Trigger Processor Hardware

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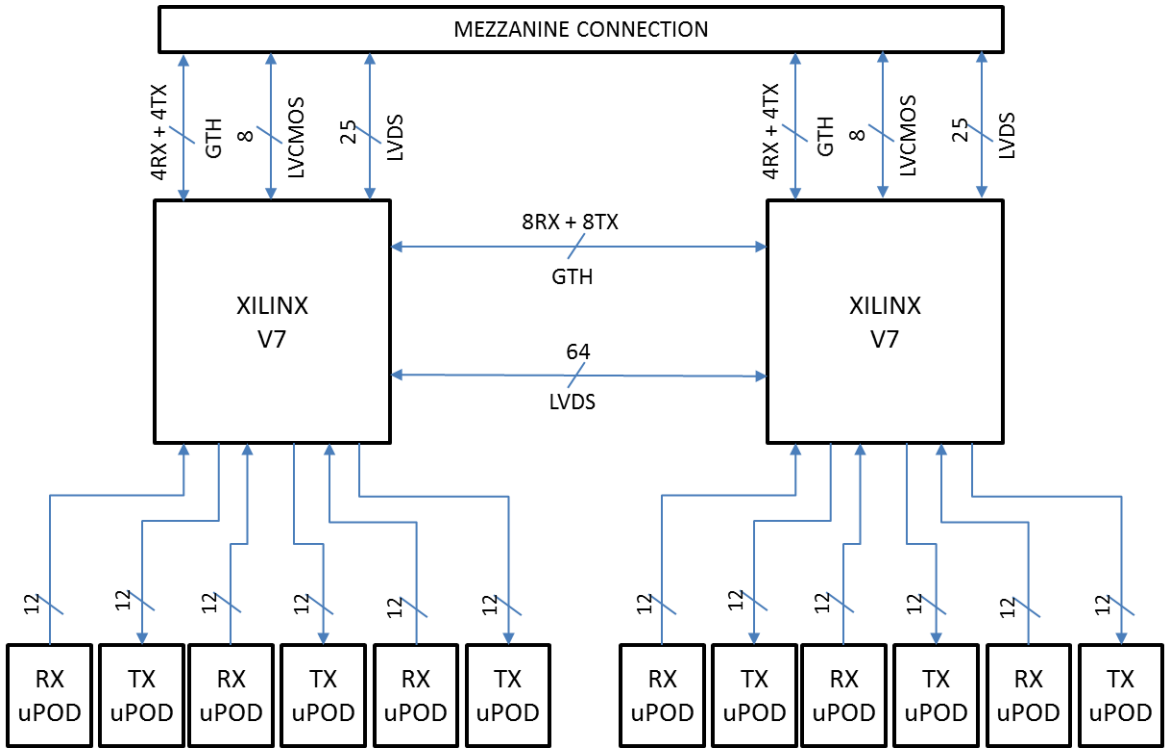
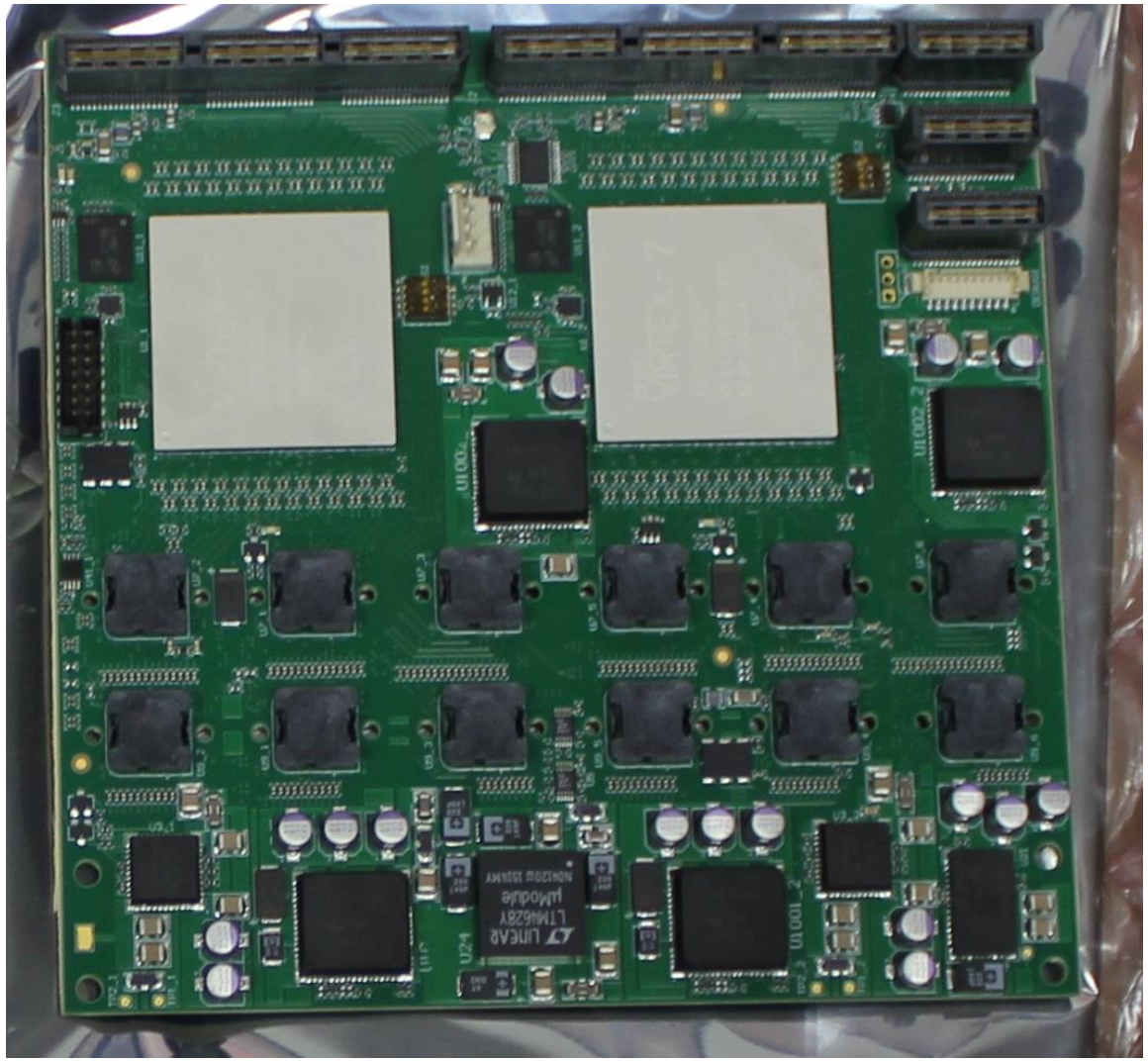
Overview

- Overview of the HORX Mezzanine Board
- Review of high-speed transmission tests with first prototype
- New high-speed transmission and latency tests
- New prototype production status
- Future tests and firmware development

