

A Compact Terabit-class ATM switching Fabric Using a 20-Gbit/s subnetwork LSI and Free-space Optical Interconnections

S. Hino, K. Hirabayashi, T. Yamamoto, Y. Ohtomo*, and S. Yasuda*
NTT Optical Network Systems Laboratories

*NTT System Electronics Laboratories

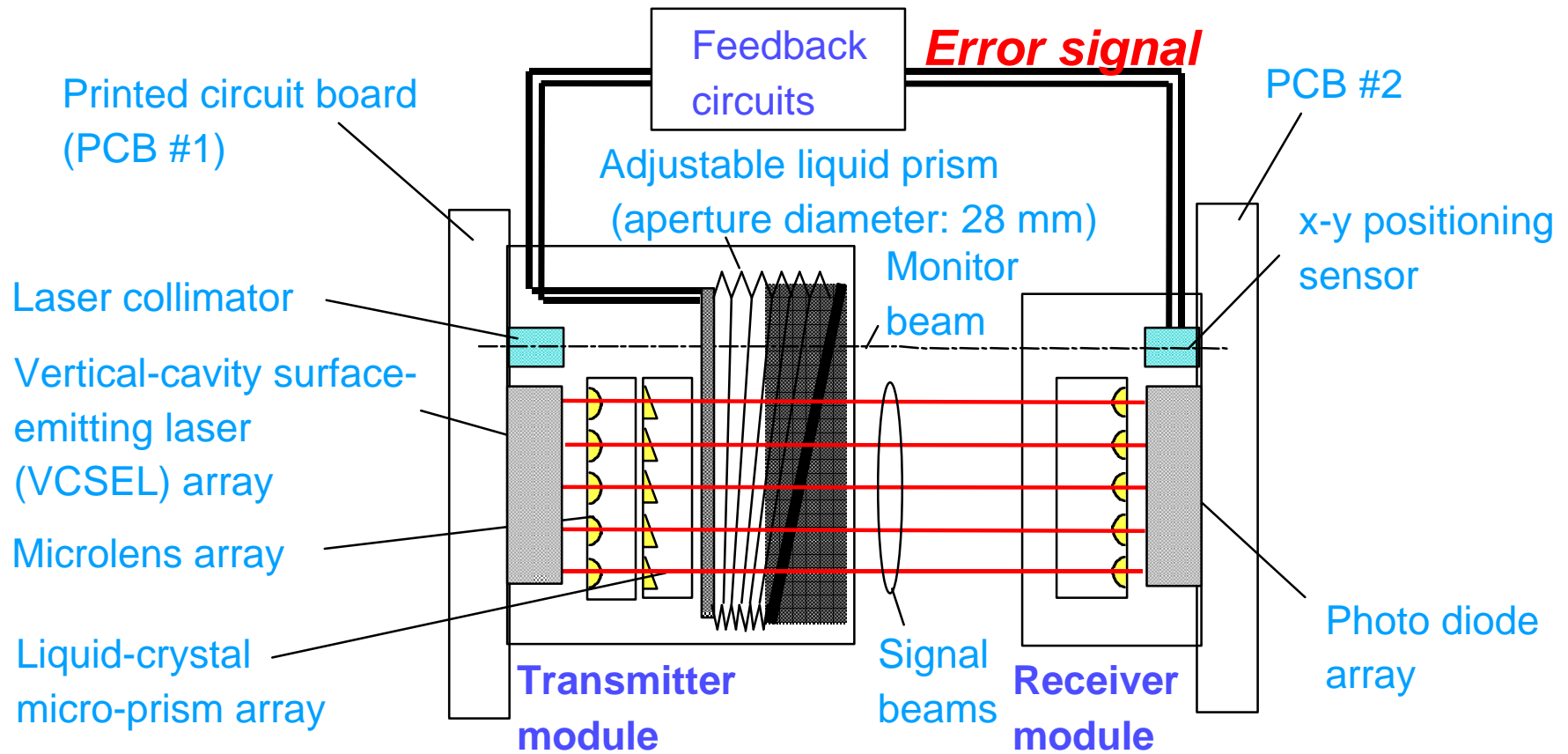
Progress in our ATM-switching LSI chips

