



ASPEN CLOUD STORAGE

Defining next generation of cloud based grid
Power-All Networks Ltd. Technical Whitepaper
September 2008, version 1.04

Table of Content

1. Introduction	3
2. Paradigm Shift to Cloud Storage	4
3. About Aspen Cloud Storage	6
4. Aspen Cloud Storage Functionality	8
5. Aspen Cloud Storage Terminology	10
6. Aspen Cloud Storage Architecture	11
7. How to use Aspen Cloud Storage	19
8. Aspen Cloud Storage Advantages	21
9. Aspen Cloud Storage Operation Modes.....	22
10. Aspen Cloud Storage Vertical Applications	23
11. Pricing and Billing Model	25
12. Sample Code	28
13. Aspen Cloud Storage Comparisons	29
14. Conclusion	31
15. Contact	32

1. Introduction

Explosive Growth of Digital Media and User Generated Content

With the wide use of Web 2.0, there is an explosive growth of digital media and user generated content. Video streaming and big file sharing becomes more and more popular. Everyday there is lot of new launched websites providing free services for file download or video streaming. These kind of services required huge size of storage, CPU power and bandwidth. To build and maintain a scalable and reliable Internet storage is a complicated and expensive work.

Power-All's Aspen Cloud Storage is to resolve all kinds of traditional storage issues and focus the storage usage for Internet.

About This Whitepaper

This whitepaper introduces Power-All Aspen Cloud Storage from overview, structure to detailed technical implementation.

2. Paradigm Shift to Cloud Storage

Issues about Traditional Storage to Internet business

Traditionally most website runners are headache about providing a fast and reliable storage for their web content. For companies having plenty of budgets, they can buy storage product from market. For startups, they can't afford buying storage product and have to build it by themselves. To build a scalable and reliable storage, it requires experienced skillful engineering team which is another type of cost to startups. No matter buying or self-building, there is still an upfront cost and maintenance cost.

Besides upfront cost, companies require engineering effort to design a scalable and fast storage suitable for Internet. In web industry, website runners are always side tracked by this kind of engineering effort and can't 100% focus to their core business development.

Thirdly, using resources efficiently is a key factor to save cost. By Moore's law, if company has deployed too much storage equipments without fully utilized, the equipment will be wasted as hardware price per Gigabyte is dropping every day.

In addition to hardware, bandwidth and data centre space is required for Internet business. Again, if companies subscribed too much bandwidth or rack space, it results higher cost to company.

Besides cost issue, most traditionally storage products are not suitable to be accessed directly from Internet. For many SAN/NAS protocols such as iSCSI, CIFS, NFS, they are not designed to deliver content to anonymous Internet public users. Therefore, web site runners are always required having application between users and storage using HTTP.

To summarize, traditional web site runners need to cover following cost for storage to serve their users:

- Scalable Storage Equipments
- Internet bandwidth
- Internet data centre rack space
- Electricity
- Extra resources for sudden burst of traffic

2. Paradigm Shift to Cloud Storage (continued)

- Manpower to setup and maintain infrastructure
- Spare parts for replacement of hardware replacement.
- Additional Internet connections and equipments for redundancy or load balancing

Next Generation of Storage – Cloud Storage

To eliminate all previous mentioned issues, new type of next generation storage appears which is called Cloud Storage. Cloud Storage is a service based storage designed for Internet application. It is an on-demand usage based service for storage. With Cloud Storage, companies do not need having upfront cost and ongoing engineering cost.

Cloud computing gained prominence in 2007 as a term used to describe computing that is made generally available on a publicly available IP basis (i.e. the Internet) -- "in the cloud". The term derives from the fact that most technology architecture diagrams depict the Internet or IP availability by using a drawing of a cloud. The computing resources being accessed are typically owned and operated by a third-party on a consolidated basis in [Data Center] locations. Consumers of the "cloud" are concerned with services it can perform rather than the underlying technologies used to achieve the requested function.

“Cloud” based services have following characteristics:

- Unlimited Scalability
- No upfront cost
- Pay-as-you-go based service
- High availability of service
- sharing of peak-load capacity among a large pool of users, improving overall utilization

Power-All’s Aspen Cloud Service belongs to Cloud Computing and would like to achieve above characteristics for Internet storage.

3. About Aspen Cloud Service

What is Aspen Cloud Service?

Aspen Cloud Service is a series of services provided by Power-All. Aspen Cloud Service is a type of Internet service which can let customers to use Power-All's global grid infrastructure through standard protocols or API.

With the strength of Power-All's technologies on Internet Data Centre (IDC) infrastructure, Power-All has developed total solution building global cloud based infrastructure using PC based hardware components.

Power-All has sensed the trend of Cloud Computing and developed a new series of services called Aspen Cloud Service. By using GNTM, PGFS, and virtualization, Power-All has deployed Data Grids in different countries.

Data Grid

Data Grid is a set of a clustered storage nodes and controllers managing distributed data. In a data grid, data is unlimited scalable in size and performance as well as high reliability.

3. About Aspen Cloud Service (continued)

Aspen Cloud Characteristics

Unlimited Scalability

Aspen Cloud users do not need worrying about scalability. All resources provided Power-All Aspen Cloud is scalable dynamically.

Pay-as-you-go based service

Aspen Cloud users pay on usage like your electricity bill. There is no upfront cost required. This pricing model is suitable most companies to avoid wasting resources due to over-estimation.

