Lightware

Application Notes



Installation and Network Setup Guide for UBEX



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Document Information

All presented functions refer to the indicated products. The descriptions have been made during testing these functions in accordance with the indicated Hardware/Firmware/Software environment:

Firmware package -
Firmware package -
Firmware package -

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Contact Us

sales@lightware.com +36 1 255 3800

support@lightware.com +36 1 255 3810

Lightware Visual Engineering LLC. Peterdy 15, Budapest H-1071, Hungary www.lightware.com

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Item	Version
JBEX-PRO20-HDMI-F100	1.3.0
JBEX-PRO20-HDMI-F110	1.3.0
JBEX-MMU-X200	1.0.6



Introduction

This chapter highlights the purpose of the document and gives a chance to check into the world of UBEX network in the below listed sections:

- DESCRIPTION
- THE PURPOSE OF THE DOCUMENT

1.1. Description

Lightware's one of the most visionary development project is the UBEX (Ultra Bandwidth Extender) product family. This new optical solution allows 4K UHD@60Hz 4:4:4 uncompressed signal extension without latency. We intend to use packet-based transmission instead of the conventional method.

We use standard, certificated 10 Gbps SFP+ optical modules which are plug and play, so they are swappable by the user. There could be either duplex multimode/singlemode modules (1-1 fiber for each direction per 10 Gbps link) or bidirectional singlemode module (1 fiber for both direction per 10 Gbps link). The maximum distance is 400 m with multimode modules (OM4), and 10 km with short range singlemode modules, or 80 km with long range singlemode modules. In a typical application with standard, non-blocking 10 Gbps Ethernet switch it is necessary to use both directions of the link. Therefore the number of necessary fibers depends on the link speed and the optical module: for 10 Gbps 1 or 2 fibers, for 20 Gbps 2 or 4 fibers are needed. One of the primary advantages of the new architecture is scalability.

Matrix Management Unit

UBEX-MMU-X200 is a Matrix Management Unit (MMU) for the UBEX AV Over IP optical extender product line. With a standard Ethernet switch installed as a crosspoint, a virtual matrix can be created with UBEX devices connected to the IP network as input and output endpoints. The virtual matrix established requires to be managed and controlled by the MMU also connected to the Ethernet switch.

The MMU builds and constantly updates a database of the UBEX endpoints connected, displaying a traditional crosspoint view of the virtual matrix in the Lightware Device Controller (LDC) software, also displaying connected, but inactive units.

Users connect and communicate directly with the MMU in matrix mode, and MMU connects to and relays communication to the endpoint UBEX units.

The MMU displays information about endpoints and the overall virtual AV network, backup and restore functions are also provided to save and load the configuration. The MMU also manages the firmware upgrades of the connected endpoint UBEX devices, it is possible to initiate and update of the firmware on all UBEX units present in the network. Based on the communication with the UBEX endpoints, the MMU manages and supervises bandwidth use efficiency.

The MMU also serves as an interface for third-party control systems and includes Lightware's proprietary Advanced EDID Management technology.

1.2. The Purpose of the Document

UBEX Application Modes

At first we need to clear up the application modes of the UBEX series devices. UBEX system has two main application modes:

- - devices:



This application note is related to the Matrix application mode only.

About the Document

- Hardware requirements
- Video network designing
- The steps of the network switch configuration in general terms

- UBEX Test Lab test cases, matrix architectures, and experiences

• EXTENDER mode - Point-to-point connection between a transmitter and a receiver, or between two transceiver endpoint

 MATRIX mode - Virtual A/V matrix with more transmitters. receivers, transceivers, and a Matrix Management Unit (MMU) which controls the A/V network.

UBEX - Matrix mode

The following chapters help for the integrators and our customers to install and configure an UBEX matrix in a newly installed or existing IT network system. The sections listed below are in the document:

- UBEX network installation step by step
- The required bandwidth of a stream by resolutions
- The steps of the network switch configuration by switch models
 - (for Ubiguiti, Netgear, Cisco, and Juniper switch models)
- Useful tips & tricks for the best user experience



Video Network Designing

This chapter gives useful practical advices to the network designers creating an effective and well-functioning UBEX A/V network.

- ► FIRST STEPS
- ► BANDWIDTH REQUIREMENTS
- ► 10 GIGABIT ETHERNET DESIGNING
- ► REQUIRED BANDWIDTH OF THE RESOLUTIONS

2.1. First Steps

At first, the video network designer needs to decide what purpose needs to be satisfied with the video system - it will determine the size of the matrix and the type of the network switch. The size of the matrix primarily depends on the number of inputs and outputs. When the designer knows that, the choosing of the type of the switch can be started. The following table can help in that:

		Sources / Required UBEX devices Required Required S		Required SFP/	Recommended switch type		
Business type	Destinations	Endpoints (TX/RX/TRX)	MMU	SFP+ ports in the switch	RJ45 ports in the switch	Туре	Example
Small business	up to 12 / 12	6	1	12	1	12-ports 10G (+1 1G SFP port for MMU) L3 managed switch	Ubiquiti EdgeSwitch 16 XG See also: Configuration Steps - Ubiquiti EdgeSwitch 16 XG
		12			24-ports 10G (+1 1G 1 SFP port for MMU) L3 managed switch 48-ports 10G (+1 1G 1 SFP port for MMU) L3	24-ports 10G (+1 1G	Netgear ProSafe M4300-24X24F See also: Configuration Steps - Netgear M4300-24X24F
Madium husingga	αμ το 247 24	12		24		Cisco WS-C3850-24XS See also: Configuration Steps - Cisco WS-C3850-24XS	
Medium business	up to 46 / 46 23 1 46	o to 46 / 46 23	1	46		48-ports 10G (+1 1G SFP port for MMU) L3	Cisco Nexus 5548UP See also: Configuration Steps - Cisco Nexus 5548UP Cisco Nexus 93180YC-EX
				managed switch	See also: Configuration Steps - Cisco Nexus 93180YC-EX		
Cornorate husiness	up to 94 / 94	47	1	94	1	96-ports 10G (+1 1G SFP port for MMU) L3 managed switch	Juniper QFX5100-96S See also: Configuration Steps - Juniper QFX5100-96S
	up to 100 / 100	50	1	200	1	Standalone/modular switching architecture with 10G SFP+ cards	Juniper QFX10016 and QFX10000 series line cards

Comparison table for video network designing

The Calculation

Let's see an example: the video network is designed for a small business calculated with maximum 6 source and 6 destination devices. The UBEX endpoint has 2 HDMI input ports and 2 HDMI output ports, so the network needs 3 transmitters for the 6 inputs and 3 receivers for the 6 outputs. It is 6 endpoints (the operation mode (TX, RX, or TRX) does not matter, the UBEX endpoint can be configured freely anytime by the user), moreover the network needs one Matrix Management Unit (UBEX-MMU-X200) to control the UBEX network.

The endpoints require two SFP+ ports in the switch per unit, in summary, it is 12 ports in the case of six extenders. The video network requires a 12-port 10G L3 fully managed switch to ensure the stable data transmission for the UBEX system.

ATTENTION! The SFP+ ports must support 10 Gbps Ethernet.

In the case of corporate business, the UBEX system gives an opportunity building even an 100x100 video matrix. The transmitters, receivers, and transceivers can be variated dynamically because of the MMU is able to handle it in real time. An asymmetric AV matrix can also be built with UBEX endpoints, e.g. an 1x100 or 100x1 video system. The possibilities are only limited by imagination.

The Matrix Management Unit requires one RJ45 or SFP ports with 1 GbE support to the network switch. The MMU does not transmit a video, it controls the UBEX system only.

Bandwidth Management

The next challenge of the video network designing is the bandwidth management. The next section describes how to calculate the required bandwidth based on the video resolution and refresh rate on the network and the general know-how of the bandwidth requirement calculation.

2.2. Bandwidth Requirements

The bandwidth calculation consists of two components:

- Required bandwidth of the streams (up to 2 streams per endpoint)
- Uplink bandwidth

The following sections give the details about these components.

2.2.1. Stream Bandwidth Requirements

UBEX transmitters have 2x HDMI 2.0 input ports which can receive two video streams for transmission to the receiver. The required bandwidth for the stream is calculated from the resolution, the color space, the refresh rate, and the loss ration of the video packeting (~3%).

Bandwidth Calculation

The correct formula:

```
X_{ACTIVE} \times Y_{TOTAL} \times fps \times ColorDepth \times VideoPacketizingLossRatio = Total signal bandwidth
```

Parameters:

Parameter	Description	Example (4K UHD 60 Hz 24 bit)
X _{ACTIVE}	Number of the columns of the active resolution	3840
Y _{total}	Total number of the lines including the blanking area	2250
fps	Refresh rate	60 Hz
ColorDepth	Color depth	24 bit
VideoPacketingLossRatio	The ratio of the packet loss due to the packeting and the protocol	1.03684

For the exact calculation you should know the total resolution of the stream because the transmitted number of pixels are not equal with the active pixels which are finally displayed on the receiver side. The cause is the blanking area where the embedded audio and other information travels with the HDMI signal.

INFO: The bandwidth calculation in the case of the HDMI pipes count with the **peak bandwidth** which is the summary of the video burst.

If the stream information is unknown to the designer, to get the information of the active resolution the **Frame detector** of Lightware is a useful tool. The Frame detector is available in our control software, in the Lightware Device Controller (LDC), it can be downloaded from the website www.lightware.com.



Let's see an example:

I want to transmit a UHD (3840x2160@60 Hz 24 bit) HDMI signal which is received on the HDMI input 1 port of the UBEX transmitter.

Based on the formula the calculation is the following:

3840 x 2250 x 60 x 24 x 1.03684 = 12 899 948 544 = **12.9 Gb/s**

This is the required bandwidth for the Stream 1 from the HDMI input 1 port. The HDMI input 2 receives an 1080p60 video, the required bandwidth is 3.23 Gb/s. The summary of the two values gives the final number of the required signal bandwidth for the video streams.



Bandwidth of the input streams for UBEX transmitter

The signal bandwidth which is transmitted over the SFP+ ports is measured with the **average bandwidth** which counts with active resolution lines instead of the total resolution lines.

	Measured pixel clock:	EQ4 MUS
	Scan:	progressive
	HSYNC polarity:	positive
Full vertical fram	HSYNC frequency:	135.00 kHz
ines	VSYNC polarity:	positive
Actual display area	VSYNC frequency:	60 Hz
	Horizontal sync width:	88 pixels
	Horizontal front porch:	296 pixels
	Horizontal back porch:	176 pixels
) lines	Vertical sync width:	10 lines
	Vertical front porch:	8 lines
· · · · · · · · · · · · · · · · · · ·	Vertical back porch:	72 lines
3840 pixels 176 pix	Active lines:	2160 lines
	Active pixels:	3840 pixels
les	Vertical resolution:	2250 lines
4400 pixels	Horizontal resolution:	4400 pixels

Frame detector in the LDC software

2.2.2. Endpoint Uplink Bandwidth Requirements

UBEX endpoints support video over an optical fiber SFP+ network connection up to 20 Gbps which means 2x 10 GbE SFP+ slots. The 20 GbE can ensure transmitting

- one 4K60 4:4:4 and one 4K30 4:4:4 signals, or
- 2x 4K60 4:2:2, or
- 2x 4K30 4:4:4 signals, or
- one 4K60 4:4:4 and one 1080p60 signals together and losslessly.

No compression, no latency, every single bit is received as it is transmitted.



2.3. 10 Gigabit Ethernet Designing

The video transmission is taken over the SFP+ interfaces which are required to build in 2x 10 Gigabit Ethernet connection between the UBEX transmitters and receivers. The fiber optical network solutions provide stable and trustworthy signal transmission in the video network. This section describes the details about the video matrix designing in the fiber optical network point of view.

2.3.1. Multimode Fiber

Multimode fiber is used in the LAN environment where distances between the rooms are 300 m or less.

The IEEE 802.3ae 10 Gigabit Ethernet specification includes a serial interface referred to as **10GBASE-SR** (the "S" stands for short wavelength) that is designed for 850 nm transmission on multimode fiber. The table below provides the wavelength, modal bandwidth, and operating distance for different types of multimode fiber operating at 10 Gbps.

Description	62.5 micron fiber			50 micron fibe	r
Wavelength (nm)	850	850	850	850	850
Modal bandwidth (MHz*km)	160	200	400	500	2000
Operating range (m)	2-26	2-33	2-66	2-82	2-400

To address the operating range concern, a new multimode fiber specification had to be created for 10GbE to achieve multimode fiber operating distances of 300 m (as specified in the TIA/EIA-568 and ISO/IEC 11801 cabling standards). This new fiber is referred to by some as "10 Gigabit Ethernet multimode fiber" and is an 850 nm, laser-optimized, 50/125 micron fiber with an effective modal bandwidth of 2000 MHz*km and is detailed in TIA-492AAAC. Its key difference, relative to legacy multimode fibers, are the additional requirements for DMD specified in TIA-492AAAC enabled by a new measurement standard for DMD (TIA FOTP-220). As shown in the table, this fiber can achieve 400 m of distance with a 10GBASE-SR interface. Many leading optical fiber vendors are actively marketing this new multimode fiber for 10GbE applications.

2.3.2. Singlemode Fiber

Singlemode fiber is used in the LAN environment where distances between the buildings are 80 km or less. Standard singlemode fiber can address nearly any application, depending on the level of cost and complexity that an operator is willing to employ. The latter issues become more significant as higher data rates, different wavelengths, and/or longer distances are adopted.

Attenuation

DEFINITION: Attenuation: Reduction in transmitted optical power. Attenuation as a function of distance in optical fiber is logarithmic. Attenuation as a function of optical wavelength is dominated by the degree to which light is scattered by the molecular structure of the optical fiber ("Rayleigh scattering").

For short fiber spans, optical transmission at 1310 nm remains an appealing option due to the price and availability of lasers at this wavelength. Several factors drive consideration of transmission at higher wavelengths, however. At higher data rates, requirements on receiver sensitivity typically grow more stringent, requiring higher received optical powers to maintain low error rates. Due to relatively high fiber attenuation at 1310 nm (see the table on the right side), maximum allowable transmission distances are reduced at 1310 nm compared to 1550 nm. At extended distances, which exceed the allowable sensitivities of optical receivers, signals in the 1550 nm region can be optically amplified (usually with an EDFA) whereas optical amplification is not commonly available at 1310 nm. As a result, 1310 nm transmission requires electrical regeneration, which is fundamentally more expensive than optical amplification.

WaveLenght (nm)	Maximum fiber attenuation per IEC 60793-2 (dB/km)	Typical cabled attenuation (dB/km)
1310	0.40	0.35
1550	0.30	0.25

Attenuation of standard singlemode fiber at 1310 nm and 1550 nm

2.3.3. 10 Gigabit Ethernet Fiber Design Considerations

Key factors to consider in the design of 10 Gigabit Ethernet networks are:

- The network topology, including operating distances, splice losses and numbers of connectors (i.e. the link power budget).
- The fiber cabling type (i.e. singlemode or multimode fiber) and the performance at a specified wavelength. The performance is characterized by channel insertion loss (cabling attenuation), and modal bandwidth(for multimode fiber).
- The use of mode-conditioning patch cords if required. The 1310 nm CWDM solution, 10GBASE-LX4, requires the use of a mode-conditioning patch cord on multimode fiber to achieve its specified range of operating distances.
- The implementation of a cabling design, compatible with LED and laser-based Ethernet network devices, which will allow the integration of current LED based 10 Mbps and 100 Mbps networks and laser-based 1 Gbps and 10 Gbps networks.

When designing individual fiber links, the first step is the characterization of the link power budget. This value (expressed in dB) is specified in the 10GbE standard for each optical interface. Tables for all interfaces are shown in this section. The link power budget is calculated by taking the difference between the minimum transmitter power launched into the fiber, and the minimum receiver sensitivity (see the figure below). The receiver sensitivity is the minimum amount of power that is necessary to maintain the required signal-to-noise ratio over the specified operating conditions. The link power budget determines the amount of total loss due to attenuation and other factors that can be introduced between the transmitter and the receiver.



Link Power Budget = Minimum transmit power - Minimum receiver sensitivity

Link Power Budget

Link Power Budget

The 10 Gigabit Ethernet operating distances provided in the tables below are limited by the channel insertion loss, the cable bandwidth for multimode fiber, and the optical transceiver characteristics (i.e., PMD types). 10GBASE-ER distances greater than 30 km are considered "engineered links" because to support those distances the attenuation of the cable needs to be less than the maximum specified for standard singlemode fiber. Therefore, distances greater than 30 km for installed cabling should be "field-tested" for verification of conformance to the 11 dB channel insertion loss specification. Insertion loss measurements of installed fiber cables are made in accordance with ANSI/TIA/EIA-526-14A/ method B and ANSI/TIA/EIA-526-7/ method A-1.

