A Study of Cloud Computing Environments for High Performance Applications

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Abstract

High performance applications requires high processing power to compute highly intensive and complex applications for research, engineering, medical and academic projects. In the traditional way, an organization will have to pay very high costs to run an HPC (High Performance computing) application. The organization has to purchase highly expensive hardware for running an HPC application and maintaining it afterwards. The HPC resources on the company premises may not satisfy all the demands of scientific application where resources may not suitable for corresponding requirements. Considering the case of SMEs (small and medium enterprises), an increasing demand is always challenging. Cloud computing is an on-demand, pay-as-you-go model, that offers scalable computing resources, unlimited storage in an instantly available way. In this paper we included requirements of HPC applications in cloud, cluster based HPC applications, types of clusters, Google's HPC Cloud architecture, performance analysis of various HPC cloud vendors and four case studies of HPC applications in cloud.

Keywords: Cloud, HPC, SMEs, EC2, POD Cloud, R-HPC

I. INTRODUCTION

High Performance Computing (HPC) plays an important role in both scientific advancement and economic competitiveness of a nation - making production of scientific and industrial solutions faster, less expensive, and of higher quality. HPC is a key component in many applications: designing vehicles and airplanes; designing high-rise buildings and bridges; discovery of drugs; discovery and extraction of new energy sources like oil and natural gas; weather forecasting; and many more. HPC requires very high processing power to compute largely complex scientific applications. The advantage of pay-as-you-go computing has been an industry goal for many years starting from main frame, cluster and grid computing. Cloud computing takes grid computing to a whole new level by using virtualization to encapsulate an operating system instance and run it in a cloud whenever they need computational resources. In addition cloud storage can also be used independently with operating system instances. Cloud computing also offers unlimited storage and instantly available and scalable computing resources, all at a reasonable metered cost. Cloud also having large data centres which is suitable for data-intensive applications.

II. HPC APPLICATIONS IN CLOUD

With increasing demand for high performance, efficiency, productivity, agility and lower cost, since several years, information communication technology are dramatically changing from static silos with manually managing resources and applications, towards dynamic virtual environments with automated and shared services, i.e. from silo-oriented to service oriented architectures[15]. A "traditional" cloud offers features that are attractive to the general public. These services comprise single, loosely coupled instances (an instance of an OS running in a virtual environment) and storage systems backed by service level agreements (SLAs) that provide the end user guaranteed levels of service. These clouds offer the following features:

- Instant availability – Cloud offers almost instant availability of resources.
- Large capacity – Users can instantly scale the number of applications within the cloud.
- Software choice – Users can design instances to suit their needs from the OS up.
- Virtualized – Instances can be easily moved to and from similar clouds.
- Service-level performance – Users are guaranteed a certain minimal level of performance.

Although these features serve much of the market, HPC users generally have a different set of requirements:

- Close to the "metal" – Many man-years have been invested in optimizing HPC libraries and applications to work closely with the hardware, thus requiring specific OS drivers and hardware support.
- User space communication – HPC user applications often need to bypass the OS kernel and communicate directly with remote user processes.

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Surya Santoso,H. Wayne Beaty

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Cloud Computing in Medical Imaging Ayman El-Baz,Jasjit S. Suri,2023-03-14 Today s healthcare organizations must focus on a lot more than just the health of their clients The infrastructure it takes to support clinical care delivery continues to expand with information technology being one of the most significant contributors to that growth As companies have become more dependent on technology for their clinical administrative and financial functions their IT departments and expenditures have had to scale quickly to keep up However as technology demands have increased so have the options for reliable infrastructure for IT applications and data storage The one that has taken center stage over the past few years is cloud computing Healthcare researchers are moving their efforts to the cloud because they need adequate resources to process store exchange and use large quantities of medical data Cloud Computing in Medical Imaging covers the state of the art techniques for cloud computing in medical imaging healthcare technologies and services The book focuses on Machine learning algorithms for health data security Fog computing in IoT based health care Medical imaging and healthcare applications using fog IoT networks Diagnostic imaging and associated services Image steganography for medical informatics This book aims to help advance scientific research within the broad field of cloud computing in medical imaging healthcare technologies and services It focuses on major trends and challenges in this area and presents work aimed to identify new techniques and their use in biomedical analysis   Advances in Core Computer Science-Based Technologies George A. Tsihrintzis,Maria Virvou,2020-06-18 This book introduces readers to some of the most significant advances in core computer science based technologies At the dawn of the 4th Industrial Revolution the field of computer science based technologies is growing continuously and rapidly and is developing both in itself and in terms of its applications in many other disciplines Written by leading experts and consisting of 18 chapters the book is divided into seven parts 1 Computer Science based Technologies in Education 2 Computer Science based Technologies in Risk Assessment and Readiness 3 Computer Science based Technologies in IoT Blockchains and Electronic Money 4 Computer Science based Technologies in Mobile Computing 5 Computer Science based Technologies in Scheduling and Transportation 6 Computer Science based Technologies in Medicine and Biology and 7 Theoretical Advances in Computer Science with Significant Potential Applications in Technology Featuring an extensive list of bibliographic references at the end of each chapter to help readers probe further into the application areas of interest to them this book is intended for professors researchers scientists engineers and students in computer science related disciplines It is also useful for those from other disciplines wanting to become well versed in some of the latest computer science based technologies   Advanced Informatics for Computing Research Ashish Kumar Luhach,Dharm Singh,Pao-Ann Hsiung,Kamarul Bin Ghazali Hawari,Pawan Lingras,Pradeep Kumar Singh,2018-11-28 This two volume set CCIS 955 and CCIS 956 constitutes the refereed proceedings of the Second International Conference on Advanced Informatics for Computing Research ICAICR 2018 held in Shimla India in July 2018 The 122 revised full papers

