

PAC Storage Cloud Gateway Best Practices



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Abstract:

This document provides recommendations of best practices for proposing hybrid cloud solution with PAC Storage Cloud Gateway software. Based on the experiences of the field site, PAC Storage keeps optimizing Cloud Gateway software feature to fulfill the requirements.

Change History List			
Rev.	Updates	Date	Updated by
1.0	Initial release	Aug. 2018	KevinHW.Ko
1.1	1. New cloud provider: Baidu, Tecent 2. Cloud upload scheduling	June 2019	Kenny.Mei

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Summary

This practice focuses on the proposal and configuration of the appropriate hybrid cloud solution with PAC Storage Cloud Gateway Software Suite. This software solution is designed for enterprise-level businesses that demand high availability and reliability, in which most cases require billions of files or PB-level data on the cloud. Even if Cloud's metadata-handling technology provides performance between front-end and cloud-end performance, we can also recommend better configuration principles based on the data variation and scenario. For large scale projects, trial license for POC (proof of concept) procedure may be required before making the production online.

This best practice only covers the Cloud Gateway. For details regarding storage front-end high availability and performance best practice, please refer to **PAC Storage PS Family Best Practice Guide**.

Audience

This guide is intended for the PAC Storage partners, customers, and employees who use and configure PAC Storage system with Cloud Gateway feature. We assume the audience is familiar with PAC Storage array operation.

Terminology

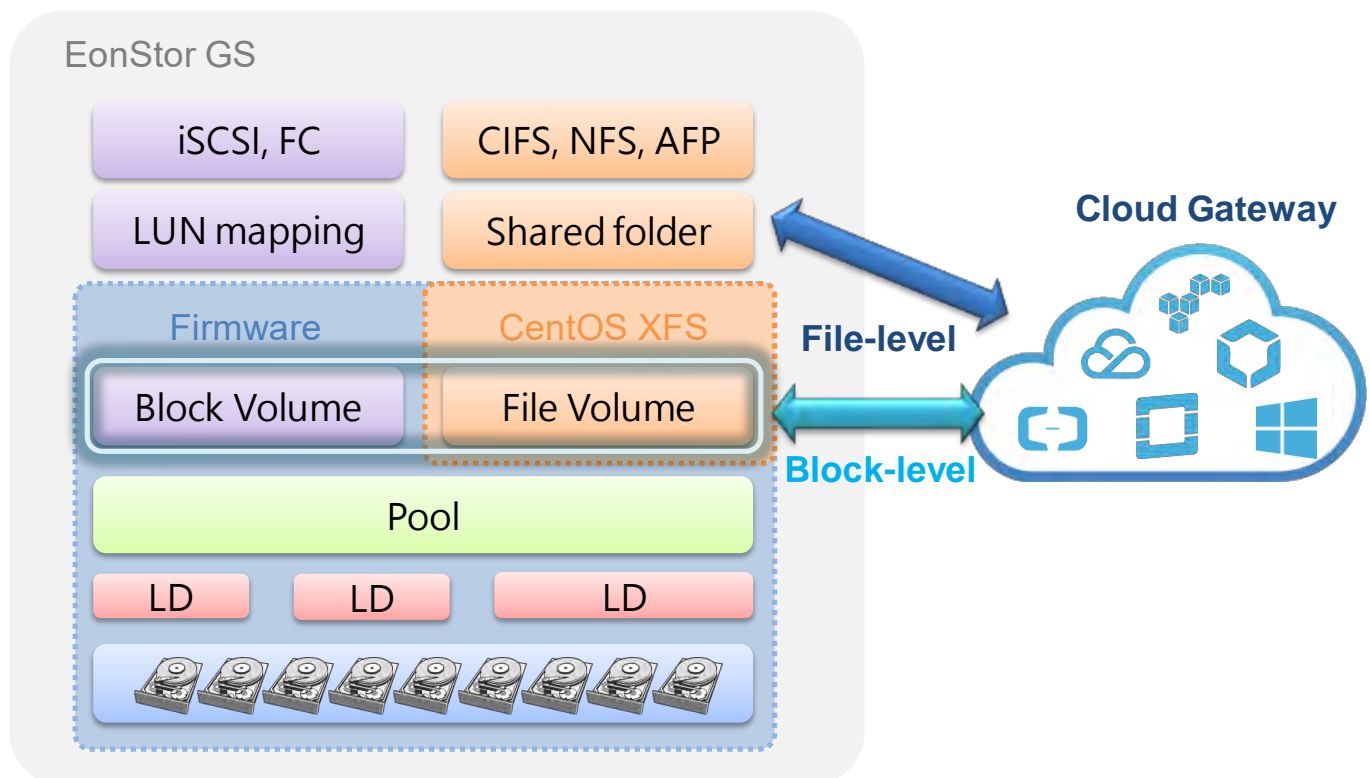
- **PAC Storage PS** – PAC Storage PS refers to all the PAC Storage products that can enable Cloud Gateway feature, including PAC Storage PS families.
- **Cloud Gateway (Block-level)** – A volume-based cloud feature that backs up volumes or recovers volumes from the public cloud.
- **Cloud Gateway (File-level)** – A folder-based cloud feature that synchronizes multiple folders of PAC Storage storages with a cloud folder.
- **Host Connection (Front-end Connection)** – The connection between host servers and PAC Storage array which serves both block-level and file-level protocols.
- **Cloud Connection** – The connection from PAC Storage array to a public cloud.
- **Pool** – the integration of logical drives where users can create volumes.
- **Block-level volume** – A block-level storage device that is accessible via block-level protocols.
- **File-level volume** – A storage device with file system that is accessible via file system shared protocols.
- **Shared folder** – A location for shared storage access via file system protocol. In the Cloud Gateway folder cache, users must specify the quota of the folder cache size.
- **Cloud Bucket** – The basic unit of storage space on the cloud storage.