High-Density Optical Receiver Mezzanine. Overview



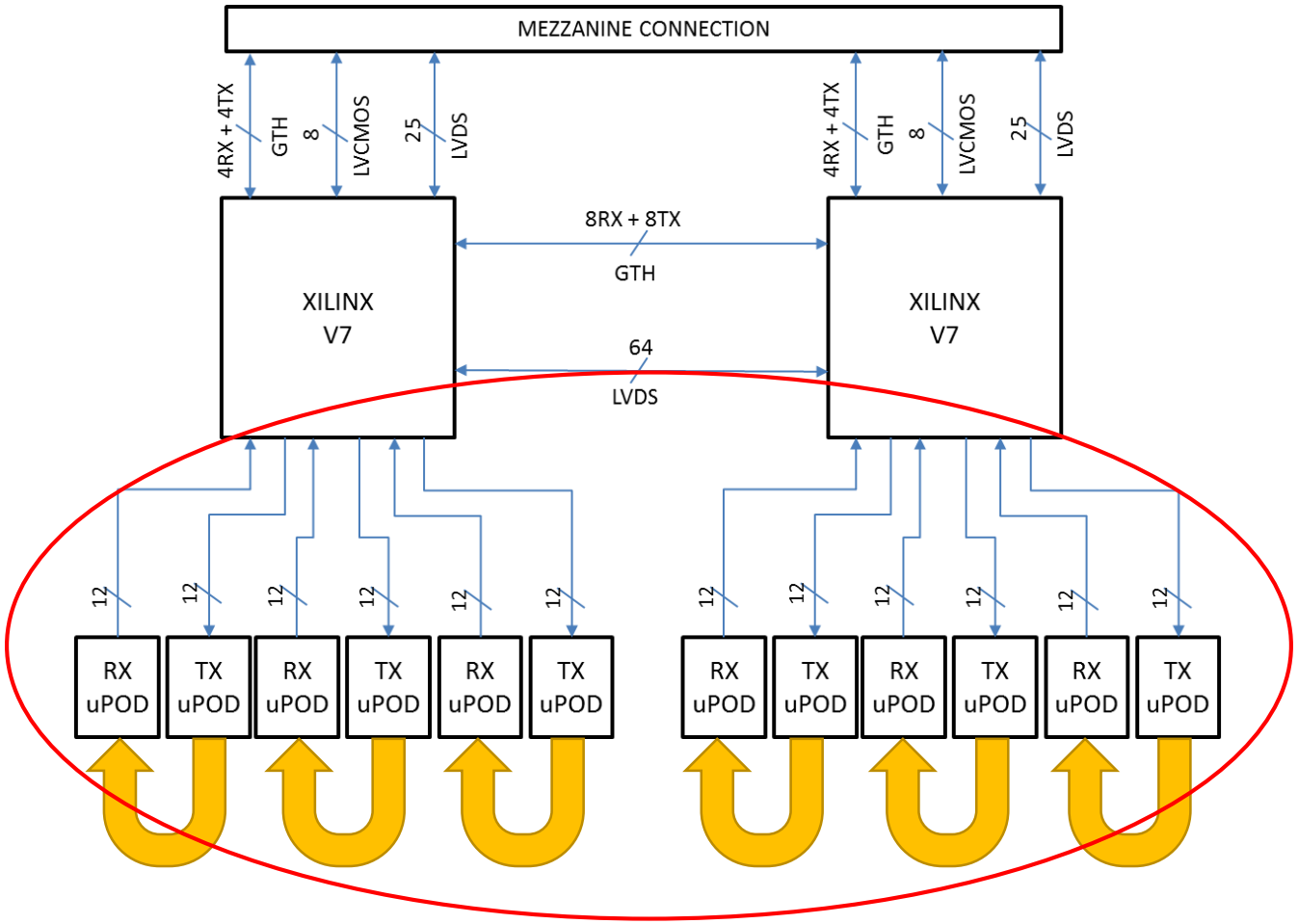
Links	High-Speed	Low Latency (LVDS)
Front-End	36 + 36 RX/TX GTH	-
Mezzanine	4 + 4 RX/TX GTH	25 + 25 LVDS
Inter-FPGA	8 RX/TX GTH	64 LVDS

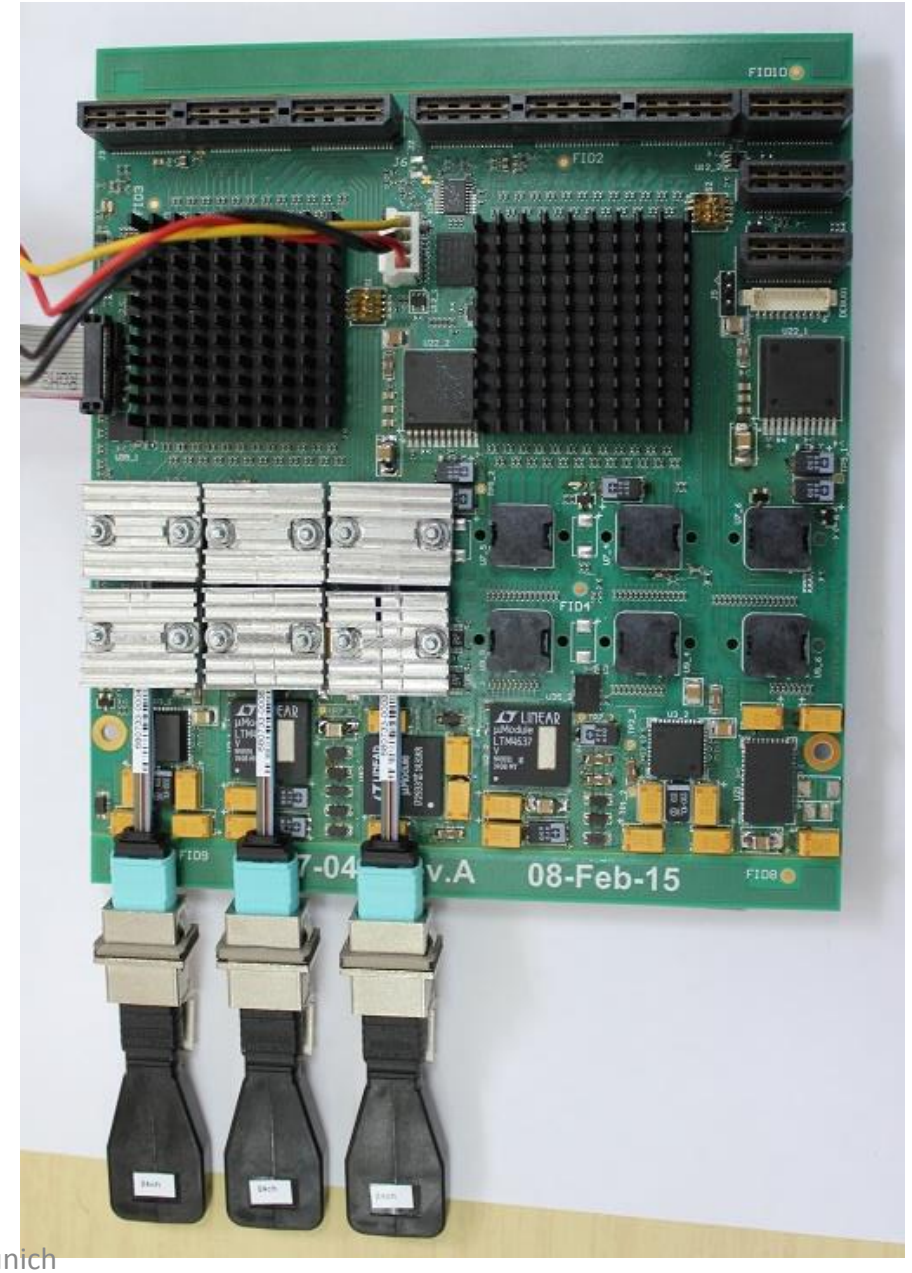


Review of High-Speed Transmission Tests

- Front-End Optical Transmission
  - Optical Loopback Tests @ 10/8.0/6.4/4.8 Gbps
  - Optical Cable Test (15m) @ 10Gbps
- On-board high-speed inter-FPGA link
- Off-board high-speed links over the mezzanine interface

