EOS Workshop 2018

EOS status of IHEP site

Haibo Li
On behalf of Computer Center, IHEP
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- IHEP Introduction
- EOS at IHEP
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Large science facilities

- IHEP: The largest fundamental research center in China
- IHEP serves as the backbone of China's large science facilities
  - Beijing Electron Positron Collider (BEPCII/BESIII)
  - Yangbajing Cosmic Ray Observatory (ASg & ARGO)
  - Daya Bay Neutrino Experiment
  - China Spallation Neutron Source (CSNS)
  - Hard X-ray Modulation Telescope (HXMT)
  - Accelerator-driven Sub-critical System (ADS)
  - Jiangmen Neutrino Underground Observatory (JUNO)
  - Large High Altitude Air Shower Observatory (LHAASO)
  - High Energy Photon Source (HEPS)
  - Under planning: XTP, HERD,CEPC …

Major Experiments at IHEP

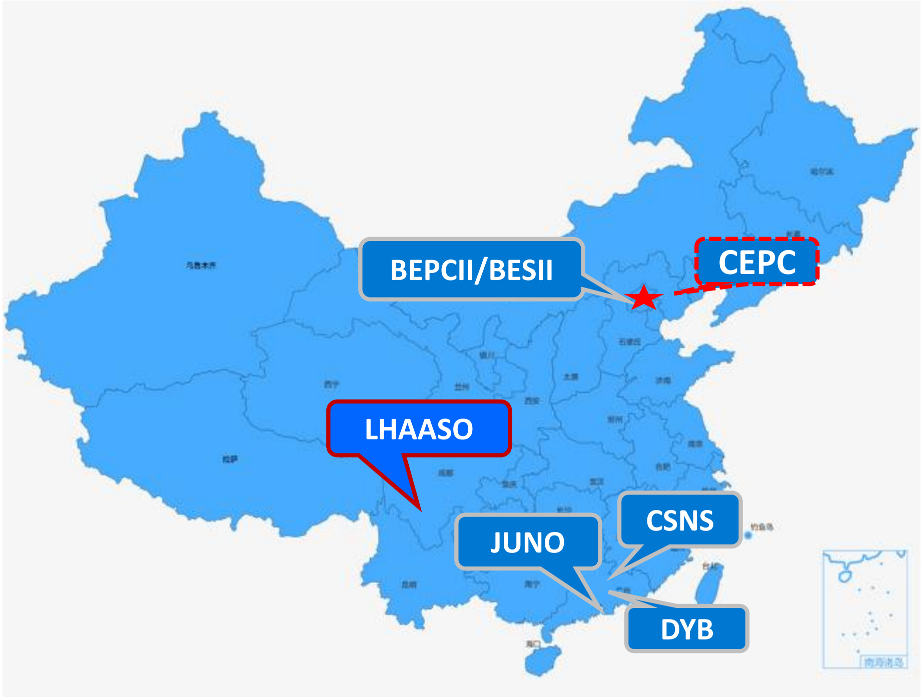
- BEPCII/BESIII
  - 5PB data in 5 years
- DYB
  - 400TB per year data collected
- JUNO

lustre

  - ~2PB raw data per year
- **LHAASO**
  - ~2PB raw data per year
  - accumulate 20PB+ in 10 years
- HMXT

