Application of unified monitoring system in LHAASO

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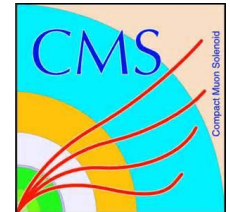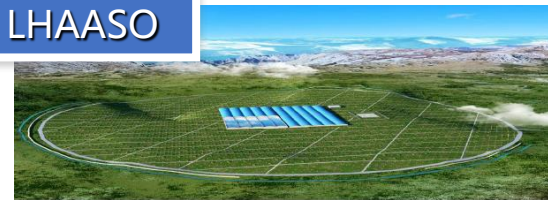
Outline

Computing Infrastructure in IHEP

- **Resources**
  - ~ 15,000 CPU cores (Htcondor)
  - ~ 3300 CPU cores (Slurm)
  - ~ 1200 CPU cores (pbs)
  - ~ 11PB Disk Storage
  - ~ 6PB Tape Storage
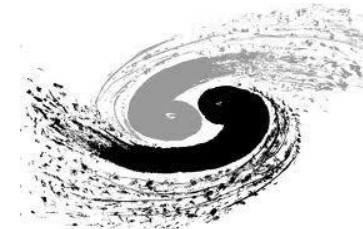
- **Users**
  - BESIII, DYB, JUNO, LHASSO, CMS, ATLAS, etc.
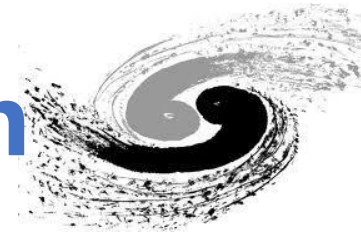 - 1700+ users (~300 active users)
  - Up to 100,000+ jobs/day

LHAASO

- The Large High Altitude Air Shower Observatory (LHAASO) project is a new generation all sky instrument to perform a combined study of cosmic rays and gamma-rays in the wide energy range 1011 -- 1017 eV.
- The experiment located at 4410m asl (606 g/cm 2) in the Sichuan province.

Offline data processing platform

- After the experimental data is acquired by DAQ, it enters the offline computing platform.
- Provide computing services for data storage, transmission, sharing, analysis and processing.

~300Mbps

~1Gbps

Small on-site data center at Haizi Mountain observatory (~ 4500m)
~2000CPU cores and 300TB disk storage for calibration and rapid reconstruction
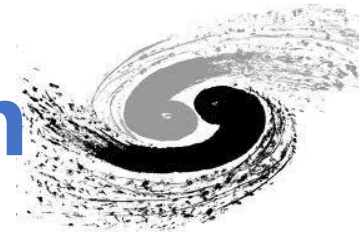
Distributed Computing sites (grid/cloud)

Operation center at Daocheng city

Large Offline data center at CC-IHEP
~4000 CPU cores and 4PB disk storage, 20PB tape storage for simulation, reconstruction, analysis, data storage and archive (in preparation)
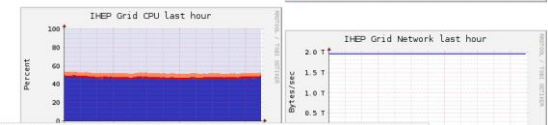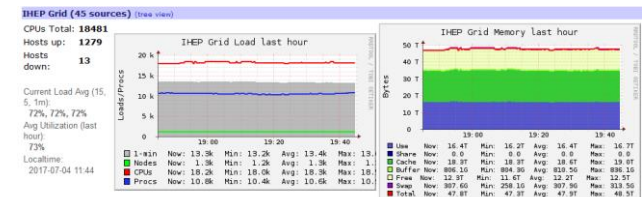
Offline data processing platform

- Calibration and rapid reconstruction job running at on-site data center and the offline data is transmitted to data center at CC-IHEP .

- Resource sharing technology, virtualization and cloud computing technology are applied into the LAHHSO offline data analyzing.

- Some distributed monitoring frameworks need to be designed and deployed to ensure a stable operation of LAHHSO experiment.