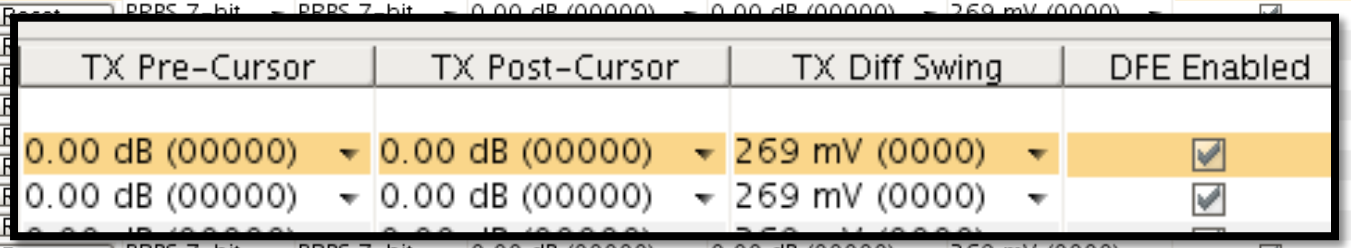
Optical Transmission Tests





Optical Transmission Tests @ 10/8.0/6.4/4.8 Gbps

TX	RX	Status	Bits	Errors	BER	BERT Reset	TX Pattern	RX Pattern	TX Pre-Cursor	TX Post-Cursor	TX Diff Swing	DFE Enabled
						Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y0/TX	MGT_X0Y0/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y1/TX	MGT_X0Y1/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y2/TX	MGT_X0Y2/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y3/TX	MGT_X0Y3/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y4/TX	MGT_X0Y4/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y5/TX	MGT_X0Y5/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y6/TX	MGT_X0Y6/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y7/TX	MGT_X0Y7/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y8/TX	MGT_X0Y8/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y9/TX	MGT_X0Y9/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y10/TX	MGT_X0Y10/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X0Y11/TX	MGT_X0Y11/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y0/TX	MGT_X1Y0/RX	10.000 Gbps	7.451E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y1/TX	MGT_X1Y1/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y2/TX	MGT_X1Y2/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y3/TX	MGT_X1Y3/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y4/TX	MGT_X1Y4/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y5/TX	MGT_X1Y5/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y6/TX	MGT_X1Y6/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y7/TX	MGT_X1Y7/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y8/TX	MGT_X1Y8/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y9/TX	MGT_X1Y9/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y10/TX	MGT_X1Y10/RX	10.000 Gbps	7.589E13	0E0	1.318E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y11/TX	MGT_X1Y11/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y12/TX	MGT_X1Y12/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y13/TX	MGT_X1Y13/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y14/TX	MGT_X1Y14/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y15/TX	MGT_X1Y15/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y16/TX	MGT_X1Y16/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y17/TX	MGT_X1Y17/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y18/TX	MGT_X1Y18/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y19/TX	MGT_X1Y19/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y20/TX	MGT_X1Y20/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y21/TX	MGT_X1Y21/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y22/TX	MGT_X1Y22/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
MGT_X1Y23/TX	MGT_X1Y23/RX	10.000 Gbps	7.452E13	0E0	1.342E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑



Optical Transmission Tests @ 10/8.0/6.4/4.8 Gbps

TX	RX	Status	Bits	Errors	BER
MGT_X0Y0/TX	MGT_X0Y0/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y1/TX	MGT_X0Y1/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y2/TX	MGT_X0Y2/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y3/TX	MGT_X0Y3/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y4/TX	MGT_X0Y4/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y5/TX	MGT_X0Y5/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y6/TX	MGT_X0Y6/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y7/TX	MGT_X0Y7/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y8/TX	MGT_X0Y8/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y9/TX	MGT_X0Y9/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y10/TX	MGT_X0Y10/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X0Y11/TX	MGT_X0Y11/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X1Y0/TX	MGT_X1Y0/RX	10.000 Gbps	7.451E13	0E0	1.342E-14
MGT_X1Y1/TX	MGT_X1Y1/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y2/TX	MGT_X1Y2/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y3/TX	MGT_X1Y3/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y4/TX	MGT_X1Y4/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y5/TX	MGT_X1Y5/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y6/TX	MGT_X1Y6/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y7/TX	MGT_X1Y7/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y8/TX	MGT_X1Y8/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y9/TX	MGT_X1Y9/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y10/TX	MGT_X1Y10/RX	10.000 Gbps	7.589E13	0E0	1.318E-14
MGT_X1Y11/TX	MGT_X1Y11/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y12/TX	MGT_X1Y12/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y13/TX	MGT_X1Y13/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y14/TX	MGT_X1Y14/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y15/TX	MGT_X1Y15/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y16/TX	MGT_X1Y16/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y17/TX	MGT_X1Y17/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y18/TX	MGT_X1Y18/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y19/TX	MGT_X1Y19/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y20/TX	MGT_X1Y20/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y21/TX	MGT_X1Y21/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y22/TX	MGT_X1Y22/RX	10.000 Gbps	7.452E13	0E0	1.342E-14
MGT_X1Y23/TX	MGT_X1Y23/RX	10.000 Gbps	7.452E13	0E0	1.342E-14

Status	Bits	Errors	BER
8.000 Gbps	1.749E13	0E0	5.716E-14
8.000 Gbps	1.749E13	0E0	5.716E-14
8.000 Gbps	1.75E13	0E0	5.716E-14
8.000 Gbps	1.75E13	0E0	5.715E-14
8.000 Gbps	1.75E13	0E0	5.715E-14
8.000 Gbps	1.75E13	0E0	5.715E-14
8.000 Gbps	1.75E13	0E0	5.714E-14
8.000 Gbps	1.75E13	0E0	5.714E-14
8.000 Gbps	1.75E13	0E0	5.714E-14
8.000 Gbps	1.75E13	0E0	5.714E-14
8.000 Gbps	1.75E13	0E0	5.713E-14
8.000 Gbps	1.75E13	0E0	5.713E-14
8.000 Gbps	1.746E13	0E0	5.728E-14
8.000 Gbps	1.746E13	0E0	5.727E-14
8.000 Gbps	1.746E13	0E0	5.727E-14
8.000 Gbps	1.746E13	0E0	5.727E-14
8.000 Gbps	1.746E13	0E0	5.727E-14
8.000 Gbps	1.746E13	0E0	5.726E-14
8.000 Gbps	1.746E13	0E0	5.726E-14
8.000 Gbps	1.747E13	0E0	5.726E-14
8.000 Gbps	1.747E13	0E0	5.725E-14
8.000 Gbps	1.747E13	0E0	5.725E-14
8.000 Gbps	1.747E13	0E0	5.725E-14
8.000 Gbps	1.747E13	0E0	5.724E-14
8.000 Gbps	1.747E13	0E0	5.724E-14
8.000 Gbps	1.747E13	0E0	5.724E-14
8.000 Gbps	1.747E13	0E0	5.723E-14
8.000 Gbps	1.747E13	0E0	5.723E-14
8.000 Gbps	1.747E13	0E0	5.723E-14
8.000 Gbps	1.748E13	0E0	5.722E-14
8.000 Gbps	1.748E13	0E0	5.722E-14
8.000 Gbps	1.748E13	0E0	5.721E-14
8.000 Gbps	1.748E13	0E0	5.721E-14
8.000 Gbps	1.748E13	0E0	5.721E-14
8.000 Gbps	1.748E13	0E0	5.72E-14
8.000 Gbps	1.748E13	0E0	5.72E-14

Status	Bits	Errors	BER
6.400 Gbps	1.768E13	0E0	5.657E-14
6.400 Gbps	1.768E13	0E0	5.657E-14
6.400 Gbps	1.762E13	0E0	5.675E-14
6.400 Gbps	1.762E13	0E0	5.675E-14
6.400 Gbps	1.762E13	0E0	5.674E-14
6.400 Gbps	1.762E13	0E0	5.674E-14
6.400 Gbps	1.763E13	0E0	5.673E-14
6.400 Gbps	1.763E13	0E0	5.673E-14
6.400 Gbps	1.763E13	0E0	5.673E-14
6.400 Gbps	1.763E13	0E0	5.672E-14
6.400 Gbps	1.763E13	0E0	5.672E-14
6.400 Gbps	1.763E13	0E0	5.671E-14
6.400 Gbps	1.763E13	0E0	5.671E-14
6.400 Gbps	1.764E13	0E0	5.67E-14
6.400 Gbps	1.764E13	0E0	5.67E-14
6.400 Gbps	1.764E13	0E0	5.669E-14
6.400 Gbps	1.764E13	0E0	5.669E-14
6.400 Gbps	1.764E13	0E0	5.668E-14
6.400 Gbps	1.764E13	0E0	5.668E-14
6.400 Gbps	1.764E13	0E0	5.668E-14
6.400 Gbps	1.765E13	0E0	5.667E-14
6.400 Gbps	1.765E13	0E0	5.667E-14
6.400 Gbps	1.765E13	0E0	5.666E-14
6.400 Gbps	1.765E13	0E0	5.666E-14
6.400 Gbps	1.765E13	0E0	5.665E-14
6.400 Gbps	1.765E13	0E0	5.665E-14
6.400 Gbps	1.765E13	0E0	5.664E-14
6.400 Gbps	1.788E13	0E0	5.594E-14
6.400 Gbps	1.788E13	0E0	5.593E-14
6.400 Gbps	1.788E13	0E0	5.593E-14
6.400 Gbps	1.766E13	0E0	5.662E-14
6.400 Gbps	1.766E13	0E0	5.662E-14
6.400 Gbps	1.766E13	0E0	5.662E-14
6.400 Gbps	1.766E13	0E0	5.661E-14
6.400 Gbps	1.767E13	0E0	5.661E-14
6.400 Gbps	1.767E13	0E0	5.66E-14