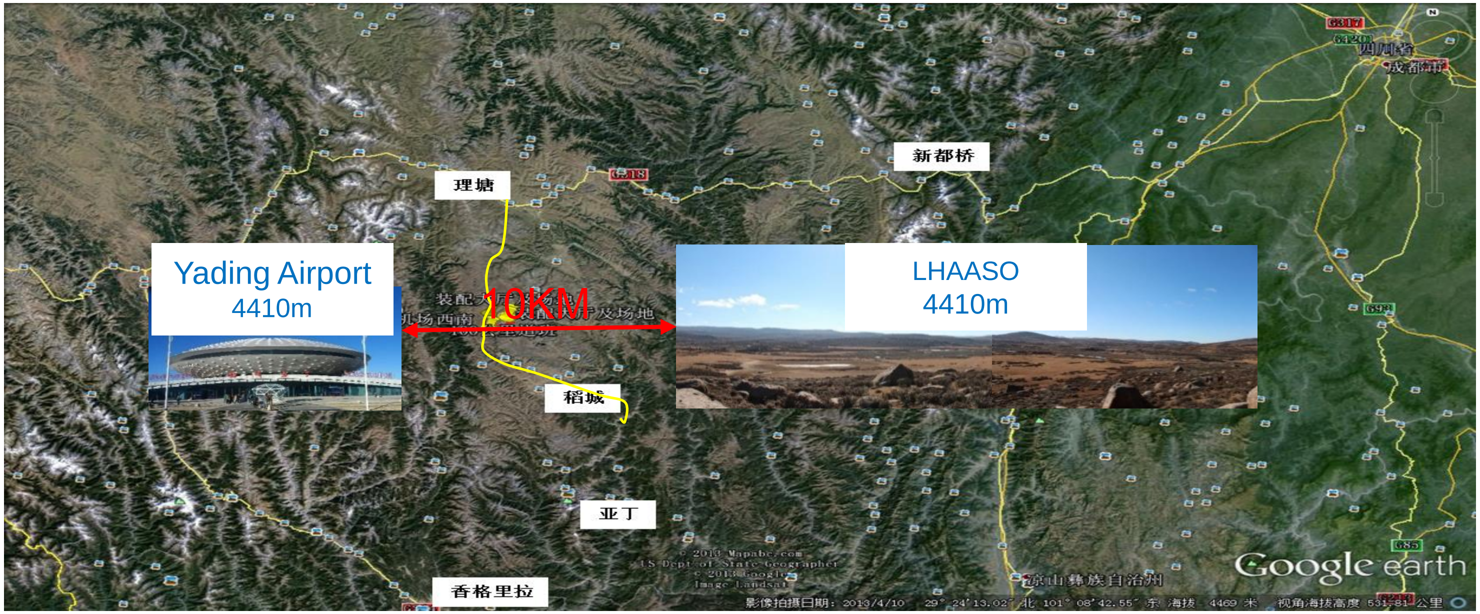
EOS

- Atlas and CMS Tier2 site
  - 940TB disk, 1088 CPU cores



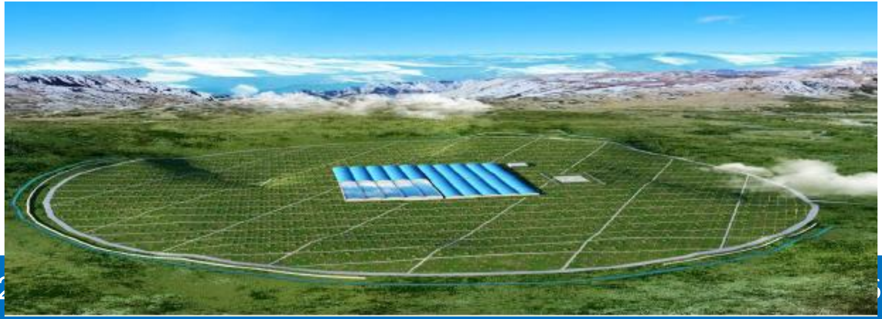
LHAASO: Large High Altitude Air Shower Observatory

- Mt. Haizi (4410 m a.s.l., 29°21' 27.6" N, 100°08'19.6" E), Sichuan, China
- LHAASO Scientific Goals
  - Origin of GCRs
  - Gamma ray astronomy
  - New physics frontier (dark matter, Lorentz invariance…)



LHAASO Computing requirements

- ~2 Petabytes (2 million Gigabytes) of data annually generated by the LHAASO detectors
  - 1.7 PB of raw data, and >200TB of reconstruction data
  - Totally >20PB for ten years
  - Start taking data in 2018, and the data increased gradually
  - Fully completed in 2020
- >2 Petabytes of data generated by MC simulation
- To build one distributed computing system containing about 6000 CPU cores to process the data
  - ~ 4500 CPU cores for reconstruction, analysis, …
  - ~ 1500 cores for production



