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Break-out cables

APPLICATION NOTE

How to use break-out cables on Teledyne LeCroy Xena E100q Chimera

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How to use break-out cables on Xena Chimera Application Note

Abstract

The Xena Chimera Chi-100G-5S-2P test module can support 100 Gbps, 50 Gbps, 40 Gbps, 25 Gbps and 10 Gbps port speeds depending on transceiver and in some cases splitter cables. This Application Note describes what can be achieved with the module and describes various topics related to this context. Finally, it includes examples on how to configure a 100 Gbps port on the Chi-100G-5S-2P test module to provide 100 Gbps on two ports or 10 Gbps on 8 separate ports using a break-out cables.

Introduction

The Xena Chimera Chi-100G-5S-2P test module can support 100 Gbps, 50 Gbps, 40 Gbps, 25 Gbps and 10 Gbps port speeds depending on transceiver and in some cases splitter cables. This Application Note describes what can be achieved with the module and describes various topics like:

- The use of parallel paths for transmission of high-speed signals
- Naming conventions for 100 G to 10 G Interface options
- Optical connectors used for high-speed transmission

You will find information on transceivers, cables and other items available from Xena Networks.

Please note, that because Chimera is a network emulator, the ports on the Chi-5S-2P test module are linked in pairs. One port is the ingress port and the other port the egress. The impairments are added to the traffic in the direction from ingress to egress port.

Finally, this application note includes two examples on how to configure

- A 100 Gbps port to provide 25 Gbps on 4 separate ports using a break-out cable.
- Two 40 Gbps ports to provide 10 Gbps on 8 separate ports using two break-out cables.

Transmission of high-speed signals

When 40 Gbps communication signals are transmitted between communication devices, they are sent as 4 parallel 10 Gbps streams (lanes). For 100 Gbps signals there are multiple options. However, Chimera supports 100 Gbps as 4 parallel 25 Gbps lanes.

For the physical media between communications devices there are two options:

- Very short ranges (up to 7 meters): Electrical cables are normally used as they are cost effective.
- Longer distances: Optical cables are used. For distances up to 100 meters multimode cables can be used; for longer distances the more expensive single mode cables are needed.

Optical 40 Gbps and 100 Gbps can be sent in two ways:

1. As 4 physical signals. This means that 4 optical fibers are needed between the communication devices (multi-fiber connections).

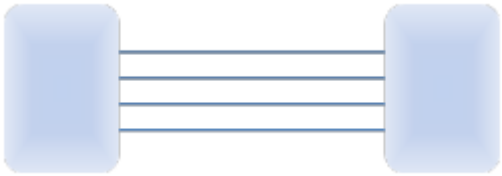

Figure 1: Several fibers between devices

2. With 4 optical wavelengths using Wavelength Division Multiplexing (WDM) techniques. This means that the signals are sent as several different wavelengths (or colors) in parallel over a single optical fiber. This is used for longer distances as only one optical cable is required.

Figure 2: A single fiber between devices – several wavelengths are used

40 Gbps and 100 Gbps Multimode fiber optic systems are normally implemented as multi-fiber connections, while Single Mode fiber optic systems normally use WDM techniques. However Single Mode fiber optic can also use multi-fiber connections, which is also known as Parallel Single Mode (PSM) or PSM4 when 4 fibers are used in parallel.

Electrical 40 Gbps and 100 Gbps are always sent as 4 physical electrical signals, which means that 4 electrical cables are needed between the devices.

Naming conventions

100 G to 10 G Interface options are normally named xxxGBASEyy#, where

- xxx indicates the speed (xxx=100 means 100 Gbps, XXX= 40 means 40 Gbps and so on)
- yy typically indicates reach and cable type:
  - yy=CR means very short reach on an electrical Copper cable
  - yy=SR means short reach on a multimode optical fiber
  - yy=LR means long reach on a single mode optical fiber
  - yy=ER means extended reach on a single mode optical fiber
- # shows number of lanes i.e. #=4 for 4 lanes and #=2 for 2 lanes

Direct attach cables (DACS) and Active Optical Cables (AOC)

40 Gbps and 100 Gbps communication devices are normally equipped with cages where transceivers can be installed. In some cases, the cables between devices are directly connected to the transceivers, which are known as Direct Attached Cables (DACs). Connections with electrical cables are normally made with DACs. DACs with optical cables and transceivers are also known as Active Optical Cables (AOC).

