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 -

Document revision: 1.8 Release date: 18-06-2019 Editor: Tamas Forgacs

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Item	Version
UBEX-PRO20-HDMI-F100	1.3.0
UBEX-PRO20-HDMI-F110	1.3.0
UBEX-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 SFP/		Recomm	nended 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 -	
						managed switch	Ubiquiti EdgeSwitch 16 XG Netgear ProSafe M4300-24X24F	
		12	1	24	1	24-ports 10G (+1 1G SFP port for MMU) L3 managed switch	See also: Configuration Steps - Netgear M4300-24X24F	
	up to 24 / 24						Cisco WS-C3850-24XS	
							See also: Configuration Steps - Cisco WS-C3850-24XS	
Medium business	up to 46 / 46 23 1			46	1		Cisco Nexus 5548UP	
		20				48-ports 10G (+1 1G SFP port for MMU) L3 managed switch	See also: Configuration Steps - Cisco Nexus 5548UP	
		23					Cisco Nexus 93180YC-EX	
					See also: Configuration Steps - Cisco Nexus 93180YC-EX			
Corporate business	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
Υ _{τοταL}	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.

4400 pixels		Horizontal resolution:	4400 pixels
		Vertical resolution:	2250 lines
		Active pixels:	3840 pixels
3840 pixels	76 pixels	Active lines:	2160 lines
· · · · · · · · · · · · · · · · · · ·		Vertical back porch:	72 lines
		Vertical front porch:	8 lines
ines		Vertical sync width:	10 lines
		Horizontal back porch:	176 pixels
		Horizontal front porch:	296 pixels
		Horizontal sync width:	88 pixels
Actual display area		VSYNC frequency:	60 Hz
		VSYNC polarity:	positive
Full vertica	l frame	HSYNC frequency:	135.00 kHz
		HSYNC polarity:	positive
		Scan:	progressive
		Measured pixel clock:	594 MHz

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.

Deversetere	10BASE-SR					
Parameters	62.5 micron MMF		50 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		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		50	micron N	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	IN 1								
					1280	x720p60 (7	720p)	1920x	1080p60 (1080p)	3840x21	60p30 (4K	UHD 30)	4096>	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	CbCr 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
	I	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
	280x720 60 Hz (720p)	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
	280x72 60 Hz (720p)	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
	1920x1080 60 Hz (1080p)	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
	20x1 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	<u> </u>	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
	3840x2160 30 Hz (4K UHD 30)	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
HDMI IN	3840x216 30 Hz (4K UHD 3	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
	160	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
ТХ	4096x2160 30 Hz (4K30)	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
	409 3 (4	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
	(60) (60)	4.4.4 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
	3840x2160 60 Hz (4K UHD 60)	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
	3840x2160 60 Hz (4K UHD 60)	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
		4.4.4 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
	4096x2160 60 Hz (4K60)	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
	409 6 (4	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 - Ubiguiti 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:

Device	Pieces	Firmware version
Ubiquiti EdgeSwitch 16 XG	1	1.8.1 (or above)
UBEX-MMU-X200	1	1.0.6
UBEX-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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			Dynamic		Enable		Enable		Down		Enable						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	
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										Pera		Next Last					@ 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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		3/6		Dynamic	Enable	Port Description			(0 to 64)		Source/Destination MAC, VLAN,	Ethertype, Incoming Port		
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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.

geSwitch - UBNT EdgeSwitch × +		
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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 > VL	AN			
Dashboi	ard Port	Summary VLAN Port Channel (LAG)	Port Mirroring Firmware Upgrade UNMS Restart Switch	
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	VLAN ID	Name	Port Participation: T Tagged U Untagged E Exclude	O Other
	1	default		
	286	VLAN0286		

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.

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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.

e i Kanaar		
ECCEMAX EdgeSwitch 16-Port 10G 1.8.1		
Switching > IGMP Snooping > Configuration		
Configuration Interface Configuration Source Specific Multicast VLA	Status Multicast Router Configuration Multicast Router VLAN Stat	tus Multi
IGMP Snooping Global Configuration and Status		
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IGMP snooping configuration page

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VLAN Configuration									
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						Copyright 2	013-2018 Ubiquiti I	Networks, Inc.	

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.

Switching	1 > IGMP Snoopir					
		ng > Interface Configuration			٩	Basic * System * Switching * Routing * Security *
Config	uration Inte	erface Configuration Sou	rce Specific Multicast VLAN Status Multicast	Router Configuration Multicast Router VLAN Status Multi	icast Router VLAN Configuration	
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0	0/3	Disable	260	10	0	Disable
9	0/4	Disable	260	10	0	Disable
9	0/5	Disable	260	10	0	Disable
)	0/6	Disable	260	10	0	Disable
1	0/7	Disable	260	10	0	Disable
9	0/8	Disable	260	10	0	Disable
9	0/9	Disable	260	10	0	Disable
9	0/10	Disable	260	10	0	Disable
9	0/11	Disable	260	10	0	Disable
9	0/12	Disable	260	10	0	Disable
9	0/13	Disable	260	10	0	Disable
9	0/14	Disable	260	10	0	Disable
9	0/15	Disable	260	10	o	Disable
9	0/16	Disable	260	10	D	Disable
9	3/1	Disable	260	10	D	Disable
9	3/2	Disable	260	10	D	Disable
9	3/3	Disable	260	10	D	Disable
9	3/4	Disable	260	10	0	Disable
1	3/5	Disable	260	10	D	Disable
ē		Disable	260	10	0	Disable

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.