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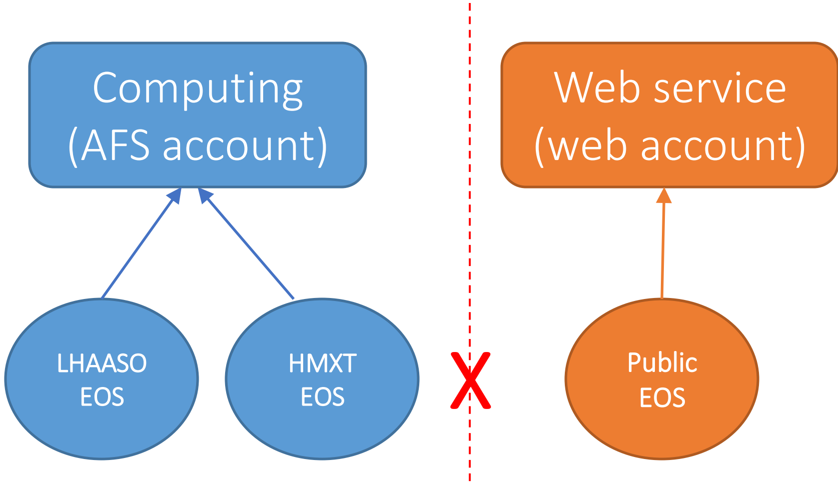
Storage resources at IHEP

- Local cluster
  - 11 PB+ disk storage
    - Lustre:8.5PB
    - EOS:1.7PB
    - Other:1.5PB
  - 5 PB tape storage:
    - Modified Castor 1.7.1.5
- Grid site
  - DPM:400TB
  - dCache:540TB

EOS at IHEP

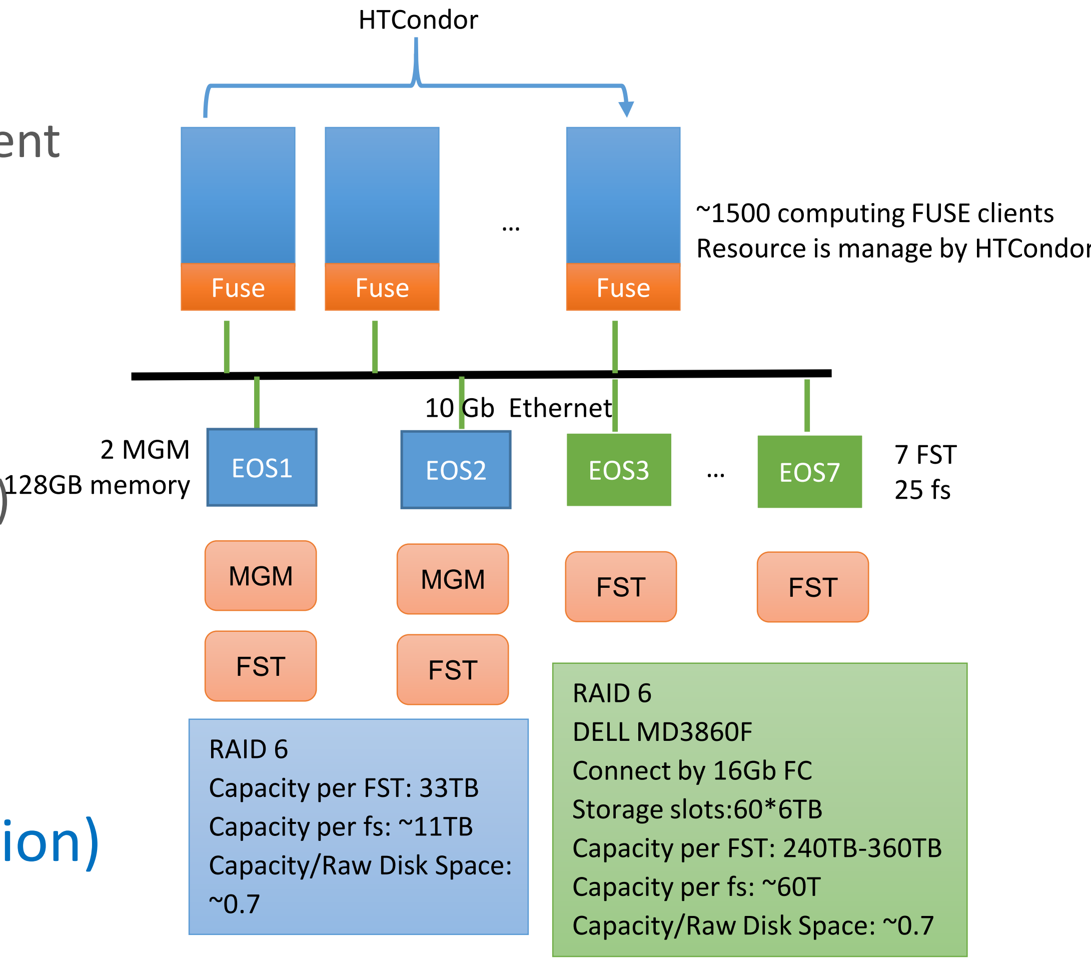
- 3 instances
  - 2 for experiment data storage providing computing service
    - ~1.7 PB capacity
    - ~60 million files
    - ~1.2 million directories
  - 1 for user data providing web and public services
    - Support for IHEPBox
    - ~160 TB capacity
    - ~7.4 million files
    - ~1 million directories