Status	Bits	Errors	BER
4.800 Gbps	5.492E13	0E0	1.821E-14
4.802 Gbps	5.492E13	0E0	1.821E-14
4.800 Gbps	5.492E13	0E0	1.821E-14
4.800 Gbps	5.492E13	0E0	1.821E-14
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4.800 Gbps	5.493E13	0E0	1.821E-14
4.800 Gbps	5.493E13	0E0	1.821E-14
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4.800 Gbps	5.493E13	0E0	1.82E-14
4.800 Gbps	5.493E13	0E0	1.82E-14
4.800 Gbps	5.493E13	0E0	1.82E-14
4.800 Gbps	5.493E13	0E0	1.82E-14
4.800 Gbps	5.494E13	0E0	1.82E-14
4.800 Gbps	5.494E13	0E0	1.82E-14
4.800 Gbps	5.494E13	0E0	1.82E-14
4.800 Gbps	5.488E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.489E13	0E0	1.822E-14
4.800 Gbps	5.49E13	0E0	1.822E-14
4.800 Gbps	5.49E13	0E0	1.822E-14
4.800 Gbps	5.49E13	0E0	1.822E-14
4.800 Gbps	5.49E13	0E0	1.822E-14
4.800 Gbps	5.49E13	0E0	1.821E-14
4.800 Gbps	5.49E13	0E0	1.821E-14
4.800 Gbps	5.49E13	0E0	1.821E-14
4.800 Gbps	5.49E13	0E0	1.821E-14
4.800 Gbps	5.491E13	0E0	1.821E-14
4.800 Gbps	5.491E13	0E0	1.821E-14
4.800 Gbps	5.491E13	0E0	1.821E-14
4.800 Gbps	5.491E13	0E0	1.821E-14

Optical Transmission Test with 15m Cable (10Gbps)

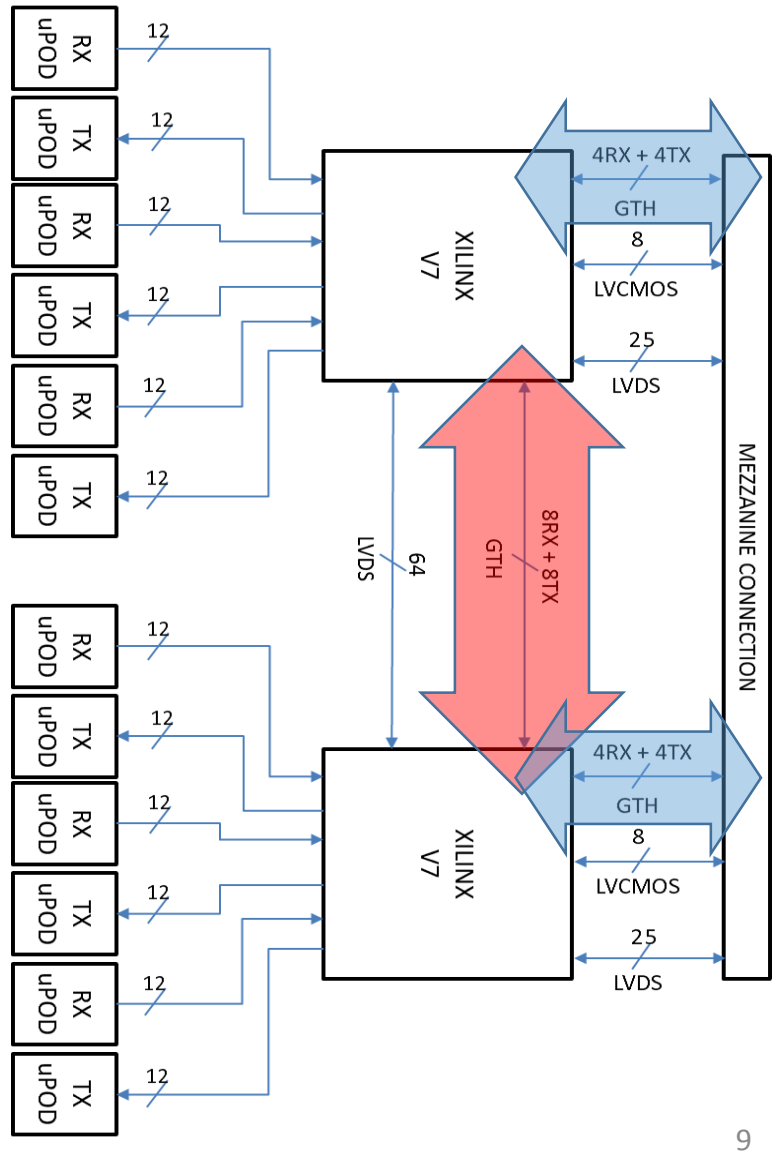
Name	TX	RX	Status	Bits	Errors	BER	BERT Reset	TX Pattern	RX Pattern	TX Pre-Cursor	TX Post-Cursor	TX Diff Swing	DFE En...
Ungrouped Links (0)													
Link Group 4 (12)							Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 2	MGT_X0Y2/TX	MGT_X1Y2/RX	10.000 Gbps	2.705E13	0E0	3.697E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 3	MGT_X0Y3/TX	MGT_X1Y3/RX	10.000 Gbps	2.705E13	0E0	3.697E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 4	MGT_X0Y4/TX	MGT_X1Y4/RX	10.000 Gbps	2.705E13	0E0	3.696E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 5	MGT_X0Y5/TX	MGT_X1Y5/RX	10.000 Gbps	2.706E13	0E0	3.696E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 6	MGT_X0Y6/TX	MGT_X1Y6/RX	10.000 Gbps	2.706E13	0E0	3.695E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 7	MGT_X0Y7/TX	MGT_X1Y7/RX	10.000 Gbps	2.706E13	0E0	3.695E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 8	MGT_X0Y8/TX	MGT_X1Y8/RX	10.000 Gbps	2.707E13	0E0	3.694E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 9	MGT_X0Y9/TX	MGT_X1Y9/RX	10.000 Gbps	2.707E13	0E0	3.694E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 10	MGT_X0Y10/TX	MGT_X1Y10/RX	10.000 Gbps	2.707E13	0E0	3.693E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 11	MGT_X0Y11/TX	MGT_X1Y11/RX	10.000 Gbps	2.708E13	0E0	3.693E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 0	MGT_X0Y0/TX	MGT_X1Y0/RX	10.000 Gbps	2.708E13	0E0	3.693E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 1	MGT_X0Y1/TX	MGT_X1Y1/RX	10.000 Gbps	2.708E13	0E0	3.692E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link Group 5 (12)							Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 15	MGT_X1Y0/TX	MGT_X0Y0/RX	10.000 Gbps	2.702E13	0E0	3.701E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 16	MGT_X1Y1/TX	MGT_X0Y1/RX	10.000 Gbps	2.702E13	0E0	3.7E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 17	MGT_X1Y2/TX	MGT_X0Y2/RX	10.000 Gbps	2.703E13	0E0	3.7E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 18	MGT_X1Y3/TX	MGT_X0Y3/RX	10.000 Gbps	2.703E13	0E0	3.699E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 19	MGT_X1Y4/TX	MGT_X0Y4/RX	10.000 Gbps	2.703E13	0E0	3.699E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 20	MGT_X1Y5/TX	MGT_X0Y5/RX	10.000 Gbps	2.704E13	0E0	3.699E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 21	MGT_X1Y6/TX	MGT_X0Y6/RX	10.000 Gbps	2.704E13	0E0	3.698E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 22	MGT_X1Y7/TX	MGT_X0Y7/RX	10.000 Gbps	2.704E13	0E0	3.698E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 23	MGT_X1Y8/TX	MGT_X0Y8/RX	10.000 Gbps	2.705E13	0E0	3.697E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 24	MGT_X1Y9/TX	MGT_X0Y9/RX	10.000 Gbps	2.706E13	0E0	3.696E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 25	MGT_X1Y10/TX	MGT_X0Y10/RX	10.000 Gbps	2.706E13	0E0	3.696E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 26	MGT_X1Y11/TX	MGT_X0Y11/RX	10.000 Gbps	2.706E13	0E0	3.695E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link Group 6 (12)							Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 27	MGT_X1Y12/TX	MGT_X1Y12/RX	10.000 Gbps	2.705E13	0E0	3.697E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 28	MGT_X1Y13/TX	MGT_X1Y13/RX	10.000 Gbps	2.705E13	0E0	3.696E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 29	MGT_X1Y14/TX	MGT_X1Y14/RX	10.000 Gbps	2.692E13	0E0	3.715E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 30	MGT_X1Y15/TX	MGT_X1Y15/RX	10.000 Gbps	2.692E13	0E0	3.714E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 31	MGT_X1Y16/TX	MGT_X1Y16/RX	10.000 Gbps	2.693E13	0E0	3.714E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 32	MGT_X1Y17/TX	MGT_X1Y17/RX	10.000 Gbps	2.693E13	0E0	3.713E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 33	MGT_X1Y18/TX	MGT_X1Y18/RX	10.000 Gbps	2.693E13	0E0	3.713E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 34	MGT_X1Y19/TX	MGT_X1Y19/RX	10.000 Gbps	2.694E13	0E0	3.712E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 35	MGT_X1Y20/TX	MGT_X1Y20/RX	10.000 Gbps	2.694E13	0E0	3.712E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 36	MGT_X1Y21/TX	MGT_X1Y21/RX	10.000 Gbps	2.694E13	0E0	3.711E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 37	MGT_X1Y22/TX	MGT_X1Y22/RX	10.000 Gbps	2.695E13	0E0	3.711E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑
Link 38	MGT_X1Y23/TX	MGT_X1Y23/RX	10.000 Gbps	2.695E13	0E0	3.71E-14	Reset	PRBS 7-bit	PRBS 7-bit	0.00 dB (00000)	0.00 dB (00000)	269 mV (0000)	☑

