Ryerson University

Department of Electrical, Computer & Biomedical Engineering
Faculty of Engineering & Architectural Science

COE838 – Systems-on-Chip Design

PROJECT SUMMARY

Semester/Year:	Winter 2025

Instructor:	Dr. Gul N. Khan
Section No:	032
Submission Date:	2025-03-02
Due Date:	2025-02-28

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SystemC based NoC (Network-on-Chip) Modeling Course Project

The objective of this project is to design and simulate a simple NoC system with a size of 1x2, as well as 4x4, using a SystemC environment. This system is composed of routers (or switches) and IP cores which are interconnected to form a specific network – that is, a mesh, torus, or hypercube.

Data from an IP core (or other hardware module) traverses through the network with the help of three modules, including a source, router and sink. As shown in Figure 1 below, the source first encapsulates the data into a packet, and then sends it out to the router, which to put it simply, is responsible for transporting that packet to the proper destination. Finally, the sink, or the receiver, returns an acknowledgement notifying the source that the packet sent is received successfully.

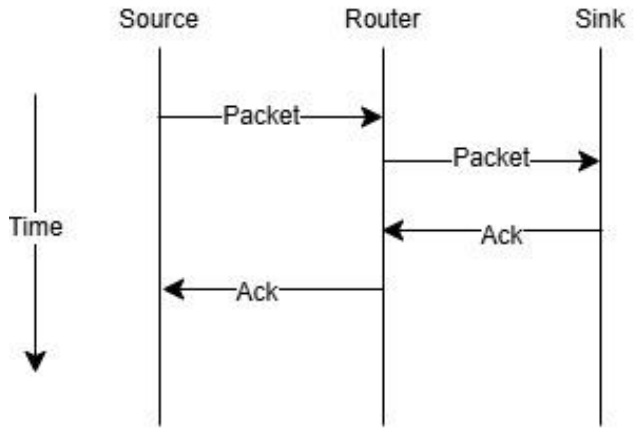

Figure 1: Communication of the source and sink with a router

As mentioned before, the source and sink communicates via packets, rather than the raw data themselves. A packet, however, is further divided into smaller pieces, called a flit. For this network, the packet is strictly required to contain at least two flits, including a header and a payload. The header flit consists of the source and sink address that is concatenated to the packet; on the other hand, the payload flit contains the actual data to be delivered.

The router is a crucial module for the functionality of NoC, as it enables IP cores to exchange data with all of the IPs in the network. This module contains three components: FIFO, arbiter, and crossbar. Figure 2 shows the interaction of these components in the case of an incoming header flit. 1) a header flit enters into the FIFO. 2) FIFO makes a request to the arbiter if the new flit can now be forwarded. 3) Arbiter checks whether the output port of the router is busy or not. If it is free, it grants the request of the FIFO. 4) Upon being granted, the FIFO delivers the flit to the crossbar. 5) Crossbar carries the flit into the corresponding output where the sink is physically connected to.

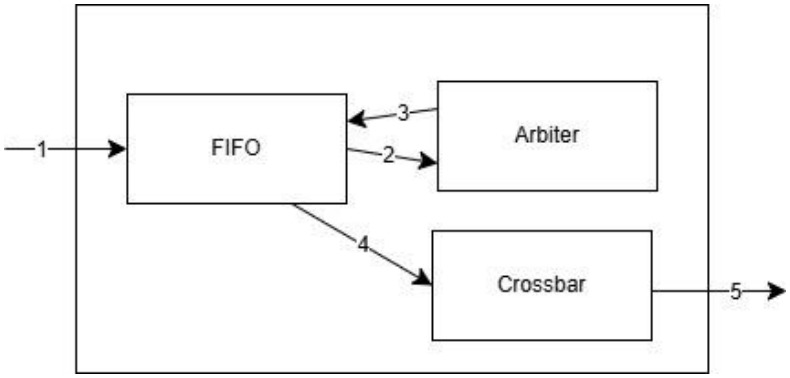

Figure 2: Components of a generic router.