γ beam test for new optical transceiver and CDCFE

2023/1/12

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Motivation

-CDCFE and optical transceiver will be upgraded around LS2
  -bandwidth will increase from 2.5Gbps to 10Gbps per lane

-beam test is scheduled in February and March to check Radiation durability
  -gamma beam: optical transceiver, Feb.20-24th
  -neutron beam: entire CDCFE and transceiver, March 6-17th
  -lead by Yu Nakazawa-san from CDC group

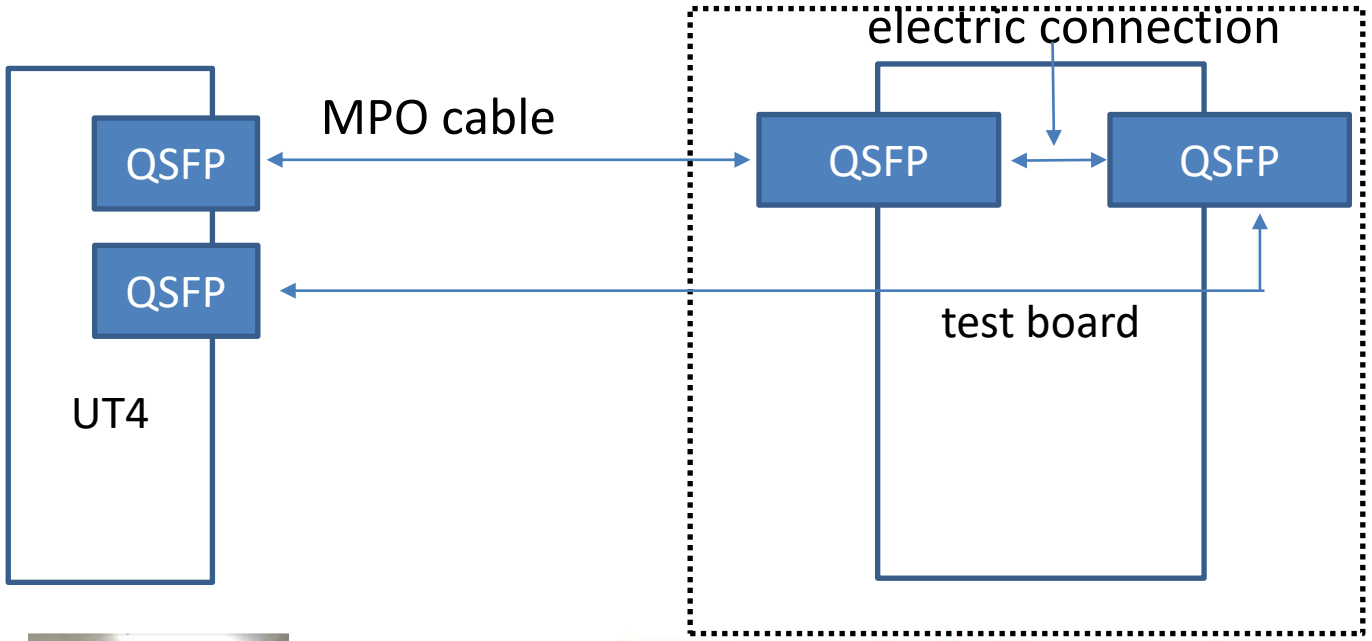
-I prepared firmware with UT4 for gamma beam test

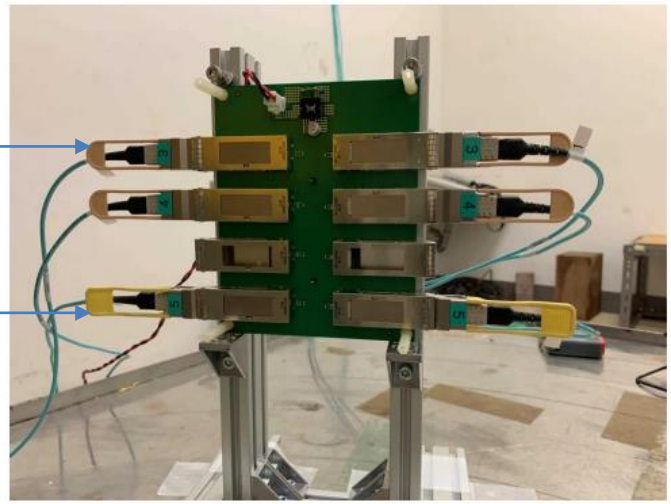
Setup

-γ (Co60,100Gy/hour) is injected to the QSFP with test board

-Loopback with UT4 to monitor optical link status

γ radiation area





Co60 source

Test plan

-Four kind of 40Gbps QSFP transceiver will be tested
(selected from 8 candidates from the beam test at the last year)

company	type	#test sample
FiberJP	QSFP-40G-85-015	8
FiberJP	QSFP-40GSR4-8515	8
Startech.com	40G-QSFP-SR4-ST	3
fs.com	QSFP-SR4-40G	8