Mezzanine Link @5Gbps / Inter-FPGA Link @10Gbps Test

Mezzanine Links

Inter-FPGA Links

Name	TX	RX	Status	Bits	Errors	BER
Ungrouped Links (0)						
MEZZ 415 (4)						
Link 0	MGT_X0Y12/TX	MGT_X0Y12/RX	5.000 Gbps	1.224E13	0E0	8.171E-14
Link 1	MGT_X0Y13/TX	MGT_X0Y13/RX	5.000 Gbps	1.224E13	0E0	8.171E-14
Link 2	MGT_X0Y14/TX	MGT_X0Y14/RX	5.000 Gbps	1.224E13	0E0	8.17E-14
Link 3	MGT_X0Y15/TX	MGT_X0Y15/RX	5.000 Gbps	1.224E13	0E0	8.169E-14
MEZZ 485 (4)						
Link 4	MGT_X0Y16/TX	MGT_X0Y16/RX	5.000 Gbps	1.223E13	0E0	8.176E-14
Link 5	MGT_X0Y17/TX	MGT_X0Y17/RX	5.000 Gbps	1.223E13	0E0	8.176E-14
Link 6	MGT_X0Y18/TX	MGT_X0Y18/RX	5.000 Gbps	1.223E13	0E0	8.175E-14
Link 7	MGT_X0Y19/TX	MGT_X0Y19/RX	5.000 Gbps	1.223E13	0E0	8.174E-14
FPGA Links 415->485 (8)						
Link 8	MGT_X0Y16/TX	MGT_X0Y20/RX	10.000 Gbps	1.148E13	0E0	8.711E-14
Link 9	MGT_X0Y17/TX	MGT_X0Y21/RX	10.000 Gbps	1.148E13	0E0	8.709E-14
Link 10	MGT_X0Y18/TX	MGT_X0Y22/RX	10.000 Gbps	1.148E13	0E0	8.708E-14
Link 11	MGT_X0Y19/TX	MGT_X0Y23/RX	10.000 Gbps	1.149E13	0E0	8.707E-14
Link 12	MGT_X0Y20/TX	MGT_X0Y24/RX	10.000 Gbps	1.149E13	0E0	8.705E-14
Link 13	MGT_X0Y21/TX	MGT_X0Y25/RX	10.000 Gbps	1.149E13	0E0	8.704E-14
Link 14	MGT_X0Y22/TX	MGT_X0Y26/RX	10.000 Gbps	1.149E13	0E0	8.703E-14
Link 15	MGT_X0Y23/TX	MGT_X0Y27/RX	10.000 Gbps	1.149E13	0E0	8.701E-14
FPGA Links 485->415 (8)						
Link 16	MGT_X0Y20/TX	MGT_X0Y16/RX	10.000 Gbps	1.169E13	0E0	8.558E-14
Link 17	MGT_X0Y21/TX	MGT_X0Y17/RX	10.000 Gbps	1.169E13	0E0	8.557E-14
Link 18	MGT_X0Y22/TX	MGT_X0Y18/RX	10.000 Gbps	1.169E13	0E0	8.556E-14
Link 19	MGT_X0Y23/TX	MGT_X0Y19/RX	10.000 Gbps	1.169E13	0E0	8.554E-14
Link 20	MGT_X0Y24/TX	MGT_X0Y20/RX	10.000 Gbps	1.169E13	0E0	8.553E-14
Link 21	MGT_X0Y25/TX	MGT_X0Y21/RX	10.000 Gbps	1.169E13	0E0	8.552E-14
Link 22	MGT_X0Y26/TX	MGT_X0Y22/RX	10.000 Gbps	1.169E13	0E0	8.551E-14
Link 23	MGT_X0Y27/TX	MGT_X0Y23/RX	10.000 Gbps	1.17E13	0E0	8.55E-14

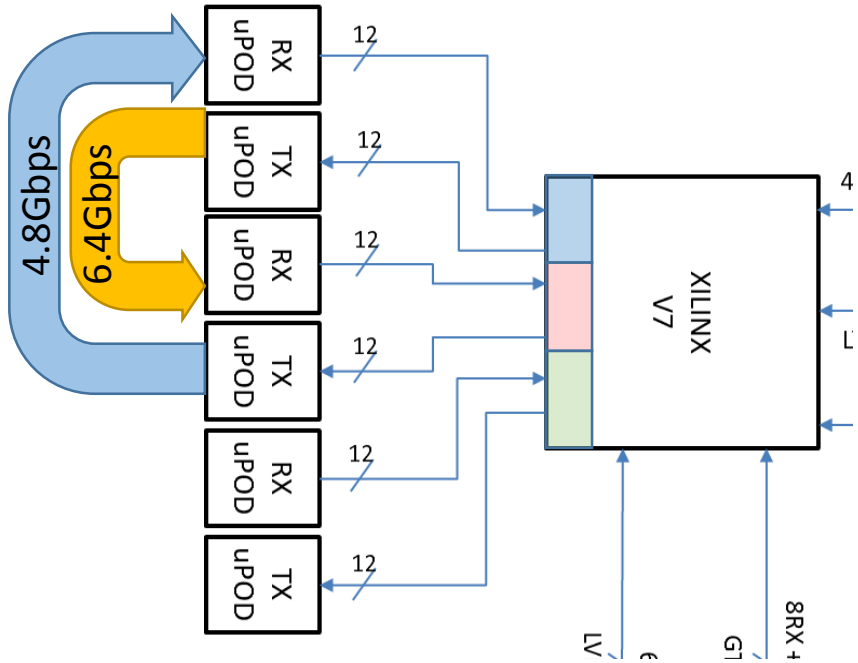


New functional tests

- Asymmetric front-end optical link
- Low-latency inter-FPGA LVDS links
- IPMI verification

