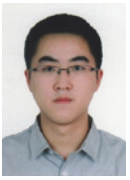
A Statistical Physics Inspired Approach for Adaptive Routing in Networks-on-Chip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Network-on-Chip (NoC) approach appears as a promising solution to solve the complex on-chip communication problems. However, most NoC performance optimization approaches considered so far solve various problems in a static manner without taking into consideration the dynamics of the network traffic.

In this project, we propose a runtime strategy for NoC performance optimization by establishing various reconfigurable preferential channels as an effective mean to create small world shortcuts in the network and so decrease source-to-destination latency. Building on our statistical physics characterization of NoC traffic, we describe the utilization of the NoC buffers via a fitness function; the fitness function associated with each NoC buffer is directly proportional with the amount of packets passing through that buffer and the packet waiting times of packets. This strategy allows us to build both centralized and distributed dynamic control approaches to balance the traffic in the network with the goal of minimizing the source to destination packet latency. Our experimental results demonstrate significant reductions in the average packet latency and major improvements in the achievable network throughput with minimum hardware and power consumption overhead.

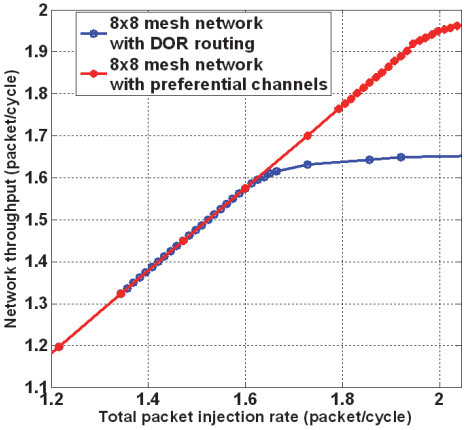

Fig. 1: Network throughput as a function of the packet injection rate for an 8x8 mesh NoC under uniform traffic with input and output buffers of 3 and 1 slot, respectively, and two routing protocols: dimensional ordered routing (DOR) and adaptive routing via fitness-based preferential channels.

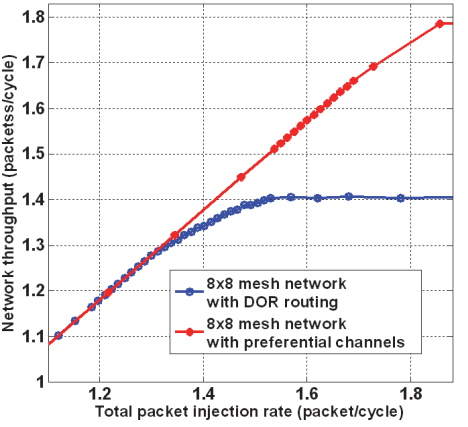

Fig 2: Network throughput as a function of the packet injection rate for an 8x8 mesh NoC under hotspot traffic with input and output buffers of 3 and 1 slot, respectively, and two routing protocols: dimensional ordered routing (DOR) and adaptive routing via fitness-based preferential channels.