Unified Monitoring Architecture
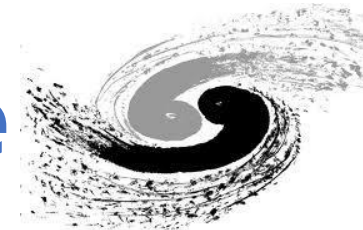
Basic Monitoring Tools

Ganglia：CPU load/Memory usage/SWAP/Network/IO...

Nagios：AFS/CVMFS/Lustre/Gluster ssh/http ...

Filebeat：syslog accesslog servicelog
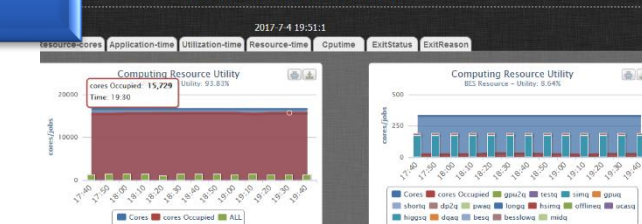
Self-plugin：collect metrics by application command

Unified Monitoring Architecture

- The Unified monitoring platform is deployed and to collect, aggregate and analyze data
- Realize real-time acquisition, analysis and correlation of multidimensional data attributes.
- Portable APIs for data analysis and alarm are provided.
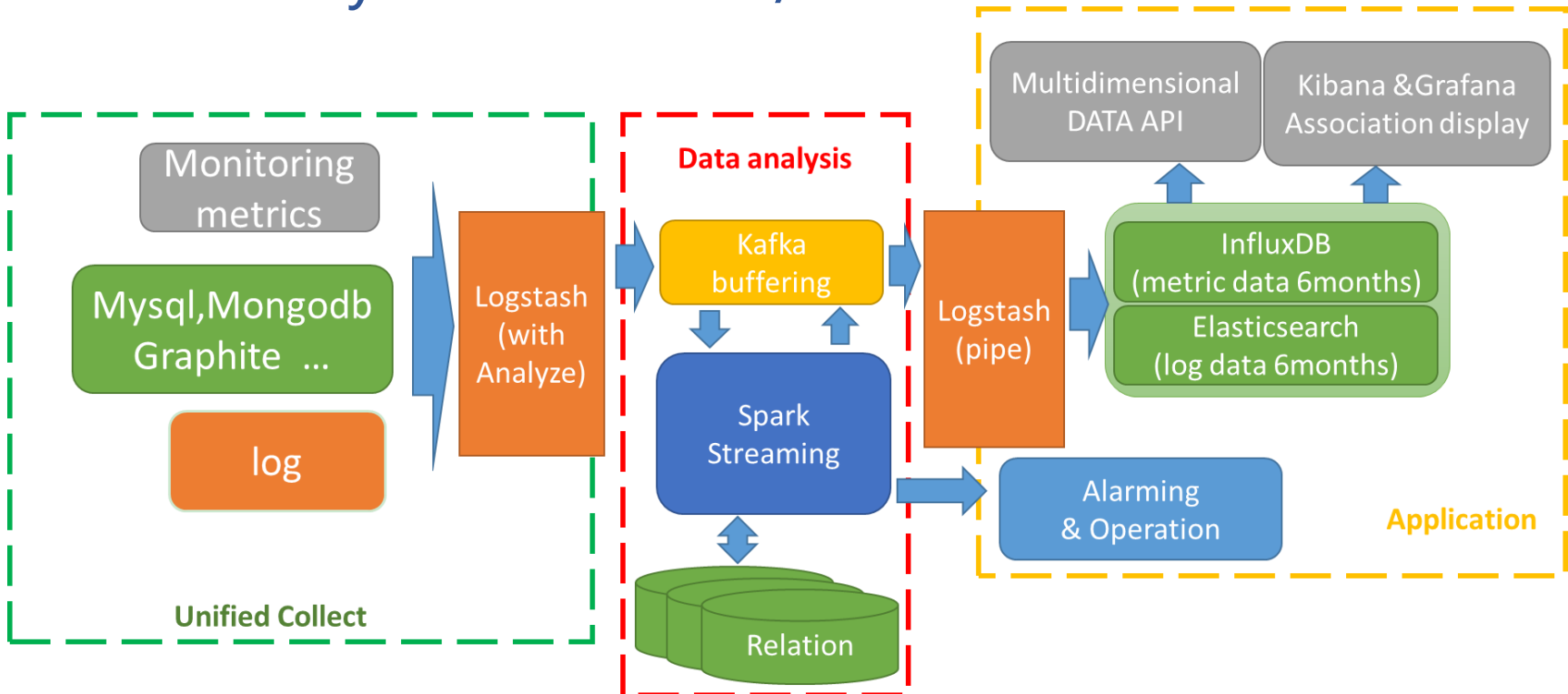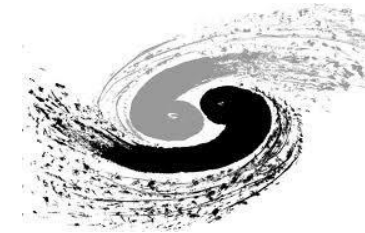
Unified Monitoring Architecture

