NEC

SX-Aurora TSUBASA

SX-Aurora TSUBASA
Operation and Management Guide
(with OSS)

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Preface

This document explains how to manage system and monitor operational status using open source software (OSS) in a large-scale SX-Aurora TSUBASA system.

The latest version of this document is available at:

https://sxauroratsubasa.sakura.ne.jp/documents/guide/pdfs/SX-Aurora_TSUBASA-OperationGuide_with_OSS_E.pdf

Definitions and Abbreviations

Term	Description
Vector Engine (VE)	The core part of the SX-Aurora TSUBASA system, on which applications are executed. A VE is implemented as a PCI Express card and attached to a server called a vector host.
Vector Host (VH)	A Linux (x86) server to which VEs are attached, in other words, a host computer equipped with VEs.
Vector Island (VI)	A set of a VH and VEs that are attached to the VH. A VI is the basic unit for the tower model and rack mount model described below.
Tower model	One of the SX-Aurora TSUBASA product models. The tower model is a desk side model that can be simply set-up.
Rack mount model	One of the SX-Aurora TSUBASA product models. The rack mount model is a 1U or 4U server model with a server rack. It covers from small systems to large scale systems.
Supercomputer model	One of the SX-Aurora TSUBASA product models. The supercomputer model is positioned as the next generation model of the SX series. It can mount up to eight 4U rack mount servers. All vector engines have water cooling devices.
VMC	Abbreviation of VE Management Controller
IB	Abbreviation of InfiniBand
BMC	Abbreviation of Board Management controller

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Chapter1 Overview

1.1 Scope

This document explains how to monitor operational status using open source software (OSS) in a large-scale SX-Aurora TSUBASA system.
The SX-Aurora TSUBASA system recommends Zabbix for operational status monitoring, and explains the usage of Zabbix.

1.2 System Architecture

The configuration for operational status monitoring of the SX-Aurora TSUBASA system depends on Zabbix. Please refer to "3. Monitoring by using Zabbix ".
The system configuration management of VHs requires Ansible, which is OSS. Therefore, the management server where Ansible is running and all VHs in a system must be connected by a network.

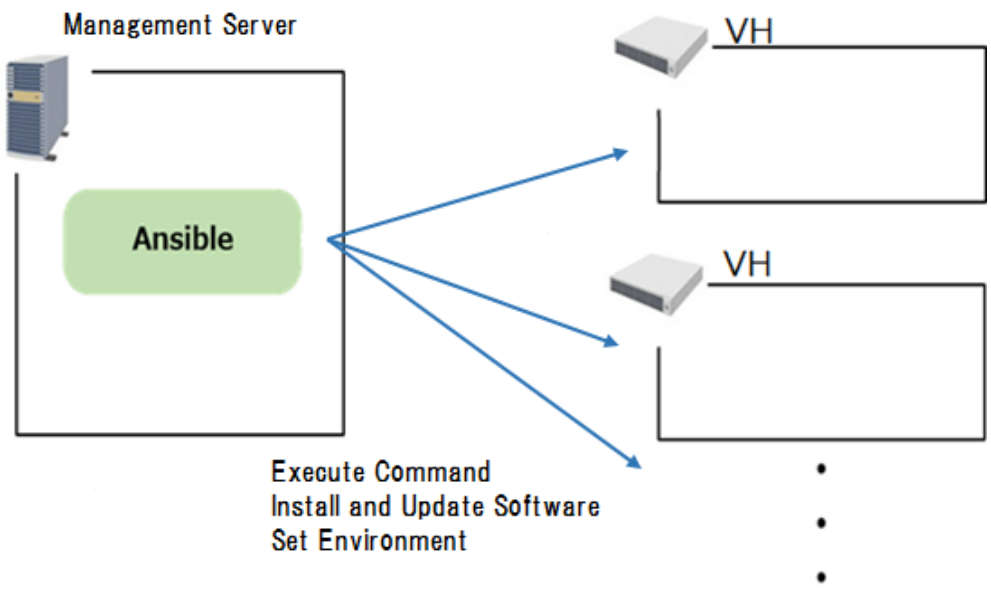

Figure 1 The Configuration of the system configuration management

1.3 Operating Environment

The following environment supports the system management of VHs described in this document.

[Management Server]

H/W	x86_64 Architecture machine
OS	Red Hat Enterprise Linux / Rocky Linux 8.8 or later
OSS	Zabbix 4.0.26 / 5.0.4 / 6.0.12
	Ansible 2.8.1 / 2.9.1

[VH]

H/W	The models listed in the SX-Aurora TSUBASA product catalog.
OS	The NEC support portal below lists the operating systems and their kernel versions verified for the SX-Aurora TSUBASA. [SX-Aurora TSUBASA] Supported OSes and kernel versions http://www.support.nec.co.jp/en/View.aspx?id=4140100078
OSS	Zabbix 4.0.26 / 5.0.4 / 6.0.12

1.4 Prerequisites

- Install OS to the Management Server.
- Install SX-Aurora TSUBASA software to the VH machines.

Chapter2　Settings of Management Server

2.1　Creating an administrative user (admin)

Create an account for an administrative user admin. And it is required to give sudo privilege and to disable requiretty for admin user. admin is a user who runs Ansible commands. You must create an admin user before you install the template package at "2.3 Installing the template Package".

```
Example:
# useradd -m admin
# passwd admin
Changing password for user admin.
New UNIX password: (Input Password)
Retype new UNIX password: (Re-input Password)
passwd: all authentication tokens updated successfully.
# visudo
:
admin ALL=(ALL) NOPASSWD: ALL
Defaults:admin !requiretty
```

When you are using Ansible, an administrative user admin remotely logs in VHs from the management server over SSH. Because of this, you need to create the administrative user admin on the VHs as well.

2.2　Setting administrative user's SSH public and private keys

Ansible used to setup the VH environment first logs into VHs over SSH for further operations. Generate public and private keys for the administrative user admin to log in VHs over SSH, and change the SSH configuration.

```
# su - admin
$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/admin/.ssh/id_rsa):
Enter passphrase (empty for no passphrase): (Input passphrase)
Enter same passphrase again: (Re-input passphrase)
Your identification has been saved in /home/admin/.ssh/id_rsa.
Your public key has been saved in /home/admin/.ssh/id_rsa.pub.
The key fingerprint is:
```

```
        :
```

The public key is created in the ~admin/.ssh/id_rsa.pub file.

Change the SSH configuration of administrative user admin, [~admin/.ssh/config], as follows to prevent the warning message from appearing when connecting to a VH over SSH.

```
$ cat ~/.ssh/config
Host *
  StrictHostKeyChecking no
$ chmod 600 ~/.ssh/config
```

2.3 Installing the template package

The template package, TSUBASA-sysmng-soft-X.Y-Z.noarch.rpm, provides sample files and tools described in this document. Download the latest TSUBASA-sysmng-soft-X.Y-Z.noarch.rpm and save it in any directory you wish on the management server.

File path:

```
https://sxauroratsubasa.sakura.ne.jp/repos/additional/management_tools/management_too
ls_elX/TSUBASA-sysmng-soft-X.Y-Z.noarch.rpm
```

For install:

```
# yum install TSUBASA-sysmng-soft-X.Y-Z.noarch.rpm
```

If you can access to the open repository, install as follows:

For install:

```
# yum install
https://sxauroratsubasa.sakura.ne.jp/repos/additional/management_tools/management_too
ls_elX/TSUBASA-sysmng-soft-X.Y-Z.noarch.rpm
```

This template package will install the property under /opt/nec/sysmng-soft/ directory.

2.4 Installing software programs

Install the following software programs used for setting up the VH environment.

2.4.1 Installing Ansible

Install Ansible on the management server. For information about verified versions, see " 1.3. Operating Environment". Please refer to the official website of Ansible for the installation sequence.

2.4.2 Installing Apache HTTP Server

You use the HTTP server to access the web interface of the management server. Install the Apache HTTP Server on the management server and start the HTTP server.

```
# yum -y install httpd
# systemctl start httpd.service
```

2.5 Setting for using Ansible

Set the management server to operate the VH by using Ansible.

2.5.1 Register VH information

Create an Inventory file for use to build the VH machine environment. The file name is /opt/nec/sysmng-soft/etc/ansible/vh-hosts.
If you have installed the SX-Aurora TSUBASA software in VH and have already updated the vh-hosts file in accordance with “SX-Aurora TSUBASA Installation Guide (with OSS)”, this process is not required. If you had installed it in a different way, please update the vh-hosts file.

Please describe the host name under groups on the vh-hosts file according to the following usage use of VH (devel, runtime, frontend).

VE1/VE2 model: [devel] [runtime] [frontend]
VE3 model: [ve3_devel] [ve3_runtime] [ve3_frontend]

(1) The environment to compile and execute programs (devel, ve3_devel)
A Linux (x86) server to which VEs are attached, and compiles programs.
(2) The environment only to execute programs (runtime, ve3_runtime)
A Linux (x86) server to which VEs are attached, and does not compile programs.

(3) The environment only to compile programs (frontend, ve3_frontend)

A Linux (x86) server to which VEs are not attached, and compiles programs.

```
$ cd /opt/nec/sysmng-soft/etc/ansible/
$ vi vh-hosts
############################
## For Aurora VE1/VE2 machine
############################
[ve1:children]
devel
runtime
frontend

[devel]
vh-devel00

[runtime]
vh-runtime00

[frontend]
vh-frontend00

############################
## For Aurora VE3 machine
############################
[ve3:children]
ve3_devel
ve3_runtime
ve3_frontend

[ve3_devel]
vh3-devel00

[ve3_runtime]
vh3-runtime00

[ve3_frontend]
Vh3-frontend00
```

In this document, all hosts registered in the vh-hosts file are eligible for the installation of Zabbix or Nagios+Ganglia agent.

2.5.2 Setting an administrative user (admin) on VH

If you have installed the SX-Aurora TSUBASA software in VH and have already updated the vh-hosts file in accordance with “SX-Aurora TSUBASA Installation Guide (with OSS)”, this process is not required. If you had installed it in a different way, you will need to set an administrative user to each VH machines.

Register the SSH public key of the root user on the management server with VHs in order to

access VHs via SSH as follows:

(1) Creation of the SSH Public and Private Key Pair of the Root user on the Management Server.

```
$ su
# ssh-keygen -t rsa
```

The public key is created in the file [~root/.ssh/id_rsa.pub].

(2) Registration of the Public Key with VHs

Please run the following command to every VH.

```
# ssh-copy-id -i ~/.ssh/id_rsa.pub vh-name01
root@vh-name01's password: (Enter root password)
```

(3) Modification of the SSH Configuration of the Root user

Modify the file [~root/.ssh/config] as follows so that warning messages are not displayed at the access to VHs via SSH.

```
# cat ~/.ssh/config
Host *
  StrictHostKeyChecking no
# chmod 600 ~/.ssh/config
```

(4) Execution of a Playbook to Configure the Management User

Please run ssh-agent command and register the private key of the root user using ssh-add command. Then, perform vh-add-admin.yml with ansible-playbook command. At the execution of vh-add-admin.yml, enter the password of the management user admin.

```
# ssh-agent bash
# ssh-add ~/.ssh/id_rsa
Enter passphrase for /root/.ssh/id_rsa: (Enter the private key
passphrase)
Identity added: /root/.ssh/id_rsa (/root/.ssh/id_rsa)
# cd /opt/nec/sysmng-soft/etc/ansible
# ansible-playbook -i vh-hosts vh-add-admin.yml
Enter the password of new user admin: (Enter a password of the
management user, admin)
confirm Enter the password of new user admin: (Enter the
password again)
# exit
# exit
$
```

At this point, the management user admin is created on VHs.

2.5.3 Checking VH connectivity

Ansible used for setting the VH environment first logs in VHs over SSH for further operations.

Start the ssh-agent and run the ssh-add command to register a SSH private key before running the Ansible command. Private key registration enables remote login without entering a passphrase. The private key to be used is created in "2.2. Setting administrative user's SSH public and private keys".

```
$ ssh-agent bash
$ ssh-add ~/.ssh/id_rsa
Enter passphrase for /home/admin/.ssh/id_rsa: (Input passphrase)
Identity added: /home/admin/.ssh/id_rsa (/home/admin/.ssh/id_rsa)
```

Run the following ansible command with the --become option to ensure that the result is “uid=0(root)”.

```
$ ansible -i vh-hosts all -m shell --become -a "id"
host001 | CHANGED | rc=0 >>
uid=0(root) …
```

Chapter3　Monitoring by using Zabbix

The configuration of Zabbix in the SX-Aurora TSUBASA system is shown in the following figure.

