Butterfly Networks

A **butterfly** **network** represents a very different approach than the preceding ones. Butterfly networks are often used as multistage networks. A butterfly network consists of $(k + 1)2^k$ nodes arranged in $k + 1$ **ranks**, each containing $n = 2^k$ nodes. The ranks are labeled 0 through k. Sometimes ranks 0 and k are combined. Figure 19 depicts a butterfly network with 8 processor nodes. In the figure, the ranks are vertical. The rank 0 nodes would be connected to processors, and the rank 3 nodes could be connected either to processor nodes or to memory nodes, if the network were being used to implement a SMP machine. In a butterfly network, there is a path of length k from any node in rank 0 to any node in rank k+1. Since k is log n +1, where n is the number of inputs, this is a log n stage network.
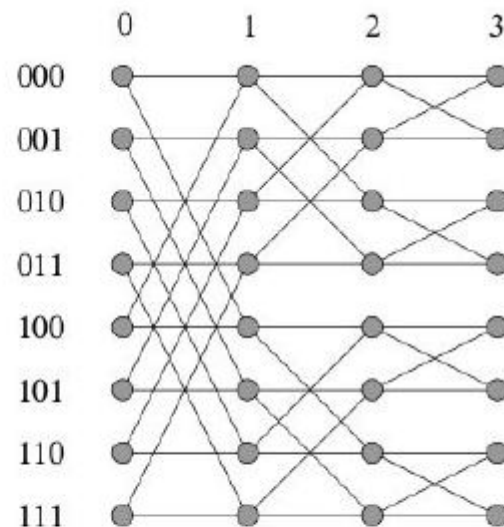

Figure 19: A butterfly network with 32 nodes.

Each switch in a butterfly network has two inputs and two outputs. The inputs come from two nodes in the preceding rank, and the outputs, to two nodes in the following rank. Which nodes depends upon the switch's position in the network.