Process	Port speed	Number of ports in a chip	Number of ports in a board	Data throughput between boards
CMOS, 0.8 μ m (GLOBECOM'92)	600 Mbit/s	2 X 2	4	4.8 Gbit/s
CMOS, 0.5 μ m (ISS'95)	2.5 Gbit/s	2 X 2	8	40 Gbit/s
CMOS/SIMOX 0.25 μ m (ISSCC'97)	2.5 Gbit/s	8 X 8	64	320 Gbit/s

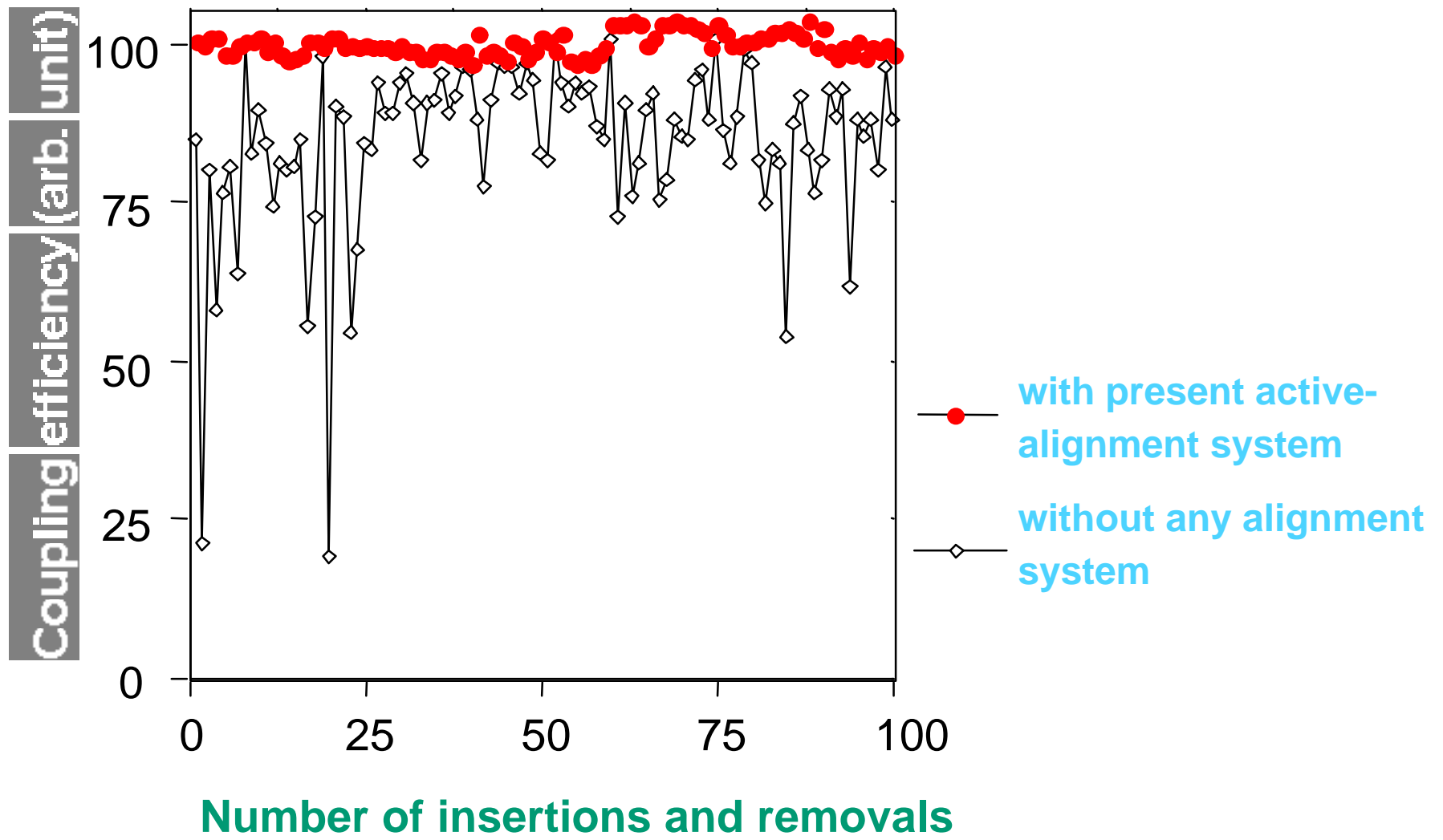
Key issues for constructing an "Over Tbit/s" switching system