- Metrics: > 400
- Concurrent nodes: > 1.5k
- Collection ability: ~ 3k records/second

Remote Data Collection

Gmond + Gmetad + Netcat command + logstash

● gmond collect node metrics(CPU, memory, load, wait IO etc.) and send to gmetad

● Collect plugin execute natcat command to pull the metrics from gmetad and push to logstash (remote) periodically

● Logstash (remote) transfer data to IHEP after compression

```
gmond ──→ Gmetad
              ↕
           plugin ──→ Logstash    ──→ Logstash
                      (remote)         (local)
```
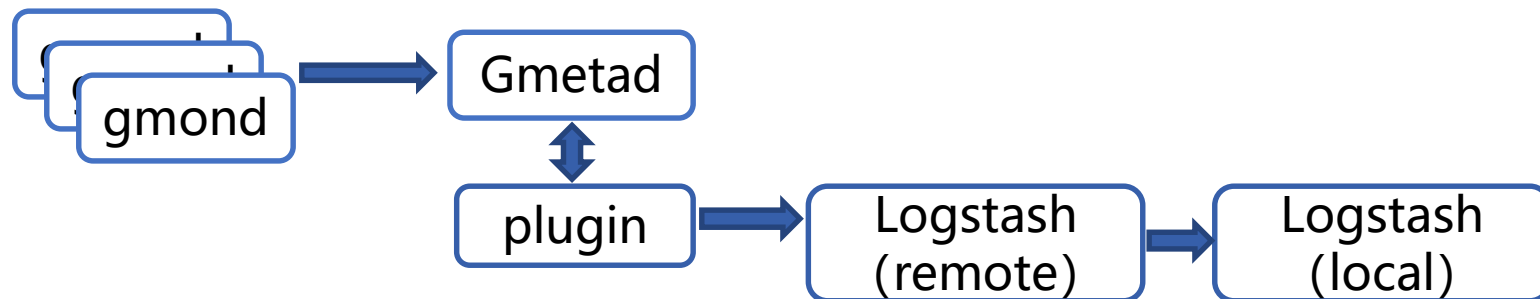
Remote Data Collect