-~1000Gy total does for each transceiver

-power cycle at every ~200Gy

-log optical link status every 1 minute

Firmware to monitor optical link

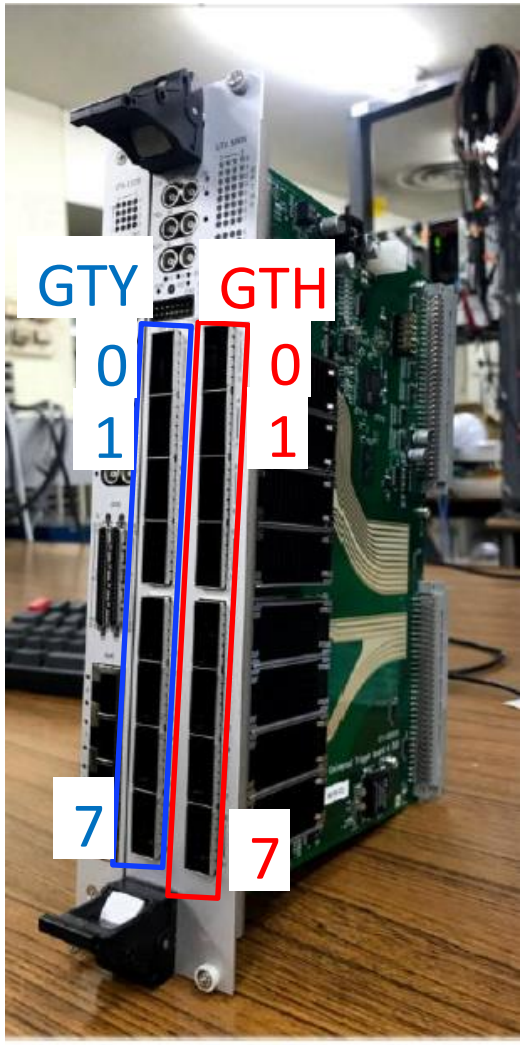
-Firmware is prepared (svn: UT4/FPGA/TSF/unified/test_opt_gamma)

-10Gbps with 8b10b or 8Gbps with 64b66b (selectable)

-8RX and 8TX

loopback

GTH Channel	TX/RX	GTY Channel	TX/RX
0	RX0	0	RX4
1	RX1	1	RX5
2	RX2	2	RX6
3	RX3	3	RX7
4	TX0	4	TX4
5	TX1	5	TX5
6	TX2	6	TX6
7	TX3	7	TX7



Monitoring

-Following variables are monitored by UT4 with VME

#variable	variable
0	tx laneup
1	tx fifo full
2	tx rxvalid
3	tx rxctrl1
4	tx rxctrl3
5	tx txbufstatus
6	tx rxbufstatus

#variable	variable	
7	rx laneup	laneup
8	rx fifo full	FIFO full flag (outside GT IP)
9	rx fifo empty	FIFO empty flag (outside GT IP)
10	rx rxvalid	8b10b/64b66b decode failure
11	rx rxctrl1	8b10b bit flip
12	rx rxctrl3	8b10b decode failure
13	rx txbufstatus	tx buffer state (inside GT IP)
14	rx rxbufstatus	rx buffer state (inside GT IP)
15	clock counter check	check of data contents, clock counter
16	constant data check	check of data contents, fixed pattern

