AI ready Industry
Powered by the ABCI

Satoshi Sekiguchi, Ph.D.

Vice President,
National Institute of Advanced Industrial Science
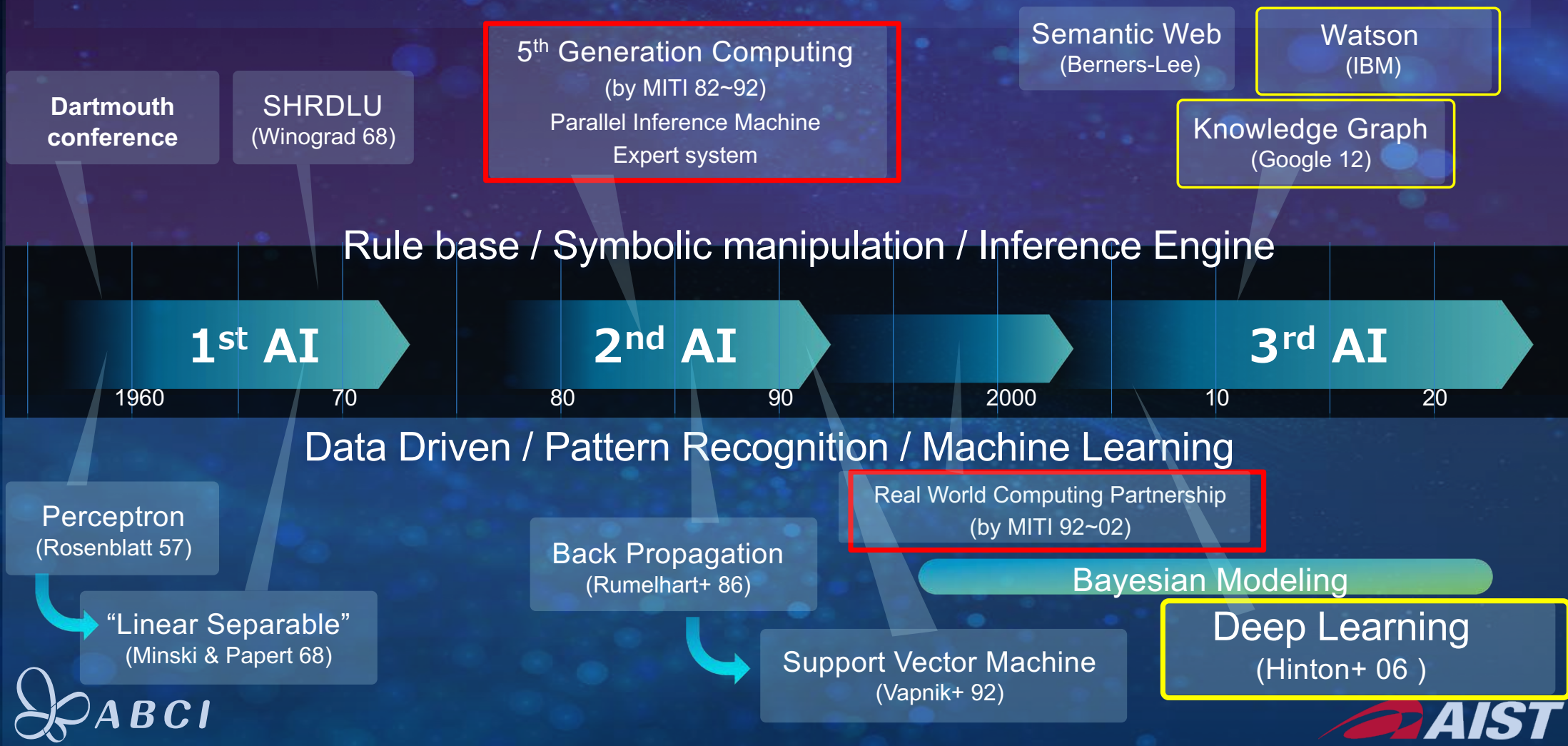and Technology (AIST), *Japan*

ABCI

AIST

Big Wave again… too late or still in time?

5th Generation Computing
(by MITI 82~92)
Parallel Inference Machine
Expert system

...ase / Symbolic manipulati...

2nd AI

80   90

...en / Pattern Recognition ...