Product number	Description	Type	Length
205898-1052	Molex Direct Attached Cable, QSFP56-to-QSFP56 (zQSFP+), 56G, AWG30, Passive, 0.5m cable	DAC	0.5 m
205898-1102	Molex Direct Attached Cable, QSFP56-to-QSFP56 (zQSFP+), 56G, AWG30, Passive, 1m cable	DAC	1 m
205898-1202	Molex Direct Attached Cable, QSFP56-to-QSFP56 (zQSFP+), 56G, AWG30, Passive, 2m cable	DAC	2 m

Table 1: 100 Gbps QSFP28 DACs available from Xena

Optical connectors

OPTICAL transceivers are equipped with connectors – unless they are a part of an Active Optical Cable. Two types are normally used:

1. **Multi-fiber connections**: Multi-fiber Push-On (MPO) connectors are used. They can connect up to 12 (MPO12) or 24 (MPO24) optical fibers. For 4 lane systems 8 fibers are required (4 for the optical transmitters and 4 fibers for the optical receivers). These systems will use 8 of the 12 fiber connections in MPO12 connectors. Multi-fiber Termination Push-on (MTP) is a brand name for an improved connector developed by US Connect; MTP connects to MPO.

Figure 3: 12 fiber ends in an MPO12 connector

2. **Single fiber connections**: Transceivers and fiber cables are normally equipped with LC connectors; two fiber cables are required, one transmit, one receive.

Break-out cables and splitters

For some applications like connecting servers to Top-of-Rack (ToR) switches in data centers, it is relevant to use the 4 25 Gbps lanes in a multi-cable connection as 4 individual 25 Gbps data streams. Hereby you can connect a 100 Gbps port in the ToR with 4 data center servers equipped with 25 Gbps ports. This is done with a DAC or AOC break out cable connecting a QSFP28 100GbE port with four independent 25GE SFP28 ports. The DAC/AOC break out cable will have a QSFP28 transceiver connected in one end breaking out to four cables, each terminated with a SFP28 transceiver

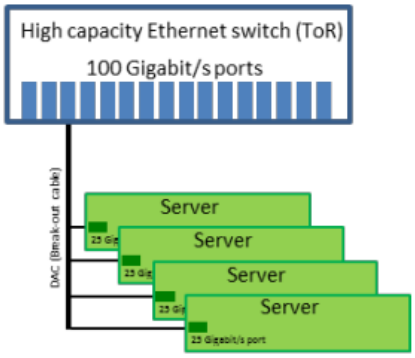

Figure 4: 100 GE to 4*25 GE break-out cable

DAC and AOC break out cables are available for electrical and optical interfaces, where 40 Gbps and 100 Gbps signals are sent as 4 physical signals. For single fiber connections break out cables are not available; splitting a WDM signal into 4 lower rate signals would require a WDM multiplexer/demultiplexer.

Figure 5: 100 Gigabit/s QSFP28 to 4 x 25 Gigabit/s SFP28 DAC electrical break-out cable

Figure 6: 100 Gigabit/s QSFP28 to 4 x 25 Gigabit/s SFP28 break-out Active Optical Cable (AOC)

In addition to DAC and AOC break out cables, passive optical breakout cables (or splitter cables) are available splitting a 4 lane signal into 4 separate signals. This means for example that 4 25 Gbps optical signals from a QSFP28 optical transceiver with MPO/MTP connector can be split into 4 individual cable pairs to be connected to SFP28 optical transceivers with LC connectors as shown in figure 10.