Zabbix server runs on the management server, and Zabbix agent on each VH. When there are 1000 or more VHs, please make a layered structure by using Zabbix-proxy. To monitor the management server, please configure Zabbix agent on the management server, too.

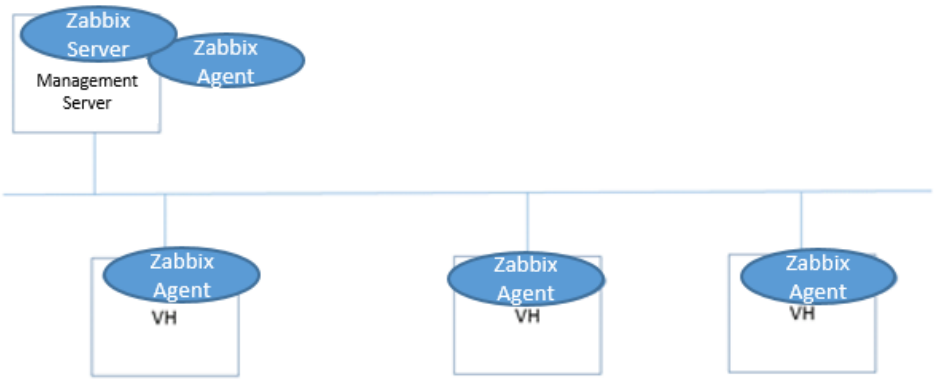

Figure 2　The Configuration of Zabbix

An example of a web interface screen shot (Dashboard) to set up Zabbix. This screen image is displayed for a user with administrative privileges. Displayed information and menus depend on user privileges. Please add users with appropriate privileges as needed. The work flow to enable the operational status monitoring of the SX-Aurora TSUBASA system using Zabbix is as follows:

1. Obtaining the packages for monitoring by Zabbix.
2. Initial Setup of Zabbix Server

   Set up Zabbix server on the management server.
3. Initial Setup of Zabbix Agent

   Set up Zabbix agent on VHs.
4. Setting of monitored VHs

   Specify monitored VHs via a Zabbix web interface.
5. Setup of monitoring items

   Set up monitoring items via a Zabbix web interface.

3.1 Obtaining the packages for monitoring by Zabbix

3.1.1 Zabbix repository configuration package

Download the Zabbix repository configuration package (zabbix-release-X.X-X.elX.noarch.rpm) from official web site, and put on /opt/nec/sysmng-soft/rpms/ of the management server.

OS	Zabbix Version	File Path
RHEL/Rocky Linux 8.x	4.0.x	https://repo.zabbix.com/zabbix/4.0/rhel/8/x86_64/zabbix-release-4.0-2.el8.noarch.rpm
	5.0.x	https://repo.zabbix.com/zabbix/5.0/rhel/8/x86_64/zabbix-release-5.0-1.el8.noarch.rpm
	6.0.x	https://repo.zabbix.com/zabbix/6.0/rhel/8/x86_64/zabbix-release-6.0-1.el8.noarch.rpm

3.1.2 Zabbix plugin package

Download the Zabbix plugin package, and put on /opt/nec/sysmng-soft/rpms/ of the management server.

File Path:

https://sxauroratsubasa.sakura.ne.jp/repos/additional/management_tools/management_tools_elX/TSUBASA-monitoring-Zabbix-X.Y-Z.x86_64.rpm

The contents of the rpm package is as follows: Samples of loadable modules, configuration files, templates, value mapping files, and source files for each validated version of Zabbix are placed under the directory /opt/nec/sysmng-soft/monitoring-sample/zabbix/ .

[VE 1 /VE 2 model] /opt/nec/sysmng-soft/monitoring-sample/zabbix/zabbix-X.X
[VE3 model] /opt/nec/sysmng-soft/monitoring-sample/zabbix/zabbix_ve3-X.X

Table 1 List of sample files Installation Path

Installation Path		Description
etc/zabbix/zabbix_agentd.d	userparameter_veos.conf	A configuration file used on VHs for monitoring of services. Please refer to "3.4.2. Configuration of Monitoring Items".
selinux	Makefile	A makefile to create an SELinux policy module.
	zabbix-agent-TSUBASA.te	A type enforcement file in which a sample policy for execution of loadable modules is described.
	zabbix-agent-TSUBASA.pp	An SELinux policy module for the sample policy described in the above cell.
usr/lib64/zabbix/mapping/	zbx_export_valuemaps.xml	A value mapping file, which is used on the management server. Please refer to "3.4.2. Configuration of Monitoring Items".
[VE1/VE2 model] usr/lib64/zabbix/modules/		The directory in which loadable modules are placed. Loadable modules are used on VHs. Please refer to "3.4.2. Configuration of Monitoring Items".
	ve_hw_item.so	A loadable module to measure the values of HW monitoring items.

	ve_os_item.so	A loadable module to measure the values of VEOS monitoring items.
[VE1/VE2 model] usr/lib64/zabbix/template/		The directory in which templates are placed. The templates are used on the management server. Please refer to "3.4.2. Configuration of Monitoring Items".
	template_ve0.xml	Templates to monitor VEOS and HW.
	…	
	template_ve7.xml	
	template_veos_service.xml	A template to monitor VEOS services
[VE1/VE2 model] usr/src/zabbix/modules/ve/		The directory in which sample sources are placed. You can create customized loadable modules from the sources to add arbitrary monitoring items. Please refer to "3.6. Creation of Loadable Modules from Source Files " for the usage.
	ve_hw_item.c	A source file of functions to measure the values of HW monitoring items
	ve_os_item.c	A source file of functions to measure the values of VEOS monitoring items
	ve_common.c	A source file of commonly used functions
	ve_item.h	A header file

	Makefile	A makefile
[VE3 model] usr/lib64/zabbix/modules/		The directory in which loadable modules are placed. Loadable modules are used on VHs. Please refer to "3.4.2. Configuration of Monitoring Items".
	ve3_hw_item.so	A loadable module to measure the values of HW monitoring items.
	ve3_os_item.so	A loadable module to measure the values of VEOS monitoring items.
[VE3 model] usr/lib64/zabbix/template/		The directory in which templates are placed. The templates are used on the management server. Please refer to "3.4.2. Configuration of Monitoring Items".
	template_ve0_aurora3.xml	Templates to monitor VEOS and HW.
	…	
	template_ve7_aurora3.xml	
	template_veos_service.xml	A template to monitor VEOS services
[VE3 model] usr/src/zabbix/modules/ve/		The directory in which sample sources are placed. You can create customized loadable modules from the sources to add arbitrary monitoring items. Please refer to "3.6. Creation of Loadable

		Modules from Source Files " for the usage.
	ve3_hw_item.c	A source file of functions to measure the values of HW monitoring items
	ve3_os_item.c	A source file of functions to measure the values of VEOS monitoring items
	ve3_common.c	A source file of commonly used functions
	ve_item.h	A header file
	Makefile	A makefile

3.2 Initial Setup of Zabbix Server

This clause explains how to install and configure Zabbix server (Ver 6.0) on the management server (RHEL 8.x).

3.2.1 Configuration of various software

Before the installation of Zabbix server, please set up the following packages.

(1) Setting of firewall

If firewall is running, only ssh is allowed in the public zone by default. Please add HTTP (80/tcp) and zabbix-trapper (10051/tcp). In the case of installing Zabbix agent on the management server, add Zabbix-agent (10050/tcp), too.

```
# firewall-cmd --zone=public --add-port=80/tcp --permanent
success
# firewall-cmd --zone=public --add-port=10051/tcp --permanent
success
# firewall-cmd --zone=public --add-port=10050/tcp--permanent
success
# firewall-cmd --reload
success
```

If firewall is not needed, please stop it.

(2) Configuration of Time Synchronization

Please configure time synchronization using ntp or chrony, since Zabbix server obtains

and stores information based on the OS time.

(3) Setup of Email

Please set up an email server on the management server so as to receive email notifications from Zabbix server.

(4) Setup of Apache HTTP Server

Zabbix server needs HTTP server for Zabbix Web Interface. Please install the Apache HTTP server package and start httpd. The following is an example of the installation using yum:

```
# yum -y install httpd
# systemctl start httpd.service
```

(5) Setup of Database

Zabbix server stores information about the configuration and data gathered from monitored VHs in a database.

a) Installation of Maria DB

Please install the following packages.

```
# yum -y install mariadb-server mariadb mariadb-devel
```

b) Performance Tuning

It is recommended that MariaDB be configured so as to reduce I/O load, because a lot of update queries occur in Zabbix.

Add the following lines in [mysqld] section in the file [/etc/my.conf.d/mariadb-server.cnf]. Note that if MariaDB is already put to other uses, the configuration for Zabbix can conflict with that for the others. Please adjust the settings according to the environment.

The first two lines are strongly recommended for Zabbix server.

```
[mysqld]
innodb_file_per_table
character-set-server=utf8

innodb_log_buffer_size=16M
innodb_buffer_pool_size=1024M
innodb_log_file_size=256M
innodb_log_files_in_group=2
skip-character-set-client-handshake

innodb_strict_mode=0
```

c) Update MariaDB to 10.5

Update MariaDB 10.5 as follows:

```
# yum -y distro-sync
# yum -y module reset mariadb
# yum -y module enable mariadb:10.5
# yum -y distro-sync
```

d) Start of MariaDB Service

Start the MariaDB service as follows:

```
# systemctl enable mariadb.service
# systemctl start mariadb.service
```

e) Autostart of the MariaDB Service

Enable autostart of the MariaDB service on the boot of the management server as follows:

```
# systemctl enable mariadb.service
```

f) Setting of the Root Password

Set the root password with the security improvement tool mysql_secure_installation at the initial installation of MariaDB.

```
# mysql_secure_installation
```

(6) PHP

Set up PHP so as to enable Zabbix web interfaces as follows:

a) Installation

Install the following packages

```
# yum -y install php php-devel php-pdo php-mysqlnd php-mbstring
php-gd php-pear zlib-devel
```

b) Configuration

Specify the following values, which are recommended for Zabbix, in the file [/etc/php.ini], and then restart httpd. Please specify your time zone for the timezone.

```
date.timezone = Asia/Tokyo
post_max_size = 16M
max_execution_time = 300
max_input_time = 300
```

3.2.2 Installation of Zabbix Server

The following are how to install Zabbix server using Zabbix repository.

(1) Installation of the Zabbix Repository Configuration Package

Please install the repository configuration package (zabbix-release-X.X-X.elX.noarch.rpm), which is get in "3.1.1 Zabbix repository configuration package".

Please confirm the file name at "3.1.1 Zabbix repository configuration package".

Case of RHEL 8.x + Zabbix 6.0.x

```
# cd /opt/nec/sysmng-soft/rpms
# yum -y install zabbix-release-6.0-1.el8.noarch.rpm
```

(2) Installation of Zabbix Server

Install the following packages. Please note that the installation of packages provided by Red Hat Network (RHN) can be required to eliminate dependency among packages. In this case, install Zabbix server after the installation of the required packages. The following case is using Zabbix 6.0.12 version.

```
# yum -y install zabbix-sql-scripts-6.0.12
  zabbix-selinux-policy-6.0.12 zabbix-web-6.0.12
  zabbix-apache-conf-6.0.12 zabbix-server-mysql-6.0.12
  zabbix-web-deps-6.0.12 zabbix-get-6.0.12
  zabbix-web-mysql-6.0.12
```

If you want to monitor the management server itself, install Zabbix agent as follows. Please refer to "3.2.4. Initial Setup of Zabbix Agent" for the configuration of Zabbix agent.

```
# yum -y install zabbix-agent-6.0.12
```

(3) Creation of a Database for Zabbix Server

Access MariaDB as the root user, and create a user zabbix and a database for Zabbix server. The password for the user zabbix also needs to be set appropriately. The password zabbix-pass is set in the following example.

```
# mysql -u root -p
Enter password : Enter the root password
mysql> create database zabbix character set utf8mb4 collate
utf8mb4_bin;
mysql> grant all privileges on zabbix.* to zabbix@localhost
identified by 'zabbix-pass';
mysql> quit;
```

(4) Import of the Initial Data for Zabbix Server

Import the initial data for the database for Zabbix server as follows, specifying the

username zabbix and the password zabbix-pass.

```
# cd /usr/share/zabbix-sql-scripts/mysql
# gzip -d server.sql.gz
# mysql -u zabbix -p zabbix < server.sql
Enter password: Input zabbix-pass
```

(5) Setting of a Password for the Database

Specify a password to access the database in the file [/etc/zabbix/zabbix_server.conf].

