

## Appendix A

# Memory Card Monitoring

This appendix describes some of the monitoring features planned for the NUMAchine memory card performance monitor.

The memory card is organized as shown in Figure A.1. The monitor receives memory block addresses, the type of transaction (Command), FIFO depth changes, and information about the state of the memory block from other components of the memory card. The monitor contains reprogrammable FPGAs and counter SRAM so that complex histograms and event counting can be done.

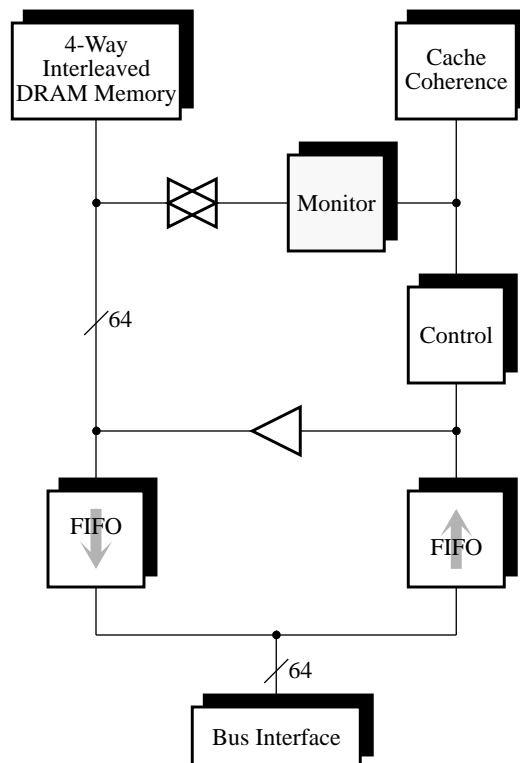


FIGURE A.1. Memory card organization.

## FIFO Depths

Dedicated hardware counters are used to maintain the current depth of the incoming and outgoing FIFOs. Two types of depths are recorded: number of packets and number of transactions. Additionally, the maximum FIFO depth is recorded in a special register.

The current queue depth is added in an accumulator on every cycle. Dividing this by the number of cycles yields the time-average queue length. If the queue depth is only accumulated after every change in queue length, a population average is obtained instead.

## Histogram Statistics

An SRAM memory and controller are used to produce different types of histograms. In particular, the most interesting types of histograms are a memory state hit table and page use statistics.

Data sharing patterns and performance prediction can make use of a memory state hit table. This table counts the number of request types that hit a particular memory block state. An example of this is shown in Table A.1.

State	Request Type			
	Read	Read Exclusive	Update	Writeback
LV	#	#	#	#
LI	#	#	#	#
GV	#	#	#	#
GI	#	#	#	#

**TABLE A.1. Memory state hit table.**

When collecting page use statistics (a.k.a. frequent flyer miles) every station's access to a page is recorded in the SRAM memory. If one page is accessed by a particular station significantly more often than the others, that page should be migrated to that station. The term 'frequent flyer miles' refers to the fact that frequent users of the page are logged, and eventually the station may collect enough points to get a free 'trip' to a new home. The best way of detecting when and how to migrate the page has not yet been decided.