



# Implementing an Affordable High Performance Computing for Teaching-oriented Computer Science Curriculum

Omar Abuzagheh, Jeongkyu Lee

Department of Computer Science and Engineering

University of Bridgeport, Bridgeport, CT

<http://www.bridgeport.edu/~jelee/mig>

## Abstract

The main objective of this poster is to present an affordable and easy-to-use high performance cluster system that can be used for the classroom in teaching-oriented computer science curriculum. In order to address this, we design and implement an affordable high performance cluster system that is based on PlayStation 3®. PS3 is a well-known for game console manufactured by Sony. Since each PS3 console has IBM Cell BE processor that consists of 8 Synergistic Processing Elements (SPEs) and 1 Power Processing Element (PPE), it can be used as a processing node with multiple-core processor in the cluster system.

In addition, the implemented cluster system has been used for new and existing computer science courses, such as CPSC 592: Parallel and Distributed Database, CPSC 590: Parallel and Distributed Processing, and CPSC 591: Parallel Programming.

## Introduction

In order to offer HPC related courses under teaching-oriented curriculum, such as Distributed and Parallel system, Parallel Programming or Distributed and Parallel Database, we need affordable infrastructure where student and instructor can design, implement and test the HPC system. An alternative approach for the HPC is cluster-based computing system because of its flexibility and feasibility of high computing power with relatively low cost. In addition, open source software including operating systems (i.e., Linux) and programming SDK help to reduce the cost, even make us easy to implement and use them.

Therefore, we design and implement an affordable high performance cluster system that is based on PlayStation 3®. PS3 is a well-known for game console. Since each PS3 device has IBM Cell BE processor that consists of 8 Synergistic Processing Elements (SPEs) and 1 Power Processing Element (PPE), it can be used as a processing node with multiple-core processor in the cluster system. 6 PS3 are connected each other through gigabit ethernet to form a cluster system. In addition, Fedora Core 12 Linux is installed as an operating system as well as IBM Cell SDK and Open-MPI as parallel programming software. All of them are open source software and easy to use in the classroom. This lineup is not only for educational purpose, but also used for military and industrial solutions.

## Design and Implementation of PS3 cluster

For the affordable high performance computer, it needs to satisfy with the following requirements: (1) price (2) processor power (3) scalability (4) easy to use.

In order to satisfy the aforementioned requirements, we adapt PlayStation 3® (PS3) based cluster system for the high performance computing environment. PlayStation, PS in abbreviated, is a video game console manufactured by Sony. The console has attracted considerable attention as a computing node because of the high performance of CELL processor used in PS3 with significantly low price comparing to other processors.