Devemetere	10BASE-SR						
Parameters	62.5 micron MMF			:			
Modal Bandwidth at 850nm (MHz*km)	160	200	400	500	2000		
Link power budget (dB)	7.3	7.3	7.3	7.3	7.3		
Operating distance (m)	26	33	66	82	400		
Channel insertion point (dB)	1.6	1.6	1.7	1.8	2.6		
Power penalty (dB) ²	4.7	4.8	5.1	5.0	4.7		

10GBASE-SR link power budget as per IEEE Draft P802.3ae/D5.0

¹ These channel insertion loss numbers are based on a wavelength of 850 nm.

² These power penalties are based on a wavelength of 840 nm.

Parameter	10BASE-LR
Link power budget (dB)	9.4
Operating distance (km)	10
Channel insertion point (dB) ³	6.2
Power penalty (dB) ⁴	3.2

10GBASE-LR link power budget as per IEEE Draft P802.3ae/D5.0

³ These channel insertion loss numbers are based on a wavelength of 1310 nm.

⁴ These power penalties are based on a wavelength of 1260 nm.

Parameter	10BASE-ER		
Link power budget (dB)	15.0		
Operating distance (km)	30	40 ⁵	
Channel insertion point (dB) 6	10.9	10.9	
Power penalty (dB) ⁷	3.6 4.1		

10GBASE-ER link power budget as per IEEE Draft P802.3ae/D5.0

⁵ Greater than 30 kilometers distance mandates an "engineered link" requiring "field testing" for verification of conformance to the 11 dB channel insertion loss specification. Insertion loss measurements of installed fiber cables are made in accordance with ANSI/TIA/EIA-526-14A/method B and EANSI/TIA/EIA-526-7/Method A1.

⁶ These channel insertion loss numbers are based on a wavelength of 1550 nm.

⁷ These power penalties are based on a wavelength of 1565 nm and other penalties.

	10	BASE-LX	4	
Parameters	62.5 micron MMF	50 mi MN	icron /IF	SMF
Modal bandwidth as measured at 1300 nm (minimum, overfilled launch) (MHz*km)	500	400	500	-
Link power budget (dB)	7.5	7.5	7.5	8.2
Operating distance (m)	300	240	400	10000
Channel insertion point (dB) ⁸	2.0	1.9	2.0	6.2
Power penalty (dB) 9	5.0	5.5	5.5	1.9

10GBASE-LX4 link power budget as per IEEE Draft P802.3ae/D5.0

⁸ These channel insertion loss numbers are based on a wavelength of 1300 nm for multimode and 1310 for single mode. An offset launch pad cord is assumed. The total insertion loss, when including the attenuation of the offset launch patch cord is allowed to be 0.5 dB higher than shown in the table.

⁹ These power penalties are based on a wavelength of 1269 nm and other penalties.

Fiber	62.5 n MI	nicron MF	50	micron M	IMF	SMF
MHz*km	160 ¹⁰	200	400	500	2000 ¹⁰	-
SR/SW 850 nm	26 m	33 m	66 m	82 m	400 m	-
LR/LW 1310 nm	-	-	-	-	-	10 km
ER/EW 1550 nm	-	-	-	-	-	40 km
LX4 1310 nm	300 500Mh	m @ z*km ¹¹	240 m	400 m	-	10 km

10GbE supported fiber and distances

¹⁰ Commonly referred to as "FDDI Grade Fiber".

¹¹ 62.5 micron multimode fiber has a model bandwidth of 500 Mhz*km at 1300 nm as opposed to 160 or 200 Mhz*km at 850nm.

DEFINITION: Modal Bandwidth: Measure of the highest frequency signal that can be supported over a given distance of multimode fiber, as limited by modal dispersion. Modal bandwidth is typically expressed in MHz*km.

10GBASE-ER Link-loss Calculation

When designing 10GBASE-ER links greater than 30 km (i.e., the cable is not already installed) a cabling link-loss calculation, which is a simple arithmetic process, is used to make sure the combined loss of the cabling components in the link does not exceed the 11 dB channel insertion loss allocated for 10GBASE-ER. The cabling linkloss is calculated by adding the connector and splice loss to the cable loss. The cable attenuation for the link is calculated by multiplying the link distance by the loss per unit distance specified for the fiber (e.g., dB/km).

As shown in the table below (scenario 1) given a cable attenuation of 0.225 db/km, the cable attenuation for a 40 km link is 9 dB (40 km x 0.225 = 9 dB). Assuming 2 dB for singlemode fiber connector and splice losses the link-loss is 11 dB (9 dB + 2 dB = 11 dB); which is an allowable channel insertion loss for 10GBASE-ER and would insure that this link can achieve 40 km. A similar calculation can be done for scenario 2 and 3.

Parameter	Scenario 1	Scenario 2	Scenario 3
Channel insertion point	11 dB	11 dB	11 dB
Required attenuation loss	0.225 dB/km	0.225 dB/km	0.3 dB/km ¹²
Connector and splice loss	2 dB	2 dB	2 dB
Maximum distance	40 km	35 km	30 km

¹² This is the maximum fiber attenuation allowed for standerd single mode fiber at 1550 nm as per IEC 60793-2. See the table in the Singlemode Fiber section for the details.

specification.

2.3.4. Conclusion

As with previous generations of Ethernet, 10 Gigabit Ethernet requires a network designer to thoroughly understand the capabilities of his/her fiber infrastructure. With 10GbE new challenges and considerations have emerged such as the effects of chromatic and polarization mode dispersion on signal integrity. In addition, decisions may have to be made regarding whether to use singlemode or multimode fiber. This paper has introduced some basic fiber related concepts and outlined some of the key points to understand and consider when designing a 10 Gigabit Ethernet network.

DEFINITION: Polarization Mode Dispersion (PMD): Difference in propagation velocity between different optical polarization states. An optical signal can be represented by two orthogonally polarized components, each of which will travel at different velocities due to inherent geometric flaws in a length of optical fiber. Since receivers used in optical communications do not discriminate between different polarization states, the two delayed polarization components will be mixed at the receiving end. This mainly applies to singlemode fiber.

gigabit-ethernet/

10GBASE-ER link-loss calculation examples

INFO: The 10BASE-E channel shall have attenuation between 5 and 11 dB. If required an attenuator can be added to comply with this

Source: https://www.10gea.org/whitepapers/optical-fiber-and-10-

2.4. Required Bandwidth of the Resolutions

The following table contains the bandwidth requirement when transmitting one or two AV signals together. The table is grouped by resolution, color space, and color depth. The values are in Gb/s.

												тх	- HDMI I	N 1								
					1280	x720p60 (720p)	1920x	1080p60 (*	1080p)	3840x21	60p30 (4K	UHD 30)	4096x	2160p30 (4K30)	3840x21	60p60 (4K	UHD 60)	4096x	2160p60 (4K60)
				No signal	YCbCr 4:2:2	RGB / YC	bCr 4:4:4	YCbCr 4:2:2	RGB / YC	bCr 4:4:4	YCbCr 4:2:2	RGB / YC	bCr 4:4:4	YCbCr 4:2:2	RGB / YC	bCr 4:4:4	YCbCr 4:2:2	RGB / YC	bCr 4:4:4	YCbCr 4:2:2	RGB / YC	bCr 4:4:4
					16 bit	24 bit	30 bit	16 bit	24 bit	30 bit	16 bit	24 bit	30 bit	16 bit	24 bit	30 bit	16 bit	24 bit	30 bit	16 bit	24 bit	30 bit
		No signal		N/A	0.96	1.43	1.79	2.15	3.23	4.03	4.30	6.45	8.06	4.59	6.88	8.60	8.60	12.90	16.12	9.17	13.76	17.20
	720 z p)	YCbCr 4:2:2	16 bit	0.96	1.92	2.39	2.75	3.11	4.19	4.99	5.26	7.41	9.02	5.55	7.84	9.56	9.56	13.86	17.08	10.13	14.72	18.16
	80x 50 H 720	RGB /	24 bit	1.43	2.39	2.86	3.22	3.58	4.66	5.46	5.73	7.88	9.49	6.02	8.31	10.03	10.03	14.33	17.55	10.60	15.19	18.63
	12	YCbCr 4:4:4	30 bit	1.79	2.75	3.22	3.58	3.94	5.02	5.82	6.09	8.24	9.85	6.38	8.67	10.39	10.39	14.69	17.91	10.96	15.55	18.99
	080 z p)	YCbCr 4:2:2	16 bit	2.15	3.11	3.58	3.94	4.30	5.38	6.18	6.45	8.60	10.21	6.74	9.03	10.75	10.75	15.05	18.27	11.32	15.91	19.35
	20×1 50 H 1080	RGB /	24 bit	3.23	4.19	4.66	5.02	5.38	6.46	7.26	7.53	9.68	11.29	7.82	10.11	11.83	11.83	16.13	19.35	12.40	16.99	20.43
	192 (1	YCbCr 4:4:4	30 bit	4.03	4.99	5.46	5.82	6.18	7.26	8.06	8.33	10.48	12.09	8.62	10.91	12.63	12.63	16.93	20.15	13.20	17.79	21.23
2	160 z 30)	YCbCr 4:2:2	16 bit	4.30	5.26	5.73	6.09	6.45	7.53	8.33	8.60	10.75	12.36	8.89	11.18	12.90	12.90	17.20	20.42	13.47	18.06	21.50
N	10X2 30 H UHL	RGB /	24 bit	6.45	7.41	7.88	8.24	8.60	9.68	10.48	10.75	12.90	14.51	11.04	13.33	15.05	15.05	19.35	22.57	15.62	20.21	23.65
DMI	38 ² (4K	YCbCr 4:4:4	30 bit	8.06	9.02	9.49	9.85	10.21	11.29	12.09	12.36	14.51	16.12	12.65	14.94	16.66	16.66	20.96	24.18	17.23	21.82	25.26
н - Х.	160 z 0)	YCbCr 4:2:2	16 bit	4.59	5.55	6.02	6.38	6.74	7.82	8.62	8.89	11.04	12.65	9.18	11.47	13.19	13.19	17.49	20.71	13.76	18.35	21.79
F	96x2 30 H 4K3	RGB /	24 bit	6.88	7.84	8.31	8.67	9.03	10.11	10.91	11.18	13.33	14.94	11.47	13.76	15.48	15.48	19.78	23.00	16.05	20.64	24.08
	400	YCbCr 4:4:4	30 bit	8.60	9.56	10.03	10.39	10.75	11.83	12.63	12.90	15.05	16.66	13.19	15.48	17.20	17.20	21.50	24.72	17.77	22.36	25.80
	:160 z) 60)	YCbCr 4:2:2	16 bit	8.60	9.56	10.03	10.39	10.75	11.83	12.63	12.90	15.05	16.66	13.19	15.48	17.20	17.20	21.50	24.72	17.77	22.36	25.80
	40X2 60 H UHI	RGB /	24 bit	12.90	13.86	14.33	14.69	15.05	16.13	16.93	17.20	19.35	20.96	17.49	19.78	21.50	21.50	25.80	29.02	22.07	26.66	30.10
	38 [,] (4K	YCbCr 4:4:4	30 bit	16.12	17.08	17.55	17.91	18.27	19.35	20.15	20.42	22.57	24.18	20.71	23.00	24.72	24.72	29.02	32.24	25.29	29.88	33.32
	160 z 0)	YCbCr 4:2:2	16 bit	9.17	10.13	10.60	10.96	11.32	12.40	13.20	13.47	15.62	17.23	13.76	16.05	17.77	17.77	22.07	25.29	18.34	22.93	26.37
	96x2 50 H 4K6(RGB /	24 bit	13.76	14.72	15.19	15.55	15.91	16.99	17.79	18.06	20.21	21.82	18.35	20.64	22.36	22.36	26.66	29.88	22.93	27.52	30.96
	405	YCbCr 4:4:4	30 bit	17.20	18.16	18.63	18.99	19.35	20.43	21.23	21.50	23.65	25.26	21.79	24.08	25.80	25.80	30.10	33.32	26.37	30.96	34.40

Legend:



The transmission is not possible with 2 pcs SFP+ modules.



Installation of the UBEX Matrix

This chapter introduces the hardware requirements of the UBEX matrix and lists the required capabilities of the network switch for the best A/V performance:

- HARDWARE REQUIREMENTS
- ETHERNET SWITCH DETAILED REQUIREMENTS
- CONNECTIONS

3.1. Hardware Requirements

The UBEX A/V network has the following hardware requirements.

Devices:

- Layer 3 (L3) network switch
 - 10 GbE support
 - IGMPv2 snooping
 - Non-blocking
 - VLAN support
 - Link Aggregation Control Protocol (LACP)
- **UBEX-MMU-X200 Matrix Management Unit**
- UBEX endpoints (transmitters, receivers, and/or transceivers)
 - UBEX-PRO20-HDMI-F100. and/or -F110

SFP+ modules:

- SFP+ transceiver modules for the endpoints
 - 1 (for 10G link) or 2 (for 20G link) modules per endpoint device
 - Singlemode or multimode
 - up to 10 GbE support
- SFP+ transceiver modules for the L3 switch
- 2 modules per endpoint device
- Singlemode or multimode
- up to 10 GbE support
- Singlemode or multimode fiber optical cables
- OM3 or OM4 is recommended

If the application does not require long cable extension, DAC cables can be applied instead of the SFP+ modules and optical cables.

DAC cables:

- DAC cables
- 2 cables per endpoint device
- up to 10 GbE support

In the virtual matrix architecture, a third-party switch is used to transfer IP packets. In connection with this switch, the following criteria must be met:

- transmission between all ports)
- 2236) snooping.
- traffic.

Optional Requirements:

- discover network topology.
- switching loops in VLAN's.

3.2. Ethernet Switch - Detailed Requirements

• 10 Gbps non-blocking switch (capable of full bandwidth

 Supports IEEE Std. 802.3ad-2000 Link Aggregation Control Protocol, with Link Aggregation Groups for each endpoint.

Supports Internet Group Management Protocol version 2 (RFC)

IPv4 (or Layer 2) Multicast Forwarding based on IGMP v2 snooping, with at least 16 addresses available for each endpoint, e.g. 4096 IPv4 multicast addresses for 256 endpoints.

- Supports IEEE Std. 802.1Q VLAN tagging: 1 VLAN reserved for UBEX control and media transmission, other(s) available for user

 Supports IEEE Std. 802.1Q (formerly 802.1p) priority code point (PCP), and implements priority based queuing for at least 1 prioritized traffic class. This is required to guarantee uninterrupted media transmission regardless of the user traffic. • Supports Link Layer Discovery Protocol (LLDP), in order to

 Supports IEEE Std. 802.1s (merged into IEEE Std. 802.1Q-2005) Multiple Spanning Tree Protocol (MSTP), in order to detect

3.3. Connections



* For the UBEX-PR020-HDMI-F110 endpoint model only.



Ethernet Switch Configuration

This chapter describes the steps of the configuration for the network switch in general terms:

- LINK AGGREGATION (LAG)
- VLAN
- IGMPv2
- OPTIONAL CONFIGURATION

ATTENTION! The UBEX extenders do not support jumbo/giant frames.

4.1. Link Aggregation (LAG)

DEFINITION: The Link Aggregation Group (LAG) applies to various methods of combining (aggregating) multiple network connections in parallel in order to increase throughput beyond what a single connection could sustain.

Create Link Aggregation Groups (LAG's)/EtherChannels etc. for each port pair that is used for 20 GbE transmission (LAG is not necessary for the ports which are used for 10 GbE transmission). The bonding mode is dynamic: 802.3-ad LACP has to be enabled for each group.

4.2. VLAN

DEFINITION: A virtual LAN (VLAN) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2). LAN is the abbreviation for local area network and in this context, virtual refers to a physical object recreated and altered by additional logic.

The UBEX network uses 802.1Q tagged frames with the VLAN ID of 286. This VLAN has to be available from each LAG, with tagged frames. The LAG's have to be in trunk mode (multiple VLAN's are available on UBEX devices, other VLAN's may be used with tagged or untagged frames).

The port where the MMU is connected is also a trunk port.

4.3. IGMPv2

DEFINITION: IGMP snooping is the process of listening to Internet Group Management Protocol network traffic. The feature allows a network switch to listen in on the IGMP conversation between hosts and routers.

IGMPv2 snooping has to be enabled for each LAG in this VLAN.

4.4. Optional Configuration

Enable Link Layer Discovery Protocol (LLDP) on all ports to access topology information in order to speed up your installation process.



Configuration Steps - Ubiquiti EdgeSwitch 16 XG

The following chapter describes and explains step-by-step the procedure of the configuration for the Ubiquiti EdgeSwitch 16 XG fully managed network switch:

- DESCRIPTION
- THE CONFIGURATION OF THE UBEX MATRIX
- FIRST STEPS
- DETAILED INSTRUCTIONS
- FINALIZING THE MATRIX

5.1. Description

This chapter helps you configure the Ubiguiti EdgeSwitch™ ES-16-XG fully managed switch for the UBEX matrix. This model of the Ubiquiti contains 12x 10G SFP+ slots which are enough to serve 6 UBEX endpoints and handle up to 12 source / destination devices. The switch is recommended for small businesses.

