Lecture 12

Network Computing II

Interconnection Networks, Grid

Ceng505 *Parallel Computing* at December 27, 2010

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- Only when the network is not busy sending another message can transmission start.

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- When only one-to-one connections are allowed, the switch is called *crossbar*.

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- The number of one-to-one connections in a binary switch is two (straight and crossed),
- while the number of all allowed connections is four (straight, crosses, lower broadcast, and upper broadcast).

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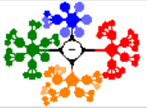

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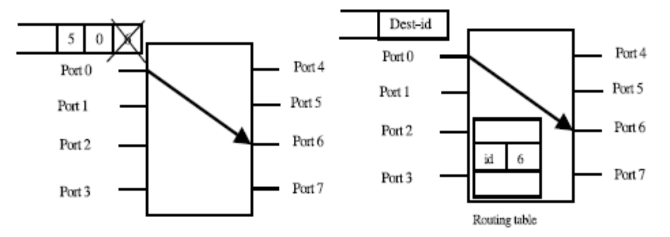

Figure: Source-path routing vs. table-based routing.

- Figure 1 illustrates the difference between source-path routing and table-based routing in the case when a packet enters an 8-port switch at port 0.

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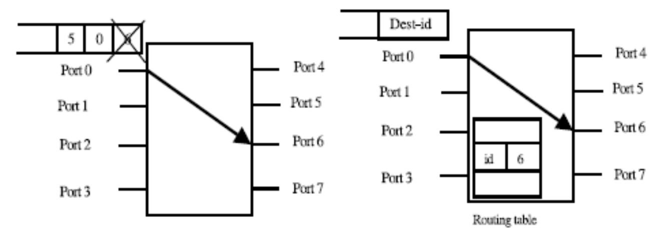

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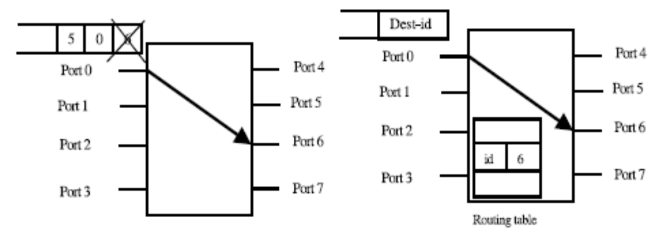

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- For any switching permutation, there may be as many packets traversing a switch concurrently as the switch has ports.

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- The most common topology is the Clos network.

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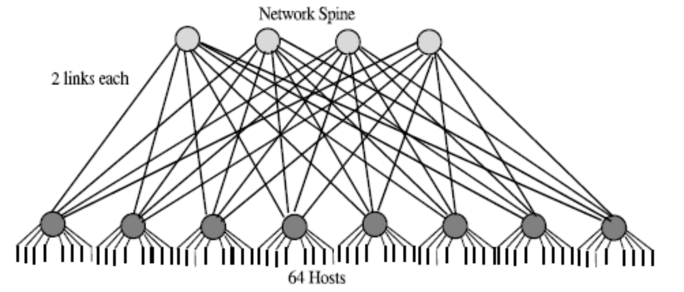

Figure: A 64-host Clos network using 16-port Myrinet switch (each line represents two links).

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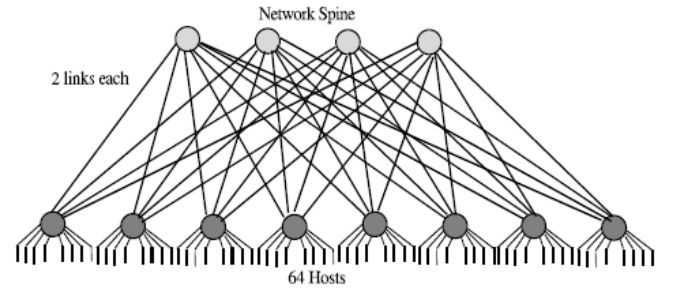