Cloud Gateway Architecture

There are two types of Cloud Gateway features for PAC Storage hybrid cloud solution:

- **Block-level Cloud Gateway** - A backup and recovery solution that provides volume-based backup to the cloud. When PAC Storage PS is connected to a cloud bucket, the system can back up both block volumes and file volumes to the cloud. From a cloud provider console, it's an unreadable backup file. Another PAC Storage PS can retrieve and recovers the volume once technical mishaps happen during production. Also, the data reduction of the uploading volume is supported to save bandwidth and cost for the hybrid cloud solution.
- **File-level Cloud Gateway** - This type of solution provides folder-based file synchronization with cloud bucket. The files on PAC Storage PS shared folder is uploaded to the cloud folder/bucket and is accessible. Its ACL (Access Control List) of the shared folder are also synchronized. It's suitable for cross-office collaboration or cloud big data analysis enhancement. Its cache mode feature saves cost, and at the same time, maximizes the efficiency for hybrid cloud solution. Users only need to purchase part of the capacity to leverage the large amount of data on the cloud.

By using PAC Storage metadata-handling technology, Cloud Gateway can support billions of files on the cloud enterprise level.



PAC Storage PS configuration architecture

Proposed Solutions

PAC Storage PS is a unified storage that provides SAN and NAS service in one device. Cloud Gateway software suite supports block-level and file-level storage with various data transferring modes. To provide more precise hybrid cloud solution, we must double confirm the requirement and user's future plans before proposing the solution. It may be a 3-year plan from on-premise solution to hybrid cloud solution.

Customer's requirements

This section details the question for the solution proposal. The below table is to help you understand the features which Cloud Gateway provides.

Application	Mode	Advanced Features	Data Variation per Day	Hot Data
Block-level	Backup	Snapshot to cloud	Required for proposal	N/A
	Cache	Data reduction and encryption to cloud	Required for proposal	Required for proposal
	Tiering	Disaster recovery	Suggest to ask PAC Storage for consultation	
File-level	Sync	ACL Synchronization Access Control Management	Required for proposal	N/A
	Cache	ACL Synchronization Access Control Management, Cache policies	Required for proposal	Required for proposal

Block-level or File-level Cloud Gateway

Users are required to know if SAN or NAS service is a better network storage solution for the application. Cloud supports block-level and file-level protocols cloud integration. For starters, we must ensure what type of service is required.