5.2. The Configuration of the UBEX Matrix

For the sake of simplicity the configuration steps of the switch are explained through a valid UBEX matrix example which contains:

De	evice	Pieces	Firmware version
Ub	piquiti EdgeSwitch 16 XG	1	1.8.1 (or above)
UE	BEX-MMU-X200	1	1.0.6
UE	BEX-PRO20-HDMI-F100/F110	6	1.3.0

ATTENTION! Always check the firmware version of the network switch before starting the configuration. The required steps with older versions than v1.7.3 may differ from the following description.

5.3. First Steps

5.3.1. Installation of the UBEX Devices

The installation steps of the endpoint and the MMU devices can be found in the Connections section.

5.3.2. Installation of the Switch

Download the user's manual for the EdgeSwitch 16 XG model from the website of the vendor and follow the instructions.

- Step 1. Install the switch correctly based on the instructions of the model.
- Step 2. Plug the cables between the UBEX endpoints and the switch based on the following options:
 - 12x 10GbE singlemode/multimode SFP+ transceiver modules and 12x singlemode/multimode fiber optical cables
 - 12x 10GbE DAC cables



Step 3. Plug a CATx cable to the copper port (UBEX network) of the UBEX MMU and to one of the copper ports of the switch.



Step 4. Connect a control device (e.g. a laptop) to the switch with a CATx cable to one of the copper ports.



The factory default settings of the switch: 192.168.1.2

Control Device Settings

Before connecting to the switch be sure the network settings of the operating system on your computer are correct. You need to set the following setting on the network card:

ATTENTION! The copper ports of the switch accept 1000BaseT (1 Gbps) Ethernet connection only.

Step 5. Open a web browser on your computer and follow the configuration steps coming in the following section.

• IP address: must be in the in the same subnet : **192.168.1.x** with the subnet mask of 255.255.255.0)

5.4. Detailed Instructions

5.4.1. Open a Web Browser

Open a web browser (e.g. Google Chrome) and enter the IP address of the switch. The login screen with the new interface appears.

You have to switch back to the legacy interface (old GUI) by clicking on the Go to the legacy interface link.



5.4.2. Login to the Switch

The login screen with the legacy interface appears. Enter the following parameters:

- Username: ubnt
- Password: ubnt



Legacy interface login screen of the switch

New GUI login screen of the switch

5.4.3. Creating LAGs

DEFINITION: The Link Aggregation Protocol (LAG) applies to various methods of combining (aggregating) multiple network connections in parallel in order to increase throughput beyond what a single connection could sustain.

The UBEX endpoint devices use 2x SFP+ ports in the switch per unit. You need to create LAGs for each port pair.

Navigate to the Basic -> Port Channel (LAG) submenu. All ports and the current LAG states are listed here.

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D	shboard Port	Summary	VLAN	Port C	hannel (LAG)	Port Mirroring	Firmware Upgrade	UNN	S Restar	rt Switch								
Po	rt Channel Sur	nmary																7
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	3/2		Dynamic		Enable		Enable		Down		Enable					Source/Destination MAC, \	LAN, Ethertype, Incoming Port	
•	3/3		Dynamic		Enable		Enable		Down		Enable					Source/Destination MAC, \	LAN, Ethertype, Incoming Port	
	3/4		Dynamic		Enable		Enable		Down		Enable					Source/Destination MAC, \	LAN, Ethertype, Incoming Port	
	3/5		Dynamic		Enable		Enable		Down		Enable					Source/Destination MAC, \	LAN, Ethertype, Incoming Port	
•	3/6		Dynamic		Enable		Enable		Down		Enable					Source/Destination MAC, \	LAN, Ethertype, Incoming Port	
										Pera	Add	Ned Last	ove				@ Coopyon 2015 2016 UK	gur Networks, Inc.

LAG Configuration page with no configured LAGs

Creating LAGs

Select the port channels one by one and select the Edit menu. The editing window pops up, you need to add the 2 ports where the UBEX endpoints are connected to the switch and set the following values for the channel:

- Admin Mode: Enable
- STP Mode: Enable
- Static Mode: Disable
- Link Trap: Disable
- Load Balance: Source/Destination MAC, VLAN, Ethertype, Incoming Port

Port channel name and Port description can also be added but it is not obligatory. When it is done, press the **Submit** button to save the configuration.

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	2			Dynamic	Enable	Enable	Down	Enable			Source/Destination MAC, VLAN,	Ethertype, Incoming Port		
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				Dynamic	Enable						Source/Destination MAC, VLAN,	Ethertype, Incoming Port		
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				Dynamic	Enable	Port Channel Name		1	(1 to 15 alphanumeric characters)		Source/Destination MAC, VLAN,	Ethertype, Incoming Port		
		3/6		Dynamic	Enable	Port Description			(0 to 64)		Source/Destination MAC, VLAN,	Ethertype, Incoming Port		
						Admin Mode		O Disable Enable						
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						Static Mode		Disable Disable						
						Link Trap		Disable Enable						
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										Submit Cancel				
												@ Copyright 2013-2018 Ubiquit	Networks. Inc.	
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Edit Existing Port window

5.4.4. VLAN Configuration

DEFINITION: A **virtual LAN** (VLAN) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2). LAN is the abbreviation for local area network and in this context, virtual refers to a physical object recreated and altered by additional logic.

Create VLAN

Navigate to the Basic -> VLAN submenu.

EdgeSwitch - UBNT EdgeSwitch × +		
← → C â https://192.168.1.2/htdocs/pages/main/main.lsp		☆) () :
EdgeMAX EdgeSwitch 16-Port 10G 1.8.1		
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VLAN wizard page

Adding a New VLAN

Type to the VLAN ID the **286** and click on the **Add** button. The new VLAN appears with 286 ID. Change the port participation from Untagged (U) to **Tagged (T)** in the Port Channels section.

Basic >	VLAN			
Dash	board Por	Summary VLAN Port Channel (LAG)	Port Mirroring Firmware Upgrade UNMS Restart Switch	
VLAN	Wizard			
Trunk P	Port			
Display	All V rows			Showing 1 to 2 of 2 e
	VLAN ID	Name	Port Participation: T Tagged U Untagged E Exclude	O Other
	1	default		
	286	VLAN0286	1 E E E E E E T T T	

ATTENTION! Do not enable **Trunk port** for the Port channels. If it is enabled, disable it.



he new VLAN

Add the MMU's port to the UBEX VLAN

Change the port participation from Exclude (E) to Tagged (T) on the port where the MMU connects to the switch - this is the copper port 16 in our example. Also add the port where the control device (e.g. laptop) connects to the switch for enabling the user Ethernet - this is the copper port 15 in our example.

When it is done, press the **Submit** button to save the configuration.

EdgeSwitch - UBNT EdgeSwitch 🗙 🕂			
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VLAN Wizard			2
Trunk Port	1 13 Per Channes		
Display All T rows		Showing 1 to 2 of 2 entries	
VLAN ID Name	Port Participation: T Tagged U Untagged E Exclu	ide O Other	Apply to All Ports
1 default			TUE
286 VLAN0286			TUE
2 Enter VLAN (D in the range 2 to 4000 Use 1 is specify a mage and 1 is separate VLAN	And De of VLAN ranges in the last	Pred Previous I And Last	

VLAN wizard page with the final configuration

ATTENTION! Do not enable Trunk port for the Port channels. If it is enabled, disable it.

5.4.5. IGMPv2 Snooping

DEFINITION: IGMP snooping is the process of listening to Internet Group Management Protocol network traffic. The feature allows a network switch to listen in on the IGMP conversation between hosts and routers.

Configuration

Navigate to the Switching -> IGMP Snooping -> Configuration submenu. Set the Admin Mode to Enable.

			_
Settering - Kull-Secong - Sconfiguration over Specific Multical VA N Status Multical Roder Configuration Multical Roder VA N Status Multi IGMP Snooping Global Configuration and Status Admin Mole Multical Control France Conti Interface () Education (Sum) Data France Forwardid by CPU Statust Terms Interface () Education (Sum) Statust Terms Interface () Education (Sum)	EGGEMAX EdgeSwitch 16-Port 10G 1.8.1		
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John Retrah	Data Frames Forwarded by CPU	0	
		Submit	Refresh

IGMP snooping configuration page

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P Basic -	· System •	Switching 👻	Routing 👻			
LAN Configuration						
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Interface Configuration

Go to the Interface Configuration tab. Set the Display to All rows and select all interfaces in the list. Select all ports and click on the **Edit** button.

Edge	Switch - UBNT Edge	Switch × +				
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•	0/6	Disable	260	10	0	Uisatore
	0/7	Disable	260	10	0	Lisbon
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	010	Disable	260	10	0	Disable
	0/15	Disable	200	10	0	Diabla
	0/12	Disable	260	10	0	Disable
	0/13	Disable	260	10	0	Disable
	0/14	Disable	260	10	0	Disable
	0/15	Disable	260	19	p	Disable
	0/16	Disable	260	10	D	Disable
	3/1	Disable	260	19	0	Disable
	3/2	Disable	260	10	D	Disable
	3/3	Disable	260	10	D	Disable
	3/4	Disable	260	10	D	Disable
	3/5	Disable	260	10	D	Disable
	3/6	Disable	260	10	D	Disable
				First Previous 1 N Refresh Ed	Not Last	

Interface configuration page

Editing the IGMP Snooping Interface Configuration

The IGMP snooping interface configuration editor appears in a new window. Set the following values for the interfaces:

- Admin Mode: Enable
- Group Membership Interval (Seconds): 260
- Max Response Time (Seconds): 10
- Multicast Router Expiration Time (Seconds): 0
- Fast Leave Admin Mode: Enable

When it is done, press the **Submit** button to save the configuration.

<u>ae</u>	MAX"									
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	3/4	Disable	260						Disable	
		Disable	260						Disable	
	3/6	Disable	260						Disable	

Interface configuration editor page

IGMP Snooping VLAN Configuration

Go to the VLAN Status tab. Click on the Add button to open the IGMP Snooping VLAN Configuration window. Select the 286 VLAN ID and set the following values:

- Fast Leave Admin Mode: Enable
- Group Membership Interval (Seconds): 260
- Max Response Time (Seconds): 10
- Multicast Router Expiration Time (Seconds): 0
- Report Suppression Mode: Disable

When it is done, press the **Submit** button to save the configuration.

	EdgeSwitch - UBNT EdgeSwitch × +			
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	EdgeMAX EogeSwitch 16-Port 10G 1.8.1			
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	Configuration Interface Configuration Source Specific Multicast VLAN	Status Multicast Router Configuration	Multicast Router VLAN Status Multicast Router VLAN Configuration	
	IGMP Snooping VLAN Status			2
	Display All V rows			Filter
The Target	VLAN ID C Fast Leave Admin Mode C Gro	oup Membership Interval (Seconds)	Max Response Time (Seconds) Multicast Router Expiration Time ((Seconds) C Report Suppression Mode C
			Table is Empty	
Interest Advin Notor Corport Widthing Singers Mode response Time (Seconds) Image: Suppression Note Image: Suppression Note			Refresh Add Edit Remove	
RdP Snopping VLAN Configuration VLAN ID Fast Later Admin Mode County Medicarbity Intrust Millitical Router Topinstion Three (second) B (b = 500) Report Suppression Mode State				_
VAN0 201 Fat Lever Admin Mole Data is Encode Orop Monierrating Interval 0000 Dig (24 6555) Mate Integroven Time (Seconda) Dig (24 6555) Dig (24 6555) Ropert Suppression Mode Dig (24 6556) Dig (24 6556) Dig (24 6556) Ropert Suppression Mode Dig (24 6556) Dig (24 6556) Dig (24 6556) Ropert Suppression Mode Dig (24 6556) Dig (24 6556) Dig (24 6556) Ropert Suppression Mode Dig (24 6556) Ropert Suppression Mode Dig (24 65676) Ropert Suppression Mode		IGMP Snooping VLAN Configuration		
Far Lave Admin Node Cincuit Group Mandeming Interval (Seconda) 200 Diag Cincuit Diag Cincuit Main Raponer Time (Seconda) 10 Diag Cincuit 0 Reports Time (Seconda) 0 Diag Cincuit 0 Diag Cincuit 0 Stemi Cincuit		VLAN ID	286 •	
Group Muniternity Interval (Seconds) Man Response Time (Seconds) Muniterat Router Expiration Time (Seconds) Report Expiration Time (Seconds) Report Expiration Mode Batalia Batemilia		Fast Leave Admin Mode	O Disable 🖲 Enable	
Multicard Route Experime Time (Second) Degree Status Report Suppression Mode Degree Status Second Cancel		Group Membership Interval (Seconds)	260 (2 to 65535)	
		Max Response Time (Seconds)	10 (1 to 25) Must be less than Group Membership Interval	
		Multicast Router Expiration Time (Seconds)	0 (0 to 3600)	
		Report Suppression Mode	Disable Enable	
			Submit Ca	incel
				<u></u>
8 Councer 201 2014 Earl II Marcel Io.				
				@ Copyright 2013-2018 Ubiquiti Networks, line.

IGMP snooping VLAN configuration page

5.4.6. LLDP

DEFINITION: The Link Layer Discovery Protocol (LLDP) is a vendor-neutral link layer protocol in the Internet Protocol Suite used by network devices for advertising their identity, capabilities, and neighbors on an IEEE 802 local area network, principally wired Ethernet.

Adding LLDP Interface

Navigate to the Switching -> LLDP ->Interface submenu. Select all interfaces and clicking on the Edit button opens the Edit LLDP Interface window. Tick all settings to enable them.

When it is done, press the **Submit** button to save the configuration.

E 6	dgeSwi	itch - UBNT EdgeSwitch 🗙 🕂											
← ·	> C	€ https://192.168.1.2/htdo	cs/pages/main/main.lsp#										☆ ① :
Eo	gel	MAX Edge Switch 16-Port 10G 1.	8.1				:::	===				a ^p New UI	Log Out
s										P			
		I Interface Local Devices											
	.LDP	Interface Summary											2
		ALV man											
	2	Interface O		¢	Transmit O	Receive	\$	Notify	Optional TL		Transmit Management Information		•
	e 2				Enable	Enable		Disable					_
	2				Enable	Enable		Disable					
					Francesse	Lindole		- Diadore			No		_
	2				Edit LLDP Interface						No		
	Ø				NOTE: Configuration will be apple	ed to all interfaces.					No		
	2	0/7	Down		Ena Receive						No		
	2		Down		Ena Notify						No		
	Z	0/9	Down		Enz Transmit Management Inform	ation					No		
	Ø		Down		Ena Optional TLV(s)						No		
	ø		Down		Port Description Ena		2				No		
	2		Down		Ena Ena		2				No		
8	2		Down		Ena System Capabilities						No		
1	2	0/14	Down		Ena						No		
8	2		Up		Ena					Submit Cancel	No		
18	2	0/16	Up		Enable	Enable		Disable			No		
												© Copyright 2013-2018 Uok	guiti Networks, Inc.

Add LLDP Interface window

LLDP Interface Summary

After adding all interfaces you can check the list on the LLDP Interface Summary page.

Edges	witch - UBNT EdgeSwitch X	+						
$\leftarrow \ \rightarrow$	C 🔒 https://192.168.3	1.2/htdocs/pages/main/main.l	sp#					☆ () :
Edge	EdgeSwitch 16-F	Port 10G 1.8.1					₽ No	ew UI 📕 Save Configuration Log Out
Switc	ing > LLDP > Interface					م	Basic + System + Switching +	Routing • Security • QoS •
Glo	bal Interface Local I	Devices Remote Devices	Statistics					
LLD	P Interface Summary							?
Directo	-							7844
Displa	y Al • rows				Showing 1 to 16 of 16 entries			Filter:
	Intertace	CLink Status	Carble	Carble	C Notify	C Optional (LV(s)	transmit Management Information	•
	0/2	Up	Enable	Enable	Enable	0, 1, 2, 3	res Ves	
	0/3	Up	Enable	Enable	Enable	0.1.2.3	Yes	
0	0/4	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/5	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
0	0/6	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
0	0/7	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
0	0/8	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/9	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/10	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
0	0/11	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/12	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/13	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/14	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	Q/15	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/16	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
				Re	For Provide 1 Red Law			© Capyort 2013-2014 Stepsit Networks Int.

LLDP Interface Summary page

LLDP Remote Device Summary

Go to the Remote Devices tab.

After the UBEX endpoints and the MMU booted up you can check the presence of the devices in the LLDP Remote Device Summary page.

					Ŷ
OGEMAX EdgeSwitch 16-Port 10G.				New UI S See Cent	guration Log C
Switching > LLDP > Remote Devices			٩	Basic + System + Switching + Routing + Se	
Global Interface Local Devices	Remote Devices Statistics				
LLDP Remote Device Summary					(
Display All V rows			Showing 1 to 4 of 4 entries	Filter:	
Interface	Remote ID	Chassis ID	Port ID	System Name	
D 0/1	1	A8:D2:36:00:51:9C	A8:D2:36:00:51:9E	UBEX-PR020-HDMI-F110	
02	2	A8:D2:36:00:51:9C	A8:D2:36:00:51:9D	UBEX-PR020-HDMI-F110	
ars	3	A8:D2:36:00:51:99	A8:D2:36:00:51:9A	UBEX-PR020-HDMI-F110	
0/4	4	A8:D2:36:00:51:99	A8:D2:36:00:51:98	UBEX-PR020-HDMI-F110	

LLDP Remote Device Summary page

5.4.7. Port Transceiver Information

Navigate to the System -> Port -> SFP information submenu. You can check the connection interfaces by ports.