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		Disable		Group Membership Interval (Seconds)	260	(2 to 65535)		Disable	
2		Disable		Max Response Time (Seconds)				Disable	
2		Disable	260		10	(1 to 25) Must be less than Group Membership Interval		Disable	
2		Disable		Multicast Router Expiration Time (Seconds)		(0 to 3600)		Disable	
		Disable	260	Fast Leave Admin Mode	O Disable Ent	able		Disable	
2	Q/14	Disable	260				Submit Cancel	Disable	
2		Disable	260					Disable	
2	0/16	Disable	260					Disable	
2	3/1	Disable	260					Disable	
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2	3/4	Disable	260					Disable	
2		Disable	260					Disable	
	3//6	Disable	260					Disable	
						tefresh Edit			

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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KG4P Snooping VLAN Configuration VLAN ID Fat Leave Admin Mode Group Mandeminip Interval (Seconds) Group Coupling Co	VLAN ID C Fast Leave Admin Mode C Gro	oup Membership Interval (Seconds)		(Seconds) C Report Suppression Mode C
KG4P Snooping VLAN Configuration VLAN ID Fail Leave Administance Group Membership Interval (Seconds) Group Membership Interval (Seconds) Main Reapone Time (Seconds) Multicast Reader Expension Time (Seconds) Bay Biological Transport Reports Toppression Time (Seconds) Bay Biological Transport			Table is Empty	
KGMP Socopping VLAN Configuration VLAN ID Fast Leave Administation Fast Leave Administation Group Membership Interval (Seconds) Baseline Time (Seconds) Main Reapones Time (Seconds) Multicast Roader Exponsion Time (Seconds) Bayeria Stoppersation Mode				
KGMP Snooping VLAN Configuration VLAN ID Fast Leave Administance Fast Leave Administance Group Membership Interval (Seconds) Group Membership Interval (Seconds) Mar Response Time (Seconds) Multicast Roafer Experision Time (Seconds) Bayeri Stoppression Time (Seconds) Report Stoppression Time (Seconds)			Refresh Add Edit Remove	
VLAN ID 2010 Fart Leaver Admin Mode © Disable It Enable Group Manniership Interval (Seconda) 200 Alar Response Time (Seconda) 10 Multicast Router Expiration Time (Seconda) 0 Report Suppression Mode 0				_
Fail Leave Admin Mode D backle Group Membership Interval (Seconda) 260 Group Membership Interval (Seconda) 200 Maa Response Time (Seconda) 10 Multicast Router Expiration Time (Seconda) 0 Report Suppression Mode 0		IGMP Snooping VLAN Configuration		
Group Membership Interval [Seconds] 200 (2 br6535) Max Response Time (Seconds) 10 (1 b 25) Must be lass than Group Membership Interval Multicast Router Expiration Time (Seconds) 0 (9 b 5000) Report Suppression Mode Image: Classic Classic Classics Image: Classics Classics		VLAN ID	286 •	
Leve Leve Max Response Time (Seconds) 10 10 (1 to 25) Mait be less than Group Membership interval Multicast Router Expiration Time (Seconds) 0 0 (to 3500) Report Expiration Mode © Enable		Fast Leave Admin Mode	O Disable 🖲 Enable	
Multicast Router Expiration Time (Seconds) 0 0 0 0 Report Suppression Mode Ø Datable Ø Datable		Group Membership Interval (Seconds)	260 (2 to 65535)	
Report Suppression Mode		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>
# Councer 201.701.1 Stars II shows in				
				@ 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.

	itch - UBNT EdgeSw		xcs/pages/main/main.lsp#										
dgel	MAX"	Switch 16-Port 10G *	1.8.1									eP New UI 🖪	Log Out
									Д				
Globa	I Interface	Local Devices	Remote Devices Statistic:										
LLDP	Interface Sun	nmary											
Display	All V rows					Showing	1 to 16 of 16 entries					Filter:	
2	Interface	\$	Link Status	\$ Transmit	C Receive	\$	Notify	Option	al TLV(s)	\$	Transmit Management Information		0
2	Q/1		Up	Enable	Enable		Disable				No		
			Up	Enable	Enable		Disable				No		
Ø	0/3		Up	Enable	Enable		Disable				No		
2	Q/4		Up	Ent Edit LLDP Interface		_		_		*	No		
Ø	0/5		Down	Enz NOTE: Configuration will be a	undied to all interferen						No		
2	0/6		Down	End Transmit	pprovidu de internación.	2					No		
e	0/7		Down	Ene Receive							No		
₹			Down	Enz Notify		2				- 8	No		
2	0/9		Down	Enz Transmit Management Inf	ormation	2				- 8	No		
2			Down	Port Description						- 8	No		
2			Down	Ens System Name		2				- 8	No		
8 8			Down	Ene System Description						- 11	No		
2 2			Down	System Capabilities		•					No		
2 2			Down	Ena							No		
				Enable	Enable		Disable		Submit	Cancel			
					1		dous 1 Next Last	ive					

Add LLDP Interface window

LLDP Interface Summary

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

	C A https://192.16	8.1.2/htdocs/pages/mair	n/main.lsp#					☆
e	MAX Edge Switch 1						¢ New	UI 🖶 Save Configuration Log C
itchin	ng > LLDP > Interface					٩	Basic + System + Switching +	Routing - Security - Qo:
Globa	Interface Loca	I Devices Remote Dev	ices Statistics					
DP	Interface Summar	/						
olav	All Y rows				Showing 1 to 16 of 16 entries			Filter:
	Interface	C Link Status	Transmit	C Receive	 Notify 	Optional TLV(s)	C Transmit Management Information	
	0/1	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/2	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/3	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/4	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/5	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/6	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/7	Down	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	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	
	0/11	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	
	0/15	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
	0/16	Up	Enable	Enable	Enable	0, 1, 2, 3	Yes	
					First Previou 1 Need U			

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.

	2.168.1.2/htdocs/pages/main/main.lsp#				☆
EdgeMAX [®]		E		A New UI 😝 San	re Configuration Log O
Switching > LLDP > Remote De	vices		<i>۹</i>	Basic + System + Switching + Routing +	Security + Qos
Global Interface	Local Devices Remote Devices Statistics				
LLDP Remote Device	e Summary				(
Display All V rows			Showing 1 to 4 of 4 entries	Filter:	
Interface	Remote ID	♦ Chassis ID	Port ID	System Name	
D on	1	A8:D2:36:00:51:9C	A8:D2:36:00:51:9E	UBEX-PRO20-HDMI-F110	
0/2	2	A8:D2:36:00:51:9C	A8:D2:36:00:51:9D	UBEX-PRO20-HDMI-F110	
0/3	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.