Two separate cluster, based on different account system

Experiment data storage

- LHAASO EOS instance
  - Used for LHAASO experiment
  - Running for 2 years
  - 0.8PB -> 1.34PB
  - server version: 0.3.195
  - 7 dell disk array box (raid6)
    - Dell MD3860F
    - 60*6TB
  - 10Gb network link
- Plain mode(single replication)
- Fuse access

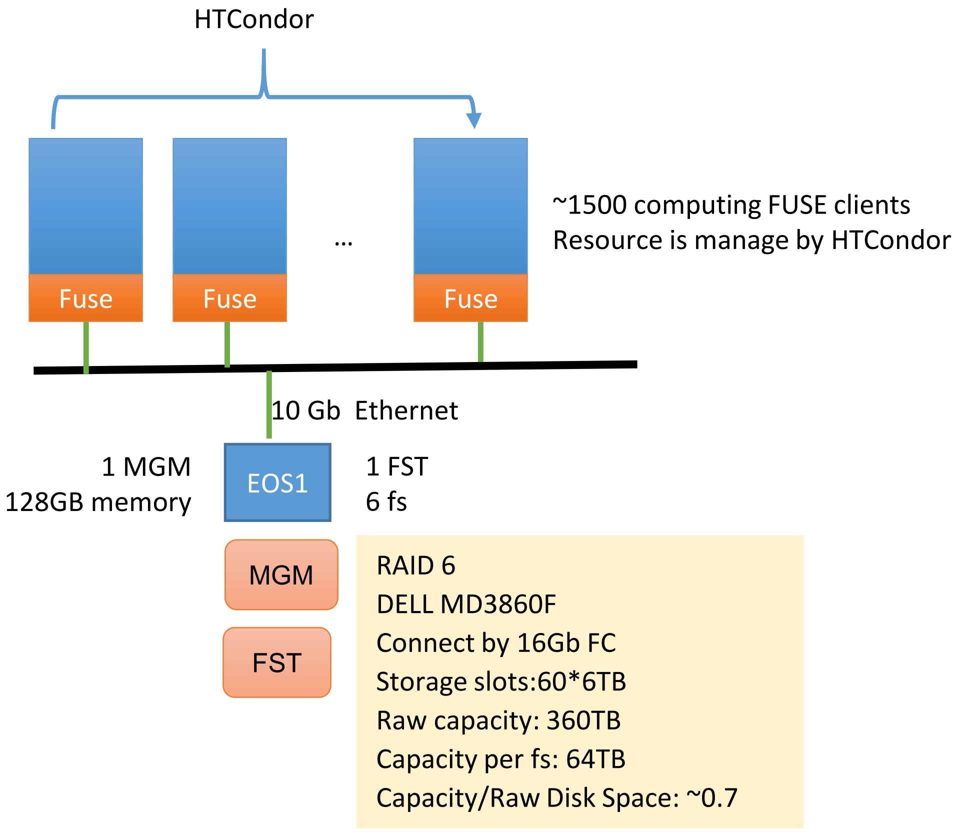


RAID 6
Capacity per FST: 33TB
Capacity per fs: ~11TB
Capacity/Raw Disk Space: ~0.7

RAID 6
DELL MD3860F
Connect by 16Gb FC
Storage slots:60*6TB
Capacity per FST: 240TB-360TB
Capacity per fs: ~60T
Capacity/Raw Disk Space: ~0.7