presented were carefully reviewed and selected from 427 submissions The papers are organized in topical sections on computing methodologies hardware information systems networks security and privacy computing methodologies

Research Advances in Cloud Computing Sanjay Chaudhary,Gaurav Somani,Rajkumar Buyya,2017-12-28 This book addresses the emerging area of cloud computing providing a comprehensive overview of the research areas recent work and open research problems The move to cloud computing is no longer merely a topic of discussion it has become a core competency that every modern business needs to embrace and excel at It has changed the way enterprise and internet computing is viewed and this success story is the result of the long term efforts of computing research community around the globe It is predicted that by 2026 more than two thirds of all enterprises across the globe will be entirely run in cloud These predictions have led to huge levels of funding for research and development in cloud computing and related technologies Accordingly universities across the globe have incorporated cloud computing and its related technologies in their curriculum and information technology IT organizations are accelerating their skill set evolution in order to be better prepared to manage emerging technologies and public expectations of the cloud such as new services **Challenges in Cybersecurity and Privacy - the European Research Landscape** Jorge Bernal Bernabe,Antonio Skarmeta,2022-09-01 Cybersecurity and Privacy issues are becoming an important barrier for a trusted and dependable global digital society development Cyber criminals are continuously shifting their cyber attacks specially against cyber physical systems and IoT since they present additional vulnerabilities due to their constrained capabilities their unattended nature and the usage of potential untrustworthiness components Likewise identity theft fraud personal data leakages and other related cyber crimes are continuously evolving causing important damages and privacy problems for European citizens in both virtual and physical scenarios In this context new holistic approaches methodologies techniques and tools are needed to cope with those issues and mitigate cyberattacks by employing novel cyber situational awareness frameworks risk analysis and modeling threat intelligent systems cyber threat information sharing methods advanced big data analysis techniques as well as exploiting the benefits from latest technologies such as SDN NFV and Cloud systems In addition novel privacy preserving techniques and crypto privacy mechanisms identity and eID management systems trust services and recommendations are needed to protect citizens privacy while keeping usability levels The European Commission is addressing the challenge through different means including the Horizon 2020 Research and Innovation program thereby financing innovative projects that can cope with the increasing cyberthreat landscape This book introduces several cybersecurity and privacy research challenges and how they are being addressed in the scope of 15 European research projects Each chapter is dedicated to a different funded European Research project which aims to cope with digital security and privacy aspects risks threats and cybersecurity issues from a different perspective Each chapter includes the project s overviews and objectives the particular challenges they are covering research achievements on security and privacy as well as the techniques outcomes and evaluations accomplished in

the scope of the EU project The book is the result of a collaborative effort among relative ongoing European Research projects in the field of privacy and security as well as related cybersecurity fields and it is intended to explain how these projects meet the main cybersecurity and privacy challenges faced in Europe Namely the EU projects analyzed in the book are ANASTACIA SAINT YAKSHA FORTIKA CYBECO SISSDEN CIPSEC CS AWARE RED Alert Truessec eu ARIES LIGHTest CREDENTIAL FutureTrust LEPS Challenges in Cybersecurity and Privacy the European Research Landscape is ideal for personnel in computer communication industries as well as academic staff and master research students in computer science and communications networks interested in learning about cyber security and privacy aspects **Cybersecurity in Cloud Computing** Akula Achari,2025-01-23 Cybersecurity in Cloud Computing delves into the security challenges and solutions in the rapidly evolving world of cloud technology We explore key concepts such as data protection threat detection and risk management within cloud environments The book highlights how cloud services can enhance scalability and flexibility while also presenting new security risks that need to be addressed Readers will gain insights into the latest cybersecurity practices including encryption methods identity management and multi factor authentication We also discuss the importance of developing a comprehensive security policy to safeguard cloud infrastructure Whether you are an IT professional or a business owner this book equips you with the tools to secure your digital assets and maintain data integrity in the cloud