> 0 0		+															
7 G 🔳	https://192.168.1.2/	"htdocs/pages/main/ma	iin.lsp#														¢
	EdgeSwitch 16-Port													8 Nev	v UI 🖪 Sav	ve Configuration	Log Out
stem > Port > SI									٩		Basic 💌	Syste	m v Switchin	1g -	Routing -	Security 🔻	
Summary	Cable Test Mirror	ing SFP Information															
ber Ports I	nformation																?
play All 🔻 re	ows						Showing 1 to 4 of	4 entries							Filter		
erface O	Vendor Name	Serial Number	Part Number	C Revision	¢ Com	pliance 🗘	Temperature (°C)	Voltage (Volt)	Current (mA)	0 Outp	t Power (dBm)	۰ ۱	nput Power (dBm)	٥	Tx Fault	Signal L	oss O
	FINISAR CORP.	AUQUIRC	FTLX8571D3BCL	A	10G	Base-SR	45.9	3.251	8.1	-2.36			2.716		No	No	
2	FINISAR CORP.	AX302NJ	FTLX1471D3BCL	A		Base-LR	41.2	3.295	43.1	-1.21			2.132		No	No	
3	Fiberstore	S1812000094-1	SFPP-PC05	A	DAG		N/A	N/A	N/A	N/A			WA		N/A	N/A	
	Fiberstore	S1812000119-1	SEPP-PC05	A	DAC		N/A	N/A	N/A	N/A		0	4/A		N/A	N/A	

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/htdoc	s/pages/main/main.lsp#				
EDGEMAX EdgeSwitch 16-Port 10G 1.8	4				
Basic > Dashboard					
Dashboard Port Summary VLAN	Port Channel (LAG) Port Mi	rroring Firm	ware Upgrade	UNMS Restart Switch	
EdgeSwitch					
System Information					
System Description					5145168, Linux 3.6.5, 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	5
Device Information					
Machine Type				EdgeSwitch 16-Port 10G	
Machine Model				ES-16-XG	
Serial Number				F09FC2664A31	
Software Version				1.8.1.5145168	
System Resource Usage					
Temperature Status				Normal	
UNMS Status					
UNMS Status				NOT CONNECTED	
		_			
Logged In Users					
	er Name				Connection From
ubnt			192.168.1.10		
		_	_		
Recent Log Entries					
Log Time	Severity				
Jan 1 01:00:27	info			packet. Can't reach DNS server at	
Jan 1 01:00:27 Jan 1 00:59:58	Info			packet. Can't reach DNS server at	
				Network Port; DHCP Server did n	
Jan 1 00:59:29 Jan 1 00:55:22	Info			ubnt connected from 192.168.1.10 ubnt connected from 192.168.1.10	

Dashboard page, the Save Configuration button on the upper right

			0 x
		\$	0 :
		🖉 New UI 😝 Save Configuration Log G	Dut
٩	Basic - System -	Switching - Routing - Security - Qo	s +
		GENUINE A PRODUCT	1
			- 12
			- 10
			- 12
	_		- 12
			- 11
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			-15
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			-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

Harris Career	

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

5 NETGEAR M4300-24X24F ×	
← → C ☆ ③ Nem biztonságos 169.254.100.100	\$ i
NETGEAR	
M4300-24X24F ProSAFE 24-port 10GBASE-T and 24-port 10G SFP+	
	Login Ø
	Usemame*
	Password
	Login
@ 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	g QoS	Security	Monitoring	N	laintenance	Help	Index	_
Management Device View	Services	Stacking SNMP	LLDP L	ink Dependency	ISDP	Timer Schedule	Applicatio	n	
Management	IPv4 Service P	Port Configuration							
System Information	Service Port	Configuration Proto	col	None Bootp	DHCP				
System CPU Status v	IP Address			192.168.3.239					
Switch Statistics	Subnet Mask	¢		255.255.254.0					
USB Device Information	Default Gate	way		192.168.2.246					
Slot Information	Burned In M			08:BD:43:71:7A:26					
Loopback Interface	Interface Sta	tus	1	Down					
Management Interfaces									
IPv4 Service Port Configuration									
IPv6 Service Port Configuration									
IPv4 Management VLAN Configuration									
IPv6 Management VLAN Configuration									
IPv4 Management Interface Configuration									
IPv6 Management Interface Configuration									
Time v									
DNS ~									
SDM Template Preference									
Green Ethernet 🗸 🗸									

Port IP address settings page

× التا ال
🛱 🛠 🗄
Welcome admin
Update Cancel Apply
 0

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.

ztonságos 169.25												
and the second se												
24-port 10GBAS	E-T and 24-port 10G S	FP+										
SI STP Multica	st MVR Address Ta	ble Por	ts LAG MRF	L2 Loop Protection								
LAG Configuratio	n											
Litto oomigutato	-											
LAG Name	Descripti	on LAG	Admin Mode	Hash Mode	STP Mode	Static Mode	Link Trap	Configured Ports	Active L Ports S	AG Lo tate Mo	cal Preference	
		10	_		×	×		Pons	Ports 3	nate Mit	ode	
			×	~							~	
□ <u>ch1</u>		lag 1		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
☐ <u>ch2</u>		lag 2		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
ch3		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			lown Di		
Ch4		lag 4		3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable Disable			own Dis		
 ch5 ch6 		lag 5		3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port			Disable					
□ <u>ch6</u> □ <u>ch7</u>		lag 6 lag 7		3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Dis		
□ <u>ch8</u>		lag 8		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Dis		
□ <u>ch9</u>		lag 9		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Dis		
ch10		lag 1		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
□ ch11		lag 1		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
Ch12		lag 1		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Dis		
ch13		lag 1		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Dis		
Ch14			4 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
Ch15		lag 1	5 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable		0	own Di	sable	
ch16		lag 1	6 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable		D	own Di	sable	
ch17		lag 1	7 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable		0	own Dis	sable	
ch18		lag 1	8 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable		D	own Dis	sable	
🗐 <u>ch19</u>		lag 1	9 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable		D	own Di	sable	
ch20		lag 2		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
ch21		lag 2		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
<u>ch22</u>		lag 2		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Dis		
□ <u>ch23</u>		lag 2		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
ch24		lag 2		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
ch25			5 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
ch26		lag 2		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Dis		
ch27 ch28		lag 2 lag 2		3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own De		
ch20		lag 2		3 Stc/Dest MAC, VLAN, EType, incoming port 3 Stc/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
ch30		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
□ <u>ch31</u>		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
□ <u>ch32</u>		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			lown Dis		
□ <u>ch33</u>		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
ch34			4 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
Ch35		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
Ch36		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			own Di		
Ch37		lag 3		3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable		0	own Dis	sable	
		100.0	8 Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			own Dis	aabla	

