

Research on the Application of Nagios in Earthquake Information Network System

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Abstract. With the continuous development of network technology, the networked seismic surveillance instruments and application services systems are used more and more in seismological industry. It has become an important task to monitor and manage those systems and instruments effectively, and to send failure messages to system administrators quickly and precisely. In this paper, the author introduced the applications of the monitoring system, the deas and methods of failure linkages alarm short message service system, both developed from the open source network management software Nagios. Meanwhile, the author researched the integrated installation of the open source network management software and the multiple-level interactive distribution technology of alarm information in depth.

1. Introduction

With the development of information technology, the networked seismic surveillance instruments and application services systems are in increasing, which has covered information network, earthquake precursor observation, earthquake quick report, earthquake early warning, GPS, emergency decision for commanding and dispatching, government affairs and other businesses. Now, there is more than 500 network equipment and application service systems in Tianjin Seismological Bureau. How to monitor and manage those effectively and give fault alarm signal in time, is the basic requirement for the systems to run normally, and also is the important part of the operation and maintenance systems.

Through investigation of the network management systems both inside and outside the industry, as well as the analysis of the application effect for the existing network management system in the bureau, the author concluded that general system cannot meet those specific network management needs, especially didn't have good expanding which limited the secondary development capacities. However, those excellent network management systems are too expensive to daily operation and maintenance. Since 2009, with constant testing, the author has developed a software platform based on Nagios to work for Tianjin Seismological Bureau, solving those network management problems. Now, the software system has been used fully in the daily work of Tianjin Seismological Bureau, and generalized the use in the national earthquake system. The following is explanation of construction and development of the system.

2. Function Design of Network Management System

In view of the need to manage the unit network system, the network management system designed by the author have a richer and more practical management functions, including:

- Ability to monitor all kinds of equipment (including devices without SNMP).
- Ability to monitor the application service system.
- Network flow statistics.
- Graphical representation of monitoring information.
- Statistical statements of monitoring information.

- SMS Linkage alarm function of failure status.
- Online application for multi-level user
- Secondary development interface functions, etc.

3. Architecture Design of Network Management System

The network management system developed by the author used open source software, and also part of it was developed in second time. The system structure which realized is as shown in Fig. 1

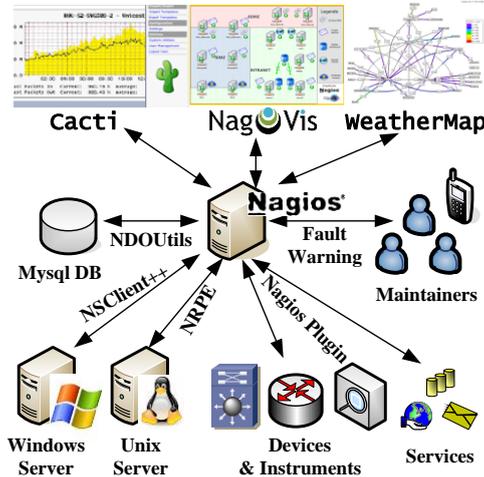


Fig. 1 System structure diagram

In recent years, open source network management software has become the dominant force in the network management system. Software including Nagios referred here, all have good application market and user groups, and have stable and reliable operation. Function of the relevant software module were shown in Table 1.

Table 1. the function of main components in system

Application components	Functions
Nagios	Core monitoring software, realize the monitoring of host, equipment and service
Nagios-plugins	Nagios basic plug-in, extend the monitoring capacity of Nagios monitoring system
NDOutils	Add Nagios configuration information and monitoring data to database, realize monitoring data sharing
NRPE	Nagios for Unix client, deployed in Nagios system and monitored Unix or Linux server, realize the detailed monitoring of the server
NSClient++	Nagios for Windows client
NagVis	Monitoring information system, realize the graphical display of Nagios to monitor information
Cacti	Network traffic analysis and graphical display tools, with powerful monitoring data to demonstrate capability
Weathermap	Cacti graphical display the data flow information, can be mapped the flux distribution in the network system pressure/flow chart, is an excellent tool to check the network traffic load

