국가와 국민을 위한
데이터 생태계 중심기관 KISTI

Asia-Pacific Research Platform Activities & Related work

KISTI/KREONET
Jeonghoon Moon
30th Jan 2025

KiSTi 한국과학기술정보연구원
Korea Institute of Science and Technology Information
www.kisti.re.kr

Contents

Overview of APAN APRP WG

[1] Overview & Past APAN Meeting
[2] Upcoming APAN 59th Meeting Yokohama, Japan

APAN APRP(Asia-Pacific Research Platform) WG

- **Since 2018 APRP WG initiated at APAN 45th 2018 in Singapore**
  APRP – Asia Pacific Research Platform Working Group
  APAN meeting held 2 times in a year

- **Objectives**
  APRP WG develops technologies to provide data-intensive science (HEP, Astronomy, Earth ScienceAI, Bio, Climate/Weather, Agriculture) environments and various computing resources by linking distributed HPC systems and establishing a stable big data highway system based on NREN in the big data era, and promotes related research collaboration in the Asian region.
  - Promote **Distributed & Shared HPC ecosystem in the Asia-Pacific**.
  - Engage **APAN members and ASEAN countries**
  - Towards the setting up an **Asia Pacific Research Platform (APRP)** and **become a part of a Global Research Platform**

- **Executive member**
  Chair : Jeonghoon Moon, KISTI, Korea
  Co-Chair : Andrew Howard, NCI, Australia
  Secretary : Asif Khan, Qatar Univ. Qatar

- **Asi@Connect 5th Call project by TEIN*CC**
  Title : A High bandwidth distributed HPC (1st April 2022 – 31st July 2023)

- **A3 Foresight Program Project by A3 Countries NRF**
  Title : Data Sharing Infrastructure across Northeast-Asia Supercomputing Centers for Open Science (1st Aug. 2024 – 31st Jul. 2029, 5 Years)

APAN 57th Meeting & APRP WG session

- **APAN 57th APRP Meeting**
  - Held at Bangkok in Thailand(Jan., 2024)

- **Session Information**
  - Session 1: Infrastructure and Technical Part, Chair: Jeonghoon Moon, 1330-1500
  - Session 2: Application and Technical Part, Chair: Jeonghoon Moon, 1530-1700
    10 Presentations from 6 countries
  - Infrastructure: Country update and status of platform(KR, AU, MY, PK etc)
  - Technology: Exa-Scale data challenges(FermiLab), Quantum Safe Network(KR), Wireless Communication(KR)
  - Application: AI-Science, Bio-Science, Climate change disaster related Forest(AFaCo), Avian infection diseases

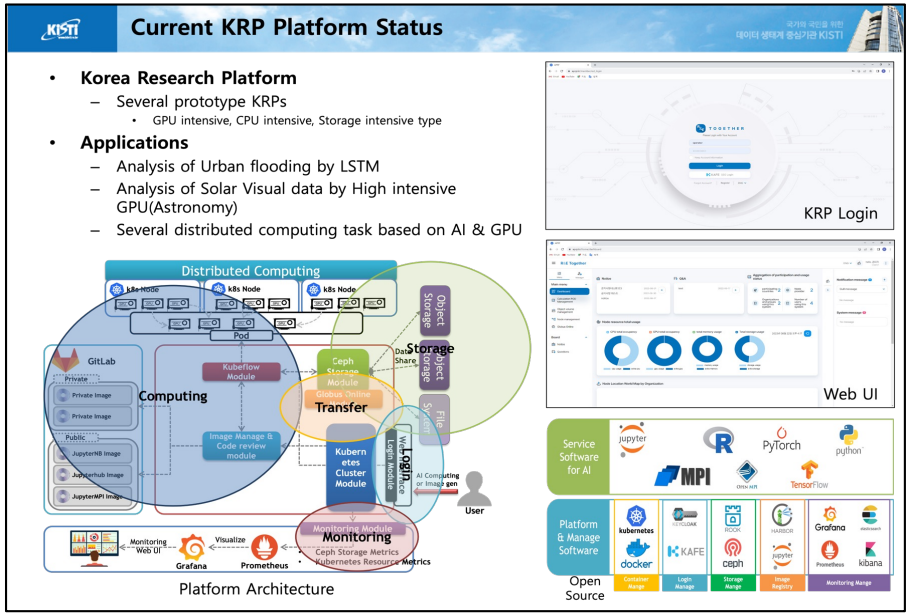
Session 1

Session1: Infra & Technical Part, Chair: Jeonghoon Moon		
1	Asif Raza(PK)	Exascale Data Challenges and Networking R&D Efforts for the HL-LHC era
2	Asif Khan(MY)	Bioinformatics & HPC
3	Yves Poppe(SG)	The road toward a Global Research Platform
4	Nor Asilah(MY)	Distributed HPC and Malaysia future works
5	Jeonghoon Moon(KR)	Korea Research Platform and future works

Session 2

Session2: App & Technical Part, Chair: Jeonghoon Moon		
1	Andrew Howard(AU)	Australia update and future works
2	Woojin Seok(KR)	Researches of Quantum Safe Network at KREONET
3	Veerachai Tanpipat (TH)/Soozin Ryang (KR)	Capacity Building for Forest, Hydrology and Climate Change Disaster Related
4	Kiwook Kim(KR)	Update of wireless communication and scientific data
5	Nurulfiza Mat Isa(MY)	Update of data driven in the fight against avian infectious diseases

Summary of Session 1



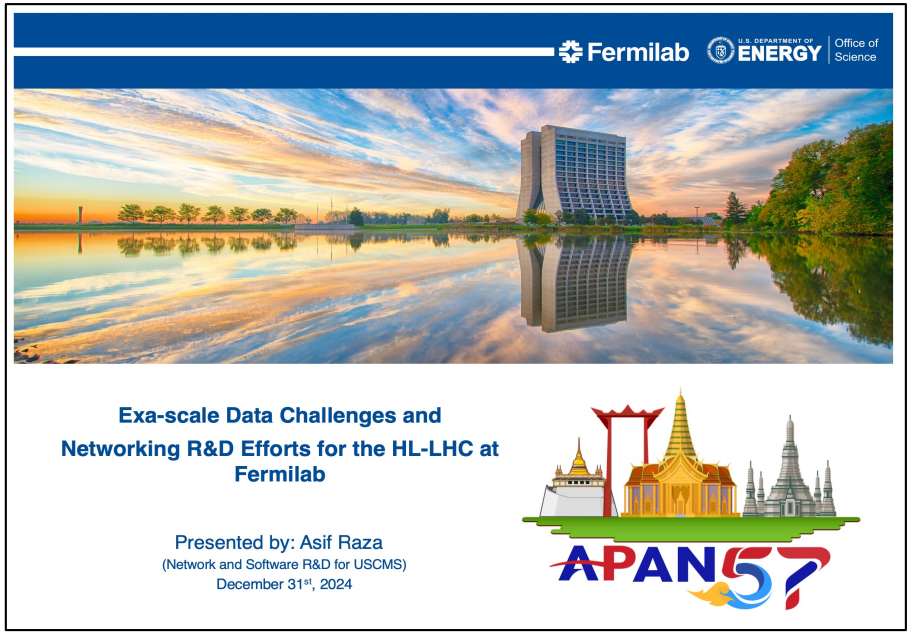
- Korea Research Platform update and current status(Jeonghoon Moon/KREONET)

- Malaysia Research Platform Update(Nor Asilah)

57th Asia Pacific Advanced Network (APAN 57th)

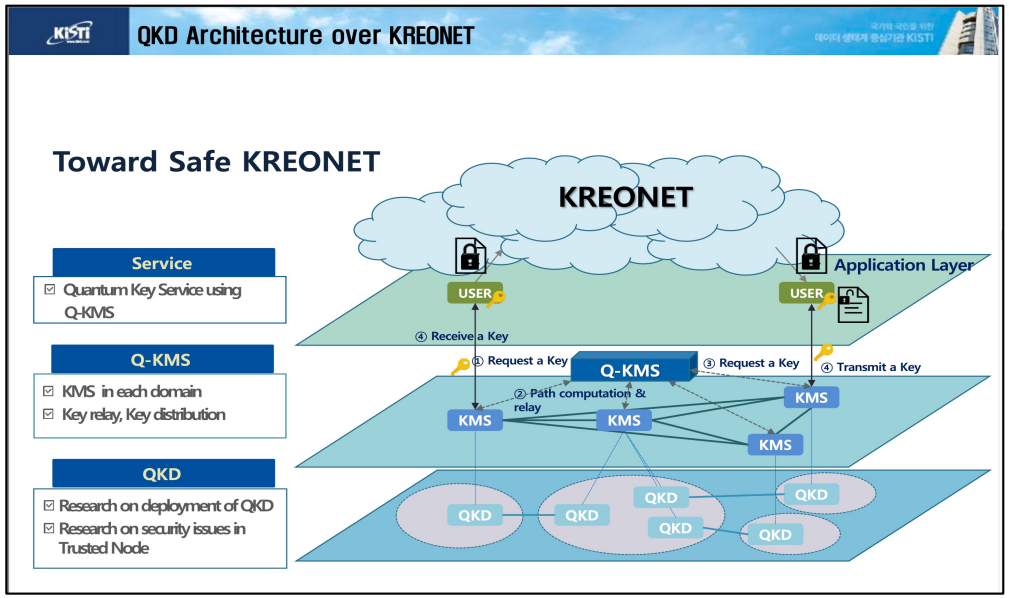
Asia Pacific Research Platform Workgroup(APRP)