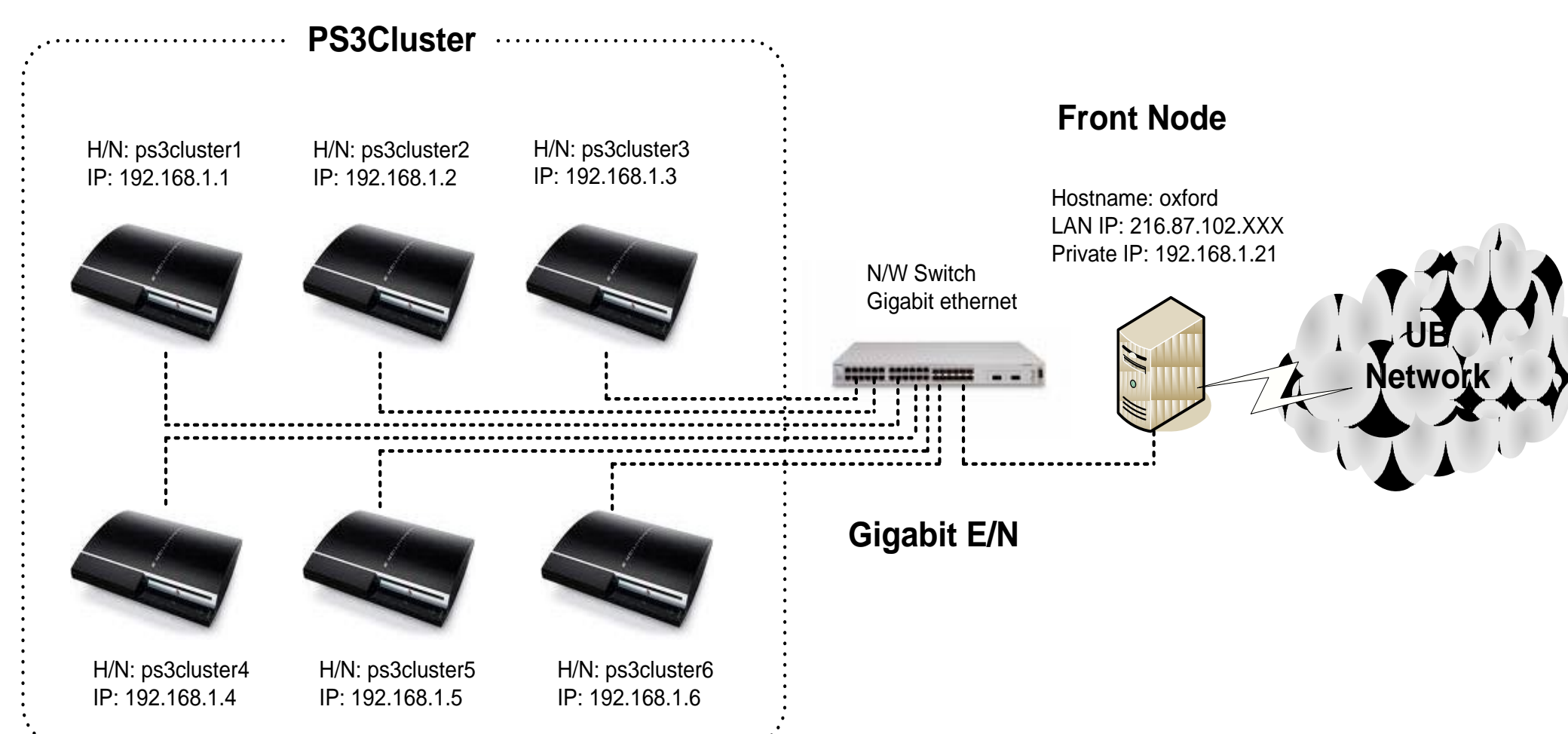


Figure 1 Overview of PS3 Cluster with 6 PlayStation 3

Six PlayStation 3 (80 GB, original model) released in 2008 are used for the cluster. To build a cluster system, they are connected to gigabit ethernet switch. In addition, a front node PC is attached to the system via the switch for security purpose. The front node is in charge of login, security, monitoring and management of UB PS3cluster.



Fig. 2 Pictures for implemented PS3 Cluster

## COURSE DEVELOPMENT

UB PS3cluster is designed and implemented in the new course in computer science and engineering department, i.e., CPSC 592: Parallel and Distributed Database in Spring 2010. A course syllabus consists of two parts: Distributed Database Systems and Parallel Database systems. One objective of this course is to provide the fundamental and advanced concepts and techniques of parallel and distributed database which have been the important issues for both academia and industries. The other objective is to prepare the students for doing research in the area of very large database systems. During the semester, we implemented Distributed and Parallel DBMS using UB PS3cluster.

Also the following courses are possible to be offered based on UB PS3cluster:

CPSC 590: Parallel and Distributed Processing, and  
CPSC 592: Parallel Programming.

## Conclusion

In this poster, we present the implementation of an affordable high performance computing (HPC) for teaching-oriented computer science program at University of Bridgeport. Although HPC is highly desired for undergraduate and graduate students, the high cost of HPC equipments and maintenance makes difficult to adapt them into the conventional computer science curriculum. In order to address this, we design and implement an affordable high performance cluster system that is based on PlayStation 3®(PS3). As a result, the PS3 cluster provides enough computing power for a HPC in CS courses, while the total cost is less than 10% of existing cluster system in market with the similar performance. In addition, the implemented clustering system has been used for new and existing computer science courses, such as CPSC 592: Parallel and Distributed Database. In the future, more courses related to HPC will be offered including CPSC 590: Parallel and Distributed Processing and CPSC 591: Parallel Programming.