



Review

A survey on resource allocation in high performance distributed computing systems



Hameed Hussain^a, Saif Ur Rehman Malik^b, Abdul Hameed^b, Samee Ullah Khan^{b,*},
Gage Bickler^b, Nasro Min-Allah^a, Muhammad Bilal Qureshi^a, Limin Zhang^b, Wang Yongji^c,
Nasir Ghani^d, Joanna Kolodziej^e, Albert Y. Zomaya^f, Cheng-Zhong Xu^g, Pavan Balaji^h,
Abhinav Vishnuⁱ, Fredric Pinel^j, Johnatan E. Pecero^j, Dzmitry Kliazovich^j, Pascal Bouvry^j,
Hongxiang Li^k, Lizhe Wang^l, Dan Chen^m, Ammar Rayesⁿ

^a COMSATS Institute of Information Technology, Islamabad 44000, Pakistan

^b North Dakota State University, Fargo, ND, USA

^c Institute of Software, Chinese Academy of Sciences, Beijing, China

^d University of South Florida, Tampa, Florida 33620-5399, USA

^e Cracow University of Technology, Cracow, Poland

^f University of Sydney, Sydney, NSW, Australia

^g Wayne State University, Detroit, MI, USA

^h Argonne National Laboratory, Argonne, IL, USA

ⁱ Pacific Northwest National Laboratory, Richland, WA, USA

^j University of Luxembourg, Coudenhove-Kalergi, L1359, Luxembourg

^k University of Louisville, Louisville, KY, USA

^l Center for Earth Observation and Digital Earth, Chinese Academy of Sciences, Beijing, China

^m China University of Geosciences, Wuhan, China

ⁿ CISCO Systems, San Jose, CA, USA

ARTICLE INFO

Article history:

Received 24 September 2011

Received in revised form 10 September 2013

Accepted 16 September 2013

Available online 14 October 2013

Keywords:

Scheduling

Resource allocation

Resource management

ABSTRACT

An efficient resource allocation is a fundamental requirement in high performance computing (HPC) systems. Many projects are dedicated to large-scale distributed computing systems that have designed and developed resource allocation mechanisms with a variety of architectures and services. In our study, through analysis, a comprehensive survey for describing resource allocation in various HPCs is reported. The aim of the work is to aggregate under a joint framework, the existing solutions for HPC to provide a thorough analysis and characteristics of the resource management and allocation strategies. Resource allocation mechanisms and strategies play a vital role towards the performance improvement of all the HPCs classifications. Therefore, a comprehensive discussion of widely used resource allocation strategies deployed in HPC environment is required, which is one of the motivations of this survey. Moreover, we have classified the HPC systems into three broad categories, namely: (a) cluster, (b) grid, and (c) cloud systems and define the characteristics of each class by extracting sets of common attributes. All of the

* Corresponding author. Address: Department of Electrical and Computer Engineering, North Dakota State University, Fargo, ND 58108-6050, USA. Tel.: +1 701 231 7615; fax: +1 701 231 8677.

E-mail addresses: ham.hamdard@gmail.com (H. Hussain), saif.rehmanmalik@ndsu.edu (S.U.R. Malik), abdul.hameed@ndsu.edu (A. Hameed), samee.khan@ndsu.edu (S.U. Khan), gage.n.bickler@ndsu.edu (G. Bickler), nasar@comsats.edu.pk (N. Min-Allah), muhdbilal.qureshi@gmail.com (M.B. Qureshi), limin.zhang@ndsu.edu (L. Zhang), ywang@itech.iscas.ac.cn (W. Yongji), nghani@usf.edu (N. Ghani), jkolodziej@uck.pk.edu.pl (J. Kolodziej), albert.zomaya@sydney.edu.au (A.Y. Zomaya), czxu@wayne.edu (C.-Z. Xu), balaji@mcs.anl.gov (P. Balaji), abhinav.vishnu@pnl.gov (A. Vishnu), fredric.pinel@uni.lu (F. Pinel), johnatan.pecero@uni.lu (J.E. Pecero), dzmitry.kliazovich@uni.lu (D. Kliazovich), pascal.bouvry@uni.lu (P. Bouvry), h.li@louisville.edu (H. Li), lzwang@ceode.ac.cn (L. Wang), chendand@pmail.ntu.edu.sg (D. Chen), rayes@cisco.com (A. Rayes).

aforementioned systems are cataloged into pure software and hybrid/hardware solutions. The system classification is used to identify approaches followed by the implementation of existing resource allocation strategies that are widely presented in the literature.

© 2013 Elsevier B.V. All rights reserved.

Contents

1. Introduction	711
1.1. Motivation	712
2. Overview of HPC systems	712
2.1. HPC systems classes	713
2.1.1. Cluster computing systems	713
2.1.2. Grid computing systems	714
2.1.3. Cloud computing systems	715
2.2. Computer clusters: features and requirements	716
2.2.1. Job processing type	716
2.2.2. QoS attributes	716
2.2.3. Job composition	716
2.2.4. Resource allocation control	717
2.2.5. Platform support	717
2.2.6. Evaluation method	717
2.2.7. Process migration	717
2.2.8. Correlation of cluster features and resource allocation	718
2.3. Grid computer systems: features and requirements	718
2.3.1. System type	718
2.3.2. Scheduling organization	718
2.3.3. Resource description	719
2.3.4. Resource allocation policies	719
2.3.5. Breadth of scope	719
2.3.6. Triggering information	719
2.3.7. System functionality	720
2.3.8. Correlation of grid features and resource allocation	720
2.4. Cloud computing systems: features and requirements	720
2.4.1. System focus	720
2.4.2. Services	720
2.4.3. Virtualization	720
2.4.4. Dynamic QoS negotiation	720
2.4.5. User access interface	721
2.4.6. Web APIs	721
2.4.7. Value added services	721
2.4.8. Implementation structure	721
2.4.9. VM migration	721
2.4.10. Pricing model in cloud	721
2.4.11. Correlation of cloud features and resource allocation	721
3. Mapping the hpc systems classification to various cluster, grid and cloud systems: comparison and survey of the existing HPC solutions	722
3.1. Cluster computing system	722
3.1.1. Enhanced MOSIX	722
3.1.2. Gluster	722
3.1.3. Faucets	722
3.1.4. Distributed Queuing System (DQS)	723
3.1.5. Tycoon	724
3.1.6. Cluster on demand	724
3.1.7. Kerrighed	724
3.1.8. Open Single System Image (OpenSSI)	724
3.1.9. Libra	724
3.1.10. Parallel Virtual Machine (PVM)	724
3.1.11. Rexec	725
3.1.12. Generic Network Queuing System (GNQS)	725
3.1.13. Load Leveler	725
3.1.14. Load Sharing Facility (LSF)	725
3.1.15. Simple Linux Utility for Resource Management (SLURM)	725
3.1.16. Portable Batch System (PBS)	725
3.1.17. Condor (HTCondor)	725

Download English Version:

<https://daneshyari.com/en/article/10358609>

Download Persian Version:

<https://daneshyari.com/article/10358609>

[Daneshyari.com](https://daneshyari.com)