Nagios + ModGearman + Filebeat + logstash

• Nagios Daemon loads a NEB (Nagios Event Broker) module
• NEB Module schedules all check jobs to the Gearmand queue
• Workers located in distributed
Servers run check commands
• Mod-Gearman collects the job results
and puts back the results onto
the check result list
• The Nagios reaper reads all checks
 from the result list and updates the
 healthy statushosts and services
•Filebeat collect reaper result and push to logstash (Local Aggregation)
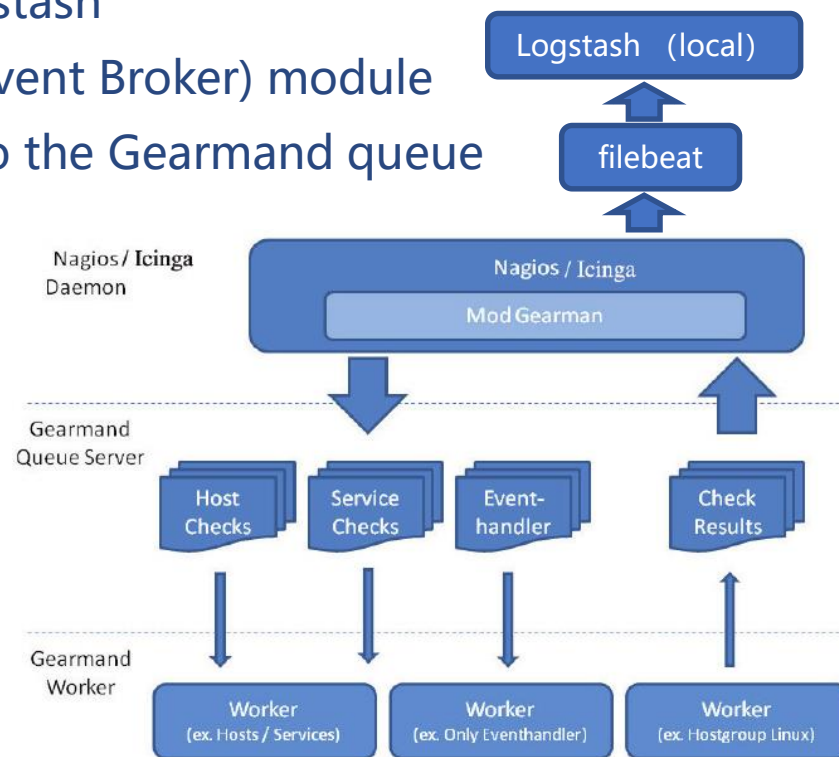
Remote Log & Special Metrics Collect
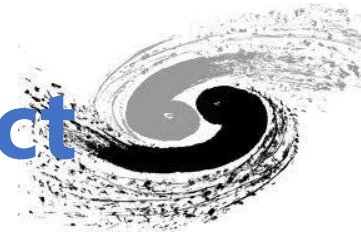
Filebeat + Flexible configuration plugin + logstash

● Filebeat used to collect log from multiple log files in time and push to logstash (remote)

