

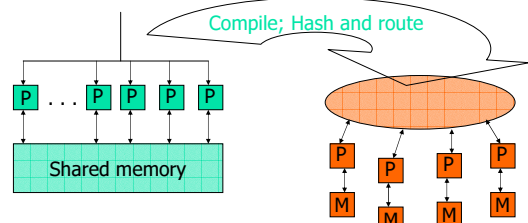
Sparse Torus as Large-Scale Routing Switch

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Motivation

High level PRAM-program
 using pardo-loop(s)

Low level program
 using message passing



Contents of the talk

- Motivation
- Structure of Sparse Optical Torus
- Routing strategies
- Sketch of analysis
- Conclusions and future work

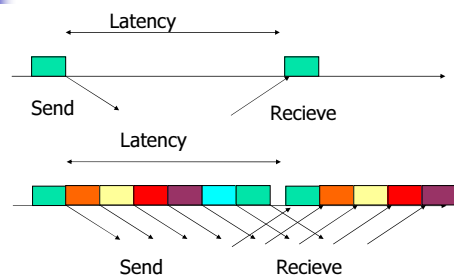
Motivation, h -relation

- h -relation is a routing problem, where
 - each processor has at most h packet to send
 - each processor is the target for at most h packet

Motivation

- Optical communication offers very high bandwidth compared to its electric counterpart
- It is good for static connections
- Is it good for dynamic connections i.e. on-line packet routing?
 - Switching at very high speed?
 - Optical buffer memories?

Motivation, slackness



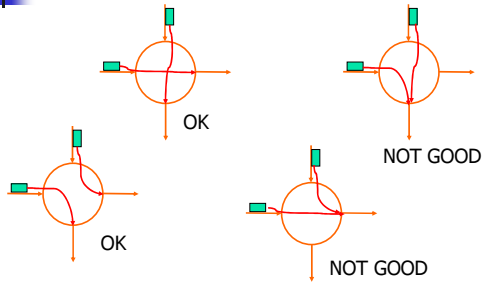
Motivation

- Problems:
 - Latencies due to speed of light
 - Network congestion
 - Components
 - Slow buffer memories (fiber loops)
 - Missing fast all-optical logic circuits
- Where can we use fast optical switches
 - in intercommunication networks
 - in implementation of shared memory

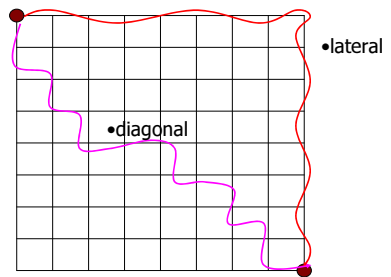
Motivation, work-optimality

- an implementation of h -relation is said to be work-optimal at cost c , if all the packets arrive at their destination in time ch .
- Preconditions:
 - h is greater than the diameter ϕ of NW
 - NW is able move $\Omega(n\phi)$ packets at the same time

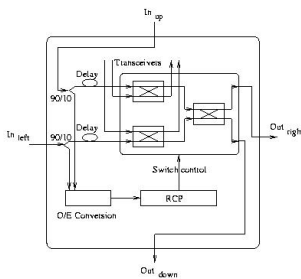
Routing nodes of SOT



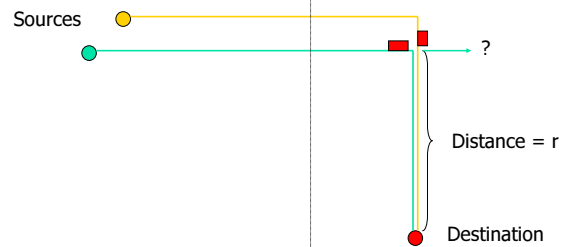
SOT, routing strategies



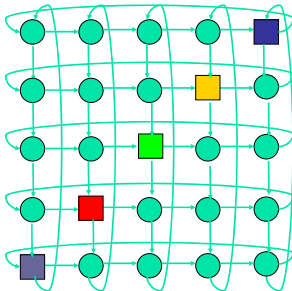
Possible structure of routing nodes



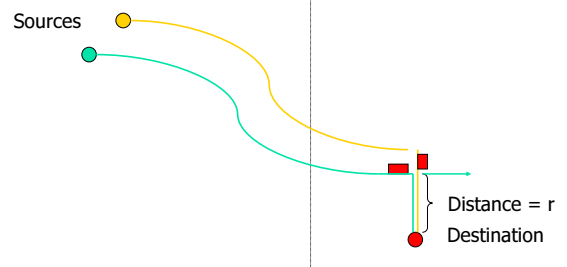
SOT, one-sided lateral



Sparse optical torus



SOT, diagonal



Sparse optical torus

- Operates under a common clock
- Bandwidth of the system is divided in time slots whose length equals to the bypass time of packet between two consecutive routing nodes

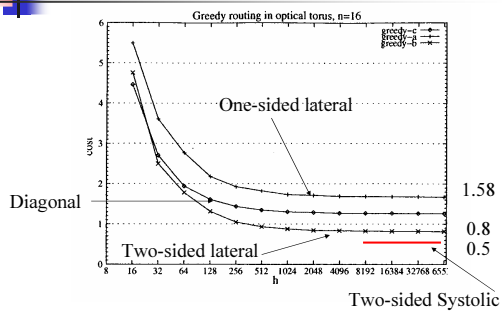
SOT, Scheduled routing

- Arrange packets according to destinations
- Repeat
 - Set the network in *turn* state
 - Repeat
 - Set the network in *cross* state
 - Absorb incoming packet
 - Inject packet so that it arrive target column during the next *turn* state
 - $n - 1$ times
- Until all the packets are routed

Analysis, Scheduled routing

- Arrangement takes linear time
- Packets routed in $(S+1)n$ time steps
- S maximum size of sending buffers
- Assuming $h = n \log n \rightarrow S$ in $\theta(\log n)$ w.h.p
- Routing time $\theta(n \log n)$ and work-optimality achieved

Results, cost with large h



Conclusions

- With large h , routing can be implemented by low cost
- If we have a large degree of parallelism, a simulation of parallel program can be implemented work-optimally
- Visualizator:
<http://www.cs.uku.fi/research/parallel/routing.html>