A Reconfigurable Extension to the Network Interface of Beowulf Clusters

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Motivation

Beowulf Clusters and Reconfigurable Computing (RC) have complementary strengths and weaknesses. Integrating the two technologies has the potential to create a system that is more than the sum of its parts.

Reconfigurable Computing

- High performance computing engine based on programmable hardware
- Advantage:
  - Impressive performance for many apps
- Disadvantages:
  - Extremely expensive (low volume)
  - Not suitable for all applications
  - Typically interfaced through a (relatively) slow PCI bus

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Beowulf Clusters

- Low cost, dedicated clusters based on commodity hardware and open source software
- Advantage:
  - Low cost / high performance for some apps
- Disadvantages:
  - Commodity memory subsystem
  - Commodity network
  - Commodity I/O bus and interrupt system
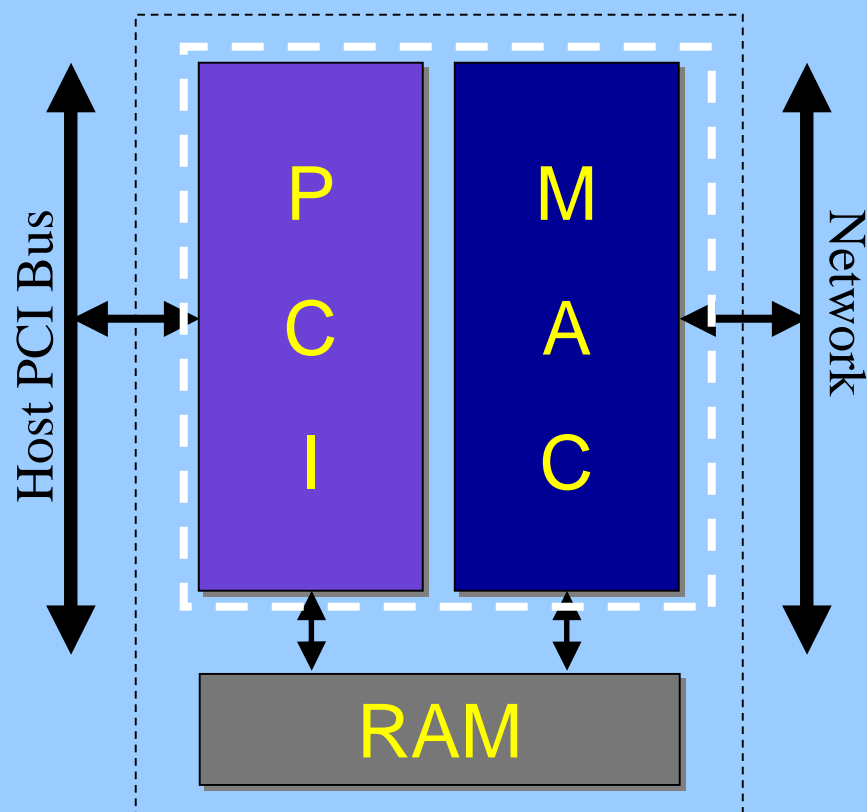
Integrating Two Technologies

- Placing RC on the PCI bus in a cluster increases the I/O problems (bus shared with network)
- Instead, Reconfigurable Computing should be:
  - placed in a commonly used data path
  - placed in a position to mitigate weaknesses in the Beowulf architecture
- The Network Interface Card (NIC) meets both of these criteria
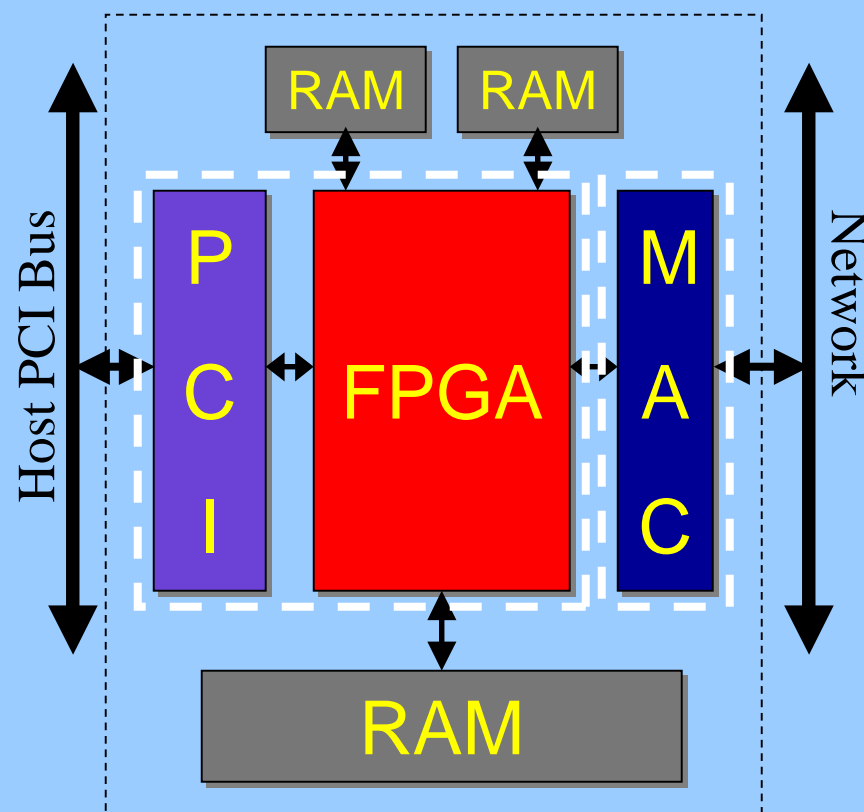
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Other Benefits
of Enhancing the NIC

- It has potential as a commodity component
  - Simple change to current NICs
  - Other applications possible

- Capable of providing network features

The INIC

Standard NIC

Intelligent NIC

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INIC Modes of Operation

Protocol Processing

(Message Passing Library)

Collective Operations

Computing

Standard NIC Functions

Computing

Protocol Processing

RAM RAM

P
C
I

FPGA

M
A
C

RAM

Beowulf Cluster Model

System I/O Interface

Node

Low Latency Network

Commodity Processor

Standard NIC

Network

Protocol Processing

Application Processing

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