SEG4135 - Lecture 3

Networks Cont.

Interconnection Networks

Interconnection networks are distinguished by

- Topology - Is determined by the way nores are interconnected
- Routing - routing decides how a message gets from source to destination
- Flow Control - negotiates how the buffer space is allocated

The topology of an interconnected network determines

- Network diameter - the AVERAGE distances between all pairs of nodes
- Bisection width - the MINIMUM number of links cut to partition the network into two halves. When a network is partitioned into two networks of the same size the bisection bandwidth measures the communication bandwidth between the two.

There are two basic types of network topology

- Static networks - where there are direct connections between nodes
    - For examples: bus, hypercube, mesh, 2d-torus
- Switch networks - uses switches to interconnect networks

Store and-forward networks

- An entire packet is buffered and its checksum is verified in each node along the path from the source to the destination.

Cut-through (wormhole) networks

- Packet is forwarded to its next hop as soon as the header is received and decoded. This decreases the latency, but a packet can still experience blocking if the outgoing channel is busy.

Network Characterization

Diameter of a network

- Shortest distance between two nodes that are places farthest from each other

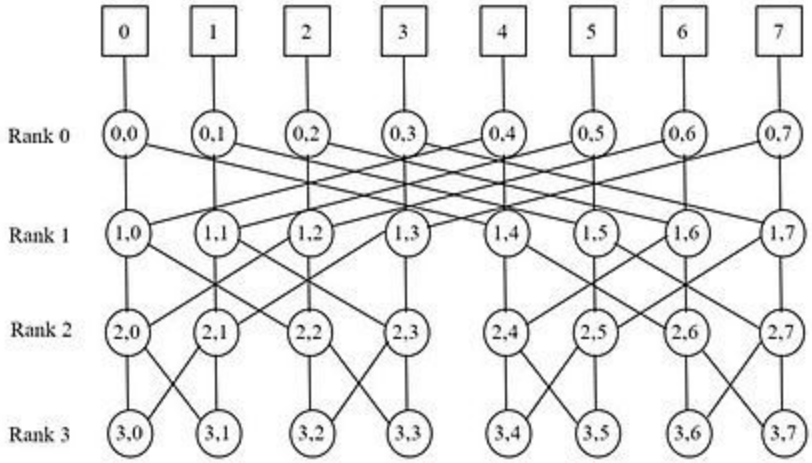
Bisection network

- If the network is cut into two equal networks of the same size, how many connections will neet to be maintained and what will the bandwidth of those be?

Cost
Power consumption

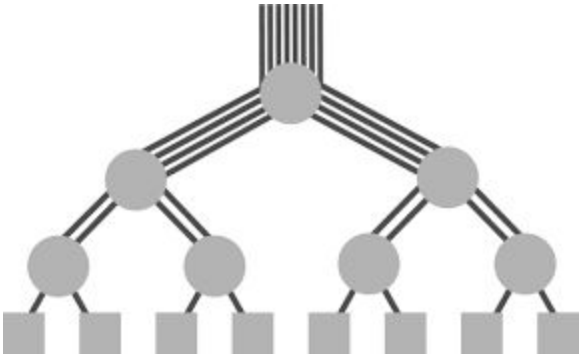
Avg hop count
Find the min and max path for all pairs of nodes.

Butterfly Networks



Fat Trees

- Optimal interconnect for large-scale clusters and for WSCs
- Servers are places at ehe leafs
- Switches populate the root and the internal nodes of the tree
- Have additional links to increase the bandwidth near the root of the ree
- A fat-tree network can be built with cheap commodity parts as all elements of a fat-tree are identical.



InfiniBand

Interconnection network used by supercomputers and computer clouds

- Has a switch fabric topology designed to be scalable
- Supports several signaling rates.
- The energy consumption depends on the throughput
- Links can be bonded together for additional throughput

Supports

- QoS Guarantees
- Failover - The capability to switch between redundant states

Myrinet

Interconnect for massively parallel systems developed at Caltech
Features:

- Robustness
- Self initializing, low-latency, cut-through
- Host interfaces that can map the network, select routes, and translate from network address to routes.

Storage area networks

Used to connect Servers to data stores

Three lower-layer protocols

- FC-0 uses laser diodes as the optical source and manages the point-to-point fiber connections
    - Point to point through lasers
- FC-1 control the serial transmission and integrates the data with clock information
    - Optical to digital conversion happens
- FC-2 handles the topologies, communication models, the classes of service, sequence and exchange identifiers, and segmentation and reassembly.
    - Translates the digital signals to usable packets

Two upper-level protocols

- FC-3 is common services
- FC-4 is the protocol mapping layer

Data Center Networks (DCNs)

Styles

Three-tier

- Multiple rooted tree topology with 3 layers
    - Core - distributes to lowest layer
    - Aggregate - Aggregates connections
    - Access - Closest to users
- Not suitable for clouds, it's not scalable.
- Bisection bandwidth is not optimal

Fat-tree

- Optimal for computer clouds
- Bandwidth is not affected for messages crossing multiple switches and interconnection network

Fatt-Tree DCNs

Assume we have K pods. In this example 4.

IP addresses have the format ***.pod.switch.1;
Switches are numbered left to right, and bottom to top.
Core switches have IP addresses of the form ***.k.i.j
Where k = 4, and j/i denote the coordinates of the switch
Servers have ip addresses ***.pod.switch.ServerID

87.3.3?

Network Resource Management Algos

AIM

- Guarantee the communication bandwidth required by an application a specified

Scope

- Manage communication of links

How

- Apply strategies to supports the data streaming and QoS

FCFS - First come first serve

- poor

FQ - Fair Queueing

- Ensures fairness
- Ensures a high-data-rate flow cannot use more than its fair share

FQ's objective

- Min-max fairness
- First it maximizes the minimum data rate of any data flows.
- Then it maximizes the second minimum data rate

FQ Throughput is low but starvation of expensive operations is avoided

Packets are first classified into flows by the system and then assigned to a queue dedicated to the flow.
Packet queues are services once packet at a time in RR order.

Presentation

Motivation

- Give current solutions or what you will be studying
- Give a high level description of your project

Experimental Settings

- Give the parameters for which you tested your project
- Graphs and stats