Experiment data storage

- HXMT EOS instance
  - New built for HXMT experiment in Dec 2017
  - 330TB capacity, 64TB used
  - Server version 4.2.7
  - 1 dell disk array box(raid6)
  - 10Gb network link
- Plain mode(single replication)
- FUSE access
- Many small files
  - ~4 KB per file



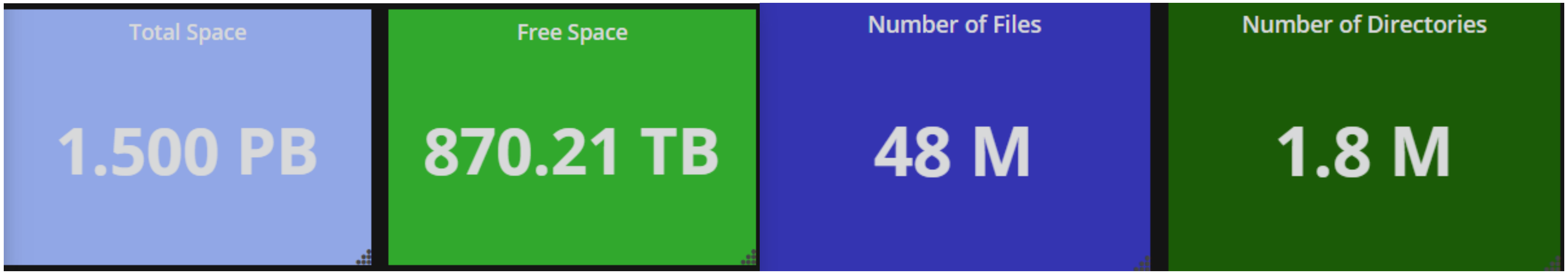
~1500 computing FUSE clients
Resource is manage by HTCondor

1 MGM
128GB memory

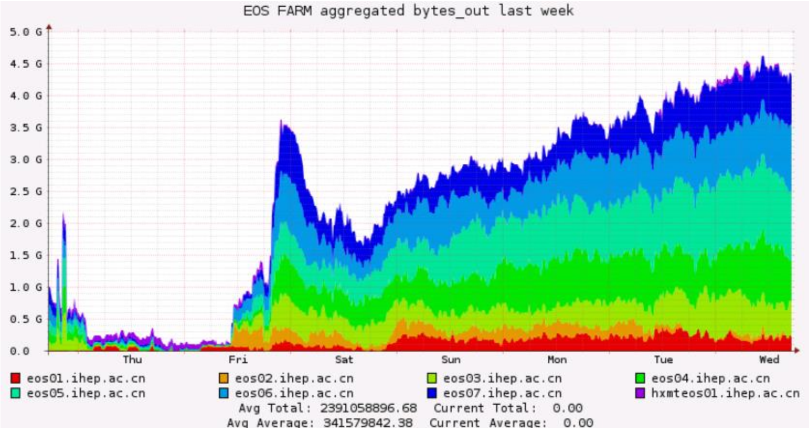
1 FST
6 fs

RAID 6
DELL MD3860F
Connect by 16Gb FC
Storage slots:60*6TB
Raw capacity: 360TB
Capacity per fs: 64TB
Capacity/Raw Disk Space: ~0.7