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.

			169.254.1	1 00.100 /l:	ase/cheetah_log	in.html							
TGEAR				_									
		-port 1	OGBASE-	T and 24	-port 10G SFP								
	witching		Routing	QoS	Security		onitoring	Ma	intenance	н	elp	Index	
N Auto-VolP	iSCSI	STP	Multicast		Address Table	Ports	LAG M		Loop Prot				
LAG		LAG M	embership										
G Configuration		LAG ID			Lag 1	-							
G Membership		LAG N	ame		ch1								
		LAG D	escription										
		Admin	Mode		Enable ~								
		Link Tr	ар		Disable ~								
		STP M	ode		Enable ~								
		Static N	Mode		Disable ~								
		Hash M	lode		Src/Dest I	AC, VLA	N, EType, inc	oming por	t v				
		Un Un											
		Ports		5 7 1	9 11 13 15	17 19	21 23 25	27 2	9 31 33	35 37	39 4	1 43 45	47
		Forts	أشت	11-11	اقاقات	اقاة	أذأ	1111		1 TT	1771		1
		Ĩ		1 I	ההה	TT		ini	<u>i i</u>	itit	iTir	<u>ini</u>	i
		L.	2 4 6	8 8 1	0 12 14 16	18 20	22 24 26	28 3	0 32 34	36 38	40 4	2 44 46	48

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.

ETGEAR [®] 300-24X24F Pro SAFE 2												
300-24X24F ProSAFE 2												
												Welcor
System Switching	Routing QoS	6 Security	Moni	toring	Maintenance Help Index							
AN Auto-VolP iSCSI	STP Multicast MVR	Address Table	Ports L	AG MRP	L2 Loop Protection							
												Cano
LAG	LAG Configuration											
A CONTRACTOR OF							1					
AG Configuration	LAG Name	Description	LAG AC	dmin Mode	Hash Mode	STP Mode	Static Mode	Link Trap	Configured Ports	LAG State	Local Preference Mode	
AG Membership											v	
	C ch1		lag 1 Er	nabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable	1/0/1, 1/0/2	Dawe	Disable	
	Ch1 ch2			nabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/3, 1/0/2		Disable	
	Ch2 ch3			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/5, 1/0/4		Disable	
	ch4			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/7, 1/0/8		Disable	
	ch5			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/9, 1/0/10		Disable	
	ch6			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/11, 1/0/12		Disable	
	ch7			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	morri, morre		Disable	
	ch8			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	Ch9			nabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch10			nabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	□ <u>ch10</u>			nabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	Ch12		lag 12 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch12			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch14		lag 14 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch15		lag 15 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch16		lag 16 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	□ ch17		lag 17 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	Ch18		lag 18 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	C ch19		lag 19 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch20		lag 20 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	□ <u>ch21</u>			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch22		lag 22 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	Ch23		lag 23 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch24		lag 24 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch25		lag 25 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	□ <u>ch26</u>		lag 26 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch27			nabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Disable	
	ch28		lag 28 Er		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			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.

AFE 24-port 10GBASE	T											
itching Routing												
	_			Maintenance Help Index								v
			Monitoring									
iooon on mulleus	t MVR Address Tab	le Ports	LAG MRF	P L2 Loop Protection								
LAG Configuration												
		i and the second	1			1	-	ños os	in the second se			
LAG Name	Descriptio	n LAG	Admin Mode	Hash Mode	STP Mode	Static Mode	Link Trap	Configured Ports	Active Ports	LAG State	Local Preference Mode	
						~	×				×	
			· · · · ·	20 D (1110) 15 (11)			·	4 10 14 4 10 10	41014 41010			
<u>ch1</u>		lag 1	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/1, 1/0/2	1/0/1, 1/0/2		Disable	
ch2 ch3		lag 2	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable Disable	1/0/3, 1/0/4	1/0/3, 1/0/4 1/0/5, 1/0/6		Disable	
□ <u>cn3</u> □ ch4		lag 3	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/5, 1/0/6	1/0/5, 1/0/6		Disable	
Cn4 ch5		lag 4 lag 5	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/9, 1/0/10	nun, nul8		Disable	
Ch5 ch6		lag 6	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/9, 1/0/10			Disable	
□ ch7		lag 7	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port 3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable	1/0/11, 1/0/12			Disable	
□ <u>ch8</u>		lag 8	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
□ <u>ch0</u>		lag 9	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
C ch10		lag 10	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
□ <u>ch11</u>		lag 11	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
□ <u>ch12</u>		lag 12		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
□ <u>ch13</u>		lag 13	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
□ <u>ch14</u>		lag 14		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
C ch15			Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
□ ch16		lag 16		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
Ch17		lag 17	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
ch18		lag 18		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
Ch19		lag 19		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Down	Disable	
Ch20		lag 20	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
Ch21		lag 21	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port	Enable	Disable	Disable			Down	Disable	
ch22		lag 22	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		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	
Ch26		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		Disable	Disable				Disable	
<u>ch28</u>			Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Down	Disable	
🔲 <u>ch29</u>		lag 29		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
<u>ch30</u>		lag 30	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
ch31		lag 31		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
<u>ch32</u>		lag 32	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
ch33		lag 33		3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
ch34			Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
ch35		lag 35	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
ch36		lag 36	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable				Disable	
Ch37		lag 37	Enabled	3 Src/Dest MAC, VLAN, EType, incoming port		Disable	Disable			Down		

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.