High availability of service

Aspen Cloud is designed without single point of failure in all components. As Power-All Aspen Cloud is built by PC components, continuous hardware components failure is expected and will not affect production service.

Sharing of peak-load capacity

Aspen Cloud is designed to share resources with large pool of users. As a result, resources utilization can be managed easier and higher.

Aspen Cloud Classification

Aspen Cloud is a series of services and Power-All defined following types:

- **Storage Related**
Including Cloud Storage, CDN, Backup, etc
- **Computation Related**
Including server virtualization, virtual infrastructure, database cloud, etc.
- **Network related**
Including IDC virtualization, virtual network appliance, etc.

4. Aspen Cloud Storage Functionality

This chapter introduces functionalities of Aspen Cloud Storage.

What is Aspen Cloud Storage?

Aspen Cloud Storage belongs to one of the core infrastructural services provided by Power-All. Aspen Cloud Storage is a next generation of storage which provides online unlimited and highly reliable storage to user through standard APIs. By using APIs, user can store the files in Aspen Cloud Storage and retrieve at anytime, anywhere. In addition, Aspen Cloud Storage is a “pay-as-you-go” service in which users only need to pay what they have used (Just like electricity bill). There is no upfront cost and with instant scalability. This billing model is suitable for most companies avoiding resources wasting due to over-commitment to storage providers.

From end user view, they can think Aspen Cloud Storage is a cloud. User does not need taking care maintenance and how it can work. Aspen Cloud Storage does all for you in backend. It results end user can put their focus on their core business.

4. Aspen Cloud Storage Functionality (continued)

Table 1 shows general features of Aspen Cloud Storage.

Table 1

Features	Description
Storage Size	Unlimited
Single File Size	1byte to 5GB
Maximum Number of files	Unlimited
Maximum Number of folders	Unlimited
Maximum Number of boxes	100
Maximum Number of files in same folder	Unlimited
File ACL	Supported
Box ACL	Supported
Support Private Access	Yes
Support Public Access	Yes
Support File Access Authentication	Yes
Support Customized Folder and File name	Yes
Support UTF8 based folder and file name	Yes
Single naming for global storage cloud	Yes
Supported web services API	REST
Support API authentication	Yes
Support Global Namespace	Yes

5. Aspen Cloud Storage Terminology

Before discussing detail of Aspen Cloud Storage, first of all, it is highly recommended to understand all terms used in Aspen Cloud Storage.

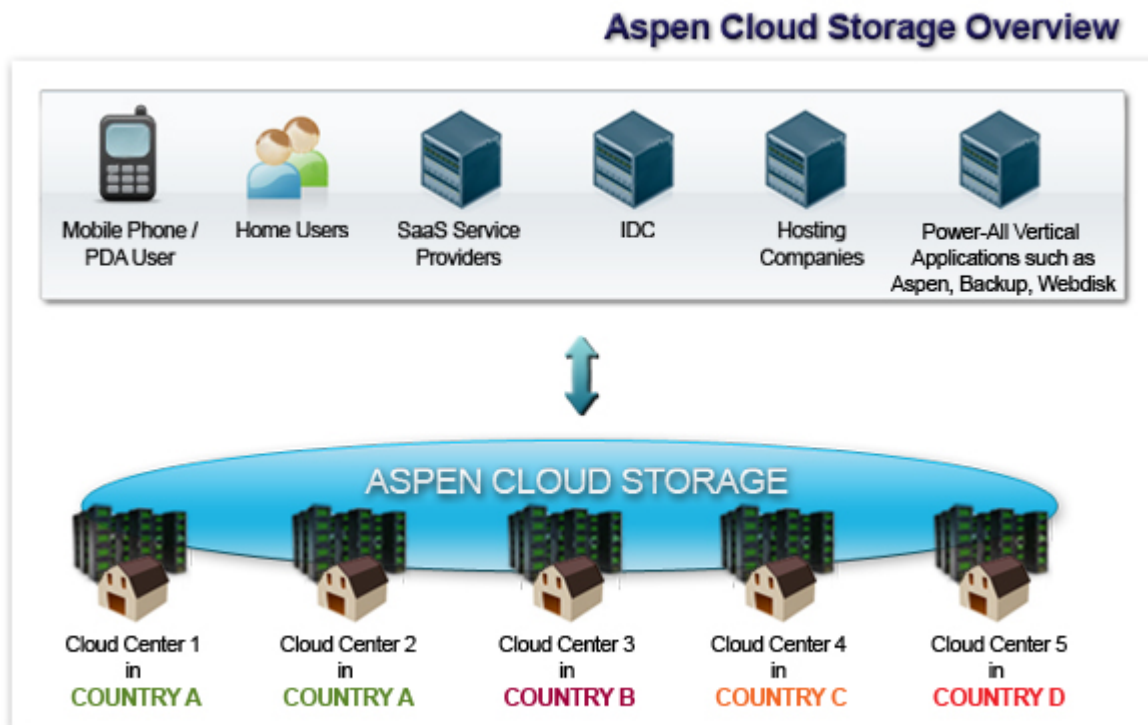
Terms	Description
1. Home Service URL	http://storage.cloudwww.com is the home web services URL of the Aspen Cloud Storage.
2. Grid	Grid is regarded as a basic unit of storage location. e.g. Hong Kong PCCW data center is a single grid. Hong Kong NTT data center is other grid. Link up different grid in different countries to form global storage. Regard Grid as a storage location.
3. Box	It is just like a folder which includes all uploaded files. Each box is associated with one storage center. No box can relate more than one storage center. Once creation of box, it should specify the Grid belonged to. After assign, can't be changed. The aim of box is to decide the storage grid. i.e. the file storage location. e.g. http://fruit.s.mygrid.asia/ (fruit is the box name) http://game.s.mygrid.asia/tvgame.jpg (game is the box name)
4. File	No folder concept in Aspen Cloud Storage but it allows slash (/) file name. Each file must be under a box. e.g. http://game.s.mygrid.asia/tvgame.jpg (Game is box name and tvgame.jpg is file name) http://game.s.mygrid.asia/world/japan/tvgame.jpg (world/japan/tvgame.jpg is file name)
5. Access ID	It is a global unique ID for each user a/c. It is system generated and can't be changed. Once user registers in portal, it will be generated.
6. Secret Access Key	It is a global unique key for signature generation. This key is confidential and should be known by account owner only. It is responsibility of owner to keep secret on key. It can be regenerated by owner via web management page. Use this key to generate resource signature for authorization.
7. ACL	Access control list (ACL) which record 3 access rights supported in Aspen Cloud Storage. i.e. Owner Only, Public Full Control, Public Read Only.
8. REST Http Method	In Aspen Cloud Storage, some http methods are supported. i.e. PUT, GET, DELETE PUT – creation of box or upload of file DELETE – deletion of box and file GET – get the resources information or download/display of the resources.