- Large-scale, high-speed switching LSIs***
- Arrangement of the switching LSIs in MCMs/boards/cabinets***
- High-density, large-scale free-space optical interconnection***

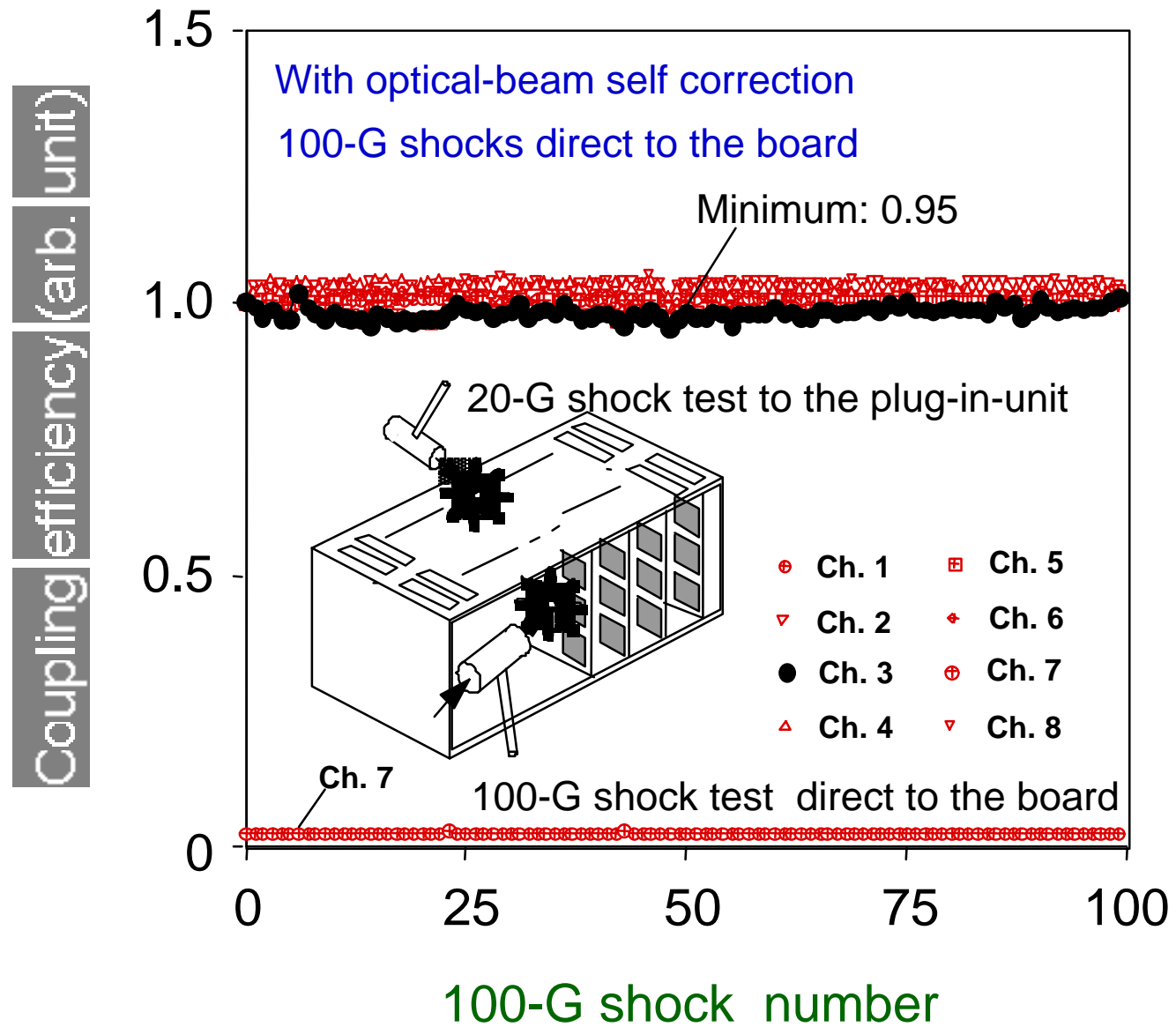
Basic setup of active-alignment system



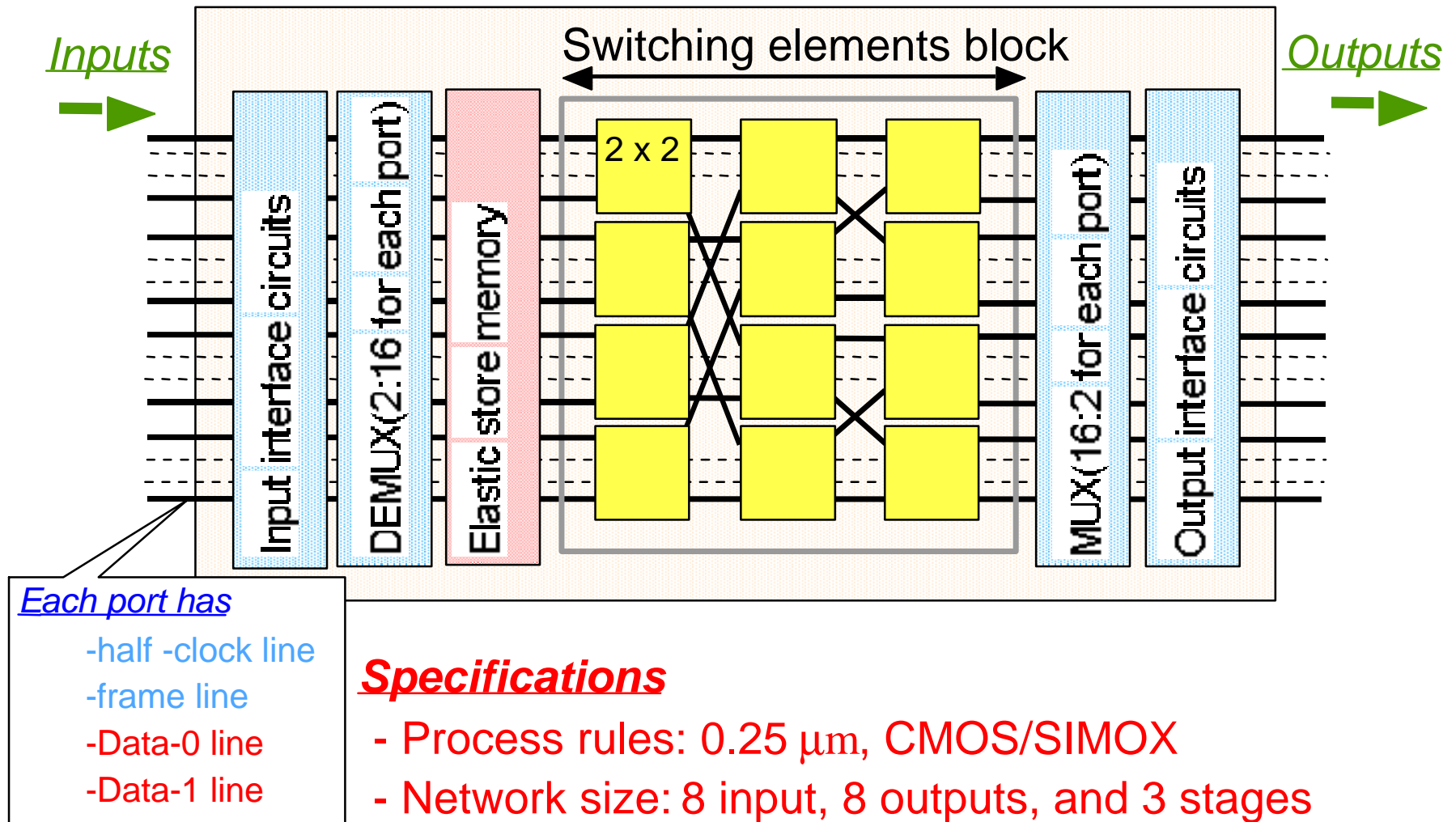
Coupling-loss distribution between prototype boards