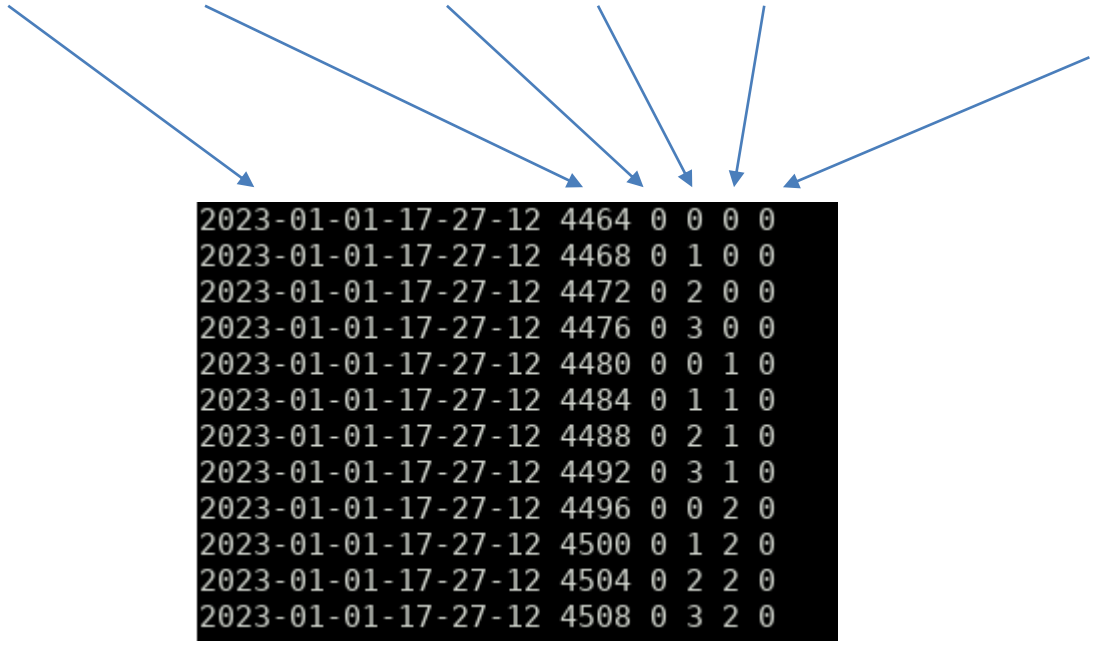
rxctrl1,3 for 8b10b

laneup=rxvalid & txdone & rxdone & txactive & rxactive & rxctrl1 & rxctrl3 &
rx_cdr_stable & user_initdone

Monitoring

-command for logging
  -ssh trgadmin@btrgpc00
  -ssh vmetrg12
  -./test.sh

-dump the counter of variables to test.txt every 1minutes
  -If variables goes to fail state, corresponding counter is incremented
  -data format: date, vme address, #variable, #lane, #TX/RX, counter of variable (falling edge)

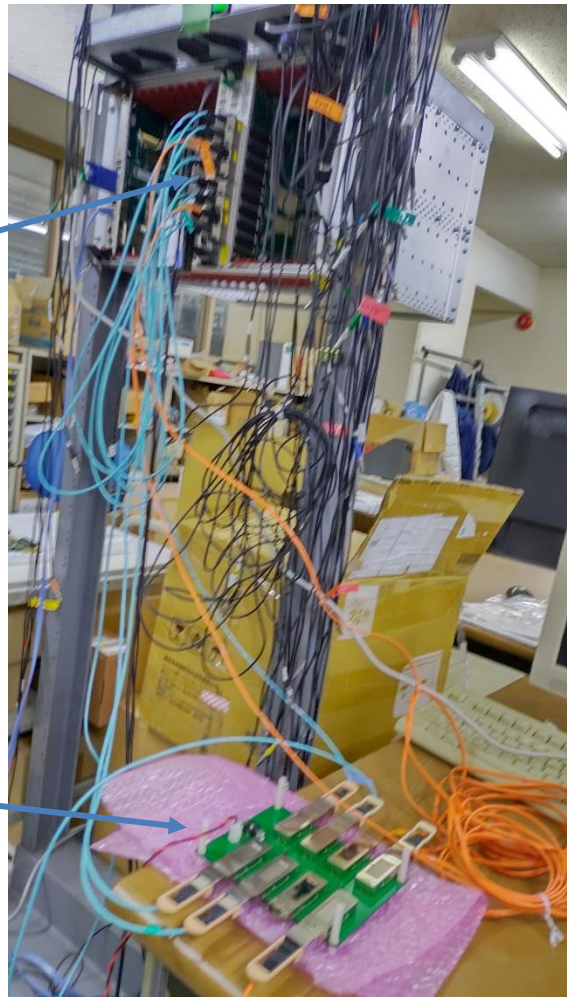


```
2023-01-01-17-27-12 4464 0 0 0 0
2023-01-01-17-27-12 4468 0 1 0 0
2023-01-01-17-27-12 4472 0 2 0 0
2023-01-01-17-27-12 4476 0 3 0 0
2023-01-01-17-27-12 4480 0 0 1 0
2023-01-01-17-27-12 4484 0 1 1 0
2023-01-01-17-27-12 4488 0 2 1 0
2023-01-01-17-27-12 4492 0 3 1 0
2023-01-01-17-27-12 4496 0 0 2 0
2023-01-01-17-27-12 4500 0 1 2 0
2023-01-01-17-27-12 4504 0 2 2 0
2023-01-01-17-27-12 4508 0 3 2 0
```

-Stability checked in test bench at B2: no error for 12hours

Stability test before gamma test

-Stability of optical link is checked in test bench at B2.
No error for 12hours.



