Integrated Monitoring results at IHEP

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Outline

1. IHEP Cluster Introduction
2. IHEP’s Monitoring System
3. Integrated Monitoring & application
4. Summary & Next work
IHEP Cluster Introduction

- **Major Projects**
  - **BEPCII/BESIII**
    - 36 Institutes from China, US, Germany, Russian, Japan,...
    - 5PB data in 5 years
  - **Daya Bay Neutrino experiment**
    - 39 Institutes from China, US, ...
    - 400TB/year data collected
  - **Yangbajing in Tibet**
    - Cosmic-ray observatory,
    - Collaborations of China, Italy, Japan
    - ~200TB raw data per year.
  - **JUNO**
    - Jiangmen Underground Neutrino Observatory
    - ~ 1PB Raw data per year
  - **LHAASO**
    - the Large High Altitude Air Shower Observatory
    - ~ 2PB Raw data per year
  - **CSNS**
    - Chinese Spallation Neutrons Source
  - **LHC**
    - Members of ATLAS and CMS
    - WLCG Tire-2 at IHEP
  - **AMS (Alpha Magnetic Spectrometer)**
IHEP Cluster Introduction

- **Computing**
  - HTCondor clusters
    - ~13,500 CPU cores
    - HTC jobs: series jobs
  - Slurm clusters
    - ~2,750 CPU cores
    - HPC jobs: parallel jobs
  - Grid site (WLCG)
    - Tier 2 site
    - 1,200 CPU Cores
    - CreamCE (PBS-2.5.5 with Maui-3.3.4)

- **Storage**
  - 5 PB LTO4 tapes managed by CASTOR 1
  - 9 PB of Lustre
  - 734 TB of gLuster with replica feature
  - 1.2 PB of EOS
  - 1.2 PB of other disk spaces

- **Operations**: 24x7
IHEP Cluster Introduction

- 10.2PB (Lustre/EOS/NFS)
- 150 GPU Cards
- 15000 CPU Cores
- 50 Xeon Phi Cards
- Mellanox SX6012
- Brocade 8770
- InfiniBand FDR 56Gb/s
- Ethernet 10/40 Gb/s
- User
- Remote Sites

2017/10/19
IHEP’s Monitoring System

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

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

Heplog: syslog accesslog servicelog

Self-plugin: collect-plugin + DB + dashboard
IHEP’s Monitoring System

- Current situation
  - The scale of the cluster is expanded
  - The computing environment is more complex
  - Various cluster monitoring tools are independent

- Goal
  - Correlation among the monitoring sources
  - Analyze various sources monitoring data
  - Unified display system health status from multiple levels
  - Show some error trends or abnormity.

Integrated the monitoring data of multiple sources based on our new monitoring system could improve the stability of our computing platform.
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Integrated Monitoring

● Architecture
Integrated Monitoring

- **Architecture**
  - Integrate all monitoring resources based on time line via ElasticStack tool
  - Attribute tags added to each monitoring log for diversity query
  - ElasticSearch/Influxdb for short term storage and fast query
  - HDFS for long term storage and offline data mining (next step)
  - Kafka buffer for data processing and online analyse (next step)
Integrated Monitoring

- Unified Data Sources

- Ganglia
- LUSTRE & EOS
- NMS
- Clouds
- Jobs
- App log
- Third-party Data
- User Data
- MySQL
- MongoDB
- RRD-tool & graphite
- Metric Beat
- DB-Beat
- Logstash (with Analyze) A
- Logstash & Beat

Unified collection
Integrated Monitoring

- **Unified Data Sources**
  - Multiple data sources
    - Mysql/ Mongodb/ Graphite/ RRD-tools/ Log/ Other third-party data ...
    - Multiple Logstash input plugins
  - Data format preprocessing
    - Extract the key information contained in unstructured data
    - Transform unstructured data into structured data
    - Add and modify fields in the event
    - Convert the field’s value to a different type
    - Powerful Logstash filter plugins
Integrated Monitoring

● Unified Data Sources

● Flexible configuration of data collection
  ● Quick collect arbitrary file data of the target node, by convenient and easy configuration operation
  ● Can add any tag into the collect event
  ● Modified Nagiosql code

data collected within two minutes after the configuration
Integrated Monitoring

- Unified Data Sources
- Flexible configuration of data collection

- create collect configuration file

 reload agent when configure file modified (worknode)
**Integrated Monitoring**

- **Unified Data Storage**
  - Elasticsearch
    - Storage and search log event.
    - For data processing and display
  - Influxdb
    - Storage and search metric event.
    - For display
  - HDFS (next step)
    - Storage offline data
    - For data-mining