Assoc. Prof. Dr. Nor Asilah Wati Abdul Hamid,
Faculty of Computer Science and Information Technology,
Institute for Mathematical Research (INSPEM),
Universiti Putra Malaysia



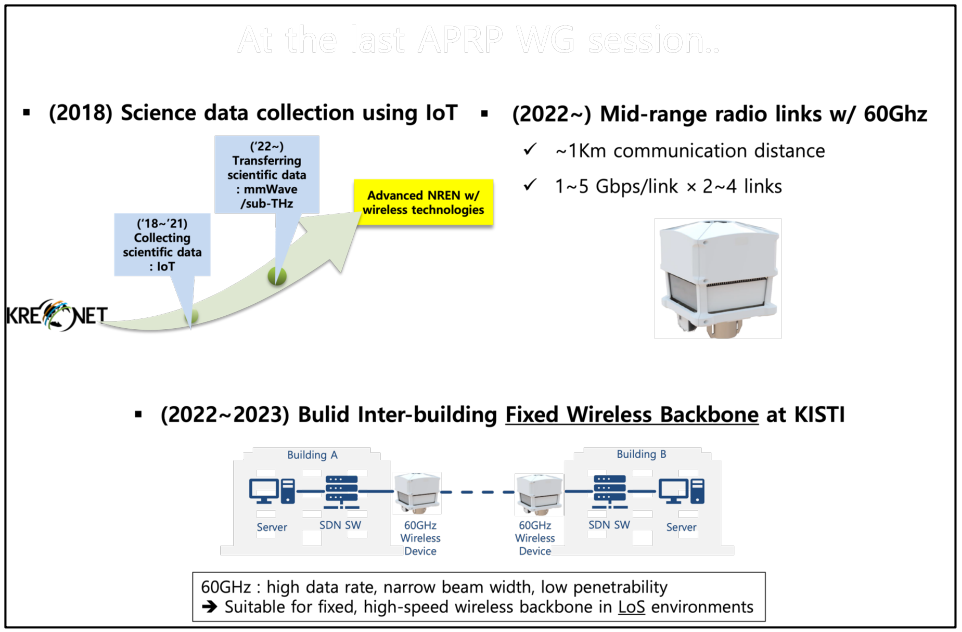
- Exa-Scale data challenges and networking R&D efforts for the HL-LHC at FermiLab (Asif Raza/FermiLab)

Summary of Session 2



- Research of Quantum Safe network at KREONET (Woojin Seok/KREONET)

- Wireless Communication and Scientific data(Kiwook Kim/KREONET)



- Capacity Building for Forest, Hydrology and Climate Change Disaster Related(Veerachai Tanpipat(TH) & Soozin Ryang(KR))

APAN 58th Meeting & APRP WG session

- **APAN 58th APRP Meeting**
  - Held at Islamabad in Pakistan(26th to 30th Aug., 2024)

- **Session Information**
  - Session 1: Keynote Speech and Technical Part, Chair: Jeonghoon Moon, 0900 – 1030
  - Session 2: Application and Country Update Part, Chair: Andrew Howard, 1100 - 1230
    10 Presentations from 6 countries
  - Keynote Speech: Quantum Network by Dr. Raj Kettimuthu (ALN/US)
  - Presenters: 10 presentations, 6 countries
  - Keywords: Big data, A3 Foresight Program, New Project, DMC/Cloud of NCI, Inter Data Center, Apply for Agricult ure, Bio-Science, AI-Science, PERN, etc

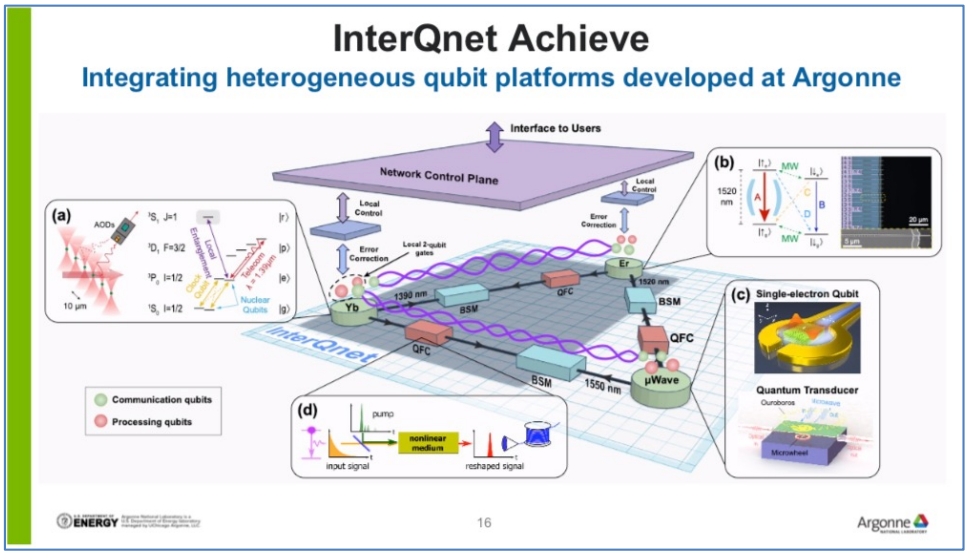
Session 1

Session1, 0900-1030 GMT +5(PK time), 28th Aug. Chair: Jeonghoon Moon(KISTI/KR)		
1	0900-0903	Introduction of APRP WG and sessions (Jeonghoon Moon/KISTI/KR)
2	0900-0918	FNAL's High-Speed Networking R&D Efforts for the HL-LHC (Asif Raza/Fermilab/US)
3	0918-1010 (Keynote)	INTERQNET: A systems approach to realize a scalable quantum network (Raj Kettimuthu/ANL/US)
4	1010-1025	NDeX Project: Inter data centers big data transfer (Kiwook Kim/KISTI/KR)
5	1025-1035	Data Sharing Infrastructure across Northeast-Asia Supercomputing Centers for Open Science (Jeonghoon Moon/KISTI/KR)

Session 2

Session2, 1100 - 1230, GMT +5(PK time), 28th Aug. Chair: Andrew Howard(NCI/AU)		
1	1100-1115	Australia Country Update and NCI future works (Andrew Howard/NCI/AU)
2	1115-1130	Introduction of PERN and activities(Ahmed Naeem/PERN/PK)
3	1130-1145	AI research activities of Sukkur-IBA Univ. in PK (Ghulam Mujtaba/Sukkur-IBA Univ.PK)
4	1145-1200	EBC-K project in MY(Nor Asilah/UPM/MY)
5	1200-1215	HPC & Bioinformatics activities(Asif Khan/Perdana Univ./MY)
6	1215-1230	Research Platform and apply for Agriculture fields (Kihyeon Kim/KISTI/KR)

Summary of Session 1



Keynote Speech: Overview of Quantum Networking Technologies and Ongoing Quantum Networking Research at Argonne(Rai Kettimuthu/ANL/US)

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FNAL's High-Speed Networking R&D Efforts for the HL-LHC era (Asif Raza/ FermiLab/US)

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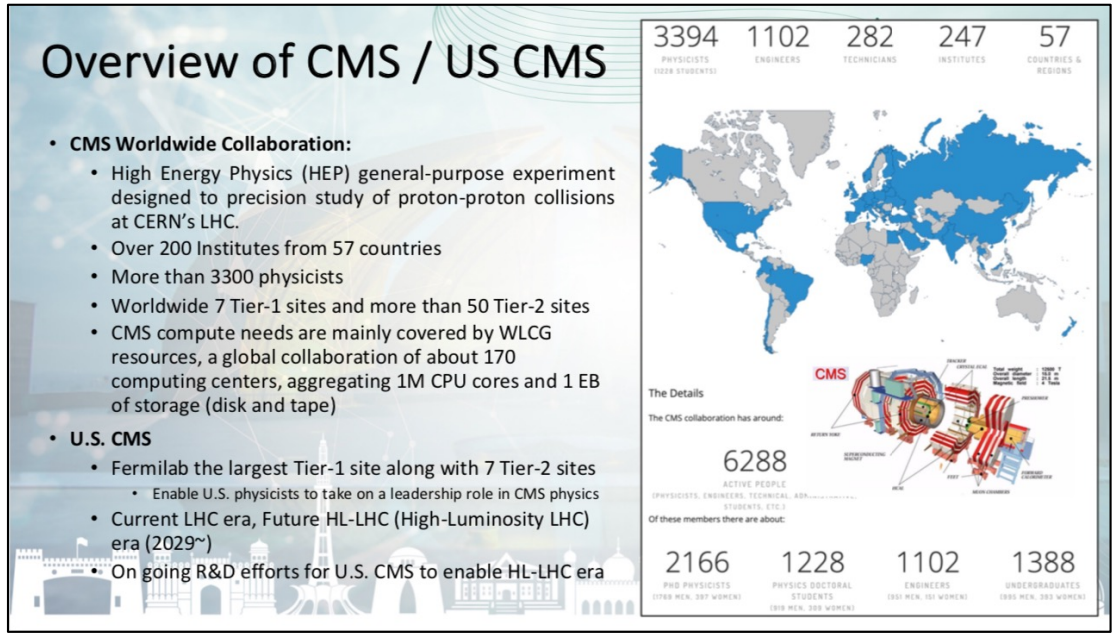

Extra Budgetary contribution from Korea (EBC-K 2024) Project(Nor Asilah/UPM/MY)

