bequant

BQN Installation Guide

Release: 4.9

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Open Software

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Contents

Preface

This guide describes the operation and management of the BQN product.

If the information included in the Release Notes is different from the information in this document, follow the information in the Release Notes.

Intended Audience

This guide is intended for network operators and administrators of a BQN. It assumes that the reader has basic knowledge of operation and management of network equipment.

Conventions

This document uses the following text format conventions:

`Text`	Fixed-width text represents text displayed on the screen. For example: `root@bqn#`
`Text`	Fixed-width bold text represents text entered by the user in an interactive session. For example: `root@bqn#` **`show interface`**
`Text`	Fixed-width italic text represents parameters passed to a command that requires the user to provide a specific value. For example: `interface` *`iface-name`*

The following syntax conventions are used throughout the document:

`[]`	Square brackets enclose optional parameters or keywords. For example, the keyword `validate` is optional: `commit [validate]`
`{}`	Braces enclose required parameters or keywords, and they are used together with pipe symbols to indicate different required keyword choices. For example: `clear config {all | candidate}`
`|`	Pipe symbols separate different keyword choices. They are used together with square brackets and braces to present optional or required keywords. For example: `clear config {all | candidate}`
`...`	Ellipses indicate that the previous keyword may be repeated. For example: `ls` *`FILE`* `...`

Several sections of the guide contain instructions for a specific server type, and those instructions are included inside a shaded box indicating the server type at the top of the box.

Dell PowerEdge R230 / R330 / R440

...

1

Introduction

The BQN product is a network element that can optimize data traffic appplying traffic policies. Policies include acceleration of TCP connections and shaping and rate limits. The BQN product also provides reporting capabilities (e.g. traffic usage per client IP address).

A BQN consists of a physical Intel-based server with a Linux-based operating system that has been customized to run the Bequant software. The BQN is managed through a CLI (Command Line Interface) shell. The CLI provides all the system administration functionality required by a telco-grade network element, including interface and service configuration, logging, monitoring, and software management. A web interface (GUI) is also available over HTTPS to provide basic configuration and monitoring of the system. The GUI is described in the *BQN Quick Start Guide* document.

2

Installation

2.1 System Requirements

The minimum hardware requirements for a BQN installation are:

- Dual-core AMD64/x86_64 based processor.
- 8 GB of physical RAM memory.
- 50 GB hard drive.
- At least 3 network interfaces: one dedicated interface for management, and the other 2 interfaces for the data plane (for optimal performance, use Intel cards in data plane interfaces of the models listed below).

Depending on the required capacity and performance of the BQN, the following servers are supported:

- HPE ProLiant DL360 Gen9 and Gen10.
- Dell PowerEdge R230 / R330 / R440
- Supermicro SYS-5018D-FN8T / SYS-1029P-WTR

Other servers with similar hardware characteristics may be used as well, although the installation and hardware support may be limited (consult Bequant for approval).

For storage, SSDs (Solid State Drive) are recommended for performance and reliability reasons. Disks which use SATA and SAS interfaces are supported, but currently NVMe (Non-Volatile Memory Express) based disks are not supported.

The BQN supports ethernet for the management and data-plane network interfaces. For the management interface, any ethernet card supported by the *Linux* operating system is valid. For the data-planet side, due to intergration and performance reasons, the network interfaces based on the following chipsets are recommended and supported:

- Intel Ethernet Controller I210
- Intel Ethernet Controller I350
- Intel Ethernet Converged Network Adapter X520
- Intel Ethernet Controller X540
- Intel Ethernet Controller X550
- Intel Ethernet Controller X710/XL710/XXV710

The following connectors are supported depending on the network card:

- Copper 1G RJ-45: 1000BASE-T
- Optical 1G SFP: 1000BASE-SX
- Optical 10G SFP+: 10GBASE-SR/1000BASE-SX and 10GBASE-LR/1000BASE-LX
- Optical 40G QSFP+: 40GBASE-SR4 and 40GBASE-LR4

More information about the supported Intel network cards can be found in their web page:

`https://www.intel.com/`

⚠ Please follow all the sections in this chapter in order to install the BQN system correctly.

2.2 Bequant Installation Image

A new installation requires the server to boot an ISO image, the Bequant Installation Image. The ISO image contains the installation programs, operating system and product software.

The integrity of the ISO file should be checked, by comparing the MD5 checksum of the file with the MD5 checksum provided by Bequant. In a UNIX-like operating system the `md5sum` program can be used to compute the MD5 checksum of a file:

```
# md5sum bqnos-R2.0.7-20170410.iso
2b1c3585c58675cf5e4d76b9a85aa8d1  bqnos-R2.0.7-20170410.iso
```

The Bequant Installation Image must be burned into a CD/DVD or a USB flash drive, depending on the device used to boot the installation software. In either case, the ISO image is bootable ready and does not need to be modified.

In a UNIX-like operating system, to burn the ISO file to a USB drive the *dd* standard UNIX tool may be used.

```
# dd if=bqn.iso of=/dev/sdg
```

where `bqn.iso` is the Bequant Installation Image file and `/dev/sdg` is the block device of the USB flash drive. Make sure that you use the correct block device name where the USB flash drive is located in your system. Note that permission to write into the block device is required.

To burn the ISO file to a CD/DVD, any burning software that allows burning an ISO image may be used.

⚠ The ISO file is already a bootable ISO, so it should be burned directly as is.

If *Rufus* (`https://rufus.ie`) is used to burn the ISO, use the following settings:

- Partition scheme: *MBR*
- Target system: *BIOS or UEFI*

The rest of the settings should be left in their default values. Once `START` is clicked, select the *Write in DD Image mode* option to write the ISOHybrid image.

Servers with a lights-out management (LOM) interface, such as the HPE iLO, Dell iDRAC or Supermicro IPMI, allow mounting and booting the ISO file as a virtual drive.

2.3 Console Access

For the installation process, access to the system console is required, which can be performed with one of the methods described in the following subsections.

2.3.1 Physical Console

If the system is connected to a monitor and a keyboard, then restart or power on the server and continue with the instructions in the next section.

2.3.2 Lights-Out Management (LOM) Interface

A system with a lights-out management (LOM) interface that provides system console access may be used (e.g. Dell iDRAC, HPE iLO, IBM IMM).

In general, to access the LOM interface in the server you need a laptop or other PC with a browser that supports Java, such as *Chrome* or *Firefox*. Make sure that the laptop has the latest version of Java installed; otherwise, install if from

`http://www.java.com`

Dell PowerEdge R230 / R330 / R440

The iDRAC network port may be a dedicated ethernet port or shared with the server embedded NIC, depending on the purchased server. In order to use the virtual console feature the *iDRAC Enterprise* license must be installed in the server.

The iDRAC interface is factory pre configured with the `192.168.0.120/24` static IP address and `192.168.0.1` gateway. You may modify it through the LCD panel on the front of the server, using the arrow and select keys and following the instructions provided.

By default the iLO uses the following TCP ports:

- Web server SSL port: 443
- Remote virtual console port: 5900

Launch the virtual console by following these steps:

1. Log into the iDRAC web page using the *root* user name and *calvin* default password (if the server was shipped from Bequant or one of its integrators, the default password is the Service Tag, which is available on the front of the server by pulling out the information tag).
2. If the Dell default password is still set, an option is available to change it to whatever value you want.
3. Navigate to the *Overview→Server→Virtual Console* page.
4. Click *Virtual Console Viewer* to launch the virtual console window.
5. If one of more Security Alert windows appear while launching the viewer click *Yes* to continue.

Visit the following Dell page to get more information about the iDRAC:

`http://www.dell.com/idracmanuals`

Reboot or power on the server to proceed with the installation and follow the instructions in the next section.

HPE ProLiant DL360 Gen9 / Gen10

The iLO port is a standard 1GbE RJ45 Ethernet port located in the back of the server. In order to use the virtual console feature the *iLO Advanced* license must be installed in the server.

By default the iLO uses the following TCP ports:

- Web server SSL port: 443
- Remote virtual console port: 17990
- Virtual media port: 17988

By default the iLO is setup with a DHCP client to get the network configuration. If the server is connected to a network where a DHCP server supplies the IP configuration, then connect the installation laptop (or any other system) to the same network to access the server; otherwise, follow the steps below to setup a network connection with the server:

1. Connect with an ethernet cable the server directly to the installation laptop to access the server.
2. Start a DHCP server program in the laptop to supply the network configuration to the server. For Windows systems, the TFTPD32 opensource software may be used as the DHCP server.
   a) Download the latest version of the TFTPD64 portable edition from:
      `http://tftpd32.jounin.net/tftpd32_download.html`
   b) Extract the contents of the ZIP file downloaded.
   c) Execute the program `tftpd64.exe` as an Administrator user.

d) If Windows Firewall is enabled, allow the `tftpd64.exe` program to access the public network if a windows asking for permission is displayed.

e) In the TFTPD32 window press the `Settings` button.

i. Under the *GLOBAL* tab, clear all the selections and enable *DHCP*.

ii. Under the *DHCP* tab, enter the following information:
IP pool start address: `192.168.0.10`
Size of pool: `10`
Def. router: `192.168.0.1`
Mask: `255.255.255.0`

iii. Press `OK` in order to apply the settings.

f) Restart the program if requested in order to apply the settings.

g) Verify that the *Software Loopback Interface* is selected as the *Server Interface*.

h) Both the laptop and the server are supplied an IP address, which is shown in the main window (usually the second address is supplied to the server).

3. Verify that the server IP address may be reached from the laptop.

Once the server is connected to the laptop, start a web browser to access the iLO web interface and enter the following URL (where 192.168.0.11 in this example is the IP address assigned to the server):

```
https://192.168.0.11
```

In some cases the browser shows an unsafe warning indicating that its security certificate may not be installed, but it can be ignored and you may proceed to the web page.

Get the virtual console by following these steps:

1. Log into the iLO web page using the *Administrator* user and password (the default password is printed on a label on top of the server).
2. Navigate to the *Remote Console→Remote Console* page.
3. Click the *Web Start* button. Depending on the web browser, accept that Java Web Start Launcher executes the Java IRC JNLP file.
4. If prompted, confirm by pressing *Run* that you want to run the application, and click *Continue* if a security warning is displayed.

The iLO Integrated Remote Console should be displayed.

Reboot or power on the server by selecting *Power Switch* and *Momentary Press* and follow the instructions in the next section.

Supermicro

The dedicated IPMI LAN port is the one located on the top-left side (front or back, depending on the model). Servers shiped by Bequant are configured so the IPMI port is also sharing the BQN management port (the integrated port on the bottom-left side).

By default IPMI uses the following TCP ports:

- Web server SSL port: 443
- Remote virtual console port: 5900
- Virtual media port: 623

Launch the virtual console by following these steps:

1. Log into the IPMI web page using the *ADMIN* user name and *ADMIN* default password (if the server was shipped from Bequant or one of its integrators, the username is *root* and the password is the serial number, which is available on the back of the server).
2. Navigate to the *Remote Control→Console Redirection* page.
3. Click *Launch Console* to launch the virtual console window.
4. If one of more Security Alert windows appear while launching the viewer click *Yes* to continue.

Visit the following page to get more information about the IPMI console:

`https://www.supermicro.com/support/resources/`

Reboot or power on the server to proceed with the installation and follow the instructions in the next section.

2.3.3 Serial Console Interface

A system with a serial port may use the serial console interface for installation.

Cambium Networks cnMaestro-Advantech / Allot ATCA Blade

These servers have a console port in the front panel that provides a serial console to access the system. Follow these steps to setup the console:

1. Connect a serial cable to the serial port in the front panel (marked as `CONSOLE`). Note that the serial cable must have an RJ45 connector to plug it into the server.
2. Start a terminal communication program (such as *miricom* or *screen*) in the system connected to the server over the serial cable. Make sure that the serial device is recognized and install the appropriate drivers if needed.

   Under Linux. if a USB serial adapter is connected to the system, usually the device used is `/dev/ttyUSB0`, and the device should be automatically supported by the kernel without having to install additional drivers.
3. Configure the terminal software with the following parameters for the serial device:

   115200 baud
   8 data bits
   no parity
   1 stop bit
   no flow control

Wait for activity in the terminal or press `ENTER` several times to verify that the serial connection has been established.

Restart or power on the system. On the Allot ATCA blade, unlatching the 2 handles and reinserting them reboots the system, and follow the instructions in the next section

2.4 BIOS Settings

2.4.1 Boot Options

The ISO supports both *legacy/MBR/BIOS* mode or *UEFI* mode. Many modern servers only support *UEFI* boot mode, but for the rest, either mode is available.

The boot mode is selected in the BIOS/System settings under the *Boot Mode* or *Boot Options* section. In order to access the BIOS/System settings you may have to press a special key during the Power-On Self Test (POST) sequence (it may be `F2`, `F9`, `DEL` or some other key displayed on the screen).

⚠ If UEFI mode is selected as the boot mode make sure that *Secure Boot* is **disabled** in the BIOS/System settings (under the *Boot Mode* or *Boot Options* section).

2.4.2 System Clock

It is necessary that the system clock is set with the correct time and date before proceeding with the installation. The system clock will most likely be set in the BIOS menu.

> ⚠ The system time must be set to Coordinated Universal Time (UTC).

The current UTC time can be otained at this page:

```
https://www.timeanddate.com/worldclock/timezone/utc
```

Dell PowerEdge R230 / R330 / R440

Follow the next instructions to verify and change the system clock.

1. Enter the *System Setup* screen during the server Power-On Self Test (POST) sequence by pressing `F2`.
2. Then select *System BIOS→Miscellaneous Settings*, and change the time under *System Time* and the date under *System Date*.
3. Click `Exit` to save the changes.

HPE ProLiant DL360 Gen9 / Gen10

Follow the next instructions to verify and change the system clock.

1. Enter the *System Utilities* screen during the server Power-On Self Test (POST) sequence by pressing `F9`.
2. Then select *System Configuration→BIOS/Platform Configuration→Date and Time* option.
3. Change the time and date and set the *Time Zone* to *UTC-00:00* and disable *Daylight Savings Time*.
4. Press `F10` to save the changes.

Supermicro

Follow the next instructions to verify and change the system clock.

1. Enter the *BIOS Setup* screen during the server Power-On Self Test (POST) sequence by pressing the `DEL` key.
2. On the *Main* tab, go to the *System Date* option and select each date field to modify its value with the `-` or `+` keys. Use the `TAB` key to switch from one field to the other.
3. On the *Main* tab, go to the *System Time* option and select each time field to modify its value with the `-` or `+` keys. Use the `TAB` key to switch from one field to the other.
4. Press `F4` to confirm and save the changes.

2.4.3 Performance Settings

The BIOS provides several settings that improve system performance.

Dell PowerEdge R230 / R330 / R440

Follow the next instructions to activate some high-performance settings:

1. Enter the *System Setup* screen during the server POST sequence by pressing `F2`.
2. Then select *System BIOS→System Profile*, and ensure that the power profile selected is *Performance*.
3. Click `Exit` to save the changes.

HPE ProLiant DL360 Gen9

Follow the next instructions to activate some high-performance settings:

1. Enter the *System Utilities* screen during the server POST sequence by pressing `F9`.
2. Then select *System Configuration→BIOS/Platform Configuration→Power Management* option.
3. Change the *Power Profile* to *Maximum Performance*.
4. Press `ESC` to go back to the *BIOS/Platform Configuration* menu.
5. Select *Performance Options→Advanced Performance Tuning Options*.
6. Change the *QPI Bandwidth Optimization (RTID)* option to *Optimized for I/O (Alternate RTID)*.
7. Disable the *I/O Non-posted Prefetching* option.
8. Press `F10` to save the changes.
9. Press `ESC` several times to get to the top of the *System Utilities* menu and select *Reboot the System* to apply the changes.