TGEAR		
	AFE 24-port 10GBASE-T and 24-port 10G SFP+ tething Routing QoS Security Monitoring Maintenance Help Index	Welcome
	tching Routing QoS Security Monitoring Maintenance Help Index ISCSI STP Multicast MVR Address Table Ports LAG MRP L2.Loop.Protection	
		Add Detete Cance
VLAN	Reset	
c	Reset Configuration	
AN Configuration		
anced	Internal VLAN Configuration	
	Internal VLAN Allocation Base 4093	
	Internal VLAN Allocation Policy O Ascending Ascending	
	VLAN Configuration	
	VLAN ID VLAN Name VLAN Type Make Static	
	286 UBEX Disable V	
	1 default Default 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.

🗧 🖉 💩 NETGEAR M4300-24X24F	×							
C 🏠 🛈 Nem bizto	onságo	os 169.2	54.100.100/base/d	heetah_login.html				
	-							
NETGEAR								
M4300-24X24F ProSAFE 2	4-por	10GBAS	SE-T and 24-port	10G SFP+				
System Switching		Routing	QoS	Security Mo	nitoring Ma	intenance	Help Index	
VLAN Auto-VolP iSCSI	ST	P Multic	ast MVR Add	ress Table Ports	LAG MRP L2	Loop Protection		
VLAN	Swite	hport Conf	iguration					
•Basic ~	1.0	AG All				Go To Interfa	ace	Go
• Advanced		Interface	Switchport Mode	Native VLAN Taggin	Accore MAN IF	Native VLAN ID	Trunk Allowed V	1 ANe
VLAN Configuration			Trunk v	Native VLAN Taggin	1 ×	1 ×	1-4093	LAINO
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		lag 4		Disable	1	1	1-4093	
Port PVID Configuration		lag 5		Disable Disable	1	1	1-4093 1-4093	
 MAC Based VLAN 		lag 6 lag 7		Disable	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		Disable	1	1	1-4093	
IP Subnet Based VLAN		lag 11 lag 12		Disable Disable	1	1	1-4093 1-4093	
Port DVLAN		lag 13		Disable	1	1	1-4093	
Configuration		lag 14		Disable	1	1	1-4093	
Voice VLAN Configuration		lag 15		Disable	1	1	1-4093	
		lag 16		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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← → C ☆ ③ Nem bizto	onságos 169.254.100.100/base/cheetah_lo	gin.html		🖬 🖈 🗄
NETOTAR				
NETGEAR				
System Switching	4-port 10GBASE-T and 24-port 10G SFF Routing QoS Security		Welcome	admin 2
		Ports LAG MRP L2 Loop Protection	Intex	
TOTAL PRIOR DOOD			Update Cancel	Apply
Multicast	IGMP Snooping Configuration			۲
10000000000	Admin Mode	Disable Enable		
IGMP Snooping	Multicast Control Frame Count	50		
Configuration	Validate IGMP IP header	Disable Enable		
Interface Configuration	Interfaces Enabled for IGMP Snooping			
IGMP VLAN Configuration	Proxy Querier Mode	Disable Enable Enable		
Multicast Router Configuration				
Multicast Router VLAN	VLAN IDs Enabled for IGMP Snooping			0
Configuration • Querier Configuration	1			
Querier VLAN Configuration				
• 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.

300-24X24F ProSAFE 2 System Switching	4-port 10GBA						
System Switching							
	Routing			•	intenance	Help	Index
LAN Auto-VolP iSCSI	STP Mult	cast MVR	Address Table Port	s LAG MRP L	Loop Protection		
Multicast	IGMP Snoopin	g Interface Con	figuration				
1FDB ~	1 LAG All				Go To Inte	rface	Go
GMP Snooping	✓ Interface	Admin Mode	Membershin Interval	Max Response Time	Expiration Time	FastLeave	Proxy Querier
Configuration		Enable v			Lipitoton rano	Enable ~	
Interface Configuration	✓ lag 1	Disable	260	10	0	Disable	Enable
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	Iag 5	Disable	260	10	0	Disable	Enable
Multicast Router VLAN	Iag 6	Disable	260	10	0	Disable	Enable
Configuration	lag 7	Disable	260	10	0	Disable	Enable
Querier Configuration	✓ lag 8	Disable	260 260	10 10	0	Disable	Enable
Querier VLAN Configuration	 lag 9 lag 10 	Disable Disable	260	10	0	Disable Disable	Enable
	✓ lag 10	Disable	260	10	0	Disable	Enable
ILD Snooping 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
	Iag 16	Disable	260	10	0	Disable	Enable
	Iag 17	Disable	260	10	0	Disable	Enable
	Iag 18	Disable	260	10	0	Disable	Enable
	Iag 19	Disable	260	10	0	Disable	Enable
	 Iag 20 Iag 21 	Disable Disable	260 260	10 10	0	Disable Disable	Enable Enable
	lag 22	Disable	260	10	0	Disable	Enable
	✓ lag 23	Disable	260	10	0	Disable	Enable
	✓ lag 24	Disable	260	10	0	Disable	Enable
	✓ lag 25	Disable	260	10	0	Disable	Enable
	Iag 26	Disable	260	10	0	Disable	Enable
	Iag 27	Disable	260	10	0	Disable	Enable
	✓ lag 28	Disable	260	10	0	Disable	Enable
	Iag 29	Disable	260	10	0	Disable	Enable
	 Iag 30 Iag 31 	Disable	260 260	10 10	0	Disable	Enable Enable
	✓ lag 31	Disable Disable	260	10	0	Disable Disable	Enable
	✓ lag 32	Disable	260	10	0	Disable	Enable
	 Iag 34 	Disable	260	10	0	Disable	Enable
	Iag 35	Disable	260	10	0	Disable	Enable
	✓ lag 36	Disable	260	10	0	Disable	Enable
	✓ lag 37	Disable	260	10	0	Disable	Enable

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.

