



# Central Management Console Installation Guide

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# Chapter 1. Introduction



## CMC overview

*The Central Management Console (CMC) aggregates information from thousands of sites and assets to deliver instant awareness of your networks and their activity patterns.*

### Overview

The [Central Management Console \(CMC\)](#) makes it easy to have visibility of all your Nozomi Networks sensors. The [CMC](#) aggregates information from thousands of sites and assets to deliver instant awareness of your [operational technology \(OT\)/Internet of Things \(IoT\)](#) networks and their activity patterns, enabling users to quickly troubleshoot issues and accelerate incident response across your network.

[CMC](#) can be deployed:

- On-premises
- In a public cloud provider such as [Amazon Web Services \(AWS\)](#) or Microsoft Azure
- At the edge on physical or virtual appliances

### Functionalities

The [CMC](#) has been designed to support complex deployments that cannot be addressed with a single sensor. The [CMC](#) shares the user experience of the sensor. In comparison to the sensor, some functionalities have been added, and some have been removed. The functionalities that have been added let you manage *hundreds* of sensors. The functionalities that have been removed increase efficiency for real-world, geographic deployments of the Nozomi Networks Solution architectures.

### Sensors

The [CMC Sensors](#) page lets you see and manage all the connected sensors. A graphical representation of all the hierarchical structure of the connected sensors and the sensor Map is presented to allow a quick health check on a user-provided raster map.

Once sensors are connected, they are periodically synchronized with the [CMC](#). In particular, the Environment of each sensor is merged into a global Environment and Alerts are received for a centralized overview of the system. Of course, Alerts can also be forwarded to a [security information and event management \(SIEM\)](#) directly from the [CMC](#), thus enabling a simpler decoupling of components in the overall architecture.

### Synchronization

To synchronize data, the sensors must be running the same major [Nozomi Networks Operating System \(N2OS\)](#) release, or one of the two prior major ones. For example, if the [CMC](#) is running version 23.0.x (the major release is 23.0), sensors can synchronize if running one of the following versions: 23.0.x, 22.5.x or 22.0.x.

Firmware update is also simpler with a [CMC](#). Once the new firmware is deployed to it, all connected sensors can be automatically updated.

## Installation options

*A list of the different installation options for Nozomi sensors.*

You can install Nozomi Networks sensors in these different methods:

- A physical installation
- A virtual installation

## Supported web browsers

*The Nozomi Networks software supports recent versions of these browsers:*

[Google Chrome](#)

[Chromium](#)

[Safari](#) (for macOS)

[Firefox](#)

[Microsoft Edge](#)

[Opera](#)



**Important:**

Microsoft Internet Explorer is not supported.



## Chapter 2. Physical installation



## Physical installation

*A physical installation is a deployment of a dedicated physical hardware sensor that will monitor your network. Typically, Nozomi Networks supplies these physical sensors.*

Physical installations are best-suited for organizations that:

- Do not use virtualized architectures
- Manage highly-distributed, dense networks
- Have special environmental conditions

## Install a physical sensor

*Before you can use your Nozomi Networks physical sensor in your network, you must install it.*

### About this task

If you purchased a physical sensor from Nozomi Networks, the appropriate release of the [N2OS](#) is already installed on it. If your organization uses a different release of the [N2OS](#), then see **Software updates and rollbacks** in the **Maintenance Guide** to upgrade the release.

## Procedure

1. Follow the procedure described in the **Quick Start Guide** that you received with the sensor.

**Note:**

The status of your sensor should now:

- Be installed in a rack
- Be powered on
- Have its monitoring ports connected to the relevant network switches

2. Connect the appropriate null-modem serial cable to the sensor's serial console.

**Table 1. Null-modem serial cables**

Physical sensor model	Connector type
N1000	RJ45 (female)
N750	
P500	
NS1	
NS20	
NSG-H	
NSG-HS	
NCMC-100	
NSG-L	
NSG-M	
R50	DB9 (female)
R150	
P550	

3. Open a terminal emulator.

**Note:**

Use the appropriate terminal emulator for your [operating system \(OS\)](#):

- On Windows, **Hyper Terminal** or **Putty**
- On macOS or other \*nix platforms, **cu** or **Minicom**

4. Connect and set the speed to 9600 bauds with no parity bit set.

5. **Optional:** Connect with [secure shell \(SSH\)](#). Use the default network settings:

IP address: 192.168.1.254

Netmask: 255.255.255.0

GW: 192.168.1.1

**Result:** A login prompt for the sensor shows.

6. Do the **Basic configuration**.

## Chapter 3. Virtual installation





## Virtual installation

*Before you install a virtual machine (VM), you should make sure that you are familiar with the minimum requirements, and the supported formats and software that you can use with the Nozomi Networks software products.*

Virtual installations are best-suited for organizations that:

- Need to separate the lifecycle of hardware from software
- Are looking to centralize the management of their assets
- Value the ability to easily scale their solutions

The Nozomi Networks solution is available in these formats:

- [open virtual appliance \(OVA\)](#)
- [virtual hard disk \(VHD\)](#)

When you deploy the [virtual machine \(VM\)](#), use a hypervisor that supports [OVA](#) or [VHD](#) file formats, such as:

- VMware
- HyperV
- KVM
- XEN

All components should be in good working condition. The overall hypervisor load must be under control, with no regular ballooning, so as to avoid unexpected behavior, such as dropped packets or overall poor system performance.

### CMC minimum requirements

Make sure that you have the minimum requirements to install a CMC sensor on a [VM](#).

4 vCPU running at 2 GHz

6 GB of RAM

10 GB of minimum disk space, running on SSD or hybrid storage (100+ GB of disk recommended)

1 [network interface controller \(NIC\)](#). The maximum number depends on the hypervisor, with one being used for management and one (or more) being used for traffic monitoring

## Virtual machine sizing

*A description of the virtual machine (VM) sizing requirements for Nozomi Networks sensors.*

The following information describes the minimum size requirements for sensor instances when they run on virtual machines. These values are based on assumed amounts of nodes and throughput, and are based on a simplified model. You should consider these recommendations as a starting point for calculating the best size for your [VM](#).

There are more elements affecting the instantaneous and average use of resources, such as the:

- Hypervisor hardware
- Specific protocol distributions
- Loading time machine snapshots
- Running of queries on big data sets etc.

Because of this, different settings might be required and should be tested during deployment.

In the table below, network elements are defined as the sum of nodes, links, and variables.

## CMC sizing recommendations

The following table gives recommended sizes for instances running the CMC.

**Table 2. CMC instances**

Number of sensors <sup>1</sup>	Max. network elements	Mode	Min. vCPU	Min. RAM (GB)	Min. disk space
25	28,000	Multicontext	4	8	100 GB
25	28,000	All-in-one	8	32	100 GB
50	200,000	Multicontext	6	12	200 GB
50	200,000	All-in-one	16	64	200 GB
100	400,000	Multicontext	10	16	1 TB
250	800,000	Multicontext	12	32	1 TB
400	1,200,000	Multicontext	16	64	1 TB

## Check the RAM of a virtual machine

*The amount of random-access memory (RAM) from the hypervisor might not correspond with the actual amount seen from within the virtual machine (VM). Therefore, it is important to confirm that your VM has sufficient RAM to support your configuration.*

### Procedure

1. Open a terminal.
2. Enter this command:

```
sysctl hw.physmem
```

**Result:** The terminal will show the physical memory of the [VM](#).

3. If the memory is insufficient for your configuration, use the [CMC sizing recommendations \(on page 19\)](#) table to identify the correct amount of *random-access memory (RAM)* that you need.

## Install a virtual machine

*Do this procedure to install a virtual machine (VM).*

### Before you begin

Make sure that:

- The [VM OS](#) is set to FreeBSD 12 or later versions (64-bit)
- The [VM](#) compatibility version is set to 15+, such as ESXi 7.0 or later (i.e., VM version 17), if possible; however, this depends on the VSphere version level

### About this task

To install the [VM](#) in the hypervisor, you need to configure the [VM](#) to enable external access. If you are not familiar with how to import the [OVA VM](#) in your hypervisor environment, refer to your hypervisor's manual or contact your hypervisor's support service.

