

Architecture of Controlling Network and Virtualized Computational Resources on SDN-enhanced Job Management System Framework

Yasuhiro Watashiba^{*}, Masaharu Shimizu[†], Susumu Date[†], Hirotake Abe^{††}, Yoshiyuki Kido[†], Kohei Ichikawa^{*}, Hiroaki Yamanaka[§], Eiji Kawai[§] and Shinji Shimojo^{†, §}

^{*} Nara Institute of Science and Technology, Japan

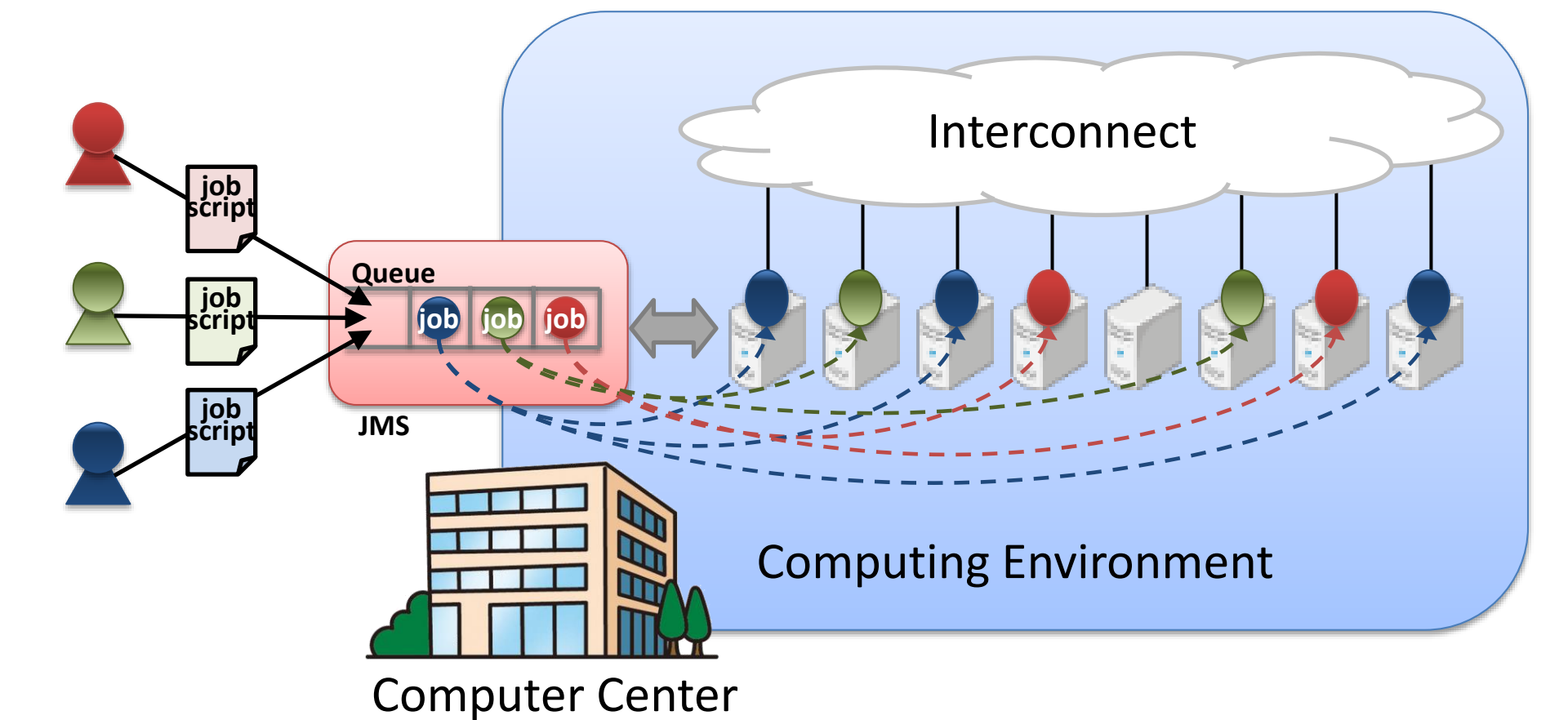
[†] Osaka University, Japan

^{††} University of Tsukuba, Japan

[§] National Institute of Information and Communications Technology, Japan

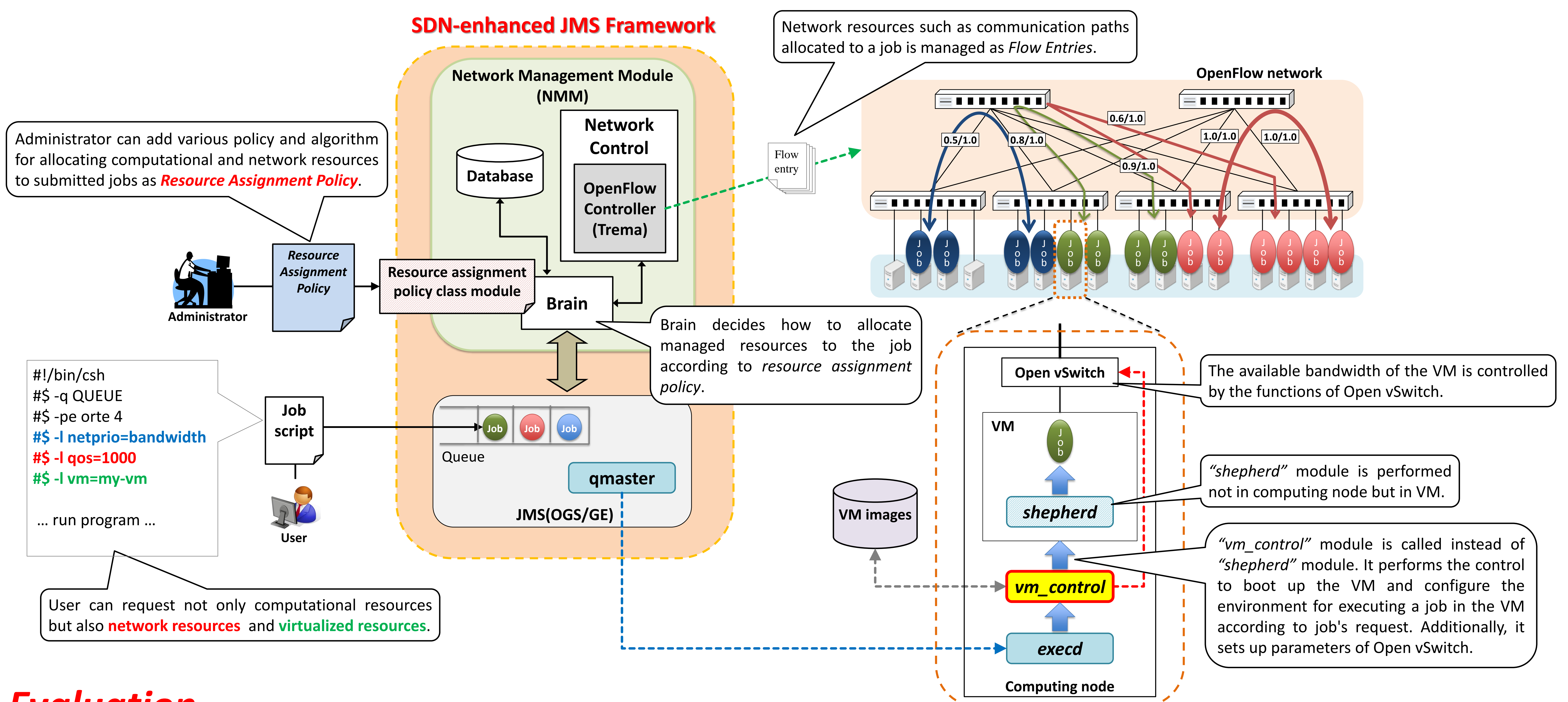
Motivation and Objectives

Nowadays, users' computation requests to a high-performance computing (HPC) environment have been increasing and diversifying for performing large-scale simulations and analysis in the various science fields. Since computer center flexibly complies such computation requests, efficient and flexible resource management system is essential for guaranteeing high performance computing capabilities for multiple users and gaining high job-throughput in computing environment.



Mechanism on SDN-enhanced JMS Framework

We have been studying and developing a novel Job Management System (JMS) for various resources of computing environment. For handling interconnect as network resources, the **SDN-enhanced JMS Framework** has been implemented by leveraging Software-Defined Networking (SDN) concept, which can dynamically control an entire network in a centralized manner [1]. Moreover, we have also been developing a mechanism for deploying job's processes to virtual machines (VMs) on computing nodes, and controlling available bandwidth on communication paths allocated to a job by using QoS functions of Open vSwitches (OVSS) connected with VMs.