Re...

Back Propagation
(Rumelhart+ 86)

ICOT Parallel Inference Machine PIM/p (2001)

(8PE Shared Mem) x 64 Hyper cubed = 512 nodes
Machine Cycle 60ns

manipulation / Inference Engine

90   2000   10

cognition / Machine Learning

Real World Computing Partnership
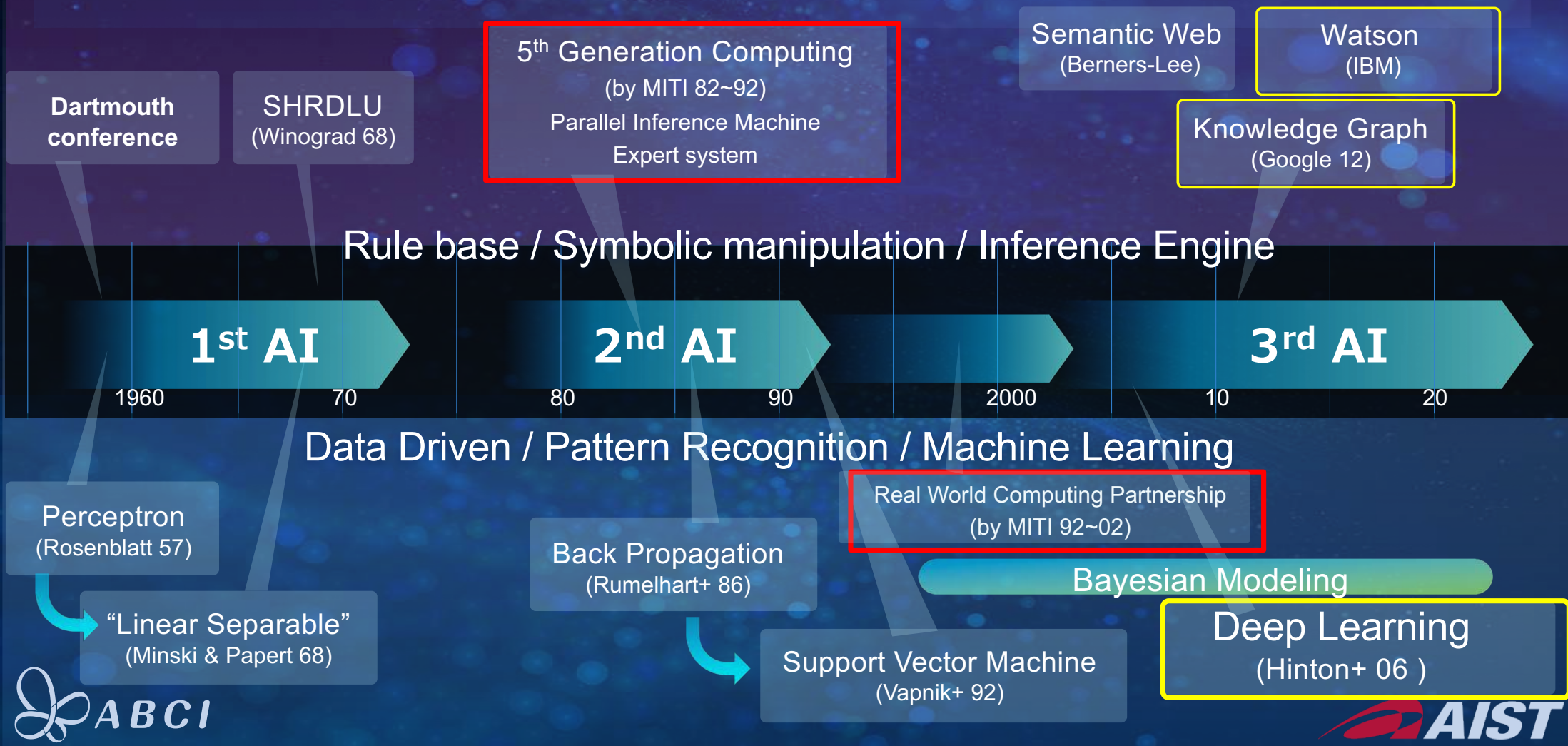(by MITI 92~02)

Bayesian Mo

RWC Score Cluster IIIe (1991)

