Invited Talk@DD23

Computational Science Activities in Korea

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www.kisti.re.kr

2015. 7. 7.

▣ "Korea is Supercom-blind"

- ❖ No supercomputer in Korea made the top500 list (2009. 6.)
- ❖ Korea used to have more than ten systems in the list

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전자신문

특별기획/ 통신강국코리아
세계로 가는 한국 ICT 4면

기획/ G밸리-지엔텔
대기업 고객 확보 '제2 성장' 꿈꾼다 10면

미래기술의 산실 '디지털 미디어
글로벌 비즈니스 '중심'으로 변신중

대한민국은 '슈퍼컴맹'

'세계 500대 리스트' 16년만에 빠져

이호준기자 newlevel@etnews.co.kr

우리나라가 2009년 상반기 세계 500대 슈퍼컴퓨터 리스트에 단 한 대도 이름을 올리지 못하며 '슈퍼컴 후진국'으로 전락했다.

과학기술 부문을 넘어 국가 경쟁력의 원천으로 꼽히는 슈퍼컴 지원책 마련이 시급하다는 지적이다.

23일(현지시각) 독일 함부르크 '인터내셔널슈퍼컴퓨팅콘퍼런스(ISC) 2009'에서 공개된 세계 500대 슈퍼컴 리스트에 따르면 한국은 지난 1993년 순위 집계가 시작된 지 16년 만에 처음으로 단 한 대도 500위권에 들지 못했다. 세계 슈퍼컴 리스트는 성능에 따라 상위 500대를 선정해 매년 6월과 11월 두 차례 발표된다.

한국은 지난해 11월에는 한국과학기술정보연구원(KISTI)이 구축 중인 슈퍼컴 4호기가 277위로 유일하게 500위권에 들었지만 다른 나라의 슈퍼컴 성능이 전반적으로 향상되면서 이번 발표에서 제외됐다.

우리나라는 슈퍼컴 성능 합계 기준으로 국가 순위를 매기는 것조차 무의미해졌다. 한국의 국가 슈퍼컴 순위는 2003년 한때 6위까지 올랐으나 2006년 10위권 밖으로 밀려난 이후 지난해 31위까지 떨어졌다. 올해는 500위권 슈퍼컴을 한 대도 보유하지 못하면서 아예 집계 대상에서 빠졌다.

반면에 같은 아시아권에서는 중국이 가장 많은 21대를 리스트에 올렸으며, 일본(15대), 인도(6대) 등의 순이었다. 싱가포르·대만·홍콩 등도 각각 1대로 이름을 올렸다.

산업계 활용도 급증…육성법 마련 시급

전자신문사와 엑스포럼 공동 주최로 24일 삼성동 코엑스에서 개막한 '2009 신재생에너지 … 리가 장착된 전기자동차에 대해 설명을 듣고 있다. 26일까지 열리는 이번 전시회에는 7개 … 인다.

한국 녹색성장 强小기

Supercomputing Act

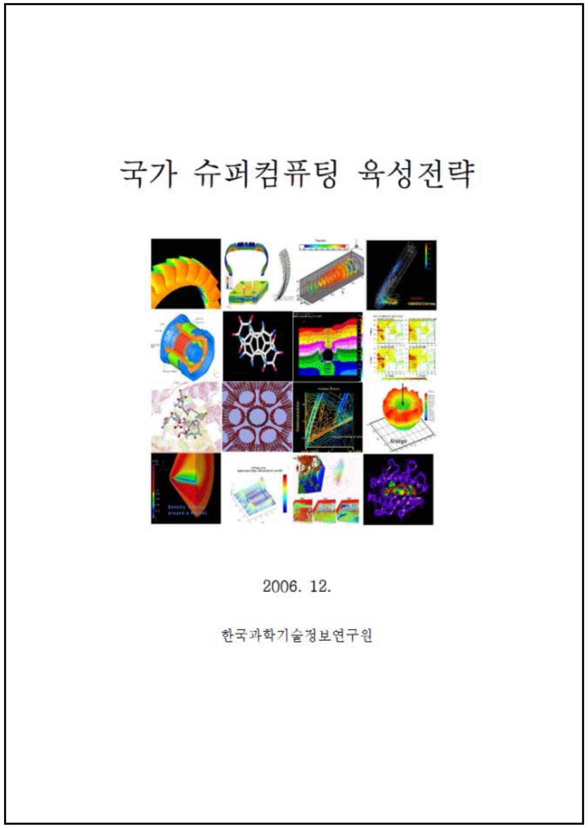
National Supercomputing Promotion Act – History (1/2)

Early Discussion

- '98: Law system maintenance on national supercomputing

Discussion in National Assembly

- '04: "Urge law system for the vitalization of national supercomputing" (State Affairs Committee)
- '05: "Urge effective utilization of supercomputer" (Science and Telecommunication Committee)
- '06: "Urge law system maintenance on national institutes" (Assembly-man Ryu)
- '08: "Demand of comprehensive plan for the promotion of supercomputing" (Assembly-woman Kim)



국가 슈퍼컴퓨팅 육성전략

2006. 12.

한국과학기술정보연구원

National Supercomputing Promotion Act – History (2/2)

Bill Consideration at National Assembly

- '09.09: Proposed in the 284th Regular Session
- '10.02: Open Forum on the Promotion of National Supercomputing
- '10.04: Invited Lecture on the Promotion of National Supercomputing
- '10.08: Introduced in the 293th Plenary Session of Education, Science and Technology Committee
- '10.11: Public Hearing
- '11.03: Approved in the Subcommittee on Bill Consideration
- '11.03: Approved in the 298th Plenary Session of Education, Science and Technology Committee
- '11.04: Approved in Plenary Session of Judiciary Committee
- '11.04: Approved in the 299th General Meeting
- '11.06: Act on "National Use and Promotion of Supercomputer" Enacted
- '11.12: Promulgate the Enforcement Ordinance and Regulation

National Supercomputing Promotion Act - Summary

▣ Title

- ❖ "Utilization and Promotion of National Supercomputing"
- ❖ **Enacted**: 2011. 6. 7, **Implemented**: 2011. 12. 8

▣ Goal

- ❖ Contributing to the enhancement of people's quality of life and the national economic development… through the efficient implementation and systematic management of national supercomputing infrastructure

▣ Key Actions

- ❖ Establishment and execution of plan for the promotion of national supercomputing ecosystem
  - Master Plan (5 years), Implementation Plan (1 year)
- ❖ National Supercomputing Committee
  - Chair: Secretary of Ministry of Science, ICT and Future Planning
  - Ministry Involved (9): **Ministry** of Science, ICT and Future Planning, **Ministry** of Strategy and Finance, **Ministry** National Defense, **Ministry** of Trade, Industry and Energy, **Ministry** of Health and Welfare, **Ministry** of Environment, **Ministry** of Oceans and Fisheries, Small and Medium Business **Administration**, Korea Meteorological **Administration**
- ❖ National Supercomputing Center
  - Support the planning and execution of national plan

National Supercomputing Plan

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❖ **3 Strategies** (or Areas)

- Expand adoption
- Efficient infrastructure (including human resource)
- R&D on core technology (including industry)

제1차 국가초고성능컴퓨팅 육성 기본계획('13 ~ '17)

제 출 자	교육과학기술부 국방부 보건복지부 국토해양부 중소기업청	기획재정부 지식경제부 환경부 국가과학기술위원회 기상청
제출년월일	2012. 12. 4.	

Vision

Top 7 Nation for Supercomputing

Expand the use of supercomputing through the creation of new demand

Establish Top 10 supercomputing service infrastructure

Secure independent supercomputing development capacity

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National Supercomputing Master Plan (2/2)

▣ Expand the use of supercomputing through the creation of new demand

- ❖ Promote national research and development using national supercomputing
- ❖ Strengthen industry innovation by using national supercomputing
- ❖ Expand public and private service based on supercomputing
- ❖ Expand public participatory activities to promote the understanding of supercomputing

▣ Establish global top 10 supercomputing service infrastructure

- ❖ Secure supercomputing resource in response to future demand
- ❖ Establish efficient national supercomputing service system
- ❖ Train demand-based experts for supercomputing ecosystem

▣ Secure independent supercomputing development capacity and foster the basis for industrialization

- ❖ Secure independent development capacity for supercomputing system
- ❖ Expand R&D of original technology for the next generation supercomputing development
- ❖ Foster industry basis related to supercomputing

National Supercomputing Implementation Plan - 2013 (1/4)

▣ Expand the use of supercomputing through the creation of new demand

- ❖ Promote national research and development using national supercomputing
  - Use of supercomputer in rare isotope science project, ocean modeling, proton therapy, weather prediction model, …
- ❖ Strengthen industry innovation by using national supercomputing
  - Support SMB product development, develop innovation model, …
- ❖ Expand public and private service based on supercomputing
  - Provide more accurate and diverse weather forecast, …
- ❖ Expand public participatory activities to promote the understanding of supercomputing
  - Hold supercomputer idea competition, …

▣ Establish global top 10 supercomputing service infrastructure

- ❖ Secure supercomputing resource in response to future demand
  - Procure KMA's next computing system (~ $50 million), establish plan for leadership computing system (KISTI-5), …
- ❖ Establish efficient national supercomputing service system
  - Establish plan for national shared supercomputing infrastructure, …
- ❖ Train demand-based experts for supercomputing ecosystem
  - Establish plan for national education & training framework, …

▣ Secure independent supercomputing development capacity and foster the basis for industrialization

- ❖ Secure independent development capacity for supercomputing system
  - Establish plan for Korean supercomputer development, …
- ❖ Expand R&D of original technology for the next generation supercomputing development
  - Initiate program for grass root research on supercomputing, …
- ❖ Foster industry basis related to supercomputing
  - Improve procurement procedure, …

National Supercomputing Implementation Plan – 2013 (4/4)

Summary of implementation plan

- 48 projects from 7 ministries
- Increase of annual budget: from $40 million to $60 million

Big scale projects are underway

- "Super Korea 2020" - $200 million
- DURE - national shared supercomputing infrastructure project
- National supercomputing education and training framework