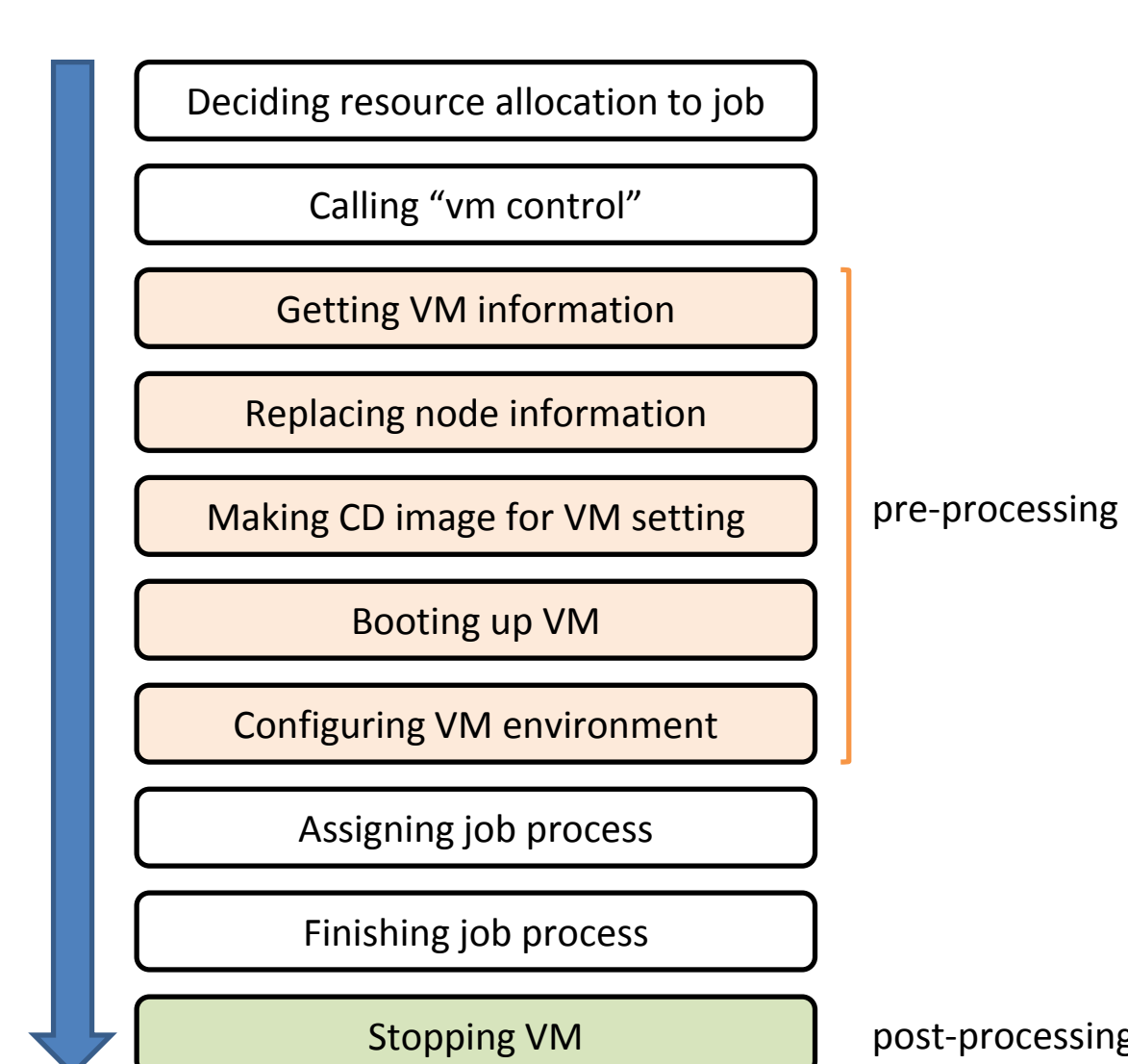
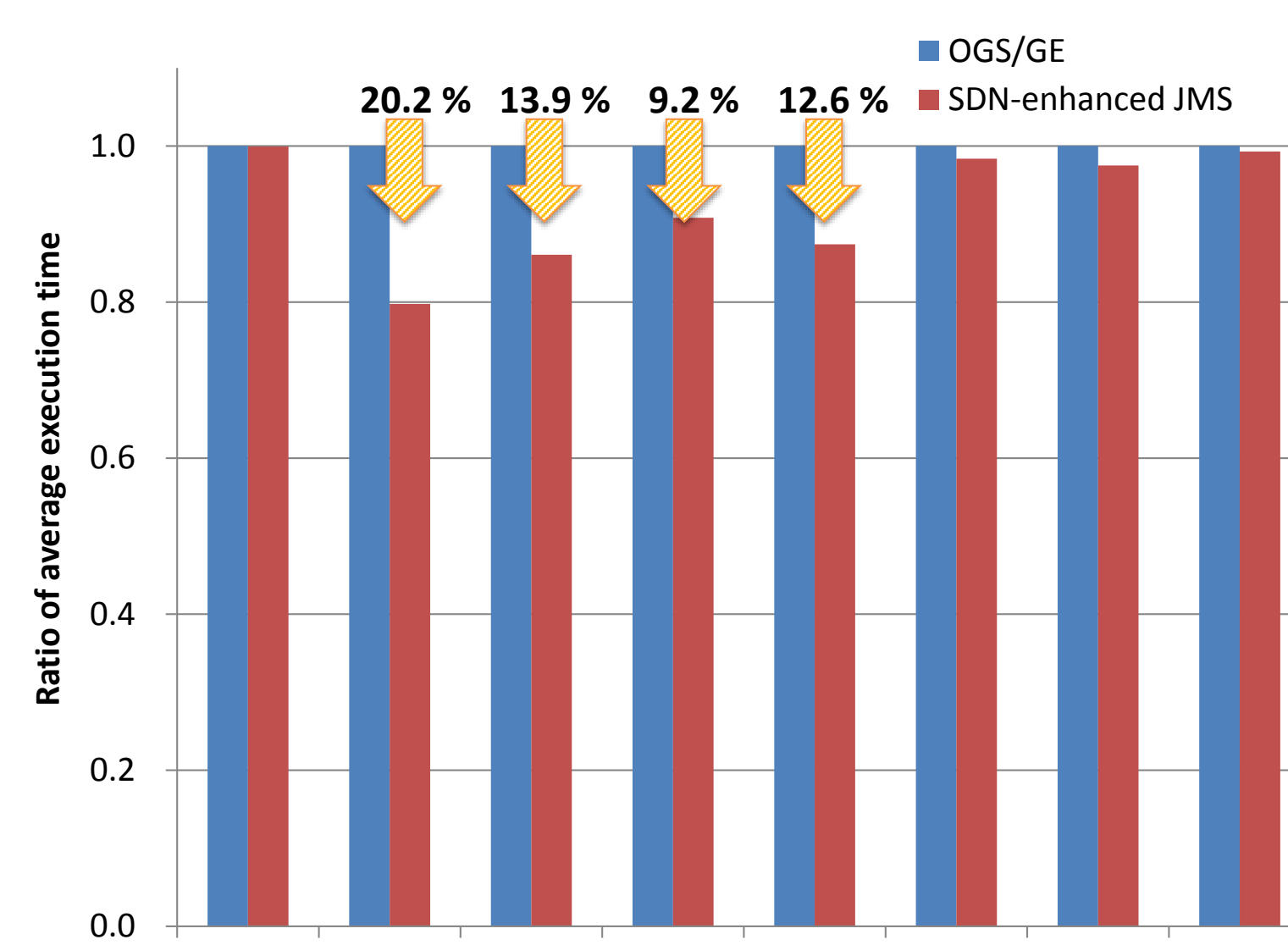
