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Korea Supercomputing Software Initiative: Design and Strategy

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Abstract. This paper presents design and strategy of KSSI (Korea Supercomputing Software Initiative) which aims to facilitate interoperability among different middleware technologies over national supercomputing infrastructures, provide guidelines for deployment and quality assurance of developed software, and present a grand-challenge problem that requires massive computing/storage power and seamless integration of various supercomputing technologies. Throughout our KSSI strategy and system, we develop and maintain a set of high-quality software technologies that can support most challenging scientific applications.

Keywords: KSSI, Middleware System, National Supercomputing Infrastructure, Quality Assurance

1 Introduction

With an exceptional increase of available computing, storage and networking resources, petascale computing systems (so called *supercomputers*) have enabled the unraveling of significant scientific discoveries and present new challenges and opportunities. Major scientific opportunities arise in various fields such as new drug discovery, understanding the origin of the universe, weather modeling, understanding global warming, national security, and economics. With an upcoming era of exascale computing, supercomputing technologies that can effectively support these grand-challenge problems will become more crucial [1].

The National Institute of Supercomputing and Networking (NISN) at KISTI is one of the largest supercomputing center in Korea and provides domestic universities, research institutes, industries and government R&D teams with advanced infrastructure which consists of supercomputers and high-speed network. This includes supporting related application technologies, performance optimization, middleware systems harnessing national supercomputing resources, scientific data visualization, HPC cloud, etc. During the past decade, we have designed and

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implemented a number of valuable technologies that can effectively leverage national supercomputing resources to support various scientific applications and communities. However, due to uncoordinated & independent software developments, they often lack compatibility, integration and strict quality assurance mechanisms.

This paper presents design and strategy of KSSI (Korea Supercomputing Software Initiative) which aims to facilitate interoperability among different middleware technologies over national supercomputing infrastructures, provide guidelines for deployment and quality assurance of developed software, and present a grand-challenge problem that can require massive computing/storage power. Similar to EMI [2, 3] or EGI [4] UMD (Unified Middleware Distribution) in Europe and XSEDE [5] TED (Technology Evaluation Database) in U.S., our KSSI strategy and system will enable us to develop and maintain a set of high-quality software technologies that can support most challenging scientific applications, improve the sustainability of developed software and effectively integrate national supercomputing resources in Korea.

2 Korea Supercomputing Software Initiative (KSSI)

In this section, we present concepts, software architecture and quality assurance mechanism of KSSI to support many challenging scientific applications by exploiting national supercomputing resources.

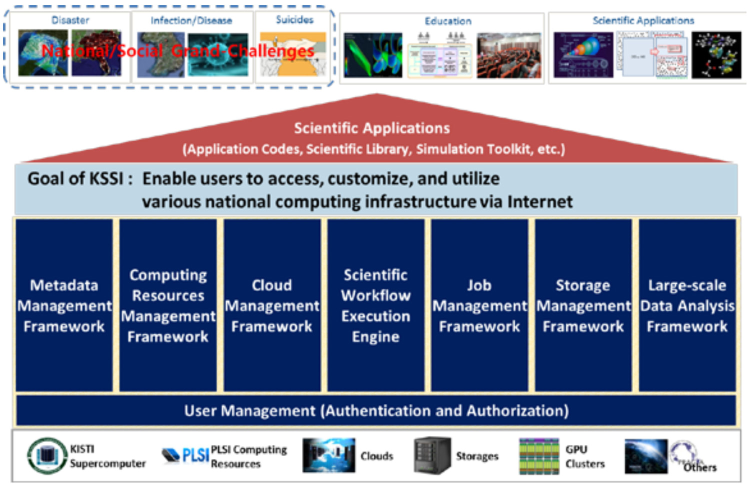

Fig. 1. KSSI Concepts and Models

Based on the past trends of distributed scientific computing (including HTC, HPC, DIC, Cloud etc.), we have driven several middleware frameworks that can support various scientific applications including metadata management, computing resource management, cloud management, scientific workflow engine, job management, storage management and large-scale data analysis (as we can see from Figure 1).