HPE ProLiant DL360 Gen10

Follow the next instructions to activate some high-performance settings:

1. Enter the *System Utilities* screen during the server POST sequence by pressing `F9`.
2. Then select *System Configuration→BIOS/Platform Configuration* option.
3. Change the *Workload Profile* to *I/O Throughput*.
4. Press `F10` to save the changes.
5. Press `ESC` several times to get to the top of the *System Utilities* menu and select *Reboot the System* to apply the changes.

2.4.4 Disk Setup

Multiple hard drives together with hardware RAID (Redundant Array of Independent Disks) support should be used for redundancy. If no RAID controller is available, then skip this section.

Note that in most cases, the RAID controllers require that the disks available to the operating system must be defined in the RAID controller configuration, even if there is only one disk or if no RAID redundancy scheme is used. Therefore, it is necessary to create a logical or virtual drive inside the RAID controller. In addition, the logical or virtual drive must be marked as a bootable disk.

The RAID controller configuration is usually available during the server Power-On Self Test (POST) sequence. If there is only one physical disk, then configure RAID 0; otherwise, the preferred RAID level is RAID 1 (mirroring), and if several disks are available, then RAID 1+0 (stripe of mirrors) should be used. If there is an odd number of hard drives, the remaining disk may be used as a spare.

Dell PowerEdge R230 / R330 / R440

By default the Dell PowerEdge R230 and R330 have one disk and RAID pass-through is enabled, which means that no configuration is required and the disk is already visible by the operating system.

If several disks are available and RAID is required, follow these instructions to enable RAID and setup a virtual drive (note that all the information stored in the disks will be erased):

1. Enter the *System Setup* screen during the server POST sequence by pressing `F2`.
2. Select the *Device Settings→Integrated RAID Controller* option to enter the controller Main Menu. Note that the RAID model number is also displayed (*Dell PERC H330 Adapter* in the PowerEdge R330).

3. Select the *Configuration Management→Convert to RAID Capable* option to convert a non-RAID disk to RAID capable, and select all the physical disks and press *OK*, and confirm the convertion and press *Yes*. Once the disks have been converted to RAID go back to the main menu.
4. Select the *Configuration Management→Create Profile Based Virtual Disk* option, and then select the RAID level: *Generic RAID0* if there is only one disk or *Generic RAID1* if multiple disks are available.
5. Accept all the parameters by default and at the bottom of the page select *Create Virtual Disk*, mark the *Confirm* option and press *Yes* to create the virtual disk.
6. Verify that the Virtual disk is bootable by selecting *Controller Management* from the Main Menu, and that the *Select Boot Device* field contains the virtual disk recently created.
7. Exit the *System Setup* menu to continue with the setup.

In case you choose to convert a RAID enabled setup to a non-RAID setup, follow this instructions (note that all the information stored in the disks will be erased):

1. Enter the *System Setup* screen during the server POST sequence by pressing `F2`.
2. Select the *Device Settings→Integrated RAID Controller* option to enter the controller Main Menu. Note that the RAID model number is also displayed (*Dell PERC H330 Adapter* in the PowerEdge R330).
3. Select the *Configuration Management→Clear Configuration* option, mark the *Confirm* option and press *Yes*.
4. From the Main Menu, select the *Configuration Management→Convert to Non-RAID Disk* option, and select the physical disks, and press *OK*, and confirm the convertion and press *Yes*.
5. Verify that the physical disk where the operating system will be installed is bootable by selecting *Controller Management* from the Main Menu, and that the *Select Boot Device* field contains the desired physical disk.
6. Exit the *System Setup* menu to continue with the setup.

HPE ProLiant DL360 Gen9 / Gen10

Follow the appropriate instructions depending on whether the server has a physical controller card or a software RAID.

- **Smart Array Controller**
  On the HPE ProLiant DL360 server with a Smart Array Controller (a physical hardware controller, not a software RAID which is not supported and is handled below), such as the *HPE Smart Array P408i-a*, follow these steps to verify and setup the disk configuration:
  1. Enter the *Intelligent Provisioning* menu during the server POST sequence by pressing `F10`. Note that it may be necessary to reboot the server first to reach this menu or if there were pending changes to be applied.
  2. Select the *HPE Smart Storage Administrator* option.
  3. Create an Array (if it does not exist already).
  4. Assign the physical disks to create the logical drive.
  5. Depending on the number of disks available, the appropriate RAID level should be selected as explained above.
  6. Once the logical drive has been created, assign it as the primary bootable disk.

  Once the disk array has been configured, exit the setup menu and reboot the server.
- **Smart Array Software RAID**
  On HPE ProLiant servers with a Smart Array software RAID, such as the *Smart Array S100i SR Gen10 RAID*, the legacy boot mode is not supported and the Smart Array software RAID must be disabled following these steps:
  1. Enter the *System Utilities* screen during the server Power-On Self Test (POST) sequence by pressing `F9`.

2. Then select *System Configuration→BIOS/Platform Configuration→Storage Options→SATA Controller Options* option.
3. Change the *Embedded SATA Configuration* option to *SATA AHCI Support*.
4. Press `F10` to save the changes.
5. Press `ESC` several times to get to the top of the *System Utilities* menu and select *Reboot the System* to apply the changes.

2.4.5 Console Redirection

Enable console redirection after the BIOS POST sequence.

Dell PowerEdge R230 / R330 / R440

Follow the next instructions to enable console redirection:

1. Enter the *System Setup* screen during the server POST sequence by pressing `F2`.
2. Then select *Network* and press `ENTER`.
3. Find the *Enable NIC* option and ensure it is set to *Enabled*.
4. On the *NIC Selection* option, check that the current NIC used to communicate with IPMI is selected.
5. Then, locate the *IPV4 SETTINGS* tab, and ensure that the *Enable IPV4* option is set to *Enabled*. The IP address, netmask and other network parameters will be set later on during the installation.
6. Click `Exit` to save the changes.

HPE ProLiant DL360 Gen9 / Gen10

Follow the next instructions to enable console redirection:

1. Enter the *System Utilities* screen during the server POST sequence by pressing `F9`.
2. Then select *System Configuration→iLO Configuration Utility→Network Options* option.
3. Ensure that the current port used to reach IPMI is selected in the *Network Interface Adapter* option.
4. Press `ESC` to go back one level to the *iLO Configuration Utility* menu.
5. Select *Setting Options* and press `ENTER`.
6. Ensure both *iLO Functionality* and *iLO Configuration Utility* are enabled.
7. Press `F10` to save the changes.
8. Press `ESC` several times to get to the top of the *System Utilities* menu and select *Reboot the System* to apply the changes.

Supermicro

Follow the next instructions to enable console redirection:

1. Enter the *BIOS Setup* screen during the server Power-On Self Test (POST) sequence by pressing the `DEL` key.
2. On the *Advanced* tab, go to the *Serial Port Console Redirection* option ane enter it.
3. Ensure that the *SOL Console Redirection* option is set to *Enabled* (press `ENTER` to change it in a submenu).
4. Press `F4` to confirm and save the changes.

2.5 Boot Bequant Installation ISO

If physical access to the system is available, insert the USB drive or CD/DVD containing the Bequant Installation ISO, as described in the *Bequant Installation Image* section.

HPE ProLiant DL360 Gen9 / Gen10

On the HPE ProLiant DL360 server, if the remote console iLO is used for installation and the server is not accessible, follow these instructions to create a virtual DVD with the BQN ISO:

1. Select the *Virtual Drives* menu on the remote console window and select the *Image File CD/DVD-ROM* option.
2. In the dialog window, select the ISO file containing the BQN installation software image.

Supermicro

On the Supermicro server, if the remote console is used for installation and the server is not accessible, follow these instructions to create a virtual DVD with the BQN ISO:

1. Select the *Virtual Media* menu on the remote console window and select the *Virtual Storage* option.
2. Under the *Logical Drive Type* the pull-down selector choose the *ISO File* option.
3. Press the *Open Image* button and browse for the ISO file containing the BQN installation software image.
4. Press the *Plug in* buffon to enable the virtual drive.
5. Press `OK` to create the virtual drive.

Start or reboot the system to boot the Bequant Installation image. Make sure that the USB or CD/DVD is selected for booting. The device boot order is permanently configured in the BIOS settings, but it may also be possible to select a one-time boot device.

Dell PowerEdge R230 / R330 / R440

On the Dell PowerEdge server, follow these steps to boot the BQN ISO:

1. Enter the *Boot Manager* screen during the server POST sequence by pressing `F11`.
2. Then enter *One-shot Boot Menu*, and select the removable device holding the BQN ISO.

HPE ProLiant DL360 Gen9 / Gen10

On the HPE ProLiant DL360 server, to boot the BQN ISO:

1. After the POST sequence, press `F11` to enter into the *One-Time Boot Menu*.
2. If the Bequant image was burned to a CD/DVD or the ILO Virtual Media was used, enter `1` to select *One Time Boot to CD-ROM*.
3. If the Bequant image was burned to a USB drive, enter `3` to select *One Time Boot to USB DriveKey*.

Supermicro

On the Supermicro server, to boot the BQN ISO:

1. After the POST sequence, press `F11` to enter into the one-time *Boot Menu*.
2. If the Bequant image was burned to a USB drive select it from the list of devices.
3. If a virtual drive was created with the ISO image, then select the *Virtual CDROM* entry from the list of devices.

Allot ATCA Blade

On the Allot ATCA blade, the USB drive is automatically booted by default.

2.6 Software Installation

Once the Bequant Installation image loads the bootloader, it presents several boot options (shown in Figure 2.1):

Figure 2.1 Boot menu.

- *BQN OS installation*: This is the default option for all installations except when a serial console is used. Note that this option will boot after 10 seconds if no keys are pressed, or press `ENTER` to proceed.
- *BQN OS installation (serial)*: This option should be selected on systems with a serial console, such as the Cambium Networks cnMaestro. Use the `UP` and `DOWN` arrow keys to select this option and press `ENTER` to proceed.
- The rest of the options should only be used if indicated by Bequant engineers.

After the operating system boots, the Bequant installation program is started automatically.

Allot ATCA Blade

On the Allot ATCA Blade, the Bequant installation program must be started manually:

1. As indicated on the screen, press `CTRL-D`.
2. Enter the following command to reset the terminal:

```
Welcome to rescuPress enter for maintenance(or type Control-D to continue):
linux:~ # stty sane
linux:~ #
```

3. Execute the installation program at the prompt:

```
linux:~ # /bqn/sbin/bqninstall -f
```

Follow these steps to install the BQN software in a server:

1. Select *Install* at the main *BQN Installation* screen.
2. If the system only has one disk, then proceed to the next step; otherwise, the installation program shows all the available disks and asks the user to select where the BQN software should be installed, as shown in Figure 2.2. The disk type and size is displayed for each disk for better identification.

⚠ Note that if a USB drive is used as the installation medium it may be displayed in the list of available disks, sometimes selected by default in first position. If that happens, scroll down the list to select the right hard disk.

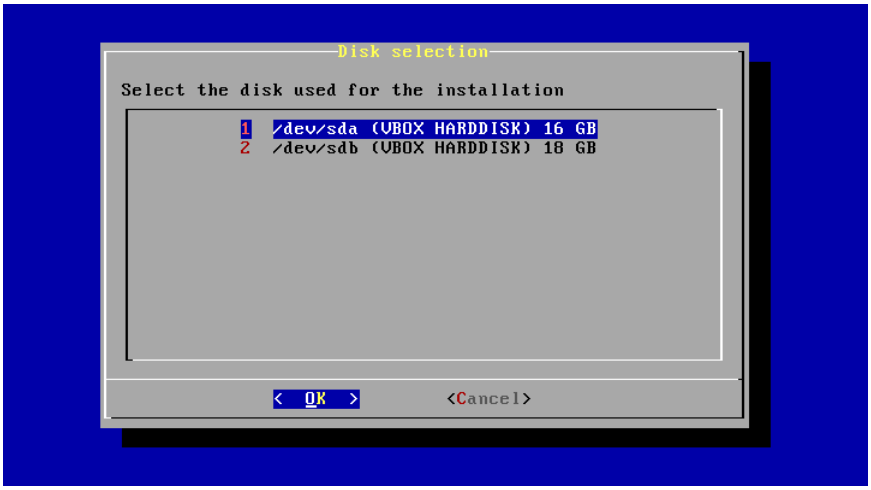

Figure 2.2 Disk selection menu.

3. Select whether to perform a default or a custom partition of the disk.
   The default partition scheme uses the whole disk and erases all the existing data. This partition scheme creates a swap partition with a size equal to the amount of physical RAM memory, and the rest of the disk space is reserved for the *BQN OS* linux partition.
   Select the *default* partition scheme unless the server is shared with another operating system, it is requested by Bequant or you need to change the disk label format or the swap size (see boxes below).

⚠ Note that the disk must use the DOS or MBR disk label format. If the server is being reused from a previous installation, it may not have either of those formats. The format can be changed using the `fdisk` command as indicated below in the *Advanced* box.

⚠ If the server has more than 64 GB of RAM (e.g. 128 GB), the swap should be set to a maximum of 64 GB, using the `fdisk` command as indicated below in the *Advanced* box.

⚙ Advanced (optional)

The *custom* partition scheme allows the user to manually create and select the partitions to be used, without modifying any other existing partitions. The installation program will show all the available swap and linux partitions (type 82 and 83 respectively), as shown in Figure 2.3, and will allow the user to modify the partition table with the *fdisk* utility.

The installation requires 2 partitions:

a) Linux swap: fdisk type 82

b) Linux partition: fdisk type 83

If a partition type does not exist, a new one must be created using the *fdisk* utility. The following *fdisk* commands are used to modify the partition table:

- n: Create a new partition, either a primary of a logical partition (inside an extended partition).
- p: Print the partition table.
- d: Delete a partition.
- t: Change the partition system ID, which is set to *Linux* (83) by default. For a *Linux swap* partition the system code is 82.

- o: Create an empty DOS partition table. This command is required if the disk was previously partitioned with a different partition table type, such as GPT (if UEFI was used).
- w: Write partition table to disk and exit.
- q: Quit without saving changes.

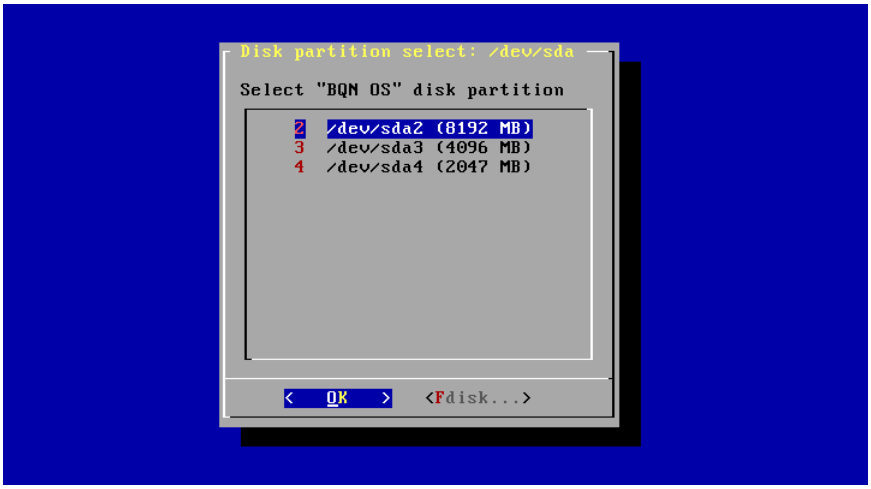

Figure 2.3 Linux partition selection menu.

4. Confirm the partition selections to proceed with the installation of the BQN operating system. This process step may last for a few minutes while the progress percentage is displayed.
5. After the BQN software as been installed, select the console keyboard mapping. Note that the United States (*us*) keymap is selected by default. Scroll the different options with the `UP` and `DOWN` arrow keys, press `SPACE` to select a keymap and finally press `ENTER` to accept the selection.
6. Enter a hostname for the BQN or press `ENTER` to accept the default value.