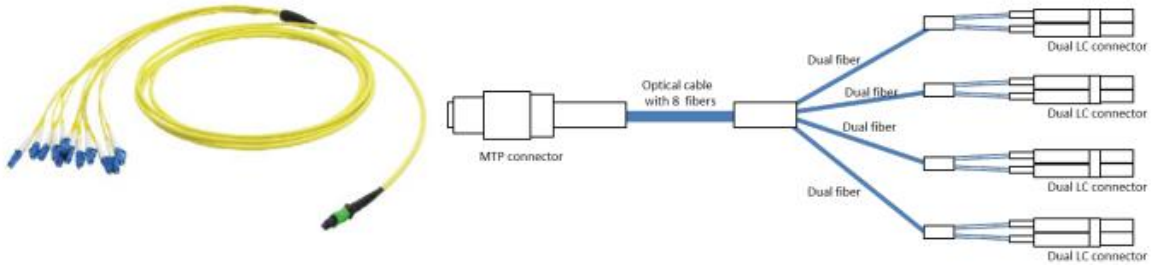

Figure 7: MTP to 4 dual LC passive optical splitter cable

	Description	Cable type	Length	See Fig.
SR4-4xLC	Optical splitter cable, SR4 MTP(F) <-> 4 x LC	MMF	5 m	10
iSM4-4xLC	Optical splitter cable, iSM4 MTP(F) <-> 4 x LC	SMF	5 m	10
SR4-LOOP	Loopback fiber cable, SR4, MTP(F)	MMF		11

Table 2: Cables and splitters available from Xena

As you can see in table 2, splitter cables are equipped with MTP connectors. They can split signals from optical (multi-fiber) transceivers that also are equipped with MTP connectors; they cannot split signals from optical (WDM) transceivers with LC connectors.

Multiport speeds in Chi-100G-5S-2P

Xena Networks Chi-100G-5S-2P 100 G and 40 G test module can support 100 Gbps, 50 Gbps, 40 Gbps, 25 Gbps and 10 Gbps port speeds as outlined in Table 3. Please note that the ports are linked together as pairs a mentioned previously.

Product number	Port speed	Interface form factor	No. of ports	Type of interface
Chi-100G-5S-2P	100G	QSFP28	2	100GBASE-SR4/LR4/CR4
	50G	QSFP28	4	50GBASE-SR2/LR2/CR2
	40G	QSFP28, QSFP+	2	40GBASE-SR4/LR4/CR4
	25G	QSFP28	8	25GBASE-SR/LR/CR
	10G	QSFP28, QSFP+	8	10GBASE-SR/LR/CR

Table 3: Xena Chi-100G-5S-2P test module

Transceivers available for Chimera

P/N	Description	Wavelength	Connector	Reach	Cable type
TR-FC85S	Innolight 100G QSFP28 100GBASE-SR4	850 nm	MPO	100 m	MMF

TR-FC13L	Innolight 100G QSFP28 100GBASE-LR4	1310 nm	LC	10 km	SMF
FTL410QE4C	Finisar 40G QSFP+ 40GBASE-SR4	850 nm	MPO	100 m	MMF
FTL4C1QE3C	Finisar 40G QSFP+ 40GBASE-LR4	1310 nm	LC	10km	SMF
TR-IQ13L	Innolight 4x10G QSFP+ 4x10GBASE-LR4 Parallel Single Mode (PSM)	1310 nm	MPO	10km	SMF

Table 4: Transceivers available from Xena.

What goes where

Table **5** shows how the transceivers and break-out cables can be used with Chi-5S-2P.

		Cables and splitters	
	Connector	SR4-4xLC	iSM4-4xLC
100 Gbps QSFP28			
TR-FC85S (SR4)	MPO	x	
TR-FC13L (LR4)	LC		
40 Gbps QSFP+			
FTL410QE4C (SR4)	MPO	x	
FTL4C1QE3C (LR4)	LC		
TR-IQ13L	MPO		x

Table 5: Chimera Chi-5S-2P transceivers, cables and splitters.

Configuring Chimera

The first step in configuring the Xena Chi-100G-5S-2P test module is to select and reserve the test module in ValkyrieManager. Select the module in the ValkyrieManager Testbed explorer window, right-click on it and Reserve Module.