These disk storage types are recommended and supported:

- LSI Logic
- LSI Logic SAS
- SATA



**Important:**

[N2OS](#) does not support VMware Paravirtual SCSI (PVSCSI) storage type.



**Important:**

[N2OS](#) does not support the IDE storage type.

### Procedure

1. Make sure that you are familiar with the minimum resource requirements.
2. Import the [VM](#) in the hypervisor and configure the resources.
3. Wait for the [VM](#) to finish importing.
4. In the hypervisor settings for the [VM](#) disk, set the desired size.



**Note:**

Some hypervisors, such as VMware ESX >= 6.0, permit you to change the disk size at this stage.

5. If your hypervisor does not permit you to change the disk size at this stage, do not continue with this procedure until you have completed the procedure: [Add a secondary disk to a virtual machine \(on page 24\)](#).
6. Boot the [VM](#).

**Result:** The [VM](#) boots into a valid [N2OS](#) environment.

7. Log in as admin.

**Result:** You are logged in instantly as no password is set by default.

8. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

## Expand a disk on a virtual machine

*The monitoring scope of your sensor will dictate the size requirements of your virtual hard drive. Do this procedure to adjust the size of the virtual hard drive.*

### Before you begin

Edit your [VM](#) settings from the hypervisor.

### Procedure

1. Restart the [VM](#).
2. Log in to the [VM](#).
3. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

4. To run data enlarge, enter this command:

```
data_enlarge
```

**Result:** The virtual machine can now detect the newly allocated space.

## Add a secondary disk to a virtual machine

*If the main disk is not large enough when it is first imported, you can do this procedure to add a larger virtual data disk to the virtual machine (VM).*

### Before you begin

You should be familiar with managing virtual disks in your hypervisor environment. If you are not, refer to your hypervisor manual or contact your hypervisor's support service.

### About this task

**Note:**

When you add a disk, use a disk type of SCSI or SATA that uses a storage type of:

- LSI Logic SAS
- LSI Logic, or
- SATA

IDE disks are not recommended.

### Procedure

1. Add a disk to the [VM](#).
2. Restart the [VM](#).
3. In the [VM](#) console, to obtain the name of the disk devices, enter this command:

```
sysctl kern.disks
```

4. Assuming **ada1** is the device disk added as a secondary disk (note that **ada0** is the OS device), execute this command to move the data partition to it:

```
data_move ada1
```



## Add a monitoring interface to the virtual machine

*By default, the virtual machine (VM) has one management network interface and one monitoring interface. Depending on deployment needs, it might be useful to add more monitoring interfaces to the sensor.*

### Procedure

1. If the **VM** is powered on, shut it down.
2. From the hypervisor configuration, add one or more network interfaces.
3. Power on the **VM**.

### Results

The new interface(s) is (are) now automatically recognized and used.

## Cloud deployment

### AWS deployment

*If your organization uses Amazon Web Services (AWS) to host applications, or the data for the assets that you want to monitor, you can deploy your sensors in AWS.*

Before you can deploy with [AWS](#), you must open a support case in the Nozomi Networks Support Portal to request access to the [Amazon Machine Image \(AMI\)](#). For this, you will need to know the:

- Organization's [AWS](#) account *identifier (ID)*
- [AWS](#) region where you intend to deploy the [AMI](#)

To find your [AWS ID](#), refer to Amazon's documentation on [AWS](#) identifiers. Upon receipt, we will grant access to the [AMI](#).

## Deploy a CMC image with Microsoft Azure

Nozomi Networks delivers the CMC image in a special Azure virtual hard disk (VHD) for use in the Microsoft Azure cloud.

### Before you begin

Make sure that:

- The Azure storage account that is to be used has the capabilities to store Page Blobs

**Note:**

This is a Microsoft Azure requirement when uploading [VHD](#) images to be used for virtual machines in the Azure environment.

- The Azure user that will do the installation has the necessary permissions to access the Storage Explorer
- There are well-defined security groups for accessing the virtual machine to be instantiated in Azure

**Note:**

There are a number of prerequisites to run Nozomi Networks platform images on Azure. For more details, please contact your Nozomi Networks support team.

### Procedure

1. Log in to the Azure console.
2. If your subscription (default values) does not have a **Storage Account** resource type, create one.
3. Make sure that the **Storage Account** type supports Page Blobs.
4. From the menu, select **Storage Account and Storage Explorer (preview) > Blob Container**.
5. Make sure the Azure user has permissions to access the Storage Explorer.
6. If a Blob Container does not exist, create one.
7. Select **Upload** for the [VHD](#).
8. Wait for the upload to finish.
9. From Azure home, select **Create a resource** and choose **Managed Disks** with these settings:
  - SourceType=Storage Blob
  - select the Nozomi Networks [VHD](#) as SourceBlob
  - Size = <deployment size>
  - OS = Linux, Gen1
10. Leave the other parameters with their default settings.

11. Once the disk is created, select it.
12. Select **+Create VM**.
13. Choose the required *central processing unit (CPU)* and *RAM*.
14. Network Firewall rules - allow *SSH*, *hypertext transfer protocol (HTTP)* and *hypertext transfer protocol secure (HTTPS)*.
15. In the **Management** tab for **Boot Diagnostics**, select **Enable with custom storage account**.
16. Choose or create a **Diagnostics storage account**.
17. Leave the other parameters with their default settings.
18. Once the virtual machine is created, select it.
19. Scroll down to the **Support + troubleshooting** section and select **Serial Console**.
20. Log in to the console.

**Note:**

The default console credential has no password initially and you must change it the first time that you log in.

**Result:** A prompt with the text `N2OS - login` shows.

21. Type `admin` and then press **Enter**.
22. To elevate your privileges, enter the command:

```
enable-me
```

**Result:** Your privileges have been elevated.

23. To launch the initial configuration wizard, enter the command:

```
env TERM=xterm /usr/local/sbin/setup
```

24. Before you continue, **Do the basic configuration** procedure.
25. To expand the disk space, enter the command:

```
data_enlarge
```

26. Log in to the web *user interface (UI)*.
  - a. In the **username:** field, type `admin`
  - b. In the **Password:** field, type `nozominetworks`

## Chapter 4. Basic configuration



## Do the basic configuration

*Before you can use the Nozomi Networks Operating System (N2OS) software, you must do the basic configuration.*

### Before you begin

You have installed the [N2OS](#) software.

### About this task

After you have done this procedure, your system management interface will be set up and reachable:

- As a text console through [SSH](#)
- As a web console through [HTTPS](#)

**Note:**

The configuration of more than one **mgmt** interface is not supported.

**Note:**

You can use either a serial console (for physical sensors) or the text hypervisor console (for virtual sensors). This is dependent on the sensor model.

**Note:**

The sensor's shell has two users: **admin** and **root**. You should use **admin** to log in to both. If you want to elevate from **admin** to **root**, you should use the **admin** password. The **root** account does not have a separate password.

## Procedure

1. The console shows a prompt with the text `N2OS - login:`. Type **admin** and then press **Enter**.

**Note:**

In a virtual sensor, you are instantly logged in, as no password is set by default. In physical sensors, **nozominetworks** is the default password.

**Note:**

If you ever need to change the password, you can use the **change\_password** command.

2. To elevate your privileges, enter the command:

```
enable-me
```

**Result:** Your privileges have been elevated.

3. To launch the initial configuration wizard, enter the command:

```
setup
```

4. For virtual sensors, at the prompt, choose the **admin** password first.

**Attention:**

You should select a strong password as this will permit the **admin** user to access the sensor through [SSH](#).

5. In the menu, select **Network Interfaces**.
6. Select the management interface, then select **Enter**.

**Note:**

Depending on the sensor model, the management interface can be named **em0** or **mgmt**.

