A 32Gbps Low Propagation Delay 4×4 Switch IC for Feedback-Based System in 0.13 μm CMOS Technology

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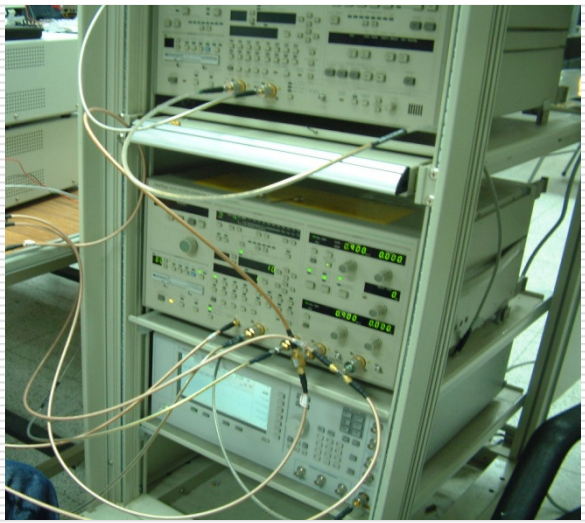
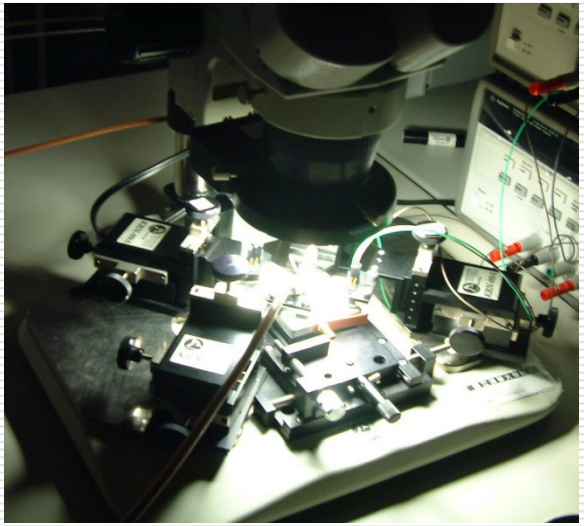
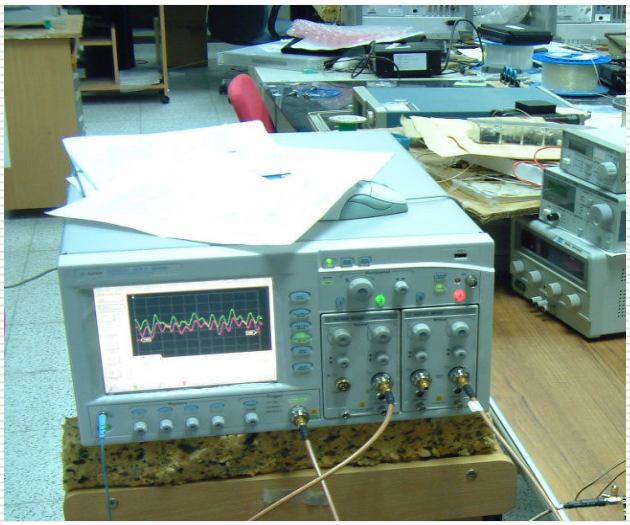