6. Aspen Cloud Storage Architecture

This chapter introduces Aspen Cloud Storage Architecture from overview to detailed implementation. The term “PGFS” is mentioned frequently in this chapter which is core component in Aspen Cloud Storage. This white paper focuses on Aspen Cloud Storage. For more detail about PGFS, please refer to white paper of PGFS.

As described in previous chapters, Aspen Cloud Storage is a cloud based storage service which can be accessed over Internet using HTTP. Power-All has designed Aspen Cloud Storage as a global service and has storage centers in many major cities under single name space. Software developer can enjoy this global service by using simple RESTful APIs. Diagram 1 shows the overview of Aspen Cloud Storage.

Diagram 1



6. Aspen Cloud Storage Architecture (continued)

Infrastructure Overview

Aspen Cloud Storage is global cloud storage with backend powered by Power-All's technology. Aspen Cloud Storage is built from multiple storage centers in different locations. With Power-All IDC experience in Asian countries especially China, Power-All has deployed the first cloud storage in China's major cities. More storage centers will be deployed around the world soon.

With the expertise in storage and IDC, Power-All builds the whole infrastructure using its own equipments including router, clustered application servers, clustered storage, global load balancer, etc. With total solution in infrastructure, Power-All can configure all equipments from network to application level optimizing for Aspen Cloud Storage environment.

Diagram 2 refers 3 layers of Aspen Cloud Storage.

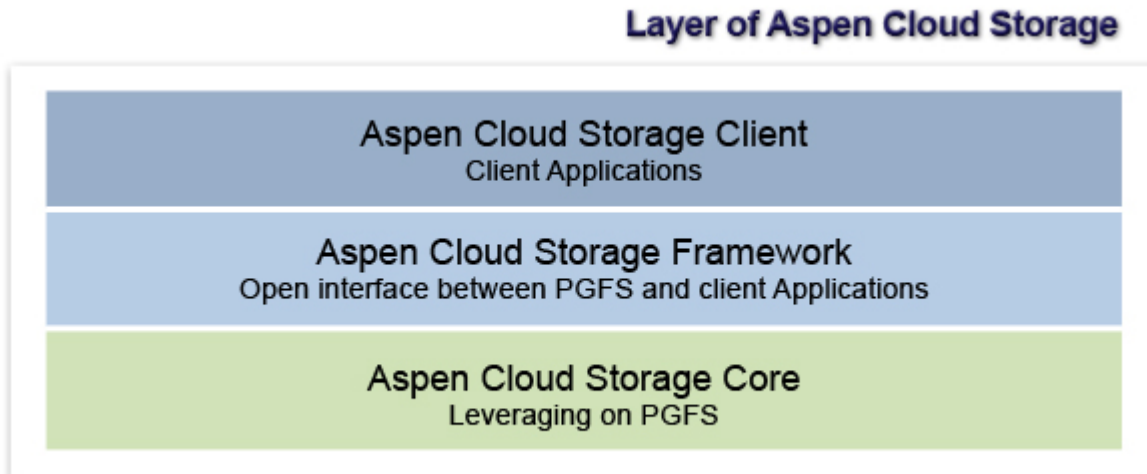
Layer 1 is core layer of Aspen Cloud Storage which is powered by PGFS to enable high performance and high reliability backend storage to customer.

Layer 2 is the Aspen Cloud Storage Framework which is a software interface between PGFS and customer, the framework is to provide a standard interface for various platforms and a billable environment. In addition, Aspen Cloud Storage is a multi-grids design, the framework software is also the controller to enable single namespace storage.

Layer 3 is the layer referring customer side. Customer can develop their software with various programming languages as well as various platforms through standard RESTful APIs.