The password zabbix-pass is specified in the following example.

```
DBPassword=zabbix-pass
```

(6) Setting of the Timezone

Specify your time zone in the file[/etc/httpd/conf.d/php.conf].

```
php_value date.timezone Asia/Tokyo
```

3.2.3 Start of Zabbix Server

(1) Start of Zabbix Server

Start Zabbix server as follows. Restart httpd as the files related to PHP are updated at the installation of Zabbix server.

```
# systemctl start zabbix-server
# systemctl restart httpd
```

(2) Autostart of Zabbix Server

Enable autostart of Zabbix server on the boot of the management server as follows:

```
# systemctl enable zabbix-server
```

(3) Restart of Zabbix Server

After update of the configuration file of Zabbix server, please restart Zabbix server as follows:

```
# systemctl restart zabbix-server
```

3.2.4 Initial Setup of Zabbix Server

(1) Confirmation of Connection to Zabbix Server

Please confirm that the following URL is accessible using a browser.

```
http://<the IP address or hostname of Zabbix server>/zabbix/
```

(2) Configuration of Zabbix Server

The above URL displays the configuration screen of Zabbix server. Please configure Zabbix server while referring to the Zabbix official document.

(3) Configuration of Users

The account Admin, which has administrative privileges, is initially registered with Zabbix server.

The initial password is zabbix. Please change the password appropriately and add users with appropriate privileges to access and change the configuration of monitored VHs while referring to the Zabbix official document.

3.3 Initial Setup of Zabbix Agent

This clause explains how to install and configure Zabbix agent.
It can be done on each VH manually or on all VHs at once from the management server using Ansible.

3.3.1 Manual Setup

Zabbix Agent can be manually configured on each VH as follows:

(1) Installation

1. Setting of firewall

   If firewall is running, only ssh is allowed in the public zone by default. Please add zabbix-agent (10050/tcp).

```
# firewall-cmd --zone=public --add-port=10050/tcp --permanent
success
# firewall-cmd --reload
success
```

   If firewall is not needed, please stop it.

2. Installation of the Zabbix Repository Configuration Package

   Please obtain the repository configuration package (zabbix-release-X.X-X.elX.noarch.rpm) from Zabbix official website, and install the package by rpm command. Please confirm the file name at "3.1.1 Zabbix repository configuration

package".

Case of RHEL 8.x + Zabbix 6.0

```
# yum –y install zabbix-release-6.0-1.el8.noarch.rpm
```

3. Installation of Zabbix Agent

   Please install the following package. The following case is using Zabbix 6.0.12 version.

```
# yum -y install zabbix-agent-6.0.12
```

4. Installation of libyaml

   Please install the following package.

```
# yum -y install libyaml
```

5. Installation of the Zabbix Plugin Package

   Please install the rpm package [TSUBASA-monitoring-Zabbix-X.Y-Z.x86_64.rpm], which is obtain in " 3.1 Obtaining the packages for monitoring by Zabbix".

```
# yum –y install TSUBASA-monitoring-Zabbix-X.Y-Z.x86_64.rpm
```

6. Configuration of a SELinux Policy

   If SELinux is configured to be Enforcing, configure an SELinux policy using the Zabbix plugin so that Zabbix agent can access VE information. If SELinux is configured to be Permissive or Disabled, this step can be skipped.

   The plugin includes the following three sample files for the SELinux policy:

   - 「zabbix-agent-TSUBASA.te」 (A policy definition file)
   - 「Makefile」 (A makefile to generate a policy module from the above file)
   - 「zabbix-agent-TSUBASA.pp」(A policy package)

   The samples have the definitions of the policy required for Zabbix agent to have access to VE information.

   If a site specific policy for Zabbix agent is not needed, execute the following command to apply the sample policy:

```
# semodule -i /opt/nec/sysmng-soft/monitoring-sample/zabbix/
zabbix-6.0/selinux/zabbix-agent-TSUBASA.pp
```

   If a site specific policy for Zabbix agent is needed, please create a policy package for the SELinux policy as follows:

i. Modification of the Policy Definition File

Copy the sample policy definition file and makefile into a working directory, and modify the policy definition.

In the following example, the working directory is [/tmp/selinux].

```
# mkdir /tmp/selinux
# cd /opt/nec/sysmng-soft/monitoring-sample/zabbix/zabbix-6.0/selinux/
# cp zabbix-agent-TSUBASA.te /tmp/selinux
# cp Makefile /tmp/selinux
# cd /tmp/selinux
# vi zabbix-agent-TSUBASA.te
```

ii. Creation of a Policy Package

Execute make command at the working directory to create a policy package whose name is [zabbix-agent-TSUBASA.pp]

```
# cd /tmp/selinux
# make
```

iii. Application of the Policy Package

Execute semodule command to enable the SELinux policy.

```
# semodule -i zabbix-agent-TSUBASA.pp
```

If the OS version of VH is RHEL or Rocky Linux 8.x, execute following command.

```
# setsebool -P domain_can_mmap_files 1
```

(2) Zabbix Agent Configuration File

1. Association of Zabbix Agent with Zabbix Server

Please specify the IP address or hostname of Zabbix server in the file [/etc/zabbix/zabbix_agentd.conf] to allow access from Zabbix server.

```
Server= <the IP address or hostname of Zabbix server>
```

2. Activation of the Active check Function

If you want to make Zabbix agent notify Zabbix server, which is called active check, please add the following lines:

```
Hostname= <the hostname of Zabbix agent>
ServerActive= <the IP address of Zabbix server>
```

The specification of "Hostname" must be the same as the hostname of the VH specified in " 3.4.1. Configuration of Host Information".

(3) Start of Zabbix Agent

1. Start of Zabbix Agent

   Start Zabbix agent as follows:

```
# systemctl start zabbix-agent
```

2. Autostart of Zabbix Agent

   Enable autostart of Zabbix agent on the boot of the VH as follows:

```
# systemctl enable zabbix-agent
```

3. Restart of Zabbix Agent

(1) After update of the configuration file of Zabbix Agent, please restart Zabbix agent as follows:

```
# systemctl restart zabbix-agent
```

3.3.2 Procedure with Ansible

By the following procedure, the settings of Zabbix agent for multiple VHs can be executed from the management server in a lump.

(1) Settings to use Ansible

Execute the settings of “2.5 Setting for using Ansible” to use Ansible.
If you have already done, this procedure is not required.

(2) Locating of TSUBASA-monitoring-Zabbix-X.Y-Z.x86_64.rpm

The zabbix-agent role installs the TSUBASA-monitoring-Zabbix-X.Y-Z.x86_64.rpm on each VH machine. Place the TSUBASA-monitoring-Zabbix-X.Y-Z.x86_64.rpm downloaded in “3.1 Obtaining the packages for monitoring by Zabbix” under /opt/nec/sysmng-soft/rpms/ on the management server.

(3) Create the playbook vh-set.yml

Edit the file “/opt/nec/sysmng-soft/etc/ansible/vh-set.yml” as following. Please be sure to include the “gather_fatcs: true” line.

```
---
- name: Set VH machine
```

```
hosts: all
become: yes
gather_facts: true
roles:
- zabbix-agent
```

(4) Settings of variables for zabbix-agent role

Set the following variables in [roles/zabbix-agent/vars/main.yml]

Variable	Value
monitoring_zabbix_version	Version of TSUBASA-monitoring-Zabbix package Example : 2.0.2-1
zabbix_agent_version	Version of zabbix-agent Example : 6.0.12
zabbix_agent_major	Major version of zabbix-agent Example : 6.0
zabbix_agent_server	The value set for 'Server' variable in the Zabbix configuration file, [/etc/zabbix/zabbix_agentd.conf].

Please enable the following variable if you use the Active Check. For details, please refer to "3.3.1 Manual setup (2) Zabbix Agent Configuration File".

Variable	Value
zabbix_agent_hostname	The value set for the 'Host' variable in Zabbix configuration file, [/etc/zabbix/zabbix_agentd.conf]. The inventory_hostname used in this variable is a built-in variable of Ansible. This is expanded to a hostname of the target VH.
zabbix_agent_serveractive	The value set for the 'ServerActive' variable in Zabbix configuration file, [/etc/zabbix/zabbix_agentd.conf].

Confirm the settings of "3.4.2 Configuration of Monitoring Itmes (3) Information Gathering with Loadable Modules". Check the following variables are set to enable.

Variable	Value
zabbix_agent_loadmodulepath	The value set for the 'LoadModulePath' variable in Zabbix configuration file, [/etc/zabbix/zabbix_agentd.conf]. No need to change.
zabbix_agent_loadmodules	The value set for the 'LoadModule' variable in Zabbix configuration file, [/etc/zabbix/zabbix_agentd.conf]. No need to change.

Set the following variables for the function of "3.4.2 Configuration of Monitoring Items (5) Monitoring of VEOS Services".

Variable	Value
zabbix_agent_mon_veos	*enabled* or *disabled*

(5) Execution of Playbook

Run playbook by administrative user admin, so the settings described in "3.3.1. Manual Setup ", "3.4.2. Configuration of Monitoring Items (3) Information Gathering with Loadable Modules" and "3.4.2. Configuration of Monitoring Items (5) Monitoring of VEOS Services " are performed and Zabbix agent is started on each VHs.

```
$ cd /opt/nec/sysmng-soft/etc/ansible
$ ansible-playbook -i vh-hosts vh-set.yml
```

3.4 Configuration of monitoring information

3.4.1 Configuration of Host Information

Monitored equipment needs to be registered as a host in Zabbix.

There are two methods of monitoring sensor information of VEs. One is to register VEs as hosts in Zabbix, in addition to VHs. The other is to specify sensor information of VEs as

monitoring items of the VH to which the VEs are connected.

In the case of registering VEs as hosts, hosts are configured as shown in orange in the following figure.

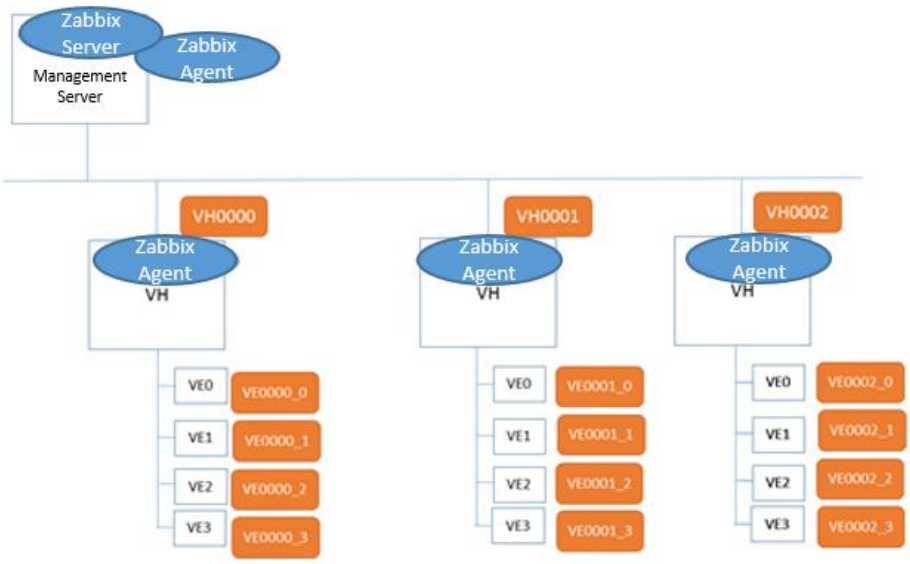

Figure 3　VEs are registered as Hosts

In the case of not registering VEs as hosts, hosts are configured as shown in orange in the following figure.