IETGEAR' 4300-24X24F Pro SAFE 2	4-nort 10GBA	SE-T and 24-	port 10G SF	P+					Welcome
System Switching			Securi		Maintenance	lelp Index		_	
VLAN Auto-VoIP iSCSI									
									Update Cance
Multicast	IGMP VLAN C	onfiguration		0					
MFDB ~	VLAN ID	Admin Mode	Fast Leave	Membership Interval	Maximum Response Time	Multicast Router Expiry Time	Report Suppression	Proxy Querier	
IGMP Snooping	286	Enable v	Enable v	260	10	0	Disable ~	Enable v	
Configuration	□ 1	Enable	Enable	260	10	0	Disable	Enable	
Interface Configuration	286	Disable	Disable	260	10	0	Disable	Enable	
IGMP VLAN Configuration									
Multicast Router Configuration									
Multicast Router VLAN Configuration									
Querier Configuration									
Querier VLAN Configuration									
MLD Snooping ~									

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.

	0GBASE-T and 24-p	ort 10G SEP+									Welco	ome
	Routing QoS		onitoring Mai	ntenance Help	Index						Welco	ane a
ment Device View Service												-
nan bene nan oarn	tes charling crim	n allen ann eapa	indentity indentity i	mer cerredule - Applicate								
LLDP R	emote Device Inventory											
						_						_
Configuration				Search Interface	Go	>						
Port	Remote Device ID	Management Address	MAC Address	System Name	Remote Port ID							
ce Configuration 1/0/1				UBEX-PRO20-HDMI-F100	02:00:00:01:45:C2	:2						
ics <u>1/0/2</u>				UBEX-PRO20-HDMI-F100								
Device 1/0/3 ation				UBEX-PRO20-HDMI-F100								
1/0/4				UBEX-PRO20-HDMI-F100								
te Device 1/0/5				UBEX-PRO20-HDMI-F100								
te Device 1/0/6				UBEX-PRO20-HDMI-F100								
te Device <u>1/0/7</u> ory <u>1/0/8</u>				UBEX-PRO20-HDMI-F100 UBEX-PRO20-HDMI-F100								
ED ~ 1/0/1				UBEX-PRO20-HDMI-F100 UBEX-PRO20-HDMI-F100								

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.

		Security Monitoring	Maintenance	Help Index	
Management Device		LLDP Link Dependency ISDF		Application	
LLDP	LLDP Interface Selection				
• LLDP	^ Interface: 1/0/1 ▼				
Global Configuration					
Interface Configuration	on Remote Device Information				
Statistics Local Device	Remote ID	17			
Information	Chassis ID	A8:D2:36:00:51:70			
 Remote Device Information 	Chassis ID Subtype	MAC Address			
Remote Device	Port ID	02:00:00:01:45:C2			
Inventory • LLDP-MED	Port ID Subtype	MAC Address			
LEDT MED	System Name	UBEX-PRO20-HDMI-F100			
	System Description	UBEX-PRO20-HDMI-F100			
	Port Description System Capabilities Supported	2 station only			
	System Capabilities Enabled	station 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.

STP N	nting QoS Multicast MVR seiver Information		Monitoring Ports LAG MRP	Maintenance		ndex			
Port Transc		Address Table	Ports LAG MRP	L2 Loop Protec	tion				
	ceiver Information								
	ceiver Information								
1 All									
Port	Vendor Name	Link Length 50um	Link Length 62.5um	Serial Number	Part Number	Nominal Bit Rate	Revision	Compliance	
1/0/1		0	0	S1812000153-1		10300	A	DAC	
1/0/2	Fiberstore	0	0	S1812000151-2	SFPP-PC07	10300	A	DAC	
		0	0	S1812000127-1		10300	А	DAC	
		0	0	S1812000124-2		10300	А	DAC	
	FINISAR CORP.		0		FTLX2071D333	10300	А	10GBase-LR	
	FINISAR CORP.		0		FTLX2071D333	10300	A	10GBase-LR	
	FINISAR CORP.		3		FTLX8574D3BCL		A	10GBase-SR	
	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									
1/0/23 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.

GEAR'								
X24F ProSAFE 2	4-port 10GBA	SE-T and 24-po	rt 10G SFP+					Welcon
n Switching	Routing	1 QoS	Security Mo	nitoring	Maintenance	Help Index		
Auto-VoIP iSCSI			Idress Table Ports					
Auto-voir 1303	STE mui	icast myrk Ac	difess lable in oits	DAG MIRE	cz coop Protection			
								Cano
	Switchport Co	nfiguration						
~	1 LAG AII				Go To Inter	face Go		
d A	-							
						D Trunk Allowed VLANs		
Configuration	1/0/46	Trunk 👻	Disable	1 👻	1 ×	1-4093		
Frunking Tration	1/0/1	General	Disable	1	1	1-4093		
/lembership	1/0/2	General	Disable	1	1	1-4093		
itatus	1/0/3	General	Disable	1	1	1-4093		
	 1/0/4 1/0/5 	General General	Disable	1	1	1-4093		
1D Configuration	1/0/5	General	Disable	1	1	1-4093		
ased VLAN	1/0/7	General	Disable	1	1	1-4093		
Based VLAN	1/0/8	General	Disable	1	1	1-4093		
Configuration	1/0/9	General	Disable	1	1	1-4093		
Based VLAN fembership	1/0/10	General	Disable	1	1	1-4093		
	1/0/11	General	Disable	1	1	1-4093		
et Based VLAN	1/0/12	General	Disable	1	1	1-4093		
LAN ration	1/0/13	General	Disable	1	1	1-4093		
	1/0/14	General	Disable	1	1	1-4093		
LAN ration	1/0/15	General	Disable	1	1	1-4093		
witch	 1/0/16 1/0/17 	General General	Disable	1	1	1-4093		
ration	1/0/17	General	Disable	1	1	1-4093		
Port	1/0/19	General	Disable	1	1	1-4093		
ration	1/0/20	General	Disable	1	1	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 1/0/28 	General General	Disable	1	1	1-4093		
	1/0/28	General General	Disable	1	1	1-4093		
	1/0/29	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.