EOS running status



Total Space	Free Space	Number of Files	Number of Directories
1.500 PB	870.21 TB	48 M	1.8 M

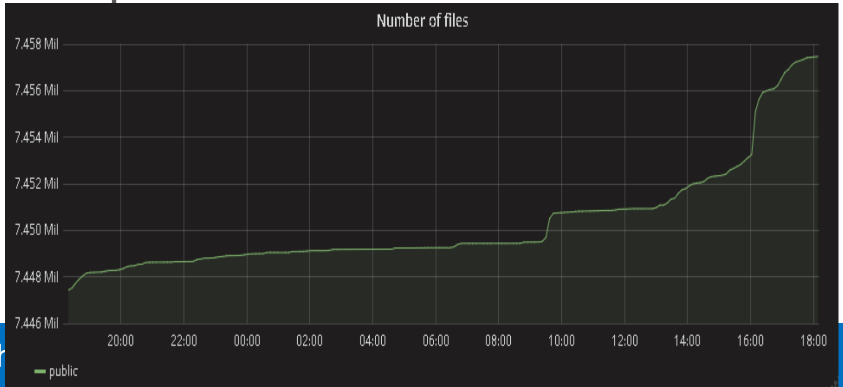


- Read peak: 4.5GB/s
- Peak values allowed by the environment (mainly 5 FST each has 10Gb Ethernet)

User data storage

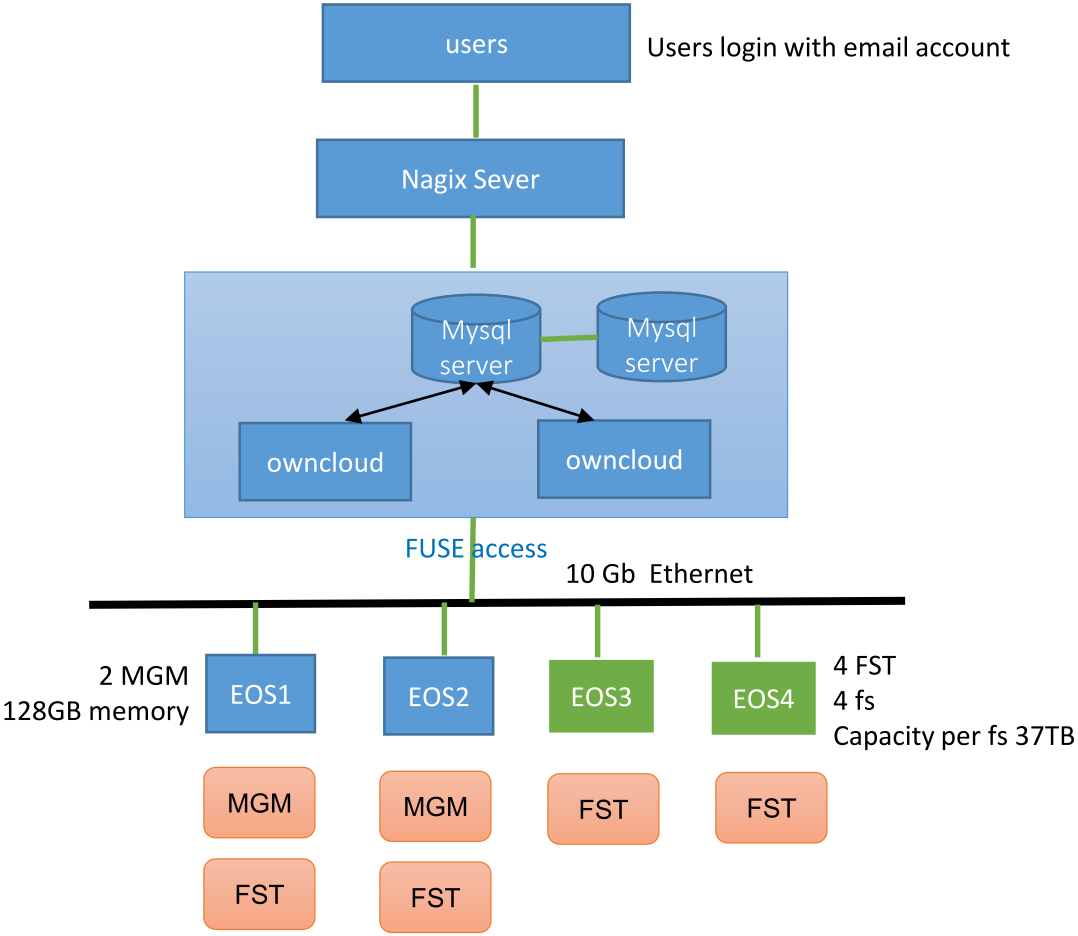
- IHEPBox use-case
  - IHEPBox is based on owncloud integrated with EOS
- Fast growing service
  - Integrate some plug-in to interact with IHEPBox , such as documents\galleries\calendar\activity…
  - Large and growing user base
    - 4K+ users, 1K+ active users,100GB per user
    - 160 TB ,used 21TB