All Servers

Note that pre configured BQNs usually use the following naming convention:

`bqn`*`client`*

where *`client`* is the name or some abbreviation where the BQN will be deployed (e.g. `bqntef` at Telefonica). If several BQNs may be deployed at the same client, use a number at the end of the name to differentiate all the BQNs (e.g. `bqntef1`).

7. Select the timezone to use in the BQN. Note that *Europe/Madrid* is selected by default. Scroll the different options with the `UP` and `DOWN` arrow keys, press `SPACE` to select a timezone and finally press `ENTER` to accept the selection.

> ⚠ Make sure you select the right timezone corresponding to the server's location.

Note that the timezone may be changed at any time using the `system date timezone` command.

8. Enter the *root* user password twice.
Note that a user password can be changed at any time using the `system users passwd` command.

Dell PowerEdge R230 / R330 / R440

Pre configured Dell PowerEdge servers should use the Service Tag as the default password.

HPE ProLiant DL360 Gen9 / Gen10

Pre configured HPE ProLiant servers should use the HPE server serial number as the root password. The serial number is printed on a label on top of the server.

Supermicro

Pre configured Supermicro servers should use the serial number as the default password. The serial number is printed on a label on the back of the server.

9. Install the bootloader at the Master Boot Record (MBR). If more than one disk is available, indicate whether the other disks are removable or not.
10. If the installation process detects that there was a working BQN OS installed in the same operating system partition being used now, then it is possible to restore the old BQN configuration. If the configuration is restored, skip the rest of steps. Note that only the configuration is restored, users such as `bqnadm` and `bqnop` will have to be created using the `system users add` command.
11. The installation process may setup the BQN management interface of the BQN by pressing `YES`; otherwise, press `NO` and skip the rest of the steps.
12. Select the network interface used for management if multiple interfaces are available (see the *Locating Network Interfaces* section in the *User Guide* to select the desired management interface) and enter the management IP address used by the BQN. In addition, enter the gateway used to set the default route if required.

Dell PowerEdge / HPE ProLiant / Supermicro

On pre configured Dell PowerEdge and HPE ProLiant servers, the first embedded network interface should be used as the management interface: `en0o1`.

In addition, pre configured servers use the `192.168.0.121/24` management IP address and the `192.168.0.1` gateway IP address.

At this point the BQN OS has been installed successfully.

Confirm the system reboot to apply the changes and remove the installation media so that the BQN boots the installed operating system.

⚠ If the system does not reboot after one minute, manually reset the system to boot the operating system.

2.7 LOM Final Configuration

To access the lights-out management (LOM) interface from the management network, it is recommended to configure an IPv4 static address.

Dell PowerEdge R230 / R330 / R440

The iDRAC interface is factory pre configured with the `192.168.0.120/24` static IP address and `192.168.0.1` gateway. You may modify it through the LCD panel on the front of the server, using the arrow and select keys and following the instructions provided.

The iDRAC settings can also be modified through the web page:

1. Log into the iDRAC web page using the *root* user and password (if the server was shipped from Bequant or one of its integrators, the default password is the Service Tag, which is available on the front of the server by pulling out the information tag).
2. Navigate to the *Overview→iDRAC Settings→Network* page.
3. Under the *IPv4 Settings* section enter the required network configuration.
4. Click *Apply* to commit the changes.

The factory default password for the *root* user is *calvin*. If the server has to be shipped to a customer, change the password to the Service Tag value (available on the front of the server by pulling out the information tag).

If access to the system console is available, follow these instructions to change the iDRAC password:

1. Enter the *System Setup* screen during the server Power-On Self Test (POST) sequence by pressing F2.
2. Select the *iDRAC Settings→User Configuration* option
3. Enter the *root* password in the *Change Password* field and confirm it.
4. Go back to the *System Setup* screen and confirm that the settings must be saved.
5. Exit the *System Setup* menu to continue with the setup.

If the iDRAC is accessible through the internet, follow these instructions to change the iDRAC password:

1. Log into the iDRAC web page using the *root* user and password.
2. Select the *Change Default Password* option and enter and confirm the new password.
3. Click *Continue* to commit the changes.

HPE ProLiant DL360 Gen9 / Gen10

On the HPE ProLiant DL360 there is an iLO dedicated ethernet port on the back of the server. If the iLO dedicated network port is used then follow these steps to configure a static IP address (skip this set of instructions if the shared network port will be used instead):

1. Log into the iLO web page using the *Administrator* user and password (the default password is printed on a label on top of the server).
2. Navigate to the *Network→iLO Dedicated Network Port* page.
3. Click the *IPv4* tab.
4. Disable DHCP by clicking the *Enable DHCPv4* check box to deselect the option.
5. Enter the IP address in the *IPv4 Address* field (e.g. 192.168.0.120).
6. Enter the IP address mask in the *Subnet Mask* field (e.g. 255.255.255.0).
7. Enter the gateway IP address in the *Gateway IPv4 Address* field (e.g. 192.168.0.1).
8. Apply the configuration by pressing the *Submit* button.

In deployments where there is only one physical cable for the management network, it is possible to configure both the iLO and the server operating system to share the same LAN port. Follow these steps to share the network port:

1. Log into the iLO web page using the *Administrator* user and password (the default password is printed on a label on top of the server).
2. Navigate to the *Network→Shared Network Port* page.
3. Click the *General* tab.
4. Select the *Use Shared Network Port* check box.
5. Depending on the server configuration, select LOM, or FlexibleLOM.
6. Select a value from the *Port* menu.
7. To use a VLAN, select the *Enable VLAN* check box and enter VLAN tag.
8. Click *Submit* to apply the changes.

Note that the IPv4 settings for the shared network port are different than the settings for the iLO dedicated network port. Therefore, to set an IPv4 static address using the shared network port follow these instructions:

1. Navigate to the *Network→Shared Network Port* page.
2. Click the *IPv4* tab.
3. Disable DHCP by clicking the *Enable DHCPv4* check box to deselect the option.
4. Enter the IP address in the *IPv4 Address* field (e.g. 192.168.0.120).
5. Enter the IP address mask in the *Subnet Mask* field (e.g. 255.255.255.0).

6. Enter the gateway IP address in the *Gateway IPv4 Address* field (e.g. 192.168.0.1).
7. Apply the configuration by pressing the *Submit* button.

Note that the iLO may need to be reset in order to apply the changes:

1. Navigate to the *Network→iLO Dedicated Network Port* or the *Network→Shared Network Port* page, depending on the configuration used.
2. Click the *General* tab.
3. Press the *Reset* button and confirm that the changes will be applied.

The iLO reset may take a few minutes until access to the server is restored with the new settings. After the IP address has changed, it may be necessary to login again using the new static IP address. If the shared network port was configured, the cable connecting to the management network can be plugged into the selected LAN port.

Supermicro

The IPMI interface is factory pre configured with the `192.168.0.120/24` static IP address and `192.168.0.1` gateway.

The IPMI network settings can be modified through the web page:

1. Log into the IPMI web page using the *root* user and password (if the server was shipped from Bequant or one of its integrators, the default password is the serial number, which is available on the back of the server).
2. Navigate to the *Configuration→Network* page.
3. Select the *Use the following IP address* toggle.
4. Under the *IPv4 Setting* section enter the required network configuration.
5. Click *Save* to commit the changes.

If access to the system console is available, the IPMI network settings can be modified using these instructions:

1. Enter the *BIOS Setup* screen during the server Power-On Self Test (POST) sequence by pressing the `DEL` key.
2. On the *IPMI* tab, go to the *BMC Network Configuration* option and press `ENTER`.
3. Make sure that *Update IPMI LAN Configuration* is set to *Yes*.
4. Set the *Configuration Address Source* option to *Static*.
5. Enter the correct IP address, subnet mask and gateway IP address. If a VLAN is required, enable the *VLAN* option and enter the *VLAN ID* tag.
6. Press `F4` to confirm and save the changes.

If the server has to be shipped to a customer, change the password to the serial number value (available on the back of the server or under the *System→Hardware Information* page).

1. Log into the IPMI web page using the *ADMIN* user and the default *ADMIN* password.
2. Navigate to the *Configuration→Users* page.
3. Select the existing *ADMIN* user click the *Modify User* button.
4. Select the *Change Password* toggle and enter the new password.
5. Click the *Modify* button.
6. Select the next available user entry and click the *Add User* button.
7. Enter *root* as the user name and the server's serial number as the password. Make sure that the *Network Privileges* option is set to *Administrator*.
8. Click the *Add* button.

3

Post-Installation Configuration

This chapter provides a quick guide to configure a BQN with the Bequant TCP Acceleration (BTA) service.

3.1 Prerequisites

This section describes the information needed to configure a BQN. It assumes that the BQN has been successfully installed following the instructions in the *Installation* chapter.

Basic IP information for the management interface:

- IP address and network prefix length of the assigned BQN management interface.
- Gateway IP address in the management network.
- Interface and VLAN ID, if any, for the BQN management interface.
- IP address of Network Time Protocol (NTP) server.

Other optional information:

- IP address, network prefix length and gateway for the server lights-out management (LOM) interface.
- If SNMP is configured, the IP address of the SNMP Network Management System (NMS) is needed, together with its SNMP community string.

In addition, the network where the BQN is being deployed will need steering of user traffic through the Bequant data interfaces (those used to process traffic). Traffic routing should be symmetrical (uplink and downlink directions). Also, it is necessary the appropriate routing of management traffic to reach the OAM and LOM IP addresses.

3.2 Automatic Setup

This section describes how to configure a BQN. The BQN will be configured to optimize traffic between an access network and the internet using the network configuration shown in Figure 3.1. Note that the BQN may be directly connected to the routers or through switches. BQN data interfaces are associated in pairs called *wires*. A wire behaves as a 2-port transparent bridge (a *bump-in-the-wire*), with traffic comming into one interface going out the other interface and vice versa. Wires are directional: the first interface in the pair must be connected to the access side router/switch and the second port to the Internet side.

References to the different sections in the user guide are indicated for further information.

Step 1: Installation

If the server does not have the BQN Software installed, follow the *Installation* chapter instructions to install the software. Make sure you configure a management IP address and default gateway during the process.

As instructed, reboot the system after the software has been installed and the installation media has been removed.

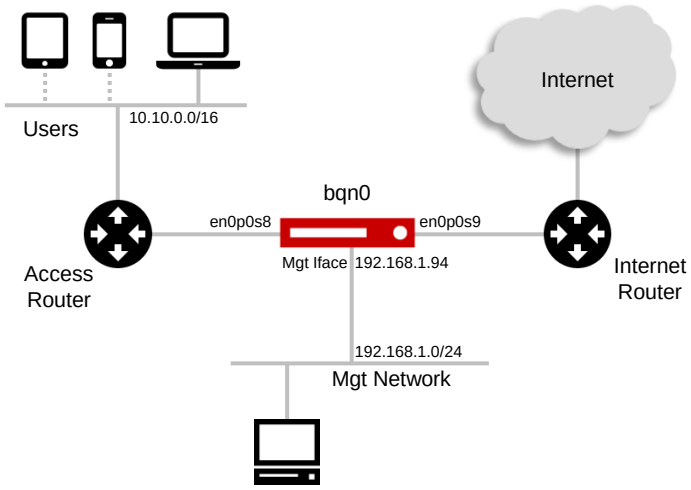

Figure 3.1 Network topology in wire mode.

Step 2: Update to latest BQN version

The ISO many not contain the lastest BQN package (BPKG). To transfer the BPKG package you will need an scp client, and a ssh client to access the server shell. Linux and OSX have `ssh` and `scp` by default, as well as Windows PowerShell starting at Windows 10. For older Windows versions, one example of popular clients are *putty* and *pscp* respectivelly (see `https://www.putty.org`). In this example, we will install a BQN package `bqn-R3.1.17.bpkg` in a BQN server with OAM IP address 192.168.0.121. First, we transfer the BPKG to the BQN server:

```
mylaptop$ scp ./bqn-R3.1.17.bpkg root@192.168.0.121:
Password:
bqn-R3.1.17.bpkg                                  100%   18MB   1.3MB/s   00:13
```

Log in as `root` via SSH and start the BQNSH shell.

```
mylaptop$ ssh root@192.168.0.121
bqn0:/ # bqnsh
Copyright (c) 2009-2015 Bequant S.L.
root@bqn0#
```

Install the lastest BQN package and activate it (reload):

```
root@bqn0# system software install /root/bqn-R3.1.17.bpkg
Name:      bqn
Version:   R3.1.17
Priority:  50
Size:      18585542
Reload:    1
Files:     2

Install package "bqn-R3.1.17"

Enable boot flag
root@bqn0# system software reload bqn R3.1.17
Package "bqn-R3.1.2" must be stopped first.

WARNING: Service may be interrupted during the reload

Continue?  (yes/no):  yes
root@bqn0#
%ERR-EIO: Process terminated
bqn0:/ #
```

Start the BQNSH shell again (it may take a few seconds while the software is reloading).


```
bqn0:/ # bqnsh
Copyright (c) 2009-2015 Bequant S.L.
root@bqn0#
```

Step 3: Execute the BTA wizard tool.

The `wizard bta` command will collect system information about the server and will perform the following tasks:

- Obtain server vendor and model, CPU information and network interfaces available.
- Create default operator and administrator users.
- Configure the NTP service and set several public NTP servers.
- Configure the management network interface and enable the SSH service.
- Enable the WEB service.
- Create one or more *wires* (depending on the number of available network interfaces and their physical location).
- Configure the packet engine feature to forward traffic.
- Configure the BTA feature to accelerate 99% of the TCP connections randomly and to meassure the acceleration.
- Configure the generation of SDRs to have metrics of traffic consumption per client IP address.
- UDR generation is left disabled by the wizard.

Execute the BTA wizard command.

```
root@bqn0# wizard bta
System vendor: Dell Inc.
System name: PowerEdge R230
System serial: M9PJML5
System suported: yes
CPU model: Intel(R) Xeon(R) CPU E3-1220 v6 @ 3.00GHz
CPU cores: 4

Management interface: en0o1
Management IP: 192.168.0.121/24
Management gateway: 192.168.0.1

Wire 1: en0p2s0f0-en0p2s0f1

BTA random acceleration: 99%

If the proposed configuration is not valid execute the command
     wizard bta interactive
to manually enter the configuration.

Proceed with configuration?  (yes/no) [yes]:  yes
```

Step 4: Confirm configuration parameters.

If any of the configured parameters are not correct, abort the execution of the wizard command (i.e. say **no** to proceed with the installation) and execute it interactively to select individual parameters with `wizard bta`. In any case, note that the generated configuration can be changed at any time.

Confirm that the configuration is correct and proceed with the setup (press `ENTER` to continue):

```
Proceed with configuration?  (yes/no) [yes]:  yes
Set "bqnadm" user password to "M9PJML5"
Set "bqnop" user password to "M9PJML5"
root@bqn0#
```

Note that the passwords for the *bqnadm* and *bqnop* users can be changed with the `system users passwd` command.

Dell PowerEdge R230 / R330 / R440

For pre configured Dell PowerEdge servers use the Service Tag as the default password.

HPE ProLiant DL360 Gen9 / Gen10

For pre configured HPE ProLiant servers use the serial number as the default password. The serial number is printed on a label on top of the server.

Supermicro

For pre configured Supermicro servers use the serial number as the default password. The serial number is printed on the back of the server.

The rest of the setup will be done as the *bqnadm* user. Log out (typing the `exit` command twice) and log in again using the *bqnadm* user.

```
root@bqn0# exit
bqn0:~ #
```

Now the BQN web interface is enabled and it is possible to perform the test of steps using the web interface. See the *BQN Quick Start Guide* for more details.