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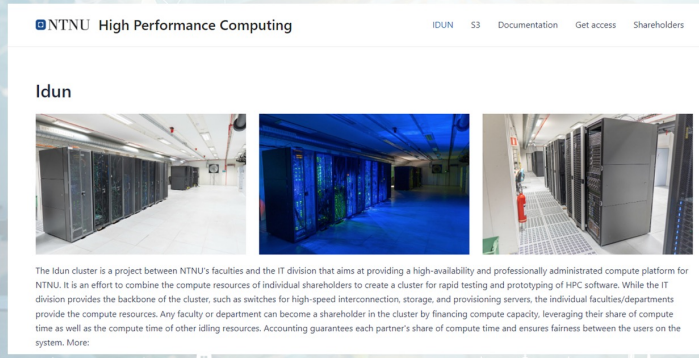
Summary of Session 2

Available Computational Resources for Training and Testing AI Models

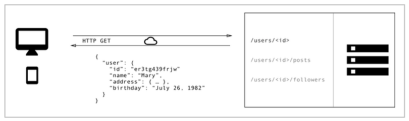


Introduction to NDeX(Kiwook Kim/KISTI/KR)

4. Agricultural Big Data Research Platform Linkage Plan

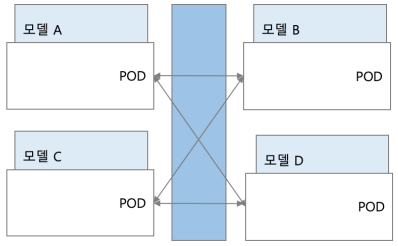
- **Platform Composition Plan (Draft)**
  - Platform and SW Configuration for Container and API Networking Processing
  - Container Control/Management -> Kubernetes Open Source SW
  - Model Management -> Harbor
  - Data Management -> Ceph
  - (Option 1) API Networking -> Self-made API Protocol
  - (Option 2) DevOps/MLOps -> Dizest, Argo, Mlflow

API Networking Protocol Development



Rest API-based Protocol
Pipelining/Ensemble Linkage between Models

(Option 1) API Networking Protocol Creation



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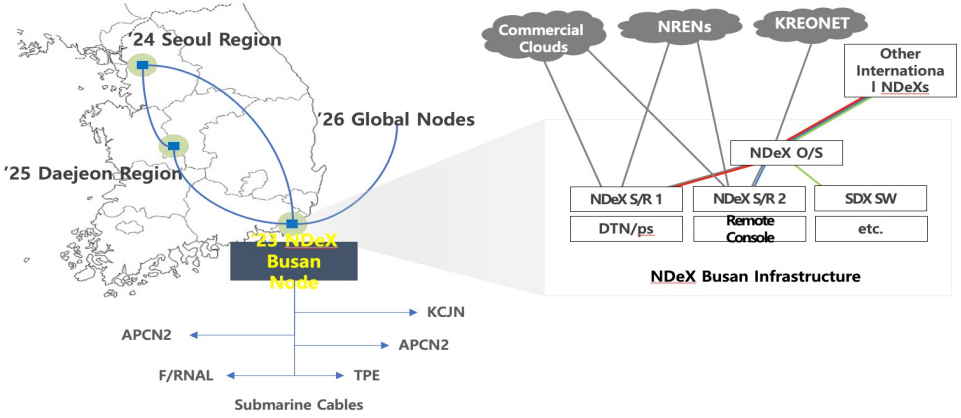
AI Research Activities@Sukkur-IBA University (Ghulam Mjtaba/Sukkur-IBA Univ/PK)

Building Distributed NDeX Infrastructures

- NDeX Regional Node Establishment Plan
  - '23 : Completed pilot node in the Busan metropolitan area.
  - '24 : New node to be built in the Seoul metropolitan area.
  - '25 : Additional node planned for the central region of Korea.



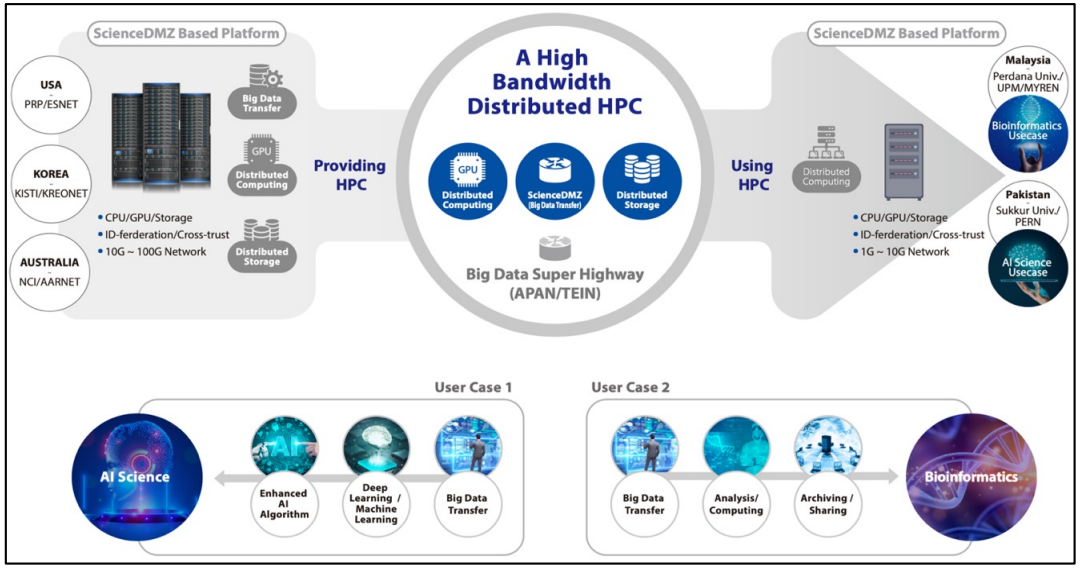
Big Data Research Platform (Kihyeon Kim/KISTI/KR)

Asia-Pacific Research Platform Setup@UPM/Malaysia

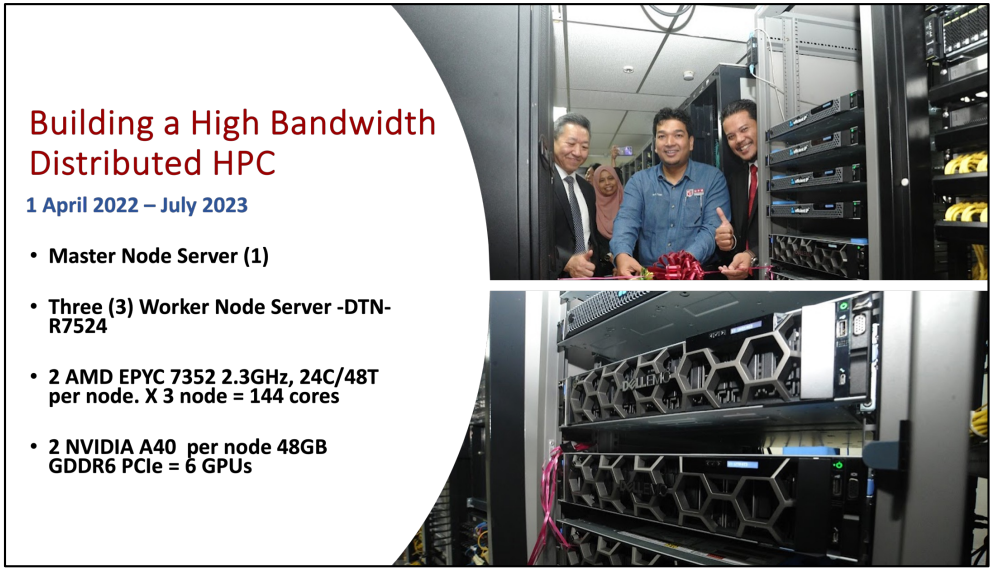
- Asia-Pacific Research Platform setup complete at UPM of Malaysia(Feb. 2024)
- Test running for various Applications (refer. Table)
  - APRP platform is being tested and used by Jupyter/Python users.
  - There are about 5 categories of the application areas

No.	SW	Time (days / hours) (Laptop with 1 processor)	Time (days/hours) (Max core available are 48 cores)	Reduce to
1.	Gromacs	3 months (90days)	With 48 cores	9 days
2.	Pythons	15 hours	With 24 cores	2 hours

- Open plan to APRP WG members (Pakistan, Nepal, Sri-Lanka and Thailand)
- Share the computing resources with KR, AU, JP, SG etc



Architecture of APRP



APRP setup@UPM

Upcoming APAN 59th Meeting at Yokohama Japan

- **APAN 59th APRP WG Session**
  - Held at Yokohama in Japan (5th Mar. 2025)
- **Session Information**
  - Session 1: Country Update(AU, KR, MY, PK, ASEAN, etc), 0900 – 1030
  - Session 2: Technology & Application (Wireless, Transfer, AI, HPC, Medical, etc) 1100 - 1230

Korea Research Platform(KRP)

Korea Research Platform (KRP) for Domestic

- Since 2015, Global partner of PRP project
- Since 2018, Leading of APAN APRP WG
- Since 2021, Expanding to 7 Korea National Research Institute
- Since 2022, Asi@Connect Project/TENI*CC for international
- Since 2024, A3 Foresight Program Project by A3 countries NRF

National Scale

Establish a high-reliability & high-speed transfer system without boundaries between participants

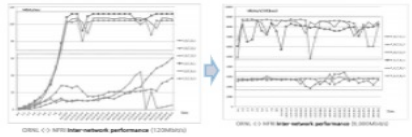
☞ For 25 Korea National Research Institutes & 4 University of Advanced Science & Technology

Key elements

- Borderless single domain transfer performance level
  - ☞ Esnet ScienceDMZ level
- A Unified authentication system without boundaries