NETGEAR M4300-24X24F	×tonságos 169.254.100.10	O denne debenste belanin i	h dare l	_	_	_	_
→ C [] () Nem bizt	tonsagos 169.254.100.10	D/base/cheetah_login.	ntmi	_			
NETGEAR							
14300-24X24F ProSAFE	24-port 10GBASE-T and	24-port 10G SFP+					
System Switching	Routing Qo	S Security	Monitoring	Maintenance	Help	Index	
Save Config Reset Exp	oort Upgrade File Man	agement Troublesho	oting				
	Save Configuration						
Save Configuration Auto Install Configuration	Saving all applied chang configuration panels that to be saved, thus retaining to be saved.	es will cause all change were applied, but not s	es to aved,				
Auto motari configuration	to be saved, thus retainin system reboot.	ng their new values acr	oss a 🔛				
					-	Confi	

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.

300-24X24F P	roSAFE 24-p	ort 10GBASE	-T and 24-por	t 10G SFP+					
System	Switching	Routing	QoS	Security	Monitoring	Maintenance	Help	Index	
ave Config R	eset Export	Upgrade	File Managemen	t Troublesh	ooting				
Export	H	TP File Export							
ile Export	_	ile Type	Text Configura	ation	v				
TTP File Export		no type	Text comigan						
JSB File Export									

Nelcome ad Cancel Ap



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									Cros	spoint	EDID M	anagement		Control	Se	ttings	0	Device (Discov	/ery
Vide	20 /	udio	Ø	Audio	Follows	s Video															😴 Show I	nactive UBEX	(es 💽	🕈 Show Di	sabled	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									SELECTE	STREAM								
												11/01										8:D2:36:F0	:00:02		Destin	ation:				
												11/02																		
												12/01									SEARCH									
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								\square				13/01									STREAM	52.30.10.0		ORT		C	EVICE			
									\square			14/01									- Settin	js —								
												15/01											Str	eam name Enabled		:36:F0:00:0	2.81			
												20/01												Tile icon	Q					
												20/02													CHA	NGE				
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																					— Tags									
																									#1	idd tag 🕂				
																					Signa	info								
																								Resolution Pixel clock						

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
- TROUBLESHOOTING COMMANDS
- 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):

|--|--|--|--|

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	<pre>interface TenGigabitEthernet2/0/23 no ip igmp snooping tcn flood exit</pre>

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-channel11 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.
7.6. Troubleshooting Commands

7.6.1. LLDP Activation

The Command

Type and apply the following command:

lldp run

7.6.2. 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).

7.6.3. 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.

7.6.4. 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.

7.6.5. Querying the Details of the Installed Transceiver Modules

The Command

Type and apply the following command:

show interface transceiver

7.7. 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

7.8. 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	Device Dis	scovery
	Show Inactive UBEXes	😴 Show D	isabled Stream	S	
	SELECTED STREAM Source: A8:D2:36:F0:00):02.S1	Destination:		
	SEARCH				
	SOURCE: 1/01 A8:D2:36:F0:00:0	2.S1		<>	Ð
	STREAM Settings	PORT		DEVICE	
		Stream name Enabled	A8:D2:36:F0:0	0:02.\$1	
		Tile icon	CHANGE		
	Scaler settings				
		Scaling mode	Passthrough		
		prced resolution	1920x1080p6		
		Image position	Fit No conversion		
	Tags (A8:D2:36:F0:00:02:ST) (A8		(#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
- TROUBLESHOOTING COMMANDS
- 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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aludo 🔛		the day in the				hand here			
cisco	AT DAT DAT	AT BAT BAT BAT	T B AT B AT B A	TRATIATEA	AVLAT		LAVE A		= R
.0	And in case of the local division of the loc	أنحال كالمرال كالمرال الأحدال		كر افتار اختلا اخ	Statistics of the local division of the loca	No. of Concession, Name	The state of the state	a de la de la de la de	

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	C
Port Channel 3	interface port-channel1 switchport mode trunk speed 10000 exit
Port Channel 4	interface port-channel2 switchport mode trunk speed 10000 exit
Port Channel 48	interface port-channel46 switchport mode trunk 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.

diala	-11	Hardin Hard		0			
cisco	AV	AV	AT	AT	AT	AV	AT
.0		No.	ACC NO.				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.

8.6. Troubleshooting Commands

8.6.1. 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).

8.6.2. 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.

8.6.3. Switching on the Support for Unsupported SFP+ Modules

The Command

Type and apply the following command:

service unsupported-transceiver

8.6.4. Querying the Details of the Installed Transceiver Module

The Command

Type and apply the following command:

show interface transceiver

8.7. 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 - 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
- TROUBLESHOOTING COMMANDS
- 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	C
Port Channel 3	interface port-channel3 switchport switchport mode trunk switchport access vla exit
Port Channel 4	interface port-channel4 switchport switchport mode trunk switchport access vla exit
Port Channel 48	interface port-channel48 switchport switchport mode trunk 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	nmand
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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.

9.6. Troubleshooting Commands

9.6.1. 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).

9.6.2. 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.

9.6.3. 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.

9.6.4. Querying the Details of the Installed Transceiver Module

The Command

Type and apply the following command:

show interface transceiver

9.7. 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
- TROUBLESHOOTING COMMANDS
- 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.