7. Choose a method to configure the [internet protocol \(IP\)](#) address.

**Choose from:**

- To configure all automatically, move the cursor to **DHCP** and select **Enable**, then (go to step [9 \(on page 33\)](#))
- Do a static configuration (go to step [8 \(on page 33\)](#))



8. Do a static configuration.
  - a. Move the cursor to **ipaddr** and edit the values for the *IP* address.
  - b. Move the cursor to **netmask** and edit the values for the netmask.
9. Move the cursor to **X Save/Exit** and select **Enter**.
10. In the menu, select **Default Router/Gateway**.
11. Enter the *IP* address of the default gateway.
12. Press **tab** and then select **Enter** to save and exit.
13. In the menu, select **DNS nameservers**.
14. Configure the *IP* addresses of the *domain name server (DNS)* servers.
15. Move the cursor to **X Exit** and select **Enter**.

**Result:** The basic configuration is complete.

16. **Do the web console configuration** procedure.

## Do the web console configuration

Once you have completed the basic configuration, you must configure the web console.

### Before you begin

Make sure that you have:

- Completed the **Do the basic configuration** procedure
- A [supported web browser \(on page 8\)](#) installed

### About this task

The product integrates self-signed SSL certificates to get started, so add an exception in your browser. Later in this chapter, we describe the steps to import valid certificates

### Procedure

1. In your browser, enter `https://<sensor_ip>` where `<sensor_ip>` where `<sensor_ip>` is the management interface *IP* address .
2. If you get a security warning, accept them and continue.


**Result:** The login screen shows.

3. In the **username** field, enter **admin**
4. In the **password** field, enter **nozominetworks**
5. Select **Log in**.



**Note:**

On first login, you will be prompted to change the default password for security reasons.

6. If necessary, change the default password.
7. In the top navigation bar, select 

**Result:** The administration page opens.

8. In the **System** section, select **General**.

**Result:** The **General** page opens.

9. In the **hostname** field, enter a new hostname.
10. In the **System** section, select **Date and time**.

**Result:** The **Date and time** page opens.

11. In the Timezone field, select the correct timezone.

12. **Optional:** If necessary, in the **NTP** section, select the **Enabled** checkbox to enable the *network time protocol (NTP)* client.

**Result:** The web console configuration is complete.

13. Do the **Install a license** procedure.

## Install a license

*Before you can use the Nozomi Networks Operating System (N2OS) software, you must install a license.*

### Before you begin

Make sure that you have completed the:


- **Do the basic configuration** procedure
- **Do the web console configuration** procedure

### About this task

For this sensor, you can activate the license(s) that follow:

- Base: a Base license is mandatory, and includes passive monitoring
- Arc (optional)
- Asset Intelligence (optional)
- *Federal Information Processing Standards (FIPS)* (optional)
- Smart Polling (optional)
- Threat Intelligence (optional)

### Procedure

1. In the top navigation bar, select   
**Result:** The administration page opens.
2. In the **System** section, select **Updates and licenses**.  
**Result:** The **Updates and licenses** page opens.
3. In the top right of the **Base** section, select **Set new license**.
4. To copy the **Machine ID**, select **Copy**.
5. In the **License key** field, paste the license key that you received from Nozomi Networks.
6. To install another license, in the top right of the applicable section, select **Set new license**.
7. To copy the **Machine ID**, select **Copy**.
8. In the **License key** field, paste the license key that you received from Nozomi Networks.

### Results

After the license is confirmed, the sensor begins to monitor the configured network interfaces.

## Chapter 5. Additional settings



## Network requirements

### Operator access to Guardian, CMC, and RC

*The required ports and protocols for operator access to Guardian, CMC, and RC.*

**Table 3. Operator access to Guardian, CMC, and RC**

Port	Protocol	Source	Destination	Purpose
tcp/443	https	Operator	Guardian/CMC	Operator's https access to Guardian/CMC Web UI
tcp/22	ssh	Operator	Guardian/ CMC/RC	Operator's ssh access to Guardian/CMC/RC shell

### Communications between Guardian, CMC, and RC

*The required ports and protocols for communications between Guardian, CMC, and RC.*

**Table 4. Communications between Guardian, CMC, and RC**

Port	Protocol	Source	Destination	Purpose
tcp/443	https	Guardian/ CMC	CMC	Sync from Guardian to CMC or between CMCs of different tiers in the hierarchy
tcp/443	https	RC	Guardian	Sync from Remote Collector to Guardian
tcp/6000	proprietary (over TLS)	RC	Guardian	Transmission of monitored traffic from Remote Collector to Guardian

### Operator access to Vantage

*The required ports and protocols for operator access to Vantage.*

**Table 5. Operator access to Vantage**

Port	Protocol	Source	Destination	Purpose
tcp/443	https	Operator	Vantage	Operator's https access to Vantage Web UI

## Communications between Guardian, CMC, and Vantage

*The required ports and protocols for communications between Guardian, CMC, and Vantage.*

**Table 6. Communications between Guardian, CMC, and Vantage**

Port	Protocol	Source	Destination	Purpose
tcp/443	https	Guardian/ CMC	Vantage	Sync from Guardian or CMC to Vantage



## Install an SSL certificate

You need to install a secure sockets layer (SSL) certificate to securely encrypt traffic between client computers and the Nozomi Networks Operating System (N2OS) sensor over hypertext transfer protocol secure (HTTPS).

### Before you begin

Make sure that:

- You have both the certificate and the key file in [privacy-enhanced mail \(PEM\)](#) format
- Your certificate is password-protected
- The certificate chain is complete

**Note:**

You can use a command to combine certificates. Use a command such as:

```
cat https_nozomi.crt bundle.crt > https_nozomi.chained.crt
```

### About this task

**Important:**

You should not use a self-signed certificate in a production environment.

During the initial boot, the sensor generates a self-signed certificate. However, Nozomi Networks recommends that you install a certificate obtained from a well-known, trusted [certificate authority \(CA\)](#). To add a private [CA](#) to the system's trust store, see [Install a CA certificate \(on page 43\)](#).

### Procedure

1. Change the name of the certificate file to `https_nozomi.crt`.
2. Change the name of the key `https_nozomi.key`.
3. Upload the certificate and key files to the sensor.
  - a. Open a terminal.
  - b. Change directory into the `/data/tmp` folder
  - c. To upload, enter this command:

```
scp https_nozomi.* admin@<sensor_ip>:/data/tmp
```

4. Log into the console, either directly or through [SSH](#).
5. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

6. If your certificate key is password-protected, to remove the protection, enter these commands:

```
cd /data/tmp  
openssl rsa -in https_nozomi.key -out https_nozomi_nopassword.key  
mv https_nozomi_nopassword.key https_nozomi.key
```

**Note:**

This will stop you being prompted for your password each time the server restarts.

7. To enable the certificate, enter this command:

```
n2os-addtlscert https_nozomi.crt https_nozomi.key
```

**Note:**

If you removed password protection from the certificate, change the second parameter of the command to:

```
https_nozomi_nopassword.key
```

8. To restart the web server and apply the change, enter this command:

```
service nginx stop
```

9. Verify that the [secure sockets layer \(SSL\)](#) certificate is correctly loaded.
- In your browser, enter: `https://<host>`, where <host> can be the [IP](#) address or [fully qualified domain name \(FQDN\)](#) covered by the certificate
  - Make sure that the certificate is recognized as valid.

## Results

The [SSL](#) certificate is working correctly and will be applied on the next reboot.

## Install a CA certificate

If an issuing certificate authority (CA) for the hypertext transfer protocol secure (HTTPS) certificate is not immediately trusted, you will need to install a certificate authority (CA) certificate to the Nozomi Networks Operating System (N2OS) sensor.

### Before you begin

Make sure that:

- Your intermediate CA and Root CA certificates are combined
- The certificate must be in PEM format

**Note:**

These formats are not supported:

- Distinguished Encoding Rules (DER)
- PKCS#12

### Procedure

1. Upload the CA certificate to the sensor.
  - a. Change the name of the CA certificate to `cert.crt`
  - b. Open a terminal.
  - c. To upload, enter this command:

```
scp cert.crt admin@<sensor_ip>:/data/tmp
```

2. Log into the console, either directly or through SSH.
3. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

4. Change directory into the `/data/tmp` folder.
5. To add the CA certificate to the trust store, enter this command:

```
n2os-addcacert cert.crt
```

### Results

The sensor now trusts the imported CA certificate. You can now use it to secure HTTPS communication to the sensor.