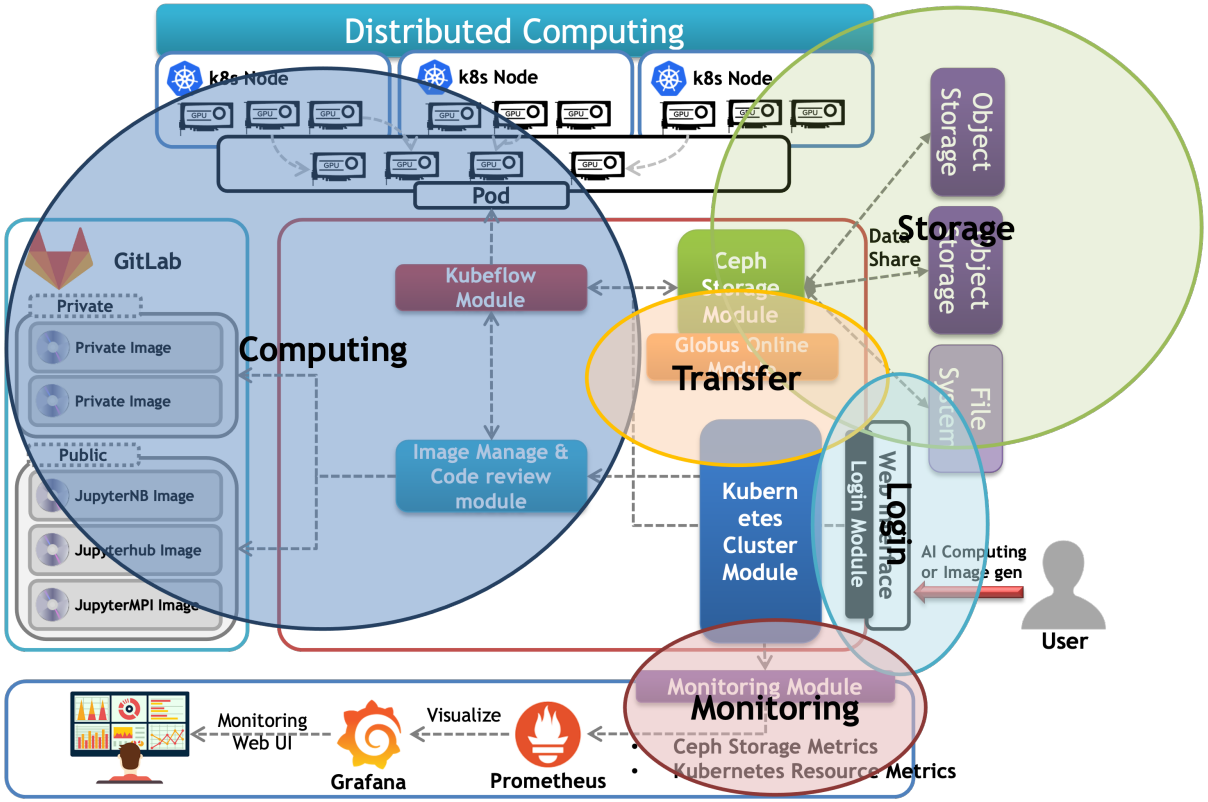
Example of Nuclear Fusion Research

Improve transfer performance about 75 times after ScienceDMZ deploy
☞ To expand the national scale

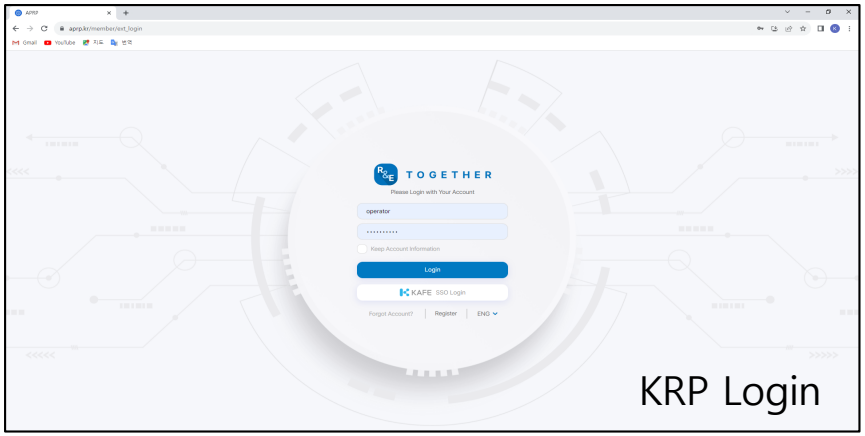


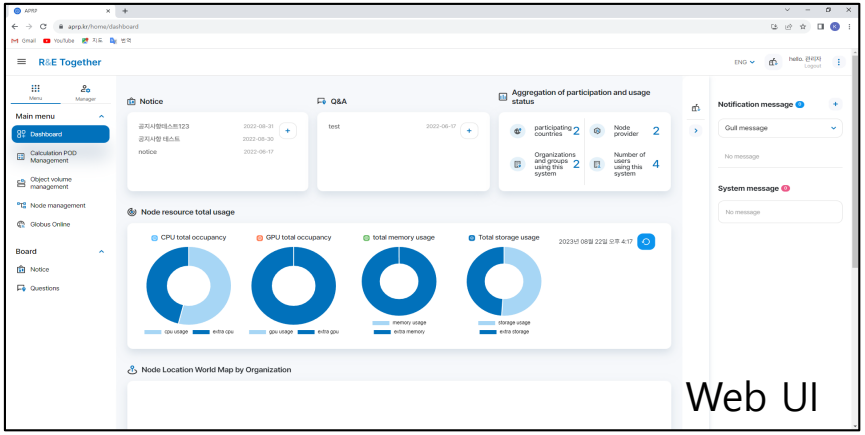
Current KRP Platform Status

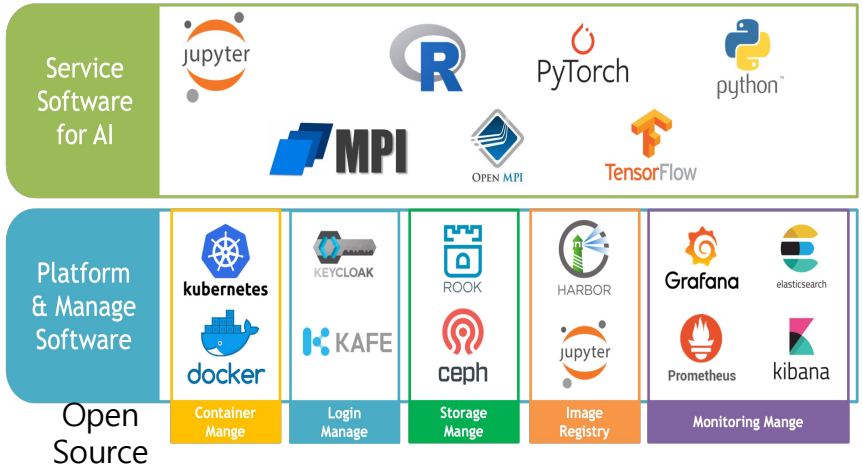
- **Korea Research Platform**
  - Several prototype KRPs
    - GPU intensive, CPU intensive, Storage intensive type
- **Applications**
  - Analysis of Urban flooding by LSTM
  - Analysis of Solar Visual data by High intensive GPU(Astronomy)
  - Several distributed computing task based on AI & GPU



Platform Architecture







Related Project 1 – Smart Agriculture

1. Korea Rural Development Administration project (Grant March 2022-2024)

- Title: Development of integrated linkage system for agricultural big data and utilization model
- Participants: Seoul National Univ., KISTI
- Total Budget: About 450,000$(3years)
- KISTI: 150,000$(For 3years)
- Research Contents (KISTI/KREONET part)
  - Agriculture big data transfer
  - Running Crop model on the Research Platform (Using CPU & GPU)
  - Establishment Research Platform for end-user(Farmer) & developer(Agriculture Researcher)

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농촌진흥청
Rural Development Administration

2. High Performance Research Platform for Medical

- Tentative title: Establishment of a high-performance collaborative research platform dedicated to medical research for gene scissors research.
- Participants: KISTI, Yonsei Medical University

연세대학교 의과대학
YONSEI UNIVERSITY
COLLEGE OF MEDICINE

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A3 Foresight Program Project

[1] Overview of the A3 Foresight Project
[2] A3 Countries strategies and Key technologies

Overview of A3 Foresight Program Project

- **Main Title**
  - Data Sharing Infrastructure across Northeast-Asia Supercomputing Centers for Open Science

- **Participants Countries and institutes:**
  - Korea: KREONET/KISTI
  - Japan: R-CCS/RIKEN, Osaka Univ.
  - China: NSCC-GZ, Sun Yat-Sen Univ.

