

Study of High Performance Computing Activation Strategy

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Abstract

High Performance Computer (also called "supercomputer") is a computer which can process the complex and large-scale operation in computational science. In general, High Performance Computer represents the top 500 computers which is based on the computer performance in the world. After the successful commercialization of CDC6600 which has the 9MFLOPS performance in 1964, TFLOPS and PFLOPS High Performance Computer have been developed. High Performance Computer is the public resource which can be developed and provided by government. For the efficient application of High Performance Computer, government has to support the related activities such as research, resource allocation, and professional manpower training. To build a basis of the development of High Performance Computing can improve the quality of life and develop the national economy. For this reason, Korean government preceded the establishment of law for national supercomputing promotion from 2009. As a result of this effort, Korean government enacted the 'National Supercomputing Promotion Act' in 2011. This study provides the domestic and international trend of High Performance Computer, and analyses the major contents of National Supercomputing Promotion Act. This effort will be helpful to propose the strategy in order to provide more efficient service as a momentum of national supercomputing center.

Keywords: *High Performance Computer, Cyberinfrastructure, Supercomputer, Promotion Act, Computational Science, Computational Engineering*

1. Introduction

The high performance computer is a public resource the government should develop and provide. To apply the public resource effectively, high performance computer related technologies should be promoted such as high performance computer related research and development, effective distribution of the resource and training of professional manpower. At the state level, to promote the high performance computer related technologies, a national high performance computing law is necessary. By this necessity, South Korea carried out procedures for the enactment of a law for high performance computer related technology development, application and promotion since 2009. Accordingly, in June, 2011, 'National Supercomputing Promotion Act' was enacted. This paper will investigate the trend of the world policies for high performance computer, analyze and sum up the main contents of this law. According to this act, high performance computing refers to computing, communication, and information technology includes application of high-capacity, high-speed computer network using high performance computer or high performance computer technology, establishment

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and application of special-purpose experiments system, system software and large amounts of data management. This paper will investigate the trend of the world policies for high performance computer and describe major contents of National Supercomputing Promotion Act. This effort will be helpful to propose the strategy in order to provide efficient service as a momentum of national supercomputing center.

2. Trend of the world policies

2.1. United States

The U.S. recognized the importance of high performance computer early as a national infrastructure, enacted related laws since 1991, and the government led the related technologies and policies, maintaining the global leading position. The high performance computer related representative law of the U.S., 'High Performance Computing Act (1991)' provides pan-governmental high performance computing program guidelines. The law specifies the obligation of providing computing resource and high performance & high speed network and providing the national information infrastructure, and individual ministries are promoting research and development business autonomously. This bill was revised to High Performance Computing Revitalization (2004). In addition, with core bases of Next Generation Internet Research Act (1991), American Competitiveness Initiative (ACI) and TeraGrid technology since 2000, establishment of national cyberinfrastructure is in progress [1].

2.2. Japan

Japan prepared 'HPCI (High Performance Computing Infrastructure) Strategy Program' through scientific technology basic planning since the late 1980s and has promoted high performance computing application national research and development business. The HPCI Strategy Program drew out application plan and detailed research and human resource development program by area for 6 years since 2010. In addition, it makes a comprehensive promotion of performing research and review. The HPCI Program aims at applying next generation high performance computer, training manpower and establishing a base of state-of-the-art computing research education beyond a joint application program. Also, since 2006, it was extended and promoted to 'Science Grid NAREGI' in 'Development and Application of Advanced High-Performance Supercomputing Program' of the Japanese Ministry of Education, linked to approximately 100TF class resources [2].

2.3. European Union (EU)

Europe promotes technological development by establishing a network for joint application of high performance computer resources spread in 27 member countries and supporting funds for high performance computer related studies [3]. Centering on the European Union (EU), it promotes PCP (Pre-Commercial Procurement) actions and stimulates high performance computing research and development and application to medium and small firms. It establishes and provides European high performance computer infrastructure providing extensive benefits for users in academia and industry, especially, medium and small firms. Through strategic joint application and commercialization, and transfer procurement policy, it has established the pan-European HPC management plan.

2.4. China

As a result of full investment to hold its own high performance computer technology based on a medium-and long-term scientific technology plan, China has secured global level technical skills. In 'China medium-and long-term scientific technology plan' established in 2009, it took modernization through science technology innovation as a priority strategy and invested resources worth of dozens of trillions. Through establishing the 'National high performance computing environment,' high performance computer regions such as Beijing, Nanjing, Shanghai and Xian were interlocked. China invested development cost of approximately 100 billion won to develop Tianhe-1 (MilkyWay-1) and for 3 years, about 400 teams participated in its own development of Tianhe-2 (MilkyWay-2) to take the first place of the top 500 in June 2013.

