Optical and Electronic Network-on-Chip for Multiprocessor Systems
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OVERVIEW

Modern multiprocessor system-on-chip (MPSoC) designs show a clear trend toward the integration of multiple processor cores on a single chip. The performance of an MPSoC strictly depends on the efficiency of the information exchange among resources. Therefore, global communication becomes a performance bottleneck of MPSoC. On-chip optical communication and integration technologies propose an attractive solution for MPSoC on-chip communication. However, crosstalk noise is an intrinsic characteristic of photonic devices. Large crosstalk noise will lower signal-to-noise ratio (SNR) of an ONOC and cause high bit error rate (BER).

To analyze and model the crosstalk noise and signal-to-noise ratio of optical routers and ONOCs, an automated crosstalk analyzer for optical routers is developed.

Optical Router Elements Model

Typical optical routers consist of a few basic elements, which can be modeled as following: (a) Waveguide crossing (b) Parallel switching element in OFF state (c) Parallel switching element in ON state (d) Crossing switching element in OFF state (e) Crossing switching element in ON state

Crosstalk Analyzer Algorithm Design

Divide & conquer approach is applied to the algorithm design phase. These bottom-up levels of models are built: basic elements, optical router & network. The recursive algorithm is used in the simulator implementation.

To demonstrate the crosstalk analyzer, crosstalk performance comparison is done for two different kinds of optical routers: (a) Optimized crosster (b) the Cux.

Simulation Results

Cux suffers from less power loss than optimized crosster for every signal path, and has less crosstalk noise on average, thus Cux has better performance than optimized crosster in terms of BER, therefore Cux has lower BER.

Conclusion

To analyze the crosstalk issue in optical router, an automated crosstalk analyzer is developed. The analyzer can be adaptively configured according to different router structures, thus being applicable to general optical router structures.