Step 5: Remove unused wires.

This step can be performed using the web interface. See the *BQN Quick Start Guide* for more details.

If the server has several data plane network interfaces, then multiple wires may be configured. If the final BQN deployment is known, then remove the unused wires; otherwise, proceed with the next step.

In this example, 2 wires have been created, but only the one containing the *en0p0s8* and *en0p0s9* will be used, so the other one will be removed.

```
root@bqn0# show config running | match wire
  wire en0p0s10 en0p0s16 directed
  wire en0p0s8 en0p0s9 directed
root@bqn0# configure
root@bqn0(config)# pkteng
root@bqn0(config-pkteng)# no wire en0p0s10 en0p0s16 directed
root@bqn0(config-pkteng)# commit
root@bqn0(config-pkteng)# end
root@bqn0# show config running | match wire
  wire en0p0s8 en0p0s9 directed
```

Step 6: Generate diagnostic.

This step can be performed using the web interface. See the *BQN Quick Start Guide* for more details.

A diagnostic file will be used by Bequant to validate the configuration and to generate a license for this BQN. To generate a diagnostic file:

```
bqnadm@bqn0# system diagnostic
Get OS information...done
Get system information...done
Get network information...done
Get BQN information...done
Get PKTENG information...done
Get files...done

Created diagnostic file: /home/bqnadm/diagnostic-20200121161004

bqnadm@bqn0# file ls -l
total 1108
drwxr-xr-x 2 bqnadm users    4096 Sep 27  2013 bin
-rw-r--r-- 1 root   users 1673430 Jan 21 16:10 diagnostic-20200121161004
```

Note that the diagnostic file is generated in the *home* directory of the user executing the command. The file can be retrieved from the BQN through an SCP (secure copy) connection to the *bqnadm* account via the management interface IP address.

```
mylaptop$ scp bqnadm@192.168.0.121:diagnostic-20200121161004 .
```



```
Password:
diagnostic-20200121161004                     100% 1634KB  16.1MB/s   00:00
```

Step 7: License installation.

This step can be performed using the web interface. See the *BQN Quick Start Guide* for more details.

Upon reception of the diagnostic file generated in the previous step, Bequant will provide a valid license, which must be installed in the BQN.

```
bqnadm@bqn0# set license load file://bqn0.lic
bqnadm@bqn0# show license
FEATURE                        EXPIRATION VALID      USAGE
bta              2018-12-31T00:00:00+0100 yes         1000
```

More detailed information about this procedure is available in the *License Management* section in the *User Guide*.

Step 8: Verify status.

This step can be performed using the web interface. See the *BQN Quick Start Guide* for more details.

After the license has been installed, the global status of the BQN should indicate that it is ready to process traffic.

```
bqnadm@bqn0# show system status
CPU usage:               normal
Disk usage:              normal
Network interfaces:      down
PKTENG status:           ready
BTA status:              ready
BTC status:              disabled
SSH service status:      ready
WEB service status:      ready
NTP service status:      ready
```

Note that the status of the network interfaces may be *down* because the data plane network interfaces are not connected (for more information see the *Troubleshooting* chapter).

3.3 Manual Setup

To manually setup the BQN, follow all the steps described in the *Automatic Setup* section, but when *step 3* is reached, instead of entering the `wizard bta` command, enter the `wizard bta interactive` command. When executing the interactive wizard, all the parameters may be validated first and the wire configuration can be specified manually. Note that the value of some parameters could be presented with a default value between square brackets `[ ]`, and in that case the value is accepted by pressing `ENTER`.

In the following example, one single wire will be created using the *en0p0s8* and *en0p0s9* network interfaces (note that if the wizard was not excuted interactively, 2 wires would be created using the other 2 interfaces).

```
root@bqn0# wizard bta interactive
Available network interfaces:
  en0p0s8
  en0p0s9
  en0p0s17
  en0p0s10
  en0p0s16
Enter management interface [en0p0s17]:
Enable VLAN on management interface? (yes/no) [no]:
Enter management IP address and prefix [192.168.1.77/24]:
Enter default gateway IP address [192.168.1.1]:
Configure a nameserver? (yes/no) [no]:

Available network interfaces:
  en0p0s8
  en0p0s9
  en0p0s10
  en0p0s16
```



```
Select access-side interface for wire:  en0p0s8
Select internet-side interface for wire:  en0p0s9
Create another wire?  (yes/no):  no
Enable SDR generation?  (yes/no) [yes]:  yes
Enter random acceleration percentage [99]:
System vendor: innotek GmbH
System name: VirtualBox
System serial: 0
System suported: no
CPU model: Intel(R) Core(TM) i7-4790S CPU @ 3.20GHz
CPU cores: 4

Management interface: en0p0s17
Management IP: 192.168.1.77/24
Management gateway: 192.168.1.1

Wire 1: en0p0s8(access)-en0p0s9(internet)

BTA random acceleration: 99%

If the proposed configuration is not valid execute the command
     wizard bta interactive
to manually enter the configuration.

Proceed with configuration?  (yes/no) [yes]:  yes
```


4

Troubleshooting

4.1 Overview

This chapter provides general information to conduct troubleshooting on the BQN.

4.2 Problems Accessing the Management Interface

As indicated in the *Network Management Interface* section in the *User Guide*, the BQN uses a dedicated network interface for management. The management interface supports both the SSH and WEB (HTTPs) services.

In case of problems accessing the configured management IP check the following:

- Ensure that the management network interface port is connected to the appropriate network.
- Verify that the link state of the management network interface is up (see the *Network Interface* section in the *User Guide*). If the management interface is connected to a network switch, verify that the port in the switch is up and its attributes match the properties shown by the `show interface` command.
- Verify using the system console that the management IP address and network prefix are correct. If accessing the management IP address from a different network, make sure that static routing is configured to the access network, as explained in the *Network Interface* section in the *User Guide*,
- Verify, using the system console, that the SSH service is up and running and its status is *active (running)*.

  ```
  bqnadm@bqn0# show service ssh
  sshd.service - OpenSSH Daemon
     Loaded: loaded (/bqn/img/linux/usr/lib/systemd/system/sshd.service; disabled)
     Active: active (running) since Tue 2021-06-29 12:22:20 VET; 1 day 21h ago
     . . .
  ```

  If the WEB service is used, also verify that it is up and running and its status is *active (running)*.

  ```
  bqnadm@bqn0# show service web
  bqnadm@bqn-inter_brm# show service web
  bqnweb.service - BQN WEB Service
     Loaded: loaded (/bqn/img/bqn/usr/lib/systemd/system/bqnweb.service; disabled)
     Active: active (running) since Wed 2021-06-30 04:33:48 VET; 1 day 4h ago
     . . .
  ```

- If there are firewalls in the management network, allow access to TCP port 22 for the SSH service and TCP port 443 for the WEB service.
- If you suspect the OAM IP settings are incorrect or unknown, connect a monitor and a keyboard to the server and login as root to change it. For example, to change to OAM IP 10.10.10.12/24:

  ```
  bqn0:~ # bqnsh
  root@bqn0# show interface management detail
  Interface: en0o1
  IP address: 192.168.0.121/24
  Default gateway: 192.168.0.1
  Nameserver: n/a
  ```

```
root@bqn0# set interface en0o1 management 0 10.10.10.12/24 gateway 10.10.10.1
root@bqn0# show interface management detail
Interface: en0o1
IP address: 10.10.10.12/24
Default gateway: 10.10.10.1
Nameserver: n/a
```

- The BQN management interface may be protected by its own firewall. The problem could be that your source IP address is not included in that firewall white list. This could happen even for addresses from the same subnet of the BQN management IP, if the subnet is not part of the firewall rules. You can disable the firewall temporarily until the connection to the management port is restored. Connect a monitor and a keyboard to the server and login as root:

```
bqn0:~ # bqnsh
root@bqn0# show interface firewall
IFACE            CHAIN   RANGE
en0o1            input   10.0.0.0/8
en0o1            input   172.16.0.0/12
en0o1            input   192.168.0.0/16
root@bqn0# clear interface en0o1 firewall input
root@bqn0# show interface firewall
IFACE            CHAIN   RANGE
```

  Once the management IP is reachable, you can define the new white list of allowed source IP ranges.

If the problem persists, follow the instructions in the *Contacting Bequant Support* section for assistance.

4.3 CPU Usage Issues

The system management process monitors the global CPU usage status and detects when a CPU usage is higher than normal. When the CPU usage level is different than *normal*, it is necessary to analyze which CPU core has the high load and why.

```
bqnadm@bqn0# show system alarms
TYPE                STATUS     UPDATES TIME
cpu                 critical         1 2021-06-29T15:56:56+0200
disk                normal           1 2021-06-09T11:27:41+0200
license-available   normal           1 2021-06-09T11:27:41+0200
license-expiration  normal           1 2021-06-09T11:27:41+0200
license-usage       normal           1 2021-06-09T11:27:41+0200
memory-dpdk         normal           1 2021-06-29T10:48:18+0200
memory-pool         normal           1 2021-06-29T10:48:18+0200
process             normal           3 2021-07-01T15:37:58+0200
time                normal           2 2021-07-01T15:37:58+0200
traffic-uplink      normal           2 2021-07-01T15:37:58+0200
traffic-downlink    normal           2 2021-07-01T15:37:58+0200
traffic-low         normal           2 2021-07-01T15:37:58+0200
traffic-inverted    normal           2 2021-07-01T15:37:58+0200
wire                normal           4 2021-07-01T15:38:33+0200
bqnadm@bqn0# show system cpu
CPU   USER   NICE    SYS  IO-WA    IRQ   SOFT  STEAL  GUEST   IDLE
all  12.91   0.00   0.41   0.00   0.00   0.12   0.00   0.00  86.56
  0   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00 100.00
  1  97.77   0.00   2.23   0.00   0.00   0.00   0.00   0.00   0.00
  2   0.00   0.00   0.41   0.00   0.00   0.41   0.00   0.00  99.19
  3   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00 100.00
bqnadm@bqn0# show system cpu level
CPU  LEVEL
  0  normal
  1  high
  2  normal
  3  normal
```

There are several possible causes of high CPU usage. The following sections cover some common ones,

4.3.1 A process not part of BQN product

In this case, CPU 1 has the high load, and as we can see with the `show system process top` command, the process that causes the high CPU load is a `bash` process, which is not part of the standard BQN processes.

```
bqnadm@bqn0# show system process top
top - 19:19:26 up 49 min,  3 users,  load average: 0.53, 0.14, 0.05
Tasks: 137 total,   2 running, 135 sleeping,   0 stopped,   0 zombie
%Cpu(s):  0.2 us,  0.1 sy,  0.0 ni, 99.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:   4046260 total,   488456 used,  3557804 free,    29668 buffers
KiB Swap:  2097148 total,        0 used,  2097148 free,   213880 cached

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM     TIME+ COMMAND
 6145 root      20   0   11556   2404   2196 R 100.0 0.059   0:48.98 bash
    1 root      20   0   37148   5060   3420 S 0.000 0.125   0:01.16 systemd
    2 root      20   0       0      0      0 S 0.000 0.000   0:00.00 kthreadd
    4 root       0 -20       0      0      0 S 0.000 0.000   0:00.00 kworker/0:0H
    5 root      20   0       0      0      0 S 0.000 0.000   0:00.00 kworker/u8:0
    6 root      20   0       0      0      0 S 0.000 0.000   0:00.00 ksoftirqd/0
    7 root      20   0       0      0      0 S 0.000 0.000   0:00.07 rcu_preempt
    8 root      20   0       0      0      0 S 0.000 0.000   0:00.00 rcu_sched
    9 root      20   0       0      0      0 S 0.000 0.000   0:00.00 rcu_bh
   10 root      rt   0       0      0      0 S 0.000 0.000   0:00.00 migration/0
   11 root       0 -20       0      0      0 S 0.000 0.000   0:00.00 lru-add-drain
   12 root      rt   0       0      0      0 S 0.000 0.000   0:00.00 watchdog/0
   13 root      20   0       0      0      0 S 0.000 0.000   0:00.00 cpuhp/0
```

In this example, the `bash` process was started to simulate a process with a very high CPU usage, and after terminating it the global CPU usage level drops back to *normal*.

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           1 2021-06-09T11:27:41+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

Do not stop any process that is part of the BQN software, since the service may be compromised. In addition, avoid executing any program that may affect the performance of the BQN. If you must, use always `nice` execution mode.

4.3.2 Not enough IO PKTENG processes

The BQN packet processing processes are called PKTENG. Some of them (the IO instances) are dedicated to handling input-output operations between the BQN software and the network cards and others (the workers) are specialized in BQN packet processing as such.

Which CPU cores are assigned to the IOs which ones to the workers, can be obtained with the command:

```
bqnadm@bqn0# show pkteng affinity
FUNCTION                                  AFFINITY COUNT
cpu-available                                   ff     8
pkteng-all                                      ff     8
pkteng-worker                                   fe     7
pkteng-io                                       01     1
```



```
en0o7-io                                          01     1
en0o8-io                                          01     1
```

In this example, there is one single IO process, running on core number 0, and shared between both ports of the `en0o7-en0o8` wire. The other cores are sssigned to workers. If the core 0 has a very high load during peak traffic hours, an extra core for IO can be added. For example, to add core number 1.

```
bqnadm@bqn0# configure
bqnadm@bqn0(config)# pkteng
bqnadm@bqn0(config-pkteng)# dimension 6 0x3F 0x3C
bqnadm@bqn0(config-pkteng)# root
bqnadm@bqn0(config)# interface en0o7
bqnadm@bqn0(config-iface)# nic io affinity 0x03
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# interface en0o8
bqnadm@bqn0(config-iface)# nic io affinity 0x03
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# commit
bqnadm@bqn0(config)# end
bqnadm@bqn0# show pkteng affinity
FUNCTION                                    AFFINITY COUNT
cpu-available                                     ff     8
pkteng-all                                        3f     6
pkteng-worker                                     3c     4
pkteng-io                                         03     2
en0o7-io                                          03     2
en0o8-io                                          03     2
bqnadm@bqn06#
```

And now two cores (0 and 1) are assigned to IO processes, shared between the two ports of the wire. Note that there is one less worker (6 instead of the original 7). There is a trade off to reach between IOs and workers.

4.3.3 Overloaded PKTENG worker

All traffic from a given customer IP address is processed by one particular BQN worker instance. If the customer concentrates too much traffic (for example, because the BQN is behind a NAT encompassing many end subscribers), the core of that worker may have very high load.

In the following example, core 6 has high load:

```
bqnadm@bqn0# show system cpu
CPU   USER   NICE    SYS  IO-WA    IRQ   SOFT  STEAL  GUEST   IDLE
all   5.59   0.00   1.40   0.00   0.00   0.00   0.00   0.00  93.01
  0   6.45   0.00   1.61   0.00   0.00   0.00   0.00   0.00  91.94
  1   5.65   0.00   1.61   0.00   0.00   0.00   0.00   0.00  92.74
  2   3.20   0.00   2.40   0.00   0.00   0.00   0.00   0.00  94.40
  3   4.76   0.00   1.59   0.00   0.00   0.00   0.00   0.00  93.65
  4   5.56   0.00   1.59   0.00   0.00   0.00   0.00   0.00  92.86
  5   7.09   0.00   0.79   0.00   0.00   0.00   0.00   0.00  92.13
  6  81.53   0.00   1.57   0.00   0.00   0.00   0.00   0.00  17.90
  7   4.80   0.00   0.80   0.00   0.00   0.00   0.00   0.00  94.40
```

You can verify that core 6 is a worker:

```
bqnadm@bqn0# show pkteng affinity
FUNCTION                                    AFFINITY COUNT
cpu-available                                     ff     8
pkteng-all                                        ff     8
pkteng-worker                                     fe     7
pkteng-io                                         01     1
en0o7-io                                          01     1
en0o8-io                                          01     1
```

In this example, all cores are workers except core 0.

