dropping a message is relatively large. As messages pass through the network, some messages will be dropped off. Thus, although the network loading in the switching elements of the first stage is 100 percent, the network loading at later stages decreases gradually due to message dropping. From the previous analysis, we have seen that the lighter the network loading, the more effective the short-circuit switching. Therefore, for small n_b, the probability that a message can bypass a buffer in short-circuit is high and throughput in short-circuit network is higher than that in message switching. As n_b increases, less messages are dropped and the network loadings at each stage become closer to 100 percent, which renders the short-circuit switching less effective. Therefore, for large n_b, the throughputs of the two networks become closer. Since the network contains 32 source PEs and the average transmission time is 10 time units, the limit for the throughput of the network is 3.2 messages per time unit. From Fig. 8, we see that both curves will approach the limit when the number of buffers are larger than 16.

6. CONCLUSIONS

From the analytical and simulation results, it is seen that networks with short-circuit switching outperform store-and-forward networks and circuit switching networks, especially in large networks under moderate loading conditions. When network loading is low, short-circuit works like circuit switching and so, delay time is reduced since there is no delay in each stage. When network loading is heavy, short-circuit switching exploits the advantages of store-and-forward networks (i.e., pipeline transmission) and thus increases the throughput.

The simulation presented in this paper is limited to networks of relatively small sizes. However, by extrapolating the simulation results, we can predict that short-circuits are exploited more effectively when the network size is larger. The more the number of stages of the network, the more flexibility exists for establishing partial paths.

The hardware complexity of the switching elements used in short-circuit switching networks is comparable to those used in message switching networks [8]. Both use four queues of buffers in each switching element. The only additional hardware needed to implement short-circuits is four multiplexers, four demultiplexers, and some logic circuits to control these multiplexers and demultiplexers.

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