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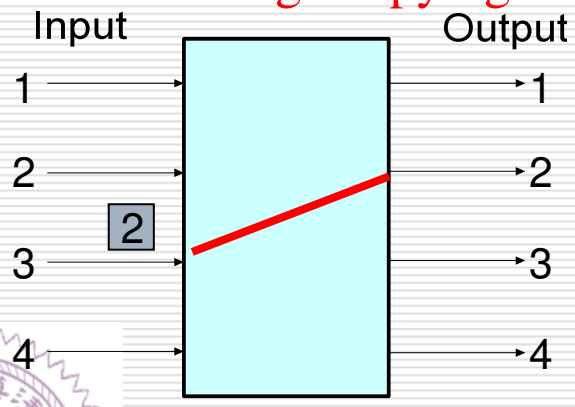
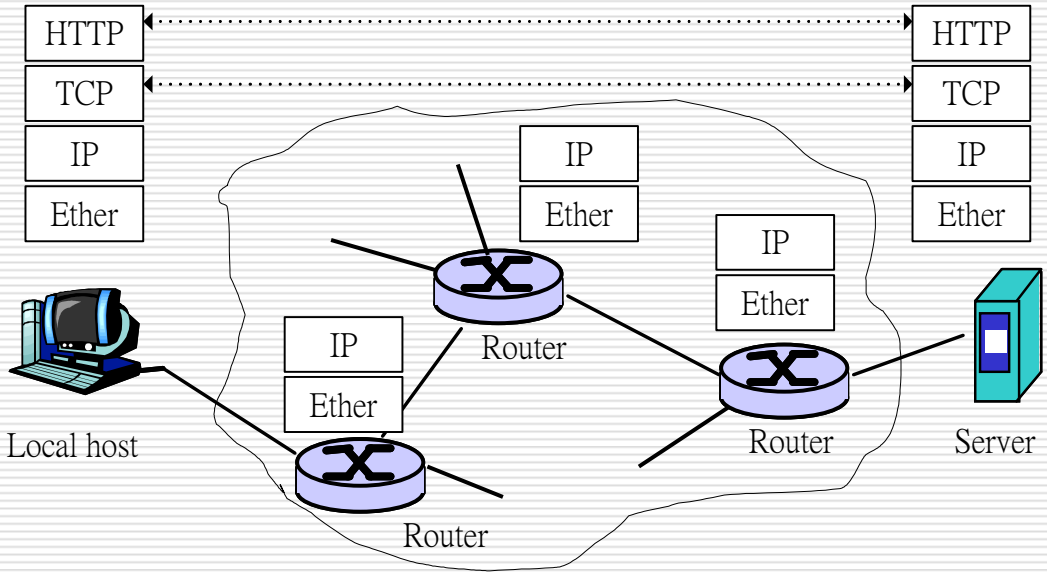
Network Router/Switch

- A router/switch is a network element with multiple input ports and output ports.
- *N*x*N* switch: *N* input ports and *N* output ports
- Basic functions:
  - ✓ table lookup
  - ✓ message copying

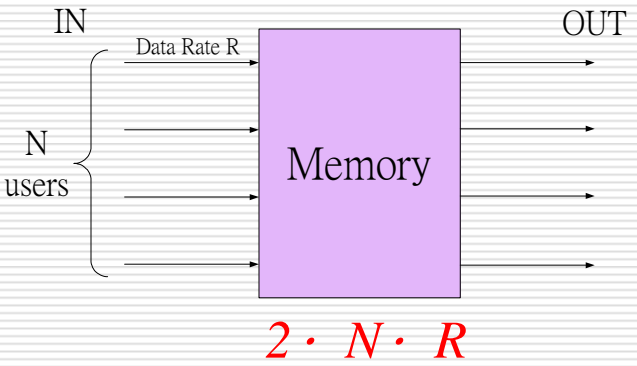


4x4 switch

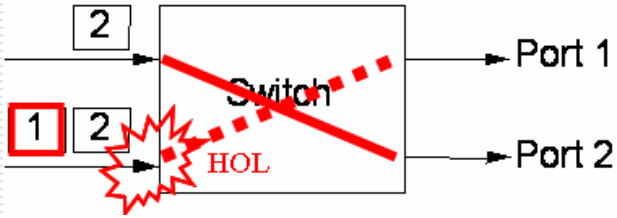


Output Switch and Input Switch

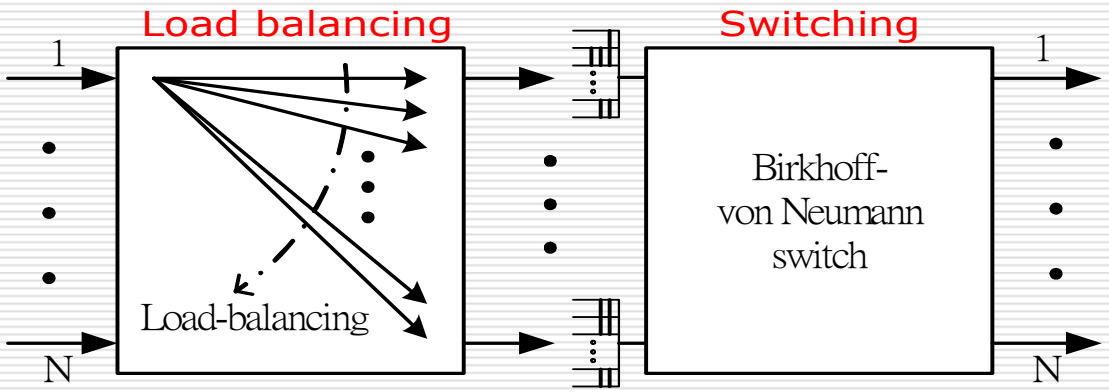
- Output-buffered switch:
  - ✓ Feature: common shared memory, speedup of N requirement
  - ✓ Problem: memory access limitation
  - ✓ Solution: parallel-buffered switch



