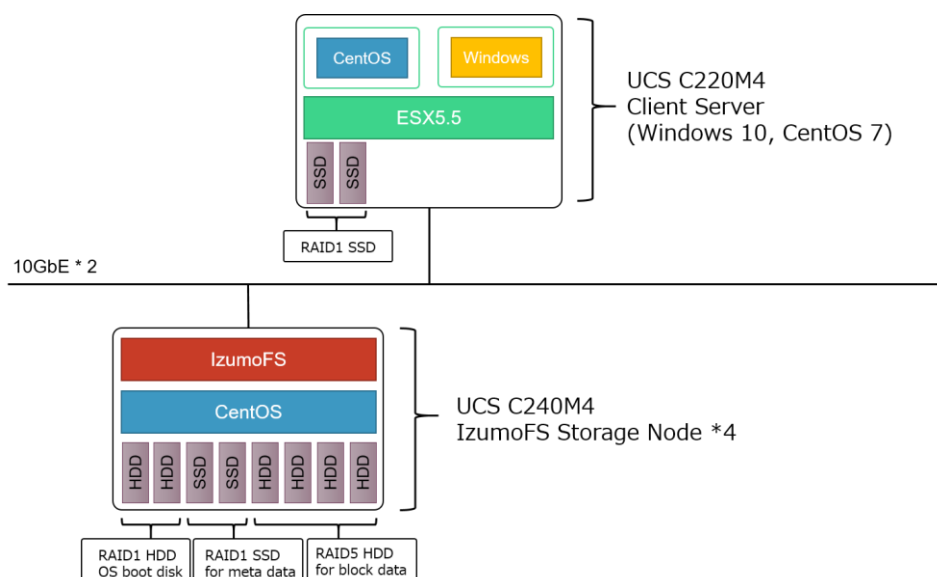*Figure 3 Server and network configuration*

Figure 4 Installed components

	Client server	IzumoFS Nodes
CPU	Intel Xeon Processor E5-2660 v3 (25M Cache, 3.30 GHz 10c/20t)	Intel Xeon Processor E5-2680 v3 (30M Cache, 3.30 GHz 12c/24t)
memory	128GB	128GB
Media	- RAID1 SATA SSD *2	- RAID1 SATA SSD *2 (meta data) - RAID1 SATA HDD *2 (OS boot) - RAID5 SATA HDD *4 (block data)
NW	10GbE * 2	10GbE * 2

Table 1 Hardware Specs

Result of Compatibility Testing

We confirmed the compatibility of running IzumoFS on Cisco UCS C240 M4 through installation, functionality testing, and resilience testing. Since the test focuses on compatibility between Cisco UCS C240 M4 and IzumoFS, a performance test of IzumoFS was done as an internal operation.

A series of tests successfully confirmed compatibility between Cisco UCS C240 M4 and IzumoFS. Also, it confirmed that Cisco UCS C240 M4 operates as specified by IzumoFS. For the test, we used IzumoFS Version 2.1.2, which was the latest version at the moment. Contents of the tests are as follows.

Installation
- Configuration of Cisco UCS Service Profile
- Installation of operating systems
- Creation of partitions for block data and meta data
- Installation of JDK
- Installation of IzumoFS
- Installation of IzumoFS CLI
- Setup of a network interface for inter-node transaction

Functionality testing
- Scaling: Scale storage capacity by adding new storage nodes without interrupting I/O
- Attaching iSCSI volume: create and attach an iSCSI volume
- iSCSI volume snapshot: create and restore snapshots
- Publish SMB/NFS shared folder: create and use SMB/NFS shared folders
- SMB/NFS shared folder snapshot: create and restore snapshots
- Inline Deduplication: store data with inline deduplication
- Secret sharing: create a shared folder with secret sharing configured and confirm security of split shares
- Real time I/O monitoring: monitor real-time transition of capacity, throughput, IOPS, and latency

- Node replacement: replace node without data rebalancing

Resilience testing
- Storage Node failure: I/O failovers as configured on surviving nodes
- Storage Node network interface failure: I/O failovers as configured on surviving nodes
- IzumoFS service failure: I/O failovers as configured on surviving nodes

Product Roadmap

IzumoBASE is trying to convert complicated operations of contemporary storage systems to simple ones and to make contemporary storage systems stable infrastructures -- just as if twisting a tap always lets water come out. Specifically, as shown in the illustration of Solution Use Cases, we aim IzumoFS at comprehensive use cases such as on-premise, cloud, and wide area cluster.