TIPS AND TRICKS: this table can be used for debugging purpose as well. If you are sure that an SFP+ transceiver module or fiber optical cable or DAC cable is connected to a port but it is not in the table, might be the module or the cable has contact problem or it is faulty.

EdgeSwitch - UBNT EdgeSwitch × +				x
← → C https://192.168.1.2/htdocs/pages/main/main.lsp#			☆ () :
EdgeMAX EdgeSwitch 16-Port 10G 1.8.1			A New UI 😝 Save Configuration Log Out	3
System > Port > SFP Information		Basic -	System - Switching - Routing - Security - QoS	
Summary Cable Test Mirroring SFP Information				1
Fiber Ports Information			?	
Display All V rows	Showion 1 to 4 of 4 entries	es	Filter;	
Interface C Vendor Name C Serial Number C Part Number C	Revision C Compliance C Temperature (*C) C Vol	roltage (Volt) C Current (mA) C Output Power (dBm)	C Input Power (dBm) C Tx Fault C Signal Loss C	
0/1 FINISAR CORP. AUQUIRC FTLX8571D3BCL	A 10GBsse-SR 45.9 3.2	1.251 8.1 -2.361	-2.716 No No	18
0/2 FINISAR CORP. AX302NJ FTLX1471D3BOL	A 10GBase-LR 41.2 3.2	.295 43.1 -1.214	-2.132 No No	18
0/3 Fiberstore S1812000094-1 SFPP-PC05	A DAC N/A N/A	VA N/A N/A	N/A N/A N/A	10
0/4 Fiberstore S1812000119-1 SFPP-PC05	A DAC N/A N/A	I/A N/A N/A	N/A N/A N/A	
	Retreats		@ Copyright ST-15-2011 Librard Instruments into	0

SFP information page

5.4.8. Save the Configuration

Click on the Save Configuration button on the upper right corner of the page to save the current configuration settings.

WARNING! Always save the configuration before power off the switch otherwise the settings will be lost.

EdgeSwitch - UBNT EdgeSwitch × +						
→ C 🔒 https://192.168.1.2/htdocs/p	ages/main/main.lsp#					
EdgeMAX EdgeSwitch 16-Port 10G 1.8.1						
Basic > Dashboard						
Dashboard Port Summary VLAN	Port Channel (LAG) Port Mir	roring Firm	nware Upgrade	UNMS Restart Switch		
EdgeSwitch						
System Information						
System Description				EdgeSwitch 16-Port 10G, 1.8.1.5145168, Linux 3	16.5, 1.0.0.4872137	
System Name				UBNT EdgeSwitch		
System Location						
System Contact						
IP Address				192.168.1.2		
Burned In MAC Address				F0:9F:C2:66:4A:31		
System Up Time				0 days, 1 hours, 3 mins, 36 secs		
Device Information						
Machine Type				EdgeSwitch 16-Port 10G		
Machine Model				ES-16-XG		
Serial Number				F09FC2864A31		
Software Version			1.8.1.5145168			
System Resource Usage						
Temperature Status				Normal		
UNMS Status						
UNMS Status				NOT CONNECTED		
		_	_			
Logged In Users						
User	Name				Connection From	
ubrit 192.168.1.10						
Recent Log Entries	Recent Log Entries					
Log Time	Severity					
Jan 1 01:00:27	Info	DNS Client: Fai	led to send query	packet. Can't reach DNS server at 255.255.255.255		
Jan 1 01:00:27	Info	DNS Client: Fai	iled to send query	packet. Can't reach DNS server at 255.255.255.255		
Jan 1 00:59:58	Notice	Failed to acquir	re an IP address or	n Network Port; DHCP Server did not respond.		
Jan 1 00:59:29	Info	HTTPS Session	n 9 started for user	ubnt connected from 192.168.1.10		
Jan 1 00:55:22	Info	HTTPS Session	n 8 ended for user	ubnt connected from 192.168.1.10		

Dashboard page, the Save Configuration button on the upper right

			0 x
		\$	0 :
		A New UI 😝 Save Configuration Log G	Dut
٩	Basic - System -	Switching - Routing - Security - Qo	s -
		GENUINE ME PRODUCT	1
			- 12
			- 10
			- 12
	_		- 12
			- 11
			- 12
			-15
			- 12
			-88
			- 62
	00:00:00	Idle Time	
			_
Description			
or an a post of the second sec			
			- 1
		Copyright 2013-2018 Ubiquiti Networks	. Inc.

5.5. Finalizing the Matrix

The UBEX AV matrix is ready to use now.

The Lightware Device Controller software

Download the Lightware Device Controller (LDC) software from the website (www.lightware.com) to control the matrix. Install the software to a control system (e.g. a laptop). Establish the connection between the Matrix Management Unit (MMU) and the computer via Ethernet, or RS-232 interface.

Open the LDC and find the MMU in the Device discovery list. Double click on the name of the MMU to connect. The matrix crosspoint menu opens where you can configure the video system and see all information about the network.



LDC crosspoint menu

22



Configuration Steps - Netgear M4300-24X24F

The following chapter describes and explains step-by-step the procedure of the configuration for the Netgear M4300-24X24F fully managed network switch:

- DESCRIPTION
- THE CONFIGURATION OF THE UBEX MATRIX
- FIRST STEPS
- DETAILED INSTRUCTIONS
- FINALIZING THE MATRIX

6.1. Description

This chapter helps you configure the Netgear ProSAFE® M4300-24X24F managed switch for the UBEX matrix. This model of the Netgear contains 24x 10G SFP+ slots which are enough to serve 12 UBEX endpoints and handle up to 24 source / destination devices. The switch is recommended for medium businesses.

6.2. The Configuration of the UBEX Matrix

For the sake of simplicity the configuration steps of the switch are explained through a valid UBEX matrix example which contains:

Device	Pieces	Firmware version
Netgear M4300-24X24F	1	Firmware ver.: 12.0.2.9 Boot ver.: 1.0.0.8
UBEX-MMU-X200	1	1.0.6
UBEX-PRO20-HDMI-F100/F110	12	1.3.0

6.3. First Steps

6.3.1. Installation of the UBEX Devices

The installation steps of the endpoint and the MMU devices can be found in the Connections section.

6.3.2. Installation of the Switch

Download the user's manual for the M4300-24X24F model from the website of the vendor and follow the instructions.

- Step 1. Install the switch correctly based on the instructions of the model.
- Step 2. Plug the cables between the UBEX endpoints and the switch based on the following options:
 - 12x 10GbE singlemode/multimode SFP+ transceiver modules and 12x singlemode/multimode fiber optical cables
 - 12x 10GbE DAC cables

- on the following options:
- 1x 1GbE DAC cable
- 1x CATx cable

- OOB port
- Any 10G copper port

The factory default settings of the switch:

Control Device Settings

Before connecting to the switch be sure the network settings of the operating system on your computer are correct. You need to set the following setting in the network card:

Step 3. Plug the cables between the UBEX MMU and the switch based

 1x 1GbE singlemode/multimode SFP transceiver module and a singlemode/multimode fiber optical cable

Step 4. Connect a control device (e.g. a laptop) to the switch with a CATx cable to one of the following ports:



IP address of the OOB port: 192.168.0.239 • IP address of the copper ports: 169.254.100.100

• IP address: must be in the in the same subnet : **192.168.0.x** with the subnet mask of 255.255.255.0

Step 5. Open a web browser on your computer and follow the configuration steps coming in the following section.

6. Configuration Steps - Netgear M4300-24X24F

6.4. Detailed Instructions

6.4.1. Login to the Switch

Open a web browser (e.g. Google Chrome) and enter the IP address of the switch. The login screen appears. Enter the following parameters:

- Username: admin
- Password: (empty) no password needed

S NETGEAR M4300-24X24F ×	o ا الآ
← → C ☆ ③ Nem biztonságos 169.254.100.100	\$ ÷
NETGEAR	
M4300-24X24F ProSAFE 24-port 10GBASE-T and 24-port 10G SFP+	
	Login 💿
	Ilsomamo*
	Descuord
© 2016 NETGEAR, Inc. All rights reserved.	

Login screen of the switch

6.4.2. IP Address Settings

You can change the default static IP address to any other one you want.

Navigate to the System -> Management -> Management Interfaces -> IPv4 Service Port Configuration -> submenu and check the Service Port Configuration Protocol to None. When it is done, press the Update button to save the configuration.

System Switching	Routing	QoS	Security	Monitoring	N	laintenance	Help	Index				
Management Device View	Services	Stacking SNMP	LLDP Li	nk Dependency	ISDP	Timer Schedule	Applicatio	m				
Management	IPv4 Service P	ort Configuration										
System Information	Service Port	Configuration Proto	ol (None 🔘 Bootp 🤇	DHCP							
System CPU Status v	IP Address		1	192.168.3.239								
Switch Statistics	Subnet Mask		2	55.255.254.0								
USB Device Information	Default Gate	way		92.168.2.246								
Slot Information	Burned In MA	AC Address	0	8:BD:43:71:7A:26								
Loopback Interface	Interface Stat	tus	C	lown								
Management Interfaces 🔺												
Configuration												
IPv6 Service Port Configuration												
IPv4 Management VLAN Configuration												
IPv6 Management VLAN Configuration												
IPv4 Management Interface Configuration												
IPv6 Management Interface Configuration												
Time v												
DNS v												
SDM Template Preference												
Green Ethernet 🗸 🗸												

Port IP address settings page

0.6.3
□ ☆ :
Welcome admin
Update Cancel Apply

6.4.3. Creating LAGs

DEFINITION: The Link Aggregation Protocol (LAG) applies to various methods of combining (aggregating) multiple network connections in parallel in order to increase throughput beyond what a single connection could sustain.

The UBEX endpoint devices use 2x SFP+ ports in the switch per unit. You need to create LAGs on the two ports.

Navigate to the Switching -> LAG -> LAG Configuration submenu. All ports and the current LAG states are listed here.

SAFE 24-	port 10GBASE-T and 2	4-port 10G SFF	+										
witching	Routing QoS	Security	1	fonitoring	Maintenance Help Index								
iscsi	STP Multicast MVR	Address Table	Ports	LAG MRP	12 Loop Protection								
10001	off monoust myre	riddiess fabro	1 onto	in the second se	Ez coop riolectori								
<u> </u>	AG Configuration												
			LAG	lare real of				10000	Configured	Active	LAG	Local Preference	
	LAG Name	Description	ID	Admin Mode	Hash Mode	STP Mode	Static Mode	Link Trap	Ports	Ports	State	Mode	
				~	×	~	~	~				~	
	Ch1		lag 1	Enabled	3 Src/Dest MAC, VI AN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch2		lag 2	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch3		lag 3	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch4		lag 4	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch5		lag 5	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch6		lag 6	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch7		lag 7	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch8</u>		lag 8	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch9		lag 9	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch10		lag 10	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch11		lag 11	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch12</u>		lag 12	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch13		lag 13	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch14		lag 14	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch15		lag 15	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch16		lag 16	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch17</u>		lag 17	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch18</u>		lag 18	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	cn19		lag 19	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Cn2U		lag 20	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
			lag 21	Enabled	2 Storbest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
			ag 22	Enabled	2 Storbest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch23		lan 24	Enabled	3 Src/Dest MAC VI AN EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch25		lan 25	Enabled	3 Src/Dest MAC VI AN EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch26		lag 26	Enabled	3 Src/Dest MAC VLAN EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch27		lag 27	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch28		lag 28	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch29		lag 29	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch30		lag 30	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch31		lag 31	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch32		lag 32	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch33		lag 33	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch34		lag 34	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch35		lag 35	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch36		lag 36	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	

LAG Configuration page with no configured LAGs

Click on the first channel (ch1) to enter the LAG Membership settings page. Tick the two ports (where the two ports of the UBEX endpoint are connected to the switch) the graphic port table below. Press Apply when a LAG has been configured.

🚽 🔕 NETGEAR M4300-24X24F	×
	onságos 169.254.100.100/base/cheetah_login.html
NETGEAR	
M4300-24X24F ProSAFE 24	4-port 10GBASE-T and 24-port 10G SFP+
System Switching	Routing QoS Security Monitoring Maintenance Help Index
VLAN Auto-VoIP iSCSI	STP Multicast MVR Address Table Ports LAG MRP L2 Loop Protection
LAG	LAG Membership
LAG Configuration	LAG ID Lag 1 v
LAG Membership	LAG Name ch1
	LAG Description
	Admin Mode Enable 🗸
	Link Trap Disable v
	STP Mode Enable ~
	Static Mode Disable v
	Hash Mode Src/Dest MAC, VLAN, EType, incoming port 👻
	Unit 1
	Ports 1 3 5 7 5 1 1 3 5 7 1 2 2 2 2 2 2 3 3 5 7 9 9 6 8 6 6 6 2 4 6 1 0 12 4 6 0 3 2 2 4 3 3 3 3 3 8 8 0 6 4 4 6 6

LAG Membership page

When all 6 LAGs for the 6 endpoints are created, check the configuration on the LAG Configuration Page in the Configured Ports section.

📩 🖉 🔕 NETGEAR M430	00-24X24F	×						-	-										- 1	
		nságos 169.254.1	100.100/bas	e/cheetah_logi	in.html														6	☆ :
	-														_					
NETGEAI	R'																			
M4300-24X24F Pr	roSAFE 24	-port 10GBASE-	T and 24-p	ort 10G SFP+														1	Velcome admi	n 🗐 🛛
System	Switching	Routing	QoS	Security		Monitorina	Maintenance	Help	Index											
VE AN Auto VolE	D ienei	STD Multisopt	1/0/D	Address Table	Dorto	LAC MDD	1.2 Loop Protos	lion												
VEAN Auto-Voir	r 13031	ore munucast	mvrx .	Nucless lable	PUILS	DAG MINE	E2 E00p Protec	0011												
	_																		Cancel A	ppiy
LAG		LAG Configuration																		0
 LAG Configuration 	n)	E LAG Name		Description	LAG	Admin Modo	Harb Mode			STP Mode	Static Mode	Link Tran	Configured	Active	LAG	Local Preference				
·LAG Membership		E Dio Name		Description	ID	Autor mode	Tidali mode			OTT MOUS	Otatic mode	Link nap	Ports	Ports	State	Mode				
						~			×	~	~	~				~				
		ch1			lag 1	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable	1/0/1, 1/0/2		Down	Disable				
		<u>ch2</u>			lag 2	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable	1/0/3, 1/0/4		Down	Disable				
		<u>ch3</u>			lag 3	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable	1/0/5, 1/0/6		Down	Disable				
		<u>ch4</u>			lag 4	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable	1/0/7, 1/0/8		Down	Disable				
		ch5			lag 5	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable	1/0/9, 1/0/10		Down	Disable				
		<u>ch6</u>			lag 6	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable	1/0/11, 1/0/12		Down	Disable				
		<u>ch7</u>			lag 7	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		<u>ch8</u>			lag 8	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch9			lag 9	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch10			lag 10	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch11			lag 11	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch12			lag 12	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch13			lag 13	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch14			lag 14	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch15			lag 15	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		<u>ch16</u>			lag 16	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch17			lag 17	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch18			lag 18	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch19			lag 19	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		<u>ch20</u>			lag 20	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch21			lag 21	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		<u>ch22</u>			lag 22	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch23			lag 23	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch24			lag 24	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch25			lag 25	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		<u>ch26</u>			lag 26	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		<u>ch27</u>			lag 27	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				
		ch28			lag 28	Enabled	3 Src/Dest MAC,	VLAN, EType,	incoming port	Enable	Disable	Disable			Down	Disable				

LAG Configuration page with six configured LAGs

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LAG Configuration Checking

Navigate to the Switching -> LAG -> LAG Configuration submenu. All ports and the current LAG states are listed here. Check the Configured Ports and Active Ports sections in the table.