● Center configuration portal is provided to set policy and collect rules

● Configuration file will be synchronized periodically by configuration plugin
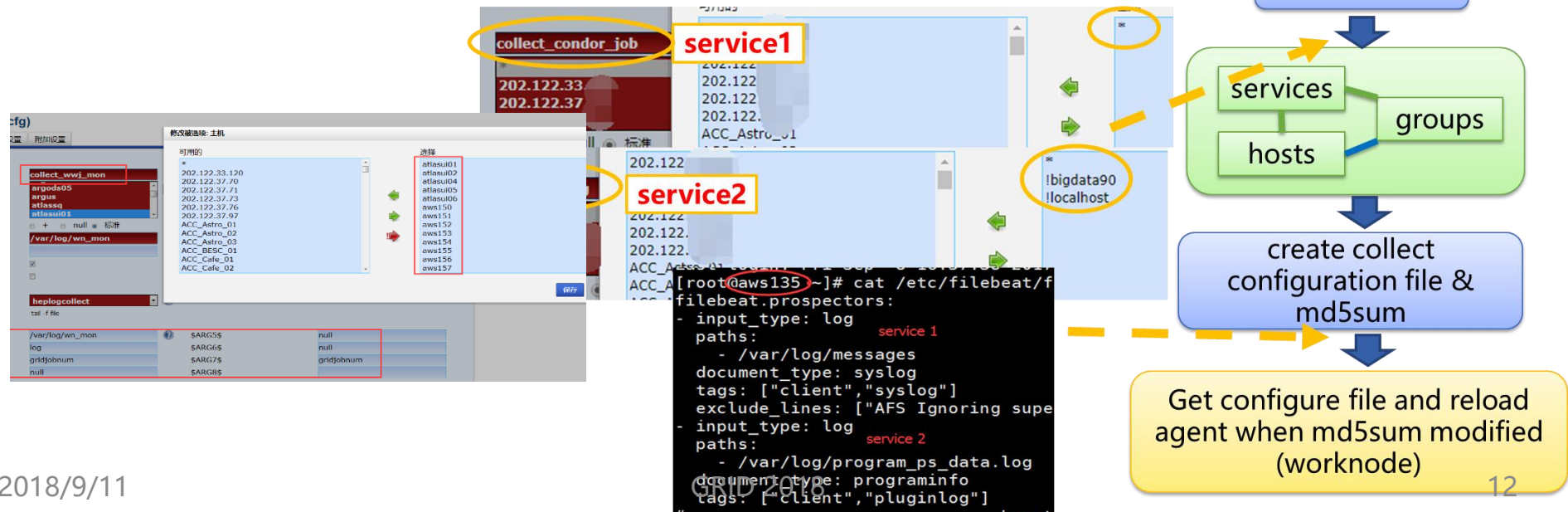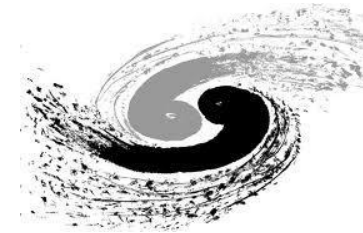
# Unified Monitoring Architecture With Remote Site
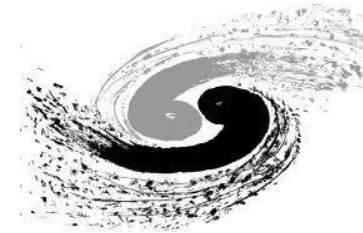
- Remote site logstash collect the monitoring data and transfer to logstash running in IHEP with Lumberjack plugin.

- Monitoring data can be compressed significantly to save network bandwidth(15:1)