Now that cloud computing has become popular, we can say that we are going into an era of IoT where everything is connected to the Internet. In such times, it's required to have an infrastructure with tens of billions of devices constantly generating and analyzing data. This is a vision so-called fog computing or edge computing.

IzumoFS supports active-active utilization of geographically distributed nodes by taking advantage of its flexibility which is characteristic of SDS. As a product roadmap for the future, we are planning to extend the product to focus on wide area clustering, aiming for new products that match IoT and fog computing era.

Appendix

Cisco UCS Directorer Collaboration
Cisco UCS Director

Cisco UCS Director can orchestrate IT processes including not only Cisco products but also products of other companies. By integrating and automating IT infrastructure, a user can manage complex tasks as a series of processes and improve operational efficiency.

By using a self-service portal, users can quickly request the necessary IT infrastructure from administrators and administrators can manage and approve those request to dispatch a new IT infrastructure on a centralized system. These workflows are made up of subdivided tasks, allowing flexible orchestration depending on the practical business process.

IzumoFS - Cisco UCS Director Collaboration

Currently, management of IzumoFS's shared folder through Cisco UCS Director is under development. Figure 5 shows the screen under development. With this feature, a user can create, edit or delete IzumoFS's shared folders from Cisco UCS Director.
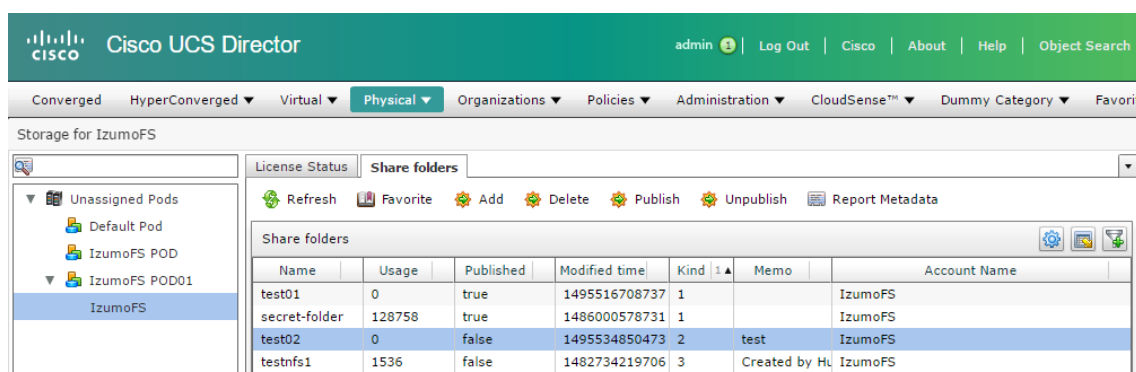