Dual Pentium III 933MHz x512
Rpeak 955.4GFlops
Rmax 618.3GFlops

During the AI winter, continue to develop faster machines
+ data driven approaches
Followed by Grid Computing, cloud computing

Approaches for AI

5th Generation Computing
(by MITI 82~92)
Parallel Inference Machine
Expert system

Semantic Web
(Berners-Lee)

Watson
(IBM)

Dartmouth
conference

SHRDLU
(Winograd 68)

Knowledge Graph
(Google 12)

Rule base / Symbolic manipulation / Inference Engine

1st AI → **2nd AI** → **3rd AI**

1960   70   80   90   2000   10   20

Data Driven / Pattern Recognition / Machine Learning

Perceptron
(Rosenblatt 57)

Real World Computing Partnership
(by MITI 92~02)

Back Propagation
(Rumelhart+ 86)

Bayesian Modeling

"Linear Separable"
(Minski & Papert 68)

Support Vector Machine
(Vapnik+ 92)

Deep Learning
(Hinton+ 06)

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3rd AI

10

AI for changing industry

Deep Learning
(Hinton+ 06)

Machine

DL

深層学習

AIST

Open innovation

AIRC

Artificial Intelligence Research Center

First in the world to serve as a core hub for AI research

https://www.airc.aist.go.jp/

"We want to create "space" for open innovation that connects industry, academia, and government together"

Dr. Tsujii Junichi
Director of AIRC

Mobility

Productivity manufacturing industry
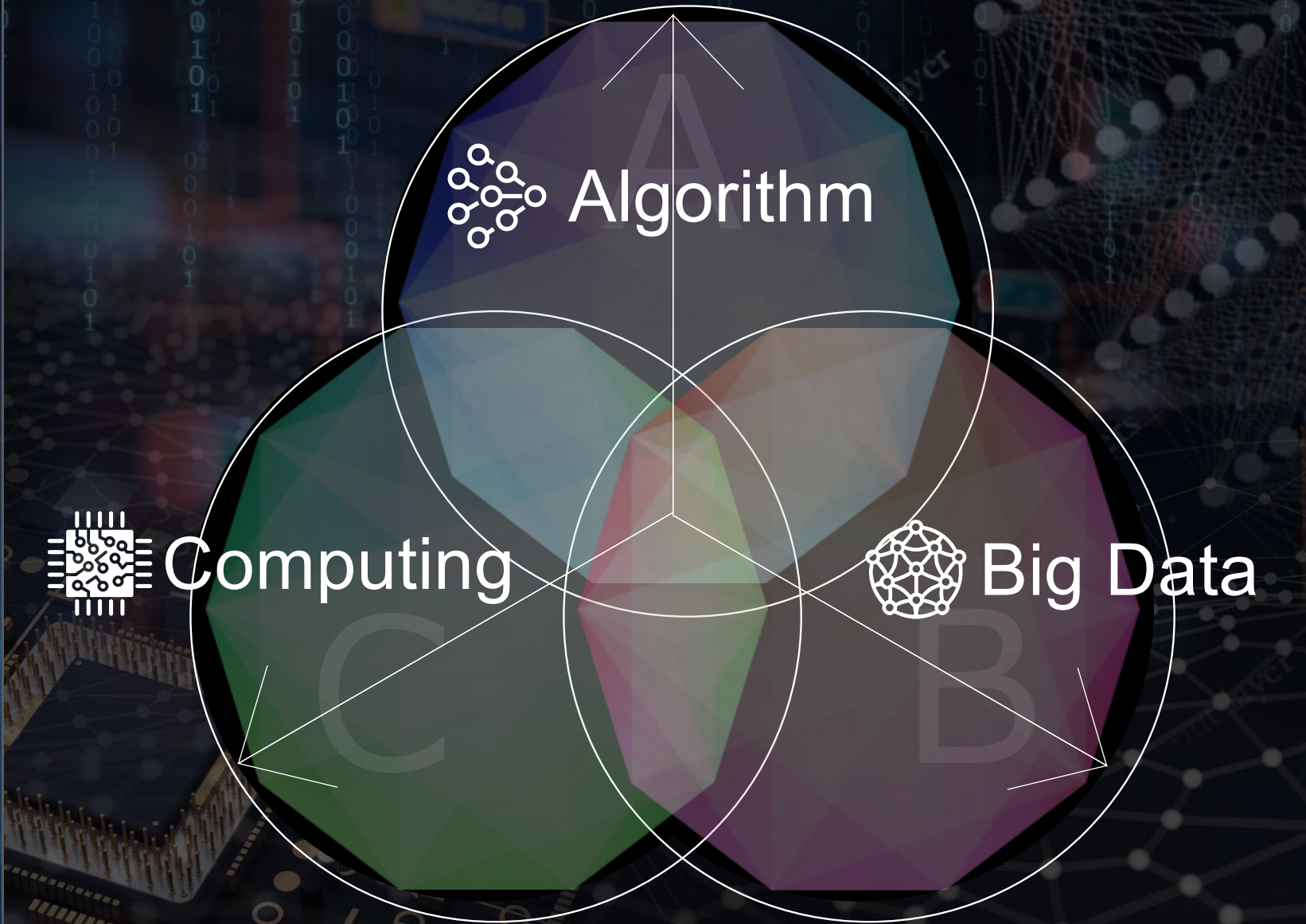
Productivity service industry