6. Aspen Cloud Storage Architecture (continued)

Diagram 2

**Technology**

Aspen Cloud Storage is powered by Power-All technology. Power-All has solid experience in storage area such as CSAN product as well as IDC infrastructure. Aspen Cloud Storage leverages on following proprietary technologies:

- **PGFS** – PGFS stands for Power-All Global File System which is a proprietary clustered file system. Each Aspen Cloud Storage center consists of a PGFS cluster and connected to Aspen Cloud Storage application servers. PGFS enables Aspen Cloud Storage software true parallel I/O, unlimited scalability and data redundancy. For more detail of PGFS, please refer to PGFS whitepaper downloadable from Aspen Cloud Storage website.
- **GNTM** – GNTM stands for Global Network Traffic Manager which is global load balancer software to balance the traffic globally.
- **Aspen Cloud Storage Framework** – It is the proprietary software to make PGFS as a global storage platform. The framework is an interface between PGFS and end user. Standard web services RESTful APIs are provided which enables Aspen Cloud Storage compatible with various platforms. In addition, Aspen Cloud Storage Framework can count on usage in real time enabling “**pay-as-you-go**” service, just like electricity bill.

6. Aspen Cloud Storage Architecture (continued)

Unlimited Storage

One of the key features in Aspen Cloud Storage is unlimited capacity. With the power of PGFS and multi-grids design, Aspen Cloud Storage can be claimed as unlimited capacity. Total storage size can be extended dynamically while single namespace is maintained. Usually there are two ways to extend storage. One is to add additional storage nodes within PGFS cluster (within a storage center). Another way is to add additional storage centers to the namespace. All storage extension work is transparent to customers. Therefore customers can enjoy the unlimited storage without concerning backend infrastructure.

Service Availability

Aspen Cloud Storage's structure has no single point of failure. Each component inside a storage center can be added or removed dynamically without interrupting production service. Aspen Cloud Storage has 24 x 7 technical support team monitoring all services and providing a non-stop service to customers.

Aspen Cloud Storage has automated monitoring system running 24 x7. If any component is faulty, monitoring system will notify controller to carry fail-over automatically within seconds.

Data Security

Aspen Cloud Storage supports Access Control List (ACL) to either box or file. API is provided to configure ACL to a particular box or file. ACL allows owner or public or other Aspen Cloud Storage users to access a particular box or file. Either full control or read-only can be granted to different identifies. For private upload or download, user authentication is required before accessing the storage.

Aspen Cloud Storage will release more APIs in future to enhance data security such as data encryption.

6. Aspen Cloud Storage Architecture (continued)

Data Reliability

Preventing data loss is always one of the primary objectives of Aspen Cloud Storage. Aspen Cloud Storage has been designed with multi-levels of mechanism

Each storage center is a storage grid powered by PGFS. A storage grid consists of many storage nodes and each storage node is equipped with hardware RAID5 which is fault tolerant to single drive failure. In addition to hard drive fault tolerant, there is a second level providing fault tolerant to whole storage node failure. In current deployment, Aspen Cloud Storage has 2 replicas in each storage center. Aspen Cloud Storage is upgradeable with $n \times$ replicas in each centers, more replicas can be added dynamically without affecting service.

In terms of technology, Aspen Cloud Storage can allow real time data replication between different locations. But practically there many factors affecting such as inter-Grids transfer cost, or Internet congestion, etc. To ensure high quality and easy to use, Aspen Cloud Storage does not replicate data to other grids. If customer requires storing data in multiple locations as redundancy or load balancing, Power-All has offered another service called Aspen-CDN which is a global content delivery network service (CDN). It allows data replication and global load balancing on top of all storage centers. For detail about Aspen-CDN, please visit Aspen Cloud website.

Data Integrity

Since Aspen Cloud Storage is an online storage which transferring data over Internet. To ensure data integrity after transfer over Internet, Aspen Cloud Storage provided API to check message digest of file. If message digest is different to recorded one, it means the upload/downloaded file has been corrupted.

6. Aspen Cloud Storage Architecture (continued)

Load Balancing

Each storage center is equipped with Power-All's load balancer which can distribute traffic to multiple application servers on top of PGFS. In addition, there are some global API such as creating box name, global load balancing will be used to redirect the API call to nearest storage center to process.

Single Namespace

One of the key functions of Aspen Cloud Storage framework is to control global namespace. The framework software can process and redirect user's requests according to customer's defined location. Aspen Cloud Storage uses box to handle location redirection. As all box name under same domain, which means it is a global name space.

Alias Namespace is also supported for those customers who want to use their own domain name for cloud storage service. By default, the domain s.mygrid.asia is used for all API calls. To enable alias namespace, customer simply can configure their own DNS servers setting up a CNAME record pointing to s.mygrid.asia.

Standard Web Services API

Aspen Cloud Storage provides a unified storage platform compatible with most OS platforms and programming languages including Java, C, .Net, PHP, etc. Aspen Cloud Storage has 13 raw APIs which provides all basic operations including file I/O, authentication and file/box management. All APIs can be connected through REST interface.

Aspen Cloud Storage understands that it is always time consuming to developer writing program from beginning using 13 raw APIs. For fast development, Power-All has developed many ready-to-use programming libraries in different programming platforms. All libraries is open source, developers can use it directly or modifies it.

6. Aspen Cloud Storage Architecture (continued)

Low Cost PC Components

In order to provide competitive pricing to customers, Aspen Cloud Storage infrastructure is built by using standard PC components. By using Power-All technologies, Aspen Cloud Storage is fault tolerant to any component inside the grid. Therefore, Aspen Cloud Storage can offer competitive price to customers while keeping high quality of service.

Diagram 3 below shows an example of storage node using PC components.