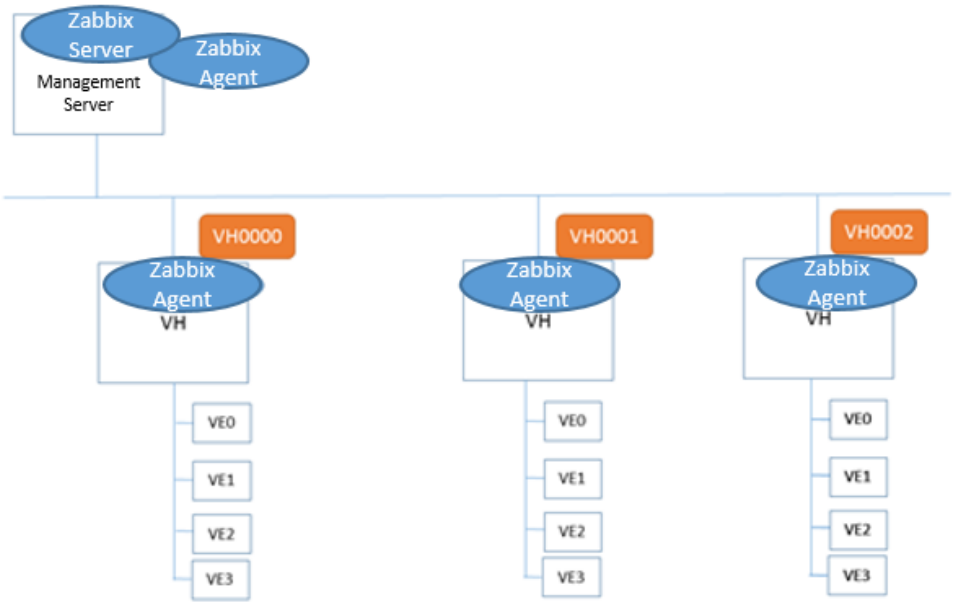

Figure 4　VEs are not Registered as Hosts

Registered hosts can be organized into multiple host groups and need to belong to one or more host groups in Zabbix. Two examples of the configurations of host groups are shown in the red frames in following figures.

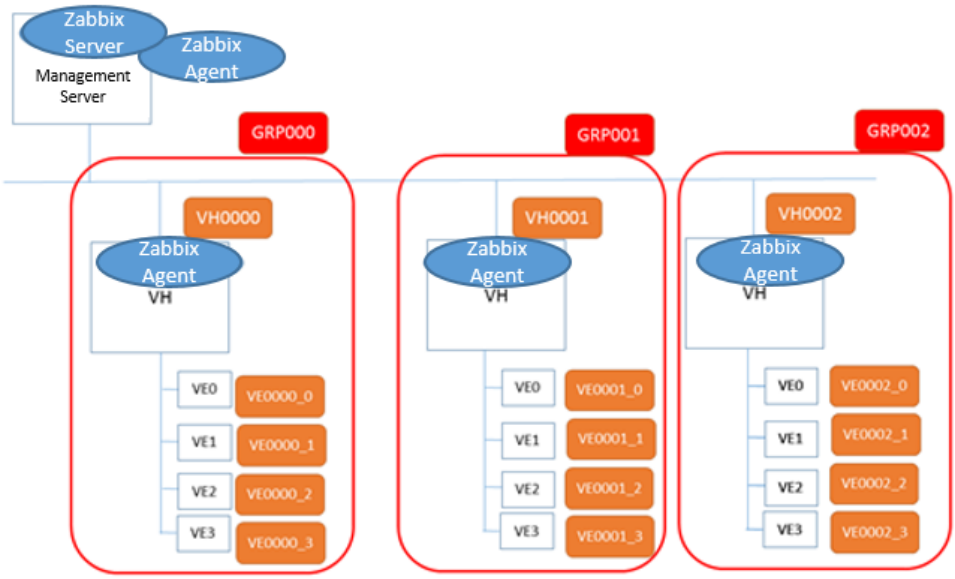

Figure 5 Example 1: Configuration of Host Groups

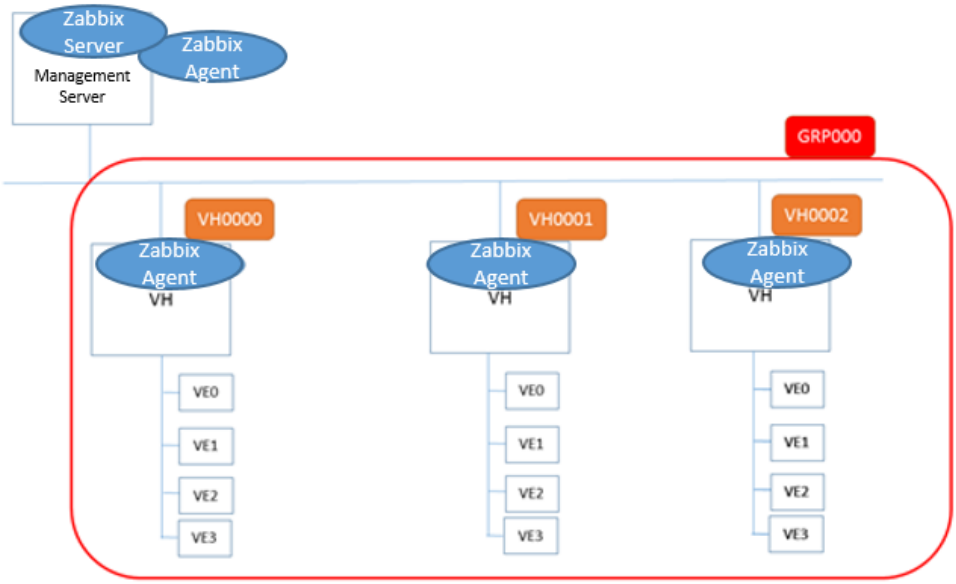

Figure 6 Example 2: Configuration of Host Groups

Various management idea can make by the host information and group information. Please configure to suit your site.

Register VHs as hosts via the Zabbix web interface on the management server. If you want to configure VEs as hosts, register VEs as hosts, too.

(1) Registration of VHs as Hosts

Please register the IP addresses or hostnames of VHs managed by the management server. Each hostname needs to be the same as that specified for Hostname in the file [/etc/zabbix/zabbix_agentd.conf] so that Zabbix server recognizes the correspondence between VHs and Zabbix agents.

Also specify one or more host groups to which each VH belongs. Host groups can be added or changed after the beginning of operation. Please refer to the Zabbix official document.

(2) Registration of VEs as Hosts

In the registration of VEs as hosts, please specify the IP address of the VH to which each VE is connected because Zabbix server obtains information of VEs from the VH. VEs are associated with their host names using monitoring items.

Also, specify one or more host groups to which each VE belongs. Host groups can be added or changed after the beginning of operation. Please refer to the Zabbix official document.

3.4.2 Configuration of Monitoring Items

To configure monitoring items for VHs and VEs, templates of monitoring items need to be linked with monitored devices via the Zabbix server web interface, and the load module needs to be attached to zabbix agent. Please refer to "3.4.2. Configuration of Monitoring Items (1) Configuration of Monitoring Items Using Templates" and "3.4.2. Configuration of Monitoring Items (3) Information Gathering with Loadable Modules" for how to link templates and attach the module.

Please also refer to "3.4.2. Configuration of Monitoring Items (2) Addition of Monitoring Item" for how to add monitoring items that are not included in the templates and "3.4.2. Configuration of Monitoring Items (5) Monitoring of VEOS Services " for the configuration of monitoring items for VEOS services.

(1) Configuration of Monitoring Items Using Templates

Link the Template for Linux OS with Host. And, Link the Templates for VEs which are included in the Zabbix plugin package file.

1. Linking of the Template for Linux OS with Hosts
   Link the template for Linux OS "Template OS Linux", which is included in the Zabbix standard release, with VH hosts. Please refer to the Zabbix official document.
2. Import of Value Mappings
   The templates for VEs use value mappings, which are the correspondence between monitoring items and displayed strings, specific to VEs. The value mappings are defined in the file "zbx_export_valuemaps.xml" included in the Zabbix plugin package file. Please import the file.
   Please refer to the Zabbix official document.

3. Linking of Templates for VEs
   Link the templates for VEs which are included in the Zabbix plugin package file downloaded in “3.1 Obtaining the packages for monitoring by Zabbix”. The template is provided for each VH number. Import the configured VH templates.
   Please refer to "A.2. The Items and Triggers Provided by the Templates" or the details of monitoring items and triggers defined in the templates. Triggers are the conditions to refresh the current system status.
   Please refer to "3.4.2. Configurataion of Monitoring Items (2) Addition of Monitoring Items" for how to add monitoring items.
   Please refer to "3.4.2 Configuration of Monitoring Items (6) Performance Tuning" for how to delete monitoring items or change monitoring intervals.
   In the case that VEs are registered as hosts as shown in “Figure5 Example 1: Configuration of Host Groups”, please link each template with the VE of the corresponding VE number.
   In the case that monitoring items for VEs are included in those for VHs as shown in “Figure 6 Example 2: Configuration of Host Groups”, please link each template for VEs with the VH to which the corresponding VE is connected.

(2) Addition of Monitoring Items

Please add monitoring items which are not included in the templates while referring to the Zabbix official document. For example, the monitoring items in the templates do not

include monitoring of specific processes or logs.

(3) Information Gathering with Loadable Modules

The Zabbix plugin package file "3.1. Obtaining the packages for monitoring by Zabbix" includes loadable modules (ve_hw_item.so, ve_os_item.so) to gather values of monitoring items specific to the TSUBASA system. The loadable modules include all the monitoring items described in " A.1. The Item Keys Provided by the Loadable Modules".

1. Installation of the Loadable Modules

   Please install the Zabbix plugin package file.

2. Configuration

   Please specify the path to the loadable modules for "LoadModulePath" and the file names of the loadable modules for "LoadModule" in the file [/etc/zabbix/zabbix_agentd.conf] as follows:

```
# LoadModulePath=${libdir}/modules
LoadModulePath=/opt/nec/sysmng-soft/monitoring-sample/zabbix/
zabbix-X.X.X/usr/lib64/zabbix/modules/
# LoadModule=
LoadModule=ve_hw_item.so
LoadModule=ve_os_item.so
```

3. Restart of Zabbix Agent

   Restart Zabbix agent for the configuration to take effect.

```
# systemctl restart zabbix-agent
```

(4) Information Gathering with User Parameters

Monitoring items can also be specified using the command described in Appendix A, instead of using the loadable modules.

It will be useful in the case that the number of monitoring items is small.

To monitor the number of VEs and cores on each VE, for example, please add the following lines in the file [/etc/zabbix/zabbix_agentd.conf]. Please configure the monitoring items using the command according to the user site.

```
# UnsafeUserParameters=0
UserParameter=ve_Attached_num[*],/opt/nec/ve/bin/vecmd info |
 awk /Attached Ves/ ‘ { n=split($$0,a,”: ”); print a[2]; exit }’
UserParameter=ve_cores[*],/opt/nec/ve/bin/vecmd –N $1 info |
 awk / Cores/ ‘ { n=split($$0,a,”: ”); print a[2]; exit }’
```

(5) Monitoring of VEOS Services

To monitor services or logs of VEOS, please configure as follows:

1. Installation of the Zabbix Plugin Package File

   Install the Zabbix plugin package file.

2. Copy of Configuration File

   The configuration file for monitoring of VEOS services is [/opt/nec/sysmng-soft/monitoring-sample/zabbix/zabbix-3.0.11/etc/zabbix/zabbix_agentd.d/userparameter_veos.conf].

   Copy it into the directory [/etc/zabbix/zabbix_agentd.d].

```
# cp /opt/nec/sysmng-soft/monitoring-sample/zabbix/zabbix-X.X.X/
etc/zabbix/zabbix_agentd.d/userparameter_veos.conf /etc/zabbix/
zabbix_agentd.d
```

3. Activation of the Active Check Function of Zabbix Agent

   Please enable the active check function of Zabbix agent while referring to "3.3.1 Manual Setup (2) Zabbix Agent Configuration File"

4. Restart of Zabbix Agent

   Restart Zabbix agent for the configuration to take effect.

```
# systemctl restart zabbix-agent
```

5. Linking of the Templates for Monitoring VEOS Services

   ease link the templates for monitoring VEOS services via the Zabbix server web interface. Please refer to the Zabbix official document how to link templates. The monitoring items defined in the templates are described in "A.2. The Items and Triggers Provided by the Templates".

⚠ Notice
Please give the root privileges or read permission of [/var/log/messages] to Zabbix agent so that it can monitor the logs of MMM.

(6) Performance Tuning

A lot of monitoring items are configured by linking the templates for the SX-Aurora

TSUBASA system. The loadable modules enable all the possible monitoring items. However, monitoring too many items will burden the system. Therefore, please reduce monitoring items or change monitoring intervals while referring to the Zabbix official document.