Figure 5 IzumoFS Share Folders on Cisco UCS Director

In addition, operations on IzumoFS's shared folder through Cisco UCS Director "Task" is also under development. With this task, IzumoFS workflow (Figure 6) and catalog (Figure 7) can be created on Cisco UCS Director. For example, a user can send a request for paying out a shared folder to Cisco UCS Director administrator at required timing (Figure 8). By approving received requests, the Cisco UCS Director administrator can pay out shared folders to end users without opening the IzumoFS administration console (Figure 9 - 11).
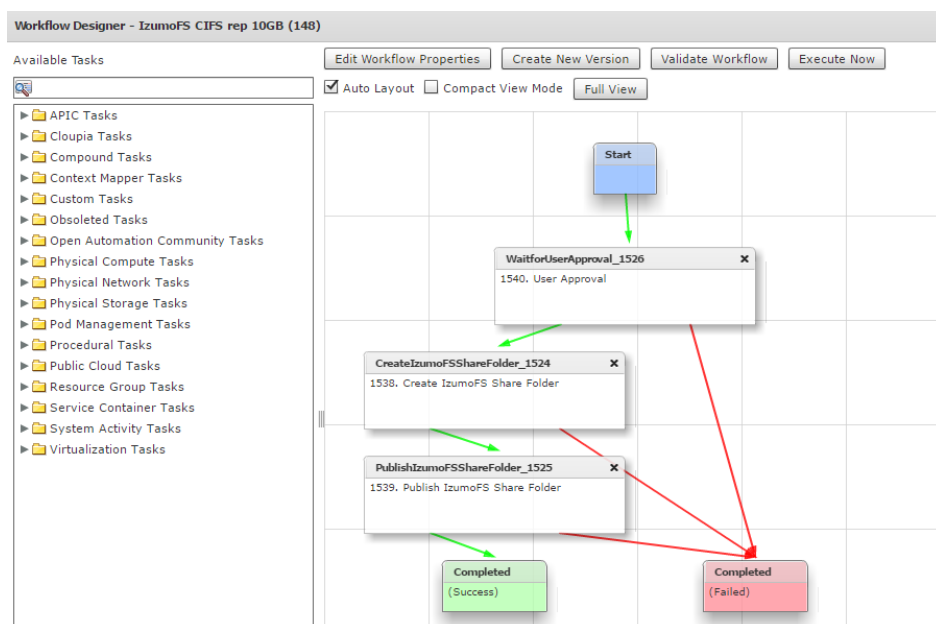
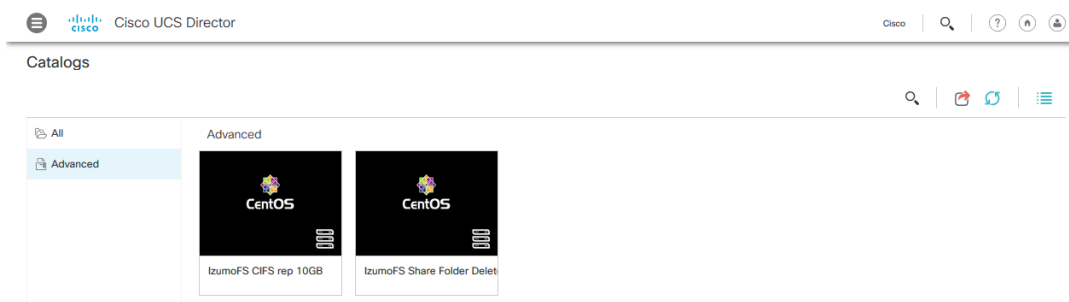*Figure 6 Cisco UCS Director Workflow*
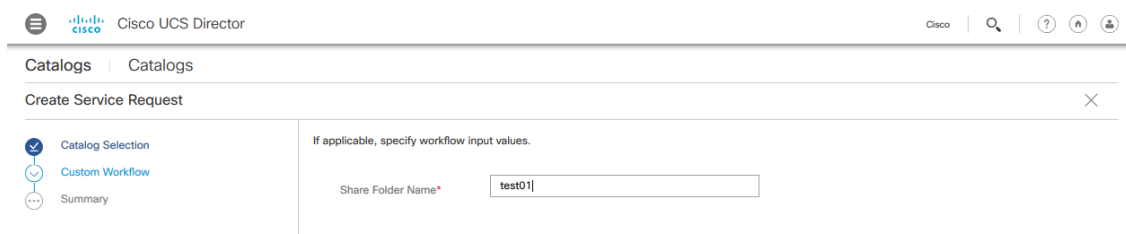

