

I certify that I have read this dissertation and that, in my opinion, it is fully adequate in scope and quality as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this dissertation and that, in my opinion, it is fully adequate in scope and quality as a dissertation for the degree of Doctor of Philosophy.

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## *Abstract*

In recent years, interconnection network fabrics, historically used in high-end multiprocessor systems, have been deployed in a wide spectrum of communication systems -- I/O interconnects, high-speed network switches, terabit Internet routers and on-chip interconnects. This thesis proposes flow control and micro-architectural mechanisms for extending interconnection network performance, and improving the performance of the overall system.

The thesis introduces flit-reservation flow control where control flits traverse the network in advance of data flits, reserving buffers and channel bandwidth on their behalf. Reserving resources ahead of time yields two performance improvements. First, it enables routing and arbitration to be carried out beforehand, reducing network latency. Second, this advance scheduling makes very efficient use of buffers, pushing throughput beyond that of existing flow control methods. Our simulations show flit-reservation flow control reducing latency by up to 33%, and matching or surpassing the throughput performance of virtual-channel flow control with just half the number of buffers.

Next, this thesis proposes a delay model developed for pipelined routers. Motivated by the model, the effect of speculation on the critical path of routers is investigated. While previous models claim that the complexity of virtual-channel flow control leads to high router latency which overwhelms its throughput advantages over wormhole flow control, the proposed model concludes otherwise. Simulations based on the pipelines prescribed by the proposed model demonstrate that a speculative virtual-channel router can have the same router latency as a wormhole router, while extending its throughput by up to 50%.



## *Acknowledgments*

*Now this is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning.*

*- Sir Winston Churchill (1874 - 1965), Speech in November 1942*

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*To Chin Kai*