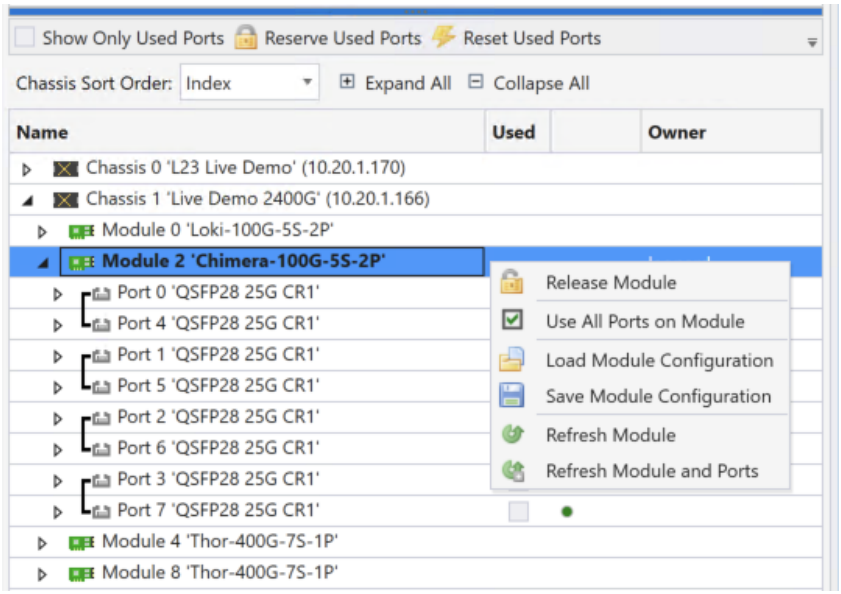

Figure 8: Reserve module

Select the Resource Properties tab and you will now see the Module Properties. Next step is to select the Media Configuration to be used for the test. In the example on Figure 9 QSFP28 is selected from the drop-down menu.

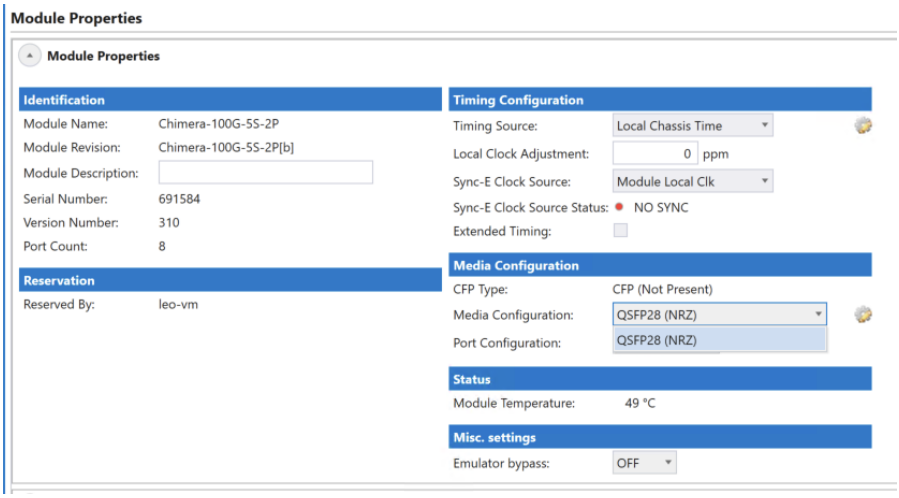

Figure 9: Select Media Configuration

You can either configure a the 100G transceivers in the Chi-100G-5S-2P test module as two single 100 Gbps port or to act as eight independent 25 Gbps ports. To do the former, the speed setting must be configured to 2 x 100G in the Module Properties.

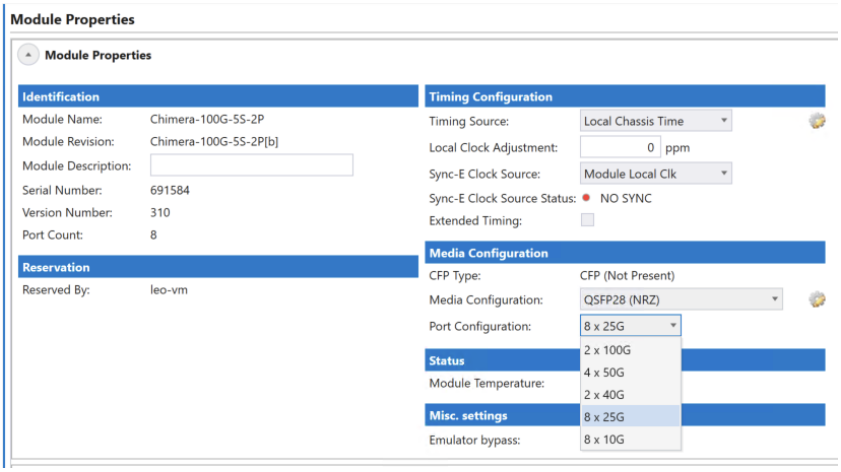

Figure 10: Change speed selection

The ValkyrieManager Testbed explorer window will change in accordance with the new setting. As mentioned in the introduction, the ports on the Chi-5S-2P test module are linked in pairs as shown on Figure 11.