- **Block-level Cloud Gateway**

It's a volume-based backup solution suitable for structured data. Both block volume and file volume are supported. Even though NAS file sharing service is used on the front-end application, we can still use block-level Cloud Gateway to back up the file volume. However, the backup file is an unreadable data for recovery on the cloud. Users can't access the files on the cloud. Please note that only thin-provisioned volumes are supported by PAC Storage block-level Cloud Gateway.

- **File-level Cloud Gateway**

Folder-based Cloud Gateway detects and updates the data for each file. The data on the cloud is saved in the cloud folder. Each file in the cloud is accessible via the console of public cloud provider. Since we can directly use the data on the cloud, file-level Cloud Gateway is suitable for centralizing data from multiple PAC Storage arrays and implementing the big data solution on the cloud.

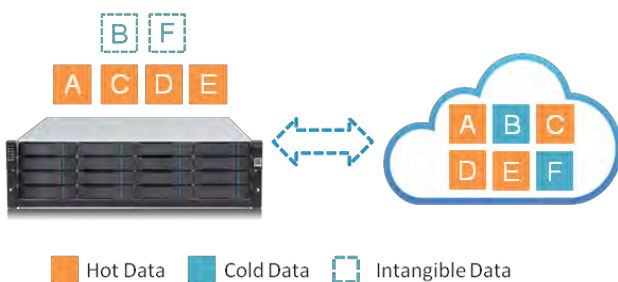
Cloud Mode Selection

PAC Storage Cloud Gateway supports various modes for both block-level and file-level to cater different scenarios.

- **Block-level Cloud Gateway**
 - **Cloud Volume Cache (recommended)**
The whole volume is uploaded to the cloud but only the hot data remains on the on-premised storage.
 - **Cloud Volume Backup**
The whole volume is backed up to the cloud and remains on the on-premised storage. That means users need double capacity for all the hybrid cloud solution.
 - **Cloud Volume Tiering**
The whole volume is separated into hot data and cold data. Only the cold data is uploaded to the cloud and hot data remains on the on-premised storage. Since there is no complete data on cloud or on-premised site, cloud snapshot should be taken for disaster recovery solution.
- **File-level Cloud Gateway**
 - **Cloud File Cache (recommended)**
All the files are uploaded to cloud. The on-premised storage is read cache or write buffer which only keeps the hot data for accelerating data access.
 - **Cloud File Sync**
Each file in the cloud folder is synchronized between on-premised storage and cloud. With bi-directional synchronization, users need double capacity for all data.

Folder Cache Mode Policies

With more than 7 different types of cache policies, IT administrators can customize the folder cache policy for specific file types or file name based on their needs.



Expression:

Cache Policy:

☒ Pre-populate
☐ Sequential-populate

- Advanced Cache Policy

Policy	Suitable Scenario
Default (Least Recently Used, LRU)	For general purposes
Uncacheable for read	Users may not access some files very frequently and they don't need low latency for these files. The policy bypasses the local cache so that the client can read/write directly from/to cloud without consuming cache space.
Uncacheable for write	
Low Priority	The archived history files for evidence purpose.
High Priority	To ensure that most of these files are located in the cloud cache for frequent data access.
Not Applicable	There may be private policy for some files on the cloud. We can make them as unreachable for the clients.
Local Only	Some applications generate temporary files during the process. Most of these files are meaningless for data analysis. We don't need to upload these temporary files.
Function	Suitable Scenario
Pre-populated	Force download the files from the cloud to the cloud cache. Ensure that the files are located in the cloud cache.
Sequential-populate	Similar to the Pre-populated. The files are force downloaded to the cloud cache. In addition, the system also pre-allocates a space for the files. It's suitable for large files (such as video files) to be downloaded in an efficient way.