3. Korea Supercomputing Promotion Act in 2011

3.1. Overview

South Korea constructed the first supercomputer (KISTI-1) in 1998. KISTI-2 was constructed in 1997; KISTI-3 in 2002; and KISTI-4 in 2009 and they are operating now. In 2009 when KISTI-4 was constructed, the 'National Supercomputing Promotion Act' was proposed in the national assembly, which was enacted and proclaimed in June 2011, and has been effective 6 months later since December 2011.

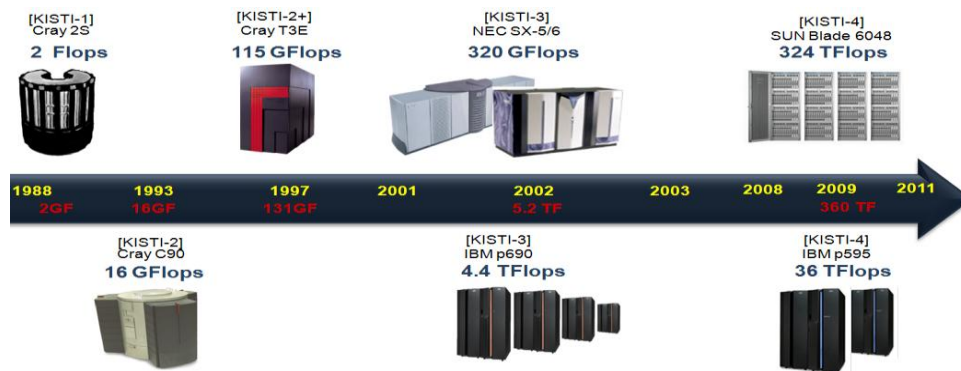


Figure 1. History of KISTI Supercomputer

This law consists of establishing high performance computing environment, developing technologies, training professional manpower and application to various categories. This law includes network-related content as well as computer systems (hardware and software). In addition, its contents consist of installing organizations dedicated at the national level, carrying out businesses such as developing, introducing, operating, managing and applying high performance computer and establishing high performance computing related life cycle ecosystem.

3.2. Composition of the Act

The 'National Supercomputing Promotion Act' consists of 21 Articles in 4 Chapters including general provisions, national high performance computing promotion/development promoting system, creation of national high performance computing foundation, and national high performance computing activation.

Table 1. Composition of National Supercomputing Promotion Act

Chapter	Article
Chapter 1 General provisions	1. Purpose 2. Definitions 3. Responsibility of the state 4. Relationships with other law
Chapter 2 National high performance computing promotion/development promoting system	5. Establishment of national high performance computing promotion basic planning 6. Establishment of action plan 7. National high performance computing committee 8. Consideration policies for national High performance computing promotion 9. National high performance computing center
Chapter 3 Establishment of national High performance computing foundation	10. Expansion of research and development investment 11. Development of professional manpower 12. Establishment, maintenance, application and improving high performance research network 13. Collection and supply of technical intelligence 14. Investigation of high performance computing research and development activities
Chapter 4 National High performance computing activation	16. Promotion of joint research and development 17. Joint application of high performance computing resources 18. Support for industry 19. International cooperation 20. Practical application of the results of research and development 21. Stimulation of application of the national high performance computing

3.3. Analysis of Major Contents

The enactment of the ‘National Supercomputing Promotion Act’ aims to promote sustainable application and establish a development base through effective establishment and systematic management of the national high performance computer to contribute to improving the people's quality of life and developing the national economy. The definition of terms in this act is as follows:

Table 2. Definition of Terms

Term	Definition
High performance computing	This refers to computing, communication and information technology including application of high-capacity and high-speed computer network using high performance computer or high performance computer technology, establishment and application of special-purpose experiment system and management of system software and large amounts of data.
National high performance computing	This refers to the development, establishment, operation and application of high performance computing system at the state level such as scientific technology, national defense, education, society, culture and economy applied for public and industrial purposes.
High performance computing resource	This refers to resources necessary for the promotion of high performance computing and national high performance computing related to this such as facility, technology, software (application and system software), network-based, human resources and information set up by the ordinance of the Minister of Science, ICT & Future Planning.
High performance research network	This refers to high performance computing related network for high-tech research.