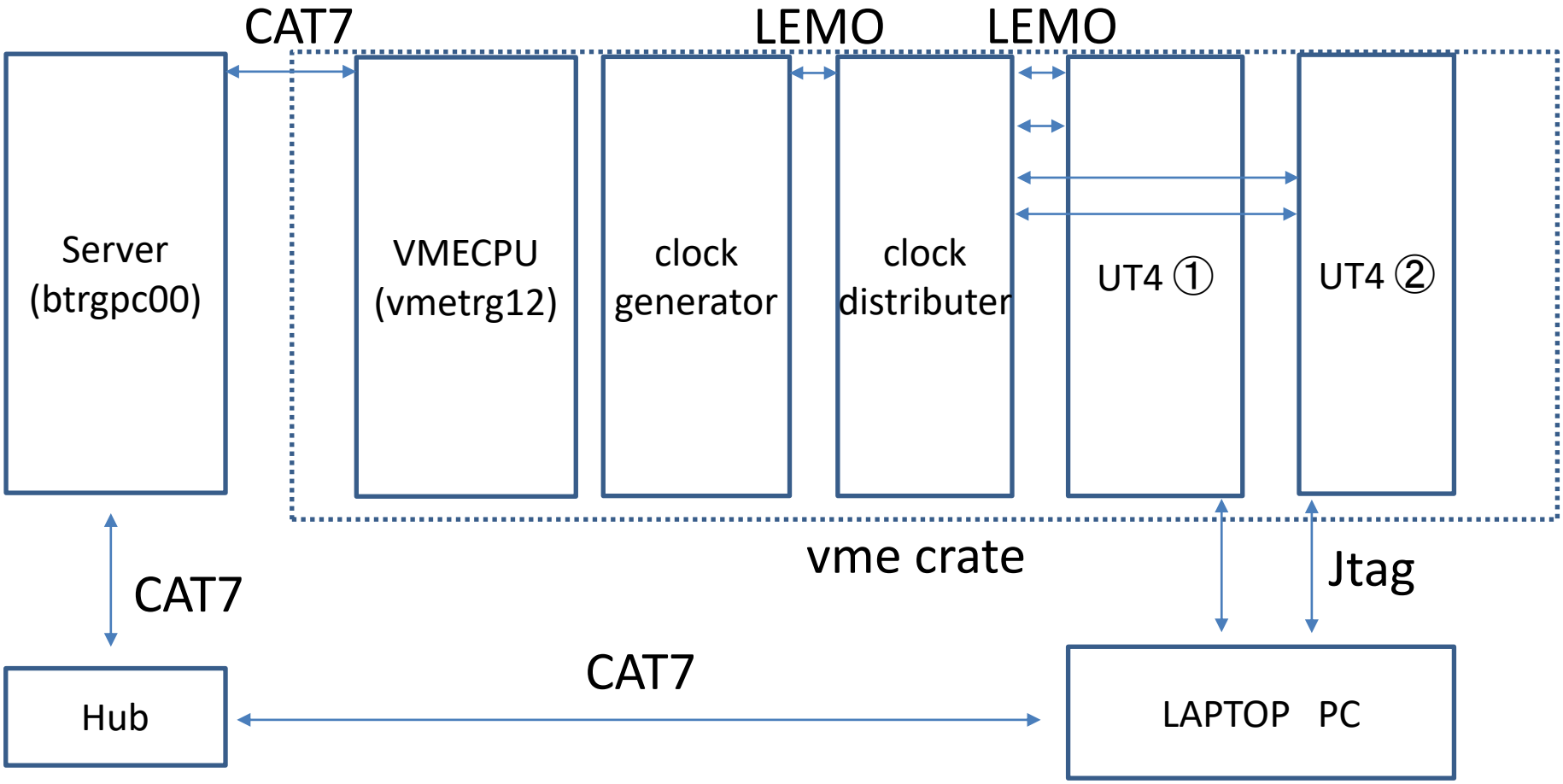
Summary

-CDCFE and optical transceiver will be upgraded around LS2
  -bandwidth will increase from 2.5Gbps to 10Gbps per lane

-I prepared firmware with UT4 for gamma beam test
  -monitor optical link state continuously

backup

Needed equipment to use UT4



Needed equipment to use UT4

equipment	quantity	present location
Laptop PC to program FPGA	1	need confirmation
server (btrgpc00)	1	B2 TRG testbench
VME crate	1	B2 TRG testbench
VME CPU	1	B2 TRG testbench
UT4 VU080	2	B2 TRG testbench
Clock generator	1	need confirmation
Clock distributer	1	need confirmation
LEMO cable	5 (many)	B2 TRG testbench
CAT7 cable	3 (many)	B2 TRG testbench
Jtag cable	2	B2 TRG testbench
Hub	1	B2 TRG testbench
QSFP Transceiver		B2 Koga's desk