Snapshot and Snapshot to cloud (Block-level Cloud Gateway only)

The best Snapshot practice is to have 30% of total data capacity as a reserved space. When using Snapshot with Cloud Gateway, additional reserved space in pool must be considered. It also mandatory to know the total capacity if Snapshot feature is required. Block-level Cloud Gateway also supports Snapshot to cloud feature so that it is easier to retrieve and recover the volume from cloud to the point-in-time image. For tiering mode, Snapshot to cloud is required for further disaster recovery solution.

Cloud folder connection number (File-level Cloud Gateway only)

PAC Storage PS allocates 1 GB memory RAM of the controller for each cloud folder. Before enabling the file-level Cloud Gateway, please ensure that the memory size per controller is enough for your cloud folders plan.

Data Variation per Day

In general, it's acceptable to finish updating the data on the cloud between 8 hours to 1 day. That's why data variation per day does matter. According to this requirement, we can estimate how much capacity of the on-premised cache storage should be proposed. It's also important to estimate the required cloud connection bandwidth. As Cloud Gateway constantly synchronizes local data changes to the cloud, having enough network bandwidth becomes a key factor in proper data syncing and overall system processing.

Hot Data Estimation (Cache mode only)

To ensure that the hot data is located in the on-premised storage for accelerating data access, it's better to have the cache capacity which is larger than hot data. If the hot data requested from the front-end hosts or clients is much larger than the proposed cache size, the low cache hit rate may result to data transferring between cloud and on-premised storage more frequently. Not only performance impact happens but also the bandwidth of cloud connection is getting higher.

Block Size of I/O Behavior (Block-level Cloud Gateway only)

Block-level Cloud Gateway supports data reduction function to save the bandwidth of cloud connection. However, the deduplication efficiency depends on the application. We strongly recommend using the trial version to test the deduplication before enabling it for production. To use bandwidth efficiently, compression is always recommended.

Storage Configuration Principle

This section provides the detailed configuration guidelines based on the customer's requirements, which you can find in the previous sections. For cloud volume backup and cloud folder sync modes, the best practice is to simply create a space according to the required capacity. The principles below focus on the cloud cache mode configuration. PAC Storage and its partners can propose appropriate solutions with the said principles.

The Bandwidth of Cloud Connection

When using cloud cache mode, the on-premised storage only keeps the hot data. Every data updated in the cloud cache must be uploaded to the cloud as soon as possible. The dirty cache (the updated data which hasn't been uploaded to the cloud) can't be deleted before it is uploaded to the cloud. The performance of cloud connection should be enough for data variation per day. In addition, we need to ensure that the bandwidth of cloud connection is enough for the throughput. Please refer to the Cloud Gateway performance report to get the cloud connection performance.

Cloud Connection Bandwidth > Cloud Connection Performance

The Maximum of Data Variation per Day = Cloud Connection Performance

For example:

If the maximum performance of the cloud connection on the report is 500 MB/s, we can estimate that the maximum of data variation per day is $500 \text{ MB/s} \times 60 \times 60 \times 24 = 43.2 \text{ TB}$. We just need to ensure that the bandwidth to the cloud is more than 500 MB/s.

Storage Capacity (Cache mode only)

To propose cloud volume cache, the size of cache must be the same or larger than the estimated hot data. The remaining pool space should be reserved for data variation per day and data services (snapshot as example). The best practice of snapshot reserved space is 30% of whole data on the cloud. Note that the volume should be a thin-provisioned volume.

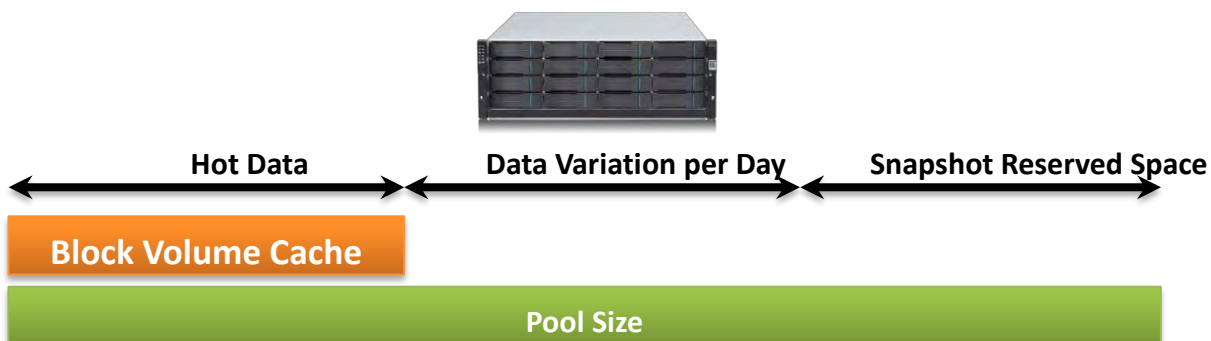
Block Volume Cache Size = Allocated Size of thin-provisioned Volume = Hot Data