To promote and stimulate the promotion of the national high performance computing, in accordance with a presidential decree, the national high performance computing center may

be established or designated. The national high performance computing center should carry out the following businesses:

Table 3. Detail of National High Performance Computing Center Business

Classification	Detail
Securing and operating resources	<ul style="list-style-type: none"> - Prediction of demands for the necessary national high performance computing resources - Security and management of the global level high performance computing resources - Management and operation of high-tech research networks
Research and development	<ul style="list-style-type: none"> - Execution of the national high performance computing research and development through industry-academia-research cooperation - The High performance computing resource-linked technical support and management of joint application - Supply of the high performance computing-related base, applied research and research results
Training manpower	<ul style="list-style-type: none"> - Development of the high performance computing related professional manpower, education training and technical support
Spread of application	<ul style="list-style-type: none"> - Collection and supply of the high performance computing related technical intelligence - Execution of tasks of the high performance computing related international cooperation - Survey on domestic/overseas high performance computing and study on policies like activation plan

The government should establish plans for training manpower of high performance computing to develop manpower resources necessary for the promotion of the national high performance computing, establish manpower-related education and training programs, and consider policies for overseas training of professional manpower, attracting and utilizing excellent human resources from foreign countries. The government should make efforts for the establishment, maintenance, application and improvement of the national high performance computing related high performance research networks. The government should make efforts to collect and manage data and information about the national high performance computing and support them to related institutes.

4. Activation of HPC Application

The government may provide necessary support for the industries' activities of the national high performance computing research and development to stimulate and the industrialization of the results of the research and development. The government should preferentially promote support for technology-integrated medium and small firms related to high performance computing and venture enterprises using new technologies.



Figure 3. Application of HPC

The government should make efforts for the promotion of the international cooperation of research and technologies of the national high performance computing and consider an effective plan for the introduction of advanced technologies. The government should establish and promote support policies necessary for the stimulation of the commercialization of the results of the national high performance computing related research and development. The government should stimulate the application of the national high performance computing in the sectors of science technology, government and industries. The government should stimulate joint research and development between academia/research institutes and industries for effective promotion of the studies of the national high performance computing and technology development. The government should interlock the domestic high performance computing resources to establish a system of joint application at the state level. The Program in Partnership & Leadership for the Nationwide Supercomputing Infrastructure promoted by the national high performance computing center is composed and operated as follows:

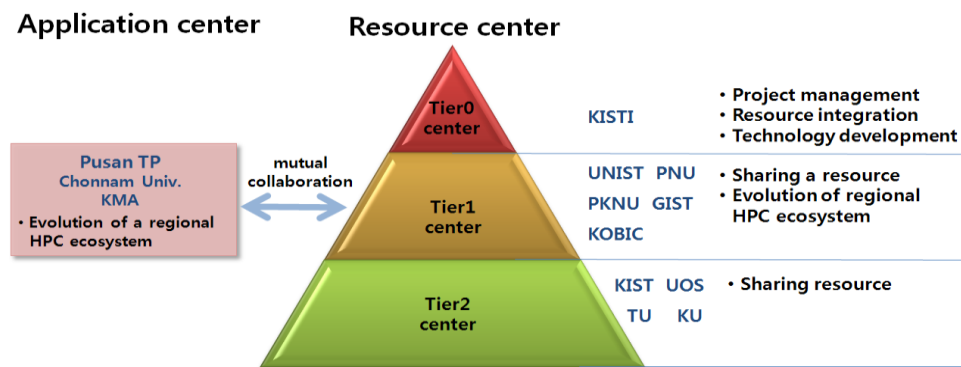


Figure 4. Building PLSI partnership (2012)[11]

5. Conclusion

High performance computing infrastructure is the essential infrastructure for the development of the national scientific technology, the improvement of the national competitiveness and the promotion of public welfare, which becomes a measure of a country's power. High performance computer contributes to improving the national science technology skills by the exploration of knowledge for the improvement of the national state-of-the-art scientific technical skills and technological innovation for industrial competitiveness. High performance computer is essential infrastructure inevitable for protecting the lives and property of the people, managing crises for the prevention of various disasters and promoting the public welfare. To create creative and fusion knowledge and bring about ICT development through high performance computer, high performance computing infrastructure establishment business should continuously and consistently be promoted. For this purpose, legal and institutional framework corresponding to it should be prevented. Fortunately, South Korea enacted 'National Supercomputing Promotion Act' in June 2011 to prepare a policy foundation for establishing and applying high performance computer resources. Yet, instead of being content to the enactment of the law, the state should actively promote the businesses for the application and promotion of high performance computer such as introducing and establishing high performance computers, establishing pan-departmental joint application network, developing high performance computer related technologies, and training professional manpower. This will contribute to the

implementation of job creation and the creative economy. In addition, it will get on the list of advanced countries of high performance computing and improve its national image as a power of ICT technologies.

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