Based on these different middleware frameworks, KSSI enables users with various scientific applications (application codes, scientific library, simulation toolkits, etc.) to access, customize, and utilize national computing infrastructures via Internet.

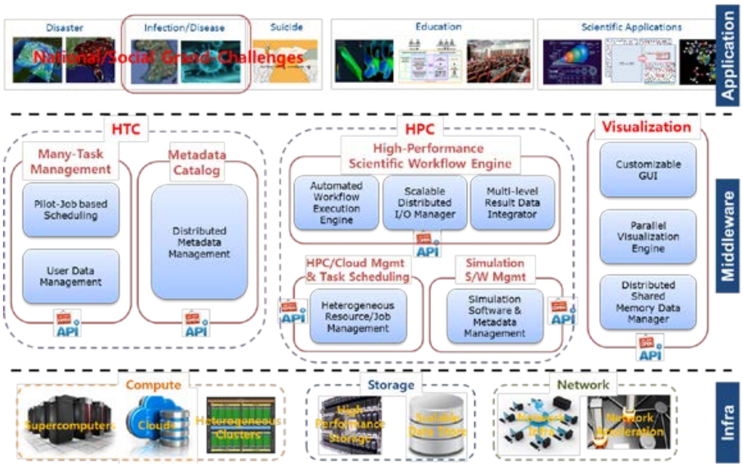

Fig. 2. KSSI Software Architecture

However, since we cannot support all of technical areas presented in Figure 1, we have elaborated some of key middleware technologies that can be interoperable each other, and be integrated to support grand-challenging national/social problems. Figure 2 shows current KSSI software architecture and it consists of three major categories (HTC, HPC and Visualization) and 6 different middleware technologies (Many-Task Management, Metadata Catalog, High-Performance Scientific Workflow Engine, HPC/Cloud management & Task Scheduling, Simulation S/W Management, and Scientific Visualization). All of KSSI middleware systems can effectively utilize national supercomputing resources consisting of compute/storage/network and be interoperable each other throughout Open API. As a targeting grand-challenge problem, KSSI aims to address infectious disease surveillance which can automate the analysis of infectious disease outbreaks, in order to help contain diseases and minimize their impact.

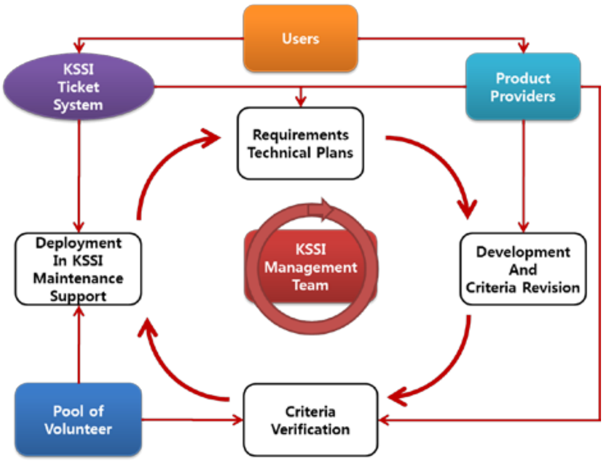

Fig. 3. KSSI Quality Assurance Process

Finally, to improve the sustainability of developed supercomputing software, we have analyzed the product management system in EMI [3] and driven our KSSI quality assurance system. As we can see from Figure 3, KSSI QA is basically a circular system that can take inputs from users who are actively utilizing KSSI software products and reflect requirements from the users to the future product development coordinated by KSSI Management Team. The collected requirements from users are analyzed into technical plans which will result in new criteria for the products so that they can be integrated into the development process. Once the development is finished, a pool of volunteers acts as evaluators for the product based on the determined criteria to rigorously verify the functionalities of the product.

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