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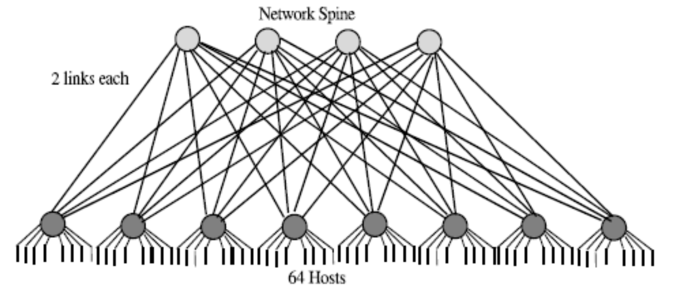

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- The thick line connecting a spine switch to a leaf switch represents two links.

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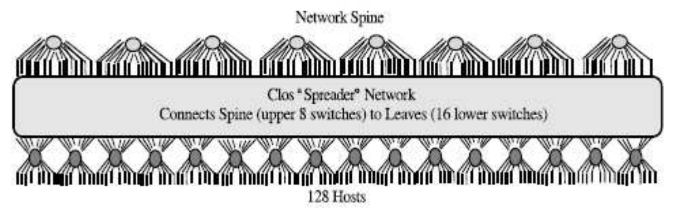

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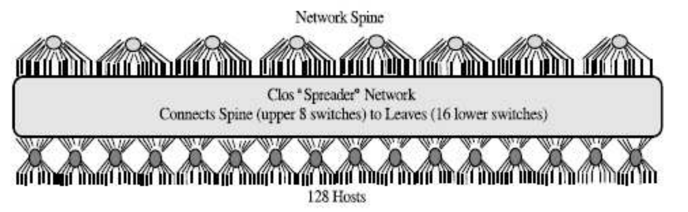

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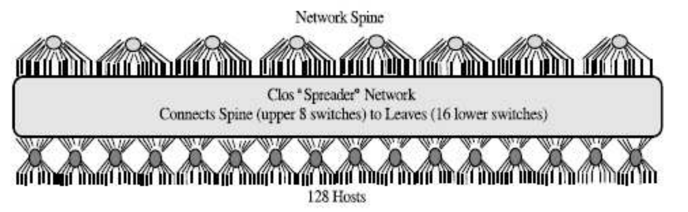

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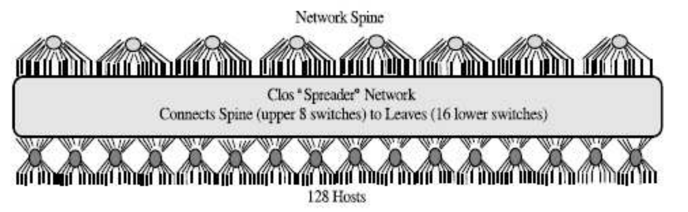

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- Routes between hosts connected to different Xbar16s traverse three Xbar16 switches.

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- At the host interface, a control program is executed to perform source-route translation.

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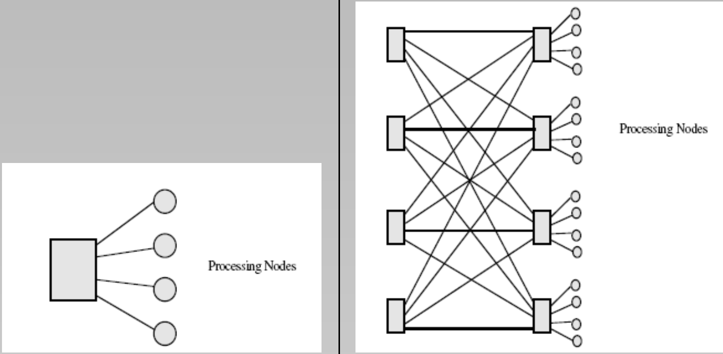

