# Connection of optical module and FPGA



## Overview

Design Approach for a FPGA based Ethernet Bridge for Optical Fiber. The implementation uses an Altera Stratix IV chip with integrated PCIe interface logi.

## Key Takeaways

Connecting an FPGA to an optical module requires high-speed serial interfaces, careful PCB routing, and proper transceiver configuration to ensure reliable data transfer.

### High-

Speed Interface ConsiderationsFPGAs typically connect to optical modules such as SFP+, QSFP, or XFP using SERDES (Serializer/Deserializer) ports capable of multi-gigabit data rates.

### Modern FPG

As, like the Altera Stratix V or Xilinx Kintex-7, support SERDES speeds from 1 Gbps up to 28 Gbps, enabling direct interfacing with optical transceivers for Ethernet, SONET/SDH, or custom protocols. The FPGA's high-speed I/O pins must be routed carefully on the PCB to minimize signal degradation, reflections, and crosstalk, especially for distances beyond a few centimeters.

### PCB and Signal Routing

When connecting to an optical module, high-speed traces must be designed with controlled impedance and minimal length mismatch. Differential pairs are commonly used for LVDS or CML signaling. Proper termination and careful layout are critical to maintain signal integrity at 10 Gbps or higher.

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For multi-channel optical modules, each channel requires its own SERDES lane, and the FPGA logic must handle serialization and deserialization efficiently.

## FPGA I

P and Protocol HandlingFPGAs often use IP cores to manage optical communication. For Ethernet, the F-Tile Triple-Speed Ethernet IP or similar cores provide MAC, PCS, and PMA functions, including frame alignment, CRC generation, and payload handling. For custom high-speed links, cores like Xillyp2p simplify connecting Kintex-7 GTX transceivers to optical fibers, providing diagnostic signals for error detection.

Protocol-specific handling, such as SONET/SDH framing or 10G Ethernet, requires careful clock management and real-time data processing.

## Transceiver Configuration

Optical modules like SFP+ or QSFP require proper configuration for speed and mode.

## The FPG

A must support the module's data rate (1G, 10G, or higher) and signaling standard. Control signals such as TX enable, RX enable, and reset are used to manage transmission and reception. Some modules support auto-negotiation, but manual configuration may be necessary when switching between speeds or protocols.

Error Detection and ReliabilityHigh-speed optical links require robust error detection. CRC-32 is commonly used for Ethernet, while simpler systems may use CRC-16.

## FPG

A logic should implement these checks to ensure data integrity, and diagnostic outputs from transceivers or IP cores can help monitor link quality.

## Summary

To connect an FPGA to an optical module effectively: Use high-speed SERDES interfaces compatible with the optical module.

## Design PC

B traces with controlled impedance and minimal skew. Implement protocol-specific IP cores for Ethernet, SONET/SDH, or custom protocols. Configure transceiver control signals and data rates correctly.

Include error detection and diagnostic logic to maintain link reliability. This approach ensures high-speed, reliable communication between the FPGA and optical modules in data center or network applications.

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## Article Content

Design Approach for a FPGA based Ethernet Bridge for Optical Fiber ...

The implementation uses an Altera Stratix IV chip with integrated PCIe interface logic and high-speed input/output for connecting optical fiber interfaces. The interface is designed with...

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The main aim of this paper is to present an approach to establish optical fiber communication by employing the standard IEEE 802.3 Ethernet and Optical Sensing circuits that can be implemented

Optical fiber link with Ultrascale GTH and Xillyp2p

This guide has presented a complete example of setting up a Multi-Gigabit Transceiver (GTH) on an AMD (formerly Xilinx) UltraScale FPGA and connecting it to a Xillyp2p IP core.

connect SFP+ module to FPGA board

If your FPGA supports sfp+ you would need to make sure you are using a supported sfp+ model/manufacturer for your hardware. Your network device needs to support 10Gbase-T as well.

Design and FPGA Implementation of Optical Fiber Video Image

Then Optical module 1 converts electrical signals into optical signals and transmits them to optical module 2 through optical fiber cables. At the same time, Optical module 2 converts optical signals

High Performance Interconnects for FPGA Applications

This learning module discusses high-performance interconnect solutions that simplify interfacing to FPGAs and exceed the performance demands of next-generation FPGA-based

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Samtec''s 25/28 Gbps FireFly™ FMC+™ Module provides up to 400/448 Gbps full-duplex bandwidth over up to 16 channels from an FPGA to an industry-standard multi-mode fiber optic cable. The

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Industry observers also expect demand for optical fiber, optical modules, and related connectivity technologies to remain strong as AI-driven data center investments continue to grow.

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OSFP Transceivers: High-Density Optical Connectivity from 400G to

As hyperscale data centers shift toward AI-optimized fabrics and ultra-high-bandwidth switching platforms, the OSFP (Octal Small Form-Factor Pluggable) form factor has become central

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• Flat carrier board capable of connecting any combination of up to 8 digital and analog conditioning modules. Each module controls 16 or 32 lines for a total of up to 256 I/0 lines. • 16 SFP multi-mode

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The implementation of self-contained, intelligent functions within an optical module to perform aspects of test and characterisation can potentially reduce costs by allowing for reduced floorspace in the

Google''s High-Speed Interconnect Architecture to Push 800G+ Optical ...

In an OCS-enabled architecture, Ironwood TPUs rely on high-speed copper for short-reach connections, while the all-optical network handles inter-rack data transmission. As a result, AI

Connect two fpga by optical-fiber : r/FPGA

Connect two fpga by optical-fiber Hello everyone ! I want to connect to fpga boards by the fiber-optic cable, the first board send the data from the output of OSERDES and the second board receive the

(PDF) Fingertip-Size Optical Module, “Optical I/O Core”, and Its ...

Optical I/O core based on silicon photonics technology and optical/electrical assembly was developed as a fingertip-size optical module with high bandwidth density, low power consumption,

Design Approach for a FPGA based Ethernet Bridge for Optical Fiber ...

Figures Block Diagram of FPGA Based Ethernet Bridge for Optical Fiber Communication. RTL Diagram of Transmitter Module. Transmitter Block Finite State Machine.

14 Gbps FireFly™ FMC™ Development Kit

Samtec offers a VITA™ 57.1 compliant, 14 Gbps FireFly™ FMC™ Module for connecting FPGAs to fiber optic cables for high-speed multi-gigabit transmissions.

connect SFP+ module to FPGA board

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Hello everybody, I want get 1 to 10G Ethernet data from the network to my FPGA for processing. My FPGA transceivers support both 1GBASE-T and 10GBASE-T ethernet standards The

The Application of FPGA in Optical Fiber Sensing and ...

To obtain pulsed light signal used as pulsed pump light for optical fiber sensing and communication systems, a design scheme of generating pulsed light based on continuous laser and

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