To see if one subscriber IP concentrates too much traffic:

```
bqnadm@bqn0# show statistics subscribers top all direction downlink categories 3
```



```
              TIME       GIGABYTES 192.168.0.172 192.168.0.162 192.168.0.151       REST
. . .
2022-02-13T20:00:00       1266.7381      21.4273%       1.6588%       1.1133%   75.8006%
2022-02-13T21:00:00       1331.1814      21.5691%       1.6492%       1.2478%   75.5339%
2022-02-13T22:00:00       1300.7372      21.7482%       1.6918%       1.7568%   74.8032%
2022-02-13T23:00:00        996.2735      21.7821%       1.5547%       2.0467%   74.6165%
2022-02-14T00:00:00        592.4524      21.9644%       2.1929%       1.6904%   74.1523%
. . .
```

Here, IP 192.168.0.172 is concentrating during the peak hours more that a fifth of the network traffic. That traffic falls in one single worker. To see which one:

```
bqnadm@bqn0# show subscriber 192.168.0.172
Address:                 192.168.0.172  Instance:                           6
Active flows:                     1073  Total created flows:          4135963
Active shaped flows:                 2  Duration:                142:06:26.563
Rate-limit enabled:                 no  Automatic Congestion Management:    no
DoS volume detection/attack:    no/ no  DoS SYN detection/attack:       no/ no
UDR generation enabled:    yes (2.00%)  Blocked subscriber:                 no
Uplink sent bytes:         74601462570  Downlink sent bytes:     1546323242173
Uplink TCPO bytes:         21459531298  Downlink TCPO bytes:     1023234486404
Uplink current Mbps:            25.046  Downlink current Mbps:          16.566
Uplink max Mbps:                20.210  Downlink max Mbps:              77.392
Uplink current RTT (ms):         0.934  Downlink current RTT (ms):       1.110
Uplink min RTT (ms):             0.544  Downlink min RTT (ms):           0.608
Uplink current TCP RTX rate:     0.03%  Downlink current TCP RTX rate:   4.77%
Uplink average TCP RTX rate:     0.28%  Downlink average TCP RTX rate:   3.41%
Policy monitor:        monitor-default  Policy rate:              rate-default
User Name:                         n/a  Calling Station Id:               n/a
NAS Identifier:                    n/a
NAS IP Address:                    n/a  NAS Port:                         n/a

FLOW-SHAPING-POLICY  DOWNLINK-RCV DOWNLINK-SND   UPLINK-RCV   UPLINK-SND
30Mbps               681204472902 664643445514  12020979178  18434850761
SUBS-RATE-POLICY     DOWNLINK-RCV DOWNLINK-SND   UPLINK-RCV   UPLINK-SND
rate-default         1552099551638 1546323242173  67542149609  74601462570
```

The instance processing this subscriber is number 6, which corresponds to core number 6 (in this example core 0 is used by BQN; in machines where core 0 is not used by BQN, an instance 6 would be core 7).

Now that the issue has been identified, if there is a NAT between the subscribers and the BQN, one possible solution is to assign more IP addresses to the NAT so the BQN sees the traffic more evenly distributed between more IPs.

If only TCP Optimization funcionality is used (no bandwidth management of any kind), a possible solution is to configure a per-flow distribution across workers. This will solve the load distribution issue, but only TCPO can be used. The rest of features are per subscriber, and requires all subscriber traffic processed by the same worker instance, so they will not be available.

```
bqnadm@bqn0# configure
bqnadm@bqn0(config)# pkteng
bqnadm@bqn0(config-pkteng)# steering flow
bqnadm@bqn0(config-pkteng)# root
bqnadm@bqn0(config)# commit
bqnadm@bqn0(config)# end
bqnadm@bqn0#
```

4.3.4 CPUs running at lower than expected frequency

In some rare cases, the CPU clock frequency may be reduced due to high temperature, power supply or hardware problems, which may result in a high CPU usage. In those cases make sure that the hardware is working within the recommended working parameters.

```
bqnadm@bqn0# show system cpu frequency
CPU CURRENT MINIMUM MAXIMUM
  0    1282     800    2200
  1    1808     800    2200
```



```
  2    1517     800    2200
  3    1423     800    2200
  4    1556     800    2200
  5    1047     800    2200
  6    1443     800    2200
  7     800     800    2200
bqnadm@bqn0# show system sensors
SENSOR            CURRENT  MAXIMUM CRITICAL
Core1                41.0     82.0    104.0
PackageId0           41.0     82.0    104.0
Core2                41.0     82.0    104.0
Core0                41.0     82.0    104.0
Core3                41.0     82.0    104.0
```

If the problem persists, follow the instructions in the *Contacting Bequant Support* section for assistance.

4.4 Disk Issues

4.4.1 Disk Usage Issue

The system management process monitors the status of the `/` filesystem and detects when there is no more space or if the filesystem is in read-only mode. If the usage of a filesystem is above 85%, the status is set to *warning*, and if it reaches 99% then the status is *critical*.

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 warning          1 2021-06-09T11:27:41+0200
license-available    normal           1 2021-06-09T11:27:41+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
bqnadm@bqn0# show system filesystem
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        2.0G   96K  2.0G   1% /dev
tmpfs           2.0G     0  2.0G   0% /dev/shm
tmpfs           2.0G  8.6M  2.0G   1% /run
/dev/sda3       7.0G  6.6G  621M  92% /
/dev/loop0      1.3M  1.3M     0 100% /bqn/img/bqnos
/dev/loop1      254M  254M     0 100% /bqn/img/linux
/dev/loop2      3.4M  3.4M     0 100% /bqn/img/bqnkernel
/dev/loop3      149M  149M     0 100% /bqn/img/kernel
/dev/loop4      1.5M  1.5M     0 100% /bqn/img/gui
/dev/loop5       13M   13M     0 100% /bqn/img/bqn
tmpfs           2.0G     0  2.0G   0% /sys/fs/cgroup
tmpfs           2.0G  8.6M  2.0G   1% /var/run
```

In this example, the filesystem mounted on `/` is getting full, and unnecessary files should be deleted.

Once the full filesystem is clean from unnecessary files and the usage of the filesystem is below 85%, the global disk status is restored to *normal*.

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           1 2021-06-09T11:27:41+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
```



```
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
bqnadm@bqn0# show system filesystem
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        2.0G   96K  2.0G   1% /dev
tmpfs           2.0G     0  2.0G   0% /dev/shm
tmpfs           2.0G  8.6M  2.0G   1% /run
/dev/sda3       7.0G  597M  6.5G   9% /
/dev/loop0      1.3M  1.3M     0 100% /bqn/img/bqnos
/dev/loop1      254M  254M     0 100% /bqn/img/linux
/dev/loop2      3.4M  3.4M     0 100% /bqn/img/bqnkernel
/dev/loop3      149M  149M     0 100% /bqn/img/kernel
/dev/loop4      1.5M  1.5M     0 100% /bqn/img/gui
/dev/loop5       13M   13M     0 100% /bqn/img/bqn
tmpfs           2.0G     0  2.0G   0% /sys/fs/cgroup
tmpfs           2.0G  8.6M  2.0G   1% /var/run
```

If the problem persists, follow the instructions in the *Contacting Bequant Support* section for assistance.

4.4.2 Disk hardware issue

In the face of hard disk hardware failures, the OS protects itself by placing the filesystem in read-only node.

The sympton of the problem is that statistics are not shown and configuration changes are not possible. Operations not requiring disk, like traffic processing, are not affected.

To confirm the problem, see if the syslog displays multiple disk errors:

```
bqn0:# less /var/log/messsages
. . .
[4486534.464803] print_req_error: I/O error, dev sda, sector 66617040
[4486534.464811] print_req_error: I/O error, dev loop1, sector 42706
[4486534.464815] sd 0:0:0:0: [sda] tag#2 FAILED Result: hostbyte=DID_BAD_TARGET driverbyte=DRIVER_OK
[4486534.464816] sd 0:0:0:0: [sda] tag#2 CDB: Read(10) 28 00 03 f8 7e d0 00 00 08 00
[4486534.464825] sd 0:0:0:0: [sda] tag#3 FAILED Result: hostbyte=DID_BAD_TARGET driverbyte=DRIVER_OK
. . .
```

To complete the problem analysis, log into the BQN server root account and run the following command in the Linux shell. Save the response for later reference (note that in this example `/dev/sda` is the disk device for the hard disk):

```
bqn0:# smartctl -all /dev/sda
smartctl 6.2 2013-07-26 r3841 [x86_64-linux-4.12.14-155.g4755291-default] (SUSE RPM)
Copyright (C) 2002-13, Bruce Allen, Christian Franke, www.smartmontools.org

=== START OF INFORMATION SECTION ===
Model Family:     Seagate Barracuda 7200.14 (AF)
. . .
```

Also, run the following test (it will take a few minutes, the command itself will give an estimate of its duration):

```
bqn0:# smartctl -t short /dev/sda
smartctl 6.2 2013-07-26 r3841 [x86_64-linux-4.12.14-155.g4755291-default] (SUSE RPM)
Copyright (C) 2002-13, Bruce Allen, Christian Franke, www.smartmontools.org

=== START OF OFFLINE IMMEDIATE AND SELF-TEST SECTION ===
Sending command: "Execute SMART Short self-test routine immediately in off-line mode".
```



```
Drive command "Execute SMART Short self-test routine immediately in off-line mode" successful.
Testing has begun.
Please wait 1 minutes for test to complete.
Test will complete after Tue Feb 15 11:30:27 2022

Use smartctl -X to abort test.
bqn0:#̃
```

Once the test has been completed, retrieve the result and send it to Bequant support along with the response of the `smartctl -all` command (see *Contacting Bequant Support* section):

```
bqn0:#̃ smartctl -l selftest /dev/sda
smartctl 6.2 2013-07-26 r3841 [x86_64-linux-4.12.14-155.g4755291-default] (SUSE RPM)
Copyright (C) 2002-13, Bruce Allen, Christian Franke, www.smartmontools.org

=== START OF READ SMART DATA SECTION ===
SMART Self-test log structure revision number 1
Num  Test_Description    Status                  Remaining  LifeTime(hours)  LBA_of_first_error
# 1  Short offline       Completed without error       00%     17734         -
# 2  Short offline       Completed without error       00%     17695         -
# 3  Extended offline    Completed without error       00%      5419         -
# 4  Extended offline    Completed without error       00%      5085         -
# 5  Extended offline    Completed without error       00%      4791         -
# 6  Extended offline    Completed without error       00%      4517         -
# 7  Extended offline    Interrupted (host reset)      00%      4515         -
# 8  Extended offline    Interrupted (host reset)      00%      4513         -
# 9  Extended offline    Completed without error       00%      4474         -
#10  Extended offline    Completed without error       00%      4250         -
#11  Extended offline    Completed without error       00%      4086         -
#12  Extended offline    Completed without error       00%      4061         -
#13  Short offline       Completed without error       00%         0         -
bqn0:#̃
```

Once the disk hardware failure is confirmed, the disk must be replaced by a new one. We recommend a RAID 1 (mirroring) to avoid data losses as a result of disk failures.

4.5 Wire Problems (Data Plane Interfaces)

The management system monitors all the configured wires. If there are no wires configured or none of them have their interfaces up, the state of the system wires will be *critical*. If some of the configured wires are up, but others are not, the state will be *notice*.

```
bqnadm@bqn0# show system alarms
TYPE                STATUS     UPDATES TIME
cpu                 normal           1 2021-06-29T15:56:56+0200
disk                normal           1 2021-06-09T11:27:41+0200
license-available   normal           1 2021-06-09T11:27:41+0200
license-expiration  normal           1 2021-06-09T11:27:41+0200
license-usage       normal           1 2021-06-09T11:27:41+0200
memory-dpdk         normal           1 2021-06-29T10:48:18+0200
memory-pool         normal           1 2021-06-29T10:48:18+0200
process             normal           3 2021-07-01T15:37:58+0200
time                normal           2 2021-07-01T15:37:58+0200
traffic-uplink      normal           2 2021-07-01T15:37:58+0200
traffic-downlink    normal           2 2021-07-01T15:37:58+0200
traffic-low         normal           2 2021-07-01T15:37:58+0200
traffic-inverted    normal           2 2021-07-01T15:37:58+0200
wire                notice           5 2021-07-01T17:28:21+0200
```

Use the `show interface` command to locate the interface with no link:

```
bqnadm@bqn0# show pkteng wire
ACC-IFACE        ACC-PCAP  INET-IFACE       INET-PCAP
en0o3            no        en0o4            no
en0o5            no        en0o6            no
bqnadm@bqn0# show interface
```



```
IFACE                TYPE       MAC                STATE LINK
lo0                  loopback   00:00:00:00:00:00  up    yes
en0o1                ethernet   08:00:27:45:36:8c  up    yes
en0o2                ethernet   08:00:27:b8:59:0c  down  no
en0o3                ethernet   08:00:27:0f:f4:1c  up    yes
en0o4                ethernet   08:00:27:0c:46:75  up    no
en0o5                ethernet   08:00:27:9b:3f:4a  up    yes
en0o6                ethernet   08:00:27:9b:3f:4d  up    yes
```

In the example above the `en0o4` interface has no link and it is part of a wire. Note that the interface `en0o2` is not used and its status does not affect system alarms. After connecting the cable of `en0o4` correctly, the status is restored to *normal*:

```
bqnadm@bqn0# show interface
IFACE                TYPE       MAC                STATE LINK
lo0                  loopback   00:00:00:00:00:00  up    yes
en0o1                ethernet   08:00:27:45:36:8c  up    yes
en0o2                ethernet   08:00:27:b8:59:0c  down  no
en0o3                ethernet   08:00:27:0f:f4:1c  up    yes
en0o4                ethernet   08:00:27:0c:46:75  up    yes
en0o5                ethernet   08:00:27:9b:3f:4a  up    yes
en0o6                ethernet   08:00:27:9b:3f:4d  up    yes
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           1 2021-06-09T11:27:41+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           5 2021-07-01T17:28:21+0200
```

The attributes (duplex, speed) of the network interfaces in the BQN must match the network attributes of the port where it is connected (switch, router, server, etc.) Use the `show interface` command to check the properties of the network interfaces in the BQN. Note that the default behaviour should be auto-negotiation.

```
bqnadm@bqn0# show interface detail
lo0: UP LOOPBACK RUNNING
  Link type: loopback
  Link detected: yes         Auto-negotiation: unknown
  MTU: 65536
en0o1: UP BROADCAST RUNNING MULTICAST
  Link type: ethernet        MAC: 08:00:27:45:36:8c
  Link detected: yes         Auto-negotiation: on
  Duplex: Full               Speed: 1000Mbps
  MTU: 1500
en0o2: BROADCAST MULTICAST
  Link type: ethernet        MAC: 08:00:27:b8:59:0c
  Link detected: no          Auto-negotiation: on
  Duplex: unknown            Speed: unknown
  MTU: 1500
en0o3: UP PROMISC RUNNING
  Link type: ethernet        MAC: 08:00:27:0f:f4:1c
  Link detected: yes         Auto-negotiation: on
  Duplex: Full               Speed: 1000Mbs
  MTU: 2026
en0o4: UP PROMISC RUNNING
  Link type: ethernet        MAC: 08:00:27:0c:46:75
  Link detected: yes         Auto-negotiation: on
```



```
  Duplex: Full               Speed: 1000Mbs
  MTU: 2026
en0o5: UP PROMISC RUNNING
  Link type: ethernet        MAC: 08:00:27:9b:3f:4a
  Link detected: yes         Auto-negotiation: on
  Duplex: Full               Speed: 1000Mbs
  MTU: 2026
en0o6: UP PROMISC RUNNING
  Link type: ethernet        MAC: 08:00:27:9b:3f:4d
  Link detected: yes         Auto-negotiation: on
  Duplex: Full               Speed: 1000Mbs
  MTU: 2026
```

Sometimes the problem is that the interface is non-Intel and has to be set in PCAP mode (see the *Non-Intel Interfaces* section).