Pool Size = Hot Data + Data Variation per Day + Snapshot Reserved Space

(Snapshot Reserved Space = Cloud Data x 30%)

For example:

The customer's requirement is 100 TB hot data with 100 GB data variation per day. After 3 years, we estimated that the total capacity would be $365 \times 3 = 110 \text{ TB}$, so that Snapshot reserved space is accommodated of $110 \text{ TB} \times 30\% = 33 \text{ TB}$. The solution should include $100 \text{ TB} + 100 \text{ GB} + 33 \text{ TB} = 133.1 \text{ TB}$ Pool with 100 TB block volume.



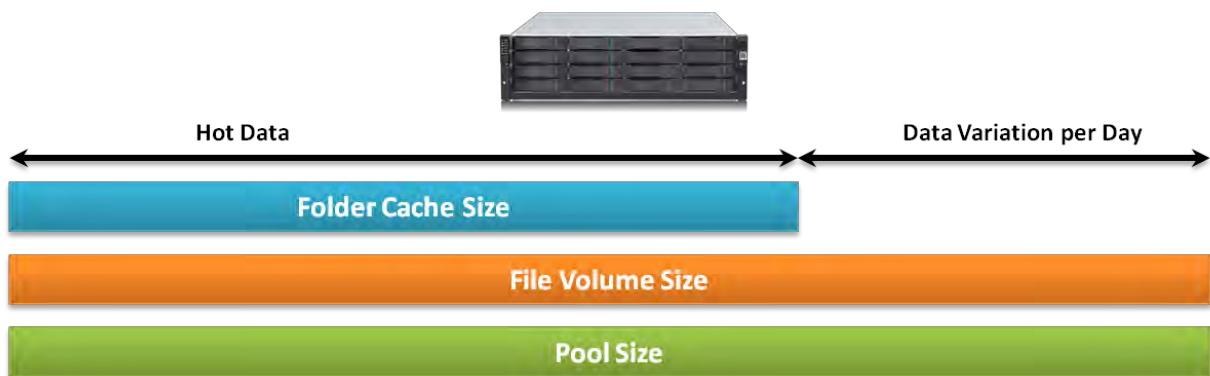
To propose a cloud folder cache, the size of folder cache must be the same or larger than the estimated hot data. Unlike the cloud volume, we should create an additional file volume capacity for data variation per day. Please don't use Snapshot when using the folder cache mode since the volume snapshot only includes the metadata. It's meaningless to only recover the metadata.