## Enable SNMP

*To monitor the health of the Nozomi Networks Operating System (N2OS) sensor, you need to enable the simple network management protocol (SNMP) daemon.*

### About this task

The current *simple network management protocol (SNMP)* daemon supports versions v1, v2c and v3. This feature is not available with a container installation.

### Procedure

1. Log into the console, either directly or through [SSH](#).
2. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

3. Edit these variables as necessary:
  - location
  - contact
  - community



**Important:**

For community, it is important to use a strong password.

4. Change the value of other variables as necessary.

**Note:**

For SNMP v3 User-Based Security Model (USM), uncomment the following sections in `/etc/snmpd.conf` to create a user `bsnmp` and set privacy and encryption options to SHA message digests and AES encryption for this user:

```
engine := 0x80:0x10:0x08:0x10:0x80:0x25
snmpEngineID = $(engine)

user1 := "bsnmp"
user1passwd :=
    0x22:0x98:0x1a:0x6e:0x39:0x93:0x16: ... :0x05:0x16:0x33:0x38:
    0x60

begemotSnmpdModulePath."usm" = "/usr/lib/snmp_usm.so"

%usm

usmUserStatus.$(engine).$(user1) = 5
usmUserAuthProtocol.$(engine).$(user1) =
    $(HMACSHAAuthProtocol)
usmUserAuthKeyChange.$(engine).$(user1) = $(user1passwd)
usmUserPrivProtocol.$(engine).$(user1) = $(AesCfb128Protocol)
usmUserPrivKeyChange.$(engine).$(user1) = $(user1passwd)
usmUserStatus.$(engine).$(user1) = 1
```

5. Edit the `/etc/rc.conf` file with this line:

```
bsnmpd_enable="YES"
```

6. To start the service, enter this command:

```
service bsnmpd start
```

7. If you enabled the User-Based Security Model (USM) in step 3 (on page 44), replace the default value for the `user1passwd` [variable](#).

a. To convert the SHA or MD5 output to exe format, enter this command:

```
sh -c "SNMPUSER=bsnmp SNMPPASSWD=<newpassword>
SNMPAUTH=<sha|md5> SNMPPRIV=<aes|des> bsnmpget -v 3 -D -K -o
verbose"
echo <SHA output> | sed 's/.\{2\}/:0x&/g;s/^\{6\}/g'
```

b. To restart the service, enter the command:

```
service bsnmpd restart
```

8. To save all of the settings, enter this command:

```
n2os-save
```

9. To check the functionality, run a test command from an external system (the `<sensor_ip>` has to be reachable). For example, for the USM case, with the default values in the `/etc/snmpd.conf` file, use a command similar to this:

```
snmpstatus -v3 -u bsnmp -a SHA -A <password> -x AES -X <password> -l
authPriv <sensor_ip>
```

## Results

[SNMP](#) has been enabled.


## Configure an internal firewall

Do this procedure to configure the internal firewall to restrict access to components such as: the management interface, the secure shell (SSH) terminal, the simple network management protocol (SNMP) service, and internet control message protocol (ICMP) of the full stack edition.

### About this task

To limit access to these services, you must use the [command-line interface \(CLI\)](#) to add the required configurations.

### Procedure

1. In the top navigation bar, select   
**Result:** The administration page opens.
2. In the **Settings** section, select **CLI**.  
**Result:** The **CLI** page opens.
3. In the [CLI](#), enter the necessary configuration lines.

**Note:**

For example, the lines below permits connections only from networks 192.168.55.0/24 or from the host 10.10.10.10:

```
conf.user configure system firewall https 192.168.55.0/24,  
10.10.10.10
```

4. Log into the text console, either directly, or through [SSH](#).
5. To apply the new settings, enter this command:

```
n2os-firewall-update
```

### Results

The internal firewall has been configured.

## Disable internal packet-rate protection of the management interface

*If necessary, do this procedure to disable internal packet-rate protection in the management interface.*

### Procedure

1. In the top navigation bar, select .

**Result:** The administration page opens.

2. In the **Settings** section, select **CLI**.

**Result:** The **CLI** page opens.

3. In the [CLI](#), enter this command:

```
conf.user configure system firewall disable_packet_rate_protection  
true
```

4. Log into the text console, either directly, or through [SSH](#).

5. To apply the new settings, enter this command:

```
n2os-firewall-update
```

### Results

The internal packet-rate protection has been disabled.



## Configure IPv6

*You can configure IPv6 to access physical and virtual sensors. This is not possible for container installations.*

### Procedure

1. Log into the text console, either directly, or through [SSH](#).
2. To enable IPv6 on the management interface, enter this command:

```
n2os-setupipv6
```

3. To reboot the sensor, enter this command:

```
reboot
```

4. Wait for the sensor to reboot.
5. To retrieve the address, use a command such as:

```
ifconfig
```

**Note:**

You can now enclose the address in square brackets [ ] to access the sensor [UI](#). Similarly, you can configure sensors to synchronize towards a [CMC](#) or another sensor in [high availability \(HA\)](#) mode. To do this you can specify the IPv6 address in square brackets [ ].

### Results

IPv6 has been configured.

## Enable 802.1x on the management interface

*This topic describes how to enable 802.1x support for the management interface. Configuration of the RADIUS server and the creation of possible certificates are not discussed*

### Before you begin

- Make sure that you have serial access to the sensor as part of this configuration is performed via serial console
- If the 802.1x is already configured, switch side and ports are already closed. Make sure that you have a network patch to reach the sensor through a direct network connection
- If the authentication process is through [transport layer security \(TLS\)](#) certificates, confirm that you have `ca.pem`, `client.pem`, and `client.key` files, as well as the `client.key` unlock password
- If the authentication process is through the [protected extensible authentication protocol \(PEAP\)](#), confirm that you have the identity and password

### Procedure

1. Log into the console, either directly or through [SSH](#).
2. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

3. To create the directory `/etc/wpa_supplicant_certs` and change the directory permissions to 755, enter this command:

```
mkdir /etc/wpa_supplicant_certs  
chmod 755 /etc/wpa_supplicant_certs
```



**Important:**

You must use this exact directory name. No other name is permitted.

4. To create the file `/etc/wpa_supplicant.conf`, enter this command:

```
vi /etc/wpa_supplicant.conf
```



**Important:**

You must use this exact file name. No other name is permitted. If necessary, you should rename the file to this name.

5. Examples of `wpa_supplicant.conf` are shown below:

- Configuration for [PEAP](#) authentication:

```
ctrl_interface=/var/run/wpa_supplicant
ctrl_interface_group=0
eapol_version=1
ap_scan=0
network={
    ssid="NOZOMI8021X"
    key_mgmt=IEEE8021X
    eap=PEAP
    identity="identity_for_this_guardian_here"
    password="somefancypassword_here"
}
```

- Configuration for [TLS](#) authentication:

```
ctrl_interface=/var/run/wpa_supplicant
ctrl_interface_group=0
eapol_version=1
ap_scan=0
network={
    ssid="NOZOMI8021X"
    key_mgmt=IEEE8021X
    eap=TLS
    identity="client"
    ca_cert="/etc/wpa_supplicant_certs/ca.pem"
    client_cert="/etc/wpa_supplicant_certs/client.pem"
    private_key="/etc/wpa_supplicant_certs/client.key"
    private_key_passwd="somefancypassword_private_key_here"
}
```

6. For [TLS](#) authentication, use Ethernet to connect to the sensor and copy the required files to the expected location.



**Note:**

If the sensor is not reachable via [SSH](#) using the actual network, we suggest that you configure the `mgmt` interface with a temporary [IP](#) address and connect the sensor with a direct Ethernet patch cable.

7.

**Note:**

If you are using [PEAP](#) authentication, you can skip the next step.

For [TLS](#) authentication, upload the certificate files to the sensor with an [SSH](#) client in the `/etc/wpa_supplicant_certs/` folder.

```
scp ca.pem client.pem client.key admin@<sensor_ip>:/tmp/
```

8. In the sensor serial console, with elevated privileges, move the files to the expected location:

```
mv /tmp/ca.pem /tmp/client.pem /tmp/client.key /etc/  
wpa_supplicant_certs
```

9.