24F ProSAFE Switchin	E 24-port 10GBASE-T and												
IF ProSAFE Switchin	E 24-port 10GBASE-T and												
Switchin		24-port 10G SFP	+										
	ing Routing Qo	S Security	M	onitoring	Maintenance Help Index								
uto-VoIP iSC	SI STP Multicast MV	R Address Table	Ports	LAG MRP	L2 Loop Protection								
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						-	1		()		_		
guration	LAG Name	Description	LAG	Admin Mode	Hash Mode	STP Mode	Static Mode	Link Trap	Configured Ports	Active	LAG	Local Preference Mode	
bership			10			_			1 0115	1 0110	oute	mode	
				· · · · ·			V		4 10 14 4 10 10	41014 41010		v	
	U ch1		lag 1	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable	1/0/1, 1/0/2	1/0/1, 1/0/2	Up	Disable	
			lag 2	Enabled	3 StorDest MAC, VLAN, EType, incoming port	Enable	Disable	Disable	1/0/5, 1/0/4	1/0/5, 1/0/4	Up	Disable	
	CIID ob 4		lag 4	Enabled	2 StorDest MAC, VLAN, EType, incoming port	Enable	Disable	Disable	1/0/7 1/0/9	1/0/5, 1/0/6	Up	Disable	
	- <u>cna</u>		lag 6	Enabled	2 Storbest MAC, VLAN, EType, incoming port	Enable	Disable	Disable	1/0/9 1/0/10	1/0/7, 1/0/8	Down	Disable	
			lag 6	Enabled	3 Storbest MAC, VEAN, EType, incoming port	Enable	Disable	Disable	1/0/3, 1/0/10		Down	Disable	
	Child child		lag 7	Enabled	3 Str/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable	10/11, 10/12		Down	Disable	
	E ch8		lag 8	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch9		lag 9	Enabled	3 Src/Dest MAC, VI AN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch10		lag 10	Enabled	3 Src/Dest MAC, VI AN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	C ch11		lag 11	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch12		lag 12	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch13		lag 13	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch14		lag 14	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch15		lag 15	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch16		lag 16	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch17		lag 17	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch18		lag 18	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch19		lag 19	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch20		lag 20	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch21</u>		lag 21	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch22</u>		lag 22	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch23</u>		lag 23	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>ch24</u>		lag 24	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	0 ch25		lag 25	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Cn20		lag 20	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	<u>cn27</u>		lag 27	Enabled	3 StorDest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	C ch20		lag 20	Enabled	2 StorDest MAC, VEAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch30		lag 30	Enabled	3 Str/Dest MAC, VEAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch31		lag 31	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch32		lag 32	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch33		lag 33	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch34		lag 34	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch35		lag 35	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	Ch36		lag 36	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
	ch37		lag 37	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
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LAG Configuration page

6.4.4. VLAN Configuration

DEFINITION: A **virtual LAN** (VLAN) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2). LAN is the abbreviation for local area network and in this context, virtual refers to a physical object recreated and altered by additional logic.

Create VLAN

Navigate to the Switching -> VLAN -> Basic -> VLAN Configuration submenu. Create a VLAN and set the following values:

- VLAN ID: 286
- VLAN Name: any unique name (e.g. UBEX)
- Make static: Disable

When it is done, press the **Add** button to save the configuration.

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0-24X24F ProSA	AFE 24-port 10GBASE-T and 24-port 10G SFP+	Welcome
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	VLAN ID VLAN Name VLAN Type Make Static	
	286 UBEX Disable V	
	1 detault Disable	

VLAN Configuration page

VLAN Membership

After that navigate to the Switching -> VLAN -> Advanced -> VLAN Membership submenu. Select the 286 in the VLAN ID menu.

Set all LAG's to T (Tagged). Also add the port where the control device (e.g. laptop) connects to the switch for enabling the user Ethernet.

When it is done, press the **Apply** button to save the configuration.



VLAN Membership page

VLAN Trunking Configuration

Go to the Switching -> VLAN -> Advanced -> VLAN Trunking Configuration submenu. Select all LAGs and set the Switchport Mode to Trunk. When it is done, press the **Apply** button to save the configuration.

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VLAN Auto-VolP iSCS	SI S	STP Multic	ast MVR Add	Iress Table	Ports LAG MI	RP L2L	oop Protection	
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VLAN	-	itemport con	iguration					
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Advanced		Interface	Switchport Mode	Native VLA	Tagging Access	VLAN ID	Native VLAN ID	Trunk Allowed VLANs
 VLAN Configuration 			Trunk 👻		1 ~		1 ~	1-4093
VLAN Trunking		lag 1	General	Disable	1		1	1-4093
Configuration		lag 2	General	Disable	1		1	1-4093
VLAN Membership		lag 3	General	Disable	1		1	1-4093
VLAN Status		ag 4	General	Disable	1		1	1-4093
Port PVID Configuration		ag 5	General	Disable	1		1	1-4093
 MAC Based VLAN 		ag 7	General	Disable	1		1	1-4093
Protocol Based VLAN		lag 8	General	Disable	1		1	1-4093
Group Configuration		lag 9	General	Disable	1		1	1-4093
 Protocol Based VLAN Group Membership 		lag 10	General	Disable	1		1	1-4093
IP Subnet Based VI AN		lag 11	General	Disable	1		1	1-4093
Port DV/LAN		lag 12	General	Disable	1		1	1-4095
Configuration		ag 14	General	Disable	1		1	1-4093
Voice VLAN		ag 15	General	Disable	1		1	1-4093
Configuration		lag 16	General	Disable	1		1	1-4093
GARP Switch		lag 17	General	Disable	1		1	1-4093

VLAN Trunking Configuration page

6.4.5. IGMPv2 Snooping

DEFINITION: IGMP snooping is the process of listening to Internet Group Management Protocol network traffic. The feature allows a network switch to listen in on the IGMP conversation between hosts and routers.

Configuration

Navigate to the Switching -> Multicast -> IGMP Snooping -> Configuration submenu. Check the settings are set to the following values:

- Admin Mode: Enable
- Validate IGMP IP header: Enable
- Proxy Querier Mode: Enable

When it is done, press the Update button to save the configuration.

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• MLD Snooping ~					

IGMP snooping configuration page

Interface Configuration

Go to the Switching -> Multicast -> IGMP Snooping -> Interface Configuration submenu. Select all LAGs and set the following values:

- Admin Mode: Enable
- Fast Leave: Enable
- Proxy Querier: Disable

When it is done, press the **Apply** button to save the configuration.

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4300-24X24F ProSAFE 24	1-port 10	GBAS	E-T and 24-p	ort 10G SFP+				
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VLAN Auto-VolP iSCSL	STP	Multica	est MVR	Address Table Por	rts LAG MRP I	2 Loop Protection		
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Configuration			Enable 🗸				Enable v	Disable ~
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IGMP VLAN	🕑 lag	2	Disable	260	10	0	Disable	Enable
Configuration	🕑 lag	3	Disable	260	10	0	Disable	Enable
Multicast Router	🕑 lag	4	Disable	260	10	0	Disable	Enable
Configuration	🗹 lag	5	Disable	260	10	0	Disable	Enable
Multicast Router VLAN Configuration	🕑 lag	6	Disable	260	10	0	Disable	Enable
Comiguration	Iag	1	Disable	260	10	0	Disable	Enable
Querier Configuration	✓ lag	0	Disable	260	10	0	Disable	Enable
Querier VLAN Configuration	✓ lag	10	Disable	260	10	0	Disable	Enable
bull D D	 Iag 	11	Disable	260	10	0	Disable	Enable
MED Shooping V	✓ lag	12	Disable	260	10	0	Disable	Enable
	✓ lag	13	Disable	260	10	0	Disable	Enable
	🕑 lag	14	Disable	260	10	0	Disable	Enable
	🕑 lag	15	Disable	260	10	0	Disable	Enable
	🕑 lag	16	Disable	260	10	0	Disable	Enable
	🕑 lag	17	Disable	260	10	0	Disable	Enable
	🕑 lag	18	Disable	260	10	0	Disable	Enable
	🕑 lag	19	Disable	260	10	0	Disable	Enable
	Iag	20	Disable	260	10	0	Disable	Enable
	✓ lag	21	Disable	260	10	0	Disable	Enable
	I lag	22	Disable	260	10	0	Disable	Enable
	 Iaq 	24	Disable	260	10	0	Disable	Enable
	✓ lag	25	Disable	260	10	0	Disable	Enable
	🕑 lag	26	Disable	260	10	0	Disable	Enable
	🕑 lag	27	Disable	260	10	0	Disable	Enable
	🕑 lag	28	Disable	260	10	0	Disable	Enable
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	🕑 lag	30	Disable	260	10	0	Disable	Enable
	🕑 lag	31	Disable	260	10	0	Disable	Enable
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Interface Configuration Page

IGMP VLAN Configuration

Go to the Switching -> Multicast -> IGMP Snooping -> IGMP VLAN Configuration submenu. Select the 286 VLAN ID and set the following values:

- Admin Mode: Enable
- Fast Leave: Enable
- Membership Interval: 260
- Maximum Response Time: 10
- Multicast Router Expiry Time: 0
- Report Suppression: Disable
- Proxy Querier: Enable

When it is done, press the Apply button to save the configuration.

		- 1 und 2-4	port roo or			APR - 10			Welcome
System Switching	Routing	QoS	Securi	ty Monitoring	Maintenance	Help Index			
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Multienet	IGMP VLAN Co	nfiguration							
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GMP Snooping	VLAN ID	Admin Mode	Fast Leave	Membership Interval	Maximum Response Time	Expiry Time	Report Suppression	Proxy Querier	
Configuration	286	Enable ~	Enable v	260	10	0	Disable ~	Enable ~	
Interface Configuration	286	Enable	Enable	260	10	0	Disable	Enable	
IGMP VLAN Configuration									
Multicast Router Configuration									
Multicast Router VLAN Configuration									
Querier Configuration									
Querier VLAN Configuration									
MLD Snooping v									

IGMP VLAN Configuration page

6.4.6. LLDP

DEFINITION: The Link Layer Discovery Protocol (LLDP) is a vendor-neutral link layer protocol in the Internet Protocol Suite used by network devices for advertising their identity, capabilities, and neighbors on an IEEE 802 local area network, principally wired Ethernet.

Remote Device Inventory

Navigate to the System -> LLDP -> LLDP -> Remote Device Inventory submenu. Check the connected and explored devices by port or IP address.

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Remote Device Inventory page

TIPS AND TRICKS: this table can be used for debugging purpose as well. If you are sure that a UBEX device is connected to a port but it is not in the table, check the SFP+ transceiver modules or the fiber optical connections or the DAC cable connections - might be the module or the cable has a contact problem or it is faulty.

Remote Device Information

Clicking on the Port opens the detailed information window about the remote device.

Management Device View	Services Stacking SNMP					
		LLDP Link	Dependency I	SDP Timer Schedule	e Application	
LLDP	LLDP Interface Selection					
LLDP	Interface: 1/0/1 ~					
Global Configuration						
Interface Configuration	Remete Device Information					
Statistics	Remote Device Information					
Local Device Information	Remote ID	17				
Remote Device	Chassis ID	A8:D2:3	6:00:51:70			
Information	Chassis ID Subtype	MAC Ac	Idress			
Remote Device Inventory	Port ID	02:00:0	0:01:45:C2			
LLDP-MED v	Port ID Subtype	MAC Ad	Idress	-		
	System Name	UBEX-F	ROZU-HDMI-F10	0		
	Port Description	2	ROZU-HDMI-F H	0		
	System Capabilities Supported	station of	anly			
	System Capabilities Enabled	station o	only			
	Time To Live	112				
	Management Address Type	IPv4				
	Management Address	10.0.81	112			

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Welcome admin
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6.4.7. Port Transceiver Information

Navigate to the Switching -> Ports -> Port Transceiver submenu. You can check the connection interfaces by ports.

TIPS AND TRICKS: this table can be used for debugging purpose as well. If you are sure that an SFP+ transceiver module or DAC cable is connected to a port but it is not in the table, might be the module or the cable has contact problem or it is faulty.

uto-VoIP iSCS					maintenanee	Thomp	IIUEX			
	STP	Multicast MVR	Address Table	Ports LAG MRP	L2 Loop Protec	tion				
	Port Tran	sceiver Information								
Ports	1 All									
iption	Port	Vendor Name	Link Length 50um	Link Length 62 5um	Serial Number	Part Number	Nominal Bit Rate	Revision	Compliance	
ceiver	1/0/1	Fiberstore	0	0	S1812000153-1	SEPP-PC07	10300	A	DAC	
	1/0/2	Fiberstore	0	0	S1812000151-2	SFPP-PC07	10300	A	DAC	
	1/0/3	Fiberstore	0	0	S1812000127-1	SFPP-PC05	10300	A	DAC	
	1/0/4	Fiberstore	0	0	S1812000124-2	SFPP-PC05	10300	А	DAC	
	1/0/5	FINISAR CORP.	0	0	UWQ192T	FTLX2071D333	10300	A	10GBase-LR	
	1/0/6	FINISAR CORP.	0	0	UWQ1F3Q	FTLX2071D333	10300	A	10GBase-LR	
	1/0/7	FINISAR CORP.	8	3	UX11KA4	FTLX8574D3BCL	10300	A	10GBase-SR	
	1/0/8	FINISAR CORP.	8	3	UWR0Z8N	FTLX8574D3BCL	10300	A	10GBase-SR	
	1/0/9									
	1/0/10									
	1/0/12									
	1/0/13									
	1/0/14									
	1/0/15									
	1/0/16									
	1/0/17									
	1/0/18									
	1/0/19									
	1/0/20									
	1/0/21									
	1/0/22									
	1/0/24									
	1/0/24									
	1 All									

Port Transceiver Information page

6.4.8. Adding the MMU to the VLAN Membership

Once the MMU boots up and available, it is needed to be added to the VLAN membership.

Switchport Configuration

Navigate to the Switching -> VLAN -> Advanced -> VLAN Trunking Configuration submenu. Select the port of the MMU (e.g. 1/0/46) and set the following values:

- Switchport Mode: Trunk
- Access VLAN ID: 1
- Native VLAN ID: 1
- Trunk Allowed VLANs: 1-4093

When it is done, press the **Apply** button to save the configuration.

NETGEAR M4300-24X24F	×						
	nság						
-	-						
IETGEAR							
4300-24X24F ProSAFE 24	-poi	t 10GBA	SE-T and 24-port	10G SFP+			
Sustam Switching	÷.	Pouting	0.00	Socurity Mon	itoring Mai	ntonanco	Holo Indox
System Suncting		Routing	405	Security Mon	ioning mai	itteriance	neip index
VLAN Auto-VoIP ISCSI	51	P Multic	ast MVR Add	iress Table Ports L	AG MRP L2	Loop Protection	
VLAN	Swit	hport Con	figuration				
Basic	11					Go To Intorfa	aa
	-	AG All				Go to interna	
Advanced ^		Interface	Switchport Mode	Native VLAN Tagging	Access VLAN ID	Native VLAN ID	Trunk Allowed VLANs
VLAN Configuration		1/0/46	Trunk 👻	Disable	1 👻	1 ×	1-4093
VLAN Trunking Configuration		1/0/1	General	Disable	1	1	1-4093
MAN Mambashis		1/0/2	General	Disable	1	1	1-4093
VLAN Membership		1/0/3	General	Disable	1	1	1-4093
VLAN Status		1/0/4	General	Disable	1	1	1-4093
Port PVID Configuration		1/0/5	General	Disable	1	1	1-4093
MAC Based VLAN		1/0/6	General	Disable	1	1	1-4093
- Drotonol Raced V/LAN		1/0/7	General	Disable	1	1	1-4093
Group Configuration		1/0/8	General	Disable	1	1	1-4093
Protocol Based VI AN		1/0/10	General	Disable	1	1	1-4093
Group Membership		1/0/10	General	Disable	1	1	1-4093
IP Subnet Based VLAN	-	1/0/11	General	Disable	1	1	1.4093
0.000.000		1/0/12	General	Disable	1	1	1-4093
Configuration		1/0/13	General	Disable	-		1-4093
Maine MI AN		1/0/14	General	Disable	1	1	1.4003
Configuration	-	1/0/15	General	Disable	1	1	1.4093
GARP Switch		1/0/17	General	Disable	1	1	1.4093
Configuration		1/0/18	General	Disable	1	1	1.4093
GARP Port		1/0/19	General	Disable	1	1	1.4093
Configuration	-	1/0/20	General	Disable	4	4	1.4093
		1/0/21	General	Disable	1	1	1.4093
	-	1/0/22	General	Disable	1	1	1.4093
	-	1/0/23	General	Disable	1	1	1-4093
		1/0/24	General	Disable	1	1	1-4093
		1/0/25	General	Disable	1	1	1.4093
		1/0/26	General	Disable	1	1	1-4093
		1/0/27	General	Disable	1	1	1-4093
		1/0/28	General	Disable	1	1	1-4093
		1/0/29	General	Disable	1	1	1-4093
		1/0/30	General	Disable	1	1	1.4093
		1/0/31	General	Disable	1	1	1-4093
		1/0/32	General	Disable	1	1	1-4093
		1/0/33	General	Disable	1	1	1-4093
		1/0/34	General	Disable	1	1	1.4093
		1/0/35	General	Disable	1	1	1.4093
		1/0/36	General	Disable	1	1	1-4093
		1/0/37	General	Disable	1	1	1-4093

VLAN Trunking Configuration page

VLAN Membership

Go to the Switching -> VLAN -> Advanced -> VLAN Membership submenu. Select the 286 VLAN ID and set all LAG's to T (Tagged). Select the port in the Unit graphical layout where the MMU is connected to the switch (e.g. 46).