- **Duration :** Aug. 2024 – Jul. 2029 (5 Years)

- **Budget :** Korea(300,000$), Japan(347,000$), China(562,000$)

The A3 Team

NSCC-GZ, Sun Yat-sen University

- PI: Yutong Lu 卢宇彤
- Professor, Director

R-CCS, RIKEN

- PI: Hidetomo Kaneyama 金山 秀智
- Expert Technician

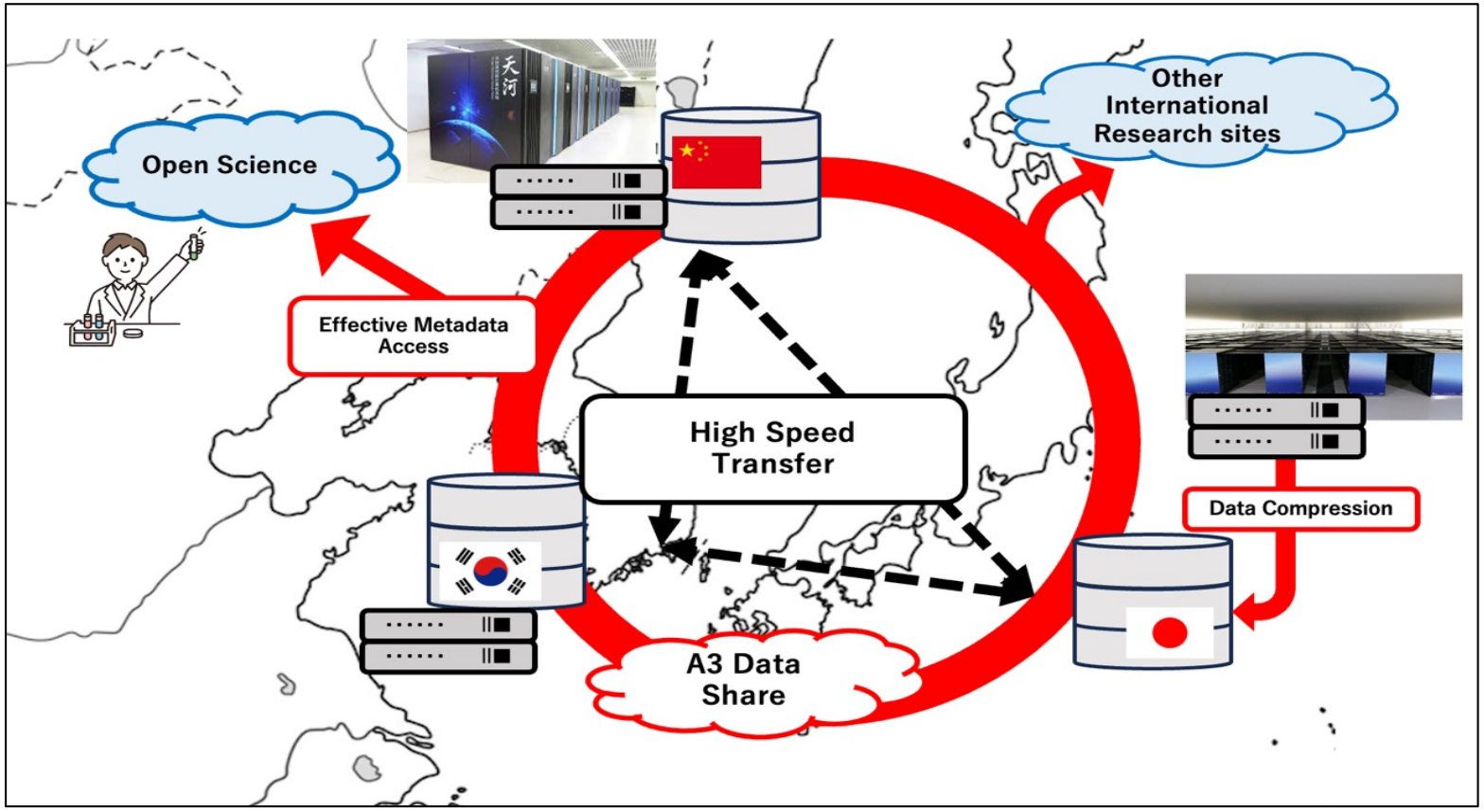
KISTI

- PI: Jeonghoon Moon 문정훈
- Principal Researcher

A3 Foresight Project - Objective

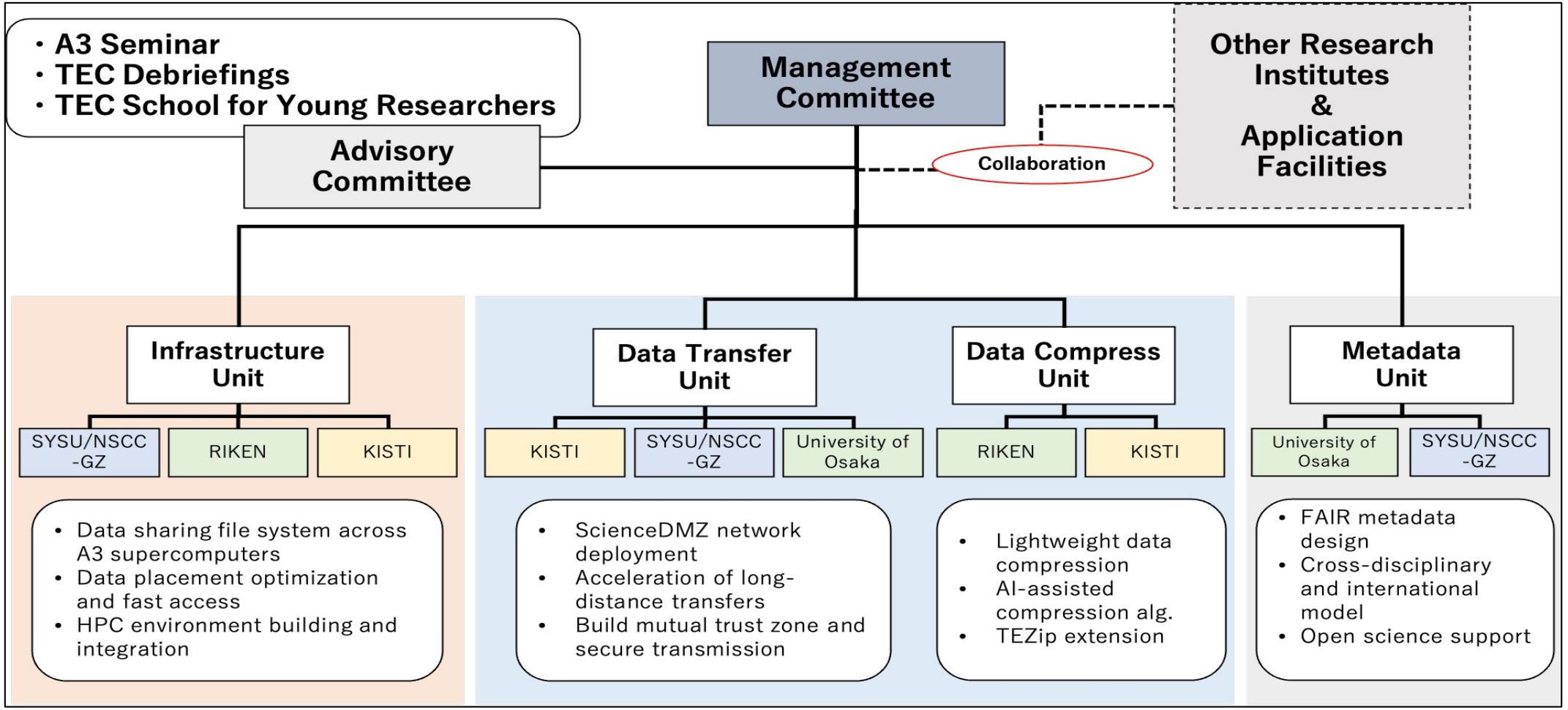
Objective:

According to the Boundless advancement of science and technology through LLM (Large-Scale Language Model) and Advancement of science and technology without boundaries through open science, **this project aims to lead the development of an advanced research environment (system and element technology) for the utilization and sharing of research data and to establish an infrastructure for sharing advanced research data between Korea, China, and Japan.**



Strategies – 4 Units

- **Strategies (Divide into 4 Units)**
  - Unit 1: Infrastructure Unit (Leading by China: NSCC-GZ , KISTI, RIKEN)
  - Unit 2: Data Transfer Unit (Leading by Korea: KISTI, NSCC-GZ, Osaka Univ)
  - Unit 3: Data Compress Unit (Leading by Japan: RIKEN, KISTI)
  - Unit 4: Metadata Unit (Leading by Japan: Osaka Univ., NSCC-GZ)