The author developed the software modules, and through the monitoring system of Nagios Fault linkage alarm alarm events and logic match the operations staff, alarm information, automatic generation message system of fault events through GSM Modem or other mobile phone short message sending system to realize the alarm information notices

4. Design and Implementation of System Integration Installation Script

To realize the functions of system architecture diagram (Fig. 1), it is needed for more than ten kinds of open source software to install and debug. The process is tedious and error-prone, and spends a lot of time usually. For fast setup and deployment, the author written the installation script. Through

simple operation of seven scripts, an open source network management system, with the whole functions of Nagios, Cacti, Nag Vis, Weather MAP and fault linkage alarm, could be deployed within 20 minutes.

4.1 System installation environment

The Nagios server used here is DELL 1900. It has Intel CPU 2.4GHz, 4GB memory, Gigabit Ethernet NIC and 80GB SATA hard disk. The operating system is Suse Enterprise Server 10 with SP2, being installed such as Apache2, PHP5, MySQL5, C/C++ development libraries, Gd library, net-SNMP and Oracle system components, etc.. The default language is English, and Simplified Chinese Language is supported.

4.2 The function of the installation script

The functions of the seven scripts are shown in Table 2. The scripts are executed in sequence with user interaction, and provide simple parameter information.

Upon execution of the script, those application platform will be set up by 12 components, including cacti-0.8.7d.tar.gz, cacti-plugin-0.8.7d-PA-v2.4.zip, graphviz-2.24.0.tar.gz, nagios-3.0.6.tar.gz, nagios-plugins-1.4.13.tar.gz, nagvis-1.4.1.tar.gz, ndoutils-1.4b7.tar.gz, npc-2.0.3.tar.gz, nrpe-2.12.tar.gz,

Php-weathermap-0.97a.zip, fault alarm message management platform and fault alarm message generated trigger.

Table 2. system integration of Nagios for script

Script	Realized functions
01_install_nagios.sh	Create Nagios users and user groups, install Nagios, Nagios-plugins, NRPE software and special commands of Check_voip, Check_oracle
02_install_cacti.sh	Create Cactiuser users and user groups, create Cactidb database, install Cacti basic system and so on
03_install_cacti_.sh	Install Cacti plugin, etc
04_install_ndo_npc_.sh	Install ndoutils components of Nagios and NPC components of Cacti, etc
05_install_nagvis.sh	Install nagvis and its relevant software, such as Graphviz
06_install_weathermap.sh	Install weathermap components of Cacti.
07_install_smsdb.sh	Install fault linkage alarm message system

The following are the statements of 01_install_nagios.sh script. During its execution, the user would need to create passwords for Nagios users, Nagiosadmin users and Nagvis users. Upon execution of the script, a Nagios system would be installed for monitoring the stored data. The address <http://nagios server IP address/nagios> can be used to log in and access.

```
#!/bin/sh
--- Note: create a user
/usr/sbin/user add -m nagios
echo "Please input password for user 'nagios'"
passwd nagios
/usr/sbin/groupadd nagios
/usr/sbin/usermod -G nagios nagios
/usr/sbin/groupadd nagcmd
/usr/sbin/usermod -G nagcmd nagios
/usr/sbin/usermod -G nagcmd wwwrun
--- Note: the installation nagios3.0.6
Cd.
Tar xzf nagios-3.0.6.tar.gz
Cd nagios-3.0.6/
./configure --with-command-group=nagcmd
Make all
Make install
Make install-init
Make install-config
```

```

Make install-commandmode
Make install-webconf
Echo "Please input password for user 'nagiosadmin'"
htpasswd2 -c /usr/local/nagios/etc/htpasswd.users nagiosadmin
Echo "Please input password for user 'nagvis'"
htpasswd2 /usr/local/nagios/etc/htpasswd.users nagvis
Service apache2 restart
---- Note: the installation nagios-plugins
Cd.
Tar xzf nagios-plugins-1.4.13.tar.gz
Cd nagios-plugins-1.4.13
./configure --with-nagios-user=nagios --with-nagios-group=nagios
Make
Make install
/usr/local/nagios/bin/nagios -v /usr/local/nagios/etc/nagios.cfg
chkconfig -s nagios 35
Service nagios start
---- Note: the installation nrpe
Cd.
Tar xzf nrpe-2.12.tar.gz
Cd nrpe-2.12
./configure
Make all
Make install-plugin
Echo "Finished! Good Luck!"