Zabbix server stores history data, trend data, and event data in MariaDB. The amount of disk space required for the management server can be estimated as follows:

1. History Data

   History data is raw monitoring data gathered by Zabbix. The amount of disk space for history data can be estimated as follows:

```
(The number of monitoring items
  * the amount per monitoring item [Byte])
    / Average monitoring intervals [second]
      * 3600 [second]
      * 24 [hour]
      * the retention period [day]
```

   In addition, the amount for log data is needed to monitor logs or SNMP traps.

2. Trend Data

   Trend data is the statistical data per hour of numerical values in the history data (maximum, minimum, and average), and used for drawing graphs. The amount can be estimated as follows:

```
(The number of monitoring items
  * the amount per trend data [Byte])
  * 24 [hour]
  * the retention period [day]
```

   The amount per trend data depends on the database, but is normally around 128 bytes.

3. Event Data

   The amount of event data can be estimated as follows. As it is difficult to predict the number of failures, the worst case estimation is recommended.

```
The number of failures and recoveries per day
* the amount per event [Bye]
* the retention period [day]
```

   The amount per event depends on the database, but is normally around 130 bytes.

3.4.3 Configuration of Triggers

Triggers are the conditions to refresh the current system status. Please add triggers which are not included in the templates, or modify the thresholds or conditions for the preset

triggers as necessary while referring to the Zabbix official document. Please refer to "A.1. The Item Keys Provided by the Loadable Modules" for the triggers preset in the templates.

3.4.4 Configuration of Actions

Please configure actions, which is the actions of Zabbix to the system administrator on detection of failure. Templates for actions are not included in the Zabbix plugin package. Please configure actions while referring to the Zabbix official document as necessary.

3.5 Customization of the Web Interface

It is possible to customize the web interface so as to display various data such as the network map of a system in Zabbix.
It is also possible to display data in hierarchical representation such as (Cluster map) - (Rack map) - (VH and VE map). Please create interfaces for users with various privileges such as the system administrator, maintenance service staff, and administrators of a small set of VHs so that they can easily monitor the system status.
It is helpful to create a screen in which multiple monitoring items are summarized to check information which dynamically changes and is regularly updated. For example, a screen to see the status of all VEs at a glance can make it unnecessary to find the information among a lot of monitoring data.
It is possible to see created maps and screens easily by placing them on the dashboard. Please refer to the Zabbix official document.

3.6 Creation of Loadable Modules from Source Files

Source files of loadable modules are placed in the directory [/opt/nec/sysmng-soft/monitoring-sample/zabbix/zabbix-3.0.11/usr/src/zabbix/modules/ve] by installing the package file. It is possible to add monitoring items by editing the source files to customize the loadable modules.
Creation of Loadable modules requires the development environment for Zabbix. Please prepare the environment in advance while referring to the Zabbix official document. In the following example, the environment is prepared in the directory [/tmp/zabbix_src]

(1) Installation of libyaml and libyaml-devel

Please install the Zabbix plugin package file.

```
# yum -y install libyaml libyaml-devel
```

(2) Installation of the Zabbix Plugin Package

Please install the Zabbix plugin package file.

(3) Copy of Source Files of Loadable Modules

Copy the source files of loadable modules into the directory src/modules under the Zabbix development environment as follows:

```
$ cp -r /opt/nec/sysmng-soft/monitoring-sample/zabbix/
zabbix-X.X.X/usr/src/zabbix/modules/ve /tmp/zabbix_src/
zabbix-X.X.X/src/modules/
```

(4) Editing of the Source Files

Please edit the source files.

```
$ cd /tmp/zabbix_src/zabbix-X.X.X/src/modules/ve
$ vi ve_hw_item.c
```

(5) Generation of Loadable Modules

Make the loadable modules as follows:

```
$ make
```

(6) Copy of the Loadable Modules

Copy the created loadable modules into VHs.

(7) Registration of the Loadable Modules with Zabbix Agent

Please register the loadable modules with Zabbix agent on VHs. Please refer to "3.4.2 Configuration of Monitoring Items (3) Information Gathering with Loadable Modules" for the registration. Please restart Zabbix agent after the registration.

3.7 Exclusion of monitoring hosts for updating SX-Aurora TSUBASA software

This clause explains how to exclude monitoring hosts when updating SX-Aurora TSUBASA software.

1. Log in to Zabbix via Web interface as administrator.
2. Click on 'Configuration' and 'Maintenance' of upper part. Display a screen of Maintenance Mode.
3. Click on 'Create maintenance period'. Display a screen of creating maintenance period.
4. Input a maintenance information to 'Maintenance' tab. Select 'No data collection' as Maintenance Type.
5. Click on 'Periods' tab and 'New'. Input the maintenance period.
6. Click on 'Add' of 'Maintenance Period' field, create the period.

7. Click on 'Hosts & Groups' tab, select the target hosts and groups. And click on 'add' of the screen lower part, create the maintenance period.

3.8 Inclusion of monitoring hosts updating SX-Aurora TSUBASA software

This clause explains how to include monitoring hosts when updating SX-Aurora TSUBASA software.

1. Log in to Zabbix via Web interface as administrator.
2. Click on 'Configuration' and 'Maintenance' of upper part. Display a screen of Maintenance Mode.
3. Click on the checkbox of maintenance period which was created on "3.7. Exclusion of monitoring hosts for updating SX-Aurora TSUBASA software", and click on 'Delete'.

Appendix A Monitoring Items of Zabbix (for VE1,2)

A.1 The Item Keys Provided by the Loadable Modules

The following tables show the item keys provided by the Zabbix loadable modules. An item key can take parameters which are passed to the loadable modules. The loadable modules obtain information about VEs or cores specified with the parameters.

Table 2 The Item Keys Provided by ve_hw_item.so

Item Key Name				
	Meaning	Attribute	Parameter	Remarks
vehw.attached_ves				
	The number of VEs	Numerical Value (Integer)	None	Return an integer in decimal
vehw.mmm_version				
	Version of MMM	String	None	An example of the return value: 01.000
vehw.ve_state				
	VE Status	String	ve – VE number	The return value is "0","1","2","3", or "4". The meanings of the values are as follows: 0:UNINITIALIZED 1:ONLINE 2:OFFLINE 3:MAINTENANCE 4:UNAVAILABLE
vehw.ve_model[ve]				
	VE model	String	ve – VE number	An example of the return value: A1
vehw.product_type[ve]				
	Product type	String	ve – VE number	An example of the return value: 00
vehw.cores[ve]				
	The number of available cores on a VE	Numerical Value (Integer)	ve – VE number	Return the number of cores in decimal.
vehw.ve_chip_sn[ve]				
	The serial number of a	String	ve – VE number	An example of the return

	VE chip			value : 0x0123456789ABCDEF
vehw.ve_board_sn[ve]				
	The serial number of a VE card	String	ve – VE number	An example of the return value: 0x0123456789ABCDEF
vehw.ve_driver_version[ve]				
	VE driver version	String	ve – VE number	An example of the return value: 01.00
vehw.vmcfw_version[ve]				
	VMCFW version	String	ve – VE number	An example of the return value: 01.00
vehw.core_clock[ve]				
	Core clock frequency	Numerical Value (Integer)	ve – VE number	The unit of the return value is Hz. An example of the return value: 1600000000
vehw.base_clock[ve]				
	Base clock frequency	Numerical Value (Integer)	ve – VE number	The unit of the return value is Hz. An example of the return value: 1000000000
vehw.memory_clock[ve]				
	Memory clock frequency	Numerical Value (Integer)	ve – VE number	The unit of the return value is Hz. An example of The return Value: 1000000000
vehw.memory_size[ve]				
	Total memory size	Numerical Value (Integer)	ve – VE number	The unit of the return value is GByte. An example of the return value: 48
vehw.l1_icache_size[ve]				
	L1 I cache size per core	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/core. An example of the return value: 32000
vehw.l1_dcache_size[ve]				
	L1 D cache size per core	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/core. An example of the return value:

				32000
vehw.l2_cache_size[ve]				
	L2 cache size per core	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/core. An example of the return value: 256000
vehw.l3_cache_size[ve]				
	LLC size of a VE chip	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/VE. An example of the return value: 16000000
vehw.partitioning_mode[ve]				
	Partitioning mode	String	ve – VE number	The return value is "0" or"1". The meanings of The values are as follows: 0: disabled. 1: enabled.
vehw.throttling_level[ve]				
	Throttling level	Numerical Value (Integer)	ve – VE number	An example of the return value: 2
vehw.pci.bus_id[ve]				
	PCI bus ID	String	ve – VE number	An example of the return value: 0000:22:00.0
vehw.pci.vendor_id[ve]				
	PCI vendor ID	String	ve – VE number	An example of the return value: 0x001C
vehw.pci.device_id[ve]				
	PCI device ID	String	ve – VE number	An example of the return value: 0x1BCF
vehw.pci.class_code[ve]				
	PCI class code	String	ve – VE number	An example of the return value: 0x0B4000
vehw.pci.current_link_speed[ve]				
	The current link speed	Numerical value (floating point number)	ve – VE number	The unit of the return value is GT/s. An example of the return vaule: 8.0
vehw.pci.max_link_speed[ve]				
	The maximum link speed	Numerical value (floating point number)	ve – VE number	The unit of the return value is GT/s. An example of the return vaule:

				8.0
vehw.pci.negotiated_link_width[ve]				
	The current link width	String	ve – VE number	An example of the return value: x16
vehw.pci.maximum_link_width[ve]				
	The maximum link width	String	ve – VE number	An example of the return value: x16
vehw.temperature.chip_core[ve,core]				
	VE core temperature	Numerical value (floating point number)	ve – VE number core – core number	The unit of the return value is degrees Celsius. An example of the return value: 30.125
vehw.temperature.diode0[ve]				
	VE CPU Temperature (core 8,9 side)	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 33.1
vehw.temperature.diode1[ve]				
	VE CPU temperature (core 0,1 side)	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 34.25
vehw.temperature.aux_power_side[ve]				
	Power connector side temperature (intake)	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 30.25
vehw.temperature.bracket_side[ve]				
	LED bracket side temperature (exhaust)	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 31.5
vehw.temperature.adt7462[ve]				
	Board temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 32.75
vehw.fan_speed[ve]				
	Fan rotation number	Numerical value (floating point number)	ve – VE number	The unit of the return value is rpm. An example of The return value:

				7700
vehw.voltage.core_vdd_0[ve]				
	VE internal voltage 0	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 0.903
vehw.voltage.core_vdd_1[ve]				
	VE internal voltage 1	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 0.904
vehw.voltage.ve_vdd[ve]				
	0.89V_VDD voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 0.891
vehw.voltage.ve_avdd[ve]				
	0.90V_AVDD voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 0.900
vehw.voltage.hbm_e_vddc_1_2v[ve]				
	1.2V_HBM_ E_VDDC voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.199
vehw.voltage.hbm_e_vddq_1_2v[ve]				
	1.2V_HBM_ E_VDDQ voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.201
vehw.voltage.hbm_w_vddc_1_2v[ve]				
	1.2V_HBM_ W_VDDC voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.2
vehw.voltage.hbm_w_vddq_1_2v[ve]				
	1.2V_HBM_ W_VDDQ voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.206
vehw.voltage.aux_12v[ve]				

	The auxiliary power unit 12V voltage0	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 11.9375
vehw.voltage.edge_12v[ve]				
	Edge 12V voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 12.0625
vehw.voltage.edge_3_3v[ve]				
	Edge 3.3V voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 3.3024
vehw.voltage.vpp_2_5v[ve]				
	2.5V_VPP voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 2.509
vehw.current.aux_12v[ve]				
	The auxiliary power unit 12V current 0	Numerical value (floating point number)	ve – VE number	The unit of the return value is A. An example of The return value: 1.211
vehw.current.edge_12v[ve]				
	Edge 12V current	Numerical value (floating point number)	ve – VE number	The unit of the return value is A. An example of The return value: 1.213
vehw.voltage.pll_0_89v[ve]				
	0.89V_PLL voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 0.891
vehw.voltage.vddh_1_8v[ve]				
	1.8V_VDDH	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.8
vehw.eccs.mcu_correctable_error[ve]				
	ECC information	String	ve – VE number	An example of the return