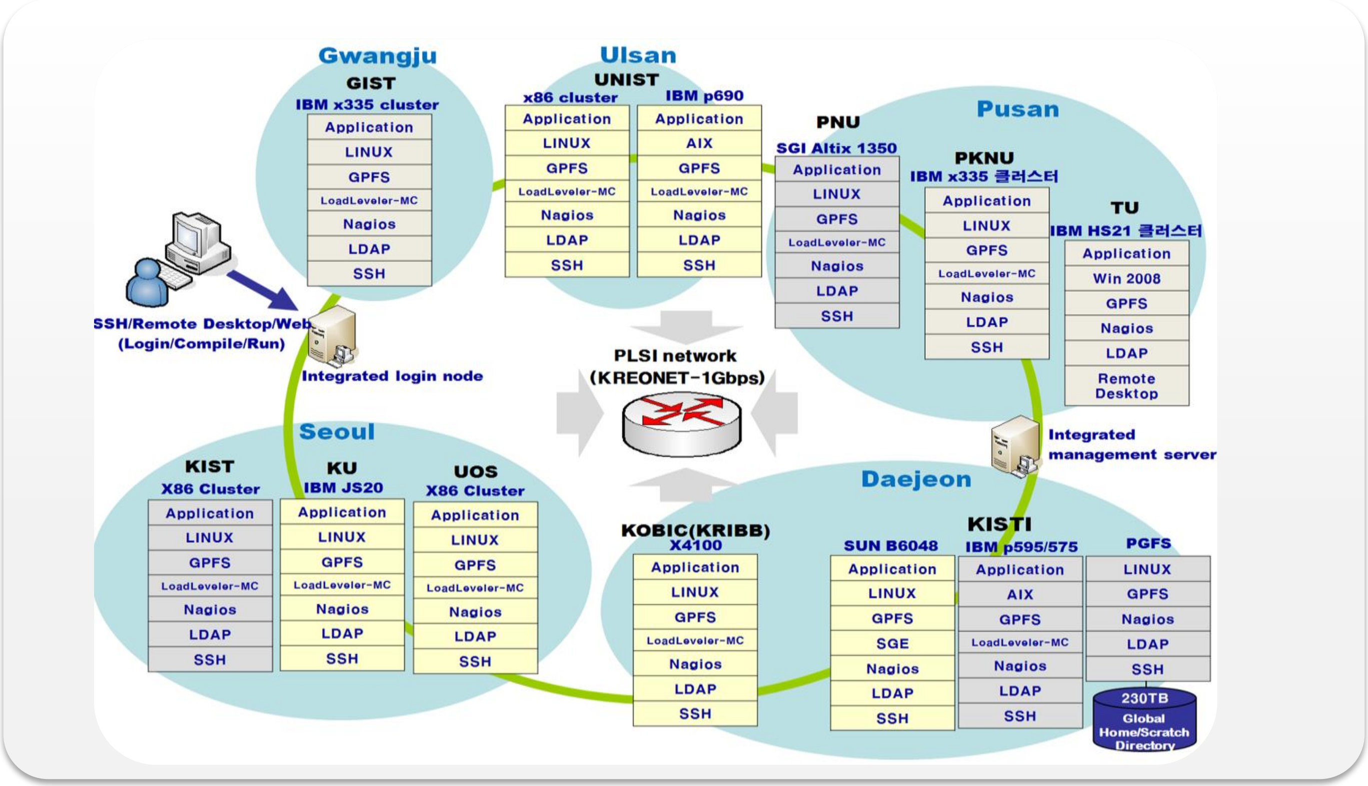
Supercomputing Infrastructure

National Supercomputing Infrastructure - Present

❖ Shared Infrastructure

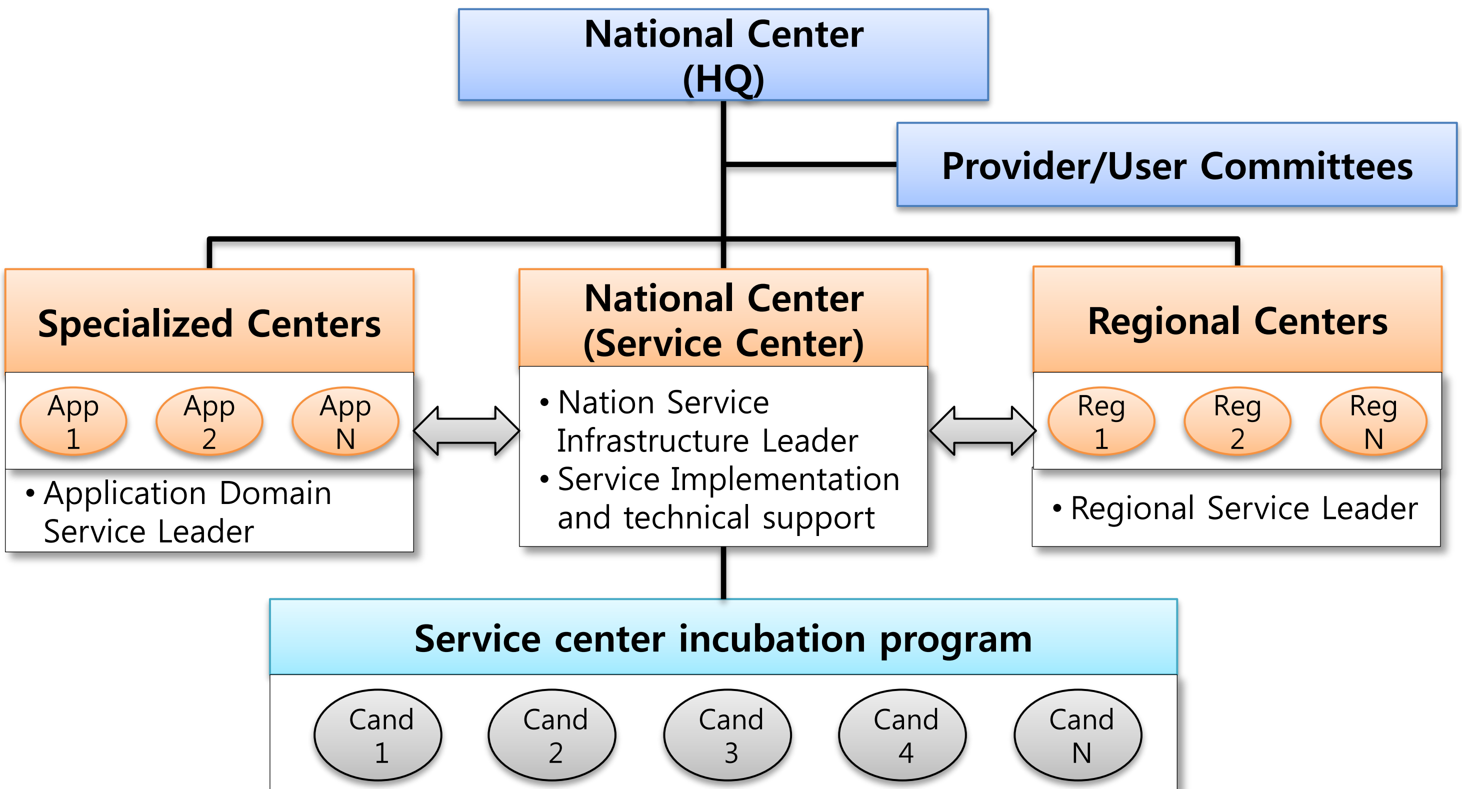
- 10 Participants: KISTI, PKNU, PNU, UNIST, GIST, KIAS, …
- Resource: 21 Systems, 8338 CPU, 394 TF (380 TF from KISTI)
- Service: Integrated System(File system, Batch Queuing System), User Portal, Support, Training

✓ Serving as Pilot National Supercomputing Infrastructure



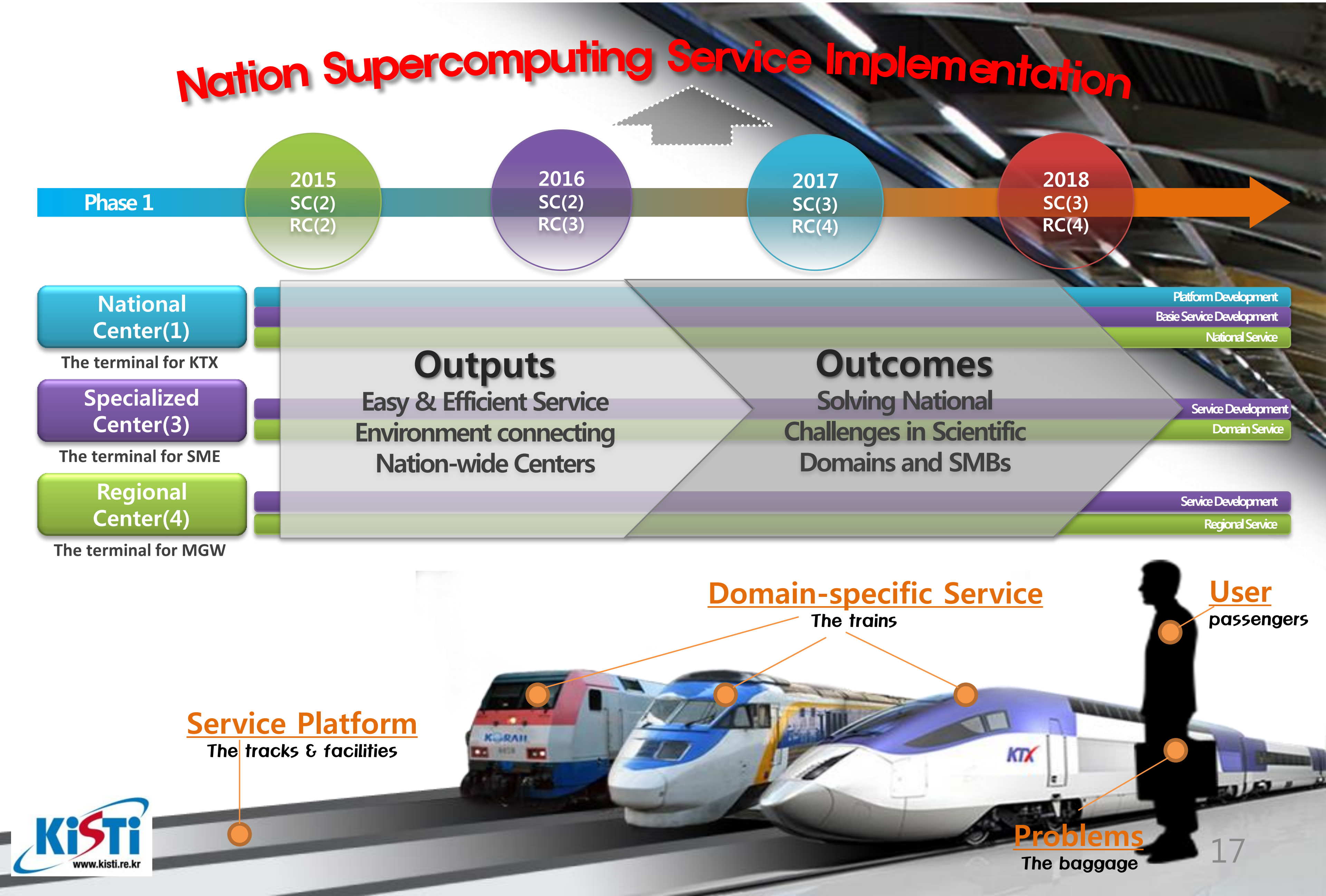
National Supercomputing Infrastructure – Master Plan

- Establish efficient national supercomputing service
  - Three types of designated centers: national – specialized – regional
    - ✓ National center (KISTI): world-class resource, support large scale national strategic projects, national service infrastructure leader
    - ✓ Specialized center: support specific domain demands (or ministry), application domain service leader
    - ✓ Regional center: support regional demands, institute service leader

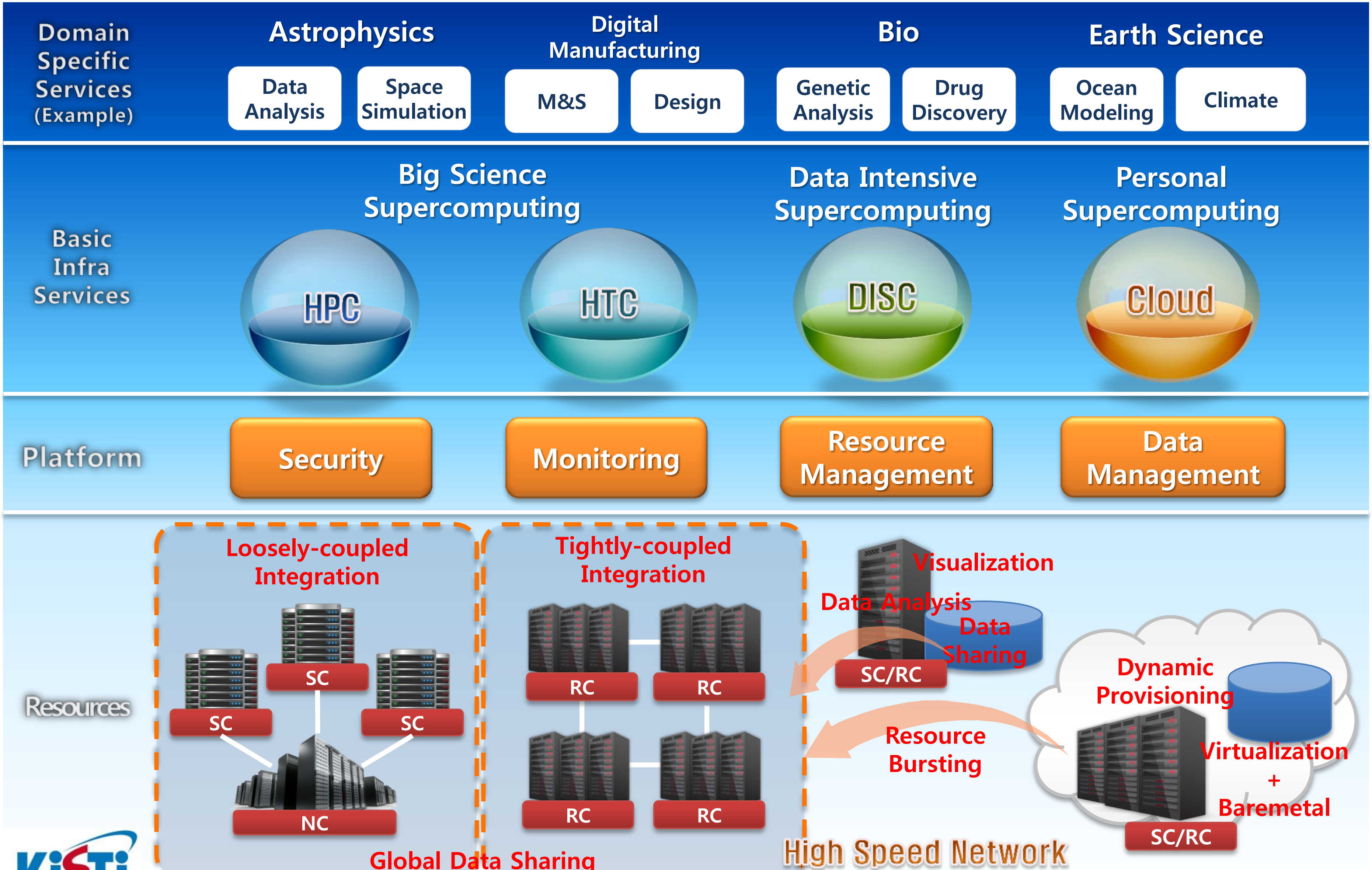


KiSTi www.kisti.re.kr

National Supercomputing Infrastructure – DURE Centers



National Supercomputing Infrastructure – DURE Services



SuperKorea 2020

Large-scale HPC system project

- Budget: $200 million
- Duration: 2015~2019 (5 years)
- Goals:
  - Procurement and operation of leadership system (KISTI-5)
  - Build supercomputer with Korean technology