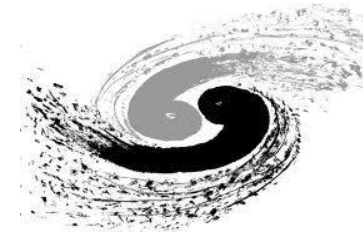- Ssl certificate guarantee the security of data transmission
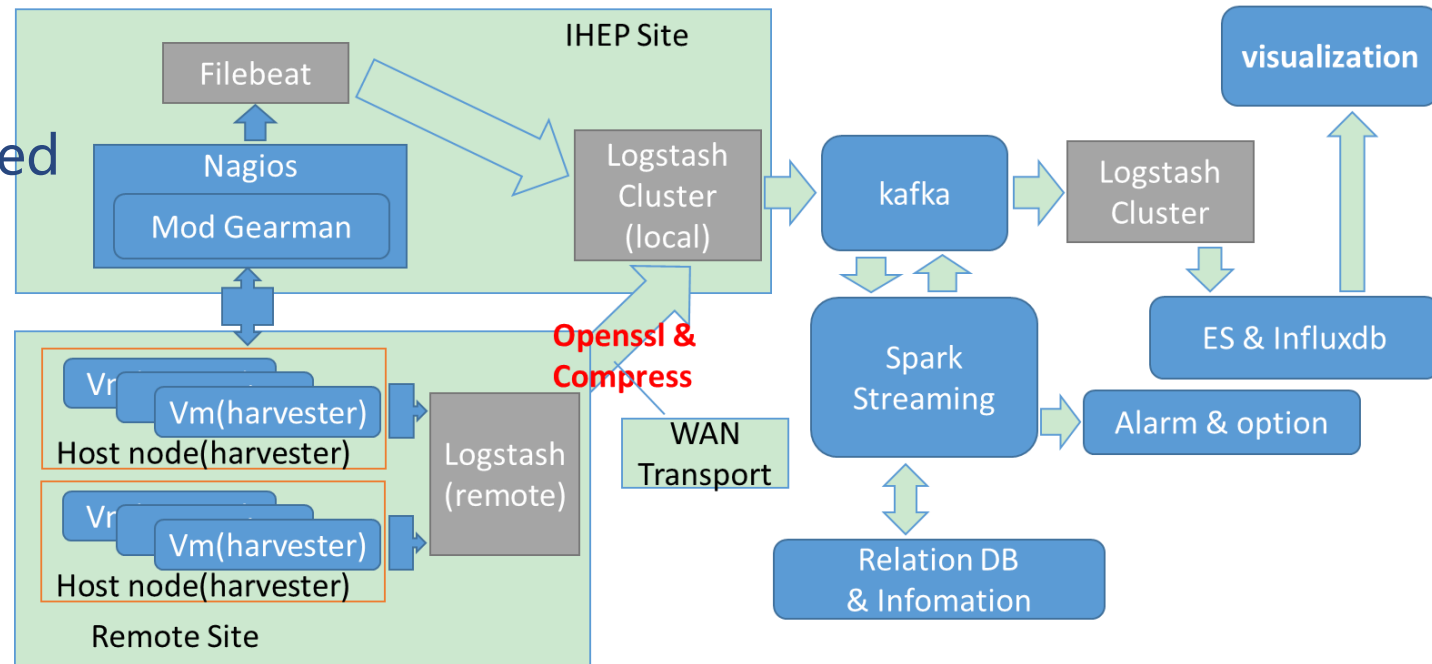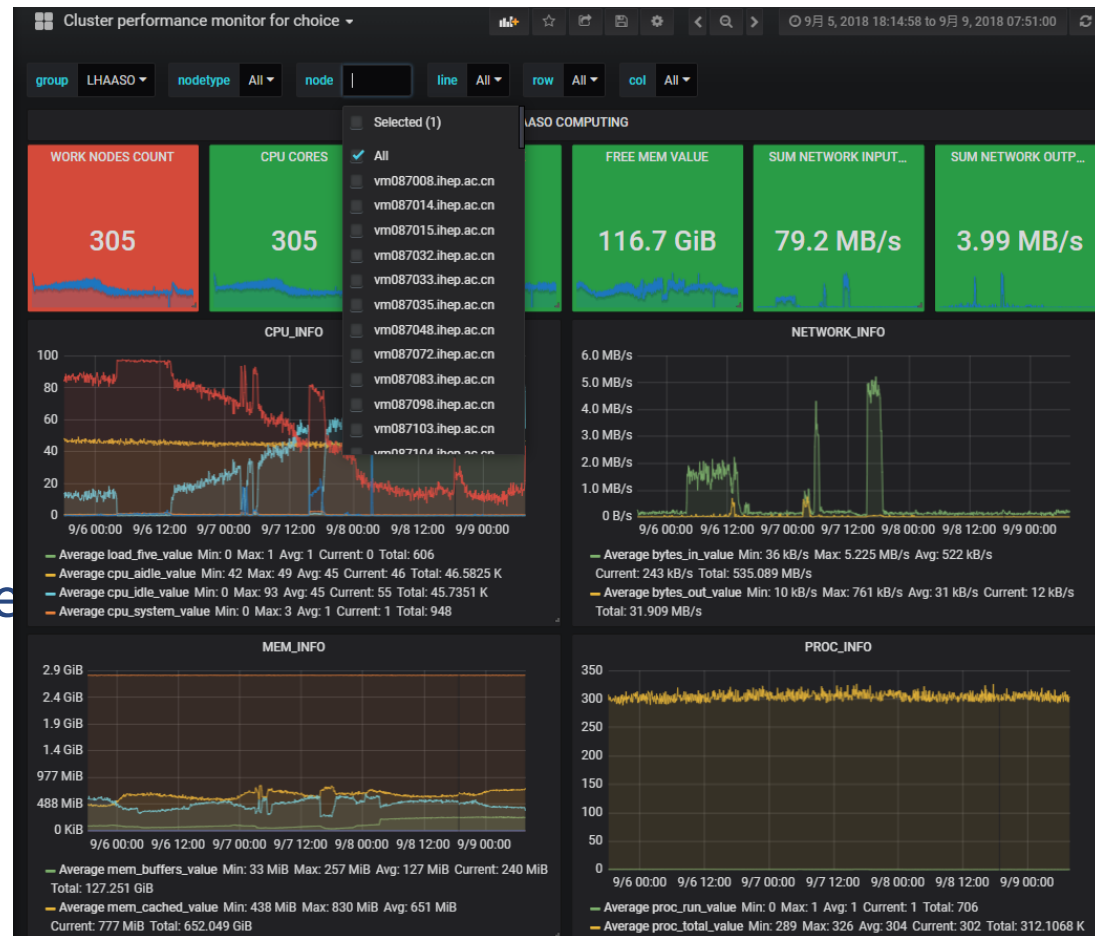
Monitoring Applications(1)