Another possible source of problems is the compatibility of SFP transceivers (see the *SFP+ Modules* section).

4.5.1 Non-Intel Interfaces

When a data network interface is not Intel based, it may not be compatible unless it is placed in PCAP mode. Only interfaces of 1G should be placed in PCAP mode (10G or more must be Intel-compatible).

In the following example, the interfaces `en0p3s0` and `en0p4s0` are Broadcom based and must be in PCAP mode in order to be part of a wire. Setting an interface in PCAP mode reduces the server throughput capacity significantly, so Intel interface cards are highly recommended:

```
bqnadm@bqn0# show pkteng wire
ACC-IFACE        ACC-PCAP  INET-IFACE       INET-PCAP DIRECTED
en0p3s0          no        en0p4s0          no        yes
bqnadm@bqn0# show interface
IFACE                TYPE       MAC                STATE LINK
lo0                  loopback   00:00:00:00:00:00  up    yes
en0p1s0              ethernet   30:27:14:23:ba:12  up    yes
en0p2s0              ethernet   30:27:14:23:ba:13  down  no
en0p3s0              ethernet   30:27:14:23:ba:14  down  no
en0p4s0              ethernet   30:27:14:23:ba:15  down  no
bqnadm@bqn0# show interface en0p3s0 device
Driver: bnx2
PCI class: 0x20000
PCI vendor ID: 0x14e4 : Broadcom Inc.
PCI device ID: 0x1639 : NetXtreme II BCM5709 Gigabit Ethernet
PCI sub-vendor ID: 0x103c : Hewlett-Packard Company
PCI sub-device ID: 0x7055
PCI slot: 0000:02:00.0
NUMA node: 0
bqnadm@bqn0# show interface en0p4s0 device
Driver: bnx2
PCI class: 0x20000
PCI vendor ID: 0x14e4 : Broadcom Inc.
PCI device ID: 0x1639 : NetXtreme II BCM5709 Gigabit Ethernet
PCI sub-vendor ID: 0x103c : Hewlett-Packard Company
PCI sub-device ID: 0x7055
PCI slot: 0000:02:00.0
NUMA node: 0
bqnadm@bqn0# configure
bqnadm@bqn0(config)# interface en0p3s0
bqnadm@bqn0(config-iface)# nic pcap
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# interface en0p4s0
bqnadm@bqn0(config-iface)# nic pcap
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# commit
bqnadm@bqn0(config)# end
bqnadm@bqn0# show interface
```



```
IFACE               TYPE       MAC                STATE LINK
lo0                 loopback   00:00:00:00:00:00  up    yes
en0p1s0             ethernet   30:27:14:23:ba:12  up    yes
en0p2s0             ethernet   30:27:14:23:ba:13  down  no
en0p3s0             ethernet   30:27:14:23:ba:14  up    yes
en0p4s0             ethernet   30:27:14:23:ba:15  up    yes
bqnadm@bqn0# show pkteng wire
ACC-IFACE        ACC-PCAP  INET-IFACE       INET-PCAP DIRECTED
en0p3s0          yes       en0p4s0          yes       yes
```

4.5.2 SFP+ Modules

If *SFP+* ports are used, then make sure that the Direct Attach Cable (DAC) or the transceivers are compatible with Intel network cards In addition, ensure that the transceivers are facing the right way and are fully inserted in both ports.

In general, if there are connectivity problems and the network interfaces have no link, perform the following instructions.

1. Make sure that the transceivers are fully inserted into the network ports, and that they correspond with the configured network interfaces in the BQN.
2. Verify that the transceivers are of the supported types and of a flavor compatible with Intel network cards. The transceiver types supported are:
   - 1G ports: SFP 1000BASE-SX and 1000BASE-LX.
   - 10G ports+: SFP+ 10GBASE-SR/1000BASE-SX and 10GBASE-LR/1000BASE-LX.
   - 40G ports+: QSFP+ 40GBASE-SR4 and 40GBASE-LR4 compatible with XL710 series.
   - 25G ports: SFP28 compatible with Intel XXV710 network cards.
   - 100G ports: QSFP28 compatible with Intel E810 series.
3. If the network interface uses the Intel Ethernet Controller X710 (10G ports), make sure that the adapter qualification mechanism is disabled (to support SFP modules by vendors different than Intel) and that all the available SFP modes are fully supported. To verify the SFP+ module state the interfaces must be in PCAP mode.

   ```
   bqnadm@bqn0# system interface en0s1f1 sfp-qualification disable
   bqnadm@bqn0# system interface en0s1f1 sfp-support
   bqnadm@bqn0# show interface en0s1f1 device
   Driver: i40e
   PCI class: 0x20000
   PCI vendor ID: 0x8086 : Intel Corporation
   PCI device ID: 0x1572 : Ethernet Controller X710 for 10GbE SFP+
   PCI sub-vendor ID: 0x8086 : Intel Corporation
   PCI sub-device ID: 0x0000
   PCI slot: 0000:08:00.1
   X710 SFP+ qualification: no
   X710 SFP+ support: full
   ```

   Note that the last 2 lines indicate the SFP+ compatibility status.

> ⚠ If these parameters are modified then the system must be rebooted for the changes to take effect.

If the X710 SFP+ information displayed does not show meaningful values, execute the `/opt/bqn/sbin/x710tool` program from the *bash* shell (as `root` user), indicating the operating system name of the interface.

```
bqn0:~ # /opt/bqn/sbin/x710tool en0s1f1
DATA-STRUCT      OFFSET    VALUE DESCRIPTION
PHY-Capability   0x0000   0x000c Section Length
PHY-Capability   0x0001   0x0022 INT-EXT PHY Select
PHY-Capability   0x0002   0x0083 Internal PHY Type
PHY-Capability   0x0003   0x1871 External PHY Type
PHY-Capability   0x0004   0x0000 PHY ID 0
PHY-Capability   0x0005   0x0000 PHY ID 1
PHY-Capability   0x0006   0x3303 Module Type 0
```



```
PHY-Capability   0x0007   0x000b Module Type 1
PHY-Capability   0x0008   0x630c PHY Capabilities Misc0
PHY-Capability   0x0009   0x0a00 PHY Capabilities Misc1
PHY-Capability   0x000a   0x0a1e 40 LESM Timer Values
PHY-Capability   0x000b   0x0003 PHY Capabilities Misc2
PHY-Capability   0x000c   0x0000 PHY Capabilities Misc3
```

The `-v` flag shows more detailed information.

4. If the network interface uses the Intel Ethernet Controller X710, make sure that the adapter firmware version is up to date. To verify the adapter firmware version the interfaces must be in PCAP mode. Execute the `ethtool` program from the *bash* shell (as `root` user), indicating the operating system name of the interface.

```
bqn0:~ # ethtool -i en0s1f1
driver: i40e
version: 2.4.10
firmware-version: 4.60 0x80001f47 1.3072.0
bus-info: 0000:61:00.0
supports-statistics: yes
supports-test: yes
supports-eeprom-access: yes
supports-register-dump: yes
supports-priv-flags: yes
```

In this example, the firmware version is 4.60. At this time, the latest firmware version available is 7.2, so the firmware should be updated following the instructions described in the *Intel Ethernet Controller X710 Firmware Update* chapter.

5. If the first of the interfaces of a wire has link, then connect that transceiver together with its fiber to the second network interface of the wire. If the second network interface now has link, then the problem may be with the transceiver or the fiber originally used with the second network interface.
6. Connect the two network interfaces of a wire directly with the same fiber. Note that if both interfaces have link, then the problem may be in the other router/switch connected to the BQN.

4.6 High Memory Usage

The system monitors the BQN and the DPDK memory pools. If either of them are above 90%, the system signals it with a *warning*:

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           1 2021-06-09T11:27:41+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          warning          1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

To see memory usage:

```
bqnadm@bqn0# show statistics memory lines 1
               TIME     SYS-MB   MPOOL-MB   DPDK0-MB
2021-07-01T10:11:03   4186.395    222.819   3908.420
bqnadm@bqn0# show pkteng memory dpdk
NODE  SIZE-USED-MB SIZE-TOTAL-MB
   0        3907.2        4294.9
```


So it is confirmed that the DPDK pool is almost full. The solution to this problem is to upgrade the server RAM memory. The BQN will automatically recognize the new memory and re-dimension its pools accordingly. The following section covers a scenario where the memory upgrade can be avoided.

4.6.1 Unbalanced DPDK memory usage

The following is applicable only to NUMA servers (a dual-socket server with two CPUs). For performance reasons, a network card uses the DPDK memory pool associated to its NUMA. For example, a network card inserted in a PCI slot associated to NUMA-0 will use the DPDK memory pool of NUMA-0. Therefore, if network cards were inserted unevenly between the two NUMAs, the resulting memory usage will be unbalanced.

The unbalance can be seen with the following command:

```
bqnadm@bqn0# show statistics memory
               TIME     SYS-MB   MPOOL-MB   DPDK0-MB   DPDK1-MB
2022-02-15T05:58:49  31661.758    313.458    183.663      3.232
2022-02-15T06:03:49  31662.598    336.887    191.474      9.693
2022-02-15T06:08:49  31662.094    349.635    200.336      7.392
2022-02-15T06:13:49  31661.887    342.606    200.365      9.657
2022-02-15T06:18:49  31661.789    342.279    194.166      5.401
2022-02-15T06:23:49  31661.199    356.192    199.790      0.923
2022-02-15T06:28:49  31662.246    369.253    212.195      6.996
2022-02-15T06:33:49  31662.492    374.588    207.565      2.248
2022-02-15T06:38:49  31660.426    384.968    203.998      7.128
2022-02-15T06:43:49  31659.539    393.998    215.445      4.333
2022-02-15T06:48:49  31660.500    396.609    221.627      4.992
2022-02-15T06:53:49  31659.562    415.244    215.948      3.416
2022-02-15T06:58:49  31660.484    433.093    220.668      6.716
2022-02-15T07:03:49  31662.738    428.353    218.833      9.735
2022-02-15T07:08:49  31661.539    441.953    221.646      2.435
. . .
```

In this case, all traffic is being handled by NUMA-0, so its pool (DPDK0) has a much bigger usage.

If the memory is big enough, this imbalance poses no problem and can be left as it is (in future upgrades, extra network cards should be inserted in the NUMA-1 PCI slots). But if DPDK0 has high usage, it is possible to rebalance the memory by telling the network interfaces to use also the other DPDK pool. The following example uses too wires, both in the same NUMA:

```
bqnadm@bqn0# show pkteng wire
ACC-IFACE        ACC-PCAP  INET-IFACE       INET-PCAP
en0p5s0f0        no        en0p5s0f1        no
en0p7s0f0        no        en0p7s0f1        no
bqnadm@bqn0# show interface en0p5s0f0 device
Driver: igb_uio
PCI class: 0x20000
PCI vendor ID: 0x8086 : Intel Corporation
PCI device ID: 0x10fb : 82599ES 10-Gigabit SFI/SFP+ Network Connection
PCI sub-vendor ID: 0x1374
PCI sub-device ID: 0x0132
PCI slot: 0000:05:00.0
NUMA node: 0
bqnadm@bqn0# show interface en0p7s0f0 device
Driver: igb_uio
PCI class: 0x20000
PCI vendor ID: 0x8086 : Intel Corporation
PCI device ID: 0x10fb : 82599ES 10-Gigabit SFI/SFP+ Network Connection
PCI sub-vendor ID: 0x1374
PCI sub-device ID: 0x0132
PCI slot: 0000:07:00.0
NUMA node: 0
```

Each wire uses two IO processes:

```
bqnadm@bqn0# show pkteng affinity
```



```
FUNCTION                                    AFFINITY COUNT
cpu-available                            ffffff,ffffffff    56
pkteng-all                               000000,00fffffe    23
pkteng-worker                            000000,00ffff3e    21
pkteng-io                                000000,0000f000     4
en0p5s0f1-io                             000000,00003000     2
en0p5s0f0-io                             000000,00003000     2
en0p7s0f1-io                             000000,0000c000     2
en0p7s0f0-io                             000000,0000c000     2
```

To balance the memory usage, we can instruct the interfaces to use DPDK0 for some IO processes and DPDK1 for the other IO processes.

```
bqnadm@bqn0# configure
bqnadm@bqn0(config)# interface en0p5s0f0
bqnadm@bqn0(config-iface)# nic io numa 0x1000 0
bqnadm@bqn0(config-iface)# nic io numa 0x2000 1
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# interface en0p5s0f1
bqnadm@bqn0(config-iface)# nic io numa 0x1000 0
bqnadm@bqn0(config-iface)# nic io numa 0x2000 1
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# interface en0p7s0f0
bqnadm@bqn0(config-iface)# nic io numa 0x4000 0
bqnadm@bqn0(config-iface)# nic io numa 0x8000 1
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# interface en0p7s0f1
bqnadm@bqn0(config-iface)# nic io numa 0x4000 0
bqnadm@bqn0(config-iface)# nic io numa 0x8000 1
bqnadm@bqn0(config-iface)# root
bqnadm@bqn0(config)# commit
bqnadm@bqn0(config)# end
bqnadm@bqn0#
```

The previous configuration gets the first wire to use DPDK0 for IO 0x1000 and DPDK1 for IO 0x2000 and, similarly for the second wire. The memory usage will be more balanced:

```
bqnadm@bqn0# show statistics memory
               TIME     SYS-MB   MPOOL-MB   DPDK0-MB   DPDK1-MB
2022-02-15T05:54:06  70011.793   2547.534    691.772    557.649
2022-02-15T05:59:06  70010.953   2582.345    684.435    657.337
2022-02-15T06:04:06  70010.906   2802.498    864.704    759.575
2022-02-15T06:09:06  70011.078   2785.494    825.033    658.832
2022-02-15T06:14:06  70011.055   2845.675    721.519    768.127
2022-02-15T06:19:06  70011.664   2863.118    675.411    767.531
2022-02-15T06:24:06  70010.879   2844.638    588.927    709.374
2022-02-15T06:29:06  70011.711   2951.280    905.278    671.670
2022-02-15T06:34:06  70011.609   3016.513    689.571    821.960
2022-02-15T06:39:06  70010.617   3033.801    874.681    722.075
2022-02-15T06:44:06  70010.719   3136.536    795.822   1016.979
2022-02-15T06:49:06  70012.473   3100.317    679.810    866.036
2022-02-15T06:54:06  70011.285   3122.440    757.506    934.861
2022-02-15T06:59:06  70010.863   3083.912    690.496    862.272
2022-02-15T07:04:06  70010.906   3301.254    795.088    794.413
. . .
```

4.7 License Unavailable Issues

The management system monitors the availability of licenses.

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    critical         2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
```



```
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

If the *license-available* status is not *normal* then follow these steps:

1. Verify that there is a valid license

   ```
   bqnadm@bqn0# show license
   FEATURE                         EXPIRATION VALID  USAGE-MAX
   ```

2. If there is no license, it is possible that the BQN has not retrieved a valid license from the license manager. Make sure that the license manager has been contacted:

   ```
   bqnadm@bqn0# show remctr status
   State: idle
   Timer expiration: 00:05:23.599
   Last in "connected" state: n/a
   Session ID: 5672e81430c7f9b5
   ```

   If so, force the BQN to contact the licence manager:

   ```
   bqnadm@bqn0# system remctr connect
   bqnadm@bqn0# show license
   FEATURE                         EXPIRATION VALID  USAGE-MAX
   bta              2021-07-04T16:59:59-0500 yes         1000
   ```

3. Sometimes the BQN cannot reach the license manager, which needs to access the the *13151* TCP port at *146.59.206.4* and *46.26.190.166* IP addresses. To test if the license manager is reachable, enter the following command as *root*:

   ```
   bqn0:~ # telnet 146.59.206.4 13151
   Trying 146.59.206.4...
   telnet: connect to address 146.59.206.4: Connection refused
   bqn0:~ #
   ```

   This lack of access can be caused by a firewall rule preventing an outgoing TCP connection to those IP addresses, which requires that you review your firewall rules.