**Note:**

If you are using [PEAP](#) authentication, you can skip the next step.

In the sensor serial console, with elevated privileges, to change the certificate permission to 440, enter these commands:

```
cd /etc/wpa_supplicant_certs  
chown root:wheel ca.pem client.pem client.key  
chmod 440 ca.pem client.pem client.key
```

10. In the sensor serial console, with elevated privileges, to change the `/etc/rc.conf` file, enter the details that follow:

```
wpa_supplicant_flags="-s -Dwired"  
wpa_supplicant_program="/usr/local/sbin/wpa_supplicant"
```

11. To change the `ifconfig_mgmt` entry in the `/etc/rc.conf` file, add the prefix WPA.

**Note:**

If the sensor was configured with a direct Ethernet patch cable, you can now configure the production-ready [IP](#) address and connect the sensor to the switch. For example, if the sensor [IP](#) address is 192.168.10.10, the entry will be similar to:

```
ifconfig_mgmt="WPA inet 192.168.10.10 netmask 255.255.255.0"
```

12. To save all of the settings, enter this command:

```
n2os-save
```

13. To reboot the system, enter this command:

```
shutdown -r now
```

14. Wait for the system to reboot.

15. Log in to the sensor.

16. Enter the command: `ps aux |grep wpa` You should receive output similar to the following:

```
root 91591 0.0 0.0 26744 6960 - Ss 09:59
0:00.01 /usr/local/sbin/wpa_supplicant -s -Dwired -B -i mgmt
-c /etc/
wpa_supplicant.conf -D wired -P /var/run/wpa_supplicant/mgmt.pid
```

17. You can check the status of the `wpa_supplicant` with the `wpa_cli -i mgmt status` command. For example:

```
root@guardian:~# wpa_cli -i mgmt status
bssid=01:01:c1:02:02:02
freq=0
ssid=NOZOMI8021X
id=0
mode=station
pairwise_cipher=NONE
group_cipher=NONE
key_mgmt=IEEE 802.1X (no WPA)
wpa_state=COMPLETED
ip_address=192.168.1.2
address=FF:FF:FF:FF:FF:FF
Supplicant PAE state=AUTHENTICATED
suppPortStatus=Authorized
EAP state=SUCCESS
selectedMethod=13 (EAP-TLS)
eap_tls_version=TLSv1.2
EAP TLS cipher=ECDHE-RSA-AES256-GCM-SHA384
tls_session_reused=0
eap_session_id=0dd52aaeaa2aa3aa4deaac6aaafc65edbf58cdffecff6ff4[.
..]
uuid=8a31bd80-1111-22aa-ffff-abafa0a9afa6
```

## USB port disablement

*The Nozomi Networks Operating System (N2OS) does not support universal service bus (USB) ports.*

We do not recommend that you connect external disks or other devices to the [universal serial bus \(USB\)](#) port of a sensor, as we do not guarantee that they will work.

A [USB](#) keyboard will work in a hardened configuration. However, the **Ctrl+Alt+Del** shortcut will not work.

You can use readily available, external tools to physically block a [USB](#) port.

## Turbo capture mode enablement

*A description of how to configure the turbo capture mode, in order to handle higher traffic loads.*

The turbo capture mode allows the Nozomi Networks solution to fully leverage all the [CPU](#) cores in the system when capturing traffic from local interfaces. By fully parallelizing all packet processing stages and minimizing the packet data copies in memory, it is possible to handle extremely high loads even if arriving over a few interfaces.

When in turbo capture mode, it is not possible to simultaneously trace traffic into files. Therefore, it is no longer possible to configure continuous traces regardless if scoped (e.g. relating to a specific node) or not. Traces that are triggered by alerts are not affected and are available regardless of turbo capture mode status. However, due to the previous shortcoming, it is recommended that the turbo capture mode is enabled only when the traffic load is expected to exceed 3 [Gigabit per second \(Gb/s\)](#).

In order to enable turbo capture mode, you need to add the following line in the `/data/cfg/n2os.conf.user` file (after replacing the `interfaces` array with the ones that are applicable to the specific system):

```
turbo_capture params { "enabled": true, "pin_cores": true, "interfaces":  
  [ "vmx1", "vmx2" ] }
```

The `turbo_capture params` argument is a [JavaScript Object Notation \(JSON\)](#) object that holds all the configuration options that are relevant for the feature:

- `enabled`: (boolean) configures whether the turbo capture mode should be enabled.
- `pin_cores`: (boolean) configures whether each of the packet processing threads should be pinned to a fixed thread. In systems with high [CPU](#) core counts, fixing these threads to run only in specific [CPU](#) cores is leading to more efficient resources utilization.
- `interfaces`: (array) List of interfaces that are to be monitored in turbo capture mode. For interfaces that are not present in this array, no monitoring is to be done in turbo capture mode. Note that to be used in this mode, interface names should not contain underscore characters.

After updating the configuration file, the `n2osids` and `n2ostrace` services need to be restarted:

```
service n2osids stop  
service n2ostrace stop
```



## Chapter 6. Compatibility Reference



## Configuring SSH profiles

*Different SSH cipher configurations are necessary for system security and compatibility. N2OS provides various profiles with customized cipher parameters to meet specific requirements.*

### About this task

The **standard** profile offers the highest level of security and has been the system default since version 23.3. The **legacy** profile ensures compatibility with older systems and was the default configuration prior to version 23.3. The **ccn** profile complies with the Spanish CCN standards, while the **fips** profile adheres to [FIPS](#)-approved ciphers.

Choose the profile that best suits your needs and follow the provided commands to change it.

To change the [SSH](#) profile, use the following commands:

### Procedure

1. Log in to the console, and enter privileged mode with the command:

```
enable-me
```

2. Type the following command to change the [SSH](#) profile:

```
sysrc n2osssh_profile=<standard|legacy|ccn|fips>
```

3. Save the configuration change:

```
n2os-save
```

4. Reboot the appliance to apply the new configuration:

```
shutdown -r now
```

To disable [SSH](#) access via password authentication, you can add the postfix `-nopwd` to a profile. For example:

```
sysrc  
n2osssh_profile=<standard-nopwd|legacy-nopwd|ccn-nopwd|fips-nopwd>
```



#### CAUTION:

With this configuration, [SSH](#) access will not be possible unless the [SSH](#) key is configured in the Web [UI](#).

For more details about how to add [SSH](#) keys, see **Add an SSH key for an admin user** in the **Administrator Guide**.

## SSH compatibility

Tables that give configuration details for each profile.

### Standard SSH protocols profile (since 23.3.0)

Function	Algorithms
<b>Key exchange</b>	sntrup761x25519-sha512@openssh.com curve25519-sha256 curve25519-sha256@libssh.org diffie-hellman-group-exchange-sha256 diffie-hellman-group16-sha512 diffie-hellman-group18-sha512
<b>Ciphers</b>	chacha20-poly1305@openssh.com aes128-ctr aes192-ctr aes256-ctr aes128-gcm@openssh.com aes256-gcm@openssh.com
<b>MACs</b>	umac-128-etm@openssh.com hmac-sha2-256-etm@openssh.com hmac-sha2-512-etm@openssh.com
<b>Host Key Algorithms</b>	rsa-sha2-512 rsa-sha2-256 ssh-ed25519

### Legacy SSH protocols profile (prior 23.3.0)

Function	Algorithms
<b>Key exchange</b>	curve25519-sha256@libssh.org diffie-hellman-group18-sha512 diffie-hellman-group14-sha256 diffie-hellman-group16-sha512 diffie-hellman-group-exchange-sha256

Function	Algorithms
<b>Ciphers</b>	chacha20-poly1305@openssh.com aes256-gcm@openssh.com aes128-gcm@openssh.com aes256-ctr aes192-ctr aes128-ctr
<b>MACs</b>	hmac-sha2-256 hmac-sha2-512 hmac-sha2-512-etm@openssh.com hmac-sha2-256-etm@openssh.com umac-128-etm@openssh.com
<b>Host Key Algorithms</b>	ecdsa-sha2-nistp384 ecdsa-sha2-nistp521 ssh-rsa ssh-ed25519

### CCN SSH protocols profile

Function	Algorithms
<b>Key exchange</b>	ecdh-sha2-nistp256 ecdh-sha2-nistp384 ecdh-sha2-nistp521 diffie-hellman-group18-sha512 diffie-hellman-group16-sha512
<b>Ciphers</b>	aes256-gcm@openssh.com aes128-gcm@openssh.com aes256-ctr aes192-ctr aes128-ctr
<b>MACs</b>	hmac-sha2-256-etm@openssh.com hmac-sha2-512-etm@openssh.com hmac-sha2-256 hmac-sha2-512

Function	Algorithms
Host Key Algorithms	ecdsa-sha2-nistp384 ecdsa-sha2-nistp521 ecdsa-sha2-nistp256

For more details, see [Supported SSH protocols in FIPS mode \(on page 64\)](#).