- Error check and recovery of compute nodes
  - Health status of all computing nodes are collected and stored in Central Database
 - Central controller can modify the nodes' attributions automatically
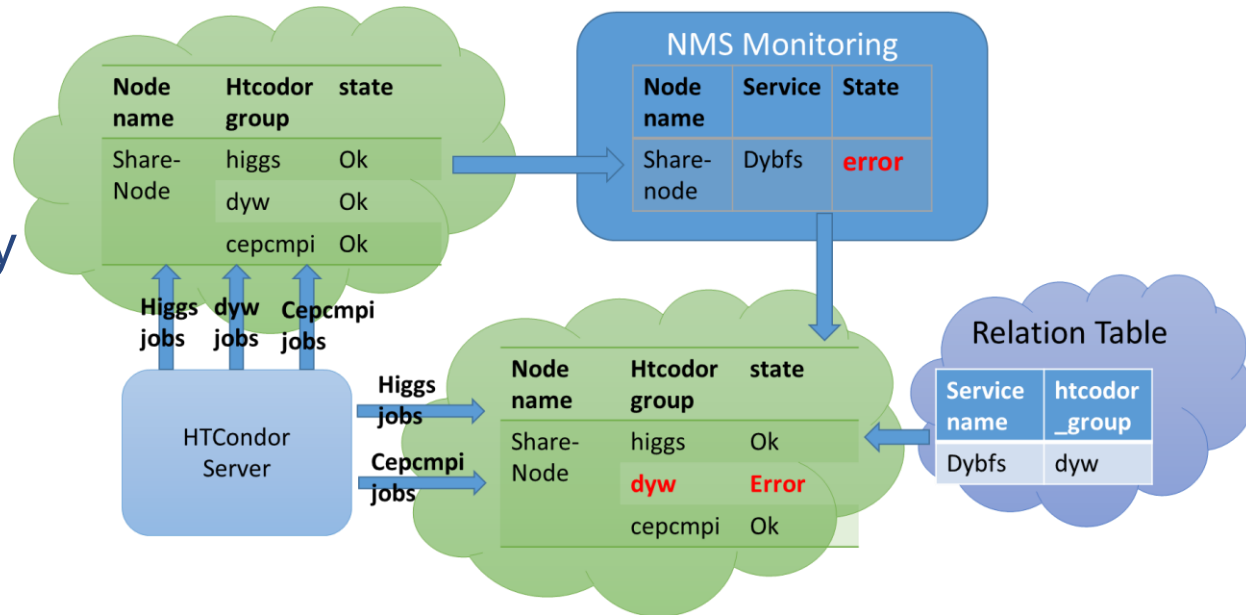
Monitoring Applications(2)