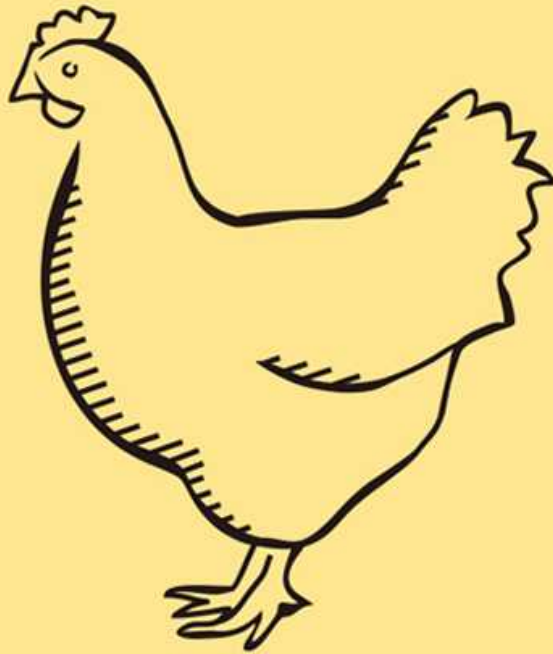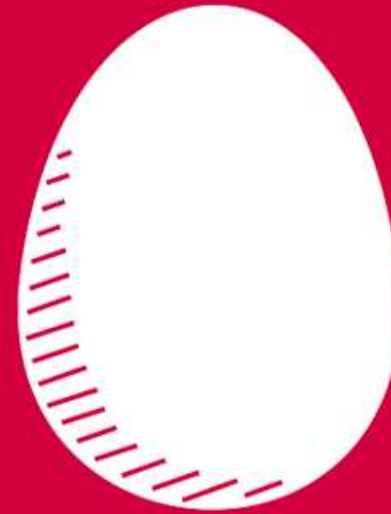Health, medical care, and welfare

Security & safety

https://www.airc.aist.go.jp/

Chicken or Egg?

Huge Demand

Limited Resources

Design: ABCI as the world's first large-scale OPEN AI Infrastructure

東京大学
THE UNIVERSITY OF TOKYO

AIST

On Univ. Tokyo / Kashiwa II Campus

- 130~200 AI-Petaflops
- < 1.1 Avg. PUE

ABCI AI Bridging Cloud Infrastructure

- **Top-Level SC compute & data capability**
  - AI-Pflops 130~200 <
  - Power Budget < 3MW
  - PUE < 1.1

- **Open Public & Dedicated infrastructure for AI & Big Data Algorithms, Software and Applications**