SuperKorea 2020 (2/3)

SuperKorea 2020 (3/3)

Computational Science Society

Introduction

- Korean Society for Computational Sciences and Engineering(KSCSE) was founded on October of 2009
- Promote and encourage the domestic computational science and engineering in science and industry
- Homepage www.cse.or.kr

Statistics (as of 2013)

- President
  - Dong-Pil Min
- Board Members
  - 6 Vice-Presidents
  - 20 Officers
- Membership
  - 386 People

Activity

- 2009
  - Inaugural Meeting and Workshop (10.12, COEX Intercontinental Hotel)
- 2010
  - Invited talks & Multicore/GPU Computing Workshop (5. 27~28, KIAS)
  - Fall Conference (12.6, Ramada Hotel)
- 2011
  - Incorporated Association (1.31, MEST)
  - Spring Conference & MPI/Heterogeneous Computing (5.19~20, Seoul National University)
  - Fall Conference (12.1, Seoul Education Culture Center)
- 2012
  - Spring Conference (6.22, Yonsei University)
  - Fall Conference (10.10, EL Tower)
- 2013
  - Spring Conference in conjunction with FKPPL Workshop (6.5, Yonsei University)
  - Fall Conference in conjunction with HPC User Forum (10.1, EL Tower)

Annual Meeting

- KSC2009
  - 10.12~13, COEX Intercontinental Hotel
  - Attendance 343: University 143, Industry 86, Government 114
- KSC2010
  - 10.6~7, Ramada Hotel
  - Attendance 246: University 81, industry 61, Government 104
- KSC2011
  - 12.1~2, Seoul Education Culture Center
  - Attendance: 354
- KSC2012
  - 10.10~12, EL Tower
  - Attendance: 301
- KSC2013
  - 9.30~10.2, EL Tower

Computing Resource

History of KISTI Supercomputers

[KISTI-1]
Cray 2S
2 GFlops

[KISTI-2+]
Cray T3E
115 GFlops

[KISTI-3]
NEC SX-5/6
320 GFlops

[KISTI-4]
SUN Blade 6048
324 TFlops

1988	1993	1997	2001	2002	2003	2008	2009	2011
2GF	16GF	131GF		5.2 TF			360 TF	

[KISTI-2]
Cray C90
16 GFlops

[KISTI-3]
IBM p690
4.4 TFlops

[KISTI-4]
IBM p595
36 TFlops

Hardware Specification : Tachyon

- Cluster system
- Ranked at 14th in top500 in Nov. 2009

[SUN Blade 6048]

	Tachyon(SUN)	
	Phase 1	Phase 2
Manufacture	SUN Blade 6048	
Architecture	cluster	
Process model	AMD (Barcelona)	Intel (Nehalem)
# of Nodes	188 nodes	3,200 nodes
# of CPU cores	3,008 (16 per node)	25,600 (8 per node)
Rpeak	24 TFlops	300 TFlops
	324 TFlops	
Total Memory	6TB	76TB
Disk Storage	207TB	1.2PB
Tape Storage	422TB	2PB
Interconnection Network	IB 4X DDR	IB 4X QDR

Hardware Specification : Gaia

- Cluster of SMPs
- Memory intensive computing system for massive parallel jobs
- Ranked at 393th in top500 in Nov. 2009

	Gaia(IBM)	
	Phase 1	Phase 2
Manufacture	IBM p595	IBM p595
Architecture	SMP	
Process model	POWER5+	POWER6
# of Nodes	10 nodes	24 nodes
# of CPU cores	640 (64 per node)	1,536 (64 per node)
Rpeak	5.9TFlops	30.7TFlops
	36.6TFlops	
Total Memory	2.6TB	9.2TB
Disk Storage	63TB	273TB
Interconnection Network	HPS	IB 4X DDR

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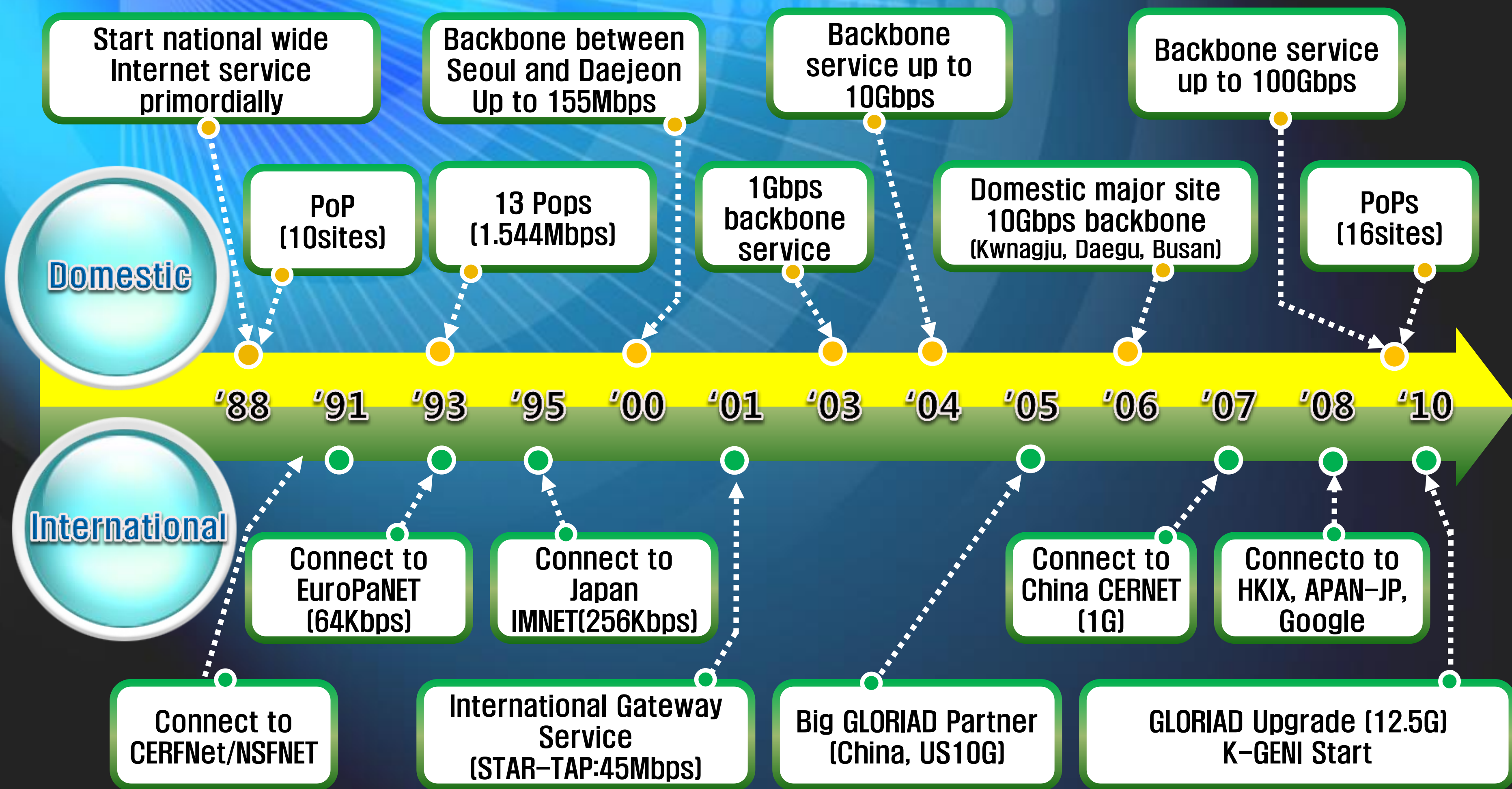
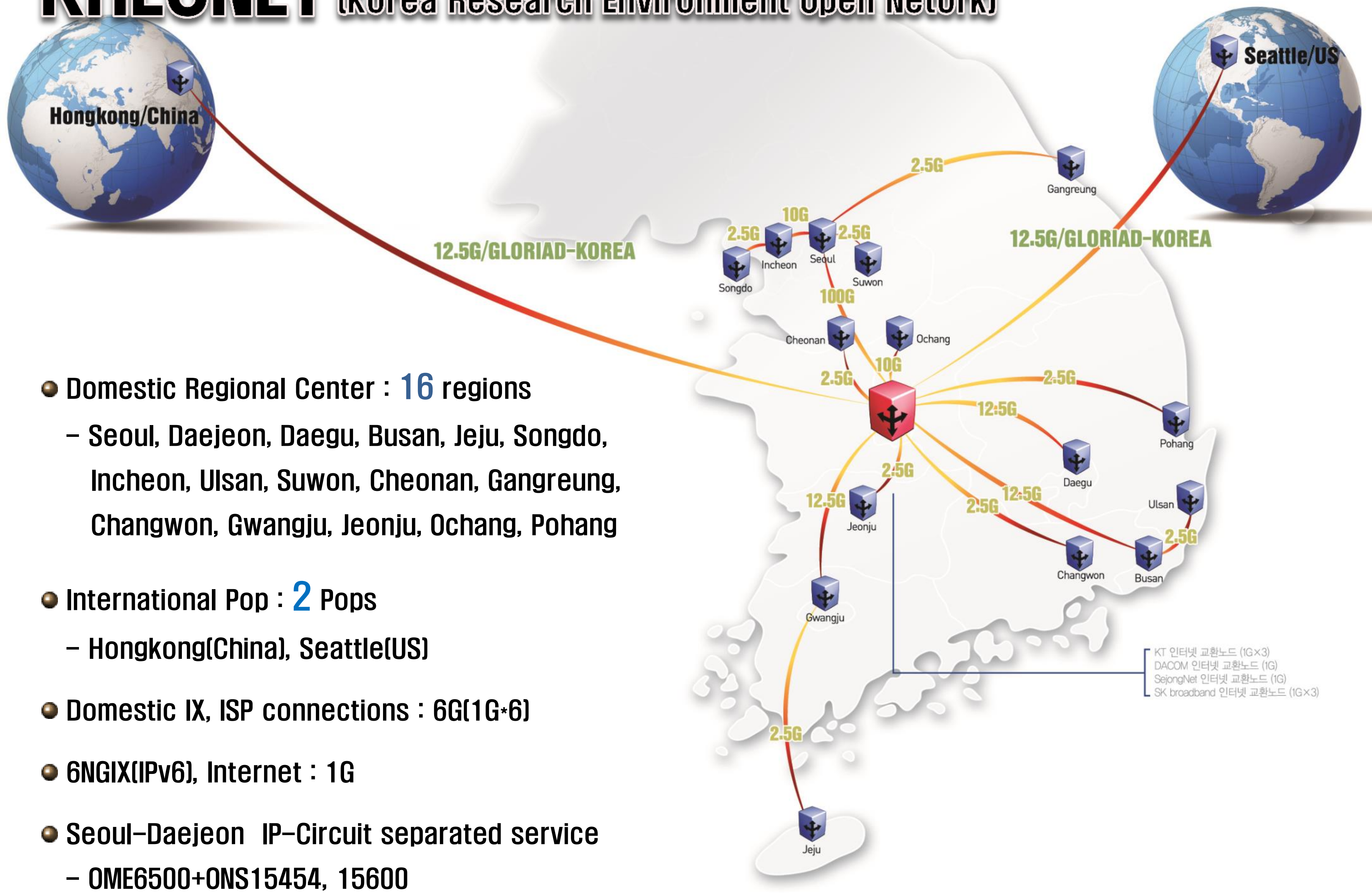
Network Resource