Diagram 3

Example of Storage Module



6. Aspen Cloud Storage Architecture (continued)

Billing System

Unlike other cloud storage companies, Aspen Cloud Storage is designed with high flexibility which allows flexible business models cooperating with different types of companies. Power-All understands that building storage centers around the world requiring huge resources therefore Power-All always looks for companies with IDC as partner to build up global cloud storage.

Besides flexibility, IDC and bandwidth pricing is different in different countries, it is not fair to customer paying a fixed rate for all storage centers among the cloud. Instead, Aspen Cloud Storage has a flexible pricing scheme providing different price according cost particular cities.

In addition, Aspen Cloud Storage is a pay-as-you-go service which can counter on resources usage in real-time like your electricity bill which is the most cost effective solution to most customers.

Based on above requirements, Power-All has developed a distributed billing system. Each storage center has a local billing system for fast processing and dedicated to the local partnered IDC. Everyday local billing information will also be uploaded to a central billing system as primary copy.

Aspen Cloud Storage Web Portal

Aspen Cloud Storage is associated with a web portal (<http://storage.cloudwww.com>) which provides all operations about Aspen Cloud Storage services including:

- Service Subscription and User Registration
- Customer Administration Tool including key generation, billing report, online payment, etc
- Technical support including trouble ticket system, knowledge base, etc
- Developer zone providing all resources for development

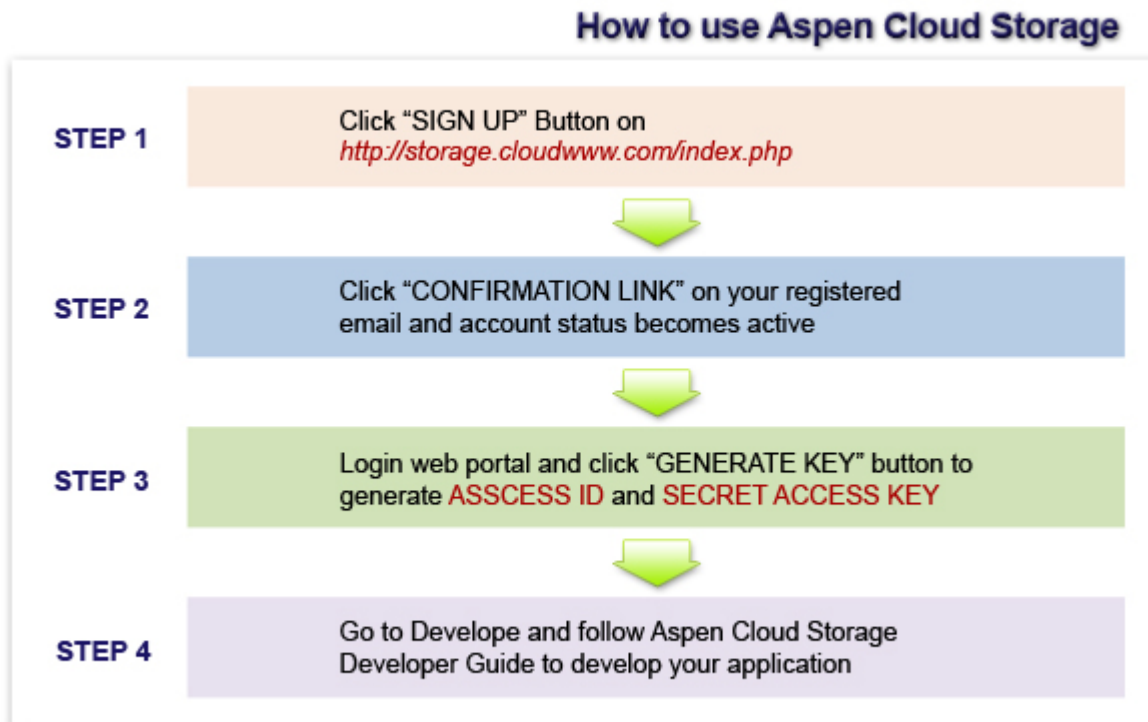
7. How to use Aspen Cloud Storage

This chapter describes how customer can use Aspen Cloud Storage.

Subscription Flow

To start using Aspen Cloud Storage, it is easy and just follows below steps. Diagram 4 is the basic steps required in order to use Aspen Cloud Storage.

Diagram 4



7. How to use Aspen Cloud Storage (continued)

Unlike other cloud storage, Power-All considers the need of customer. Besides raw APIs, Power-All has developed fast development libraries for various programming languages such as C, Java, .NET, PHP, Perl, Python, etc. Using fast development libraries can speed up development time and developer does not need to know detail of APIs.

In addition, Power-All has developed many ready-to-use applications for end user. Those applications are free and can be used directly without development effort. To download ready-to-use application, visit <http://storage.cloudwww.com/>