Asymmetric Link

- Different RX / TX speed of each GTH Quad
- Use case:
  - 4.8Gbps RX from detector (GBT)
  - 6.5Gbps TX to Sector Logic



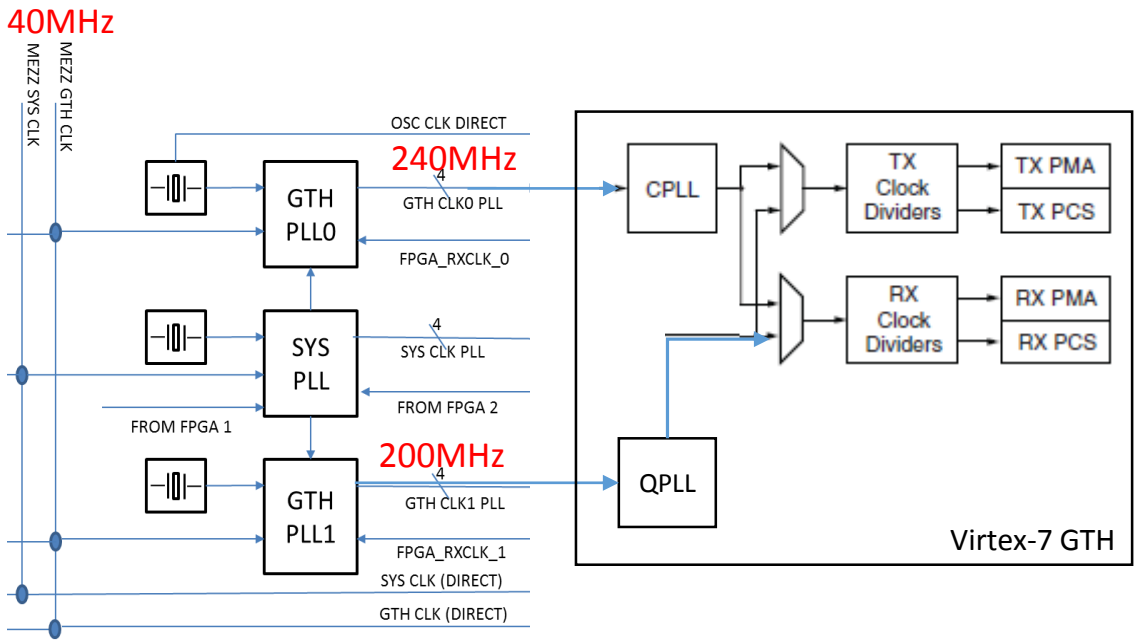
- Vivado IBERT provide access to all GTH configuration registers
- Test can be expanded/automated via tcl scripting

Name	TX	RX	Status	Bits	Errors	BER	RX PLL Status	TX PLL Status	RXUSERCL...	TXUSERCL...
Ungrouped Lin...										
Link Group 0 (4)										
Link 0	MGT_X0Y20/TX	MGT_X1Y20/RX	4.800 Gbps	9.807E12	0E0	1.02E-13	Locked	Locked	150.049	150.024
Link 1	MGT_X0Y21/TX	MGT_X1Y21/RX	4.800 Gbps	9.807E12	0E0	1.02E-13	Locked	Locked	150.049	150.049
Link 2	MGT_X0Y22/TX	MGT_X1Y22/RX	4.800 Gbps	9.807E12	0E0	1.02E-13	Locked	Locked	150.049	150.024
Link 3	MGT_X0Y23/TX	MGT_X1Y23/RX	4.800 Gbps	9.808E12	0E0	1.02E-13	Locked	Locked	150.049	150.024
Link Group 1 (4)										
Link 4	MGT_X1Y20/TX	MGT_X0Y20/RX	6.400 Gbps	1.305E13	0E0	7.661E-14	Locked	Locked	200.049	200.049
Link 5	MGT_X1Y21/TX	MGT_X0Y21/RX	6.400 Gbps	1.306E13	0E0	7.659E-14	Locked	Locked	200.049	200.049
Link 6	MGT_X1Y22/TX	MGT_X0Y22/RX	6.400 Gbps	1.306E13	0E0	7.659E-14	Locked	Locked	200.049	200.049
Link 7	MGT_X1Y23/TX	MGT_X0Y23/RX	6.400 Gbps	1.306E13	0E0	7.659E-14	Locked	Locked	200.049	200.049

QUAD_215 QUAD_115

Asymmetric Link

- Different RX / TX speed of each GTH Quad
- The Mezzanine card has two separate PLLs for the GTH reference clock, which can supply different frequencies
- RX and TX channels use either QPLL (for 4.8G) or CPLL (for 6.4G)



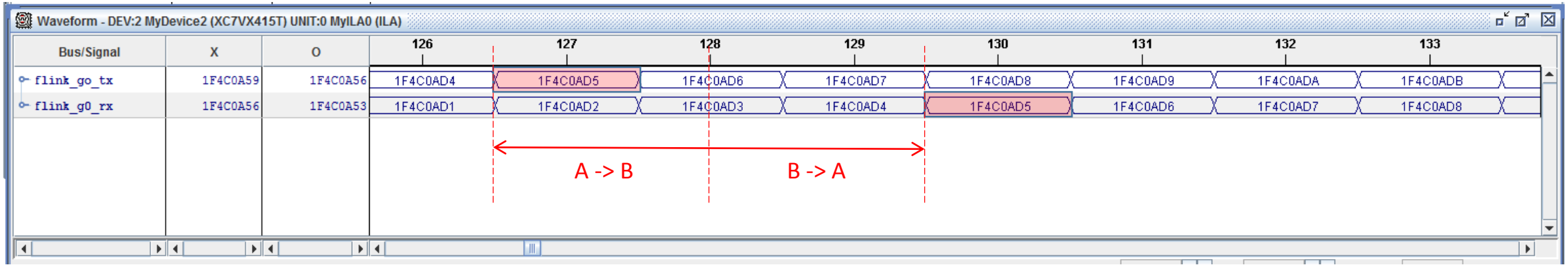
MGT_X0Y20

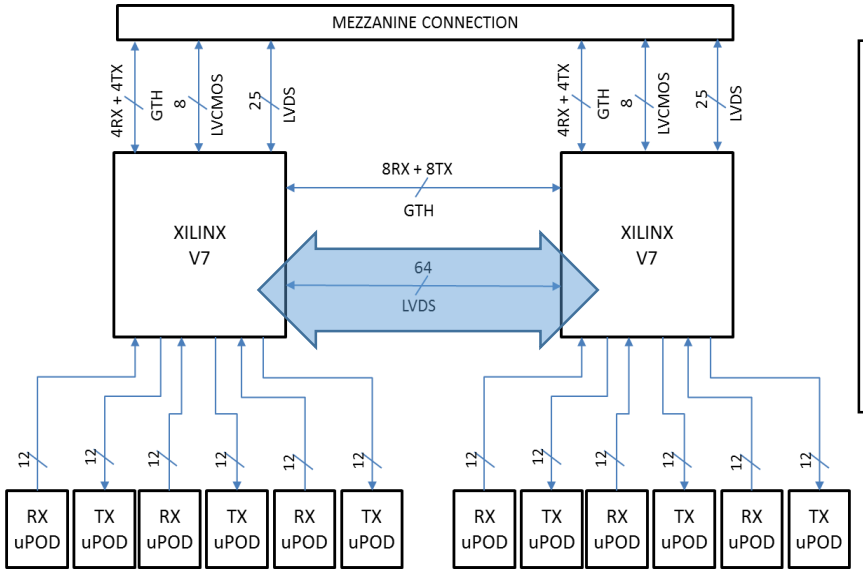
CLASS	hw_sio_gt
CPLLREFCLKSEL	GTREFCLK0
CPLL_FBDIV	4
CPLL_FBDIV_45	4
CPLL_REFCLK_DIV	1
DISPLAY_NAME	MGT_X0Y20
DRP	
ES_HORZ_MIN_MAX	32
GT_TYPE	7 Series GTH
LINE_RATE	6.400
LOGIC	
LOOPBACK	None
NAME	localhost/xilinx_tcf/Xilir
PARENT	localhost/xilinx_tcf/Xilir
PLL_STATUS	LOCKED
PORT	
RXDFEENABLED	1
RXOUTCLKSEL	RXOUTCLKPMA
RXOUT_DIV	1
RXPLL	CPLL
RXRATE	Use DRP.RX_OUT_DIV
RXTERM	800 mV
RXTERMMODE	Programmable
RXUSRCLK2_FREQ	200.048828
RXUSRCLK_FREQ	200.048828
RX_BER	8.5586579944461316e
RX_DATA_WIDTH	32
RX_INTERNAL_DATAPATH	4-byte
RX_PATTERN	PRBS 7-bit
RX_RECEIVED_BIT_COUNT	11684074777248
STATUS	6.400 Gbps
SYSCLK_FREQ	100.000000
TXDIFFSWING	269 mV (0000)
TXOUTCLKSEL	TXOUTCLKPMA
TXOUT_DIV	2
TXPLL	QPLL