The configuration steps are compatible with the following switch models:

- Juniper QFX5100-48S
- Juniper QFX5110-48S
- Juniper QFX5100-96S
- Juniper QFX5110-96S

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	18.1R3-S4.2
UBEX-MMU-X200	1	1.0.6
UBEX-PRO20-HDMI-F100/F110	47	1.3.0

Requirements 10.3. Juniper for the Switch 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

track/?tab=jnciajunos

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:

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.

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

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https://www.juniper.net/us/en/training/certification/ certification-tracks/ent-routing-switching-

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

Download the user's manual for the OFX5100/OFX5110 series 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. 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 the switch.

#### Login window in the Putty

### 10.5.4. Aggregated Ethernet Interface Configuration

#### The Command

Type and apply the following commands:

set chassis aggregated-devices ethernet device-count 47

#### Explanation

This setting reserves the resources of the switch for it. The device-count parameter needs to be set to the number of the connected endpoint devices. It is 47 in our example.

## 10.5.5. Interface Configuration for the MMU and the Uplink

ATTENTION! The switch needs one of the interface configuration command sets (for 10 Gbps SFP+ modules **OR** 1 Gbps SFP modules). The **xe** or **ge** interface parameter will be accepted when SFP+ (xe) or SFP (ge) modules are inserted to the switch.

#### The Commands for 10 Gpbs SFP+ Modules

#### Type and apply the following commands:

Port ID	Command (in this example)										
	edit interfaces xe-0/0/0										
	set native-vlan-id 1										
	edit unit 0 family ethernet-switching										
Port 0	set interface-mode trunk										
POILO	set vlan members all										
	set storm-control default										
	exit										
	exit										
	edit interfaces xe-0/0/1										
	set native-vlan-id 1										
	edit unit 0 family ethernet-switching										
Port 1	set interface-mode trunk										
POILT	set vlan members all										
	set storm-control default										
	exit										
	exit										

#### Explanation

The xe-0/0/0 and xe-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.



The link speed is applied to 10 Gbps (xe = 10 Gigabit Ethernet) automatically by the switch and the interfaces have membership to the all VLANs.

## The Commands for 1 Gpbs SFP Modules

Type and apply the following commands:

Port ID	Command (in t
	edit interfaces ge-0/0/0
	set native-vlan-id 1
	edit unit 0 family ethernet-
Port 0	set interface-mode trunk
POILO	set vlan members all
	set storm-control defaul
	exit
	exit
	edit interfaces ge-0/0/1
	set native-vlan-id 1
	edit unit 0 family ethernet-
Dout 1	set interface-mode trunk
Port 1	set vlan members all
	set storm-control defaul
	exit
	exit

#### 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.



The link speed is applied to 1 Gbps (ge = 1 Gigabit Ethernet) automatically by the switch and the interfaces have membership to the all VLANs.

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-switching

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### 10.5.6. Interface Configuration for the Endpoints

#### The Commands

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

Port ID	Command
Port 2	set $xe-0/0/2$ ether-options 802.3ad ae1
Port 3	set $xe-0/0/3$ ether-options 802.3ad ae1
Port 4	set $xe-0/0/4$ ether-options 802.3ad ae2
Port 5	set $xe-0/0/5$ ether-options 802.3ad ae2
Port 94	set xe-0/0/94 ether-options 802.3ad ae47
Port 95	set xe-0/0/95 ether-options 802.3ad ae47

#### 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 endpoint devices.

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

## 10.5.7. Aggregated Ethernet Settings

#### The Commands

Type and apply the following commands:

Aggregated Ethernet ID	Com
ae0	edit interfaces ae0 set native-vlan-id 1 set aggregated-ether-options edit unit 0 family ethernet- set interface-mode trun} set vlan members all exit
ae1 	<pre>edit interfaces ae1    set native-vlan-id 1    set aggregated-ether-options    edit unit 0 family ethernet-       set interface-mode trunk       set vlan members all    exit exit</pre>
ae47	edit interfaces ae47 set native-vlan-id 1 set aggregated-ether-options edit unit 0 family ethernet- set interface-mode trunk set vlan members all exit exit

#### Explanation

The aggregated Ethernet is set and finalized with these commands. The ae<x> increases till the last LAG interface.

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

#### nmand

```
ns lacp active
-switching
```

ns lacp active -switching

•••

```
as lacp active
```

# 10.5.8. Forwarding Options

## The Commands

Type and apply the following commands:

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

# Explanation

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

# 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.

# 10.5.10. IGMPv2 Setting

## The Commands

Type and apply the following commands:

set protocols igmp-snooping vlan default set protocols igmp-snooping vlan ubex-vlan immediate-leave

# 10.6. Troubleshooting Commands

# 10.6.1. Enabling LLDP

# The Command

Type and apply the following commands:

set protocols lldp interface all

# Explanation

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

# 10.6.2. Querying LLDP Details

# The Command

Type and apply the following command:

show lldp detail

## Explanation

The query returns with the basic information about the LLDP.

# 10.6.3. Querying LLDP Details by Ports

# The Command

Type and apply the following command: show lldp neighbors xe-0/0/4

# Explanation

The query returns with the details of the LLDP partner which is connected to the xe-0/0/4 port.

# 10.6.4. Querying LLDP Statistics by Ports

# The Command

Type and apply the following command:

show lldp statistics xe-0/0/4

# Explanation

The query returns with the statistics of the LLDP partner which is connected to the xe-0/0/4 port.

# 10.6.5. Verifying the Status of a LAG Interface

# The Command

Type and apply the following command:

show interfaces ae0 terse

# Explanation

The query returns with the status of the ae0 LAG interface. When the link is **up**, the link aggregation (LACP) is working on the selected LAG interface.

# 10.6.6. Querying the Details of the Selected Interface Port

# The Commands

Type and apply the following command:

show interfaces ge-0/0/1 detail

show interfaces xe-0/0/4 detail

# Explanation

The query returns with the details of the ge-0/0/1 and xe-0/0/4 ports. The answers contain either that the inserted SFP / SFP+ module is supported or not by the switch.

# 10.7. 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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# **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
-L	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
L	12	10Gb/s 850nm multimode SFP+ transceiver module
L	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