Mechanical-shock tests



Block diagram of the switching LSI chip

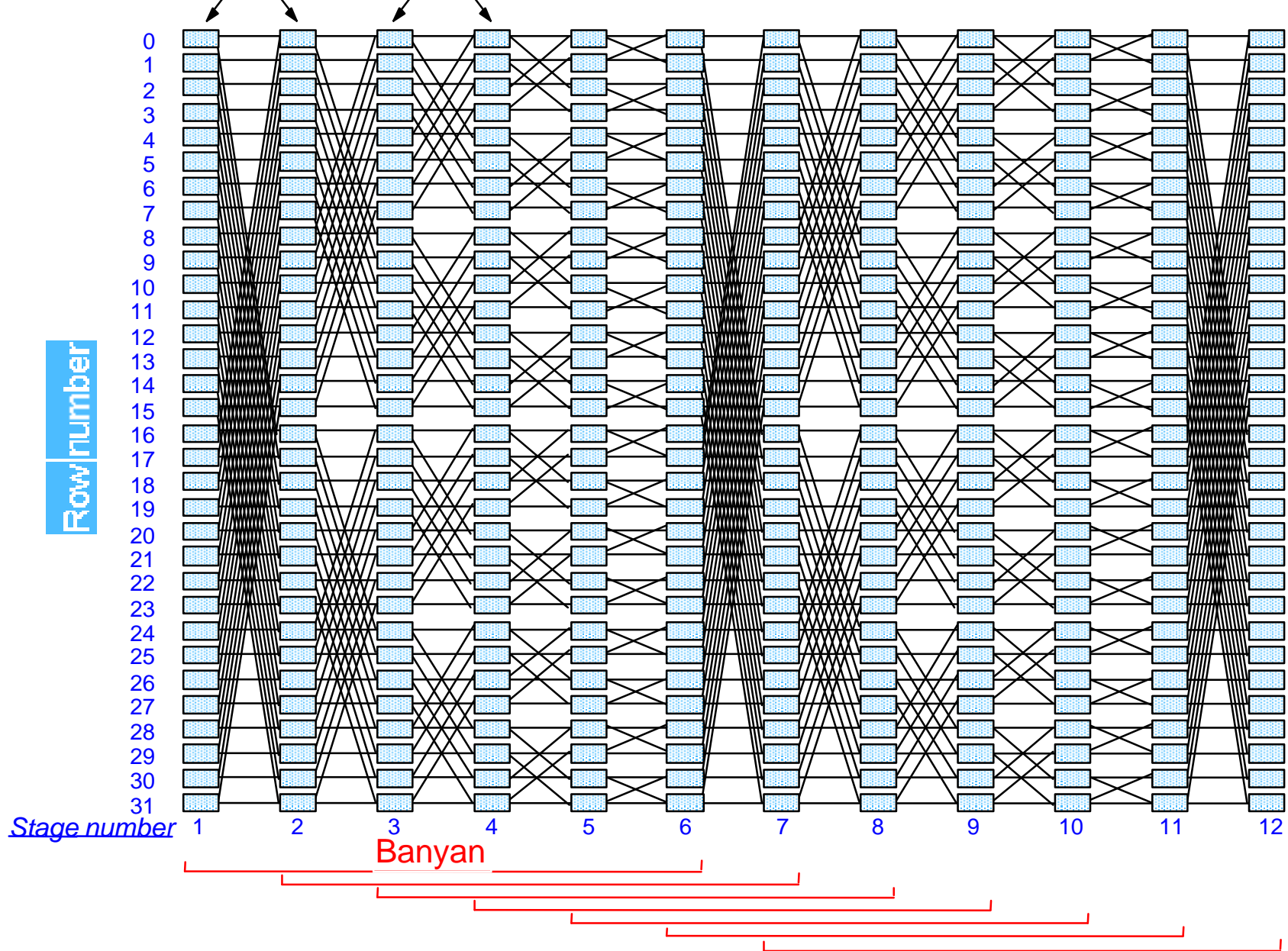


Specifications

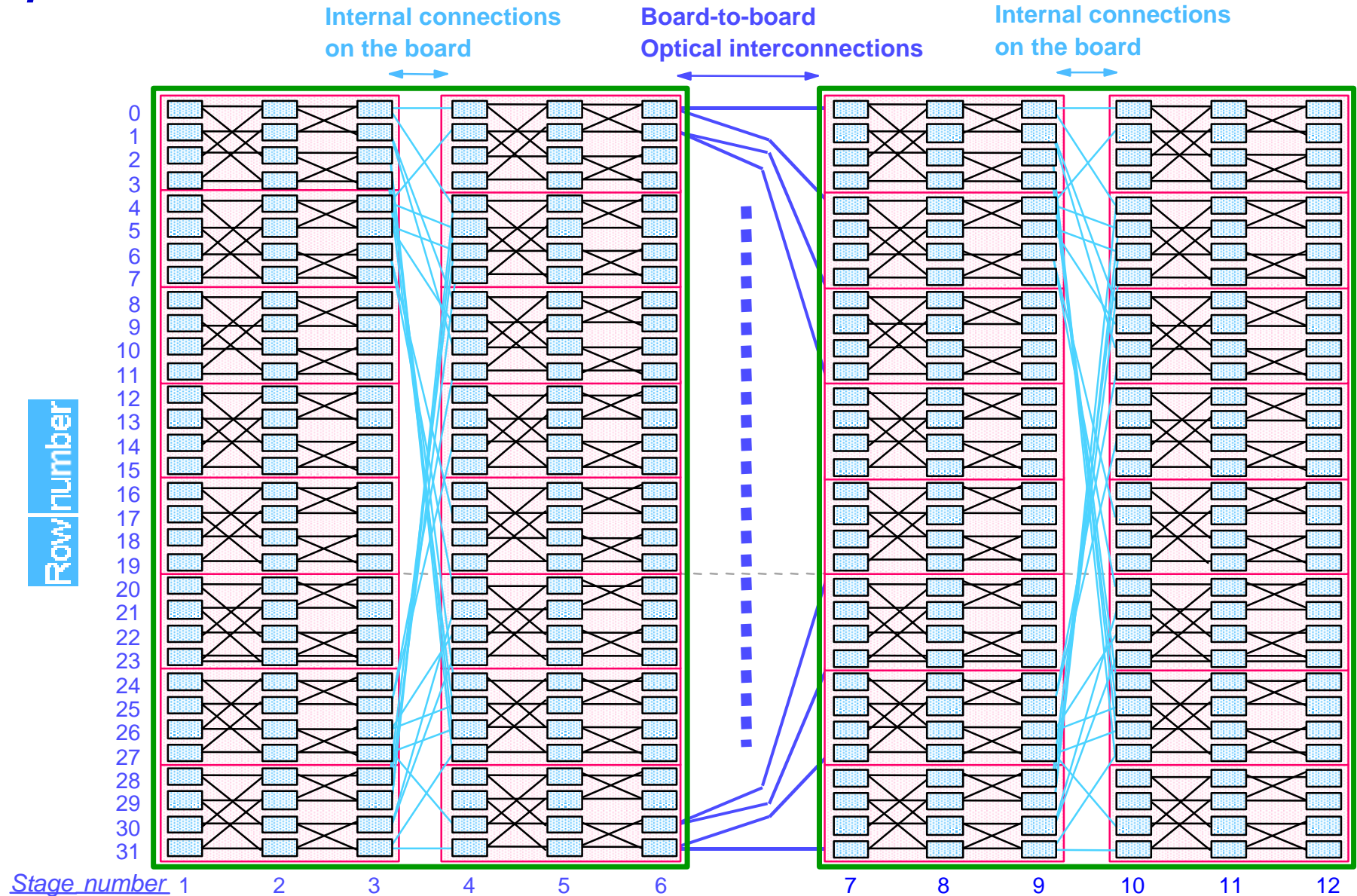
- Process rules: 0.25 μm , CMOS/SIMOX
- Network size: 8 input, 8 outputs, and 3 stages
- Port speed: 2.5 Gbit/s
- Elastic-memory size in each ports: +/-16-bit depth