KREONET History



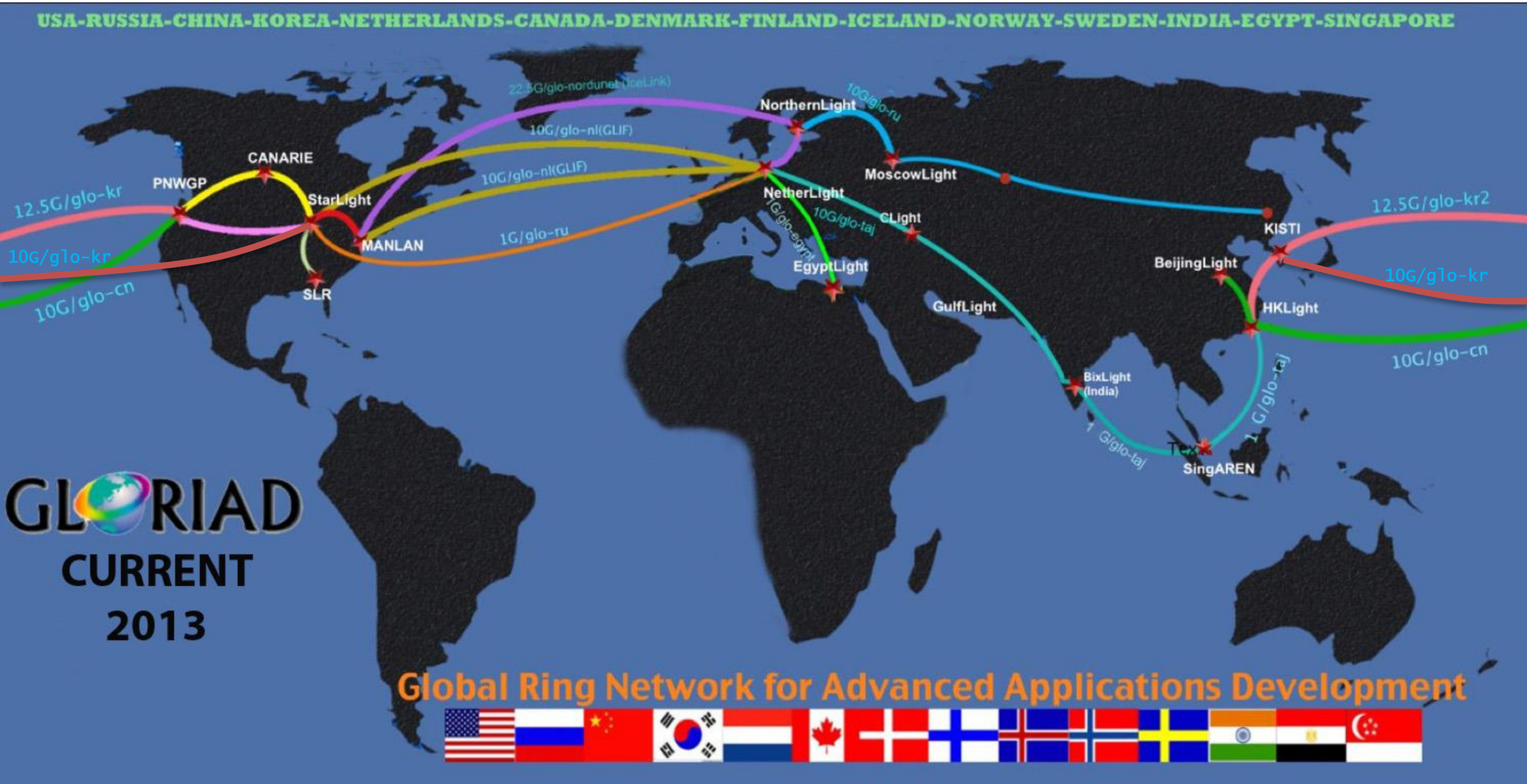
KREONET (Korea Research Environment Open Netork)



- Domestic Regional Center : 16 regions
  - Seoul, Daejeon, Daegu, Busan, Jeju, Songdo, Incheon, Ulsan, Suwon, Cheonan, Gangreung, Changwon, Gwangju, Jeonju, Ochang, Pohang
- International Pop : 2 Pops
  - Hongkong(China), Seattle(US)
- Domestic IX, ISP connections : 6G(1G*6)
- 6NGIX(IPv6), Internet : 1G
- Seoul-Daejeon IP-Circuit separated service
  - OME6500+ONS15454, 15600

GLORIAD (GLObal RIng Network for Advanced Applications Development)

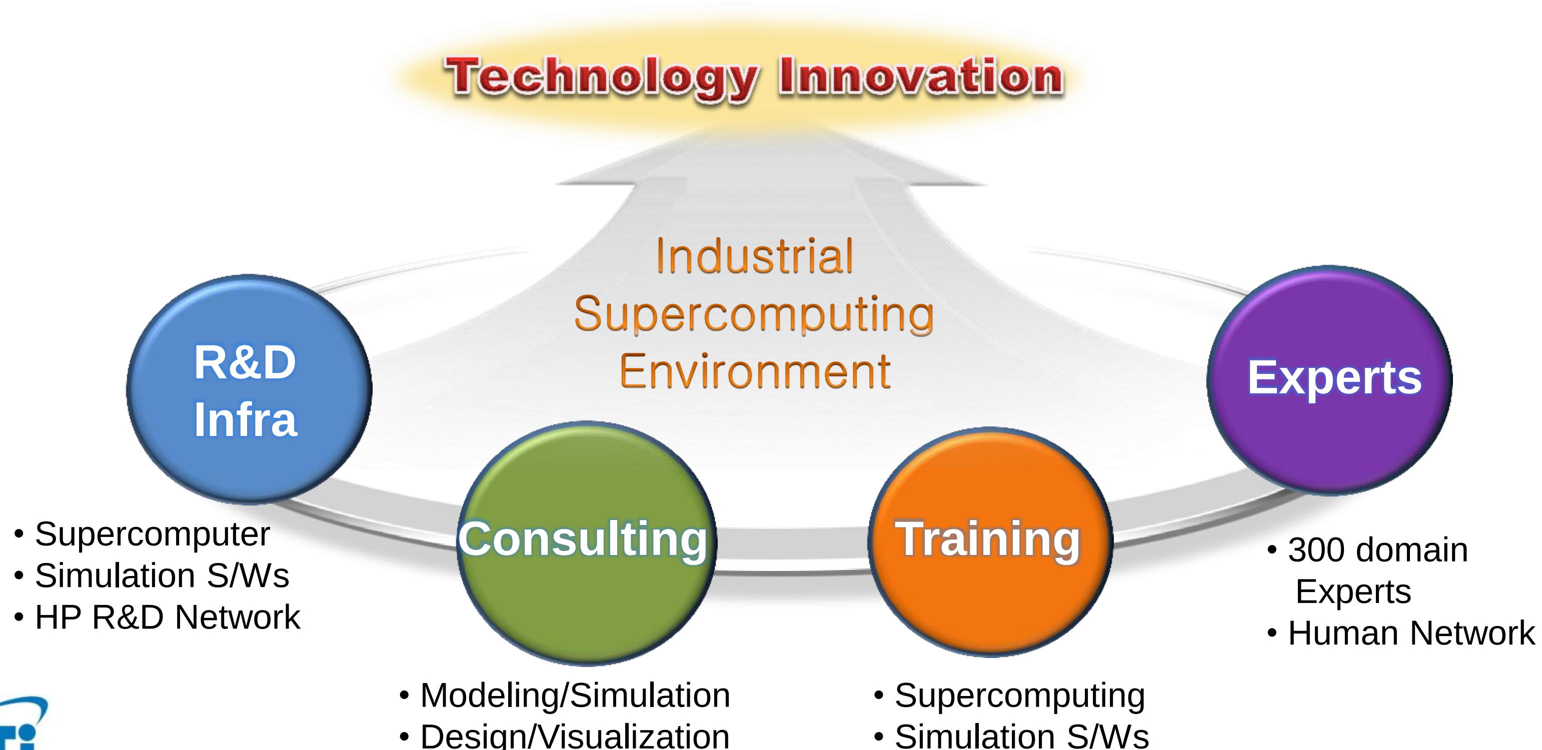
- GLORIAD is the world' s first 10Gbps global R&D network connecting the entire world with ring-shaped optical network across 15 countries.
- Supporting the data transfer for international-class R&D collaborative research



Industrial Computing Support

Engineering and supercomputing technical support

- (Objective) for achievement of industrial QCD through HPC
- (Target) especially SMBs, Manufacturing industry,
- (Support) Modeling & Simulation ← 1 SMB : 1 domain specialist
- (Program) Korea SMB Supercomputing R&D Support Program
- (Budget) about $3 MUSD/yr funded by SMBA

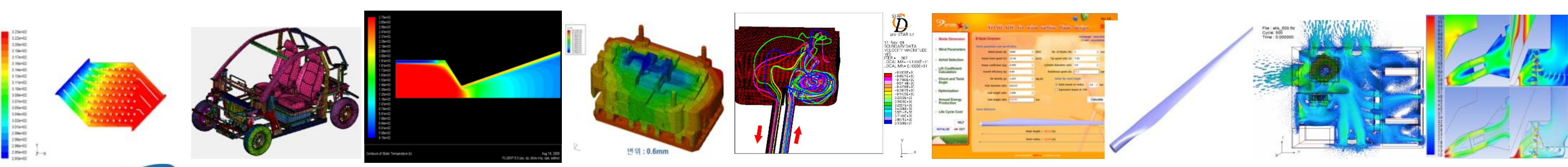


Engineering and supercomputing technical support

- (Project Number) Annually average 40 SMBs
- (Selection Rate) around 30%
- (Ongoing Project) about 50 SMB projects (2010~2012)

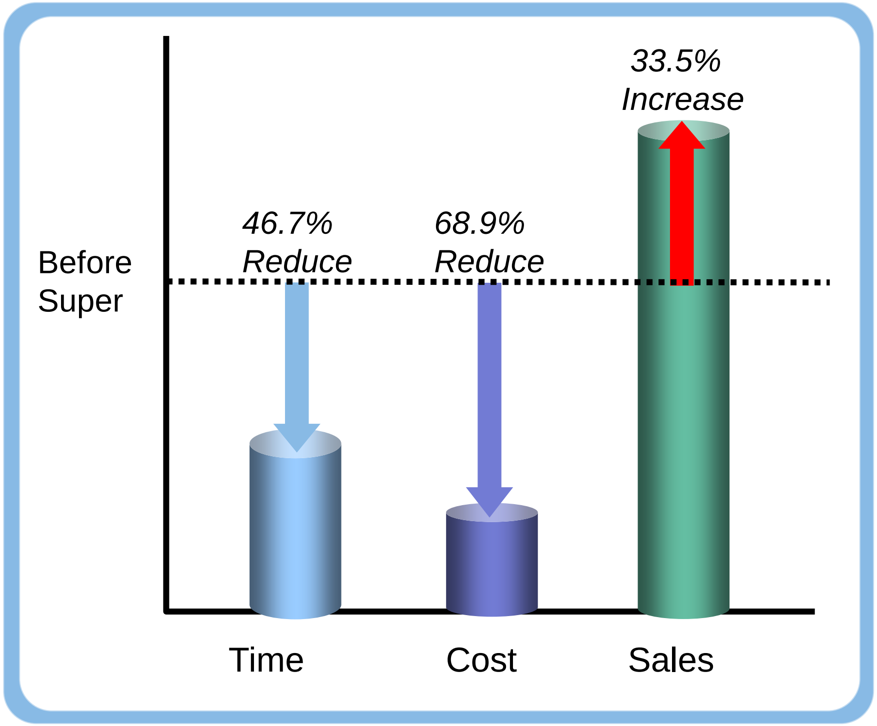
Statistics @ SMB supercomputing ('07~'09)

Areas	Thermo	Structure	Flow-Structure	IT	Life Sci.	Electronic	etc	total
Apply	118	125	20	51	25	24	53	416
Selected	43	38	10	18	8	6	2	125
Selection rate	36.4%	30.4%	50.0%	35.3%	32.0%	25.0%	3.8%	30%



Economic Effects through SMB Supercomputing

- Epoch-making increase in R&D productivity
  - Reduce effects on time/cost: average 57.8%
  - Patents, CE certificates etc.: total 50
  - Increasing rate of total sales: average 33.5 %



Major Improvements

Time Reduction

43 Month →5 Month (88% reduce)

Cost Reduction

3 M US$ →0.3 M US$ (90% reduce)

Sale Increase

Annually 5 MUS$ expected

Representative Success Stories

CT&T

e-Car Crash Simulations

Development Details

- Crash simulation for body frame with passengers' safety
- Optimized design for body structure with high lightweight and trial product

Effects

Time Reduce	Cost Reduce	Sales Increase	Property Right
17% (12 Month-> 10 Month)	**90%** (3 MUSD -> 0.3 MUSD)	**50%** (US 4,000 cars)	CE 1

Means

- Assurance of collision safety for commercial sale (no rival)
- World first development of e-Car with crash safety

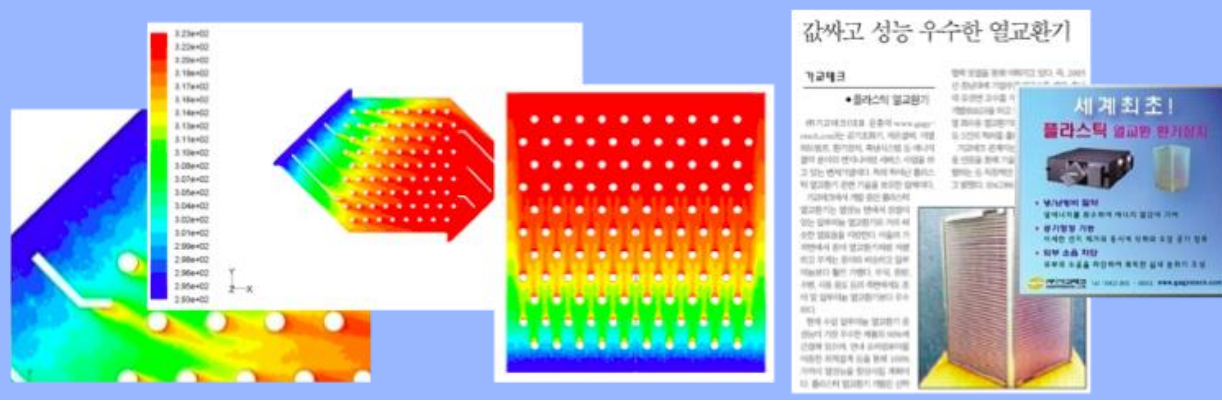
Representative Success Stories

(주)가교테크
GAGYOTECH CO., LTD.