- Input-buffered switch:
  - ✓ Feature: one buffer per input port
  - ✓ Problem: head-of-line blocking, 58% throughput
  - ✓ Solution: VOQ (virtual output queuing) technique



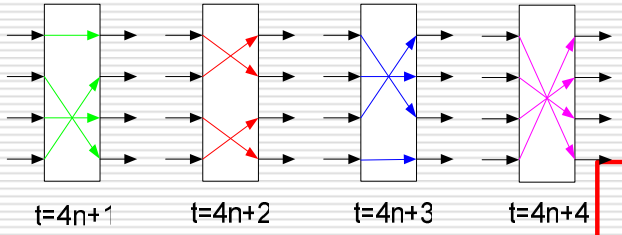
Load balanced Birkhoff-von Neumann Switch Architecture



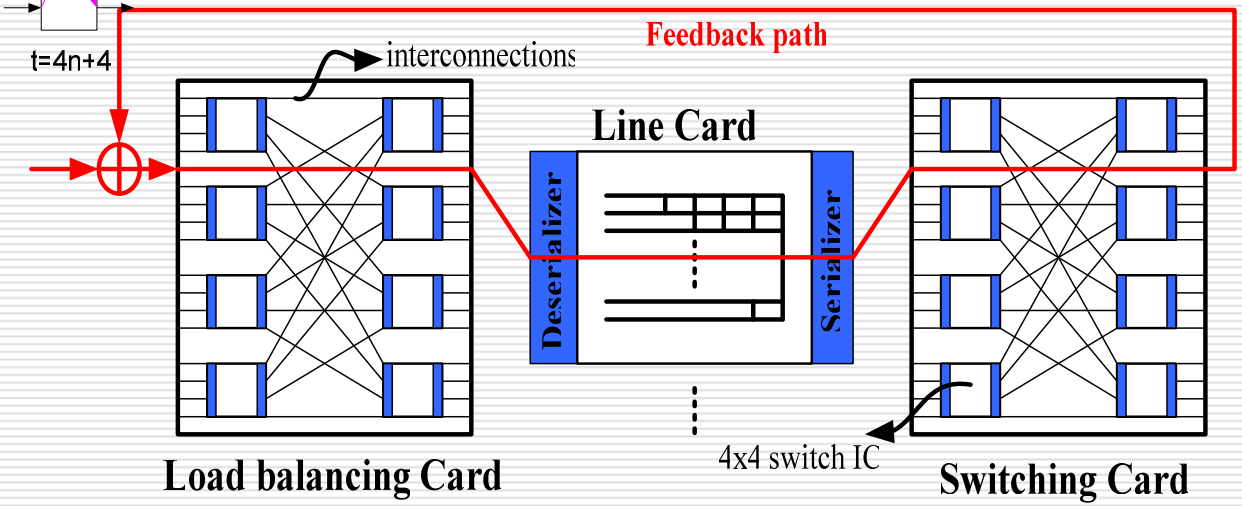
- Features:
  - ✓ 100% throughput
  - ✓ scalability: O(1), periodic, deterministic
  - ✓ lower average delay in heavy or burst traffic
  - ✓ better buffer utilization
  - ✓ lower hardware complexity
- Problem: out-of-sequence issue