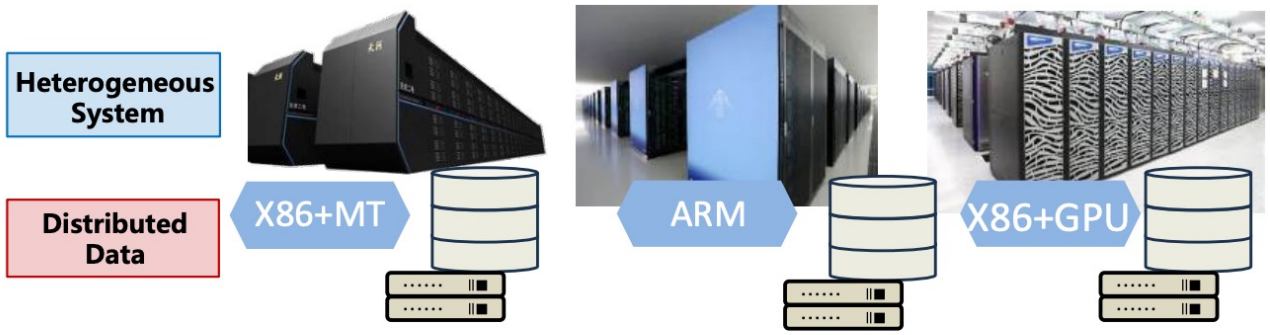


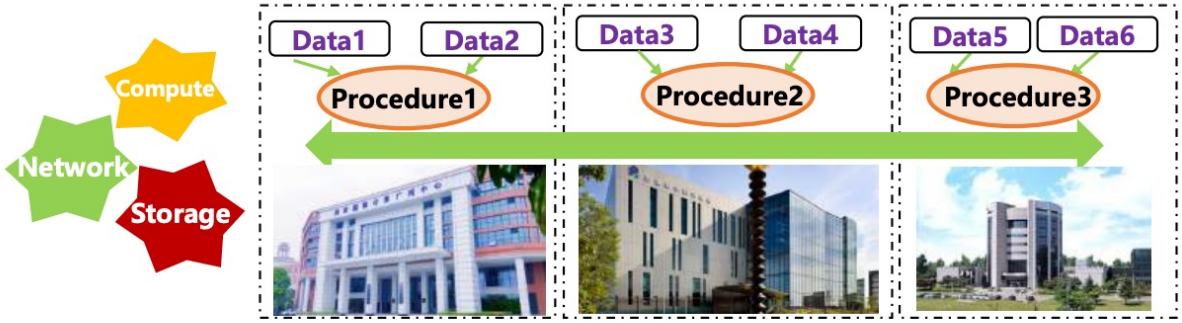
The Challenges

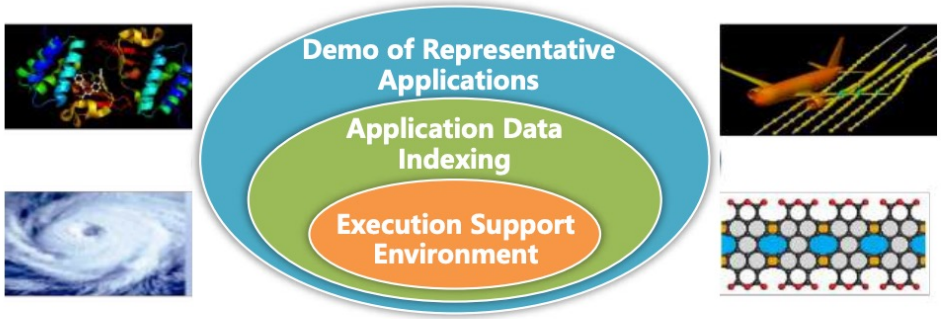
Fusing and Managing Geographically Distributed Data

Effective Long-distance Transfer and Sharing

Coordinated Processing of Cross-region Applications

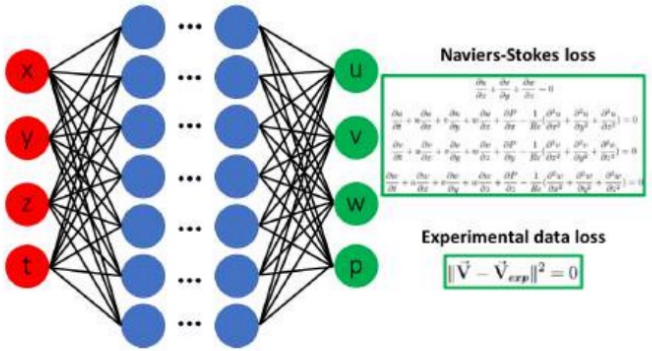






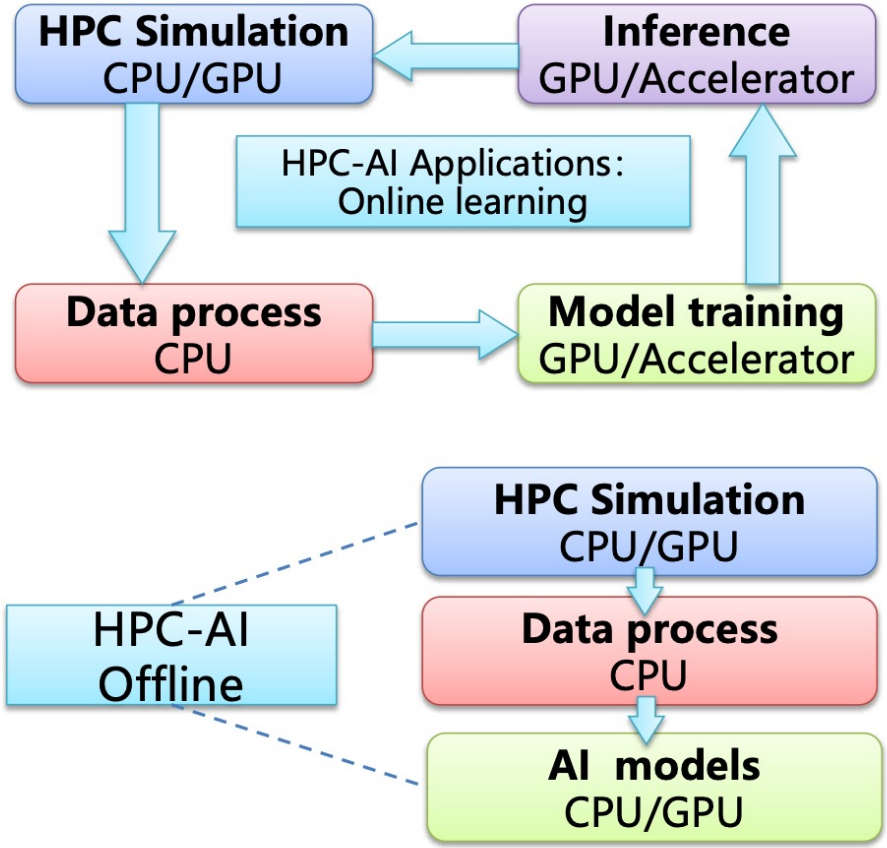
HPC+AI for Science and Engineering

Actively transforming scientific computing landscape



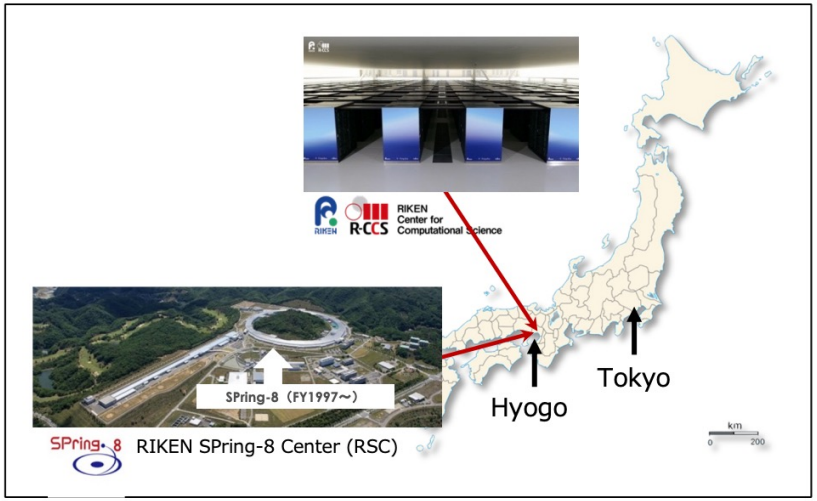
AI4SCI

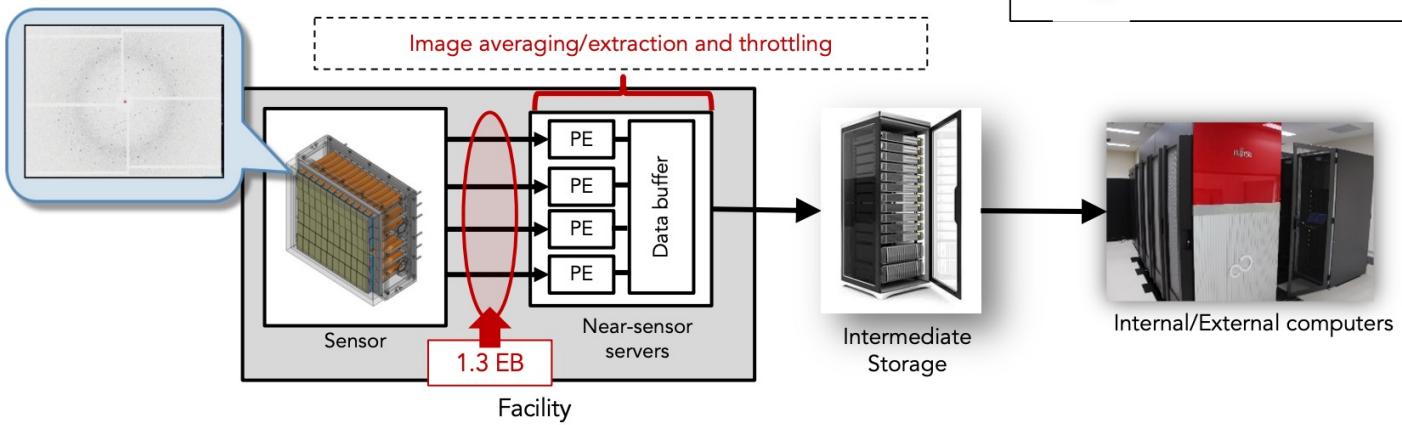
HPC



Big Data Transfer and management

- **RIKEN operates SPring-8 large synchrotron radiation facility**
  - Located in the same Hyogo prefecture as R-CCS' Fugaku
- **Big data generation at SPring-8 facilities**
  - In 2017, SPring-8 public beamlines (26 BLs) generated 320 TB/year
  - In 2025, with the next generation detector (CITIUS), the facility is projected to generate 100-400PB of data per year
- **Data transfer is a first-step for data analytics**
  - Such data generated by sensors need to be transferred to internal/external computers for the further analysis





Due to the large size, transferring data from a sensor to a computer and managing it is challenging.