- **Platform to accelerate joint academic-industry R&D for AI in Japan**

Operational before 2018 Q1

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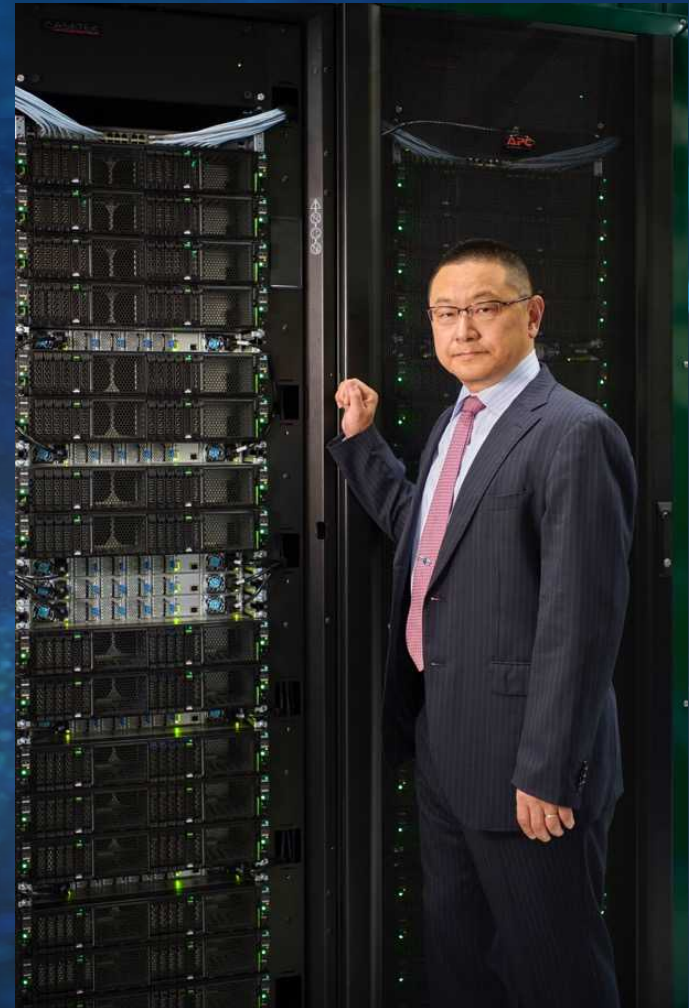Rapid Construction < 6 month

Jan. 30th 2018

Dec. 2nd 2017

Oct. 30th 2017

ABCI: System Configuration

Computing Nodes:

550 Peta AI-Flops,

476 TiB Mem, **1.6** PB NVMe SSD

Computing Nodes (w/GPU) x1088

Multi-platform Nodes (w/o GPU) x10
- Intel Xeon Gold6132 (2.6GHz/14cores) x2
- 768GiB Memory, 3.8TB NVMe SSD

Interactive Nodes x 4	Management and Gateway Nodes x 15

Storage:

22 PB GPFS

**DDN SFA14K
(w/ SS8462 Enclosure x 10) x 3**
- 12TB 7.2Krpm NL-SAS HDD x 2400
- 3.84TB SAS SSD x 216
- NSD Servers x 12

Protocol Nodes x 6

Transparent Cloud Tiering x 2

Interconnect (Infiniband EDR)
- Mellanox CS7500 x 2
- Mellanox SB7890 x 229

Gateway / Firewall
- Nexsus 3232C x2
- FortiGate 1500D x2
- FortiAnalyzer 400E x1

Service Network (10GbE)

SINET5/ Internet

100GbE

ABCI

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ABCI: Computing Node Configuration

CPU

Xeon Gold 6148 x2

Memory

384 GiB

GPU

NVIDIA Tesla V100 x4

Local Storage

1.6TB NVMe SSD

Interconnect
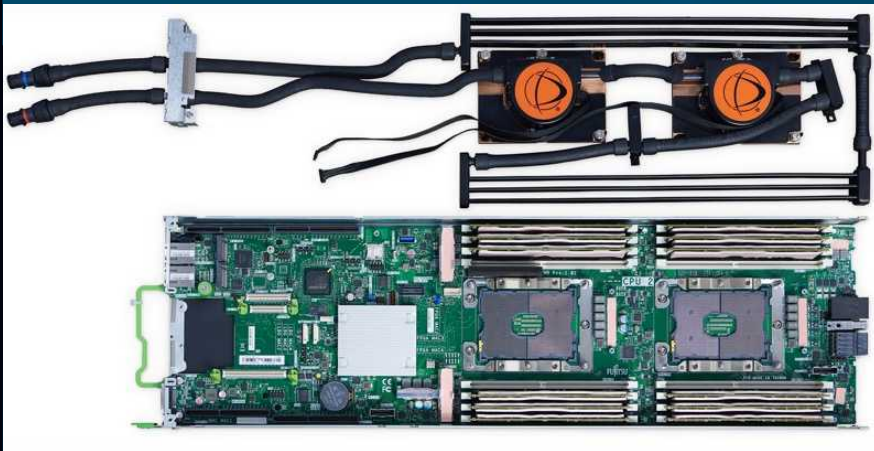
InfiniBand EDR x2

ABCI is Internationally Recognized!