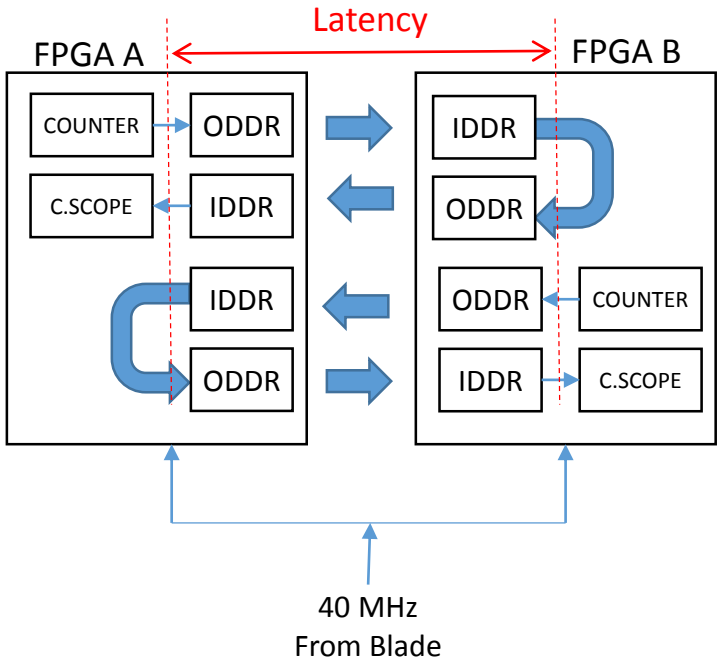
MGT_X1Y20

CLASS	hw_sio_gt
CPLLREFCLKSEL	GTREFCLK0
CPLL_FBDIV	4
CPLL_FBDIV_45	4
CPLL_REFCLK_DIV	1
DISPLAY_NAME	MGT_X1Y20
DRP	
ES_HORZ_MIN_MAX	64
GT_TYPE	7 Series GTH
LINE_RATE	4.800
LOGIC	
LOOPBACK	None
NAME	localhost/xilinx_tcf/Xilinx/0000
PARENT	localhost/xilinx_tcf/Xilinx/0000
PLL_STATUS	LOCKED
PORT	
RXDFEENABLED	1
RXOUTCLKSEL	RXOUTCLKPMA
RXOUT_DIV	2
RXPLL	QPLL
RXRATE	Use DRP.RX_OUT_DIV
RXTERM	800 mV
RXTERMMODE	Programmable
RXUSRCLK2_FREQ	150.024414
RXUSRCLK_FREQ	150.024414
RX_BER	1.1034189888503706e-13
RX_DATA_WIDTH	32
RX_INTERNAL_DATAPATH	4-byte
RX_PATTERN	PRBS 7-bit
RX_RECEIVED_BIT_COUNT	9062740537408
STATUS	4.800 Gbps
SYSCLK_FREQ	100.000000
TXDIFFSWING	269 mV (0000)
TXOUTCLKSEL	TXOUTCLKPMA
TXOUT_DIV	1
TXPLL	CPLL

Inter-FPGA Low Latency Transfer







- 320 MHz DDR transfer (640Mbps)
- Equivalent 38.4Gbps (60 LVDS*)

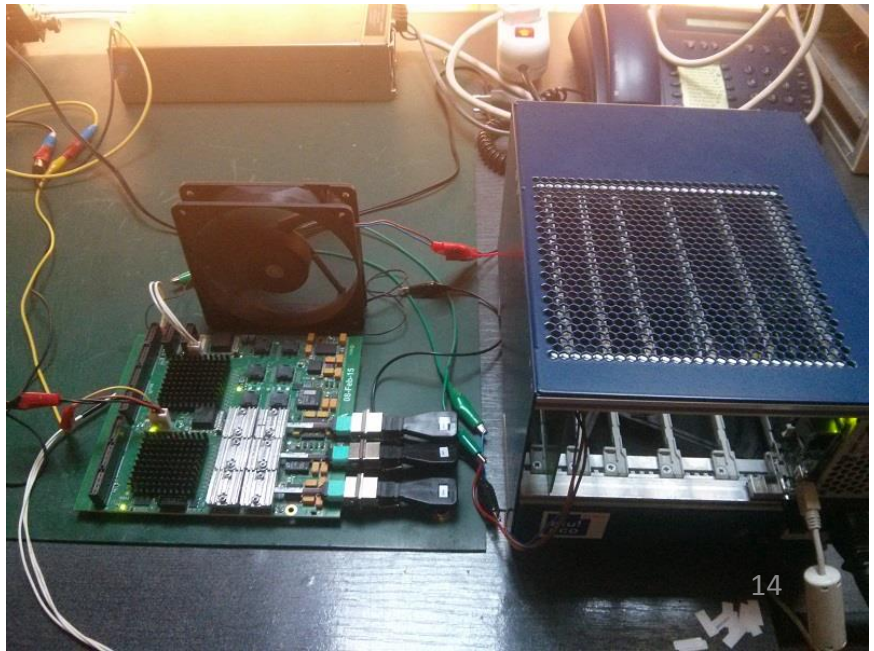
- Round-trip latency: 3 clocks (9.375ns)
- Fabric-to-Fabric latency: 1.5 clocks (4.7 ns)

* 4 out of the 64 LVDS links are placed in a distant bank wrt the others and were not used in this test

