Multi-port Remote JTAG over Optical Fibers under Radiation Environment

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JTAG at Belle II now

- FPGAs for 299 FEEs (CDC), 64 FEEs (TOP), 72 FEEs (ARICH) **inside** the detector (radiation area)
- DC-connected JTAG over LVDS / 10-15m CAT7 cables
- JTAG routing controlled by **FTSW** (front-end timing switch) modules
  (multipurpose LVDS I/O with 24-port optionally 8-port SFPs)
- CAT7 reliability has not always been perfect

Wish: fully optical connections to FEEs

- Next CDC FEE under development with fully optical connections
- Clock and trigger can already be distributed over optical fibers
- But we had **no established technique** to deliver JTAG signals over fibers

New optical JTAG technique

- Simple Ser/Des for AC-coupled connection
- JTAG receiver built only from **non-programmable discrete devices**
- **FPGA emulator** to overcome the **latency penalty** of protocol overhead and fiber length

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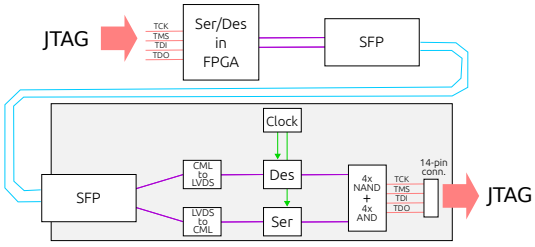
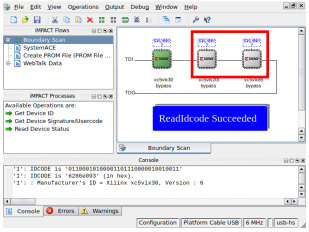
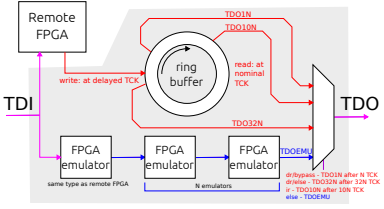




2 FPGA emulators inserted in the JTAG chain to gain 230 ns latency budget



Evaluation board produced to confirm the functionality of the optical JTAG transmission

Circuit survived after 2kGy γ-ray irradiation test