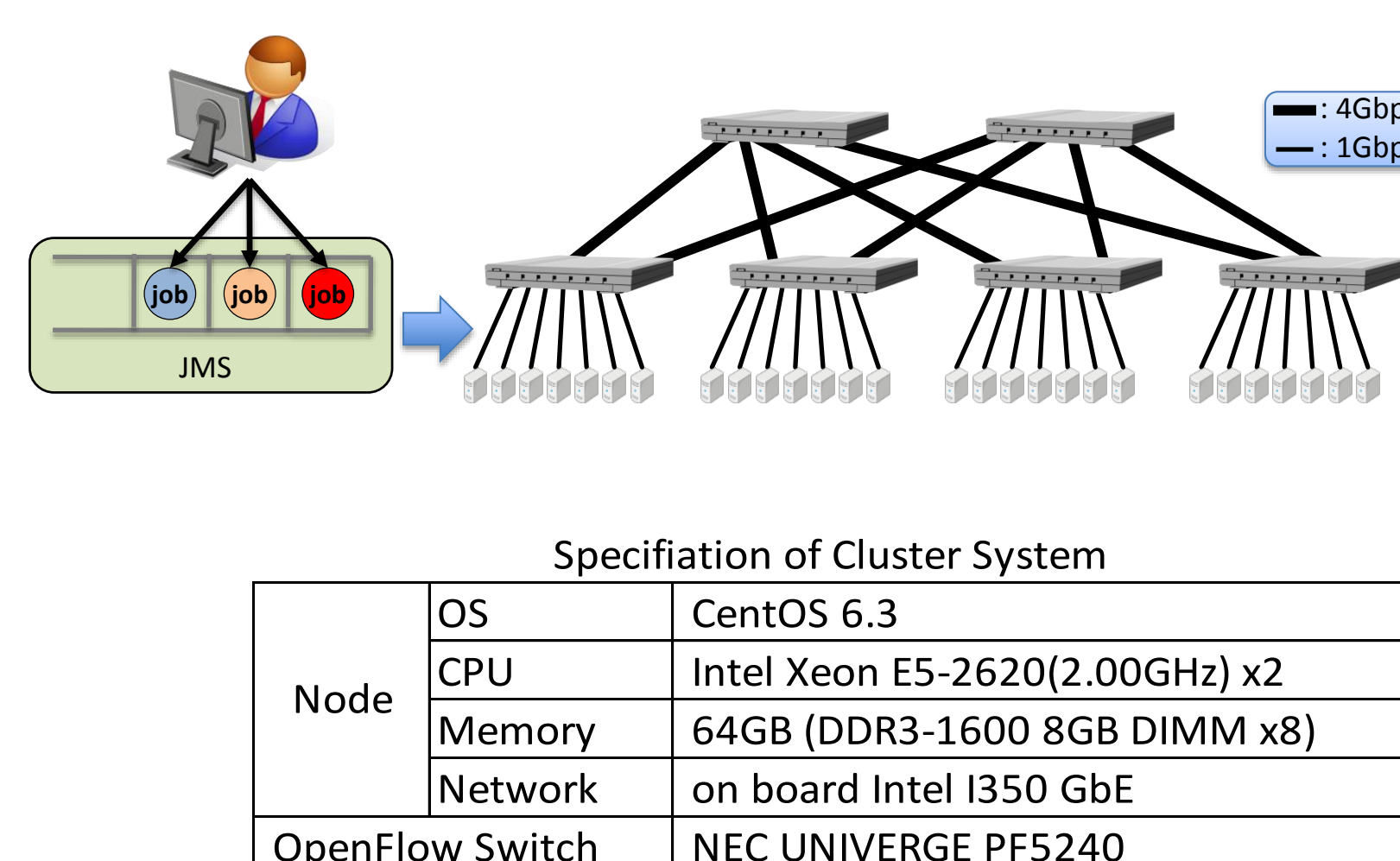
Evaluation