IPMI Management

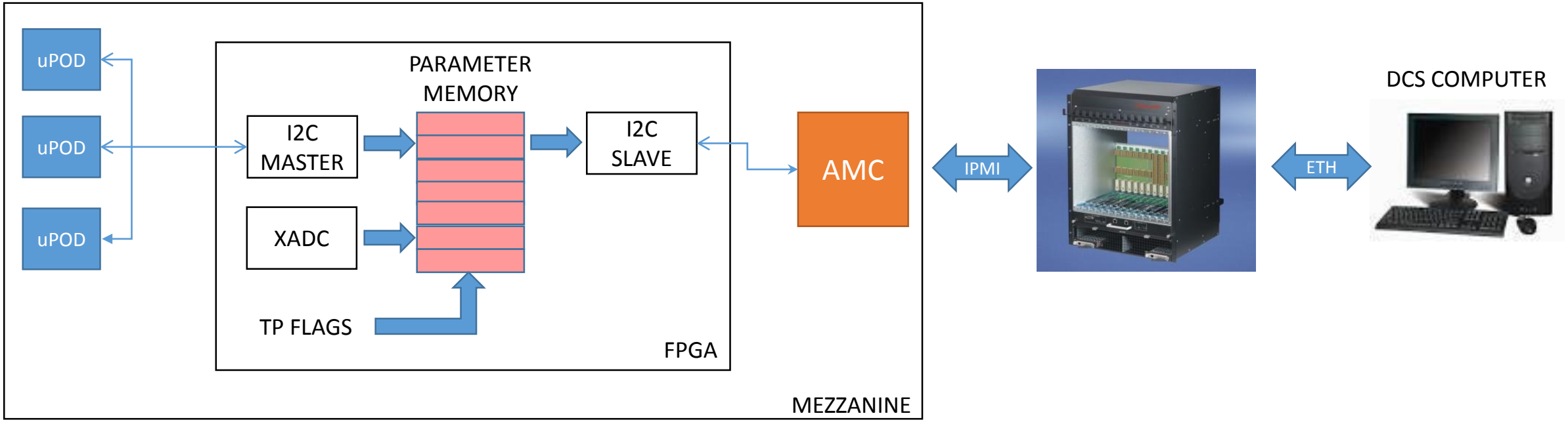
```
%>fru
---------------- FRU Summary -------------------------
 IPMB    FRU
Address ID    Device    Status     Name
-------------------------------------------------------
 0x10    0x00  MCMC1     M4 - 0     MCMC
 0xA8    0x00  CU1       M4 - 0     Cooling  Unit
 0x72    0x00  AMC1      M4 - 0     AMC Mezanine
 0xC2    0x00  PM1       M4 - 0     PDM

%>sensor amc 1
----------------Sensor List-----------------------------------------
*legend:
 Disc -> discrete
 Thr  -> threshold
 l    -> lower
 u    -> upper
 c    -> critical
 nc   -> non-critical
 nr   -> non-recoverable

-no--Device-----LocalNo--Type---Value--Unit--------State------Name------------
*14  AMC 1         1     Disc   Handle Closed                 Hot Swap Handle
*15  AMC 1         4     Thr    1.07   V           Ok         1.0V_MGT1
*16  AMC 1         5     Thr    1.06   V           Ok         1.0V_MGT2
*17  AMC 1         6     Thr    1.80   V           Ok         1.8V_1
*18  AMC 1         7     Thr    1.81   V           Ok         1.8V_2
*19  AMC 1         9     Thr    11.96  V           Ok         12V_IN
*20  AMC 1         32    Disc                      0x02
*21  AMC 1         33    Disc                      0x02
*22  AMC 1         34    Disc                      0x02
*23  AMC 1         35    Disc                      0x02
*24  AMC 1         36    Disc                      0x02
```

```
%>fruinfo amc 1

INTERNAL USE AREA
 Internal Use Area missing

PRODUCT INFO AREA
 Manufacturer Name: Samway Electronic
 Product Name:      HORX Mezanine
 Model Number:      B07-041
 Product Version:   Rev. A
 Product Serial Number: 00001

MULTIRECORD AREA

 Module Current Requirement
     Amp=7.0
```



Further developments

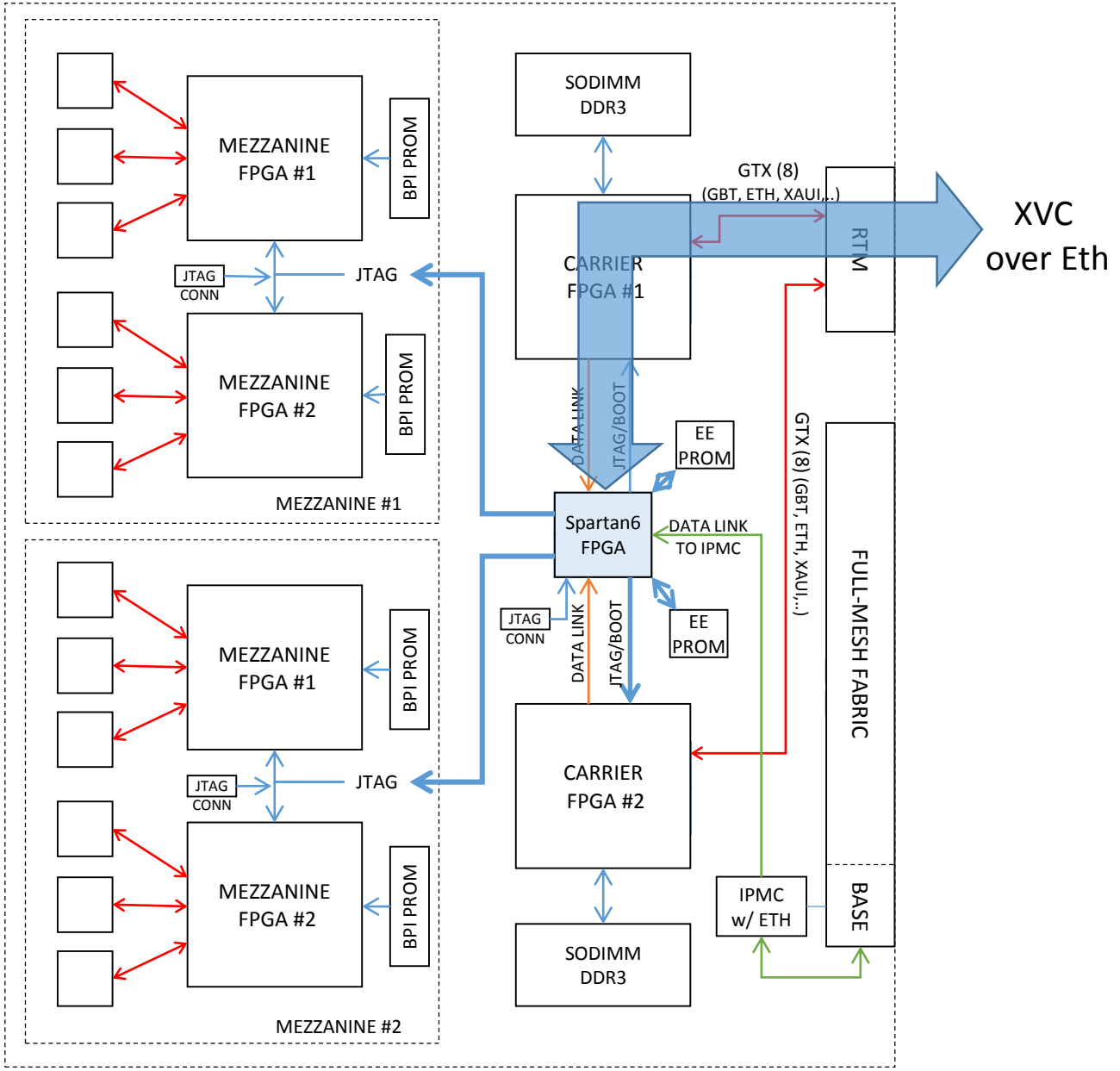
- AMC uC is has an user I2C port connected to the two FPGAs. This provides IPMI access to FPGA internal parameter table.
  - FPGA parameters (temperature, internal voltage)
  - Optical link status registers from uPOD (RX power, link-loss, tx-fault, temperature,..)



- Can be used to monitor Application Flags (Trigger Processor status, error flags, etc.)

Remote FPGA Programming

- Xilinx Virtual Cable (XVC) protocol enables remote programming/debug via Ethernet (TCP/IP)
- XVC server can be implemented in one of the two Carrier FPGAs (or both, for redundancy)
- Spartan FPGA on Carrier provide separate access to all JTAG ports in the system.
- Two options are investigated:
  - Microblaze system with LwIP
  - Open-source TCP/IP implementation using C2Verilog (Chips) from *opencores.org*



New Mezzanine Production

- Four more mezzanines were produced (received end of last week) for Bucharest, Harvard, Illinois and Weizmann groups
  - Integrate Xilinx XC7VX690T
  - New power regulators for increased max. power consumption of 690T
  - Few minor bug fixies

- 3 of 4 ATCA Blades ordered have arrived at CERN. One delayed a few weeks

Summary

- All transmission high-speed links were verified up to top speed (10Gpbs)
- Proof-of-concept of the asymmetric GTH quad operation
- Low-latency LVDS link measured
- IPMI verified

- New boards will be assembled with optic modules and connectors, then they will be tested and configured
- We will provide some firmware bits so the groups can start integrate into their own projects.
- All IBERT projects will be provided as reference
- Some of the fw developments may be delayed until the ASIC submissions are done