## HTTPS compatibility

### Supported HTTPS protocols (since 21.9.0)

TLS version	Cipher Suite Name (IANA/RFC)
TLS 1.2	TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256 TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 TLS_DHE_RSA_WITH_AES_256_GCM_SHA384
TLS 1.3	TLS_AES_256_GCM_SHA384 TLS_CHACHA20_POLY1305_SHA256 TLS_AES_128_GCM_SHA256

### Supported RC/Guardian data channel protocols (since 21.9.0)

TLS version	Cipher Suite Name (IANA/RFC)
TLS 1.2	ECDHE-RSA-AES128-GCM-SHA256 ECDHE-RSA-AES256-GCM-SHA384 DHE-RSA-AES128-GCM-SHA256 DHE-RSA-AES256-GCM-SHA384

## Supported SSH protocols in FIPS mode

A list of all the secure shell (SSH) protocols that are supported in Federal Information Processing Standards (FIPS) mode.

Table 7. Supported SSH protocols in FIPS mode

Function	Algorithms
Key exchange	ecdh-sha2-nistp256
	ecdh-sha2-nistp384
	ecdh-sha2-nistp521
	diffie-hellman-group-exchange-sha256
	diffie-hellman-group14-sha256
	diffie-hellman-group16-sha512
	diffie-hellman-group18-sha512
Ciphers	aes256-gcm@openssh.com
	aes256-ctr
	aes128-gcm@openssh.com
	aes128-ctr
MACs	hmac-sha2-256-etm@openssh.com
	hmac-sha2-512-etm@openssh.com
	hmac-sha2-256
	hmac-sha2-512
Host key algorithms	ecdsa-sha2-nistp256
	ecdsa-sha2-nistp384
	ecdsa-sha2-nistp521
	rsa-sha2-256
	rsa-sha2-512



## Chapter 7. Federal Information Processing Standards



## Federal Information Processing Standards

*A description of the use of Federal Information Processing Standards in the Nozomi Networks software.*

You can configure the [N2OS](#) software to use the FIPS-140-2 approved cryptography module. The develops [FIPS](#) for non-military American government agencies, and government contractors, to use in computer systems.

The FIPS-140 series specifies requirements for cryptography modules within a security system to protect sensitive, but unclassified, data.

To enable [FIPS](#) mode, you must install a [FIPS](#)-enabled license. To obtain a license, refer to your Nozomi Networks representative.

**Important:**

To enable [FIPS](#) mode, you must be running version N2OS 22.2.1 or later.

**Important:**

You can only connect [FIPS](#) products to other [FIPS](#) products. The use of mixed environments is not allowed.

**Important:**


Enabling [FIPS](#) mode:

- If you are running a version of [N2OS](#) that is between 22.2.1 and 23.1.0, you will need a valid [FIPS](#) license for both Guardians and [CMCs](#)
- Beginning with version 23.1.0 or later, [FIPS](#) mode can be enabled on Guardians without a license, but packet sniffing will be disabled until a valid license is activated
- The order of enabling [FIPS](#) on either device does not affect functionality
- You need a [FIPS](#) license for [CMCs](#) and Remote Collectors. Upstream sensors will manage these licenses

## FIPS mode status

When running in Federal Information Processing Standards (FIPS) mode, the sensor adds a FIPS indicator after the version string.

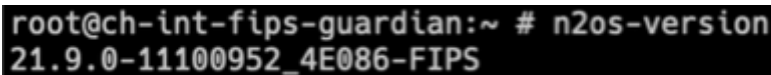
In the Web [UI](#), look to see if FIPS is shown after the version string.



21.9.0-11100952\_4E086 FIPS    TIME 17:32

If you want to add FIPS to the version string, you can enter the command:

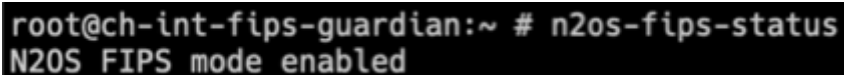
```
n2os-version
```



```
root@ch-int-fips-guardian:~ # n2os-version
21.9.0-11100952_4E086-FIPS
```

If you want to check the [FIPS](#) status, you can enter the command:

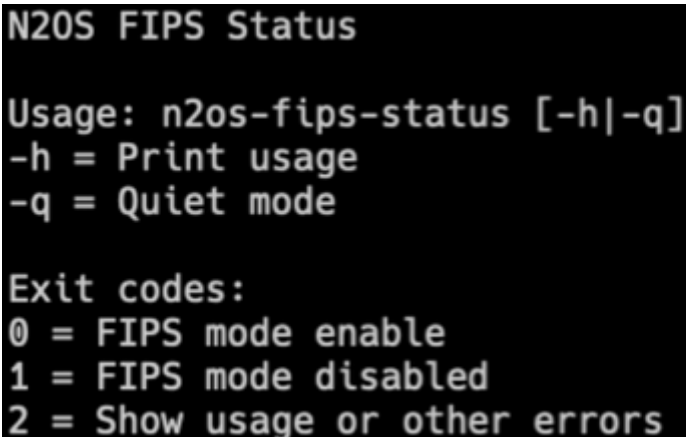
```
n2os-fips-status
```



```
root@ch-int-fips-guardian:~ # n2os-fips-status
N2OS FIPS mode enabled
```

To support additional parameters for extended usage, you can enter the command:

```
n2os-fips-status [-h | -q]
```



```
N2OS FIPS Status

Usage: n2os-fips-status [-h|-q]
-h = Print usage
-q = Quiet mode

Exit codes:
0 = FIPS mode enable
1 = FIPS mode disabled
2 = Show usage or other errors
```

## Enable FIPS mode

*It is important that you follow this procedure to make sure that you enable Federal Information Processing Standards (FIPS) mode correctly.*

### About this task

When you switch to **FIPS** mode, local user Web **UI** passwords become invalid. To take advantage of **FIPS** encryption, you can use the `n2os-passwd` command to reset the passwords.

The `n2os-passwd <USER>` command takes several seconds to several minutes to prompt the user for a new password. On the R50 platform, the prompt may take up to three minutes.



#### Important:

When you enable **FIPS**, it is critical that you change the password for **EVERY** Web **UI** local user.

### Procedure

1. Log into the console.
2. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

3.



#### Note:

For **CMCs**, version 23.1.0 or later, it is not necessary to do the next step.




#### Note:

For Guardians, version 23.1.0 or later, you can also do the next two steps after you have enabled **FIPS**.

To configure the **FIPS** license, enter the command:

```
echo 'conf.user configure license fips xxxxxxxx' | cli
```

4.  **Note:**  
For **CMCs**, version 23.1.0 or later, it is not necessary to do the next step.

To restart the *intrusion detection system (IDS)*, enter the command:

```
service n2osids stop
```

**Result:** The *IDS* stops. After a few seconds, it will automatically start again.

5. To enable *FIPS* mode, enter the command:

```
n2os-fips-enable
```

**Result:** The system automatically reboots.

6. In the container edition, stop the current container and start a new one with the same settings.

7. To change the password for every user, enter the command:

```
n2os-passwd <USER>
```

8. Log in to the sensor.

9. In the top navigation bar, select 

**Result:** The administration page opens.

10. In the **System** section, select **Updates and licenses**.

**Result:** The **Updates and licenses** page opens.

11. In the **Current license** section for **FIPS**, make sure that the **License status** shows ok.

12. Do this procedure again for all **CMCs** and Guardians.

## Disable FIPS mode

*Do this procedure to disable Federal Information Processing Standards (FIPS) mode.*

### About this task

When you switch to [FIPS](#) mode, local user Web [UI](#) passwords become invalid. You can use the `n2os-passwd` command to reset the passwords.