Optimization Design for Heat Exchanger of ventilator

Development Details

- Development of heat exchanger with plastic material instead of paper or aluminum
- Optimized product design resulted from fluid/heat simulations for 120 CAE models



Effects

Time Reduce	Cost Reduce	Sales Increase	Property Right
90% (10 Month-> 1 Month)	90% (1.2 MUSD -> 0.1 MUSD)	50% (~1 MUSD/year)	2 patents

Means

- High price competitiveness due to reducing cost of production
- Moving away with dependence on imports for heat exchangers

Environment for Industrial Application

Necessity of Development of R&D Environment

❖ Limitation of direct technical R&D support

- Total number of SMB : 3M, Manufacturing SMB : 0.3 M
- SMB targeted SMB Supercomputing:
  - minimum 10% of the Manufacturing SMB: ~ 30,000 SMBs
- If SMB supercomputing will annually cover 100 SMB, we need 300 years.
- For most of SMB to take the benefits, we HAD TO develop R&D environment for SMB

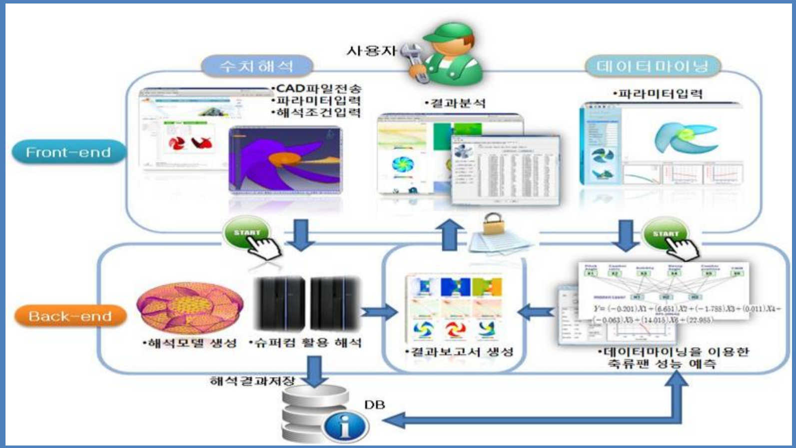
❖ Difficulty for industry people to use supercomputing

- Usually, industry has to obtain only the optimized product design
- Easy and effective R&D environment for SMB and with low cost

Automatic Product Design Platform

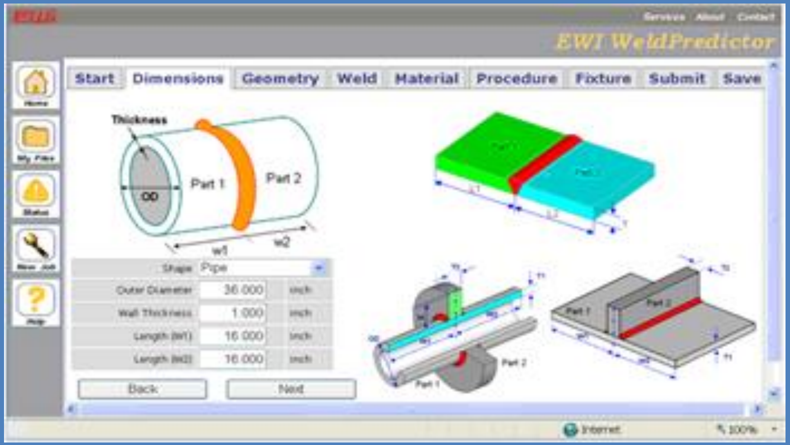
- Automatic product design with using supercomputer
- No need to know how to use supercomputer and SW
- BUT for various products, no general adaptation

FAN Simulator



- Support type: Axial, Sirocco FANs
- Performance estimation with data-mining
- Trial service: 2011. 10.

K-Weld Predictor



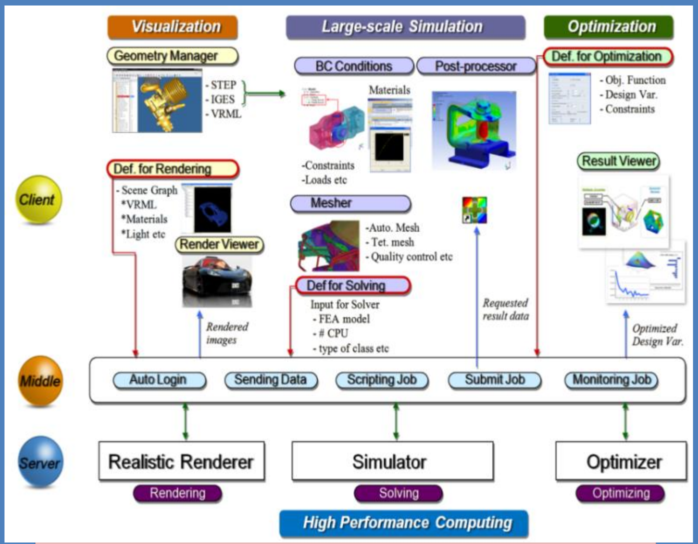
- Support type: Cylinder, Bar, Plate, etc.
- providing analysis report
- Trial service: 2011. 10.

Industrial Supercomputing R&D Environment

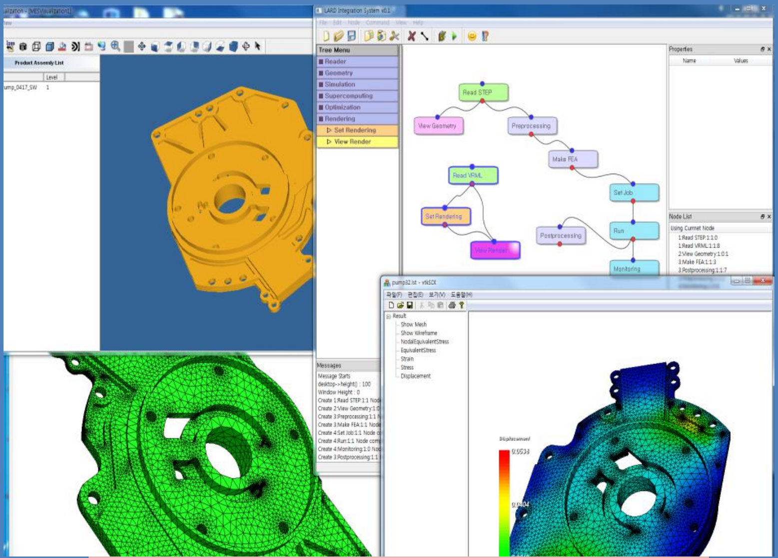
▣ LArge-scale Realistic Design platform(LARD)

- (Purpose) to provide practicable CAE software to SMB
- (Functions) Visualization, CAE Simulation, Optimization for Product Design
- (Application Domain) Structural Mechanics (*to be extended*)
- (Usefulness) very easy, highly effective and with low cost for SMB
  to use supercomputer in product design process

LARD



LARD System Architecture



LARD GUI

Cyber Environment

Cyber Environment : EDISON_CFD (1/2)

Potential flow

Simulation SW and contents based on potential/panel methods

Design optimization

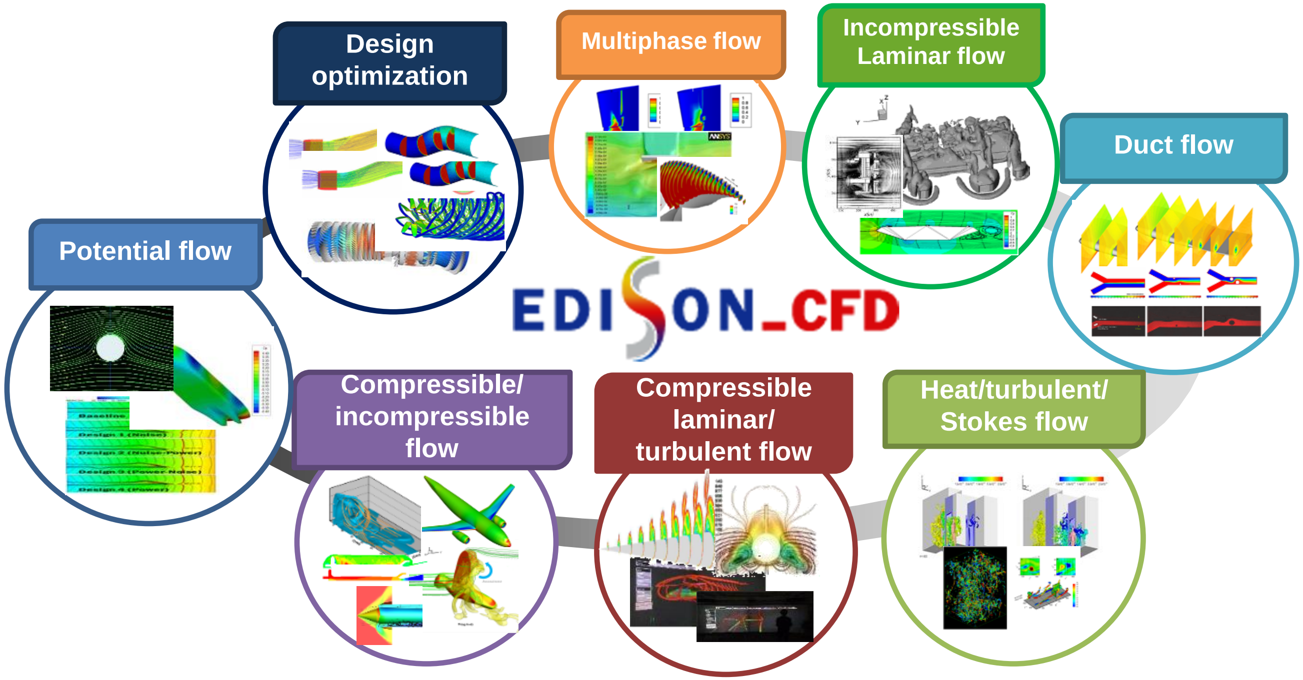
Design optimization SW and contents

Multiphase flow

Simulation SW and contents for two-phase flow

Incompressible laminar flow

SW and contents for incompressible external laminar flow



Compressible/ incompressible flow

Core/General CFD simulation SW

Compressible laminar/turbulent flow

Compressible flow simulation SW and contents based on various turbulence models

Heat/turbulent/ Stokes flow

SW and contents for low Reynolds/ Stokes flow and heat transfer

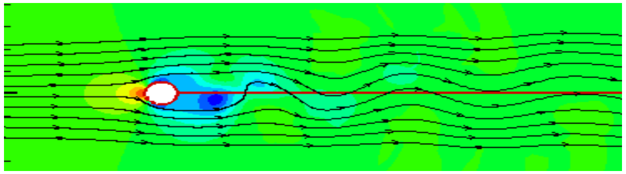
Duct flow

SW and contents for incompressible internal laminar flow

Cyber Environment : EDISON_CFD (2/2)

Flow over a circular cylinder

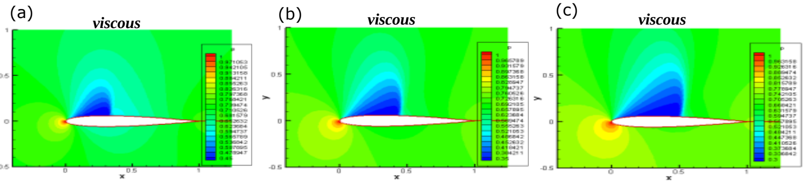
- Karman vortex street
- Reynolds number = 140, AOA = 0.0
- Grid : 101 × 81 cells



[Vorticity contour and streamline]