      7M+ files



IHEPBox

- Users
  - IHEP LDAP users
  - Local users
- Application Service
  - 1 * Nginx
  - 2 * IHEPBOX Servers
- Data Storage
  - 4 * fst
  - Two replicates
  - 2 * Mysql servers



IHEPBox demands from users

- Demand for supporting more office documents online editing, such as .docx \ .ppt \.excel
- Demand for supporting one-way synchronization rules, which means files don’t delete on client while the delete operation is initially by server.

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Issues encountered

- Most issues are related to fuse.
- Some of them has been solved with the help of EOS team.

Fuse crash

- “transport endpoint is not connected” error happens frequently on client.
  - Eosd Client :4.1.27
  - Server:0.3.195

- Solution: the eosd client plans to update to 4.2.12

Nodes Held

- When a large number of jobs (using fuse to access data in eos) are submitted, the nodes managed by HTCondor sometimes become Held state.
- The possible reason is HTCondor detected the /eos is unavailable in that situation.

- Next: Do more stress tests.

Concurrent reading error in Fuse client

- When the number of jobs exceed 11 in one node (16 cores), the job will fail with “bus error” or “segment fault”. While it runs well in lustre.
- Job type: software repository, read data
- Server version: 4.2.7
- Client version: 4.1.27

- The reason is unknown now. Next we will do more tests.

Output file synchronization problem

- When a file is being written on node1, the other node cannot read the data until the file is closed on node1.
- As a result
  - The parallel computing jobs will not run correctly.
  - Users can not read the output files until the jobs complete, which will mistaken users that the job did not run or failed
- The problem exists in all versions of EOS eosd.
- FUSEX will fix this bug, expecting.

Atime lost

- Access time (atime) is not recorded in namespace
- The latest access time cannot be found.
- It is needed in some cases, such as statistic the access frequency of the files.

RAIN issue

- In the rain mode, if a data block is damaged, the block can not be repaired automatically.
- The needs for using it as RAID6.
- The recommended configuration now uses the replica pattern with JBOD.

Large-small sites in storage federation

- If the master site has a large capacity, while the slave site has a small capacity, how to use EOS build storage federation?
- The replication mode may not suitable, because what data the remote site need may be uncertain.

- Is there similar needs on other sites?

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Future plan

- Add 1 PB capacity this year
- The OS of computing node will migrate to Centos 7
- Provide SWAN for IHEP users based on EOS in 2018
- Use EOS to build Storage federation between Beijing and Chengdu, the distance is ~2000 km and network latency is about 60ms.

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Summary

- EOS has been deployed for 2 years in IHEP.
- LHAASO mainly use EOS as storage systems, 1PB capacity will be increased in 2018.
- We will support more experiments in IHEP, but have to do more performance stress tests.
- The functionality and stability of FUSE are critical.
- More manpower on the monitoring and operation.
- More attempts will be conducted based on EOS, such as storage federation, supporting more applications.

Thanks for your attentions!

谢谢！