```

5. The Design and Implementation of Failure Linkages Alarm Short Message Service System

Nagios network management system appears the system monitoring function, but quick notice for fault events monitored is the main means to promote efficiency of management and to reduce the influence of fault. Although alarming mechanism based on cell-phone messages has become the important function of network management software, there is no independent module for short message alarm in Nagios system. To meet the needs, the author developed the failure linkages alarm short message service system, including management program and trigger for short fault alarm information.

While failure event is detected by Nagios, the system developed automatically create alarm information according the logic set for generating short information, push it to the database, hang up the cell-phone short messages through GSM Modem or other channels. The system diagram is as shown in Fig. 2

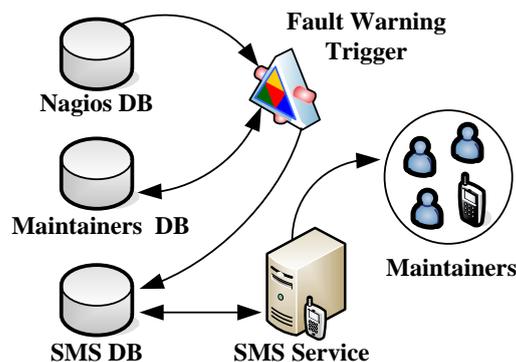


Fig. 2 Diagram of Fault linkage alarm message system

5.1 Short fault alarm information management program

The program performs the information management of the operations staff and fault alarm event. Operations staff information include basic staff information, work schedules, management area. It would permit fast comparisons, and provide basic information support to determine the scope of persons who need receive the fault alarm messages.

In the Table 3, the samples page for equipment management area of Tianjin seismic precursor network, the crustal movement observation network of Tianjin (GPS) and Jixian Seism station is described in detail. In the Table 4, the nine operations staff's comprehensive information is listed.

Table 3. Samples of management area

	Earthquake Precursory Network	GPS Observation System	Jixian Seismic Station
Management Area ID	002	003	010
IP Address Start	010.012.040.000	010.012.052.000	010.012.064.000
IP Address End	010.012.043.255	010.012.056.255	010.012.067.255
Device Name Keys	qianzhaotw	gps	xx10

Notice: Description of management area 002: management area includes IP address between 10.12.40.0 to 10.12.43.255 and equipment name containing key word of "qianzhaotw". Management area 003 and 010 has the same meaning.

Table 4. Samples of information duty

User ID	Attack time	End of job Time	Management Area ID
1	2015-3-1 08:00	2015-3-5 08:00	002(Earthquake Precursory network)
2	2015-3-5 08:00	2015-3-9 08:00	002(Earthquake Precursory network)
3	2015-3-1 08:00	2015-3-5 08:00	003(GPS observation system)
4	2015-3-5 08:00	2015-3-9 08:00	003(GPS observation system)
5	2015-3-1 08:00	2015-4-1 08:00	010(Jixian seismic station)
6	2015-3-1 08:00	2015-3-5 08:00	010(Jixian seismic station)
7	2015-3-5 08:00	2015-3-9 08:00	010(Jixian seismic station)
8	2015-3-1 08:00	2015-3-5 08:00	002,003,010 (Earthquake Precursory network) (GPS observation system) (Jixian seismic station)
9	2015-3-5 08:00	2015-3-9 08:00	002,003,010 (Earthquake Precursory network) (GPS observation system) (Jixian seismic station)