When it is done, press the **Apply** button to save the configuration.



VLAN Membership page

6.4.9. Save the Configuration

Navigate to the Maintenance -> Save Config -> Save Configuration submenu. Tick the Save Configuration option and press the Apply button.

WARNING! Always save the configuration before power off the switch otherwise the settings will be lost.

C 🏠 🛈 Nem biz	tonságos 169.254.100.10	0/base/cheetah_login.	html				_
NETCEAD				_	_		_
MA300-24Y24E ProSAFE	24-port 10GBASE-T and	24-port 10G SEP+					
System Switching	Routing Q	S Security	Monitoring	Maintenance	Help	Index	
Save Config Reset Ex	port Upgrade File Man	agement Troublesho	oting				
Save Config	Save Configuration						
Save Configuration	Saving all applied chang	es will cause all change	es to				
Auto Install Configuration	to be saved, thus retaining	were applied, but not ig their new values acr	aved, 🗹				
	system repoor.						

Save Configuration page

6.4.10. Export the Configuration

The configuration settings can be exported to a file and save to your local computer.

ATTENTION! This safety step is highly recommended to avoid any setting loss.

Navigate to the Maintenance -> Export -> HTTP File Export submenu. Select a file type (e.g. Text Configuration) and save the file to a computer.

4300-24X24F ProSA	FE 24-port 10GBA	SE-T and 24-port 10G SFP	+				
System Swite	hing Routing	QoS Security	Monitoring	Maintenance	Help	Index	
ave Config Reset	Export Upgrade	File Management Troubles	shooting				
	11770 51 5						
Export	HTTP File Expo	đ					
File Export	File Type	Text Configuration	~				
HTTP File Export							
JSB File Export							

Nelcome ad Cancel Appl



6.5. Finalizing the Matrix

The UBEX AV matrix is ready to use now.

The Lightware Device Controller software

Download the Lightware Device Controller (LDC) software from the website (www.lightware.com) to control the matrix. Install the software to a control system (e.g. a laptop). Establish the connection between the Matrix Management Unit (MMU) and the computer via Ethernet, or RS-232 interface.

Open the LDC and find the MMU in the Device discovery list. Double click on the name of the MMU to connect. The matrix crosspoint menu opens where you can configure the video system and see all information about the network.

<u>U</u>	BE,	K	N	<i>I</i> ATR	IX M	ODE	UB	BEX-MM	IU-X200	1								Crosspo	oint	EDID Managemen	Control		Settings	0	Device D	iscovery)
Vide	20 /	udio	Ø	Audio	Follows	s Video														Show Inactive UBE	Kes 💽 Show E)isable	d Streams				
1/01	1/02	2/01	2/02	3/01	3/02	10/01	10/02	13/02	14/02	15/02	21/02	0								SELECTED STREAM							
												11/01								Source: A8:D2:36:F	:00:02.S1	Dest	ination:				
												11/02															
												12/01								SEARCH							
												12/02								SOURCE: 1/01	0.02 \$1				<>	ð	
								\square				13/01								STREAM	PORT		DI	EVICE			
									\mathbb{Z}			14/01								Settings							
										\square		15/01									Stream name Enabled	A8:	D2:36:F0:00:02	.S1			
												20/01									Tile icon	Q)				
												20/02										C	HANGE				
											\square	21/01								Scaler settings							
												22/01									Scaling mode	Pas	sthrough	-			
												22/02									Image position	Fit		-			
																				Col	r space conversion	No	conversion				
																				— Tags							
																							Add tag +				
																				Signal info							
																					Resolution Pixel clock	3840 594.	0x2160p60 0 MHz				

LDC crosspoint menu



Configuration Steps - Cisco WS-C3850-24XS

The following chapter describes and explains step-by-step the procedure of the configuration for the Cisco Catalyst 3850 XS 10G SFP+ (WS-C3850-24XS) fully managed network switch:

- DESCRIPTION
- THE CONFIGURATION OF THE UBEX MATRIX
- **CISCO REQUIREMENTS FOR THE SWITCH CONFIGURATION**
- FIRST STEPS
- DETAILED INSTRUCTIONS
- FINALIZING THE MATRIX
- BANDWIDTH LIMITATIONS OF THE SWITCH

7.1. Description

This chapter helps you configure the Cisco WS-C3850-24XS managed switch for the UBEX matrix. The chassis of this model contains 24x 10G SFP+ slots which are enough to serve 11 UBEX endpoints and an MMU and handle up to 22 source / destination devices. The switch is recommended for medium businesses.

The basic chassis can be upgraded with two types of expansion cards:

Expansion card	Additional SFP+slots	Additional endpoints	All endpoints
C3850-NM-4-10G	4	2	13
C3850-NM-8-10G	8	4	15

7.2. The Configuration of the UBEX Matrix

For the sake of simplicity the configuration steps of the switch are explained through a valid UBEX matrix example which contains:

Device	Pieces	Firmware version
Cisco WS-C3850-24XS	1	15.2
UBEX-MMU-X200	1	1.0.6
UBEX-PRO20-HDMI-F100/F110	11	1.3.0

7.3. Cisco Requirements for the Switch Configuration

Cisco Certification Program

Configuring a Cisco network switch requires the knowledge of the Cisco's own software architecture, the Cisco IOS software. This is a command-based programming language which can be applied in the switch over terminal applications, for example Putty or CLI.

Step 1. Sign up for the Cisco Training to get the knowledge and skill to configure the switch. Visit the following website for the available Cisco trainings:

https://www.cisco.com/c/en/us/training-events/trainingcertifications/overview.html

Step 2. Configurator needs the Routing and Switching training course here are the details about it:

https://www.cisco.com/c/en/us/training-events/trainingcertifications/training-catalog/routing-switching.html#~skills

Step 3. Complete the exam and get the Cisco Network Certification about the Routing and Switching Track:

https://www.cisco.com/c/en/us/training-events/trainingcertifications/certifications/entry/ccent.html

7.4. First Steps

7.4.1. Configuring the Switch

At first time the switch needs to be configured locally by using the supplied RJ45 to DB9 or the USB Mini B to USB Type A adapter cable. Follow the instructions listed on the website of the vendor:

https://www.cisco.com/c/en/us/td/docs/switches/lan/ catalyst3850/hardware/installation/guide/b_c3850_hig/b_c3850_ hig_chapter_01001.html

Set an IP address for the Management Ethernet port (Mgmt 0) to be able to connect it and to set up the device for the UBEX network.

7.4.2. Installation of the UBEX Devices

The installation steps of the endpoint and the MMU devices can be found in the Connections section.

7.4.3. Installation of the Switch

model.

- - 22x 10GbE DAC cables



Step 3. Plug the cables between the UBEX MMU and the switch based on the following options:

- 1x 1GbE DAC cable



Download the user's manual for the WS-C3850-24XS model from the website of the vendor and follow the instructions.

Step 1. Install the switch correctly based on the instructions of the

Step 2. Plug the cables between the UBEX endpoints and the switch based on the following options:

 22x 10GbE singlemode/multimode SFP+ transceiver modules and 94x singlemode/multimode fiber optical cables

 1x 1GbE singlemode/multimode SFP transceiver module and a singlemode/multimode fiber optical cable

Step 4. Plug the cables between the switch and the possible other switch for the outgoing data traffic.

Step 5. Connect a control device (e.g. a laptop) to the switch with a CATx cable to the 1000 Base-T management Ethernet port (Mgmt 0):

:	Letter 1			NOR POR PROJECTIONS
	CANTON	tere witter		

7.4.4. Global Settings

See the details about the global settings of the switch on the website of the vendor and follow the instructions:

https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3850/software/release/3se/ system_management/command_reference/b_sm_3se_3850_cr/b_sm_3se_3850_cr_chapter_01. html#d25e837a1635

7.5. Detailed Instructions

7.5.1. Setting up the Control Device

The Cisco switch can be configured by protocol commands only. You need to install a terminal application to your control device, for example Putty or CLI.

The IP address of the switch in our example: 172.24.0.50

Open the terminal application (e.g. Putty), add the IP address of the switch and open it.



Putty terminal window

7.5.2. Login to the Switch

Once the terminal window is opened, you can log in to the switch by the given user name and password.



Login window in the Putty

After you logged in, the switch can be configured by protocol commands listed in the following sections.

7.5.3. IP Address Setting

The Command

Type and apply the following commands:

interface GigabitEthernet0/0

vrf forwarding Mgmt-vrf

ip address 172.24.0.50 255.255.0.0

no ip route-cache

negotiation auto

exit

Explanation

The IP address (172.24.0.50) and subnet mask of the switch have been set for the management port (Mgmt 0).

7.5.4. Default Gateway Setting

INFO: The command required only in the case when the switch has to be accessed from different subnet.

The Command

Type and apply the following commands:

ip route 192.168.2.0 255.255.254.0 172.24.0.1 permanent name test-gateway

ip route vrf Mgmt-vrf 0.0.0.0 0.0.0.0 172.24.0.1 global

ip route vrf Mgmt-vrf 192.168.2.0 255.255.254.0 172.24.0.1 permanent

7.5.5. SSH Terminal-Line Access

If you need outbound SSH terminal-line authentication, you can configure and test SSH for outbound reverse Telnets through Putty or CLI.

The Command

Type and apply the following commands:

line vty 0 4

password 12345

login local

transport input ssh

exit

7.5.6. SSH Version Configuration

The Command

Type and apply the following command:

ip ssh version 2

7.5.7. VLAN Configuration

The Command

Type and apply the following commands:

vlan configuration 286

vlan 286

name UBEX

exit

Explanation

Registers VLAN number 286. Optionally a unique name can be added to the VLAN.

7.5.8. IGMP Snooping Configuration

The Command

Type and apply the following commands:

ip igmp snooping querier

ip igmp snooping vlan 286 guerier version 2

ip igmp snooping vlan 286 querier address 10.0.0.12

ip igmp snooping vlan 286 querier query-interval 120

ip igmp snooping vlan 286 immediate-leave

Explanation

Enables IGMPv2 Snooping in the VLAN 286.

ATTENTION! IGMP querier v2 is required configuration setting.

7.5.9. Interface Configuration for the MMU

The Command

Type and apply the following commands:

Port ID	Command (in
Port 24	interface TenGigabitEthernet2/0/
	switchport mode trunk
	no ip igmp snooping tcn flood
	exit

Explanation

The TenGigabitEthernet2/0/24 is the last (24th) SFP+ port of the switch which is for the connection of the MMU. It is set to trunk mode



and the speed (1 Gbit/s) is automatically detected when an SFP transceiver module is plugged to the SFP+ slot of the switch, no further configuration step is needed.





7.5.10. Interface Configuration for the Outgoing Data Traffic

The Command

Type and apply the following commands:

Port ID	Command (in this example)
Port 23	interface TenGigabitEthernet2/0/23 no ip igmp snooping tcn flood exit

Explanation

The TenGigabitEthernet2/0/23 is the 23rd SFP+ port of the switch which is for the connection of other network switches accessing LAN and/or the Internet.



7.5.11. Port Channel Configuration for the Endpoints

The Commands

Type and apply the following commands for the desired interface ports:

Port Channel Index	Command									
Port Channel 1	interface Port-channel1 switchport mode trunk exit									
Port Channel 2	interface Port-channel2 switchport mode trunk exit									
Port Channel 11	interface Port-channell1 switchport mode trunk exit									

Explanation

The ports between the 1 and 22 are grouped by pairs to portchannels, in this case between port-channel 1 to port-channel 11.



They are set to trunk mode and the speed (10 Gbit/s) is automatically detected when an SFP+ transceiver module is plugged to the SFP+ slot of the switch

TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch. In this case the configure command needs only once at the starting of the sequence.

7.5.12. Interface Configuration for the Endpoints

The Commands

Type and apply the following commands for the desired interface ports:

Port ID	Command
Port 1	<pre>interface TenGigabitEthernet2/0/1 switchport mode trunk channel-group 1 mode active exit</pre>
Port 2	<pre>interface TenGigabitEthernet2/0/2 switchport mode trunk channel-group 1 mode active exit</pre>
Port 3	<pre>interface TenGigabitEthernet2/0/3 switchport mode trunk channel-group 2 mode active exit</pre>
Port 4	<pre>interface TenGigabitEthernet2/0/4 switchport mode trunk channel-group 2 mode active exit</pre>
Port 21	<pre>interface TenGigabitEthernet2/0/21 switchport mode trunk channel-group 11 mode active exit</pre>
Port 22	<pre>interface TenGigabitEthernet2/0/22 switchport mode trunk channel-group 11 mode active exit</pre>

Explanation

The ports between the Ethernet2/0/1 and Ethernet2/0/22 are the SFP+ ports where the UBEX endpoints are connected to the switch.

The 'active' keyword means that the switch uses the IEEE 802.3ad-2005 Link Aggregation Control Protocol (in active mode) to combine 10G ports into 20G logical channels for the UBEX devices.

TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch. In this case the configure command needs only once at the starting of the sequence.

7.5.13. LLDP Activation

The Command

Type and apply the following command:

lldp run

7.5.14. Querying LLDP Partners

The Command

Type and apply the following command:

show lldp neighbors

Explanation

The query returns with the list of connected UBEX devices (which MAC address of the UBEX endpoint is on the ports of switch).

7.5.15. Querying LLDP Details by Ports

The Command

Type and apply the following command:

show lldp neighbors interface ethernet 2/0/1 detail

Explanation

The guery returns with the details of the LLDP partner which is connected to the Ethernet2/0/1 port.

7.5.16. Switching on the Support for Unsupported SFP+ Modules

The Command

Type and apply the following command:

service unsupported-transceiver

ATTENTION! Always use high-quality SFP+ transceiver modules.

7.5.17. Querying the Details of the Installed Transceiver Modules

The Command

Type and apply the following command:

show interface transceiver

7.6. Finalizing the Matrix

The UBEX AV matrix is ready to use now.

The Lightware Device Controller software

Download the Lightware Device Controller (LDC) software from the website (www.lightware.com) to control the matrix. Install the software to a control system (e.g. a laptop). Establish the connection between the Matrix Management Unit (MMU) and the computer via Ethernet, or RS-232 interface.

Open the LDC and find the MMU in the Device discovery list. Double click on the name of the MMU to connect. The matrix crosspoint menu opens where you can configure the video system and see all information about the network.



LDC crosspoint menu

7.7. Bandwidth Limitations of the Switch

Lightware Team has done various AV tests on this switch and found limitations which might influence the audio/video configuration.

The maximal multicast load that the switch is capable of handling is approximately 98.21 Gbps (7x 4096x2160p60 + 1x 2560x1080p60). This bandwidth shall not be reached in a live installation.

Crosspoint	EDID Management	Control	Settings	G Device Di	scovery
	Show Inactive UBEXes	: 🕑 Show Dis	sabled Streams	3	
	SELECTED STREAM Source: A8:D2:36:F0:00	D:02.S1	Destination:		
	SEARCH				
	SOURCE: 1/01 A8:D2:36:F0:00:0	02.S1		<>	Ð
	STREAM Settings	PORT		DEVICE	
		Stream name Enabled	A8:D2:36:F0:0	0:02.S1	
		Tile icon	CHANGE		
	Scaler settings				
		Scaling mode	Passthrough		
	F	proced resolution	1920x1080p60		
	Color s	anage position	No conversion		
	Tags (AB:D2:36:F0:00:02:S1) (A		#1) Add tag •	Đ	
	— Signal info				
		Resolution Pixel clock	3840x2160p60 594.0 MHz		



Configuration Steps - Cisco Nexus 5548UP

The following chapter describes and explains step-by-step the procedure of the configuration for the Cisco Nexus 5548UP fully managed network switch:

- DESCRIPTION
- THE CONFIGURATION OF THE UBEX MATRIX
- CISCO REQUIREMENTS FOR THE SWITCH CONFIGURATION
- FIRST STEPS
- DETAILED INSTRUCTIONS
- FINALIZING THE MATRIX

8.1. Description

This chapter helps you configure the Cisco Nexus 5548UP managed switch for the UBEX matrix. The base chassis of this model contains 32x 10G SFP+ slots and it can be expanded with +16 10G SFP+ ports with installing an expansion module. In this case the switch is enough to serve 23 UBEX endpoints and an MMU and handle up to 46 source / destination devices. The switch is recommended for medium businesses.

INFO: The configuration steps of the Cisco Nexus 5548P and 5548UP switches are exactly the same and can be applied for both models.

8.2. The Configuration of the UBEX Matrix

For the sake of simplicity the configuration steps of the switch are explained through a valid UBEX matrix example which contains:

Device	Pieces	Firmware version				
Cisco Nexus 5548UP	1	7.3(0)N1(1)				
UBEX-MMU-X200	1	1.0.6				
UBEX-PRO20-HDMI-F100/F110	23	1.3.0				

8.3. Cisco Requirements for the Switch Configuration

Cisco Certification Program

Configuring a Cisco network switch requires the knowledge of the Cisco's own software architecture, the Cisco IOS software. This is a command-based programming language which can be applied in the switch over terminal applications, for example Putty or CLI.