Feedback-based System

Symmetric TDM Patterns



50ns for each SerDes interface

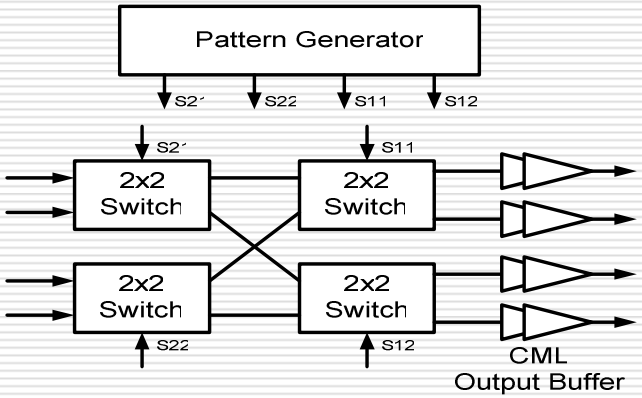


Motivation : switching packet directly in RF domain

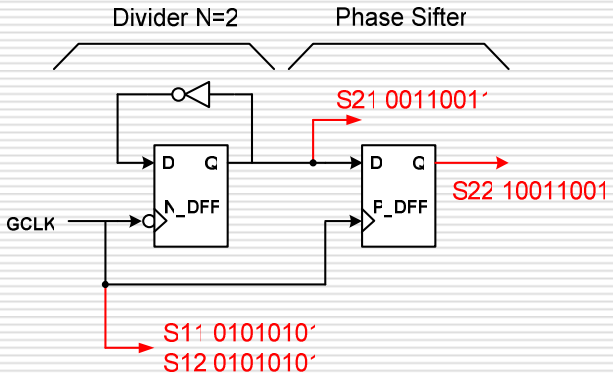
- Low propagation delay in feedback system

Proposed Low Propagation Delay 4x4 Switch Architecture and Measurement Results

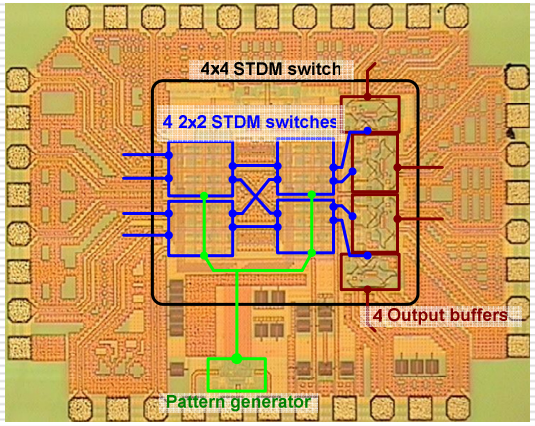
Overall Architecture

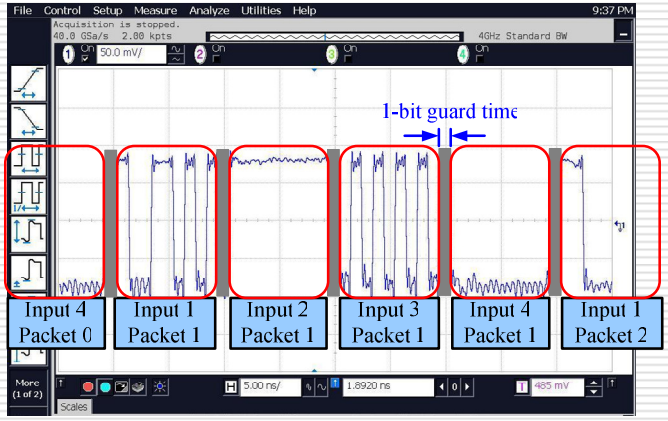


Pattern Generator

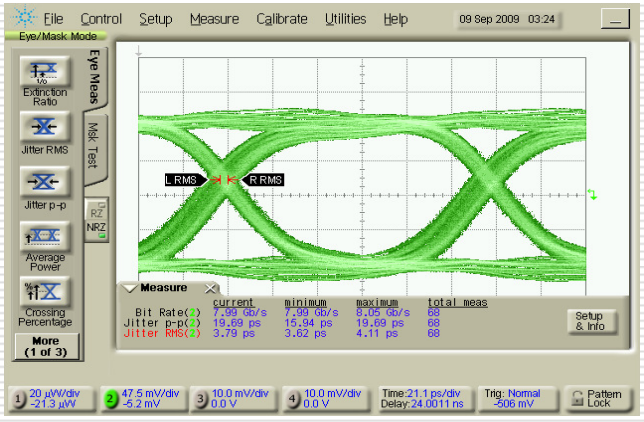


Die Photo





One of the Output Waveform



Measurement Eye Diagrams: $Jitter_{p-p}$ = 20ps @8Gbps.