### Procedure

1. Log into the console, either directly or through [SSH](#).
2. To go to privileged mode, enter this command:

```
enable-me
```

**Result:** You can now perform system changes.

3. To disable [FIPS](#) mode, enter the command:

```
n2os-fips-disable
```

4. Reboot the system, or restart the container, to apply the changes.





# Glossary



### **Amazon Machine Image**

An AMI is a type of virtual appliance that is used to create a virtual machine for the Amazon Elastic Compute Cloud (EC2), and is the basic unit of deployment for services that use EC2 for delivery.

### **Amazon Web Services**

AWS is a subsidiary of the Amazon company that provides on-demand cloud computing platforms governments, businesses, and individuals on a pay-as-you-go basis.

### **Application Programming Interface**

An API is a software interface that lets two or more computer programs communicate with each other.

### **Assertion Consumer Service**

An ACS is a version of the SAML standard that is used to exchange authentication and authorization identities between security domains.

### **Asset Intelligence™**

Asset Intelligence is a continuously expanding database of modeling asset behavior used by N2OS to enrich asset information, and improve overall visibility, asset management, and security, independent of monitored network data.

### **Berkeley Packet Filter**

The BPF is a technology that is used in some computer operating systems for programs that need to analyze network traffic. A BPF provides a raw interface to data link layers, permitting raw link-layer packets to be sent and received.

### **Central Management Console**

The Central Management Console (CMC) is a Nozomi Networks product that has been designed to support complex deployments that cannot be addressed with a single sensor. A central design principle behind the CMC is the unified experience, that lets you access information in the similar method to the sensor.

### **Central Processing Unit**

The main, or central, processor that executes instructions in a computer program.

### **Certificate Authority**

A certificate, or certification authority (CA) is an organization that stores, signs, and issues digital certificates. In cryptography, a digital certificate certifies the ownership of a public key by the named subject of the certificate.

### **Classless Inter-Domain Routing**

CIDR is a method for IP routing and for allocating IP addresses.

### **Command-line interface**

A command-line processor uses a command-line interface (CLI) as text input commands. It lets you invoke executables and provide information for the actions that you want them to do. It also lets you set parameters for the environment.

### **Comma-separated Value**

A CSV file is a text file that uses a comma to separate values.

### **Common Event Format**

CEF is a text-based log file format that is used for event logging and information sharing between different security devices and software applications.

### **Common Platform Enumeration**

CPE is a structured naming scheme for information technology (IT) systems, software, and packages. CPE is based on the generic syntax for Uniform Resource Identifiers (URI) and includes a formal name format, a method for checking names against a system, and a description format for binding text and tests to a name.

### **Common Vulnerabilities and Exposures**

CVEs give a reference method information-security vulnerabilities and exposures that are known to the public. The United States' National Cybersecurity FFRDC maintains the system.

### **Common Weakness Enumeration**

CWE is a category system for software and hardware weaknesses and vulnerabilities. It is a community project with the aim to understand flaws in software and hardware and create automated tools that can be used to identify, fix, and prevent those flaws.

### **Configuration file**

A CFG file is a configuration, or config, file. They are files that are used to configure the parameters and initial settings for a computer program.

### **Domain Name Server**

The DNS is a distributed naming system for computers, services, and other resources on the Internet, or other types of Internet Protocol (IP) networks.

**ESXi**

VMware ESXi (formerly ESX) is an enterprise-class, type-1 hypervisor developed by VMware for deploying and serving virtual computers. As a type-1 hypervisor, ESXi is not a software application that is installed on an operating system (OS). Instead, it includes and integrates vital OS components, such as a kernel.

**Extensible Markup Language**

XML is a markup language and file format for the storage and transmission of data. It defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

**Federal Information Processing Standards**

FIPS are publicly announced standards developed by the National Institute of Standards and Technology for use in computer systems by non-military American government agencies and government contractors.

**File Transfer Protocol**

FTP is a standard communication protocol that is used for the transfer of computer files from a server to a client on a computer network. FTP is built on a client-server model architecture that uses separate control and data connections between the client and the server.

**Fully qualified domain name**

An FQDN is a complete and specific domain name that specifies the exact location in the hierarchy of the Domain Name System (DNS). It includes all higher-level domains, typically consisting of a host name and domain name, and ends in a top-level domain.

**Gigabit per second**

Gigabit per second (Gb/s) is a unit of data transfer rate equal to: 1,000 Megabits per second.

**Gigabyte**

The gigabyte is a multiple of the unit byte for digital information. One gigabyte is one billion bytes.

**Graphical User Interface**

A GUI is an interface that lets humans interact with electronic devices through graphical icons.

**Graphics Interchange Format**

GIF is a bitmap image format that is widely used on the internet.

**High Availability**

High Availability is a mode that permits the CMC to replicate its own data on another CMC.

**Host-based intrusion-detection system**

HIDS is an internal Nozomi Networks solution that uses sensors to detect changes to the basic firmware image, and record the change.

**Hypertext Transfer Protocol**

HTTP is an application layer protocol in the Internet protocol suite model for distributed, collaborative, hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web, where hypertext documents include hyperlinks to other resources that the user can easily access, for example by a mouse click or by tapping the screen in a web browser.

**Hypertext Transfer Protocol Secure**

HTTPS is an extension of the Hypertext Transfer Protocol (HTTP). It is used for secure communication over a computer network, and is widely used on the Internet. In HTTPS, the communication protocol is encrypted using Transport Layer Security (TLS) or, formerly, Secure Sockets Layer (SSL). The protocol is therefore also referred to as HTTP over TLS, or HTTP over SSL.

**Identifier**

A label that identifies the related item.

**Identity Provider**

An IdP is a system entity that creates, maintains, and manages identity information. It also provides authentication services to applications within a federation, or a distributed network.

**Internet Control Message Protocol**

ICMP is a supporting protocol in the internet protocol suite. Network devices use it to send error messages and operational information to indicate success or failure when communicating with another IP address. ICMP differs from transport protocols such as TCP and UDP in that it is not typically used to exchange data between systems.

**Internet of Things**

The IoT describes devices that connect and exchange information through the internet or other communication devices.

**Internet Protocol**

An Internet Protocol address, or IP address, identifies a node in a computer network that uses the Internet Protocol to communicate. The IP label is numerical.

### ***Intrusion Detection System***

An intrusion detection system (IDS), which can also be known as an intrusion prevention system (IPS) is a software application, or a device, that monitors a computer network, or system, for malicious activity or policy violations. Such intrusion activities, or violations, are typically reported either to a system administrator, or collected centrally by a security information and event management (SIEM) system.

### ***JavaScript Object Notation***

JSON is an open standard file format for data interchange. It uses human-readable text to store and transmit data objects, which consist of attribute–value pairs and arrays.

### ***Joint Photographic Experts Group***

JPEG, or JPG, is a method of lossy compression that is used for digital images. The degree of compression can be adjusted, allowing a selectable tradeoff between storage size and image quality.

### ***Lightweight Directory Access Protocol***

LDAP is an open, vendor-neutral, industry standard application protocol that lets you access and maintain distributed directory information services over an internet protocol (IP) network.

### ***Lightweight Directory Access Protocol Secure***

LDAP over SSL or Secure LDAP is the secure version of LDAP.

### ***Managed Security Service Provider***

In computing, MSSP are network security services that have been outsourced to a service provider. A company that provides this type of service is known as an MSSP.

### ***Media Access Control***

A MAC address is a unique identifier for a network interface controller (NIC). It is used as a network address in network segment communications. A common use is in most IEEE 802 networking technologies, such as Bluetooth, Ethernet, and Wi-Fi. MAC addresses are most commonly assigned by device manufacturers and are also referred to as a hardware address, or physical address. A MAC address normally includes a manufacturer's organizationally unique identifier (OUI). It can be stored in hardware, such as the card's read-only memory, or by a firmware mechanism.