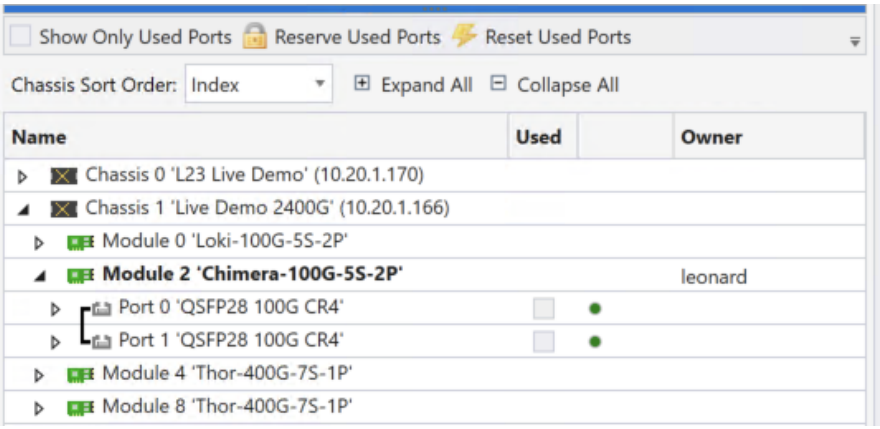

Figure 11: 2x100G test ports in the ValkyrieManager Testbed explorer window.

To configure the transceiver to eight 25 Gbps ports set the Media Configuration to 8x25G and the eight 25G ports will look like shown on Figure 12.

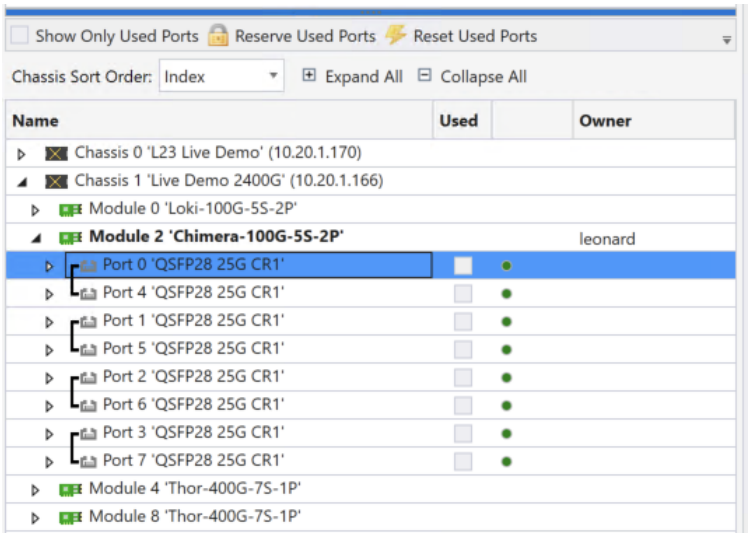

Figure 12: 8x25G test ports in the ValkyrieManger Testbed explorer window.

To make the eight 25 Gbps test ports physically available you can use 2 100 Gigabit/s QSFP28 to 4 x 25 Gigabit/s break-out cable as shown on .

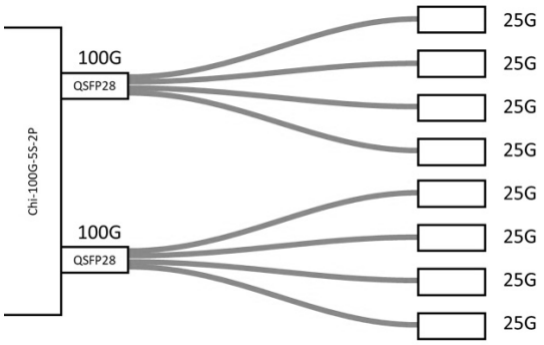

Figure 13: Break-ou1 from two 100G ports to eight 25G ports.

It is also possible to configure each the 40G transceivers in the Chi-100G-5S-2P test module act as 4 independent 10 Gbps ports. In this way the two 40G ports can be split into 8 physical 10G ports. To do that, the Media Configuration must be configured to 8 x 10G in the Module Properties.