	MCU 1Bit error			value: 2017/05/30 18:04:30
vehw.eccs.llc_correctable_error[ve]				
	ECC information LLC 1Bit error	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.core_dp_correctable_error[ve]				
	ECC information COREDP 1Bit error	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.comn_dp_correctable_error[ve]				
	ECC information COMN DP 1Bit error	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.vr_correctable_error[ve]				
	ECC information VR 1Bit error	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.errs.fault_occur_time[ve]				
	ERR information The occurrence time of a severe failure	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.errs.fault_errors[ve]				
	ERR Information The kind of a severe failure	String	ve – VE number	An example of the return value: Linkdown Error
vehw.errs.non_fault_occur_time[ve]				
	ERR Information The occurrence time of a slight failure	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.errs.non_fault_errors[ve]				
	ERR Information The kind of a slight failure	String	ve – VE number	An example of the return value: NONE

Table 3 The List of Keys Provided by ve_os_item.so

Item Key				
	Meaning	Attribute	Parameter	Remarks
ve_os.state[ve]				
	The status of OS	String	ve – VE number	The return value is "0","1","2", or "3". The meanings of the values are as follows:

				0:ONLINE 1:OFFLINE 2:INITIALIZING 3:TERMINATING
ve_vm.memory.size[ve,mode]				
	Memory usage	Numerical Value (Integer)	ve – VE number mode - total, free, buffers, cached, available, pavailable	The unit of the return value is Byte
ve_system.ve.load[ve,cpu,mode]				
	VE load	Numerical value (floating point number)	ve – VE number cpu - all, percore mode - avg1,avg5, avg15	The return value is the number of processes.
ve_system.ve.util[ve,core,type]				
	VE usage	Numerical value (floating point number)	ve – VE number core - corenumber type - idle,nice, user,system, interrupt, softirq	An example of the return value: 2017/05/30 18:04:30

A.2 The Items and Triggers Provided by the Templates

The Zabbix plugin package file includes the templates which use item keys provided by the Zabbix loadable modules. The format of an item name is an item key name followed by a VE number in square brackets as follows. Please refer to "A.1. The Item Keys Provided by the Loadable Modules" for the item names.

VE Number	Item Key Name	Item Name
0	vehw.attached_ves	vehw.attached_ves[0]
1	vehw.attached_ves	vehw.attached_ves[1]

The following Tables show the item names of VE number 0 defined in template_ve0.xml. Some items include VEOS or VEHW defined as Application. The other template of VE is different in the VE number of the item name. Some items of VEHW have triggers.

Table 4 The List of the Items of the Application Name(VEHW)

Item Name		Meaning	
	Trigger Name	Level	Trigger Condition
vehw.attached_ves		The number of VEs	
vehw.base_clock[0]		Base clock frequency	
vehw.cores[0]		The number of available cores on a VE LSI	
vehw.core_clock[0]		Core clock frequency	
vehw.current.aux_12v[0]		Auxiliary power unit 12V current	
	ve0_current.aux_12v_warn	Warning	20A or over
	ve0_current.aux_12v_error	Severe Failure	25A or over
vehw.current.edge_12v[0]		Edge 12V current	
	ve0_current.edge_12v_warn	Warning	5A or over
	ve0_current.edge_12v_error	Severe Failure	5.5A or over
vehw.fan_speed[0]		Fan rotation number	
vehw.l1_dcache_size[0]		L1 D cache size per core	
vehw.l1_icache_size[0]		L1 I cache size per core	
vehw.l2_cache_size[0]		L2 cache size per core	
vehw.l3_cache_size[0]		LLC cache size per core	
vehw.memory_clock[0]		Memory clock frequency	
vehw.memory_size[0]		Total memory size	
vehw.mmm_version		MMM version	
vehw.partitioning_mode[0]		Partitioning mode	
vehw.pci.bus_id[0]		PCI bus ID	
vehw.pci.class_code[0]		PCI class code	
vehw.pci.current_link_speed[0]		The current link speed	
vehw.pci.device_id[0]		PCI device ID	
vehw.pci.maximum_link_width[0]		The maximum link width	
vehw.pci.max_link_speed[0]		The maximum link speed	
vehw.pci.negotiated_link_width[0]		The current link width	
vehw.pci.vendor_id[0]		PCI vendor ID	
vehw.product_type[0]		Product type	
vehw.temperature.adt7462[0]		Board temperature	
	ve0_adt7462_warn	Warning	85 degree or over
	ve0_adt7462_error	Severe Failure	93 degree or over
vehw.temperature.aux_power_side[0]		Power connector side temperature (intake)	
	ve0_aux_power_side_warn	Warning	70 degree or over
	ve0_aux_power_side_error	Severe Failure	77 degree or over
vehw.temperature.bracket_side[0]		LED bracket side temperature (exhaust)	
	ve0_bracket_side_warn	Warning	70 degree or over
	ve0_bracket_side_error	Severe Failure	77 degree or over
vehw.temperature.chip_core0[0]		VE Core0 temperature	
	ve0_chip_core0_temp_warn	Warning	85 degree or over
	ve0_chip_core0_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core1[0]		VE Core1 temperature	
	ve0_chip_core1_temp_warn	Warning	85 degree or over
	ve0_chip_core1_temp_error	Severe Failure	93 degree or over

vehw.temperature.chip_core2[0]			VE Core2 temperature
	ve0_chip_core2_temp_warn	Warning	85 degree or over
	ve0_chip_core2_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core3[0]			VE Core3 temperature
	ve0_chip_core3_temp_warn	Warning	85 degree or over
	ve0_chip_core3_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core4[0]			VE Core4 temperature
	ve0_chip_core4_temp_warn	Warning	85 degree or over
	ve0_chip_core4_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core5[0]			VE Core5 temperature
	ve0_chip_core5_temp_warn	Warning	85 degree or over
	ve0_chip_core5_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core6[0]			VE Core6 temperature
	ve0_chip_core6_temp_warn	Warning	85 degree or over
	ve0_chip_core6_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core7[0]			VE Core7 temperature
	ve0_chip_core7_temp_warn	Warning	85 degree or over
	ve0_chip_core7_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core8[0]			VE Core8 temperature
	ve0_chip_core8_temp_warn	Warning	85 degree or over
	ve0_chip_core8_temp_error	Severe Failure	93 degree or over
vehw.temperature.chip_core9[0]			VE Core9 temperature
	ve0_chip_core9_temp_warn	Warning	85 degree or over
	ve0_chip_core9_temp_error	Severe Failure	93 degree or over
vehw.temperature.diode0[0]			VE CPU temperature Core8,9 side
	ve0_chip_diode0_warn	Warning	85 degree or over
	ve0_chip_diode0_error	Severe Failure	93 degree or over
vehw.temperature.diode1[0]			
	ve0_chip_diode1_warn	Warning	85 degree or over
	ve0_chip_diode1_error	Severe Failure	93 degree or over
vehw.throttling_level[0]			Throttling level
vehw.ve_board_sn[0]			The serial number of a VE card
vehw.ve_chip_sn[0]			The serial number of a VE chip
vehw.ve_model[0]			VE model
vehw.ve_state[0]			VE status
vehw.vmcfw_version[0]			VMCFW version
vehw.voltage.aux_12v[0]			Auxiliary power unit 12V voltage
	ve0_aux_12v_error	Severe Failure	Below 10.8V or above 13.2V
vehw.voltage.core_vdd_0[0]			VE internal voltage 0
	ve0_core_vdd_0_error	Severe Failure	Below 0.88V or above 1.03V
vehw.voltage.core_vdd_1[0]			VE internal voltage 1
	ve0_core_vdd_1_error	Severe Failure	Below 0.88V or above 1.03V

vehw.voltage.edge_3_3v[0]		Edge 3.3V voltage
ve0_edge_3_3v_error	Severe Failure	Below 2.97V or above 3.63V
vehw.voltage.edge_12v[0]		Edge 12V voltage
ve0_edge_12v_error	Severe Failure	Below 10.8V or above 13.2V
vehw.voltage.hbm_e_vddc_1_2v[0]		1.2V_HBM_E_VDDCvoltage
ve0_hbm_e_vddc_1_2v_error	Severe Failure	Below 1.08V or above 1.32V
vehw.voltage.hbm_e_vddq_1_2v[0]		1.2V_HBM_E_VDDQvoltage
ve0_hbm_e_vddq_1_2v_error	Severe Failure	Below 1.08V or above 1.32V
vehw.voltage.hbm_w_vddc_1_2v[0]		1.2V_HBM_W_VDDCvoltage
ve0_hbm_w_vddc_1_2v_error	Severe Failure	Below 1.08V or above 1.32V
vehw.voltage.hbm_w_vddq_1_2v[0]		1.2V_HBM_W_VDDQvoltage
ve0_hbm_w_vddq_1_2v_error	Severe Failure	Below 1.08V or above 1.32V
vehw.voltage.pll_0_89v[0]		0.89V PLL voltage
ve0_pll_0_89v_error	Severe Failure	Below 0.801V or above 0.979V
vehw.voltage.vddh_1_8v[0]		1.8V_VDDH
ve0_vddh_1_8v_error	Severe Failure	Below 1.62V or above 1.98V
vehw.voltage.ve_avdd[0]		0.90V_AVDD voltage
ve0_ve_avdd_error	Severe Failure	Below 1.08V or above 1.32V
vehw.voltage.vpp_2_5v[0]		2.5V_VPP voltage
ve0_vpp_2_5v_error	Severe Failure	Below 2.25V or above 2.75V
vehw.eccs.mcu_correctable_error[0]		ECC information: MCU 1Bit error
vehw.eccs.llc_correctable_error[0]		ECC information: LLC 1Bit error
vehw.eccs.core_dp_correctable_error[0]		ECC information: CORE DP 1Bit error
vehw.eccs.comn_dp_correctable_error[0]		ECC information: COMN DP 1Bit error
vehw.eccs.vr_correctable_error[0]		ECC information: VR 1Bit error
vehw.errs.fault_occur_time[0]		ERR information: The occurrence time of a severe failure
vehw.errs.fault_errors[0]		ERR information: The kind of a severe failure
vehw.errs.non_fault_occur_time[0]		ERR information: The occurrence time of a slight failure
vehw.errs.non_fault_errors[0]		ERR information: The kind of a slight failure

Table 5 The List of the Application Name(VEOS)

Item Name	Meaning
ve_os.state[0]	Monitor the VEOS status
ve_system.ve.load[0,all,avg1]	Monitor the VE load average over the last one minute
ve_system.ve.load[0,all,avg5]	Monitor the VE load average over the last five minutes
ve_system.ve.load[0,all,avg15]	Monitor the VE load average over the last 15 minutes

ve_system.ve.load[0,percore,avg1]	Monitor the core load average over the last one minute
ve_system.ve.load[0,percore,avg5]	Monitor the core load average over the last five minutes
ve_system.ve.load[0,percore,avg15]	Monitor the core load average over the last 15 minutes
ve_system.ve.util[0,0,idle]	Monitor the core 0 load (idle)
ve_system.ve.util[0,0,interrupt]	Monitor the core 0 load (interrupt)
ve_system.ve.util[0,0,nice]	Monitor the core 0 load (nice)
ve_system.ve.util[0,0,sortirq]	Monitor the core 0 load (softirq)
ve_system.ve.util[0,0,system]	Monitor the core 0 load (system)
ve_system.ve.util[0,0,user]	Monitor the core 0 load (user)
ve_vm.memory.size[0,available]	Monitor the VE memory size (available)
ve_vm.memory.size[0,buffers]	Monitor the VE memory size (buffers)
ve_vm.memory.size[0,cached]	Monitor the VE memory size (cached)
ve_vm.memory.size[0,free]	Monitor the VE memory size (free)
ve_vm.memory.size[0,pavailable]	Monitor the VE memory size (utilization)
ve_vm.memory.size[0,total]	Monitor the VE memory size

The following Table is the items defined in template_veos_service.xml. Some items include in the application named VEOS-SERVICE.

Table 6 The List of the Items of the Application Name (VEOS-SERVICE)

Item Name	Meaning
mmm.service	Monitor the MMM services.
mmm.messages	Monitor the logs of MMM. Only the logs with the priority EER are gathered.
ived.service	Monitor the IVED services.
ived.messages	Monitor the logs of IVED. Only the logs with the priority fatal, alert, or crit are gathered.
vemmd.service	Monitor the VEMMD services.
vemmd.messages	Monitor the logs of VEMMD. Only the logs with the priority fatal, alert, or crit are gathered.
veos.messages	Monitor the logs of VEOS. Only the logs with the priority fatal, alert, or crit are gathered.