### ***Megabyte***

The megabyte is a multiple of the unit byte for digital information. One megabyte is one million bytes.

### ***Network Address Translation***

NAT is a method of mapping an internet protocol (IP) address space into another one. This is done by modifying network address information in the IP header of packets while in transit across a traffic routing device.

### ***Network Interface Controller***

A network interface controller (NIC), sometimes known as a network interface card, is a computer hardware component that lets a computer connect to a computer network.

### ***Network Time Protocol***

The NTP is a networking protocol to synchronize clocks between computer systems over variable-latency, packet-switched data networks.

### ***Nozomi Networks Operating System***

N2OS is the operating system that the core suite of Nozomi Networks products runs on.

### ***Nozomi Networks Query Language (N2QL)***

N2QL is the language used in queries in Nozomi Networks software.

### ***Open Virtual Appliance***

An OVA file is an open virtualization format (OVF) directory that is saved as an archive using the .tar archiving format. It contains files for distribution of software that runs on a virtual machine. An OVA package contains a .ovf descriptor file, certificate files, an optional .mf file along with other related files.

### ***Operating System***

An operating system is computer system software that is used to manage computer hardware, software resources, and provide common services for computer programs.

### ***Operational Technology***

OT is the software and hardware that controls and/or monitors industrial assets, devices and processes.

### ***Packet Capture***

A pcap is an application programming interface (API) that captures live network packet data from the OSI model ( layers 2-7).

***Packet Capture Next Generation***

A pcapNg is the latest version of a pcap file, an application programming interface (API) that captures live network packet data from the OSI model (layers 2-7).

***Portable Document Format***

PDF is a Adobe file format that is used to present documents. It is independent of operating systems (OS), application software, hardware.

***Portable Network Graphics***

PNG is a raster graphics file format that supports lossless data compression. PNG was developed as an improved, non-patented replacement for graphics interchange format (GIF).

***Privacy-Enhanced Mail***

PEM is a standard file format that is used to store and send cryptographic keys, certificates, and other data. It is based on a set of 1993 IETF standards.

***Programmable Logic Controller***

A PLC is a ruggedized, industrial computer used in industrial and manufacturing processes.

***Protected Extensible Authentication Protocol***

PEAP is a protocol that encloses the Extensible Authentication Protocol (EAP) within an encrypted and authenticated Transport Layer Security (TLS) tunnel.

***Random-access Memory***

Computer memory that can be read and changed in any order. It is typically used to store machine code or working data.

***Representational State Transfer***

Representational State Transfer (REST) is an architectural style for designing networked applications. It uses stateless, client-server communication via standard HTTP methods (GET, POST, PUT, DELETE) to access and manipulate web resources represented in formats like JSON or XML.

***Secure Copy Protocol***

SCP is a protocol for the secure transfer of computer files between a local host and a remote host, or between two remote hosts. It is based on the secure shell (SSH) protocol.

***Secure Shell***

A cryptographic network protocol that let you operate network services securely over an unsecured network. It is commonly used for command-line execution and remote login applications.

***Secure Sockets Layer***

A secure sockets layer ensures secure communication between a client computer and a server.

***Security Assertion Markup Language***

SAML is an open standard, XML-based markup language for security assertions. It allows for the exchange of authentication and authorization data different parties such as a service provider and an identity provider.

***Security Information and Event Management***

SIEM is a field within the computer security industry, where software products and services combine security event management (SEM) and security information management (SIM). SIEMs provide real-time analysis of security alerts.

***Server Message Block***

Is a communication protocol which provides shared access to files and printers across nodes on a network of systems. It also provides an authenticated interprocess communication (IPC) mechanism.

***Simple File Transfer Protocol***

SFTP was proposed as an unsecured file transfer protocol with a level of complexity intermediate between TFTP and FTP. It was never widely accepted on the internet.

***Simple Mail Transfer Protocol***

SMTP is an internet standard communication protocol that is used for the transmission of email. Mail servers and other message transfer agents use SMTP to send and receive mail messages.

***Simple Network Management Protocol***

SNMP is an Internet Standard protocol for the collection and organization of information about managed devices on IP networks. It also lets you modify that information to change device behavior. Typical devices that support SNMP are: printers, workstations, cable modems, switches, routers, and servers.

***Simple Text Oriented Messaging Protocol***

STOMP is a simple text-based protocol, for working with message-oriented middleware (MOM). It provides an interoperable wire format that allows STOMP clients to talk with any message broker supporting the protocol.

### **Structured Threat Information Expression**

STIX™ is a language and serialization format for the exchange of cyber threat intelligence (CTI). STIX is free and open source.

### **Supervisory control and data acquisition**

SCADA is a control system architecture which has computers, networked data communications and graphical user interfaces for high-level supervision of processes and machines. It also covers sensors and other devices, such as programmable logic controllers (PLC), which interface with process plant or machinery.

### **Text-based User Interface**

In computing, a text-based (or terminal) user interfaces (TUI) is a retronym that describes a type of user interface (UI). These were common as an early method of human-computer interaction, before the more modern graphical user interfaces (GUIs) were introduced. Similar to GUIs, they might use the entire screen area and accept mouse and other inputs.

### **Threat Intelligence™**

Nozomi Networks **Threat Intelligence™** feature monitors ongoing OT and IoT threat and vulnerability intelligence to improve malware anomaly detection. This includes managing packet rules, Yara rules, STIX indicators, Sigma rules, and vulnerabilities. **Threat Intelligence™** allows new content to be added, edited, and deleted, and existing content to be enabled or disabled.

### **Transmission Control Protocol**

One of the main protocols of the Internet protocol suite.

### **Transport Layer Security**

TLS is a cryptographic protocol that provides communications security over a computer network. The protocol is widely used in applications such as: HTTPS, voice over IP, instant messaging, and email.

### **Uniform Resource Identifier**

A URI is a unique string of characters used to identify a logical or physical resource on the internet or local network.

### **Uniform Resource Locator**

An URL is a reference to a resource on the web that gives its location on a computer network and a mechanism to retrieving it.

### **Uninterruptible Power Supply**

A UPS is an electric power system that provides continuous power. When the main input power source fails, an automated backup system continues to supply power.

### **Universally unique identifier**

A UUID is a 128-bit label that is used for information in computer systems. When a UUID is generated with standard methods, they are, for all practical purposes, unique. Their uniqueness is not dependent on an authority, or a centralized registry. While it is not impossible for the UUID to be duplicated, the possibility is generally considered to be so small, as to be negligible. The term globally unique identifier (GUID) is also used in some, mostly Microsoft, systems.

### **Universal Serial Bus**

Universal Serial Bus (USB) is a standard that sets specifications for protocols, connectors, and cables for communication and connection between computers and peripheral devices.

### **User Interface**

An interface that lets humans interact with machines.

### **Variable**

In the context of control systems, a variable can refer to process values that change over time. These can be temperature, speed, pressure etc.

### **Virtual DOM**

A virtual DOM, or vdom, is a lightweight JavaScript representation of the Document Object Model (DOM). It is used in declarative web frameworks such as Elm, React, and Vue.js. It enables the updating of the virtual DOM is comparatively faster than updating the actual DOM.

### **Virtual Hard Disk**

VHD is a file format that represents a virtual hard disk drive (HDD). They can contain what is found on a physical HDD, such as disk partitions and a file system, which in turn can contain files and folders. They are normally used as the hard disk of a virtual machine (VM). They are the native file format for Microsoft's hypervisor (virtual machine system), Hyper-V.

### **Virtual Local Area Network**

A VLAN is a broadcast domain that is isolated and partitioned in a computer network at the data link layer (OSI layer 2).

***Virtual Machine***

A VM is the emulation or virtualization of a computer system. VMs are based on computer architectures and provide the functionality of a physical computer.

***ZIP***

An archive file format that supports lossless data compression. The format can use a number of different compression algorithms, but DEFLATE is the most common one. A ZIP file can contain one or more compressed files or directories.