Folder Cache Size = Hot Data

File Volume Size = Pool Size = Hot Data + Data Variation per Day

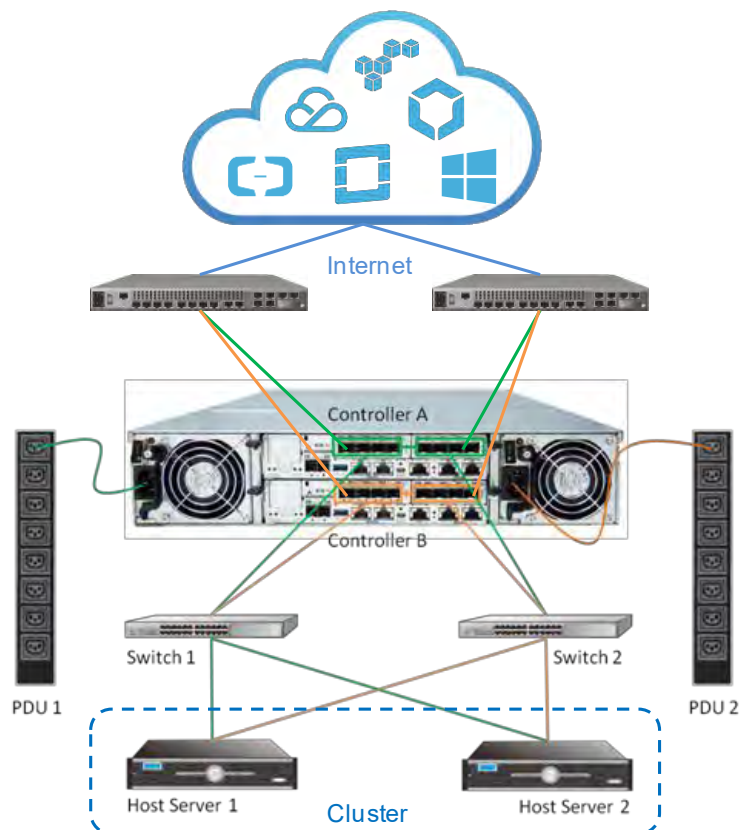
For example:

The customer's requirement is 100 TB hot data with 100 GB data variation per day. The solution should include 100 TB + 100 GB = 100.1 TB Pool and volume with 100 TB folder cache.



Cloud folder configuration based on requirement

High Availability Configuration for Hybrid Cloud Solution

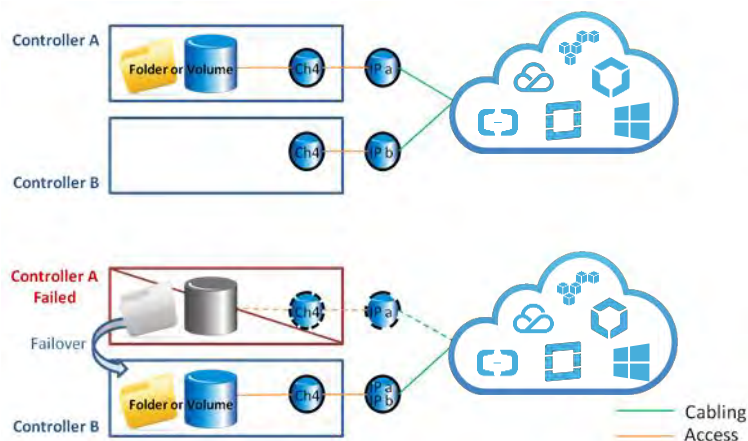


HA configuration example of hybrid cloud solution

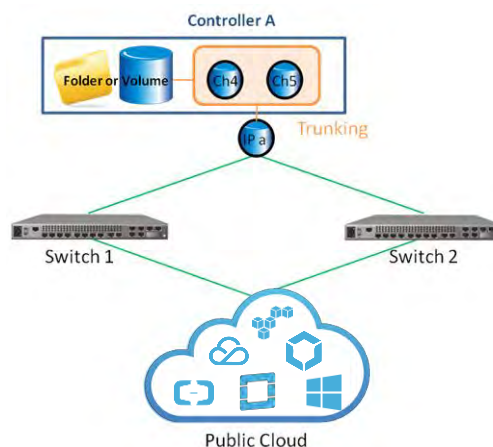
We recommend users to connect the cables to the channels with the same port number on both controllers, symmetrically to the cloud connection switch. In case of controller failure, the controller failovers to the surviving controller and continues to access cloud since it is connected to the same switch. Also, we recommend to connect channels of the different controller to the different switches with IP trunking (link aggregation), so that the storage is accessible by the surviving cables with the same IP address if one of the channels fails. To implement high availability, we use dual switches between the storage and public cloud to avoid a single path or network failure. In case of failure in switch or cable, the connection between storage and cloud is still available via the remaining path.