Rerouting Banyan network fabric having 64 inputs and 64 outputs

Switching elements(2 x 2)



64 x 64 RRB switching fabric mounted on the MCMs and the printed circuits boards



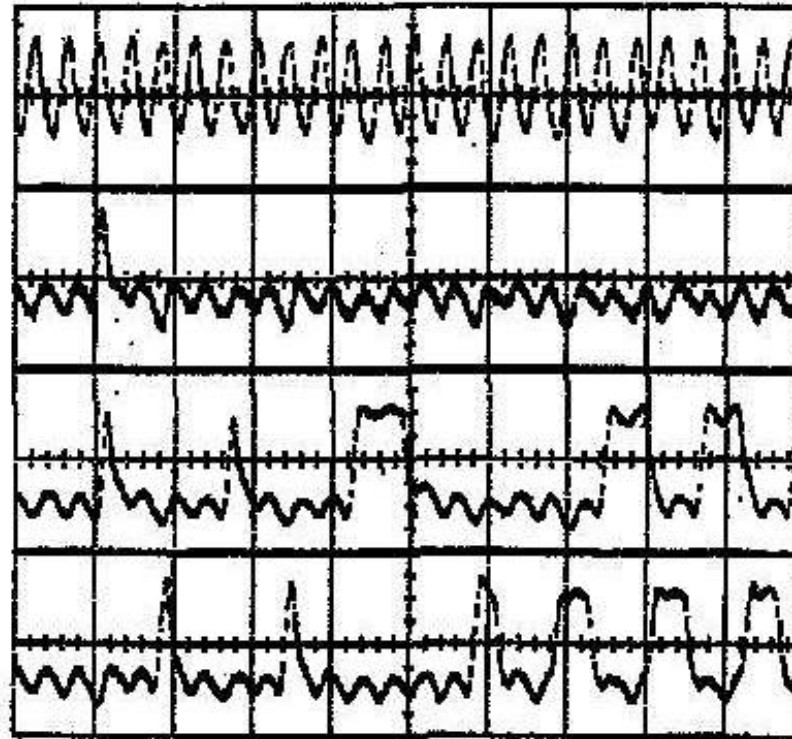
Example output signals from the LSI chip(@ 5 Gbit/s)

half clock line

frame line

Data-0 line

Data-1 line



2 ns/div.

Experimental results indicate;

- Low power consumption: 8.4 W
(10.8% lower than that of a previous chip)
- Our chip can be operated in a standard cooling system
in conventional book-shelf assembled PCBs

Summary

- **Large-scale, high-speed ATM switching LSIs needed for constructing of the "Over-Tbit/s" switching system**
 - The newly fabricated LSI chip, made by 0.25 μ m process and CMOS/SIMOX technology, consisting of the 8 x 8 subnetwork
 - High speed switching operated at 5 Gbit/s
- **Scalability of the network size and hardware volume**
 - New implementation and arranging for LSIs into MCMs/boards/cabinets
 - A Tbit/s switching system in the 8 cabinets
- **Large-scale, compact free-space optical interconnection systems based on an active-alignment system**
 - Data throughput between boards: > 540 Gbit/s