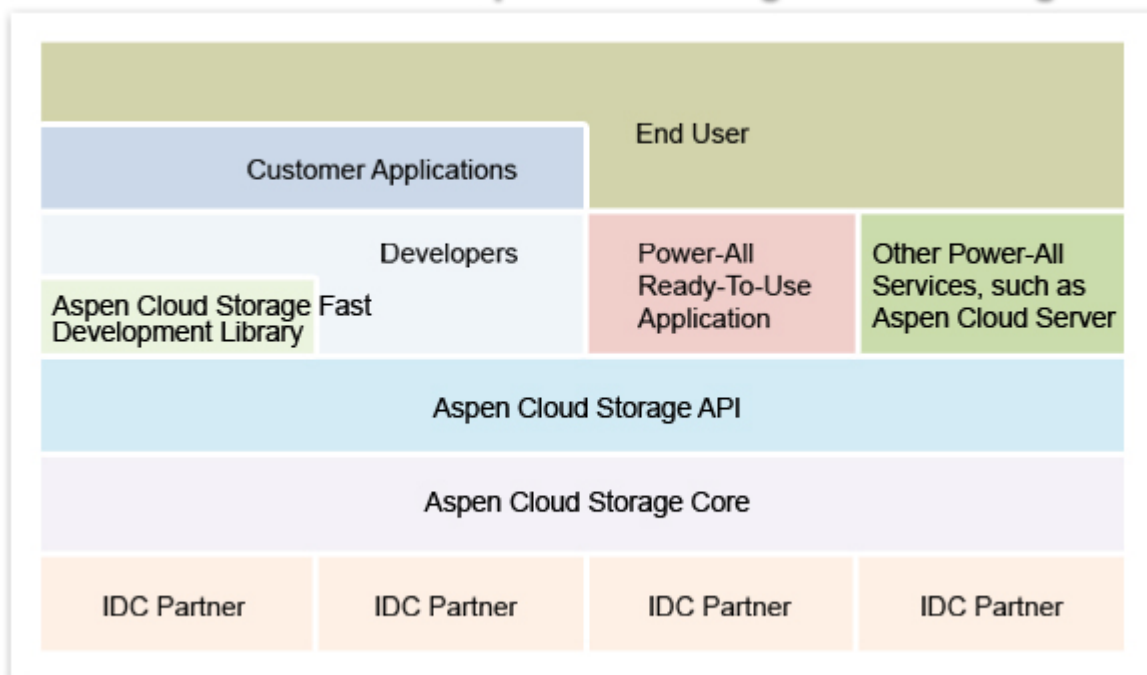
Diagram 5
Aspen Cloud Storage Structural Diagram


Diagram 5 summarizes whole structure of Aspen Cloud Storage from customer view. Power-All provides

8. Aspen Cloud Storage Advantages

This chapter summarizes all advantages using Aspen Cloud Storage

Advantages	Descriptions
1. Save operation cost	pay-as-you-go service model provides a flexible and cost effective solution to customer to avoid resources waste due to over commitment
2. No upfront cost on infrastructure	there is no upfront cost. After service subscription, customer can enjoy an unlimited storage immediately
3. Unlimited storage	as Aspen Cloud Storage is a cloud storage with unlimited size, customer does not need to worry about scalability
4. Platform Independent	Aspen Cloud Storage provides standard REST APIs which is platform independent.
5. High Reliability	Aspen Cloud Storage has multi-levels data redundancy, it ensures data never lost and minimize service downtime
6. High Performance	Aspen Cloud Storage provides true parallel I/O. In principle, Aspen Cloud Storage performance is direct proportional to size.
7. Easy to use	Aspen Cloud Storage is a full automated service, customers can serve themselves from service subscription to monthly payment.
8. Fast Development	Power-All provides lot of sample code, developer guide, and programming library for customer's fast development
9. Global Namespace	All storage centers are under same storage namespace. Developer can define location of their storage by passing location info in HTTP header in a box
10. Plenty of ready applications	Power-All has developed many ready-to-use applications, customers can run the applications and connects to Aspen Cloud Storage without development effort

9. Aspen Cloud Storage Operation Modes

This chapter introduces different operation modes offered by Aspen Cloud Storage.

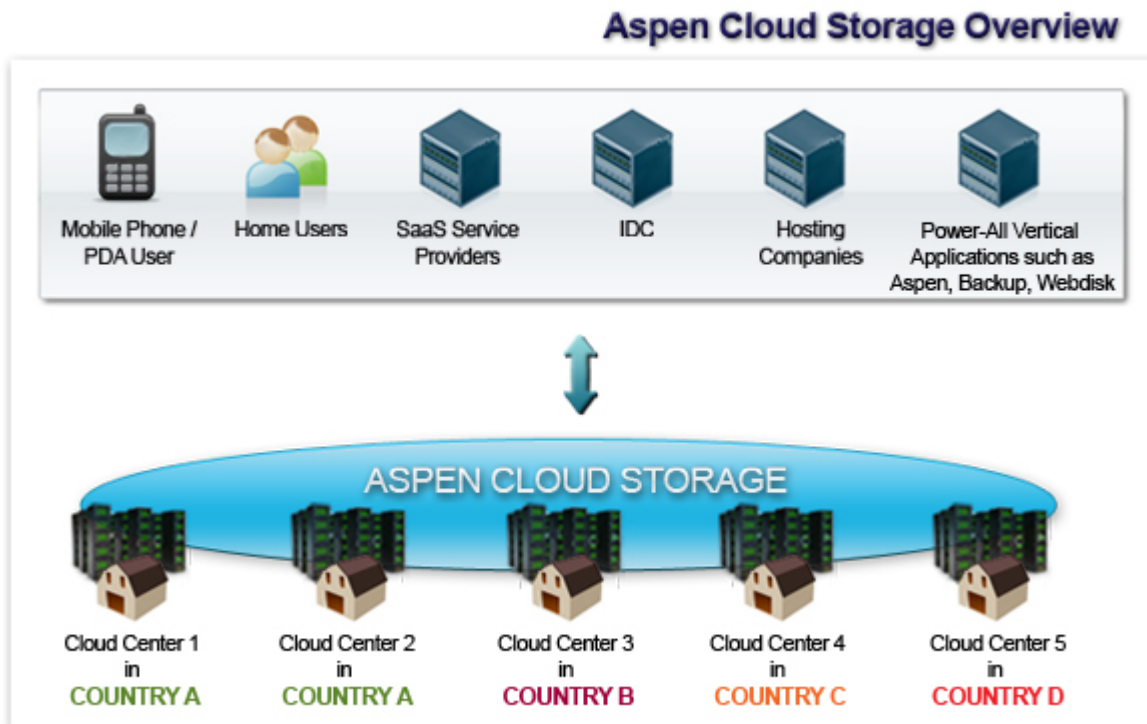
Unlike other cloud storage providers, Aspen Cloud Storage is highly flexible to support different business models. Currently Aspen Cloud Storage works with 3 different operation modes