Flow over a NACA0012 airfoil

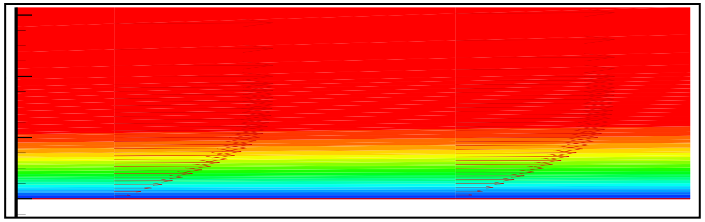
- Case1 : Mach number = 0.73, AOA = 2.0
- Case2 : Mach number = 0.73, AOA = 4.0
- Case3 : Mach number = 0.73, AOA = 6.0



[Pressure contour]

Flow over a flat plate

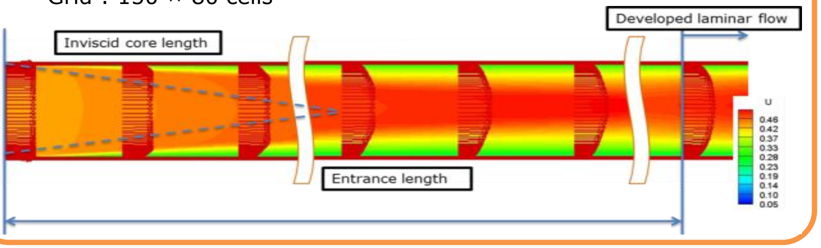
- Reynolds number = 1.08 × 10^5



[Velocity contour and vector]

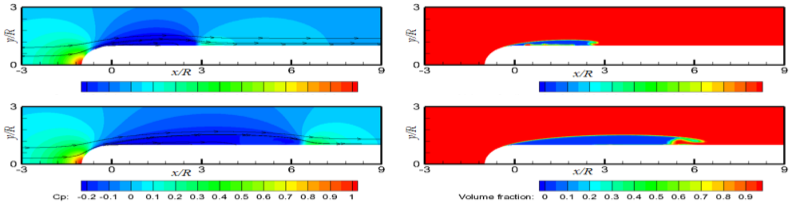
Channel flow

- Fully developed flow of channel
- Reynolds number = 1 × 10^3
- Grid : 150 × 80 cells



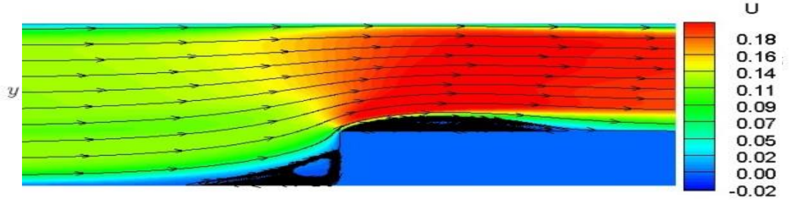
Cavitation problem

- Reynolds number = 1.36 × 10^5
- Temperature = 300K
- Grid : 144 × 80 cells



Forward facing step

- Reynolds number = 4.4 × 10^3
- Grid : 4,800 cells



[Velocity contour and streamline]

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Cyber Environment : EDISON_Chem (1/2)

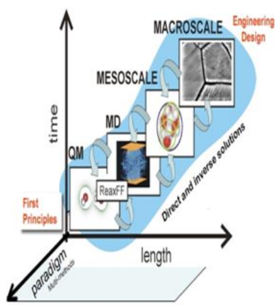
EDISON_Computational Chemistry

Advance on the students' adoptability for the advanced technology by improving education-research level

Development of simulation program and contents for Chemistry education and research

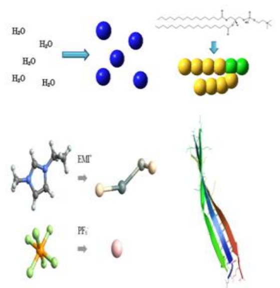
Multiscale Systems

QM/AM/MM multiscale computation S/W and contents



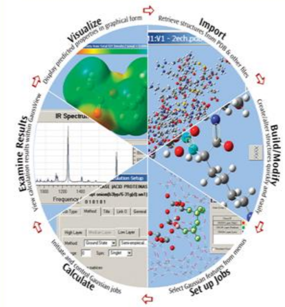
Dynamics Systems

Dynamic system modeling S/W and contents



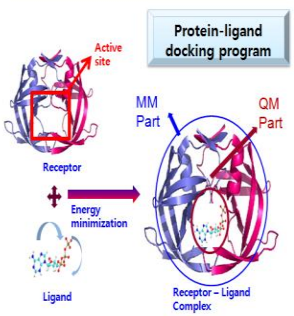
Quantum Systems

Molecular structure/energy/orbital function/spectrum computation S/W and contents



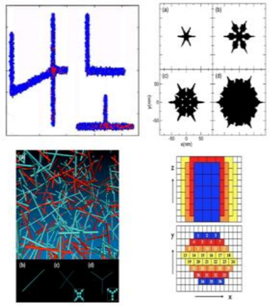
Bio-systems

Biomolecular modeling S/W and contents



Complex systems

Material and complex modeling S/W and contents



Utilization of the cyberinfrastructure of KISTI for supporting stable computational resource

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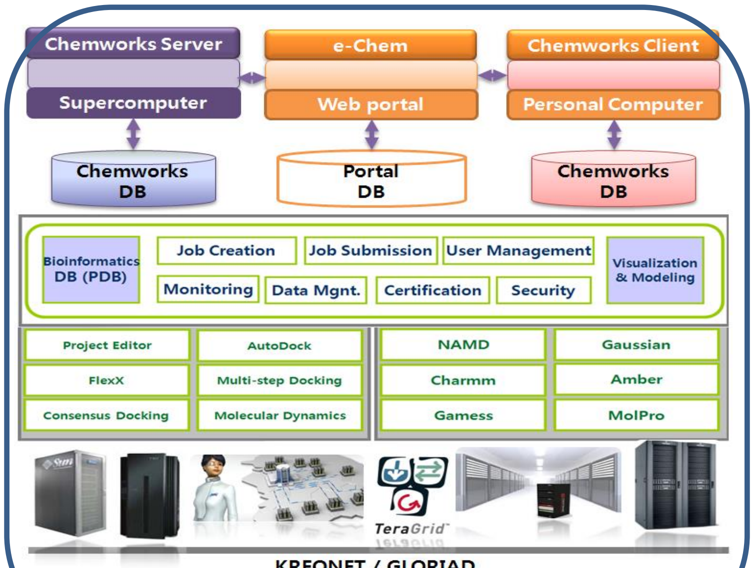
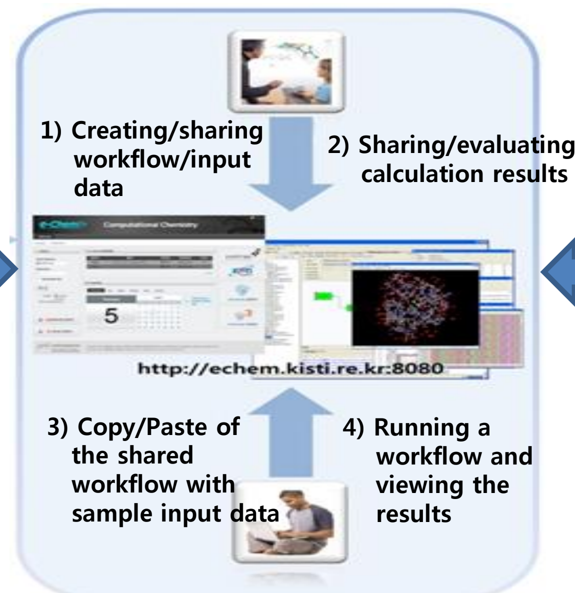
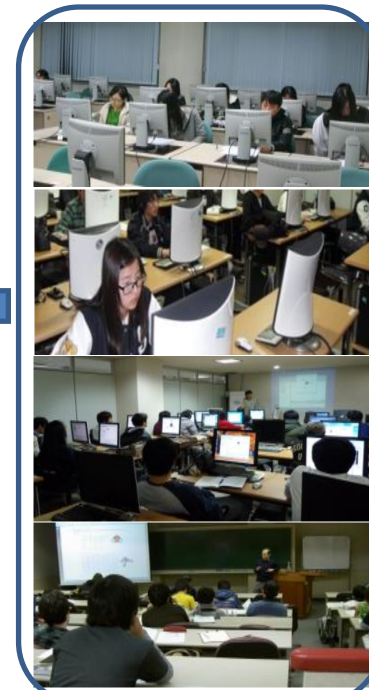
- Research and education integration environment for training the high quality human resources in computational chemistry
  - Development of web-based simulation system for computational chemistry
  - Provision of user services for research and education through the web portal using computing resources (high performance computers, high-speed network, and large scale storage) owned by KISTI
  - Improvement of sciences and engineering students' research ability and adoptability for the advanced technologies



System Architecture





Cyber Environment : EDISON_NanoPhysics (1/2)

- Providing a qualified service for on-line simulations supporting education/research activities in nanoelectronics on the EDISON platform
- Designing the policy and guideline of simulation SW developments to ease its installation on the EDISON platform
- Strengthening user's educational efficiency, research capability and technical adaptability
- Obtain core simulation technologies of nano through the localization of simulations SWs which can be used for the long-term educational and research purposes

EDISON Open Platform

- Present target SWs for development of open platform
- Establishment of the policy of SW developments through the definition of SW metadata

EDISON_Nanophysics

Development of Simulation SWs

EDISON_Nanophys Community

- Provide a guideline for SW developments through establishment of the policy in SW developments.
- Cooperative development of simulation SWs, which can be extensively utilized for education and research

Support for Online Educations

- (General/solid) Physics/Quantum mechanics
- Electronic engineering- semiconductor design engineering
- Utilized in classes of KAIST, Sookmyung Women's Uni, Korea Uni

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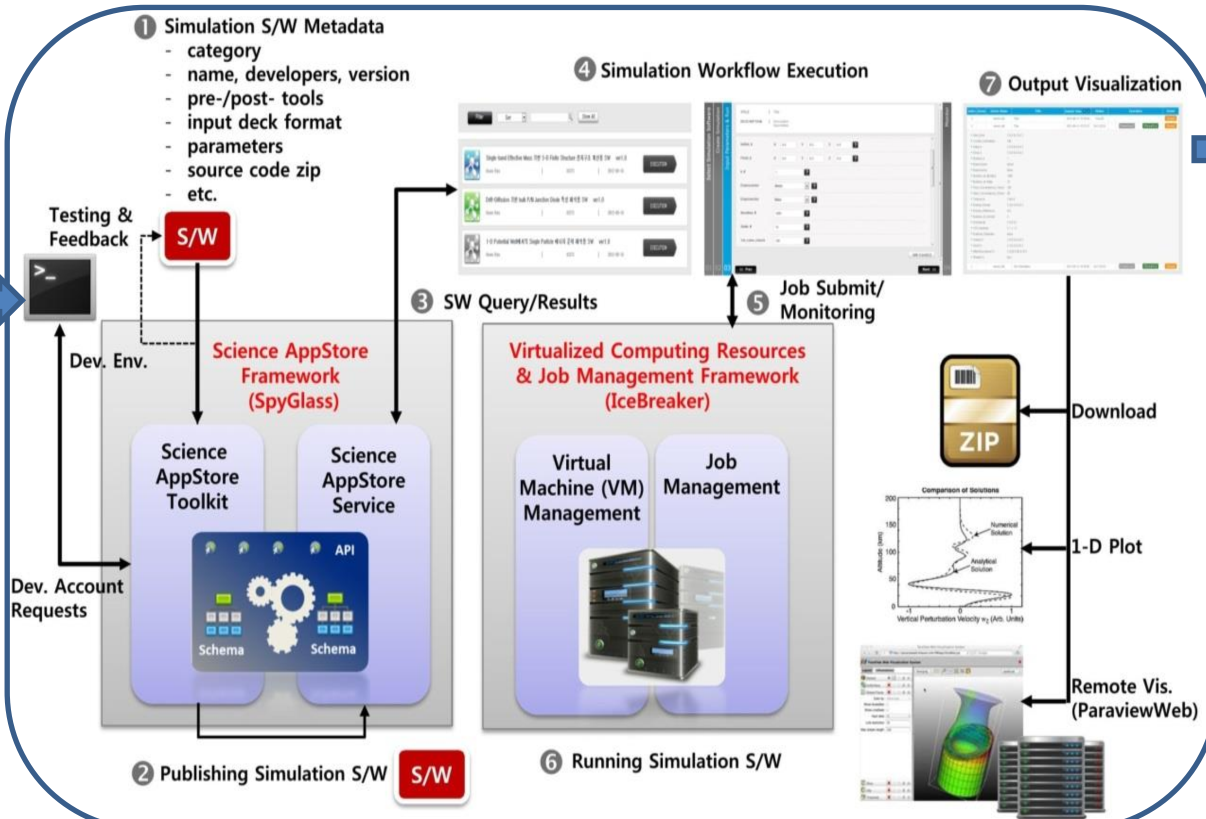
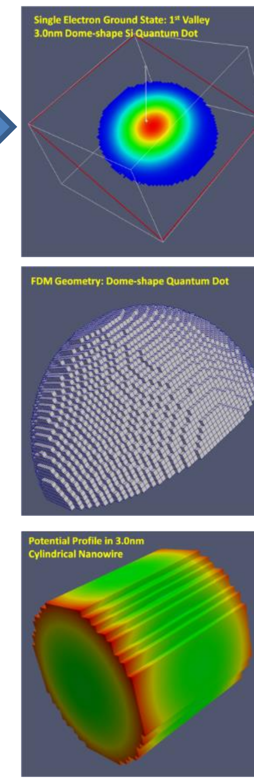
Cyber Environment : EDISON_NanoPhysics (2/2)