   If the BQN firewall is used, make sure the license manager IPs are included. For example, if *en0o1* is the management interface and the firewall is active;

   ```
   bqnadm@bqn0# show interface firewall
   IFACE            CHAIN   RANGE
   en0o1            input   10.0.0.0/8
   en0o1            input   172.16.0.0/12
   en0o1            input   192.168.0.0/16
   bqnadm@bqn0# configure
   bqnadm@bqn0(config)# interface en0o1
   bqnadm@bqn0(config-iface)# firewall input 46.26.190.166/32
   bqnadm@bqn0(config-iface)# firewall input 146.59.206.4/32
   bqnadm@bqn0(config-iface)# root
   bqnadm@bqn0(config)# commit
   bqnadm@bqn0(config)# end
   bqnadm@bqn0#
   ```

   After sorting out the firewall, the license manager should be reachable, which can be tested by entering the following command as *root*:

   ```
   bqn0:~ # telnet 146.59.206.4 13151
   Trying 146.59.206.4...
   Connected to 146.59.206.4.
   Escape character is '^]'.
   ^]Connection closed by foreign host.
   bqn0:~ #
   ```

If the problem persists, follow the instructions in the *Contacting Bequant Support* section for assistance.

4.8 License Expiration Issues

The system management process monitors if there are licenses which have expired.

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   critical         1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
bqnadm@bqn0# show license
FEATURE                        EXPIRATION VALID  USAGE-MAX
bta              2021-06-30T00:00:00+0200 no          1000
```

In that case, a license renewal will be necessary from your sales representative.

It is possible that the renewal is already waiting in the license manager but the license manager is currently not reachable. See the *License Unavailable Issues* section for details.

If the problem persists, follow the instructions in the *Contacting Bequant Support* section for assistance.

4.9 Traffic Above The License Limit

If the license limit is in *warning* state, it indicates that the system is processing more traffic throughput than the purchased license.

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        warning          1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

When the license usage is in *warning* state, the BQN continues forwarding all the traffic, so the connectivity is not lost, but some flows are not processed to keep the throughput of optimized traffic approximately within the license limit. Flows already optimized continue to be so in order to mitigate the impact on end users experience.

The system alarm will be in *warning* state during the time when traffic exceeds the license.

You will need to purchase a license upgrade from your sales representative.

4.10 No Traffic in Uplink or Downlink Directions

The BQN monitors that traffic in uplink and downlink directions are flowing through the server. When this is not the case, a *warning* alert is issued.

For example, if there is no uplink traffic flowing through the BQN:

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       warning          2 2021-07-01T15:37:58+0200
traffic-downlink     warning          2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

You can check the traffic flowing through the BQN with the following command:

```
bqnadm@bqn0# show interface pkteng bandwidth
INTERFACE         PKTS-RX-Kpps BYTES-RX-Mbps  PKTS-TX-Kpps BYTES-TX-Mbps
en0o7                    0.000         0.000         0.000         0.000
en0o8                    0.000         0.000         0.000         0.000
```

In this example, there is no traffic through the BQN.

If the traffic goes in only one direction (for example, only downlink), you would see something like:

```
bqnadm@bqn0# show interface pkteng bandwidth
INTERFACE         PKTS-RX-Kpps BYTES-RX-Mbps  PKTS-TX-Kpps BYTES-TX-Mbps
en0o7                    0.000         0.000         1.897        15.515
en0o8                    1.970        18.113         0.000         0.000
```

By default, the system reports a problem if the traffic reaches zero, but you can define a more strict threshold. For example, to report an alarm if the traffic goes below 100 Mbps in downlink and 20 Mbps in uplink:

```
bqnadm@bqn0# configure
bqnadm@bqn0(config)# system
bqnadm@bqn0(config-system)# management traffic threshold 100000 20000
bqnadm@bqn0(config-system)# root
bqnadm@bqn0(config)# commit
bqnadm@bqn0(config)# end
bqnadm@bqn0#
```

Note that in this example the traffic thresholds are specified in Kbps.

4.11 Traffic Too Low

While there is traffic in uplink and downlink directions, the BQN monitors if the total level of received traffic in both directions goes below a threshold and if it does, signals it with a *notice* alarm.

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          notice           2 2021-07-01T15:37:58+0200
```



```
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

You need to check if this low level of traffic is normal.

By default, the level of low traffic is 1 Mbps, but you can define a different threshold. For example, to raise the threshold to 500 Mbps:

```
bqnadm@bqn0# configure
bqnadm@bqn0(config)# system
bqnadm@bqn0(config-system)#  management traffic low 500000
bqnadm@bqn0(config-system)# root
bqnadm@bqn0(config)# commit
bqnadm@bqn0(config)# end
bqnadm@bqn0#
```

Note that in this example the traffic threshold is specified in Kbps.

If there is no traffic, this alarm will stay in *unknown* state.

4.12 Traffic Inverted

While there is traffic in uplink and downlink directions, the BQN monitors if the uplink received traffic is less than the downlink received traffic. Traffic usually has more throughput in the downlink direction than in the uplink direction. If this is not the case, a *warning* alarm is issued:

```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     warning          2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

For the BQN it is important the direction of the traffic, because it needs to know where the subscribers and the Internet lie. When the traffic is signalled as inverted, it is usually due to some wires that contain ports that have been connected in inverted order (the access interface is the one on the Internet side and vice versa). To verify the directionality, first list the wire configuration:

```
bqnadm@bqn0# show pkteng wire
ACC-IFACE        ACC-PCAP  INET-IFACE       INET-PCAP
en0o3            no        en0o4            no
en0o5            no        en0o6            no
```

Then check the throughput of those interfaces:

```
bqnadm@bqn0# show statistics interface speed lines 6
                              en0o3             en0o4             en0o5             en0o6 ...
                TIME  TX-Mbps  RX-Mbps  TX-Mbps  RX-Mbps  TX-Mbps  RX-Mbps  TX-Mbps  RX-Mbps ...
2021-07-02T10:25:29    95.59   345.52   341.16    97.72   270.43    36.81    38.26   266.81 ...
2021-07-02T10:30:29    84.07   308.87   306.04    84.37   264.17    32.00    33.55   261.19 ...
2021-07-02T10:35:29   110.54   357.93   352.72   113.40   268.12    36.70    38.23   265.27 ...
2021-07-02T10:40:29    92.36   338.68   336.39    93.59   296.24    40.09    41.87   291.66 ...
2021-07-02T10:45:29    97.69   334.42   332.46    99.75   290.77    38.16    39.57   284.97 ...
2021-07-02T10:50:29    90.91   351.32   348.21    93.81   278.66    40.51    41.82   274.15 ...
```

It can be observed that **en0o3** receives more than it transmits and it is configured as an access interface in the wire. Interface **en0o4** sends more than it receives and it is configured in its wire as the Internet

interface. That wire is inverted and it is causing the inverted traffic alarm. To fix it, either change the physical cables or revert the configuration:

```
bqnadm@bqn0# set wire en0o4 en0o3 0 bqnadm@bqn0# show pkteng wire
ACC-IFACE        ACC-PCAP  INET-IFACE       INET-PCAP
en0o4            no        en0o3            no
en0o5            no        en0o6            no
```

And after a while the throughput should be correct and the alarm should go to normal state:

```
bqnadm@bqn0# show statistics interface speed lines 6
                              en0o4            en0o30             en0o5             en0o6 ...
               TIME  TX-Mbps  RX-Mbps  TX-Mbps  RX-Mbps  TX-Mbps  RX-Mbps  TX-Mbps  RX-Mbps ...
2021-07-02T11:10:29   400.18    92.59    93.00   397.07   318.87    37.97    39.33   312.07 ...
2021-07-02T11:15:29   386.63   110.96   112.47   382.89   340.75    42.31    43.59   333.36 ...
2021-07-02T11:20:29   400.43   129.60   134.19   396.74   329.78    39.88    41.19   323.03 ...
2021-07-02T11:25:29   394.71    86.28    87.74   394.01   331.49    39.52    41.15   325.75 ...
2021-07-02T11:30:29   418.99   123.71   126.81   412.89   353.49    38.17    39.97   347.01 ...
2021-07-02T11:35:29   394.50   119.44   121.68   390.73   356.91    39.81    41.94   350.53 ...
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           3 2021-07-01T15:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

If there is no traffic, this alarm will stay in *unknown* state.

If the problem persists, follow the instructions in the *Contacting Bequant Support* section for assistance.

4.13 Process Issues

The management system monitors the BQN mandatory processes and in case of failure it automatically restarts them.

When a process fails, the *process* alarm is triggered, and a new process is restarted within seconds.

In the following example, the *apimgr* process has a failure and the *process* alarm is triggered.

```
bqnadm@bqn0# show process mandatory
BQN USER            PID STATE     RESPAWN           TIME INST PROCESS
  0 root           7878 stopped         0    0:00:00.925    0 apimgr
  0 root           5962 running         0    4:22:53.315    0 cfgmgr
  0 root           5943 running         0    4:22:53.467    0 ctrmgr
  0 root           5960 running         0    4:22:53.372    0 dnsmgr
  0 root           5969 running         0    4:22:53.265    0 ipmgr
  0 root           5966 running         0    4:22:53.265    0 licmgr
  0 root           5964 running         0    4:22:53.283    0 ossrv
  0 root           6048 running         0    4:22:52.787    0 pkteng
  0 root           6141 running         0    4:22:52.381    1 pkteng
  0 root           6142 running         0    4:22:52.381    2 pkteng
  0 root           6143 running         0    4:22:52.376    3 pkteng
  0 root           6041 running         0    4:22:52.813    0 pktengmgr
  0 root           5968 running         0    4:22:53.261    0 remctr
  0 root           5965 running         0    4:22:53.283    0 rtmgr
  0 root           7862 running         0    4:22:53.292    0 snmpagt
  0 root           5963 running         0    4:22:53.314    0 statmgr
```



```
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              critical         3 2021-07-01T19:37:58+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

After a short time the process is automatically restarted and the alarm is cleared.

```
bqnadm@bqn0# show process mandatory
BQN USER            PID STATE     RESPAWN           TIME INST PROCESS
  0 root           8432 running         1    0:00:01.618    0 apimgr
  0 root           5962 running         0    4:29:14.014    0 cfgmgr
  0 root           5943 running         0    4:29:14.166    0 ctrmgr
  0 root           5960 running         0    4:29:14.071    0 dnsmgr
  0 root           5969 running         0    4:29:13.964    0 ipmgr
  0 root           5966 running         0    4:29:13.964    0 licmgr
  0 root           5964 running         0    4:29:13.982    0 ossrv
  0 root           6048 running         0    4:29:13.486    0 pkteng
  0 root           6141 running         0    4:29:13.079    1 pkteng
  0 root           6142 running         0    4:29:13.080    2 pkteng
  0 root           6143 running         0    4:29:13.075    3 pkteng
  0 root           6041 running         0    4:29:13.511    0 pktengmgr
  0 root           5968 running         0    4:29:13.960    0 remctr
  0 root           5965 running         0    4:29:13.982    0 rtmgr
  0 root           7862 running         0    4:29:13.994    0 snmpagt
  0 root           5963 running         0    4:29:14.013    0 statmgr
bqnadm@bqn0# show system alarms
TYPE                 STATUS     UPDATES TIME
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           2 2021-07-01T17:21:38+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           4 2021-07-01T19:37:59+0200
time                 normal           2 2021-07-01T15:37:58+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           4 2021-07-01T15:38:33+0200
```

If the problem remains, then follow the instructions in the *Contacting Bequant Support* section for assistance.

4.14 Time Issues

As indicated in the installation procedure, it is important that the BQN has the correct system time. To that end, the BQN monitors that the NTP service is configured and synchronized.

4.14.1 NTP not configured

The management process triggers a *time* alarm when the NTP service is not configured.

```
bqnadm@bqn0# show system alarms
BQN USER            PID STATE     RESPAWN           TIME INST PROCESS
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           1 2021-06-09T11:27:41+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           4 2021-07-02T14:04:38+0200
time                 notice           2 2021-07-02T14:21:26+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           1 2021-07-02T09:42:21+0200
```

Make sure that the NTP service is configured. It is recommended to use several NTP servers for redundancy.

```
bqnadm@bqn0# configure
bqnadm@bqn0(config)# service ntp
bqnadm@bqn0(config-ntp)# server 18.26.4.105
bqnadm@bqn0(config-ntp)# server 145.238.203.14
bqnadm@bqn0(config-ntp)# server 188.119.192.10
bqnadm@bqn0(config-ntp)# server 193.145.15.15
bqnadm@bqn0(config-ntp)# root
bqnadm@bqn0(config)# commit
bqnadm@bqn0(config)# end
bqnadm@bqn0)# show service ntp
ntp.service - LSB: Network time protocol daemon (ntpd)
   Loaded: loaded (/bqn/img/linux/etc/init.d/ntp)
  Drop-In: /run/systemd/generator/ntp.service.d
           -50-insserv.conf-$time.conf
  Active: active (running) since Fri 2021-07-02 09:41:46 CEST; 4h 44min ago
  . . .
bqnadm@bqn0)#
```

4.14.2 NTP Service not Synchronized

While the NTP time is not synchronized the *time* alarm is triggered.

```
bqnadm@bqn0# show system alarms
BQN USER            PID STATE     RESPAWN           TIME INST PROCESS
cpu                  normal           1 2021-06-29T15:56:56+0200
disk                 normal           1 2021-06-09T11:27:41+0200
license-available    normal           1 2021-06-09T11:27:41+0200
license-expiration   normal           1 2021-06-09T11:27:41+0200
license-usage        normal           1 2021-06-09T11:27:41+0200
memory-dpdk          normal           1 2021-06-29T10:48:18+0200
memory-pool          normal           1 2021-06-29T10:48:18+0200
process              normal           4 2021-07-02T14:04:38+0200
time                 notice           2 2021-07-02T14:21:26+0200
traffic-uplink       normal           2 2021-07-01T15:37:58+0200
traffic-downlink     normal           2 2021-07-01T15:37:58+0200
traffic-low          normal           2 2021-07-01T15:37:58+0200
traffic-inverted     normal           2 2021-07-01T15:37:58+0200
wire                 normal           1 2021-07-02T09:42:21+0200
```

Make sure that the configured NTP servers are reachable by setting the appropriate static routes to the NTP servers.

If the management interface is behind a firewall, make sure that the NTP server IPs are reachable (NTP uses port 123 of the UDP protocol).

Once the NTP servers are reachable, the BQN NTP service should synchronize:

```
bqnadm@bqn0# show system ntp
REMOTE           REFID           ST T WHEN POLL REACH   DELAY   OFFSET  JITTER
+188.119.192.10  150.214.94.5     2 U  333 1024   377  12.666  -68.433   5.622
*145.238.203.14  .MRS.            1 U  390 1024   377  25.680  -78.606   7.907
+193.145.15.15   193.147.107.33   2 U  305 1024   377   5.027  -74.237   6.768
 18.26.4.105     .M12.            1 U 133M  256     0 100.014  -50.026   0.000
```

In this example, at least three servers are synchronized with the BQN (those marked with *+*).

Note that if the BQN system time and the network time vary, it could take some time for the system to reach the right time, and that during that period the *time* alarm will be armed.