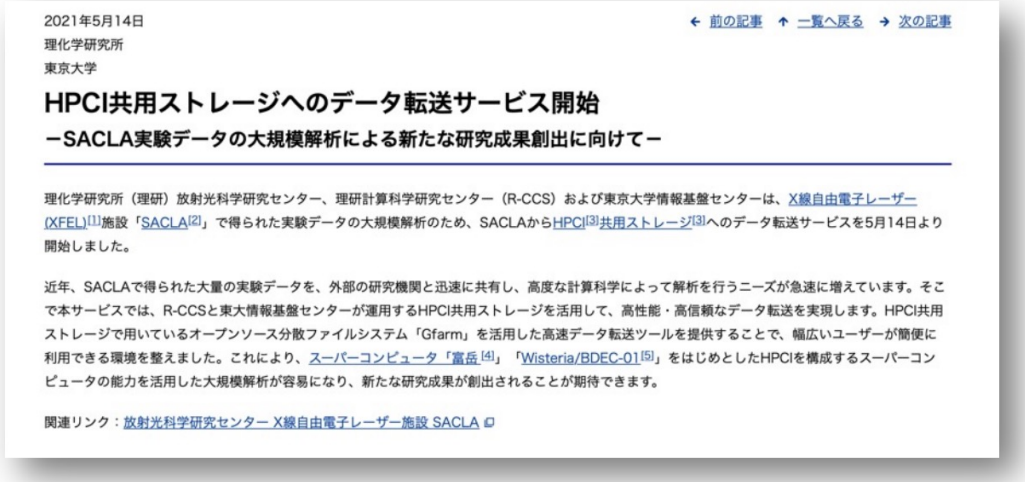
Data transfer service in SACLA (SPring-8 Angstrom Compact Free Electron Laser)

- **We lauched data transfer service from SACLA to "HPCI shared storage" in 2021**
  - "HPCI shared storage" is a geograpycally distributed storage shared by Japanese supercomputing centers including Fugaku

SACLA HPC:
Data Transfer Service to HPCI Shared Storage

Source (May 14, 2021): http://xfel.riken.jp/users/bml09-1.html

Data Transfer Service to HPCI Shared Storage
Toward the creation of innovative achievement through SACLA



Source (May 14, 2021): https://www.riken.jp/pr/news/2021/20210514_1/

We have been working on data compression to improve this data transfer service

Korea – Expand Korea Research Platform

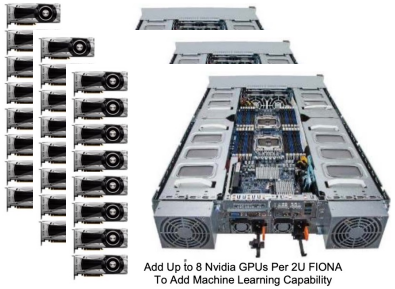
- Korea Research Platform expanding to 25 National Research Institutes
- HPC(Supercomputer, Cloud, Storage) over HPN and global federation

HPC over HPN: A High bandwidth distributed HPC

Korea Research Platform (1G ~ 100Gb/s)

Faster workflow with big data

GPU-DTNs

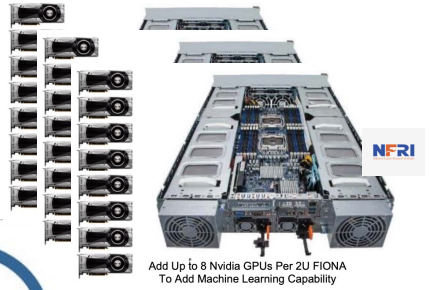


DATA center

Nurion

KISTI Supercomputer

GPU-DTNs



DATA center

A3 Foresight Project Kick off Meeting at Guangzhou

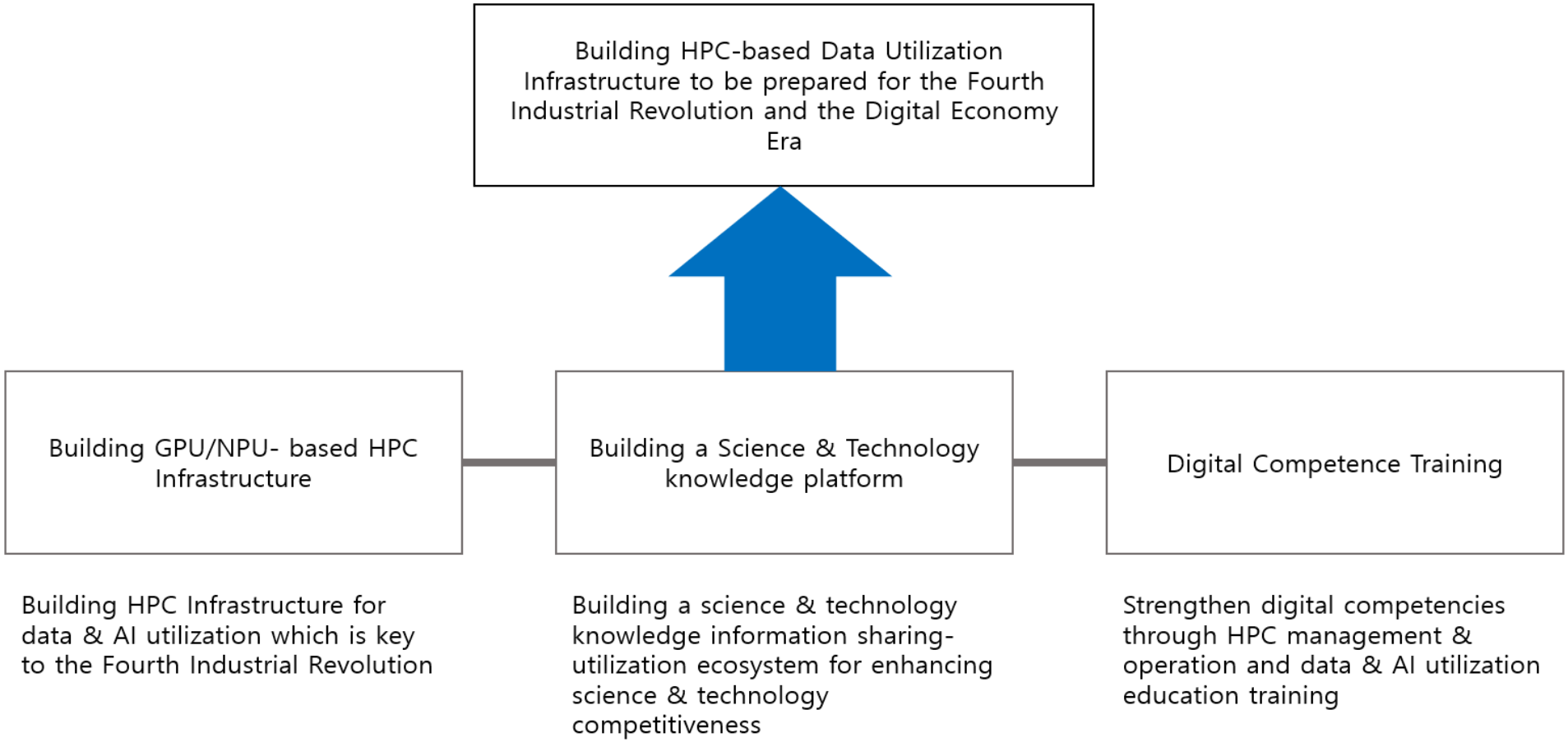
- **Technical Implementation**
  - To establish an A3 data-sharing platform for open science collaboration among Korea, Japan and China, leveraging the computational power of leading supercomputers such as **Fugaku, TH-2/TH-XY, and Nurion**
- **Core technologies and strategies**
  - **Data Management Infrastructure:** Develop integrated system to aggregate geographically distributed resources, ensuring seamless data accessibility and management.
  - **High-speed Network:** Apply advanced networking solutions to enable efficient and reliable cross-site data sharing.
  - **Data Compression:** Adopt compression techniques to reduce data volumes, enhancing transfer speeds and improving storage utilization.
  - **Metadata Access:** Provide FAIR data retrieving to empower cross-border and cross-disciplinary scientific research and discovery.

ASEAN – Korea HPC Project

[1] Overview of the project
(Title: Building HPC Infrastructure and HPC Capacity for ASEAN Data Utilization)
[2] Architecture and Infrastructure