Step 1. Sign up for the Cisco Training to get the knowledge and skill to configure the switch. Visit the following website for the available Cisco trainings:

https://www.cisco.com/c/en/us/training-events/trainingcertifications/overview.html

Step 2. Configurator needs the Routing and Switching training course here are the details about it:

https://www.cisco.com/c/en/us/training-events/trainingcertifications/training-catalog/routing-switching.html#~skills

Step 3. Complete the exam and get the Cisco Network Certification about the Routing and Switching Track:

> https://www.cisco.com/c/en/us/training-events/trainingcertifications/certifications/entry/ccent.html

8.4. First Steps

8.4.1. Configuring the Switch

At first time the switch needs to be configured locally by using the supplied RJ45 to DB9 adapter cable. Follow the instructions listed on the website of the vendor (PDF file):

https://www.cisco.com/c/en/us/td/docs/switches/datacenter/ nexus5000/hw/installation/guide/nexus_5000_hig.pdf

Set an IP address for the Management Ethernet port (Mgmt 0) to be able to connect it and to set up the device for the UBEX network.

8.4.2. Installation of the UBEX Devices

The installation steps of the endpoint and the MMU devices can be found in the Connections section.

8.4.3. Installation of the Switch

Download the user's manual for the 5548UP model from the website of the vendor and follow the instructions.

- model.

- 46x 10GbE DAC cables



- on the following options:
- 1x 1GbE DAC cable



Step 1. Install the switch correctly based on the instructions of the

Step 2. Plug the cables between the UBEX endpoints and the switch based on the following options:

 46x 10GbE singlemode/multimode SFP+ transceiver modules and 94x singlemode/multimode fiber optical cables

Step 3. Plug the cables between the UBEX MMU and the switch based

 1x 1GbE singlemode/multimode SFP transceiver module and a singlemode/multimode fiber optical cable

Step 4. Connect a control device (e.g. a laptop) to the switch with a CATx cable to the 1000 Base-T management Ethernet port (Mgmt 0):



8.4.4. Global Settings

See the details about the global settings of the switch on the website of the vendor and follow the instructions:

https://www.cisco.com/c/en/us/td/docs/switches/datacenter/ nexus5000/sw/configuration/guide/cli/CLIConfigurationGuide/ initconfig.html

8.5. Detailed Instructions

8.5.1. Setting up the Control Device

The Cisco switch can be configured by protocol commands only. You need to install a terminal application to your control device, for example Putty or CLI.

The IP address of the switch in our example: 172.24.0.50

Open the terminal application (e.g. Putty), add the IP address of the switch and open it.



8.5.2. Login to the Switch

Once the terminal window is opened, you can log in to the switch by the given user name and password.



Login window in the Putty

After you logged in, the switch can be configured by protocol commands listed in the following sections.

8.5.3. Entering to Configure Mode

The Command

Type and apply the following command:

configure

Explanation

The Configure mode is enabled and the configuration commands will be accepted by switch.

8.5.4. IP Address Setting

The Command

Type and apply the following commands:

interface mgmt0 vrf member management exit

Explanation

8.5.5. Default Gateway Setting

be accessed from different subnet.

The Command

Type and apply the following commands:

vrf context management ip route 0.0.0/0 172.24.0.1 exit

8.5.6. Switching on the LACP and LLDP

The Command

Type and apply the following commands:

feature lacp

feature lldp

8.5.7. VLAN and IGMPv2 Configuration

The Command

Type and apply the following commands:

vlan 1, 286

vlan configuration 1, 286

exit

Explanation

in both VLANs.

Putty terminal window

ip address 172.24.0.50/16

The IP address (172.24.0.50) and subnet mask (/16) of the switch have been set for the management port (Mgmt 0).

INFO: The command requires only in the case of the switch has to

ip igmp snooping version 2

Registers VLAN number 1 and number 286. Enables IGMPv2 snooping

8.5.8. Forwarding Options

The Command

Type and apply the following command:

port-channel load-balance ethernet source-mac

Explanation

The setting ensures that traffic is shared equally between the two aggregated links.

8.5.9. Interface Configuration for the MMU

The Command

Type and apply the following commands:

Port ID	Command (in this example)
Port 1	interface Ethernet1/1 switchport mode trunk speed 1000 exit

Explanation

The Ethernet1/1 is the first SFP+ port of the switch which is for the connection of the MMU. Its speed is set to 1 Gbps (1000 = 1 GbE)

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and configured as a trunk port, thus has access to both of the configured VLAN's.

8.5.10. Port Channel Configuration for the Endpoints

The Commands

Type and apply the following commands for the desired interface ports:

Port Channel Index	
Port Channel 3	interface port-channel1 switchport mode trund speed 10000 exit
Port Channel 4	interface port-channel2 switchport mode trun speed 10000 exit
Port Channel 48	interface port-channel46 switchport mode trun speed 10000 exit

Explanation

The ports between the 3 and 48 are grouped by pairs to portchannels, in this case between port-channel 3 to port-channel 23.

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cisco	111		AT	AT	AV	11
.0	100		1.			

They are set to trunk mode and speed to 10 Gbps (10000 = 10 GbE).

TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch. In this case the configure command needs only once at the starting of the sequence.

Command	
k	
k	
 k	



8.5.11. Interface Configuration for the Endpoints

The Commands

Type and apply the following commands for the desired interface ports:

Port ID	Command							
Port 3	<pre>interface Ethernet1/3 switchport mode trunk channel-group 1 mode active exit</pre>							
Port 4	<pre>interface Ethernet1/4 switchport mode trunk channel-group 1 mode active exit</pre>							
Port 47	<pre>interface port-channel1/47 switchport mode trunk channel-group 23 mode active exit</pre>							
Port 48	<pre>interface port-channel1/48 switchport mode trunk channel-group 23 mode active exit</pre>							

Explanation

The ports between the Ethernet1/3 and Ethernet1/48 are the SFP+ ports where the UBEX endpoints are connected to the switch. They are set to 10 Gbps (10000 = 10 GbE).



The 'active' keyword means that the switch uses the IEEE 802.3ad-2005 Link Aggregation Control Protocol (in active mode) to combine 10G ports into 20G logical channels for the UBEX devices.

TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch. In this case the configure command needs only once at the starting of the sequence.

8.5.12. Querying LLDP Partners

The Command

Type and apply the following command:

show lldp neighbors

Explanation

The guery returns with the list of connected UBEX devices (which MAC address of the UBEX endpoint is on the ports of switch).

8.5.13. Querying LLDP Details by Ports

The Command

Type and apply the following command:

show lldp neighbors interface ethernet 1/1 detail

Explanation

The query returns with the details of the LLDP partner which is connected to the Ethernet1/1 port.

8.5.14. Switching on the Support for Unsupported SFP+ Modules

The Command

Type and apply the following command:

service unsupported-transceiver

8.5.15. Querying the Details of the Installed Transceiver Module

The Command

Type and apply the following command:

show interface transceiver

8.6. Finalizing the Matrix

The UBEX AV matrix is ready to use now.

The Lightware Device Controller software

Download the Lightware Device Controller (LDC) software from the website (www.lightware.com) to control the matrix. Install the software to a control system (e.g. a laptop). Establish the connection between the Matrix Management Unit (MMU) and the computer via Ethernet, or RS-232 interface.

Open the LDC and find the MMU in the Device discovery list. Double click on the name of the MMU to connect. The matrix crosspoint menu opens where you can configure the video system and see all information about the network.

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																				29/01		Signal info	Pecolution	3840v2160p60			
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LDC crosspoint menu

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Configuration Steps - Cisco Nexus 93180YC-EX

The following chapter describes and explains step-by-step the procedure of the configuration for the Cisco Nexus 93180YC-EX fully managed network switch:

- DESCRIPTION
- THE CONFIGURATION OF THE UBEX MATRIX
- **CISCO REQUIREMENTS FOR THE SWITCH CONFIGURATION**
- FIRST STEPS
- DETAILED INSTRUCTIONS
- FINALIZING THE MATRIX

9.1. Description

This chapter helps you configure the Cisco Nexus 93180YC-EX managed switch for the UBEX matrix. The chassis of this model contains 48x 10G SFP+ slots which are enough to serve 23 UBEX endpoints and an MMU and handle up to 46 source / destination devices. The switch is recommended for medium businesses.

9.2. The Configuration of the UBEX Matrix

For the sake of simplicity the configuration steps of the switch are explained through a valid UBEX matrix example which contains:

Device	Pieces	Firmware version
Cisco Nexus 93180YC-EX	1	9.2(1)
UBEX-MMU-X200	1	1.0.6
UBEX-PRO20-HDMI-F100/F110	23	1.3.0

9.3. Cisco Requirements for the Switch Configuration

Cisco Certification Program

Configuring a Cisco network switch requires the knowledge of the Cisco's own software architecture, the Cisco IOS software. This is a command-based programming language which can be applied in the switch over terminal applications, for example Putty or CLI.

Step 1. Sign up for the Cisco Training to get the knowledge and skill to configure the switch. Visit the following website for the available Cisco trainings:

https://www.cisco.com/c/en/us/training-events/trainingcertifications/overview.html

Step 2. Configurator needs the Routing and Switching training course here are the details about it:

> https://www.cisco.com/c/en/us/training-events/trainingcertifications/training-catalog/routing-switching.html#~skills

Step 3. Complete the exam and get the Cisco Network Certification about the Routing and Switching Track:

> https://www.cisco.com/c/en/us/training-events/trainingcertifications/certifications/entry/ccent.html

9.4. First Steps

9.4.1. Configuring the Switch

At first time the switch needs to be configured locally by using the supplied RJ45 to DB9 adapter cable. Follow the instructions listed on the website of the vendor (PDF file):

https://www.cisco.com/c/en/us/td/docs/switches/datacenter/ nexus9000/hw/n93180ycex_hig/guide/b_n93180ycex_nxos_mode_ hardware_install_guide.pdf

Set an IP address for the Management Ethernet port (Mgmt 0) to be able to connect to it over SSH and to set up the device for the UBEX network.

9.4.2. Installation of the UBEX Devices

The installation steps of the endpoint and the MMU devices can be found in the Connections section.

9.4.3. Installation of the Switch

model.

- - 46x 10GbE DAC cables

on the following options:

- 1x 1GbE DAC cable



Download the user's manual for the Nexus 93180YC-EX model from the website of the vendor and follow the instructions.

Step 1. Install the switch correctly based on the instructions of the

Step 2. Plug the cables between the UBEX endpoints and the switch based on the following options:

• 46x 10GbE singlemode/multimode SFP+ transceiver modules and 94x singlemode/multimode fiber optical cables



Step 3. Plug the cables between the UBEX MMU and the switch based

 1x 1GbE singlemode/multimode SFP transceiver module and a singlemode/multimode fiber optical cable

Step 4. Connect a control device (e.g. a laptop) to the switch with a CATx cable to the 1000 Base-T management Ethernet port (Mgmt 0):



9.4.4. Global Settings

See the details about the global settings of the switch on the website of the vendor and follow the instructions:

https://www.cisco.com/c/en/us/td/docs/switches/datacenter/ nexus9000/sw/6-x/fundamentals/configuration/guide/b_Cisco_ Nexus_9000_Series_NX-OS_Fundamentals_Configuration_Guide/b_ Cisco_Nexus_9000_Series_NX-OS_Fundamentals_Configuration_ Guide_chapter_0100.html

9.5. Detailed Instructions

9.5.1. Setting up the Control Device

The Cisco switch can be configured by protocol commands only. You need to install a terminal application to your control device, for example Putty or CLI.

The IP address of the switch in our example: 172.24.0.50

Open the terminal application (e.g. Putty), add the IP address of the switch and open it.



9.5.2. Login to the Switch

Once the terminal window is opened, you can log in to the switch by the given user name and password.



Login window in the Putty

After you logged in, the switch can be configured by protocol commands listed in the following sections.

9.5.3. Entering to Configure Mode

The Command

Type and apply the following command:

configure

Explanation

The Configure mode is enabled and the configuration commands will be accepted by switch.

9.5.4. Setting up IP Address of the Switch

The Command

Type and apply the following commands:

interface mgmt0 vrf member management

exit

Explanation

The IP address (172.24.0.50) and subnet mask (/24) of the switch have been set for the management port (Mgmt 0).

9.5.5. Default Gateway Setting

The Command

Type and apply the following commands:

vrf context management ip route 0.0.0/0 172.24.0.1 exit

9.5.6. Switching on the LACP, LLDP, and VLAN

The Command

Type and apply the following command:

feature lacp

feature lldp

feature interface-vlan

Putty terminal window

ip address 172.24.0.50/24

INFO: The commands are required only in the case when the switch has to be accessed from different subnet.

9.5.7. VLAN and IGMPv2 Configuration

The Command

Type and apply the following commands: vlan 1-2,286 vlan configuration 286 ip igmp snooping fast-leave ip igmp snooping version 2

exit

Explanation

Registers VLAN number 1 and number 286. Enables IGMPv2 snooping and the fast-leave feature which is required for the instant switching.

9.5.8. Forwarding Options

The Command

Type and apply the following commands:

port-channel load-balance src ip

Explanation

The setting ensures that traffic is shared equally between the two aggregated links.

9.5.9. Interface Configuration for the MMU

The Command

Type and apply the following commands:

Port ID	Command (in this example)
Port 1	<pre>interface Ethernet1/1 switchport switchport mode trunk switchport access vlan 2 no shutdown exit</pre>

Explanation

The Ethernet1/1 is the first SFP+ port of the switch which is for the connection of the MMU. The port accepts SFP+ and SFP transceiver modules either.



9.5.10. Port Channel Configuration for the Endpoints

The Commands

Type and apply the following commands for the desired interface ports:

Port Channel Index	
Port Channel 3	interface port-channel3 switchport switchport mode trun switchport access vla exit
Port Channel 4	interface port-channel4 switchport switchport mode trun switchport access vla exit
Port Channel 48	interface port-channel48 switchport switchport mode trun switchport access vla exit

Explanation

The ports between the 3 and 48 are grouped by pairs to portchannels, in this case between port-channel 3 to port-channel 23.



TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch. In this case the configure command needs only once at the starting of the sequence.

Cor	Command					
k an	2					
k						
an	2					
k an	2					

9.5.11. Interface Configuration for the Endpoints

The Commands

Type and apply the following commands for the desired interface ports:

Port ID	Command
Port 3	<pre>interface Ethernet1/3 switchport switchport mode trunk switchport access vlan 2 channel-group 1 mode active exit</pre>
Port 4	<pre>interface Ethernet1/4 switchport switchport mode trunk switchport access vlan 2 channel-group 1 mode active exit</pre>
Port 47	<pre>interface port-channel1/47 switchport switchport mode trunk switchport access vlan 2 channel-group 23 mode active exit</pre>
Port 48	<pre>interface port-channel1/48 switchport switchport mode trunk switchport access vlan 2 channel-group 23 mode active exit</pre>

Explanation

The ports between the Ethernet1/3 and Ethernet1/48 are the SFP+ ports where the UBEX endpoints are connected to the switch.



The 'active' keyword means that the switch uses the IEEE 802.3ad-2005 Link Aggregation Control Protocol (in active mode) to combine 10G ports into 20G logical channels for the UBEX devices.

TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch. In this case the configure command needs only once at the starting of the sequence.

9.5.12. Querying LLDP Partners

The Command

Type and apply the following command:

show lldp neighbors

Explanation

The guery returns with the list of connected UBEX devices (which MAC address of the UBEX endpoint is on the ports of switch).

9.5.13. Querying LLDP Details by Ports

The Command

Type and apply the following command:

show lldp neighbors interface ethernet 1/1 detail

Explanation

The query returns with the details of the LLDP partner which is connected to the Ethernet1/1 port.

9.5.14. Switching on the Support for Unsupported SFP+ Modules

The Command

Type and apply the following command:

service unsupported-transceiver

ATTENTION! Always use high-quality SFP+ transceiver modules.

9.5.15. Querying the Details of the Installed Transceiver Module

The Command

Type and apply the following command:

show interface transceiver



9.6. Finalizing the Matrix

The UBEX AV matrix is ready to use now.

The Lightware Device Controller software

Download the Lightware Device Controller (LDC) software from the website (www.lightware.com) to control the matrix. Install the software to a control system (e.g. a laptop). Establish the connection between the Matrix Management Unit (MMU) and the computer via Ethernet, or RS-232 interface.

Open the LDC and find the MMU in the Device discovery list. Double click on the name of the MMU to connect. The matrix crosspoint menu opens where you can configure the video system and see all information about the network.