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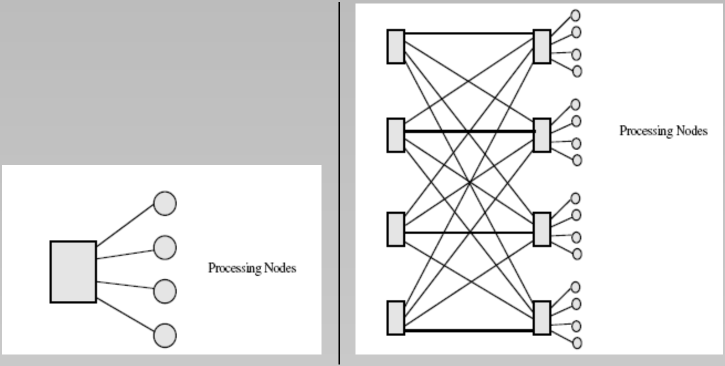

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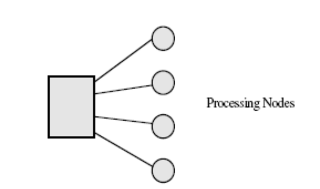

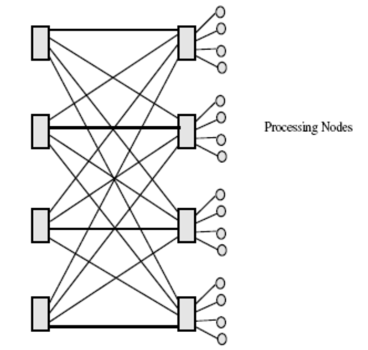

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- Packets are routed using wormhole routing flow control (each packet is divided into flow control digits (flits)).
- In QsNet, the size of each flit is 16 bits. Network nodes can send packets to multiple destinations using the network's broadcast capability.

Interconnection Networks I

Table: List of local area networks device bandwidths.

Interconnection Technology	Data Rate (bit/s)	Data Rate (byte/s)	Year
Ethernet (10BASE-X)	10 Mbit/s	1.25 MB/s	1990
Fast Ethernet (100BASE-X)	100 Mbit/s	12.5 MB/s	1995
FDDI	100 Mbit/s	12.5 MB/s	
Token Ring IEEE 802.5v	1 Gbit/s	125 MB/s	2001
Gigabit Ethernet (1000BASE-X)	1 Gbit/s	125 MB/s	1998
Myrinet 2000	2 Gbit/s	250 MB/s	
Infiniband SDR 1X[24]	2 Gbit/s	250 MB/s	
Quadrics QsNetI	3.6 Gbit/s	450 MB/s	
Infiniband DDR 1X[24]	4 Gbit/s	500 MB/s	
Infiniband QDR 1X[24]	8 Gbit/s	1 GB/s	
Infiniband SDR 4X[24]	8 Gbit/s	1 GB/s	

Interconnection Networks II

Table: List of local area networks device bandwidths, Contnd.

Interconnection Technology	Data Rate (bit/s)	Data Rate (byte/s)	Year
Quadrics QsNetII	8 Gbit/s	1 GB/s	
10 Gigabit Ethernet (10GBASE-X)	10 Gbit/s	1.25 GB/s	
Myri 10G	10 Gbit/s	1.25 GB/s	
Infiniband DDR 4X[24]	16 Gbit/s	2 GB/s	
Scalable Coherent Interface (SCI) Dual Channel SCI, x8 PCIe	20 Gbit/s	2.5 GB/s	
Infiniband SDR 12X[24]	24 Gbit/s	3 GB/s	
Infiniband QDR 4X[24]	32 Gbit/s	4 GB/s	
40 Gigabit Ethernet (40GBASE-X)	40 Gbit/s	5 GB/s	
Infiniband DDR 12X[24]	48 Gbit/s	6 GB/s	
Infiniband QDR 12X[24]	96 Gbit/s	12 GB/s	
100 Gigabit Ethernet (100GBASE-X)	100 Gbit/s	12.5 GB/s	

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- Resembling an electric power grid, the computing grid is expected to become a pervasive (spread throughout) computing infrastructure that supports large-scale and resource-intensive applications.
- The significant increase in application complexity and the need for collaboration have made grids an attractive computing infrastructure.

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  - The Globus Toolkit has grown through an open-source strategy. Version 1.0 was introduced in 1998 followed by the 2.0 release in 2002. The latest 3.0 version is based on new open-standard Grid services.

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