Appendix B Monitoring Items of Zabbix (for VE3)

B.1 The Item Keys Provided by the Loadable Modules

The following tables show the item keys provided by the Zabbix loadable modules. An item key can take parameters which are passed to the loadable modules. The loadable modules obtain information about VEs or cores specified with the parameters.

Table 9 The Item Keys Provided by ve3_hw_item.so

Item Key Name				
	Meaning	Attribute	Parameter	Remarks
vehw.attached_ves				
	The number of VEs	Numerical Value (Integer)	None	Return an integer in decimal
vehw.mmm_version				
	Version of MMM	String	None	An example of the return value: 01.000
vehw.ve_state[ve]				
	VE Status	String	ve – VE number	The return value is "0","1","2","3", or "4". The meanings of the values are as follows: 0:UNDIFINED 1:AVAILABLE 2:UNDEDINED 3:MAINTENANCE 4:UNAVAILABLE
vehw.os_state[ve]				
	OS Status	String	ve – VE number	The return value is "0","1","2",or "3". The meanings of the values are as follows: 0:ONLINE 1:OFFLINE 2:INITIALIZING 3:TERMINATING
vehw.ve_model[ve]				
	VE model	String	ve – VE number	An example of the return value: 3

vehw.ve_type[ve]				
	VE type	String	ve – VE number	An example of the return value: 30A
vehw.product_type[ve]				
	Product type	String	ve – VE number	An example of the return value: 34
vehw.cores[ve]				
	The number of available cores on a VE	Numerical Value (Integer)	ve – VE number	Return the number of cores in decimal.
vehw.ve_chip_sn[ve]				
	The serial number of a VE chip	String	ve – VE number	An example of the return value : 543856303033060 00a07048d
vehw.ve_board_sn[ve]				
	The serial number of a VE card	String	ve – VE number	An example of the return value: 2CC090004
vehw.ve_board_name[ve]				
	The name of a VE card	String	ve – VE number	An example of the return value: 2H5AAC
vehw.ve_board_parameter[ve]				
	The parameter of a VE card	String	ve – VE number	An example of the return value: 0000
vehw.ve_driver_version[ve]				
	VE driver version	String	ve – VE number	An example of the return value: 3.0.1
vehw.vmcfw_version[ve]				
	VMCFW version	String	ve – VE number	An example of the return value: 3.0.35
vehw.core_clock[ve]				
	Core clock frequency	Numerical Value (Integer)	ve – VE number	The unit of the return value is Hz. An example of the return value: 1600000000
vehw.base_clock[ve]				
	Base clock frequency	Numerical Value (Integer)	ve – VE number	The unit of the return value is Hz. An example of the return value: 1000000000
vehw.memory_clock[ve]				
	Memory clock frequency	Numerical Value	ve – VE number	The unit of the return value

		(Integer)		is Hz. An example of The return Value: 1000000000
vehw.memory_size[ve]				
	Total memory size	Numerical Value (Integer)	ve – VE number	The unit of the return value is GByte. An example of the return value: 48
vehw.l1_icache_size[ve]				
	L1 I cache size per core	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/core. An example of the return value: 32000
vehw.l1_dcache_size[ve]				
	L1 D cache size per core	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/core. An example of the return value: 32000
vehw.l2_cache_size[ve]				
	L2 cache size per core	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/core. An example of the return value: 25600
vehw.l3_cache_size[ve]				
	L3 cache size per core	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/core. An example of the return value: 16000
vehw.llc_cache_size[ve]				
	LLC size of a VE chip	Numerical Value (Integer)	ve – VE number	The unit of the return value is Byte/VE. An example of the return value: 260000
vehw.partitioning_mode[ve]				
	Partitioning mode	String	ve – VE number	The return value is "0" or"1". The meanings of The values are as follows: 0: disabled. 1: enabled.
vehw.throttling_level[ve]				
	Throttling level	Numerical Value (Integer)	ve – VE number	An example of the return value: 2

vehw.pci.bridge_id[ve]				
	PCI bridge ID	String	ve – VE number	An example of the return value: 44:00.0
vehw.pci.bus_id[ve]				
	PCI bus ID	String	ve – VE number	An example of the return value: 45:00.0
vehw.pci.vendor_id[ve]				
	PCI vendor ID	String	ve – VE number	An example of the return value: 0x001C
vehw.pci.device_id[ve]				
	PCI device ID	String	ve – VE number	An example of the return value: 0x1BCF
vehw.pci.class_code[ve]				
	PCI class code	String	ve – VE number	An example of the return value: 0x0B4000
vehw.pci.current_link_speed[ve]				
	The current link speed	Numerical value (floating point number)	ve – VE number	The unit of the return value is GT/s. An example of the return vaule: 8.0
vehw.pci.max_link_speed[ve]				
	The maximum link speed	Numerical value (floating point number)	ve – VE number	The unit of the return value is GT/s. An example of the return vaule: 8.0
vehw.pci.negotiated_link_width[ve]				
	The current link width	String	ve – VE number	An example of the return value: x16
vehw.pci.maximum_link_width[ve]				
	The maximum link width	String	ve – VE number	An example of the return value: x16
vehw.temperature.chip_location[ve,chip]				
	VE LSIx temperature	Numerical value (floating point number)	ve – VE number chip – chip number	The unit of the return value is degrees Celsius. An example of the return value: 23.91
vehw.temperature.diode0[ve]				
	VE Diode 0 Temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return

				value: 23.1
vehw.temperature.diode1[ve]				
	VE Diode 1 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 23.25
vehw.temperature.diode2[ve]				
	VE Diode 2 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 24.25
vehw.temperature.diode3[ve]				
	VE Diode 3 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 23.75
vehw.temperature.hbm_0[ve]				
	HBM0 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 25
vehw.temperature.hbm_1[ve]				
	HBM1 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 23
vehw.temperature.hbm_2[ve]				
	HBM2 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 22
vehw.temperature.hbm_3[ve]				
	HBM3 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 24
vehw.temperature.hbm_4[ve]				
	HBM4 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 24

vehw.temperature.hbm_5[ve]				
	HBM5 temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 24
vehw.temperature.inlet_side[ve]				
	Inlet side temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 34.55
vehw.temperature.outlet_side[ve]				
	Outlet side temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 34.25
vehw.temperature.vrm[ve]				
	VRM temperature	Numerical value (floating point number)	ve – VE number	The unit of the return value is degrees Celsius. An example of the return value: 36
vehw.voltage.vddh[ve]				
	VDDH voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.825
vehw.voltage.avddh[ve]				
	AVDDH voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.825
vehw.voltage.avdd[ve]				
	AVDD voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 0.851
vehw.voltage.hbm_vdd0[ve]				
	HBM VDD0 voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.231
vehw.voltage.hbm_vdd1[ve]				
	HBM VDD1	Numerical	ve – VE number	The unit of the

	voltage	value (floating point number)		return value is V. An example of The return value: 1.232
vehw.voltage.hbm_vdd2[ve]				
	HBM VDD2 voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.233
vehw.voltage.hbm_vpp0[ve]				
	HBM VPP0 voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 2.547
vehw.voltage.hbm_vpp1[ve]				
	HBM VPP1 voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 2.548
vehw.voltage.hbm_vpp2[ve]				
	HBM VPP2 voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 2.549
vehw.voltage.aux_12v[ve]				
	AUX 12V V voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 12.12
vehw.voltage.edge_12v[ve]				
	Edge 12V V voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 12.06
vehw.voltage.edge_3_3v[ve]				
	Edge 3.3V voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 3.302
vehw.voltage.core_vdd[ve]				
	CORE VDD voltage	Numerical value (floating	ve – VE number	The unit of the return value is V.

		point number)		An example of The return value: 0.806
vehw.voltage.pll_vdd[ve]				
	PLL VDD voltage	Numerical value (floating point number)	ve – VE number	The unit of the return value is V. An example of The return value: 1.748
vehw.current.aux_12v[ve]				
	AUX 12V current	Numerical value (floating point number)	ve – VE number	The unit of the return value is A. An example of The return value: 4.403
vehw.current.edge_12v[ve]				
	Edge 12V current	Numerical value (floating point number)	ve – VE number	The unit of the return value is A. An example of The return value: 0.276
vehw.eccs.mcu_correctable_error[ve]				
	ECC MCU information	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.llc_correctable_error[ve]				
	ECC LLC information	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.core_dp_correctable_error[ve]				
	ECC CORE DP information	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.comn_dp_correctable_error[ve]				
	ECC COMN DP information	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.vr_correctable_error[ve]				
	ECC VR information	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.ltc_correctable_error[ve]				
	ECC LTC information	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.eccs.vcc_correctable_error[ve]				

	ECC VCC information	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.errs.fault_occur_time[ve]				
	ERR information The occurrence time of a severe failure	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.errs.fault_errors[ve]				
	ERR Information The kind of a severe failure	String	ve – VE number	An example of the return value: Linkdown Error
vehw.errs.non_fault_occur_time[ve]				
	ERR Information The occurrence time of a slight failure	String	ve – VE number	An example of the return value: 2017/05/30 18:04:30
vehw.errs.non_fault_errors[ve]				
	ERR Information The kind of a slight failure	String	ve – VE number	An example of the return value: NONE

Table 10 The List of Keys Provided by ve3_os_item.so

Item Key				
	Meaning	Attribute	Parameter	Remarks
ve_os.state[ve]				
	The status of OS	String	ve – VE number	The return value is "0","1","2", or "3". The meanings of the values are as follows: 0:ONLINE 1:OFFLINE 2:INITIALIZING 3:TERMINATING
ve_vm.memory.size[ve,mode]				
	Memory usage	Numerical Value (Integer)	ve – VE number mode - total, free, buffers, cached, available, pavailable	The unit of the return value is Byte
ve_system.ve.load[ve,cpu,mode]				
	VE load	Numerical value (floating point number)	ve – VE number cpu - all, percore mode - avg1,avg5, avg15	The return value is the number of processes.
ve_system.ve.util[ve,core,type]				
	VE usage	Numerical value (floating	ve – VE number core - corenumber type - idle,nice,	An example of the return value:

		point number)	user,system, interrupt, softirq	2017/05/30 18:04:30

B.2 The Items and Triggers Provided by the Templates

The Zabbix plugin package file includes the templates which use item keys provided by the Zabbix loadable modules. The format of an item name is an item key name followed by a VE number in square brackets as follows. Please refer to "A.1. The Item Keys Provided by the Loadable Modules" for the item names.

VE Number	Item Key Name	Item Name
0	vehw.attached_ves	vehw.attached_ves[0]
1	vehw.attached_ves	vehw.attached_ves[1]

The following Tables show the item names of VE number 0 defined in template_ve0.xml. Some items include VEOS or VEHW defined as Application. The other template of VE is different in the VE number of the item name. Some items of VEHW have triggers.