Communication and Computing Systems B.M.K. Prasad,Krishna Kant Singh,Neelam Ruhil,Karan Singh,Richard O'Kennedy,2017-02-15 This book is a collection of accepted papers that were presented at the International Conference on Communication and Computing Systems ICCCS 2016 Dronacharya College of Engineering Gurgaon September 9 11 2016 The purpose of the conference was to provide a platform for interaction between scientists from industry academia and other areas of society to discuss the current advancements in the field of communication and computing systems The papers submitted to the proceedings were peer reviewed by 2 3 expert referees This volume contains 5 main subject areas 1 Signal and Image Processing 2 Communication Computer Networks 3 Soft Computing Intelligent System Machine Vision and Artificial Neural Network 4 VLSI Embedded System 5 Software Engineering and Emerging Technologies Computational Intelligence Techniques for 5G Enabled IoT Networks Mohit Kumar,Sukhpal Singh Gill,Vijay Kumar,Prabal Verma,2025-07-26 This book explores emerging interdisciplinary themes and applications reflecting advancements in Computational Intelligence CI for IoT and 5G networks It is divided into four sections Section 1 introduces Computational Intelligence and Sustainability Solutions for Next Gen IoT Networks Section 2 covers Optimization and Resilience Strategies for 5G Enabled IoT Networks Section 3 delves Intelligent Resource Allocation and Service Optimization in 5G IoT Networks Section 4 presents Case studies on Applied Computational Intelligence and 5G IoT Innovations for Industry 4 0 This comprehensive work is essential for researchers and professionals interested in leveraging CI IoT and 5G technologies across diverse applications *Recent Advances in Computer Based Systems, Processes and Applications* Anupama Namburu,Soubhagya

Sankar Barpanda,2020-06-14 This was the first conference organized by the school of Computer Science Engineering in VIT AP University campus with the cumulative efforts of all the faculty members The proceedings discusses recent advancements and novel ideas in areas of interest It covers topics such as advances in computer based systems processes and applications

Graphics Interface 2014 Paul G. Kry,Andrea Bunt,2014-05-06 This book is the proceedings of the 40th annual Graphics Interface conference the oldest continuously scheduled conference in the field The book includes high quality papers on recent advances in interactive systems human computer interaction and graphics from around the world It covers the following topics shading and rendering geometric modeling and meshing image based rendering image synthesis and realism computer animation real time rendering non photorealistic rendering interaction techniques human interface devices augmented reality data and information visualization mobile computing haptic and tangible interfaces and perception

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will demonstrate a pragmatic methodology used in conjunction with UML unified modeling language BPMN business process modeling notation along with engineering principles for describing an actionable architecture for cloud computing in the real world The fundamental paradigm of cloud computing whether it is for private or public usage revolves around the provisioning of services for everyone through rich resources that can be synergized through Internet based protocols The true definition of Cloud Computing is according to the author all about the practicalities of outsourcing all aspects of using computing resources to some form of external agency This means that the assumption for any cloud computing usage is the fact that the agency has a powerful resource base hardware software infrastructure platforms power supply backups failover mechanisms as well as management skills Therefore all users of the cloud computing services provided by the agency can work in a well defined demand supply mode with an insurmountable base of possible fault tolerant mechanisms to support best possible user experiences The user will have the unique experience of not being worried about where his her work is being done because cloud computing as defined above will enable him her to work in a virtualized environment but with the feeling of being close to the resources However the apparent ease available through cloud computing will raise problems associated with diverse types of risks Hence it is imperative to define new architectural blueprints as well as the associated business processes around them so as to provide measurable metrics that will allay the fears of any user The architectural blueprint is not just meant to be a lot of diagrams and documents but they are to be modeled as actionable artifacts These actionable artifacts will allow for operational excellence that covers all types of functional as well as non functional requirements that any user expects The MDA model driven architecture approach coupled with BPM business process modeling and engineering principles as posited in this paper will allow for management of distributed communication scheduling security enhancements and rights as well as many other aspects that will make the user experience enjoyable and successful   **Prosiding Konferensi Perpustakaan Digital Indonesia 10** Titiek Kismiyati,Wiratna Tritawirasta,2017 Role of digital library and web based library in sutainable development of Indonesia proceedings of a conference   Sustainability of Higher Education Rosni Bakar,Aziah Ismail,2018   **Decision Support Tool to Reduce Energy and Water Consumption in Agriculture** Olivier Jerphagnon,Stanley Knutson,Roland Geyer,Kate M. Scow,PowWow Energy, Inc,2019   **2014 IEEE 3rd International Conference on Cloud Computing and Intelligence Systems (CCIS)** IEEE Staff,2014-11-27 Research and development on cloud computing and intelligent systems have been carried out in last few years and some of them have been successfully deployed and used in many fields This year the conference aims to address Challenges for cloud computing and intelligent technology The conference will feature a comprehensive technical program including a number of keynote speeches and session discussions

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