THE ALARM SYSTEM AT HLS-II

Shuang Xu[1], Xiaokang Sun[2]
National Synchrotron Radiation Laboratory(NSRL), USTC, Hefei, Anhui 230029 China
October 09 –13, ICALEPCS 2023
Century City Convention Centre, Cape Town, SOUTH AFRICA
1. xus@ustc.edu.cn 2. Corresponding author, sunxk@ustc.edu.cn

ABSTRACT

The alarm system of HLS-II is responsible for monitoring the alarm state of the facility and distributing the alarm in time. The monitoring scope of the alarm system covers the front end devices and the server systems of HLS-II. The alarm distribution strategy of HLS-II is designed to overcome nuisance alarms. Zabbix is an open-source software tool used for monitor the server systems. Custom metrics are collected through external scripts. The alarm system of HLS-II provides multiple ways to notify the responsible operators, including WeChat, SMS and web-based GUI. It facilitates the operator to troubleshoot problem efficiently, so as to improve the availability of HLS-II.

INTRODUCTION

Hefei Light Source II (HLS-II) is a vacuum ultraviolet synchrotron light source. The monitoring scope of HLS-II alarm system includes the front end devices and the server systems.

The control system of HLS-II is a distributed system based on EPICS. Phoebus/Alarms is the latest alarm software released in EPICS community. The alarm system of HLS-II is designed based on Phoebus/Alarms.

To meet the requirement of HLS-II, the alarm distribution way, such as WeChat, needs to be customized. In addition, nuisance alarms are often observed under normal circumstances. Therefore, it is necessary to design the HLS-II alarm distribution strategy to remove nuisance alarms.

In order to achieve comprehensive monitoring of the HLS-II control system, the monitoring of the server systems is included in the alarm system. Zabbix is widely used in large scientific facilities to resolve issues related to servers and applications. Thus, Zabbix is selected as the monitoring tool for the server systems.

OVERALL ARCHITECTURE

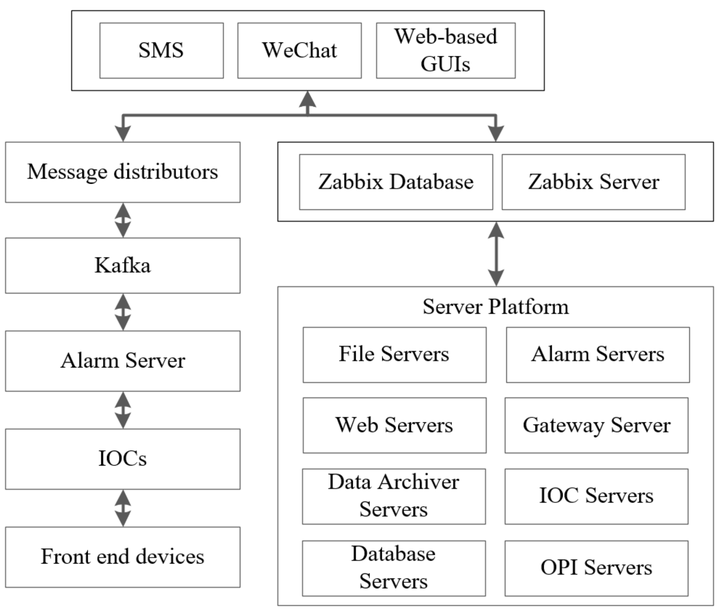

Figure 1. Architecture of the HLS-II alarm system.

The alarm system of HLS-II monitors the abnormal state of front end devices and server systems. The architecture of the HLS-II alarm system is shown in Fig. 1. The alarm server monitors the PVs stored in Kafka topic and updates their alarm states in Kafka. Kafka is a distributed messaging service. It can store messages and then efficiently send all stored messages to newly connected client.

The server systems contain OPI servers, data archiver servers, database servers, web application servers and file servers, etc. Most servers are deployed on virtual machines created by VMware vSphere. The operating system of servers is Linux.

Zabbix monitors metrics through Zabbix agents running on individual servers. The metrics are processed by the Zabbix server and then stored in the Zabbix database. The Zabbix Web provides graph graphing functionality.

ALARM DISTRIBUTION STRATEGY DESIGN

Nuisance alarms negatively impact the credibility of the alarm system and distract operators from identifying true alarms. In order to present the truly necessary alarms, the distribution strategy of HLS-II alarm system needs to be design. There are five alarm management methods used in strategy design.

Alarm deadband:

Alarm deadband is a hysteresis field of PV. Alarm deadband is suitable for analog input records with small deviation from alarm threshold.