Availability	Solution
Controller failover	Symmetrically connect the cables to the channel on both controller (A & B). In case of controller failover, the IP of the channel in the controller also experience a failover to the channel on controller B.
Cable availability on a controller	Connect at least two channels of a controller to different switch with enabling trunk group. Thus, the storage system is still accessible via the same IP address when one of the cables is disconnected.
Power availability	Plug redundant PSU to separate PDUs

- **Controller failover:** The pool assignment of the shared folders or volume switches from controller A to controller B. Moreover, the channels on the controller A also physically switches to controller B and the original IP address of the controller A is still accessible to the shared folder or volume.



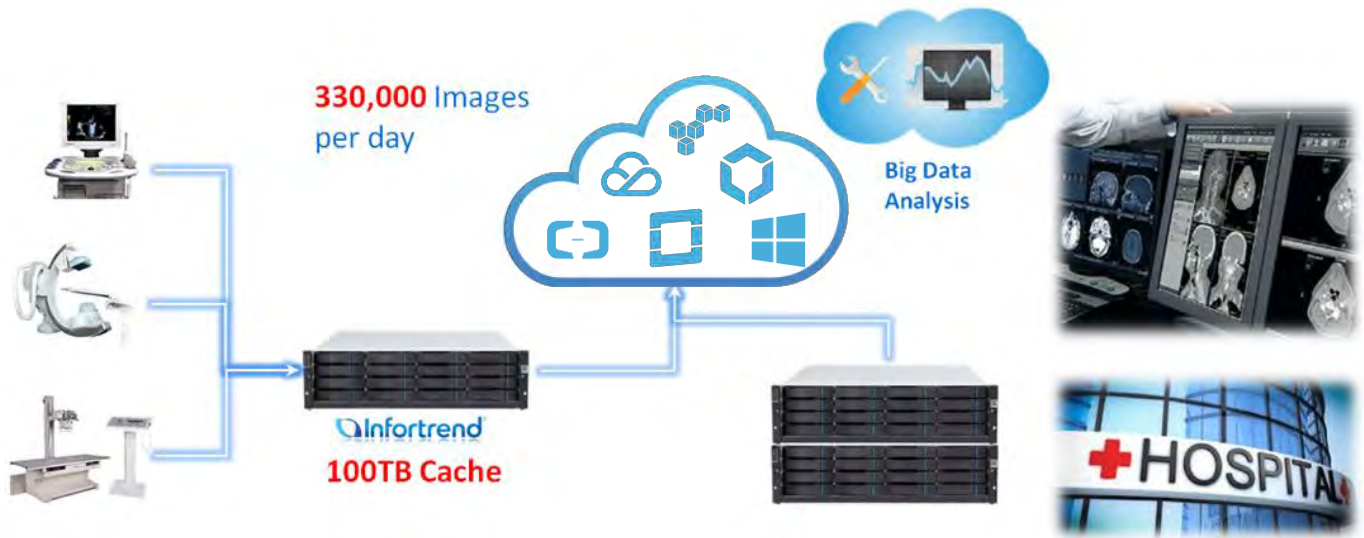
- **Cabling failover:** To avoid single point of failure, we recommend that you deploy more than one connection through a single controller and configure trunk groups across multiple ports. For the switch connection, connect the cable to redundant switch for high availability.



Use Case

Hybrid Cloud Solution for Enterprise Big Data Analysis

Picture archiving and communication system (PACS) is important for medical institutions to analyze with medical materials such as medical images. In this case, main and branch hospitals generate hundreds of thousands of medical images from medical instruments. The requirement is to centralize medical images to the public cloud for big data analysis.