If the problem persists, follow the instructions in the *Contacting Bequant Support* section for assistance.

4.14.3 Server clock not set to UTC

A correct installation of BQN requires the server clock in the BIOS to be set to UTC (Coordinated Universal Time). If this has not been done, it could be corrected by setting the local time again. The change should be run at times of low traffic, because changing the system clock may cause a brief service interruption:

```
bqnadm@bqn0# show system date full
      Local time: Tue 2022-02-15 13:06:18 CET
  Universal time: Tue 2022-02-15 12:06:18 UTC
        RTC time: Tue 2022-02-15 09:05:45
        Timezone: Europe/Madrid (CET, +0100)
     NTP enabled: n/a
NTP synchronized: no
 RTC in local TZ: no
bqnadm@bqn0# system date local 2022-02-15 13:09:00
bqnadm@bqn0# show system date full
      Local time: Tue 2022-02-15 13:09:02 CET
  Universal time: Tue 2022-02-15 12:09:02 UTC
        RTC time: Tue 2022-02-15 12:09:02
        Timezone: Europe/Madrid (CET, +0100)
     NTP enabled: n/a
NTP synchronized: no
 RTC in local TZ: no
```

4.15 Contacting Bequant Support

Please contact Bequant support at `support@bequant.com` and include the following information:

1. Detailed problem description and the steps performed so far to try to solve the problem.
2. System diagnostic file as indicated in the *Diagnostic Generation* section in the *User Guide*.

If remote access to the BQN is available, please provide detailed instructions to access it in order for Bequant engineers to directly analyze the problem.

Note that if a software bug is the cause of the problem, it may be necessary to update the software with a newer version that fixes the problem.

A

Virtual Machine Environment

This chapter describes how to prepare a VMware or KVM environment to install a BQN virtual machine.

A.1 Prerequisites

The minimum resources for a BQN virtual machine are:

- 2 vCPUs
- 8 GB of RAM
- 16 GB of disk
- 3 network ports. Two will be used for data plane processing and the third one for management.

All resources will be fully dedicated (pinned) to the virtual machine (no oversubscription). Depending on the traffic load, check with Bequant the required resources needed. As a general guideline, use the following resources:

- For each wire of 1Gbps capacity: 2 vCPUs and 8 GB of RAM.
- For each wire of 10Gbps capacity: 12 vCPUs and 32 GB of RAM.

where each vCPU is equivalent to one core of an Intel Xeon E5-2630 v4 @ 2.20GHz CPUs, with hyperthreading enabled.

For the data plane interfaces, the recommended configuration is using Intel network cards with PCI passthrough, because of performance and reliability reasons. Other options are described below, but before using them, contact Bequant support.

A.2 VMware

The management interface can be connected to a pre-existing virtual switch used for the management of other VMs.

A.2.1 PCI Passthrough Option

Follow these instruction to setup the VM using PCI passthrough:

1. Under *Host→ Manage→Hardware→PCI devices*, mark *Toggle Passthrough* in the two physical ports that will be used for the data plane of the BQN virtual machine. The management interface does not need to be in PCI-passthrough mode.
2. Create the virtual machine with the following options:
   - *Guest OS family*: *Linux*
   - *Guest OS version*: *SUSE Linux Enterprise 12*
3. Under *Memory*, mark *Reserve all guest memory*
4. In the *Machine* menu *Add other device→PCI device* page, the two physical ports previously placed in passthrough mode should be available. Select them both.

5. Select the desired amount of memory, CPUs and disk space. Check with Bequant the resources needed for you traffic throughput.
6. Configure a *CD/DVD Media* of type *Datastore ISO file* and select the BQN ISO file to install.

A.2.2 VMXNET Option

This is not a generally supported option. Contact Bequant support before using it.

Two virtual switches will be created for the data plane. The access network port will be connected to one of the virtual switches and the Internet port to the other.

1. Create two virtual switches, Access and Internet. Fore each virtual switch, set the following options under *Configuration→Networking→Virtual Switch Properties→Security*:
   - *promiscuous mode*
   - *forged transmits*
2. Create two port groups, Access and Internet, and associate them to their corresponding virtual switches. In the *Security* option, mark that they will inherit their switch settings.
3. Create the virtual machine with the following options:
   - *Guest OS family*: *Linux*
   - *Guest OS version*: *SUSE Linux Enterprise 12*
4. Create three network interfaces, one connected to the OAM switch and the other two to the Access and Internet switches. Make the Access and Internet interfaces of type VMXNET[1].
5. Select the desired amount of memory, CPUs and disk space. Check with Bequant the resources needed for you traffic throughput.
6. Configure a *CD/DVD Media* of type *Datastore ISO file* and select the BQN ISO file to install.

A.3 KVM

The software requirements are the following:

- Linux kernel of the host machine should be version 4.11 or later.
- QEMU should be version 2.9 or later.

The Virtual Machine (VM) will need one network interface for management and at least another two for data plane packet processing.

The following sections describe the configuration details. To interact with QEMU, *virt-manager* the *Virtual Machine Manager* part of the *libvirt* package are used, but equivalent commands should be available in other popular managers.

The configuration of a VM is stored on an XML file. This file is located in the following directory:

```
/etc/libvirt/qemu
```

The configuration file name is the name of the virtual machine plus the `.xml` extension. Note that it is highly inadvisable to modify the configuratioin file directly.

A.3.1 Virtual Machine Creation

1. Copy the Bequant ISO file to the host machine where the VM will be created.
2. Select *New Virtual Machine*.
3. Under *Connection*, choose the host where the VM will be created (local or remote to the *virt-manager*).
4. Select *Choose ISO or CDROM install media* as the installation method.
5. Type the path to the Bequant ISO file previously copied to the host machine.
6. Under *Choose the operating system you are installing* enter *openSUSE*.

[1] VMXNET is the preferred option for performance reasons. Use E1000 only if VMXNET is not possible

7. Under *Choose memory and CPU setting*, select the desired amount of memory and the number of CPUs. Check with Bequant the resources needed for you traffic throughput.
8. In the next window, select the desired disk size.
9. Check the option *Customize configuration before install*.

A.3.2 Virtual Disk

Select either *VirtIO* or *SATA* disk bus type. Note that the 4.12.14 kernel fails to start if the *IDE* disk bus type is selected.

A.3.3 Network interfaces

A minimum of three interfaces must be created in the VM.

The first interface, used for management, is normally already added when the VM is created. If it is not, select *Add hardware* and choose *Network*.

The other two network interfaces are for data plane traffic processing and should be added.

For the data plane interfaces, the recommended configuration is using Intel network cards with PCI passthrough, because of performance and reliability reasons. Other options are described below, but before using them, contact Bequant support.

A.3.3.1 PCI passthrough

For each network interface (e.g. for each of the two data plane interfaces):

1. Verify that the CPU of the host server has the VT-d instruction set enabled. This is usually set under the server BIOS menu.
2. The host OS kernel must have the kernel parameter `intel_iommu` enabled.
3. Select *Add Hardware*.
4. Choose *PCI Host Device*.
5. Under *Host Device* select the network interface to be used in PCI passthrough.

One example of the XML section created in the configuration file:

```
<hostdev mode="subsystem" type="pci" managed="yes">
   <source>
     <address domain="0" bus="3" slot="0" function="0"/>
   </source>
</hostdev>
```

A.3.3.2 Linux bridges

This is not a generally supported option. Contact Bequant support before using it.

For each network interface (e.g. for each of the two data plane interfaces):

1. Select *Add Hardware*.
2. Choose *Network*.
3. Under *Network source* select *Bridge Device*.
4. Under *Device name* specify the name of the bridge.
5. Select *virtio* as the *Device model*.

On the host server, check that hardware offloading is disabled in the physical interfaces participating in the bridges. If offloading needs to be disabled, enter the following commands as `root`:

```
ethtool -K 'iface1' tx on rx on tso off gso off gro off
ethtool -K 'iface2' tx on rx on tso off gso off gro off
```


Make these changes persistent according to your Linux distribution. Make sure that the interfaces are in promiscous mode (being part of a bridge they should already be).

One example of the XML section created in the VM configuration file:

```
<interface type="bridge">
   <mac address="52:54:00:84:eb:c2"/>
   <source bridge="bridgeManagement"/>
   <model type="virtio"/>
   <address type="pci" domain="0x0000" bus="0x06" slot="0x00"
function="0x0"/>
</interface>
```

A.3.3.3 MACVTAP over a device

This is not a generally supported option. Contact Bequant support before using it.

For each network interface (e.g. for each of the two data plane interfaces):

1. Select *Add Hardware*.
2. Choose *Network*.
3. Under *Network source* select *Macvtap device*.
4. Under *Device name* specify the name of the network device.
5. Select *virtio* as the *Device model*.

On the host server, check that hardware offloading is disabled in the physical interfaces being tapped. If offloading needs to be disabled, enter the following commands as `root`:

```
ethtool -K 'iface1' tx on rx on tso off gso off gro off
ethtool -K 'iface2' tx on rx on tso off gso off gro off
```

Make these changes persistent according to your Linux distribution. Make sure that the interfaces are in promiscous mode (they should already be, being tapped).

One example of the XML section created in the VM configuration file:

```
<interface type="direct">
   <mac address="52:54:00:84:eb:c2"/>
   <source dev="enp4s0" mode="bridge"/>
   <model type="virtio"/>
   <address type="pci" domain="0x0000" bus="0x06" slot="0x00" function="0x0"/>
</interface>
```


B

Intel Ethernet Controller X710 Firmware Update

This chapter describes how to update the firmware for ethernet network adapters based on the *Intel Ethernet Controller X710*.

1. Obtain the latest version of the *Non-Volatile Memory (NVM) Update Utility for Intel® Ethernet Adapters 700 Series* for the Linux operating system from the official Intel web page:

   `https://downloadcenter.intel.com/product/82947/Intel-Ethernet-Controller-X710-Series`

   At the time of writing, the latest package version is 7.2.

2. Move the downloaded package to the BQN (if downloaded from a different system) and unpack it as `root` in the home directory.

   ```
   bqn0:~ # tar xvzf 700Series_NVMUpdatePackage_v7_20_Linux.tar.gz
   ```

   and change the current directory into the Linux directory:

   ```
   bqn0:~ # cd 700Series/Linux_x64
   bqn0:~/700Series/Linux_x64 #
   ```

3. Before the Intel adapters can be updated, it is important to remove the existing PKTENG configuration so that the Intel update utility can access the ethernet adapters.

   ```
   bqn0:~/700Series/Linux_x64 # bqnsh
   Copyright (c) 2009-2015 Bequant S.L.
   root@bqn0# configure
   root@bqn0(config)# no pkteng
   root@bqn0(config)# commit
   root@bqn0(config)# end
   root@bqn0# exit
   bqn0:~/700Series/Linux_x64 #
   ```

4. Execute the Intel firmware update utility and after all the available adapters are listed enter the adapter number when prompted (in this example the *Intel(R) Ethernet Converged Network Adapter X710-4*, which is listed as `02`).

   ```
   bqn0:~/700Series/Linux_x64 # ./nvmupdate64e
   Intel(R) Ethernet NVM Update Tool
   NVMUpdate version 1.34.22.6
   Copyright (C) 2013 - 2019 Intel Corporation.


   WARNING: To avoid damage to your device, do not stop the update or reboot or power off the system during th
   Inventory in progress. Please wait [*****-....]


   Num Description                          Ver.(hex)  DevId S:B    Status
   === ================================== ============ ===== ====== ==============
   01) Intel(R) Ethernet Connection X552     n/a(n/a)   15AC 00:004 Update not
       10 GbE SFP+                                                  available
   02) Intel(R) Ethernet Converged         4.37(4.25)   1572 00:006 Update
       Network Adapter X710-4                                       available
   03) Intel(R) I350 Gigabit Network       1.99(1.63)   1521 00:011 Update not
   ```

```
    Connection                                                  available
04) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:007 Access error
    Connection
05) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:008 Access error
    Connection

Options: Adapter Index List (comma-separated), [A]ll, e[X]it
Enter selection:  02
Would you like to back up the NVM images?  [Y]es/[N]o:  Y
Update in progress. This operation may take several minutes.
[....|*****]


Num Description                          Ver.(hex)  DevId S:B    Status
=== ================================== ============ ===== ====== ==============
01) Intel(R) Ethernet Connection X552     n/a(n/a)   15AC 00:004 Update not
    10 GbE SFP+                                                 available
02) Intel(R) Ethernet Converged         4.66(4.42)   1572 00:006 Update
    Network Adapter X710-4                                      successful
03) Intel(R) I350 Gigabit Network       1.99(1.63)   1521 00:011 Update not
    Connection                                                  available
04) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:007 Access error
    Connection
05) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:008 Access error
    Connection

Please Power Cycle your system now and run the NVM update utility again to complete the update. Failure to

Tool execution completed with the following status: The selected adapter (location:[08:00:00]) cannot be up
Update the device driver and reboot the system before running this utility again.
Consult the utility documentation for more information.
Press any key to exit.
```

Note that after executing `nvmupdate64e` the version has been upgraded from 4.37 to 4.66.

> ⚠ As indicated by the utility program, the system must be restarted and the update utility must be executed again, since the update process is incremental, until the latest version is installed.
>
> ```
> bqn0:~/700Series/Linux_x64 # shutdown -r now
> ```

5. Change the current directory to the location where the update application was unpacked and execute the update utility again until the latest version is installed.

```
bqn0:~ # cd 700Series/Linux_x64
bqn0:~/700Series/Linux_x64 # ./nvmupdate64e
Intel(R) Ethernet NVM Update Tool
NVMUpdate version 1.34.22.6
Copyright (C) 2013 - 2019 Intel Corporation.


WARNING: To avoid damage to your device, do not stop the update or reboot or power off the system during th
Inventory in progress. Please wait [*****|....]


Num Description                          Ver.(hex)  DevId S:B    Status
=== ================================== ============ ===== ====== ==============
01) Intel(R) Ethernet Connection X552     n/a(n/a)   15AC 00:004 Update not
    10 GbE SFP+                                                 available
02) Intel(R) Ethernet Converged         4.66(4.42)   1572 00:006 Update
    Network Adapter X710-4                                      available
03) Intel(R) I350 Gigabit Network       1.99(1.63)   1521 00:011 Update not
    Connection                                                  available
04) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:007 Access error
    Connection
```



```
05) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:008 Access error
    Connection

Options: Adapter Index List (comma-separated), [A]ll, e[X]it
Enter selection:  02
Would you like to back up the NVM images?  [Y]es/[N]o:  Y
Update in progress. This operation may take several minutes.
[**-.......]


Num Description                          Ver.(hex)  DevId S:B    Status
=== ================================ ============ ===== ====== ==============
01) Intel(R) Ethernet Connection X552     n/a(n/a)   15AC 00:004 Update not
    10 GbE SFP+                                               available
02) Intel(R) Ethernet Converged         7.32(7.20)   1572 00:006 Update
    Network Adapter X710-4                                    successful
03) Intel(R) I350 Gigabit Network       1.99(1.63)   1521 00:011 Update not
    Connection                                                available
04) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:007 Access error
    Connection
05) Intel(R) I210 Gigabit Network         n/a(n/a)   1533 00:008 Access error
    Connection

Reboot is required to complete the update process.

Tool execution completed with the following status: The selected adapter (location:[08:00:00]) cannot be up
Update the device driver and reboot the system before running this utility again.
Consult the utility documentation for more information.
Press any key to exit.
```

⚠ Note that this time the version has finally updated to 7.32, so in this case a final reboot is requited and the update process is completed; otherwise, reboot and repeat this step until the latest version is updated.

```
bqn0:~/700Series/Linux_x64 # shutdown -r now
```


C

End User License Agreement

This chapter contains the Bequant End User License Agreement document. Note that the EULA can be displayed from the CLI using the `show license eula` command.

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