Alarm severity:

The alarm severity is used to give weight to the current alarm state. The alarm severity corresponds to the cause and the risk of the alarm.

State-based alarm methodology:

State-based alarm methodology produces dynamic alarm methods based upon HLS-II modes. HLS-II is operated with four modes, which are shutdown, maintenance, machine study and user operation.

Group alarm:

Group alarm produces a representative alarm by combining several similar alarms to avoid redundant information.

Delay timer:

The m-sample delay timer raises (clears) alarms if and only if m consecutive samples are in the alarm (non-alarm) state. The delay timer results detection delays of abnormal conditions.

SERVER SYSTEMS MORNITORING

Zabbix provides various templates. The templates contain items, triggers, graphs, etc. Table 1 lists some monitored objects, their templates and items applied in the HLS-II alarm system.

Table 1 Monitored objects, templates, items and item types

Monitored objects	Templates	Items
Server	Template OS Linux by Zabbix agent	CPU, Memory, Disk, Network, Inventory, etc.
Zabbix Server	Template App Zabbix Server	Queue, Configuration cache, etc.
Redis	Template DB Redis	Redis status, Memory, etc.
Zookeeper	Template App Zookeeper by HTTP	Zookeeper status, connection, etc.
Elasticsearch	Template App Elasticsearch Cluster by HTTP	Service status, Cluster health status, etc.
IOC log	Template IOC	IOC log size
NTP	Template NTP Service	Clock synchronization status

The Network Time Protocol (NTP) server is monitored through customized item. The python script monitor clock synchronization performance through the ntpq program. The Zabbix agent runs the python script in monitored hosts and provides the metrics to the Zabbix server.

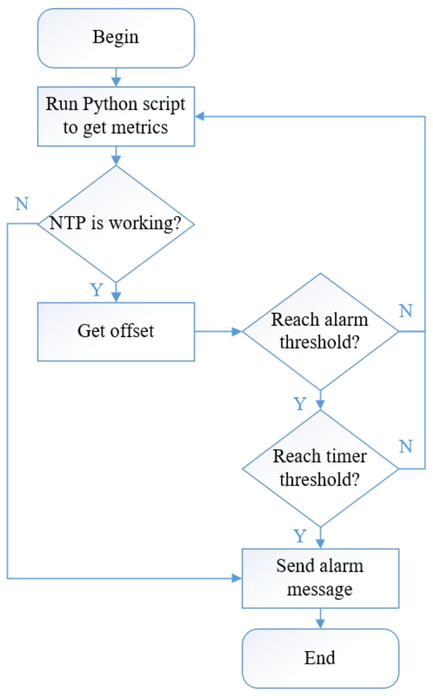

Figure 2. Flowchart of the alarm process of NTP status.

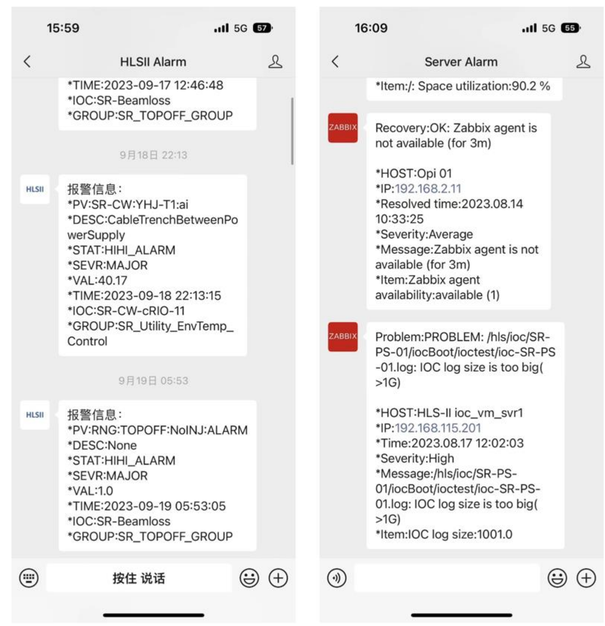

Figure 3. Screenshots of the WeChat messages of the alarm system.

CONCLUSION

The alarm system of HLS-II has been deployed since 2021 and the server systems monitoring has been incorporated since December 2022. The result shows the alarm system of HLS-II facilitates the operator to troubleshoot problem efficiently to improve the availability of HLS-II. The alarm strategy realizes the filtering of nuisance alarms. The number of alarms distributed through WeChat and SMS is generally less than 30 messages per day. The predefined templates and native GUI of Zabbix reduce manual configuration efforts. Zabbix custom templates can be flexibly customized to meet the HLS-II requirement.