Table 5 detail record of the alarm events

	Alarm Event 1	Alarm Event 2	Alarm Event 3
Alarm type	Equipment alarm	Equipment alarm	Service alarm
Alarm time	2015-3-2 18:23	2015-3-5 09:15	2015-3-6 08:02
Alarm status	Critical Alarm	Critical Alarm	Warning Alarm
Alarm details	Can't detect equipment in the system.	Can't detect equipment in the system.	Interface traffic overruns 70 Mb/s, Bindwidth is 70%.
Equipment name	xx10-qianzhaotw-XYZ	xx12-gps-ups	xx10-network-switch
Service name	NULL	NULL	Interface Traffic
Equipment IP address	10.12.64.33	10.12.84.9	10.12.64.1

5.2 Fault alarm message generation strategy and trigger Settings

Fault alarm message generated strategy is: through comparing-screening of the operations duty information and alarm events, operations staff who receive fault alarm information can be identified quickly. Filter conditions: 1. the receiver must be in working hours; 2. only receive the alarm information of the instruments and equipment managed. Here are three alarm events, as shown in Table 5, deducing the range of short message receiving staff with management area and operations staff information shown in Table 3 and Table 4.

Alarm event 1 is from seismic precursor instrument FHD of Jixian Seism station. Managerial personnel of the equipment include operations staff of No. 1, No. 2, No. 5, No. 6, No. 7, No.8 and No. 9. According to the alarm time 2015-3-2 18:23, No. 1, No. 5, No. 6 and No. 8 operations staff, four in total, were confirmed.

Alarm event 2 is from UPS equipment of GPS. Managerial personnel include NO. 3, NO.4, NO. 8, No. 9. According to the alarm time 2015-3-5 09:15, No. 4 and No. 9, two people in total, were confirmed as the receivers.

Alarm event 3 is the same as above. No. 1, No. 5, No. 6, No. 8 received the information.

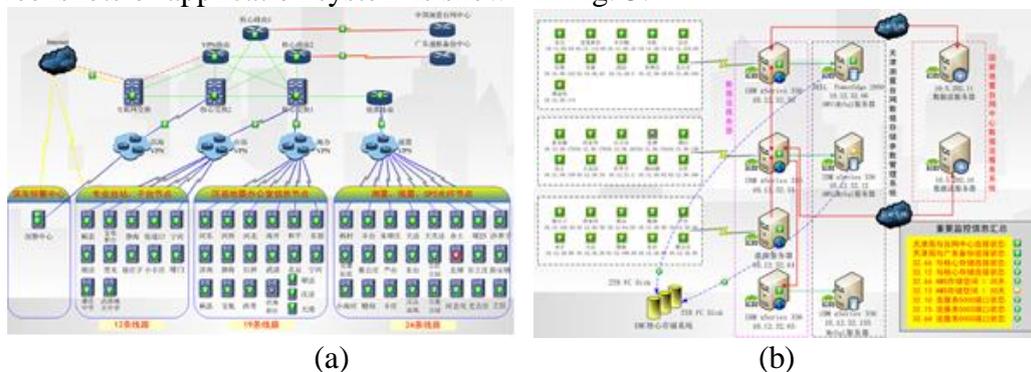
With the generation logic of SMS, it would be converted to MySQL trigger language, and then the trigger was created at Notifications data tables of Nagios database system in the Mysql5.0 platform. Whenever new records was produced in the Notifications tables (new alarm events), the trigger would be executed automatically. According to the identified failure message generation logic, short messages sent was matched automatically, and wrote into sending data. The phone's SMS system completed the data-distribution work finally.

6. Application Effect

With the work above, in Earthquake Administration of Tianjin, all kinds of business systems could be monitor and managed thoroughly; alarm messages of the fault event could be created and sent automatically in less than 5 minutes with free adjustment as requested; the same alarm event could be responded in tandem and dealt with in many areas by many people. It promoted the managing ability and level of operation and maintenance for all kinds of business system, and was well appraised by users.

Supported by this system, Tianjin earthquake precursory network won serval first prize for five consecutive years, and Tianjin seismic information network system also achieve the top three for 5 years in the national rating, and become the outstanding representative of operations management in the industry. At present, the system has been widely used in China earthquake networks center, Jilin seismological bureau, seismological bureau of Tibet, and other units, and had got good reviews.

The screenshots of application system is shown in Fig. 3.



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