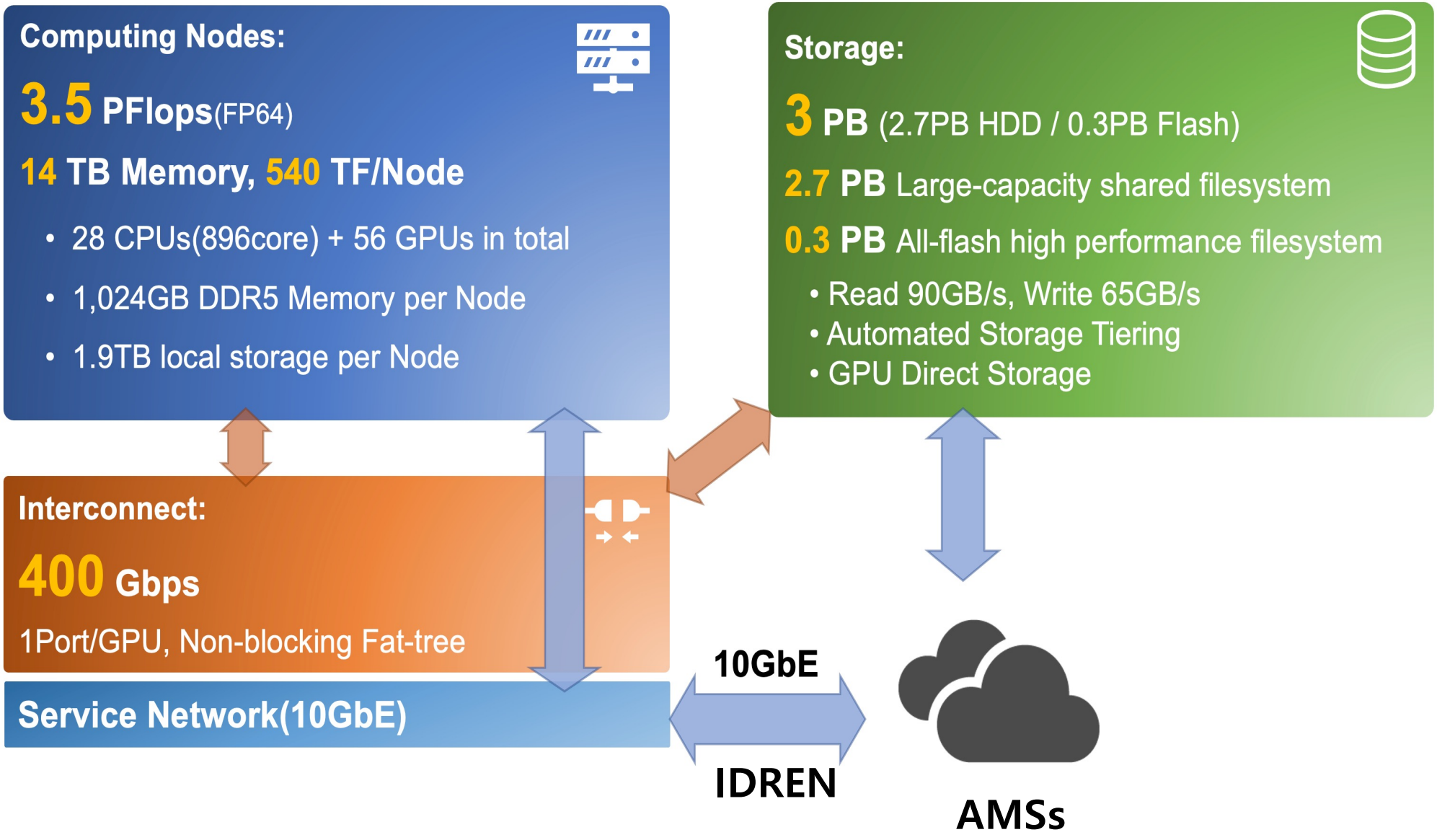
ASEAN – Korea HPC Project (KADIF)

- **Title:** Building HPC Infrastructure and HPC Capacity for ASEAN Data Utilization
- **Budget:** 10M$ for 4 year (2024 ~ 2027)
- **Background**
  - To promote S&T national infrastructure through collaboration in the field of science and technology among ASEAN countries
  - Improving national competitiveness through establishing science and technology knowledge infrastructure for the core of the 4th Industrial Revolution.



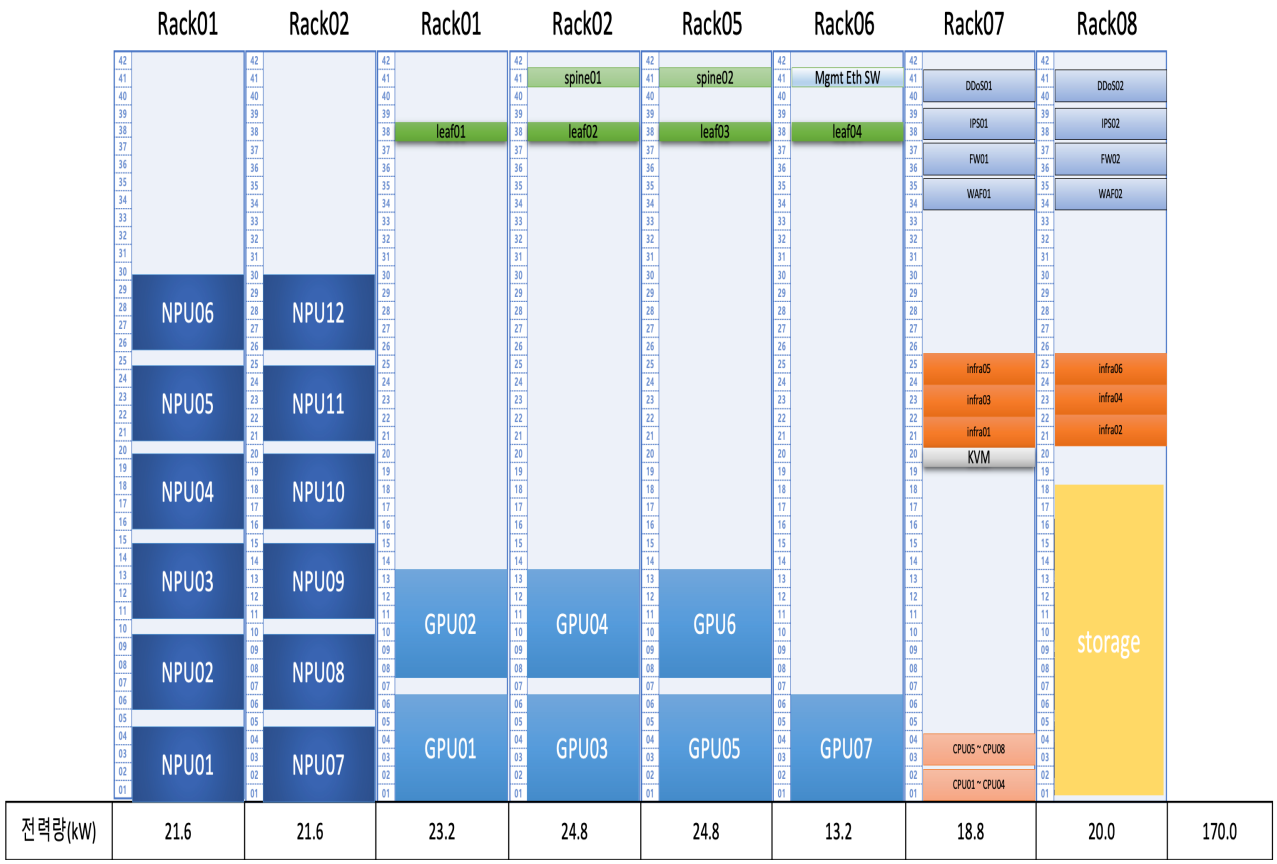
Goal of System with GPU

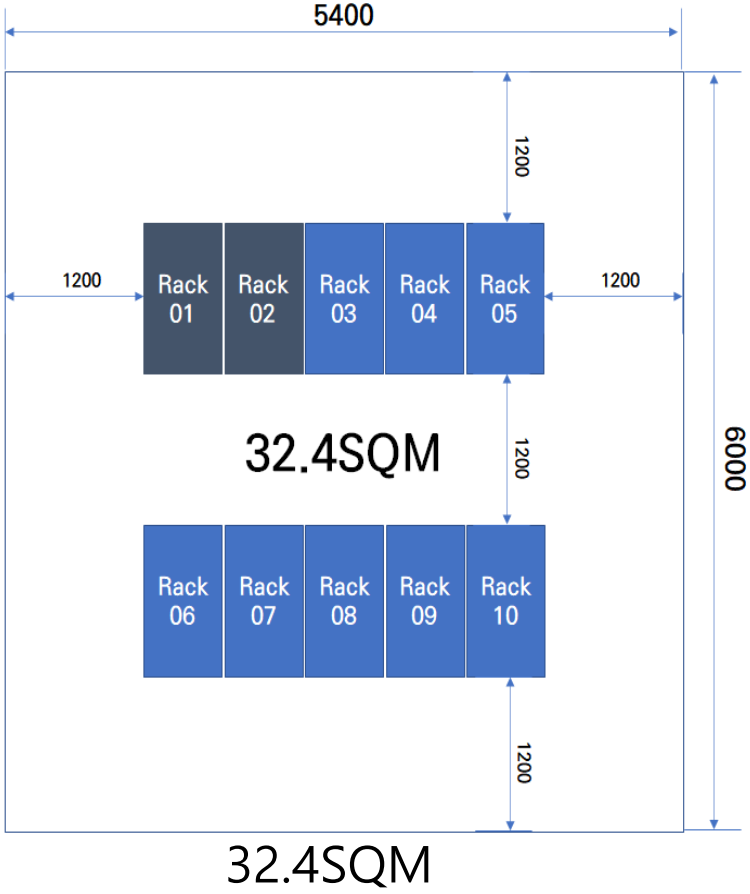
BRIN Data Center



Data Center Infrastructure

- **Interconnection**: 7 GPU nodes (3.5PFlops), 12 NPU nodes, 8 CPU nodes, 6 infrastructure nodes, and storage (4PB) 4-port connection consists of a fat tree structure topology as shown **below.**
- **Infrastructure:** 8 racks are required for HPC system, storage, security equipment, etc., total power consumption is 180kW, system weight is approximately 3,600Kg, floor space is 32.4sqm, cooling capacity is over 60RT.





Conclusion

Conclusion

- **Expand infrastructure to the Asian region**
  - Expand Networking/Computing infrastructure over APAN & TEIN Networks
  - Promote Asian research/education by utilizing APAN & TEIN-based distributed HPC resources
  - Expand the use cases in Asia & Additional collaboration with Asian countries
- **Activate of the APRP**
  - Using APAN APRP WG for managing and operating
  - Collaboration with ASEAN countries via Korea-ASEAN HPC Project
  - Collaboration with A3(Korea, China, Japan) Foresight Project
- **Expand for 3rd party research areas**
  - Smart Agriculture, Medical areas, Climate change
  - AI & Bio Science
  - Cloud computing & Wireless communication

THANK YOU