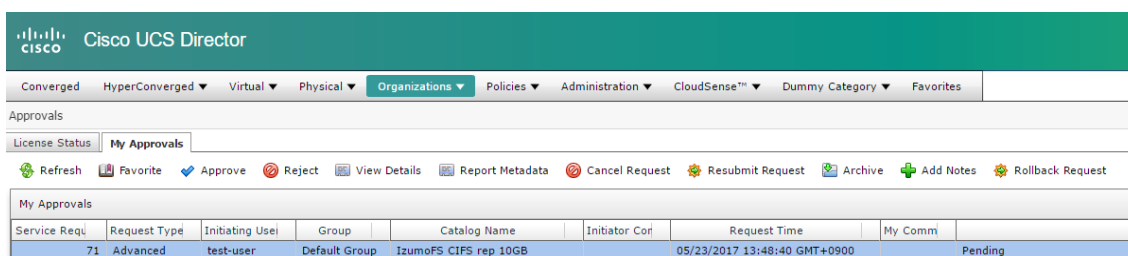*Figure 7 Cisco UCS Director catalogs*
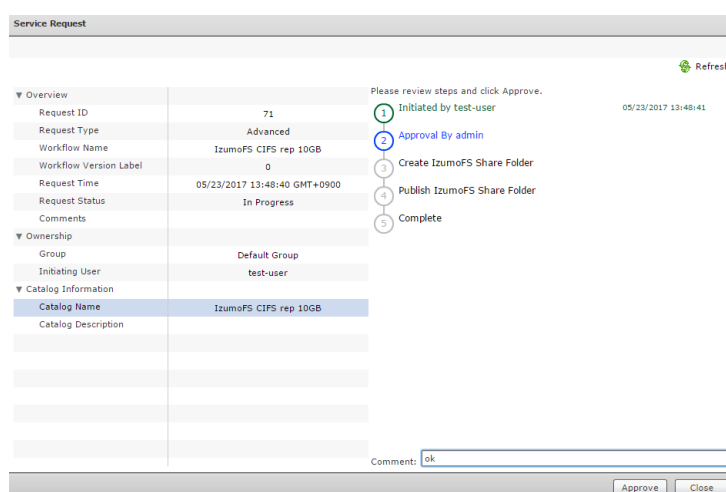

Figure 8 Share Folder Request

Figure 9 Approval request list

Figure 10 Approve request

Figure 11 Approved Share Folder in IzumoFS GUI

IzumoFS makes it easy for administrators to operate whatever they need to do with the infrastructure. In addition, through a series of Cisco UCS Director linkage functions, a user can make storage operable without opening management console of IzumoFS and incorporate communications between an administrator.

Recommended Configurations

Example configurations of IzumoFS are shown below. The performance configuration is oriented towards a high throughput. The mid-range configuration is for cost effectiveness, and the dense configuration is suitable for a large amount of data with highly integrated Cisco UCS S3260. In practical applications, these typical configuration examples will be adjusted according to data sets, environments, and requirements.

	Performance	Mid-range	Dense
model	UCS C240 M4	UCS C240 M4	UCS S3260 M4
CPU	Intel Xeon Processor E5-2643 v3 (20M Cache, 3.40 GHz 6c/12t)	Intel Xeon Processor E5-2637 v3 (15M Cache, 3.50 GHz 4c/8t)	Intel Xeon Processor E5-2680 v4 (35M Cache, 2.40 GHz 14c/28t)
memory	128GB	64GB	128GB
Media	- RAID1 SSD (meta data) - RAID1 SFF HDD (OS boot) - RAID5 SFF HDD (block data)	- RAID1 SSD (meta data and OS boot) - RAID5 LFF HDD (block data)	- RAID1 SSD (meta data) - RAID1 LFF HDD (OS boot) - RAID5 LFF HDD (block data)
NW	10GbE * 2	10GbE * 2	10GbE * 2

Resources

Cisco:

https://www.cisco.com

IzumoBASE:

https://www.izumobase.com

IzumoBASE Blog:

https://www.izumobase.com/blog

Twitter:

https://twitter.com/IzumoBASE

Facebook:

https://www.facebook.com/IzumoBASE-INC-1551591798412154

Cisco Marketplace IzumoFS solution:

https://marketplace.cisco.com/catalog/solution/155055?pid=160705

Cisco Japan Solution Partner page:

https://www.cisco.com/c/ja_jp/partners/partner-with-cisco/solution-partner-program-spp/solutions/izumobase-izumofs.html?stickynav=1

IzumoBASE, INC.

IzumoBASE, with our vision "to make storage true infrastructure", delivers IzumoFS, a Software-Defined Storage with ease, that provides cutting-edge solutions to complex data management, with the power of the newest technology

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