	A. Direct Customers	B. Branded Partners	C. OEM (coming soon)
Description	Aspen Cloud Storage is offered to customers directly by Power-All	Branded Partner offers cloud storage service to its own sales channel	Cloud Storage with separated namespace
Technology powered by	Power-All	Power-All	Power-All
Infrastructure Provider	Power-All	Power-All	Power-All
Recharge Method	Online or through account manager	Through Partner Management System	Online or through account manager
Technical Support provided by	Power-All to end users	Power-All to Branded Partners	Power-All to OEM partners
Service Domain	mygrid.asia Share same namespace with others	mygrid.asia Share same namespace with others	Customized
Billing	Power-All bills customer directly	Power-All bills Branded Partner monthly.	Power-All bills OEM partners monthly
Support Sales Agent	Yes	Yes	Yes

10. Aspen Cloud Storage Vertical Applications

This chapter introduces what kinds applications can run on top of Aspen Cloud Storage. In diagram 5, Power-All classified different types of applications which can benefit from Aspen Cloud Storage.

Aspen Cloud Storage aims to provide a general storage platform to save cost for application providers. Therefore, Power-All will not provide applications except some essential mini applications.

Diagram 5


10. Aspen Cloud Storage Vertical Applications (continued)

Power-All Classified different types of applications which can benefit from Aspen Cloud Storage.

Application Categories	Description
Website	For those websites distributing lot of static content. They can simply storage all content to Aspen Cloud Storage to save bandwidth and storage cost
ASP / SaaS providers	Application providers can store data in Aspen Cloud Storage and their focus can back to their core business
Video Surveillance	Most companies have digital based video surveillance system. To make it safe, some outdated video clips can be stored in Aspen Cloud Storage. As Aspen Cloud Storage's pay-as-you-go model, it saves lot of expense than traditional online disk.
Mobile Phone application such as Google Android, Apple iphone, Windows Mobile, Nokia Symbian, etc	As most mobile devices have limited storage capacity and bundled with wifi. Aspen Cloud Storage is ideal solution to extend its storage and provides extra data redundancy with remote storage.
Data backup or archive	With the multi-grids design, Aspen Cloud Storage is suitable for server/desktop offsite backup

11. Pricing and Billing Model

This chapter introduces Aspen Cloud Storage's pricing and billing model.

Pricing Model

Aspen Cloud Storage is a pay-as-you-go service, it charges based on 3 types of resources usage, Storage Charge, Delivery Charge and Request Processing Charge.

Charged Items	Description
Storage Charge	It refers to the charge for amount of storage used per day (unit in GB-Day). The rate of storage charge is fixed among all storage centers.
Delivery Charge	It refers to the charge for incoming / outgoing network traffic used per day (unit in GB). The rate per GB will be different in different storage centers. In some cases, incoming and outgoing charging rate will be different too. In addition, price will be different transferring during peak and non-peak hours.
Request Processing Charge	It refers to the charge for handling number of client request per day. The rate of request processing charge will be fixed among all storage centers. Different types of requests have different pricing according to the processor power consumption of request.

For exact pricing of each storage centers, please visit <http://storage.cloudwww.com>

11. Pricing and Billing Model (continued)

Prepaid Billing Mode

Aspen Cloud Storage runs in prepaid mode which means user needs to charge up his balance before using the service. Initially, there is a preloaded amount of balance for a new registered account as free trial and will be expired in 30 days. To recharge the balance, Aspen Cloud Storage supports online payment through Paypal.

GB-Day Calculation Method

Storage charge is counted in unit GB-Day which is the average amount of storage used per day. GB-Day is calculated by sampling method. Aspen Cloud Storage billing system takes sample of storage usage per 2 hours per customer. The exact sampling time interval is little bit different per customer account. Since there are 24 hours per day, 12 samples are taken everyday.

For each sampling, the amount of storage usage (in byte) will be multiplied by 2 which means assuming next 2 hours after sampling will be same usage amount. The 2-hours storage amount accumulated to “Daily Byte-Hours”.

At the end of each day, “Daily Byte-Hours” is converted to GB and then divided by number of hours of that day. The calculated result is in “GB-Day”.

Prepaid Balance Auto Deduction

At midnight (Hong Kong Time) of every day, central billing system calculates all billable usage including GB-Day, Transfer and Requests of last day (period 00:00-23:59, Hong Kong time). The total billable amount of each user is deducted automatically from prepaid balance.

11. Pricing and Billing Model (continued)

How to handle overdue payment?

Every day central billing system deducts the daily usage from prepaid balance. If current balance cannot settle the daily usage amount, all current amount is deducted automatically and system will send out alert email to customer asking to recharge the minimum (the outstanding amount after deduction from balance).