Table 11 The List of the Items of the Application Name(VEHW)

Item Name		Meaning	
	Trigger Name	Level	Trigger Condition
vehw.attached_ves		The number of VEs	
vehw.base_clock[0]		Base clock frequency	
vehw.cores[0]		The number of available cores on a VE LSI	
vehw.core_clock[0]		Core clock frequency	
vehw.current.aux_12v[0]		AUX 12V current	
	ve0_current.aux_12v_warn	Warning	20A or over
	ve0_current.aux_12v_error	Severe Failure	32.5A or over
vehw.current.edge_12v[0]		Edge 12V current	
	ve0_current.edge_12v_warn	Warning	5A or over
	ve0_current.edge_12v_error	Severe Failure	6.5A or over
vehw.l1_dcache_size[0]		L1 D cache size per core	
vehw.l1_icache_size[0]		L1 I cache size per core	
vehw.l2_cache_size[0]		L2 cache size per core	
vehw.l3_cache_size[0]		L3 cache size per core	

vehw.llc_cache_size[0]			LLC cache size per VE
vehw.memory_clock[0]			Memory clock frequency
vehw.memory_size[0]			Total memory size
vehw.mmm_version			MMM version
vehw.partitioning_mode[0]			Partitioning mode
vehw.numa_node0[0]			Numa node 0
vehw.numa_node1[0]			Numa node 1
vehw.pci.bridge_id[0]			PCI bridge ID
vehw.pci.bus_id[0]			PCI bus ID
vehw.pci.class_code[0]			PCI class code
vehw.pci.current_link_speed[0]			The current link speed
vehw.pci.device_id[0]			PCI device ID
vehw.pci.maximum_link_width[0]			The maximum link width
vehw.pci.max_link_speed[0]			The maximum link speed
vehw.pci.negotiated_link_width[0]			The current link width
vehw.pci.vendor_id[0]			PCI vendor ID
vehw.product_type[0]			Product type
vehw.temperature.chip_location0[0]			LSI0 temperature
ve0_chip_location0_temp_warn	Warning		83 degree or over
ve0_chip_location0_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location1[0]			LSI1 temperature
ve0_chip_location1_temp_warn	Warning		83 degree or over
ve0_chip_location1_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location2[0]			LSI2 temperature
ve0_chip_location2_temp_warn	Warning		83 degree or over
ve0_chip_location2_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location3[0]			LSI3 temperature
ve0_chip_location3_temp_warn	Warning		83 degree or over
ve0_chip_location3_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location4[0]			LSI4 temperature
ve0_chip_location4_temp_warn	Warning		83 degree or over
ve0_chip_location4_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location5[0]			LSI5 temperature
ve0_chip_location5_temp_warn	Warning		83 degree or over
ve0_chip_location5_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location6[0]			LSI6 temperature
ve0_chip_location6_temp_warn	Warning		83 degree or over
ve0_chip_location6_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location7[0]			LSI7 temperature
ve0_chip_location7_temp_warn	Warning		83 degree or over
ve0_chip_location7_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location8[0]			LSI8 temperature
ve0_chip_location8_temp_warn	Warning		83 degree or over
ve0_chip_location8_temp_error	Severe Failure		95 degree or over
vehw.temperature.chip_location9[0]			LSI9 temperature
ve0_chip_location9_temp_warn	Warning		83 degree or over

	ve0_chip_location9_temp_error	Severe Failure	95 degree or over
vehw.temperature.chip_location10[0]		LSI10 temperature	
	ve0_chip_location10_temp_warn	Warning	83 degree or over
	ve0_chip_location10_temp_error	Severe Failure	95 degree or over
vehw.temperature.chip_location11[0]		LSI11 temperature	
	ve0_chip_location11_temp_warn	Warning	83 degree or over
	ve0_chip_location11_temp_error	Severe Failure	95 degree or over
vehw.temperature.chip_location12[0]		LSI12 temperature	
	ve0_chip_location12_temp_warn	Warning	83 degree or over
	ve0_chip_location12_temp_error	Severe Failure	95 degree or over
vehw.temperature.diode0[0]		Diode 0 temperature	
	ve0_chip_diode0_error	Severe Failure	96 degree or over
vehw.temperature.diode1[0]		Diode 1 temperature	
	ve0_chip_diode1_error	Severe Failure	96 degree or over
vehw.temperature.diode2[0]		Diode 2 temperature	
	ve0_chip_diode2_error	Severe Failure	96 degree or over
vehw.temperature.diode3[0]		Diode 3 temperature	
	ve0_chip_diode3_error	Severe Failure	96 degree or over
vehw.temperature.hbm_0[0]		HBM0 temperature	
	ve0_hbm0_warn	Warning	81 degree or over
	ve0_hbm0_error	Severe Failure	90 degree or over
vehw.temperature.hbm_1[0]		HBM1 temperature	
	ve0_hbm1_warn	Warning	81 degree or over
	ve0_hbm1_error	Severe Failure	90 degree or over
vehw.temperature.hbm_2[0]		HBM2 temperature	
	ve0_hbm2_warn	Warning	81 degree or over
	ve0_hbm2_error	Severe Failure	90 degree or over
vehw.temperature.hbm_3[0]		HBM3 temperature	
	ve0_hbm3_warn	Warning	81 degree or over
	ve0_hbm3_error	Severe Failure	90 degree or over
vehw.temperature.hbm_4[0]		HBM4 temperature	
	ve0_hbm4_warn	Warning	81 degree or over
	ve0_hbm4_error	Severe Failure	90 degree or over
vehw.temperature.hbm_5[0]		HBM5 temperature	
	ve0_hbm5_warn	Warning	81 degree or over
	ve0_hbm5_error	Severe Failure	90 degree or over
vehw.temperature.inlet_side[0]		Inlet Side temperature	
	ve0_inlet_side_error	Severe Failure	80 degree or over
vehw.temperature.outlet_side[0]		Outlet Side temperature	
	ve0_outlet_side_error	Severe Failure	80 degree or over
vehw.temperature.vrm[0]		VRM temperature	
	ve0_vrm_error	Severe Failure	120 degree or over

vehw.throttling_level[0]		Throttling level
vehw.type[0]		VE type
vehw.ve_board_name[0]		The name of a VE card
vehw.ve_board_parameter[0]		The parameter of a VE card
vehw.ve_board_sn[0]		The serial number of a VE card
vehw.ve_chip_sn[0]		The serial number of a VE chip
vehw.ve_direve_version[0]		The driver version of a VE card
vehw.ve_model[0]		VE model
vehw.ve_state[0]		VE status
vehw.vmcfw_version[0]		VMCFW version
vehw.voltage.vddh[0]		VDDH voltage
ve0_vddh_error	Severe Failure	Below 1.26V or above 2.34V
vehw.voltage.avddh[0]		AVDDH voltage
ve0_vddh_error	Severe Failure	Below 1.26V or above 2.34V
vehw.voltage.avdd[0]		AVDD voltage
ve0_vddh_error	Severe Failure	Below 0.6V or above 1.11V
vehw.voltage.hbm_vdd0[0]		HBM VDD0 voltage
ve0_hbm_vdd0_error	Severe Failure	Below 0.84V or above 1.56V
vehw.voltage.hbm_vdd1[0]		HBM VDD1 voltage
ve0_hbm_vdd1_error	Severe Failure	Below 0.84V or above 1.56V
vehw.voltage.hbm_vdd2[0]		HBM VDD2 voltage
ve0_hbm_vdd2_error	Severe Failure	Below 0.84V or above 1.56V
vehw.voltage.hbm_vpp0[0]		HBM VPP0 voltage
ve0_hbm_vpp0_error	Severe Failure	Below 1.75V or above 3.25V
vehw.voltage.hbm_vpp1[0]		HBM VPP1 voltage
ve0_hbm_vpp1_error	Severe Failure	Below 1.75V or above 3.25V
vehw.voltage.hbm_vpp2[0]		HBM VPP2 voltage
ve0_hbm_vpp2_error	Severe Failure	Below 1.75V or above 3.25V
vehw.voltage.aux_12v[0]		AUX 12V V voltage
ve0_aux_12v_error	Severe Failure	Below 10.8V or above 13.2V
vehw.voltage.edge_12v[0]		Edge 12V V voltage
ve0_aux_12v_error	Severe Failure	Below 10.8V or above 13.2V
vehw.voltage.edge_3_3v[0]		Edge 3.3V voltage
ve0_edge_3_3v_error	Severe Failure	Below 2.97V or above 3.63V
vehw.voltage.core_vdd[0]		CORE VDD voltage
ve0_core_vdd_error	Severe Failure	Below 0.56V or above 1.04V
vehw.voltage.pll_vdd[0]		PLL VDD voltage
ve0_pll_vdd_error	Severe Failure	Below 1.26V or above 2.34V
vehw.eccs.mcu_correctable_error[0]		ECC MCU information
vehw.eccs.llc_correctable_error[0]		ECC LLC information
vehw.eccs.core_dp_correctable_error[0]		ECC CORE DP information
vehw.eccs.comn_dp_correctable_error[0]		ECC COMN DP information

vehw.eccs.vr_correctable_error[0]	ECC VR information
vehw.eccs.ltc_correctable_error[0]	ECC LTC information
vehw.eccs.vcc_correctable_error[0]	ECC VCC information
vehw.errs.fault_occur_time[0]	ERR information: The occurrence time of a severe failure
vehw.errs.fault_errors[0]	ERR information: The kind of a severe failure
vehw.errs.non_fault_occur_time[0]	ERR information: The occurrence time of a slight failure
vehw.errs.non_fault_errors[0]	ERR information: The kind of a slight failure

Table 12 The List of the Application Name(VEOS)

Item Name	Meaning
ve_os.state[0]	Monitor the VEOS status
ve_system.ve.load[0,all,avg1]	Monitor the VE load average over the last one minute
ve_system.ve.load[0,all,avg5]	Monitor the VE load average over the last five minutes
ve_system.ve.load[0,all,avg15]	Monitor the VE load average over the last 15 minutes
ve_system.ve.load[0,percore,avg1]	Monitor the core load average over the last one minute
ve_system.ve.load[0,percore,avg5]	Monitor the core load average over the last five minutes
ve_system.ve.load[0,percore,avg15]	Monitor the core load average over the last 15 minutes
ve_system.ve.util[0,0,idle]	Monitor the core 0 load (idle)
ve_system.ve.util[0,0,interrupt]	Monitor the core 0 load (interrupt)
ve_system.ve.util[0,0,nice]	Monitor the core 0 load (nice)
ve_system.ve.util[0,0,sortirq]	Monitor the core 0 load (softirq)
ve_system.ve.util[0,0,system]	Monitor the core 0 load (system)
ve_system.ve.util[0,0,user]	Monitor the core 0 load (user)
ve_vm.memory.size[0,available]	Monitor the VE memory size (available)
ve_vm.memory.size[0,buffers]	Monitor the VE memory size (buffers)
ve_vm.memory.size[0,cached]	Monitor the VE memory size (cached)
ve_vm.memory.size[0,free]	Monitor the VE memory size (free)
ve_vm.memory.size[0,pavailable]	Monitor the VE memory size (utilization)
ve_vm.memory.size[0,total]	Monitor the VE memory size

The following Table is the items defined in template_veos_service.xml. Some items include in the application named VEOS-SERVICE.

Table 13 The List of the Items of the Application Name (VEOS-SERVICE)

Item Name	Meaning
mmm.service	Monitor the MMM services.
mmm.messages	Monitor the logs of MMM. Only the logs with the

	priority EER are gathered.
ived.service	Monitor the IVED services.
ived.messages	Monitor the logs of IVED. Only the logs with the priority fatal, alert, or crit are gathered.
vemmd.service	Monitor the VEMMD services.
vemmd.messages	Monitor the logs of VEMMD. Only the logs with the priority fatal, alert, or crit are gathered.
veos.messages	Monitor the logs of VEOS. Only the logs with the priority fatal, alert, or crit are gathered.

Appendix C Trouble Shooting

C.1 Operational Status Monitoring (Zabbix)

(1) Cannot get VE information, and 'Not supported by Zabbix Agent' is shown to item information of monitoring host

- Problem

  Cannot get VE information, and "Not supported by Zabbix Agent" is shown to item information of monitoring host.

- Cause

  Configuration of loadable module for Zabbix may be wrong.

- Solution

  Check the configuration of [/etc/zabbix/zabbix_agent.conf].

  If the configuration is correct, display the following message to the log file [/var/log/zabbix/zabbix_agent.log] of zabbix agent.

  ```
  loaded modules: ve_hw_item.so, ve_os_item.so
  ```

- Related information

  "3.4.2 Configuration of Monitoring Items (5) Information Gathering with Loadable Modules"

(2) Cannot get VE sensor information, and 'File can not access' is shown to item information of monitoring host

- Problem

  Cannot get VE sensor information, and 'File can not access' is shown to item information of monitoring host.

- Cause

  VE Status is OFFLINE.

- Solution

  Set VE Status to ONLINE.

- Related information

  None.

(3) Cannot get a core temperature of VE, and 'Specified core is not available' is shown to item information of monitoring host.

- Problem

  Cannot get a core temperature of VE, and 'Specified core is not available' is shown to item information of monitoring host.

- Cause

  VE core number of the item does not available.

- Solution

  Turn off the item.

- Related information

  None.

Appendix D OSS LICENSES

D.1 Zabbix

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D.2 Ansible

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```

Appendix E History

E.1 History table

Feb. 2018	Rev. 1
May. 2021	Rev. 9
Dec. 2021	Rev.10
Jul. 2022	Rev.11
Jun. 2023	Rev.12
Jun. 2024	Rev.13

E.2 Change notes

- Rev. 9

  Zabbix 4.0 / 5.0 are supported.

- Rev. 10

  NEC yum repository URL is changed.

- Rev. 11

  Ansible License is added. (D.4)

- Rev. 12

  Zabbix 6.0 is supported.

  The VH of VE3 model is supported.

- Rev. 13

  Remove support for Ganglia-Nagios.

  Remove support for RHEL / CentOS 7.9