- Simulation SW metadata management, query, and simulation workflow executions (Science AppStore framework: SpyGlass)
- Simulation job execution and monitoring (Virtualized computing resources/job management framework: IceBreaker)
- Support of simulation results download, one-D plot, and remote visualization

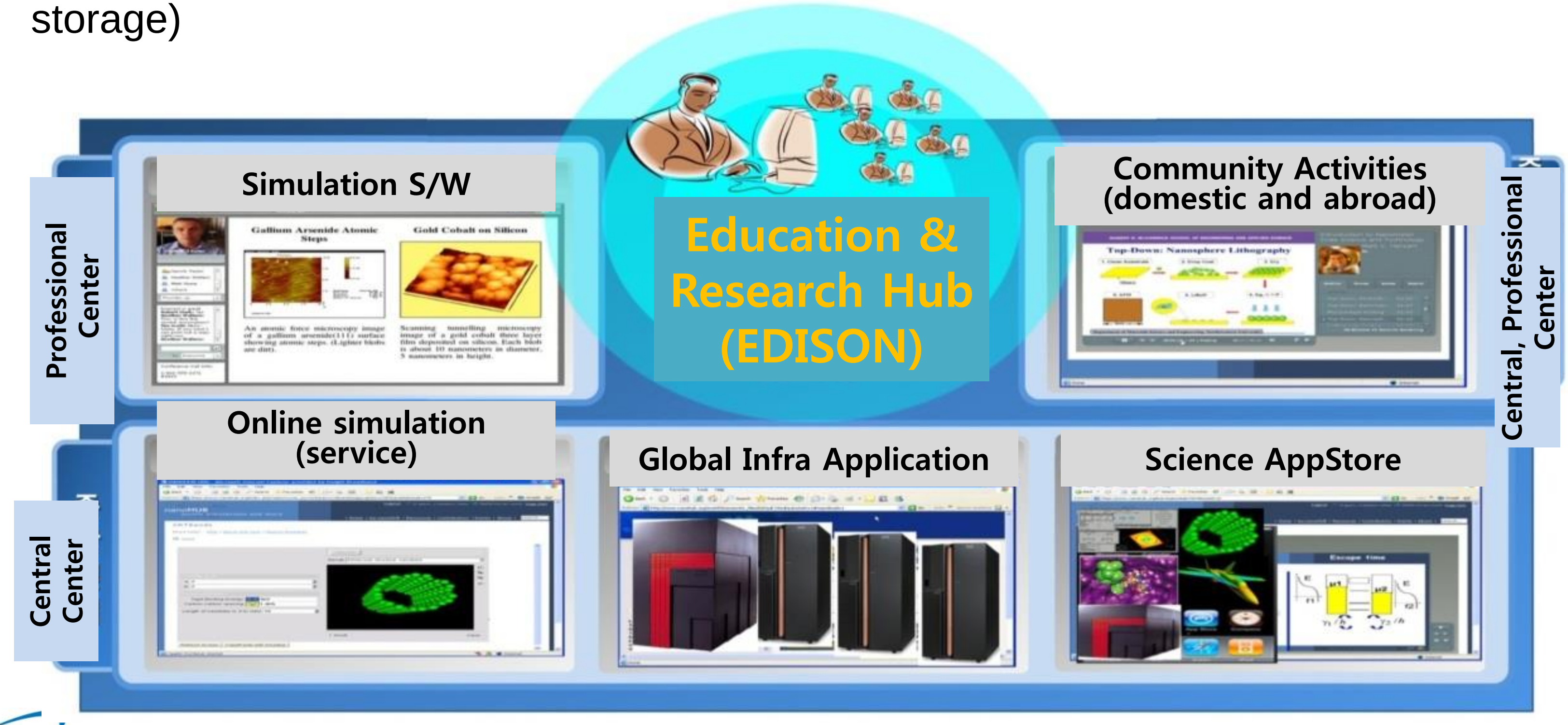
http://nano.edison.re.kr





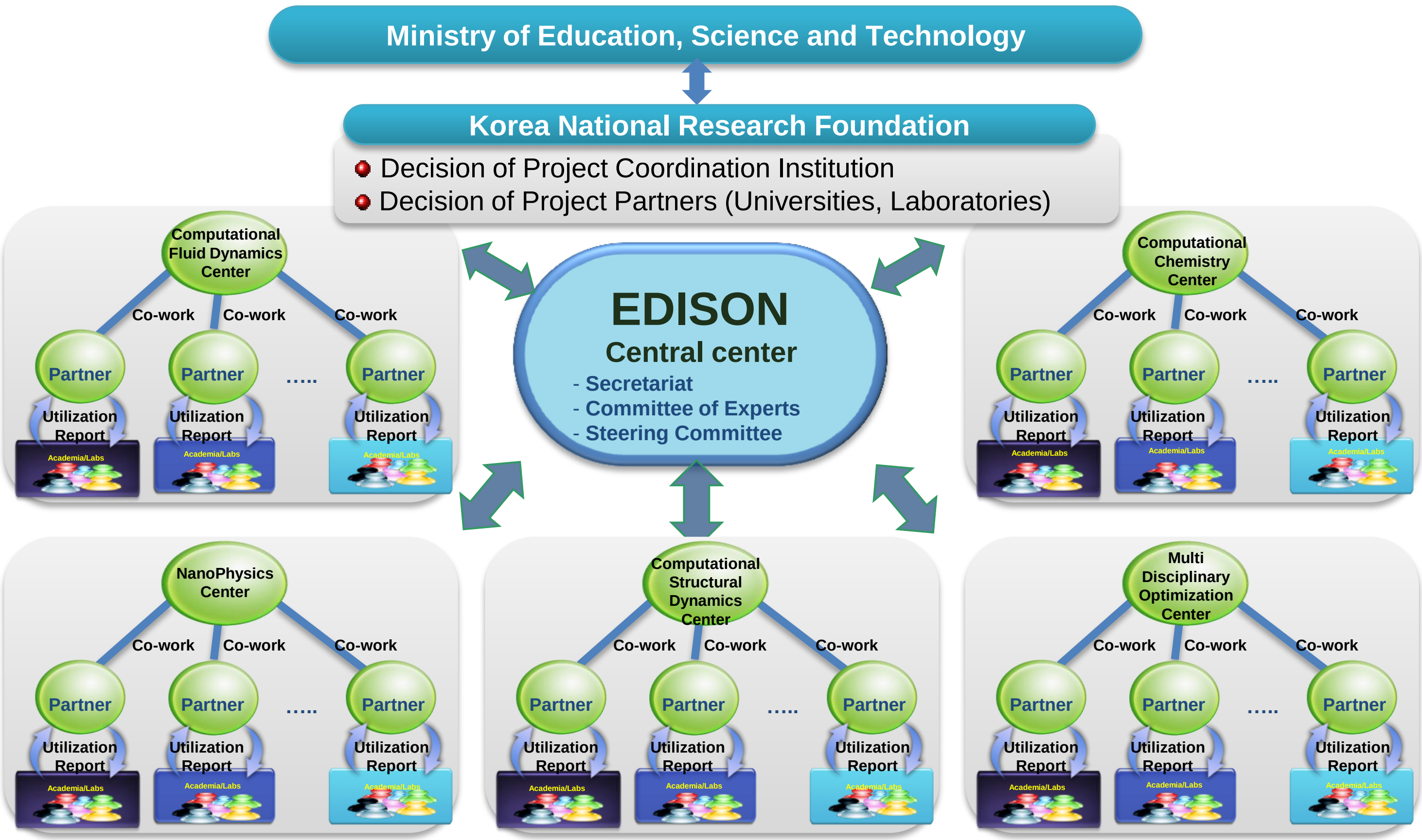
Cyber Environment : EDISON (1/7)

- ❖ Development of web-based EDISON open platform for running simulation, which can be expanded into multiple application domains, and user portal service environment
- ❖ Securement of core technologies through the localization of various computational simulation SWs developed and used for education/research fields
- ❖ Provision of user services for CFD, nanophysics and chemistry domains, powered by KISTI cyber-infrastructure (supercomputer, high-speed network, and mass storage)



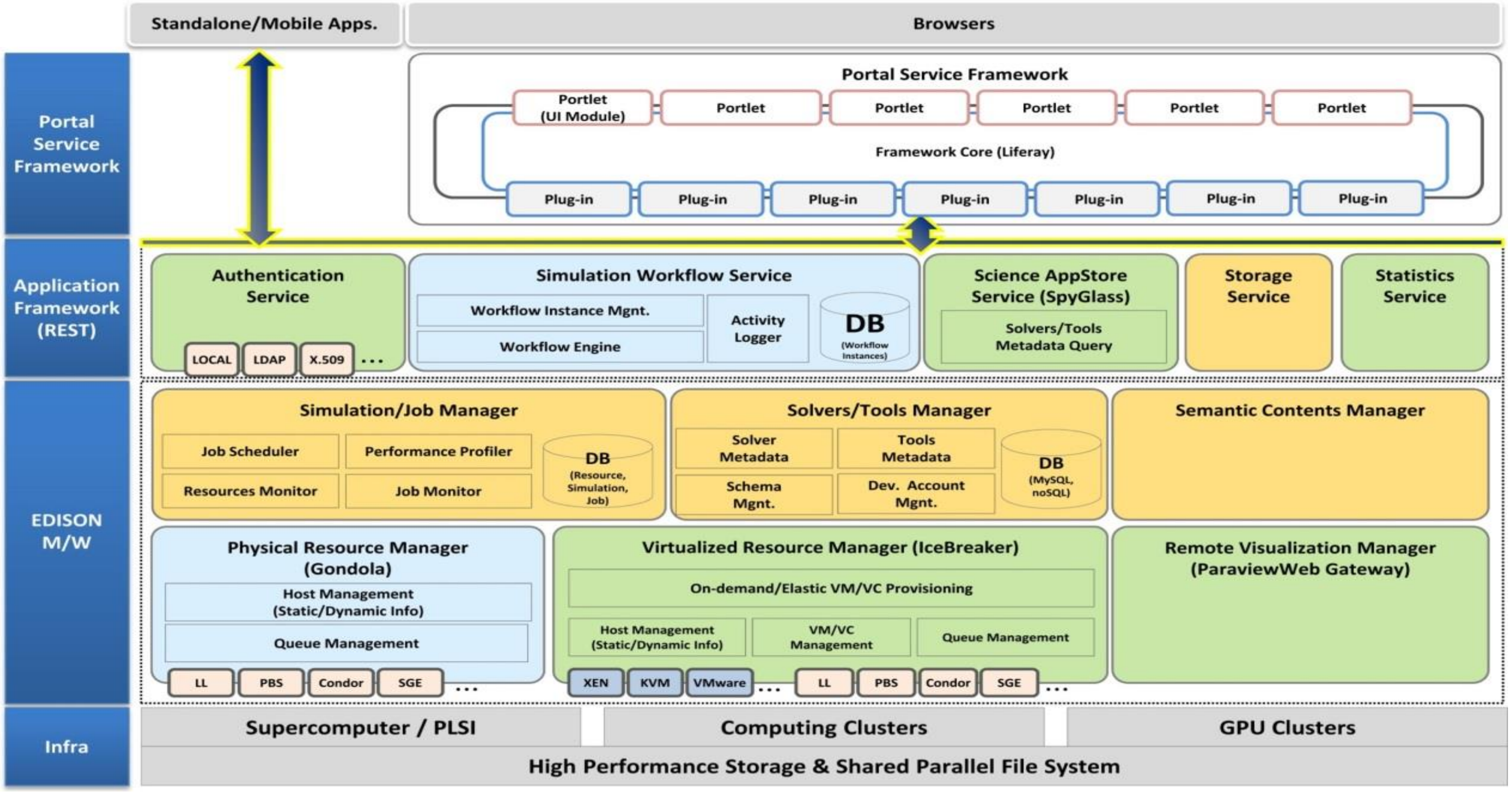
Cyber Environment : EDISON (2/7)