Rmax 19,880 TFlop/s
Ranking # 9

508.85 TFlop/s@HPCG
Ranking # 5

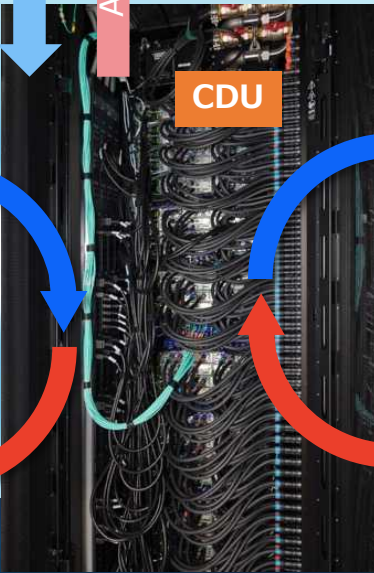**14.423 GFlops/watts**

Ranking # 3

Hybrid Cooling System

Fan Coil Unit（FCU）

Cold Water Circuit 32℃ → **Fan Coil Unit** Coolablity 10kW → 40℃ **Hot Water Circuit**

Air **35℃**
Front side

CDU Coolability 60kW

Water

Air **40℃**

Cold Aisle 35℃

Computing Server

19 or 23 inch Rack (48U)

Hot Aisle Capping

Hot Aisle 40℃

Water Block (CPU or/and Accelerator, etc.)

Water 32℃
Water 40℃

Cooling Tower

Air 35℃
Air 40℃

Air

CDU

Computing node

Liquid

Water 32℃
Water 40℃

Computing Rack

ABCI

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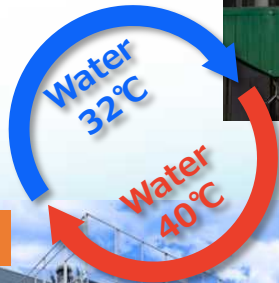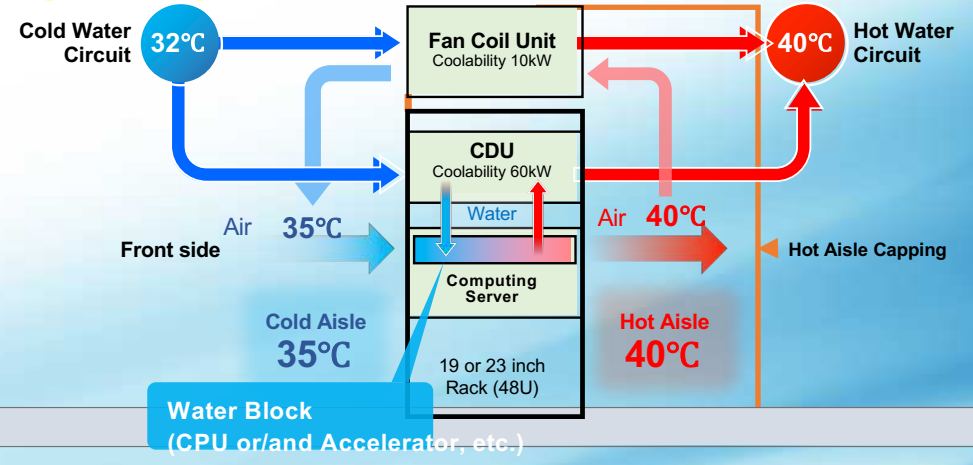
Survived the Extreme Heat of Summer!

Output Water <40℃

Intake Water <32℃

Free cooling is possible during the first grand challenge on 22-26 July 2018.