- Cluster performance monitoring
  - Real-time display cluster resource usage
  - Supports administrators to filter queries based on conditions such as group, node type, node, etc
  - Alert the missing heartbeat nodes according to the node list
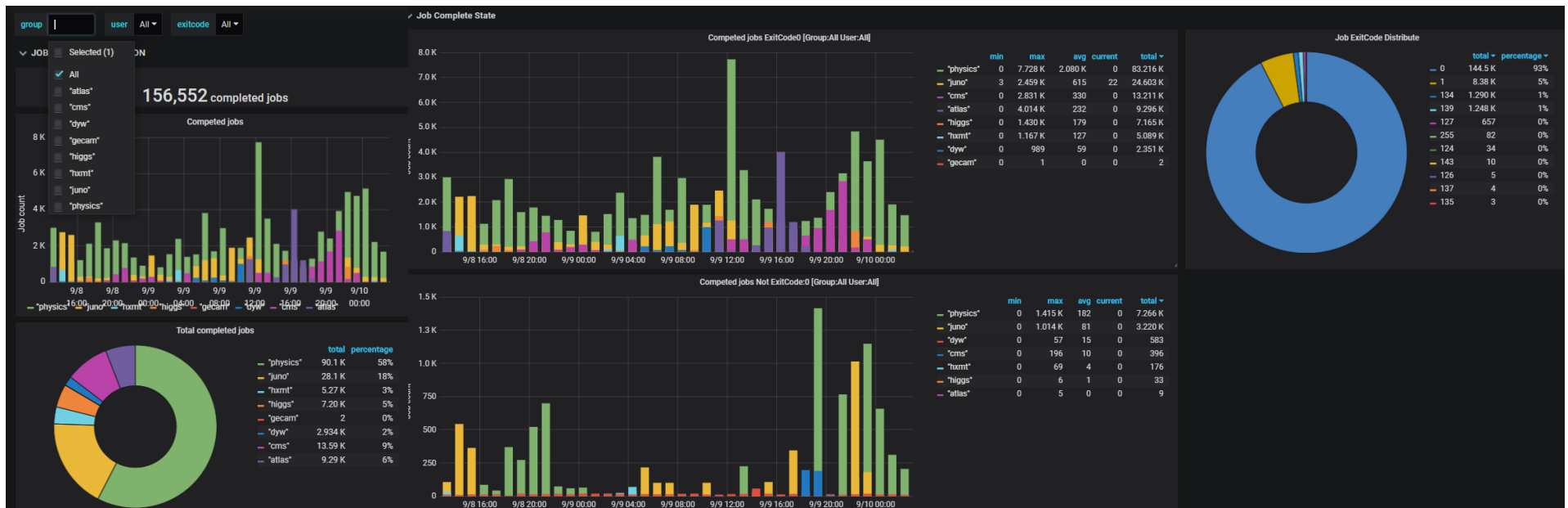 - Analyze monitoring metrics to alert unhealthy nodes
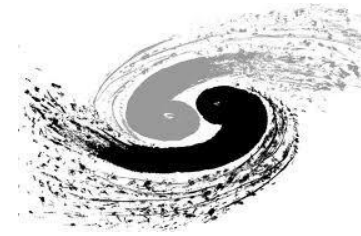
Monitoring Applications(3)
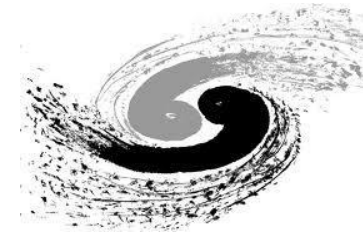
- Htcondor job status
  - Display the completed jobs classified in different metrics(group, users, exit code) in real time
  - Support administrators to filter queries based on conditions such as groups, users, exit codes, etc
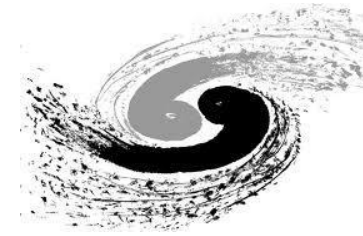
Summary and Next work

- Summary
  - Monitoring data in distributed site is collected, aggregated and analyzed with the unified monitoring system at IHEP.
  - The system was applied to LAHHSO successfully and it really benefit to operation and maintenance.

- Future work
  - Using machine learning technology to train historical data to gain the abnormal training model.

- Thank you !
- Question?