- ❖ Funding Agency: Ministry of Education, Science and Technology (via NRF)
- ❖ EDISON Central Center (KISTI)
  - Development of EDISON open platform and core technologies
  - Development of middleware and service of computing/network resources
- ❖ EDISON Application-specified Area Centers
  - Development of Simulation SWs and contents, and incorporation with lectures



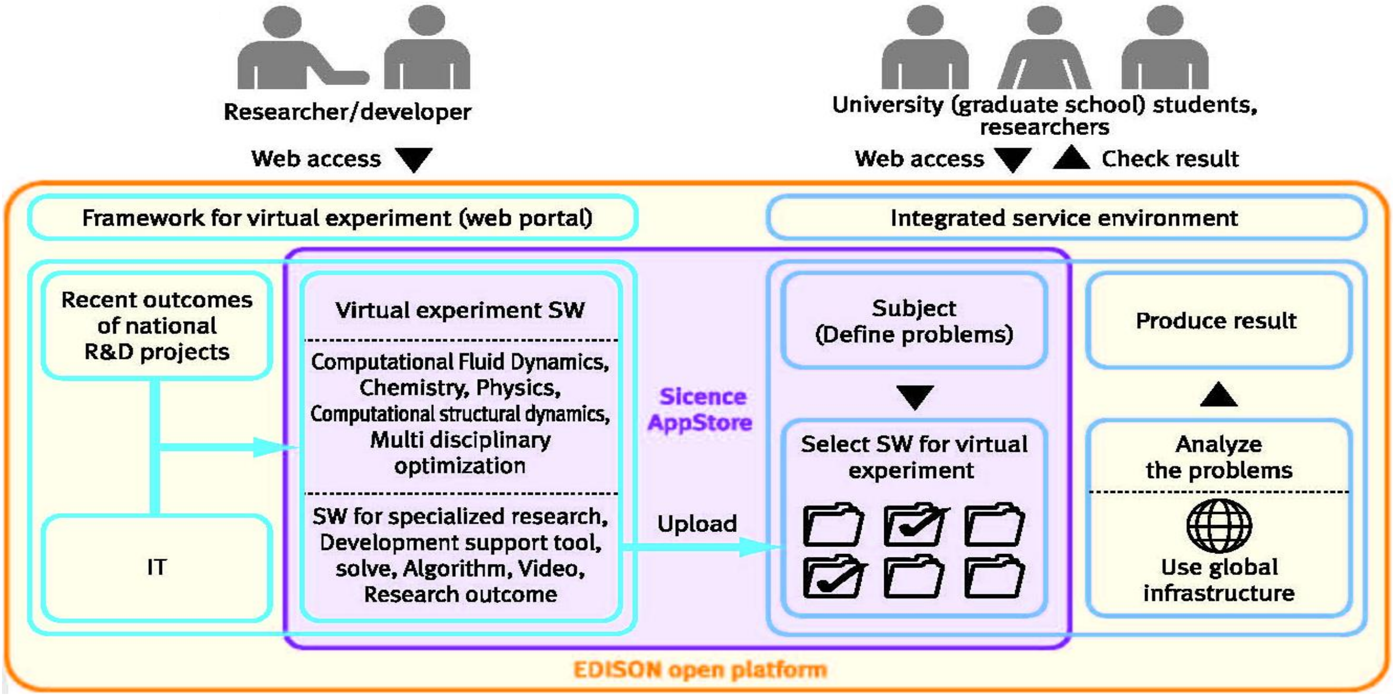
❖ Overview of EDISON Platform (An Open Software Platform)

- **C**onvenient System → Easy to Develop Simulation SWs
- **O**pen System → Easy to Expand Various Application Areas
- E**ffe**ctive System → Stable Web-based Simulation Running System
- **E**asy System → Easy to Use and Understand Simulation SWs/Contents



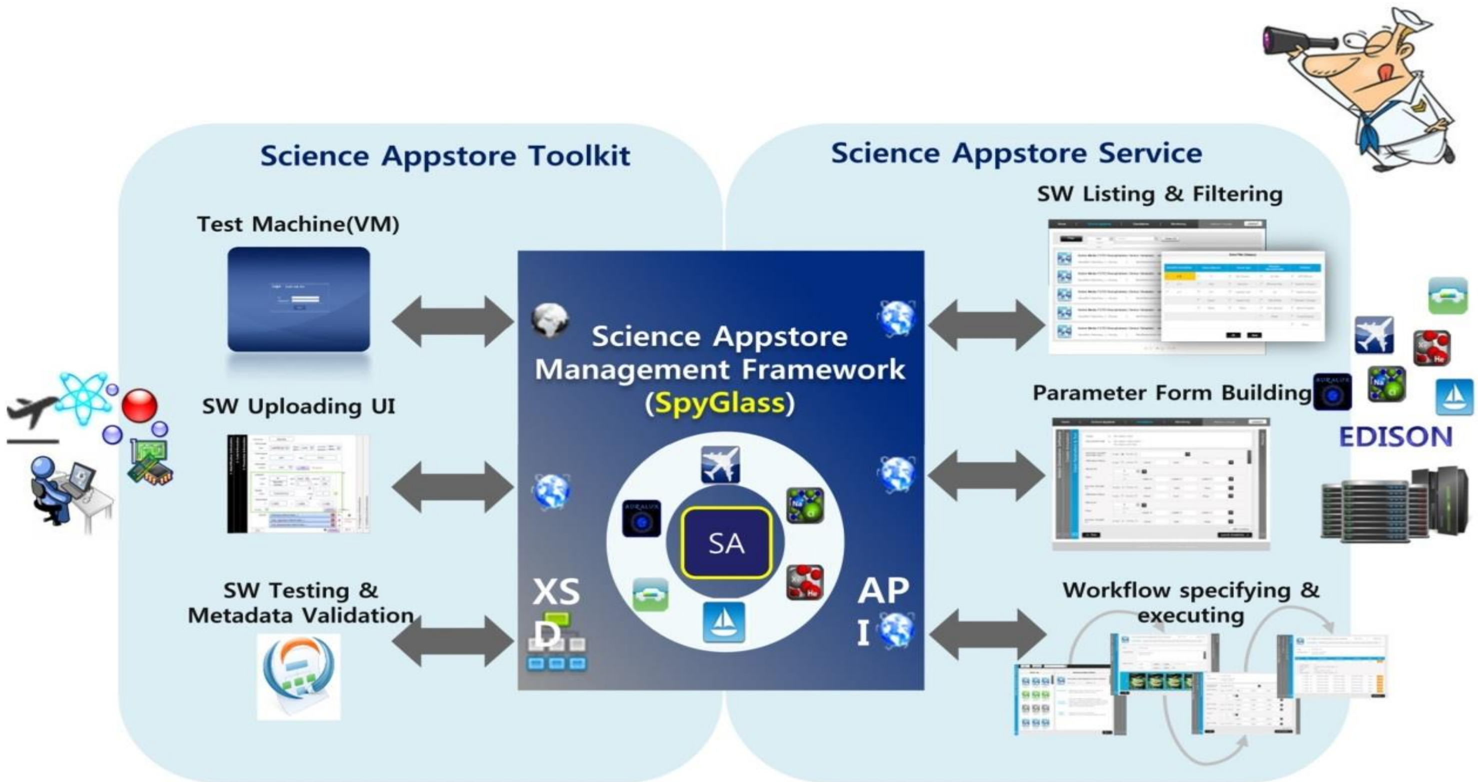
❖ Simulation Running Scenario on the EDISON Platform

- Researchers/Developers: Developing simulation SWs by combining latest research results with IT through Web environment and register developed SWs to Science AppStore
- General Users(Students/Researchers): Running their simulation jobs to solve problems by selecting simulation SWs in Science AppStore using the EDISON Infrastructure (Physical/virtual computing resources)



❖ Science AppStore framework (SpyGlass)

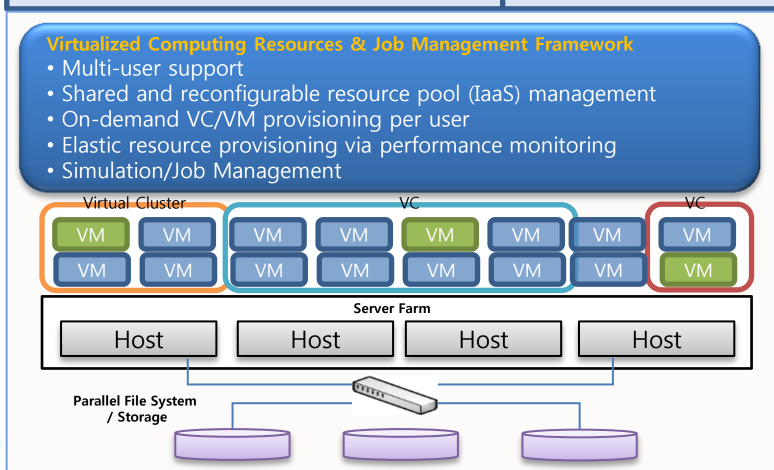
- Repository of simulation SWs and its metadata, which can be executed on the EDISON platform
- Composed of Science AppStore toolkit (SpyGlass Toolkit) and Science AppStore service (SpyGlass Services)
- HTTP(S) based RESTful interface provided

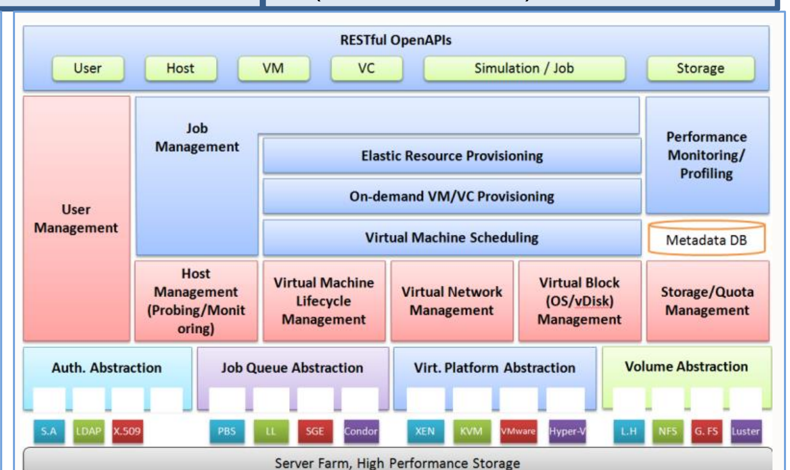


❖ Virtualized Computing Resources/Job Management Framework (IceBreaker)

- User authentication/authorization, virtualized computing resources management and job lifecycle management
- Virtual cluster and/or virtual machine provisioning via Xen virtual machine monitor (VMM, hypervisor)
- HTTP(S) based RESTful interface provided

User authentication/ authorization and management	Virtualized computing resources management	Simulation/job management
• User management (register/update/delete/retrieve) • LDAP/X.509/Simple authentication back-end supports through abstraction layer • Session management and authorization per user	• Physical resources management • XEN, KVM, VMware hypervisor support through virtual platform abstraction • On-demand virtual machine provisioning support • Virtual machine lifecycle management • Physical/virtual resources monitoring	• Simulation data management • Job lifecycle management such as submit, monitoring, cancellation, etc. • Input/output data management for simulation/job execution • Support of diverse local job manager (PBS, LL, SGE, etc.)





Cyber Environment : EDISON (7/7)

❖ Expected Contributions of Technical Perspectives

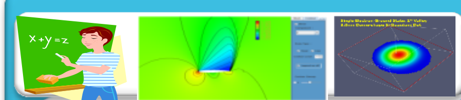
- Offering web-based open platform for education and research in science and engineering can be expected to produce more practical and inventive results
- Providing efficient educational system to student familiar to IT environments

❖ Expected Contributions of Economical & Industrial Perspectives

- Replacing expensive and imported SWs with domestically developed SWs by domestic researchers, a lot of the national asset can be saved.
- Creating new market for developed system and job market for the experts

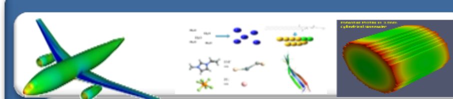
Simulation SWs & Contents of CFD, NanoPhysics & Chemistry on the EDISON Platform

Educational Application



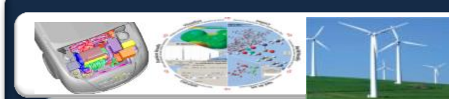
- Application as educational tools for higher education in the areas of computational science
- Utilization on education of talented student in elementary, middle, and high school for training of preliminary engineer

Research Application



- Application as basic research tools in order for training of engineers
- Utilization on advanced and leading research using excellent research results

Industrial Application



- - Application as educational system for industrial experts
- - Utilization on a technology transfer and research in industry

Super Korea!

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