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Logstash (simple) B

- **DATA MINING**
  - DATA REST API
  - Elasticsearch (log data 6months)
  - InfluxDB (metric data 6months)
- **HDFS (history all data)**

Kibana & Grafana Association display

DATA API

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2017/10/19
Integrated Monitoring

- **Unified Data Processing**
  - Data enrichment & Cluster job monitoring application
  
  - The transient state of the cluster job process is collected periodically
  - Static attribute information is collected from the scheduling server, after the job is completed.
  - Enrich the process data attribute from multiple data sources, according to the job execnode, starttime, endtime, slotid and other information.
Monitoring Applications

Data enrichment & Cluster job monitoring application

source1

```
"source": {  
  "pid": "467751",
  "type": "programinfo",
  "node": "jnws029.ihep.ac.cn",
  "@timestamp": "2017-09-28T14:58:40",
  "user": "waseem",
  "slotid": "4",
  "cpu": 92.5,
  "runtime": 5539,
}
```

source2

```
"source": {  
  "pid": "467751",
  "source": "/var/log/program_ps_data.log",
  "type": "programinfo",
  "jobgroup": "juno",
  "jobexitstatus": "0",
  "jobid": "job@schedu01.ihep.ac.cn#37103961.0#1506604138",
  "jobuser": "waseem",
  "rss": 671092,
  "mem": 1,
  "@version": "1",
  "beat": {  
    "hostname": "jnws029.ihep.ac.cn",
    "name": "jnws029.ihep.ac.cn",
    "version": "5.3.1"
  },
  "host": "jnws029.ihep.ac.cn",
  "vsz": 2134280,
  "stat": "S1",
  "starttime": "21:18",
  "offset": 4867823,
  "input_type": "log",
  "cpu": 92.5,
  "runtime": 5539,
  "message": "467683,1506610720.130369,467751,waseem,92.5,1."
}
```

Enriched fields

combined
**Integrated Monitoring**

- **Unified Data Processing**
  - Data feature matching & Abnormal identification and alarm

- Collect and index Lustre server log at real-time
- Periodically statistics the number of Lustre lock errors (error keyword: “lock callback timer expired after”) on the same client in the last 5 minutes
- Send alarm and perform the corresponding option when the error number exceeds the threshold.
Integrated Monitoring

- Unified Data Processing
  - Data feature matching & Abnormal identification and alarm

```
$postdata = 
{  
"size": 10000,  
"sort": [  
{  
"@timestamp": {  
"order": "desc",  
"unmapped_type": "boolean"  
}  
},  
{  
"query": {  
"bool": {  
"must": [  
{  
"query_string": {  
"analyze_wildcard": true,  
"query": "logsourcemds AND message:\"lock callback timer expired after\""  
}  
},  
{  
"range": {  
"@timestamp": {  
"gte": "$starttime",  
"lte": "$endtime",  
"format": "epoch_millis"  
}  
}  
]  
}  
}  
},  
"docvalue_fields": {  
"@timestamp": true  
}  
};
$resulttmparray = json_decode($posturl,$postdata),true);
$result = $resulttmparray['hit']['hits'];
$alterarray = array();
foreach($result as $v)
{
    $state = "$lock callback timer expired after (?<expiredtime>\d+)s.*?evicting client at (?<clientip>[.\d]+)\@u";

 Lustre_restartclient

ihep_computing_service@ihep.ac.cn send to shijy@ihep.ac.cn

57.109 are restarted at 2017-01-01 12:05:05
```
Integrated Monitoring

- Unified Data visualization
  - Uniform time visualization
    - Multi-data displayed with uniform time axis.
  - Uniform condition visualization
    - Multi-data displayed with same condition.
Monitoring Applications

- Unified data visualization & Cluster job monitoring

Data source: Ganglia

Data source: Job process-plugin
Monitoring Applications

- Unified data visualization & Cluster job monitoring
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Summary and Next work

● Summary
  ● Integrated monitoring platform could collect multiple data sources, and the data can be processed simply.
  ● We implemented some monitoring applications based on the collected monitoring data.

● Future work
  ● Data flow processing technology needs to be applied to the integrated monitoring.
  ● Using machine learning technology to train historical data, obtain abnormal training model.
- Thank you!
- Question?