High/Low temperature in Kashiwa in July 2018
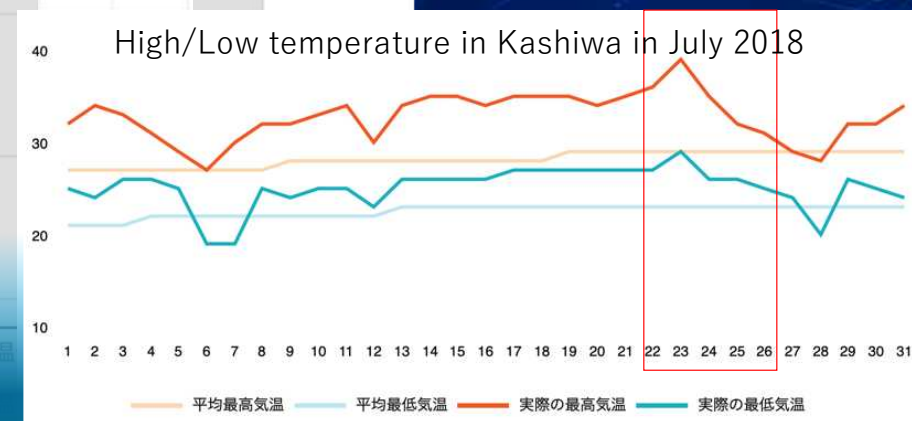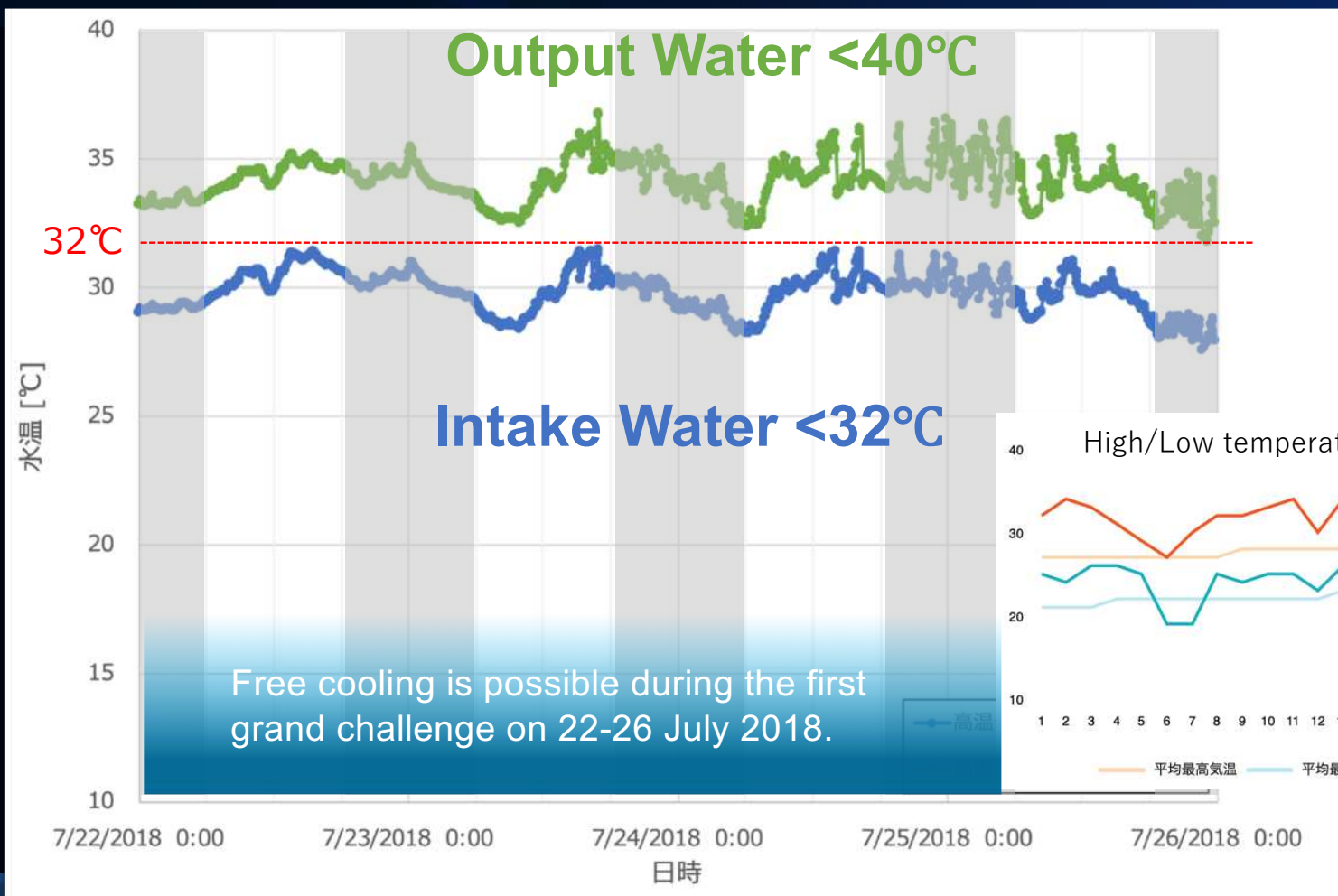
ABCI: public AI-infrastructure for everyone