In next day, if customer still does not recharge enough amount, central system will send another alert email with latest outstanding amount. Customer can ignore previous alert email, latest alert email reflects latest status of customer payment. It means customer only needs to settle latest alert email. Note that if system detects a 7 days continuous overdue alert, user account will be suspended.

For suspended account, user data will be kept for 30 days, but cloud system will not handle any requests to related user data. During suspension period, storage charge will be still counted.

If customer settled all outstanding payment during suspension period, account will be re-activated after 24 hours.

If customer does not settle outstanding payment 30 days after suspension, all user data will be deleted without further notice.

12. Sample Code

Aspen Cloud Storage provides standard RESTful API and is platform independent. Developer can call the API using his favor programming language and tool.

Below is an example of client code using PHP and Zend Framework

PHP Version (using Zend framework)

```
$url = "http://[box name].s.mygrid.asia/[file name]?extra=show";
$client = new Zend_Http_Client();
$client->setUri($url);
$client->setHeaders($headers);
$client->setMethod('GET');
$response = $client->request();

if (($response->getStatus()==200)
    return $response->getBody();    // Get the returned file attribute in XML format.
else
    // Fail to get attribute.
```

Above sample is to connect cloud storage and query a file's attributes.

13. Aspen Cloud Storage Comparisons
Aspen Cloud Storage vs Amazon S3
Features

File System	Aspen Cloud Storage	Amazon S3
Basic upload/download/delete files	Yes	Yes
Edit file	No	No
Support RESTful APIs	Yes	Yes
Global Namespace	Yes	Yes
Support Virtual Host	Yes	Yes
Support multi-platforms	Yes	Yes
Maximum Single File Size	5GB	5GB
Maximum bucket/box	100	100
Upload or Download resume	Coming Soon	Yes

Infrastructure	Aspen Cloud Storage	Amazon S3
Storage Centers Location	<ul style="list-style-type: none"> • Hong Kong • Beijing • Shanghai • ChengDu • Singapore • Bangkok • Tokyo 	<ul style="list-style-type: none"> • Europe • US
Online demand, and scalable	Yes	Yes
Data Real-time replication within country	Yes	Yes
Backend Cluster File System Technology	PGFS	Non-disclosed
Online management portal	Yes	Yes
Online billing query	Plenty	Basic

Security	Aspen Cloud Storage	Amazon S3
Data Encryption	Available Soon	No
Support folder/file ACL	Yes	Yes

13. Aspen Cloud Storage Comparisons (continued)

Development, Tools, and Support	Aspen Cloud Storage	Amazon S3
Technical Support by email	Yes	Yes
Technical Support by phone and ticket system	Yes	No
Program library for different programming languages	Plenty	Basic
Online developer zone including forum, documentation, etc	Yes	Yes
Ready-To-Use client application for iphone 3G	Yes	No
Ready-to-Use Firefox plugin	Yes	No
Ready-to-Use virtual Drive-C application for Windows	Yes	No
Ready-to-Use virtual file system for Linux	Yes	No
Ready-to-Use file manager for Windows and Linux	Yes	No
Migration tool from S3 to Aspen Cloud Storage	Yes	N/A

Pricing	Aspen Cloud Storage	Amazon S3
Charged resources	Storage + Transfer + Request	Storage + Transfer + Request
Billing Mode	Prepaid	Monthly Invoice
Billing Period	Daily	Monthly
Payment Method	Paypal	Credit Card auto payment
Transfer fee during non-peak hour is cheaper	Yes	No

Business Mode	Aspen Cloud Storage	Amazon S3
Target Regions	Asia	Europe and USA
Direct online sales mode	Yes	Yes
IDC cooperation mode	Yes	No
Dedication Billing System for partnered IDC	Yes	No
OEM mode	Coming Soon	No

14. Conclusion

Aspen Cloud Storage is one of the Aspen Cloud Services provided by Power-All Networks Ltd. Aspen Cloud Storage is also referred as Cloud Storage which is next generation of storage providing unlimited scalability as well as data redundancy.

Aspen Cloud Storage offers pay-as-you-go service just like your electricity bill. This kind of service mode will be a trend in coming years as it provides a fair billing model to customers.

With Power-All's expertise in data centre infrastructure and storage product, Aspen Cloud Storage is the first cloud storage deployed in China. Power-All believes China will be largest market in Cloud Computing in coming years and is preparing for the challenge. Besides Aspen Cloud Storage, Power-All plans to offer a series of Aspen in coming years.

To subscribe Aspen Cloud Storage, please visit

<http://storage.cloudwww.com>

15. Contact us**About Power-All Networks Ltd**

Power-All is one of the leaders in clustered storage industry. With solid experience in IDC industry, Power-All believes PC based clustered storage is a trend and next generation of main stream storage solution in the industry. By combining PGFS and other leading technologies, Power-All has developed a global cloud storage service called Aspen Cloud Storage. For more detail, please visit

Power-All Company

<http://www.powerallnetworks.com/>

Aspen Cloud Storage Portal

<http://storage.cloudwww.com>

- **For more information, please contact Power-All at:**

*Address: Power-All Networks Limited
Unit 540 & 541, 5/F,
Enterprise Place, No. 5 Science Park West Avenue,
Hong Kong Science Park, Shatin, Hong Kong.*

Phone: (852) 2111 8182

Fax: (852) 2111 8156

Email: newgen@powerallnetworks.com