1) Effectiveness of Network Resource Allocation

The experiment in which multiple parallel jobs, each of which generates four processes for executing NAS Parallel Benchmarks with class B, were submitted was conducted for assessing the effectiveness of network resource management. In the experiment, the SDN-enhanced JMS Framework achieved the reduction of average job execution time, even if a fat-tree cluster system has enough bandwidth capacity.

2) Overhead to control virtualized computational resources

We measured the overhead caused by the "vm_control" for managing VMs on the SDN-enhanced JMS Framework. The overhead of the "vm_control" has the pre-processing and the post-processing: the configuration process to prepare the environment in a VM before it starting, and removing additional setting for the VM after it stopping individually.



Average overhead time (sec)		
Number of processes	Pre-processing	Post-processing
1	1.299	0.004
2	1.315	0.004
3	1.140	0.004
4	1.196	0.004

Acknowledgments

This research was supported in part by the collaborative research of the National Institute of Information and Communications Technology (NICT) and Osaka University (Research on High Functional Network Platform Technology for Large-scale Distributed Computing).

[1] Y. Watashiba, S. Date, H. Abe, Y. Kido, K. Ichikawa, H. Yamanaka, E. Kawai, S. Shimojo, and H. Takemura, "Performance Characteristics of an SDN-enhanced Job Management System for Cluster Systems with Fat-tree Interconnect", Emerging Issues in Cloud (EIC) Workshop, The 6th IEEE International Conference on Cloud Computing Technology and Science (CloudCom 2014), pp. 781-786, December 2014.