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LDC crosspoint menu

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Configuration Steps - Juniper QFX5100-96S

The following chapter describes and explains step-by-step the procedure of the configuration for the Juniper QFX5100-96S fully managed network switch:

- DESCRIPTION
- THE CONFIGURATION OF THE UBEX MATRIX
- JUNIPER REQUIREMENTS FOR THE SWITCH CONFIGURATION
- FIRST STEPS
- DETAILED INSTRUCTIONS
- FINALIZING THE MATRIX

10.1. Description

This chapter helps you configure the Juniper QFX5100-96S managed switch for the UBEX matrix. This model of the Juniper contains 96x 10G SFP+ slots which are enough to serve 47 UBEX endpoints and an MMU and handle up to 94 source / destination devices. The switch is recommended for corporate businesses.

10.2. The Configuration of the UBEX Matrix

For the sake of simplicity the configuration steps of the switch are explained through a valid UBEX matrix example which contains:

Device	Pieces	Firmware version
Juniper QFX5100-96S	1	14.1X53-D46.7
UBEX-MMU-X200	1	1.0.6
UBEX-PRO20-HDMI-F100/F110	47	1.3.0

10.3. Juniper Requirements Switch for the Configuration

Juniper Networks Certification Program

Configuring a Juniper network switch requires the knowledge of the Juniper's own software architecture, the Junos OS. This is a commandbased programming language which can be applied in the switch over terminal applications, for example Putty or CLI.

Step 1. Sign up for the Juniper Training to get the knowledge and skill to configure the switch. Visit the following website for the available Juniper trainings:

https://www.juniper.net/us/en/training/

Step 2. Configurator needs the Enterprise Routing and Switching training course - here are the details about it:

> https://learningportal.juniper.net/juniper/user_activity_info. aspx?id=8057

Step 3. Complete the exam and get the Juniper Network Certification about the Enterprise Routing and Switching Track:

> https://www.juniper.net/us/en/taining/certification/ certification-tracks/ent-routing-switching-track?tab=inciajunos

10.4. First Steps

10.4.1. Configuring the Switch

At first time the switch needs to be configured locally by using the supplied RJ45 to DB9 adapter cable. Follow the instructions listed on the website of the vendor:

10.4.2. Installation of the UBEX Devices

The installation steps of the endpoint and the MMU devices can be found in the Connections section.

10.4.3. Installation of the Switch

- model.
- - 94x 10GbE DAC cables



https://www.juniper.net/documentation/en_US/release-independent/ junos/topics/task/configuration/gfx5100-initial-configuration-cli.html

Set an IP address for the Management Ethernet port to be able to connect it and to set up the device for the UBEX network.

Download the user's manual for the OFX5100-96S model from the website of the vendor and follow the instructions.

Step 1. Install the switch correctly based on the instructions of the

Step 2. Plug the cables between the UBEX endpoints and the switch based on the following options:

 94x 10GbE singlemode/multimode SFP+ transceiver modules and 94x singlemode/multimode fiber optical cables

- Step 3. Plug the cables between the UBEX MMU and the switch based on the following options:
 - 1x 1GbE singlemode/multimode SFP transceiver module and a singlemode/multimode fiber optical cable
 - 1x 1GbE DAC cable



Step 4. Connect a control device (e.g. a laptop) to the switch with a CATx cable to the 1000 Base-T management Ethernet port (CO):



10.4.4. Global Settings

See the details about the global settings of the switch on the website of the vendor and follow the instructions:

https://www.juniper.net/documentation/en_US/release-independent/ junos/topics/task/configuration/qfx5100-initial-configuration-cli.html

10.5. Detailed Instructions

10.5.1. Setting up the Control Device

The Juniper switch can be configured by protocol commands only. You need to install a terminal application to your control device, for example Putty or CLI.

The IP address of the switch in our example: 172.24.0.50

Open the terminal application (e.g. Putty), add the IP address of the switch and open it.



Putty terminal window

10.5.2. Login to the Switch

Once the terminal window is opened, you can log in to the switch by the given user name and password.



After you logged in, the switch can be configured by protocol commands listed in the following sections.

10.5.3. Aggregated Ethernet Interface Configuration

The Command

Type and apply the following command:

device-count 98;

Explanation

This setting reserves the resources of the switch for it.

Login window in the Putty

set configure chassis aggregated-devices ethernet

10.5.4. Interface Configuration for the MMU and the Uplink

The Commands

Type and apply the following commands:

Port ID	Command (in this example)
Port 0	<pre>set interfaces ge-0/0/0 native-vlan-id 1; unit 0 family ethernet- switching interface-mode trunk; vlan members default;</pre>
Port 1	<pre>set interfaces ge-0/0/1 native-vlan-id 1; unit 0 family ethernet- switching interface-mode trunk; vlan members all;</pre>

Explanation

The ge-0/0/0 and ge-0/0/1 are the first two SFP+ ports of the switch. One of them is for the connection of the MMU, the another one is the "uplink" for the user Ethernet connection and for controlling the MMU.

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Both of them are set to 1 Gbps (ge = Gigabit Ethernet) and they have membership to the "default" and "all" VLAN.

10.5.5. Interface Configuration for the Endpoints

The Commands

Type and apply the following commands for the desired interface ports:

Port ID	Command
Port 2	set interfaces xe-0/0/2 ether-options 802.3ad ae2;
Port 3	set interfaces xe-0/0/3 ether-options 802.3ad ae2;
Port 4	set interfaces xe-0/0/4 ether-options 802.3ad ae4;
Port 5	set interfaces xe-0/0/4 ether-options 802.3ad ae4;
Port 94	set interfaces xe-0/0/94 ether-options 802.3ad ae94;
Port 95	set interfaces xe-0/0/95 ether-options 802.3ad ae94;

Explanation

The ports between the xe-0/0/2 and xe-0/0/94 are the SFP+ ports where the UBEX endpoints are connected to the switch. They are set to 10 Gbps (xe = 10 GbE).



The switch uses the IEEE 802.3ad-

2005 Link Aggregation Control Protocol (in active mode) to combine 10G ports into 20G logical channels for the UBEX devices.

TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch.

10.5.6. Aggregated Ethernet Settings

The Commands

Type and apply the following commands:

Aggregated Ethernet ID	Com
ae2	<pre>set interfaces ae2 aggregated- active; unit 0 family ethernet-s members all;</pre>
ae4	<pre>set interfaces ae4 aggregated- active; unit 0 family ethernet-s members all;</pre>
аеб	<pre>set interfaces ae6 aggregated- active; unit 0 family ethernet-s members all;</pre>
ae94	<pre>set interfaces ae94 aggregated- active; unit 0 family ethernet-s members all;</pre>

Explanation

The aggregated Ethernet is set and finalized with these commands. The link speed must be **10g** for the ensured 10 GbE support. The ae<x> increases due to the LACP setting.

TIPS & TRICKS: The recurring commands can be scripted (e.g. in Python) and run in batch.

mand

```
ether-options link-speed 10g; lacp
switching interface-mode trunk; vlan
ether-options link-speed 10g; lacp
switching interface-mode trunk; vlan
ether-options link-speed 10g; lacp
switching interface-mode trunk; vlan
...
-ether-options link-speed 10g; lacp
switching interface-mode trunk; vlan
```

10.5.7. Forwarding Options

The Command

Type and apply the following command:

set forwarding-options storm-control-profiles default all; enhanced-hash-key hash-mode layer2-header;

Explanation

The setting ensures that traffic is shared equally between the two aggregated links.

10.5.8. IGMP Snooping and LLDP Settings

The Command

Type and apply the following command:

set protocols lldp interface all; igmp-snooping vlan default; vlan ubex-vlan immediate-leave;

Explanation

The LLDP setting is optional but it is helpful for further troubleshooting.

The IGMPv2 snooping setting is important for the fast switching between the crosspoints.

10.5.9. Creating VLAN

The Command

Type and apply the following command:

set vlans ubex-vlan vlan-id 286;

Explanation

The VLAN ID 286 has been created now.

10.6. Finalizing the Matrix

The UBEX AV matrix is ready to use now.

The Lightware Device Controller software

Download the Lightware Device Controller (LDC) software from the website (www.lightware.com) to control the matrix. Install the software to a control system (e.g. a laptop). Establish the connection between the Matrix Management Unit (MMU) and the computer via Ethernet, or RS-232 interface.

Open the LDC and find the MMU in the Device discovery list. Double click on the name of the MMU to connect. The matrix crosspoint menu opens where you can configure the video system and see all information about the network.



LDC crosspoint menu

	Crosspoint	EDID Management	Control	Settings	G Device Dis	scovery
>	*	Show Inactive UBEXes	😴 Show Dis	abled Streams		
02 () 3/01		SELECTED STREAM Source: A8:D2:36:F0:00	:11.81 [Destination:		
6/01 7/01	*	SEARCH				
10/01		SOURCE: 1/01 A8:D2:36:F0:00:1	1.S1		<>	đ
10/02		STREAM	PORT	D	EVICE	
13/01		Settings				
17/01			Stream name Enabled	A8:D2:36:F0:00:1	1.\$1	
20/01			Tile icon	_		
21/01				CHANGE		
21/02		Scaler settings				
22/01		Fo	Scaling mode	Passthrough		
22/02		F0	Image position	Fit	⊥	
23/01		Color sp	ace conversion	No conversion		
25/01		Tags				
25/02				#1) Add tag 🕇		
26/01		Signal info				
26/02			Resolution Pixel clock	3840x2160p60 594.0 MHz		



UBEX Test Lab

This chapter describes the experiences collected in our 24/7 testing laboratory using multifarious network environments and different AV equipments.

- INTRODUCTION
- THE CONCEPT
- THE ELEMENTS OF THE TEST
- THE 10 GBE MATRIX
- THE 20 GBE MATRIX

11.1. Introduction

We, at Lightware are proud of all advertised features and properties of our products are tested in our 24/7 laboratory to create perfect AV systems.

The UBEX matrix is one of the most complex AV product family which is developed by Lightware. The Test Engineering Team must specify complicated test cases with various AV peripheries and install the UBEX system into different network environments.



Hundreds of DAC cables run into the Juniper switches in the 24/7 testing room

UBEX Matrix Configurations

Two main UBEX matrix configurations were built and tested in the testing room beside of some smaller ones for special tester/developer jobs:

- 10 Gbps matrix: stress test for the MMU in the matrix control point of view. See the layout of the architecture in The 10 GbE Matrix section.
- 20 Gbps matrix: stress test for the MMU and the endpoint devices in the video transmission point of view. See the layout of the architecture in The 20 GbE Matrix section.

The third system was a simulated logical UBEX matrix which was run on a computer - it functioned as the control point beside of the real ones.

11.2. The Concept

The basic idea is building up a real matrix and a simulated one, both have exactly the same parameters. The two systems are controlled by the same LW3 commands in the same time. The answers of the commands are compared by the comparator software. If their status are not equal, one of the system has failure.



UBEX endpoints wait for the passed test result

All communication between the elements of the system is logged and analyzed after every test sequences. If the problem is deterministic, the failure status can be duplicated by resending the commands based on the system log files.

11.3. The Elements of the Test

More software elements have been made for the UBEX test which are done the bigger/smaller subtasks.

Test Case Commands

LW3 commands which modify the status of the MMU and the endpoints. See the details in the Test Cases section.

Message Repeater / Distributor

The component duplicates all test case commands - one is for the real UBEX matrix, another one is for simulated system.

MMU Model

The virtual Matrix Management Unit (MMU). Its functionality and features are similar like the real one but it is more simple because the persistence and the other network communication is unnecessary in the test point of view.

Endpoint Model

This component consists of a database which copies the internal states of a real endpoint, and some parts of its internal logic, that describes the connections between certain settings.

Comparator

The comparator gueries the actual status of the MMU and compares it to the MMU model. In the case of difference the comparator notifies the test engineer about the catch.

Emulated Endpoint

LW3 servers which can model the entire functionality and the inner status of the real endpoint in the MMU point of view. Managing of the emulated endpoints can provide realistic stress test but they does not require building a physical network capable of video transmission.



One of the tested UBEX matrix under construction

Additional advantage of the emulated endpoints is that a special failure status can be generated as well. These cases help for the software developers preparing the UBEX devices for any specific situation in the future.

11.3.1. Test Cases

This section describes some significant test cases which were applied in the UBEX systems as listed above.

 Restarting of the endpoints in random times: the MMU must detect the disappearance of the devices from the network, must establish the connection as the endpoints are rebooted, and restore the last configuration for the right device.

- Operation mode changing in random endpoints: the MMU must configure the Device Map, must detect and invalidate the ceased video streams in the receivers, and must add the new streams to the crosspoints.
- Virtual crosspoint status changing: the MMU must set the source stream on the receiver based on the actual Device Map.

11.3.2. Self-Diagnostics

The firmwares of the MMU and the endpoints contain a self-diagnostic software as well. The log files which were created during the tests were saved and analyzed. This procedure helped for the software developers to find the causes of the temporary loss of functions and eliminate them.



Curly HDMI and DAC cables meanders between the endpoint devices

11.4. The 10 GbE Matrix



The 10 GbE UBEX test matrix

11.4.1. The Architecture of the Matrix

The matrix is built with 30 UBEX endpoints and a Matrix Management Unit (MMU). The network switch is a Cisco Nexus 5548P with 48 pcs 10GbE SFP+ ports. The matrix is controlled by the MMU, the control commands are sent from a laptop which runs the LDC software.

All UBEX endpoints receive 4K UHD 30 (3840x2160p30 Hz 4:4:4) video signal on their HDMI in 1 ports (the HDMI in 2 port is not used in this test). The source is a pattern generator PC which transmits 4K30 signal on both output ports. The HDMI signal is distributed by 2 pcs Lightware MX2-8x8-HDMI20-Audio-L matrix switcher and a Lightware MX-FR17 modular matrix switcher built with HDMI input and output I/O boards.

Each UBEX endpoint is installed with one 10 GbE SFP+ module or DAC cable which is enough to transmit the 4K30 signal.

11.4.2. Test Equipment

which are installed in the UBEX matrix.

Device

MX2-8x8-HDMI20-Audio-

MX-FR17

Cisco Nexus 5548P

Club 3D HDMI cable

Finisar FTLX8571D3BCL

Finisar FTLX1471D3BCL

Fiberstore OM3 50/125

Prysmian Group Draka BendBright-XS 6001944

Fiberstore SFPP-PC05

The following table lists the most important parts of the test equipment

	Pcs	Description		
Ŀ	2	8x8 matrix switcher with HDMI 2.0 support		
	1	Modular multimedia matrix switcher up to 16 inputs and 16 outputs		
	1	Layer 3 managed switch with 32+16 10G SFP+ ports		
	33	Premium high speed HDMI 2.0 4K60Hz UHD cable, 5m		
•	12	10Gb/s 850nm multimode SFP+ transceiver module		
-	16	10Gb/s 1310nm singlemode SFP+ transceiver module		
	6	OM3 50/125 850nm multimode fiber optical cable with LC connectors, 5m		
1	8	OS2 1310nm singlemode fiber optical cable with LC connectors, 15m		
	16	10G SFP+ DAC cable, 5m		

11.5. The 20 GbE Matrix



11.5.1. The Architecture of the Matrix

The matrix is built with 15 UBEX endpoints and a Matrix Management Unit (MMU). The network switch is a Cisco Nexus 5548P with 48 pcs 10GbE SFP+ ports. The matrix is controlled by the MMU, the control commands are sent from a laptop which runs the LDC software.

All UBEX endpoints receive a **4K UHD 60** (3840x2160p60 Hz 4:4:4) video signal on their HDMI in 1 ports and a **4K UHD 30** (3840x2160p30 Hz 4:4:4) video signal on their HDMI in 2 ports. The source is a pattern generator PC which transmits the 4K60 and 4K30 signal on the output ports. The HDMI signal is distributed by 2 pcs Lightware MX2-8x8-HDMI20-Audio-L matrix switcher and a Lightware MX-FR17 modular matrix switcher built with HDMI input and output I/O boards.

Each UBEX endpoint is installed with two 10 GbE SFP+ modules or DAC cables which are able to support the successful transmission of the 4K60 and 4K30 video signals together.

11.5.2. Test Equipment

The following table lists the most important parts of the test equipment which are installed in the UBEX matrix.

Device	Pcs	Description
MX2-8x8-HDMI20-Audio-L	2	8x8 matrix switcher with HDMI 2.0 support
MX-FR17	1	Modular multimedia matrix switcher up to 16 inputs and 16 outputs
Cisco Nexus 5548P	1	Layer 3 managed switch with 32+16 10G SFP+ ports
Club 3D HDMI cable	33	Premium high speed HDMI 2.0 4K60Hz UHD cable, 5m
Finisar FTLX8571D3BCL	20	10Gb/s 850nm multimode SFP+ transceiver module
Finisar FTLX1471D3BCL	8	10Gb/s 1310nm singlemode SFP+ transceiver module
Fiberstore OM3 50/125	10	OM3 50/125 850nm multimode fiber optical cable with LC connectors, 5m
Prysmian Group Draka BendBright-XS 60019441	4	OS2 1310nm singlemode fiber optical cable with LC connectors, 15m
Fiberstore SFPP-PC05	16	10G SFP+ DAC cable, 5m