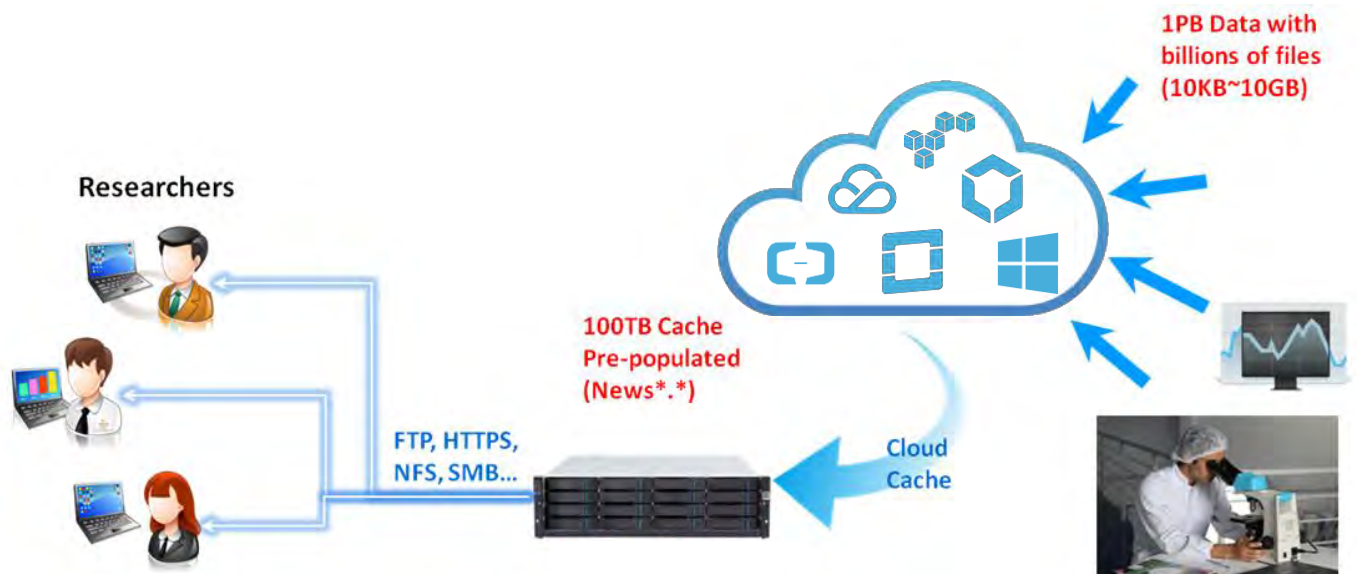


Hybrid Cloud Solution for PACS

There may be PBs of files on the cloud. For this case, the best solution is to use file-level cloud cache mode. For cache mode, the data variation per day is the most important requirement. The customer estimated 330,000 images, which needs an estimated 330 GB of space, and needs 100 TB as cache to accelerate the instrument's data written into on-premised storage. The additional requirement is to have a buffer for cloud connection maintenance. We assume that when the cloud connection is broken for a month, the cloud cache still has enough reserved space for the daily images. According to the best practice, we should create at least $330 \text{ GB} \times 30 \text{ days} = \text{around } 10 \text{ TB}$ reserved space. Therefore, 110 TB file volume (100 TB + 10 TB) and a 100 TB folder cache on the file volume must be created. Since there is no specific requirement for cache synchronization, we remain the cache policy as default (Least Recently Used, LRU).

Hybrid Cloud Solution for Genomics Institute

This genomics institute has already put billions of data on the cloud for big data analysis. The customer's requirement is to add a cloud storage gateway to accelerate the local data access for the researchers. After the data analysis on the cloud, the Cloud Gateway uses the pre-populated function to ensure that the analysis results including "New" are located on the local storage. Researchers can access these results via FTP, CIFS file protocols efficiently.



First, the customer needs file sharing on the local storage, so we proposed file-level Cloud Gateway as the solution. The researchers require a 100 TB cache folder to accelerate data access and estimate about 1 TB update data per day. In this case, $100\text{ TB} + 1\text{ TB} = 101\text{ TB}$ volumes must be created first and create a folder with 100 TB quota size. In the cache policy settings, we need to enable the pre-populated function and enter the rule of the file name.

Conclusion

This practice provides explicit configurations and recommendations for the PAC Storage Cloud Gateway in consideration of customer's requirements. By deploying a more efficient configuration, users can enjoy the advanced features on Cloud Gateway without performance hindrances in mind. The cloud cache mode increases the efficiency of data usage on between on-premised storage and cloud in a cost-effective way. Intelligent cache policies help IT administrator to take all the data in control, and ensures that the client can access the data efficiently.