Expert
- Grand Challenge for leading-edge science
- Allow to use full capacity for 24hours

Advanced & Intermediate
- Software packages, sample data set, network
- AI for industry, customize application

Novice
- Ease of use for beginners
- Simple WebUI interface

Algorithm

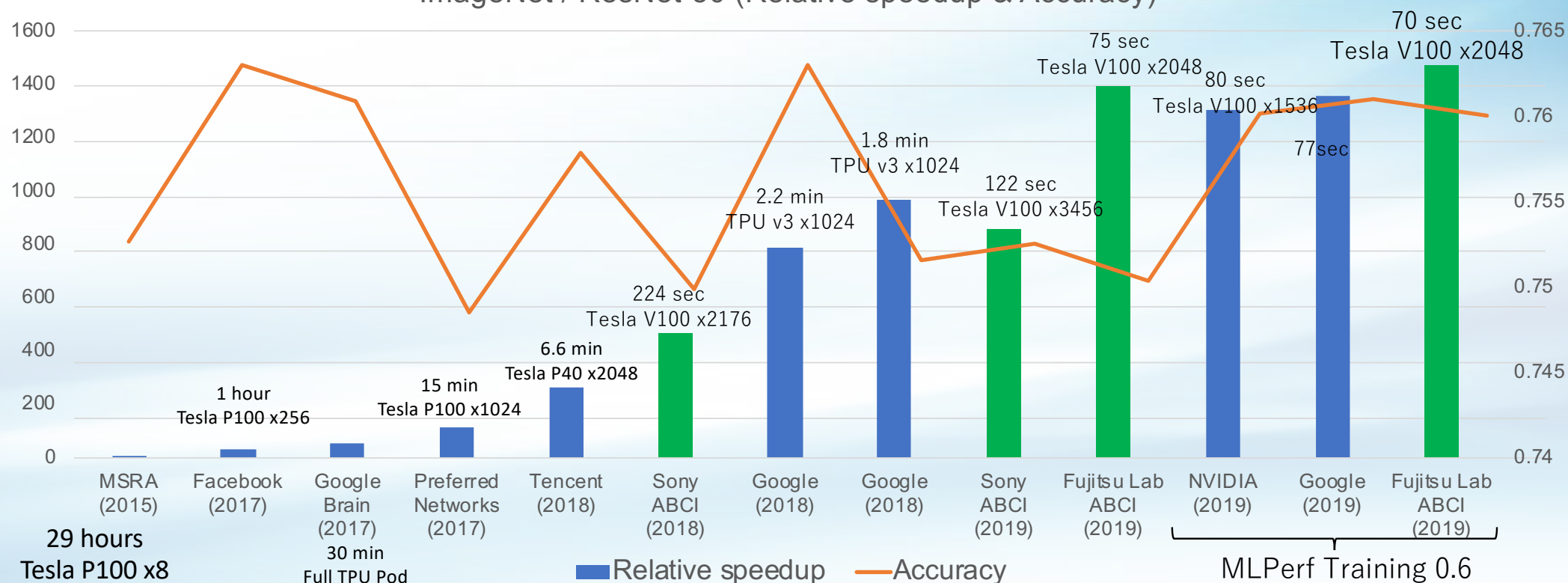Use cases and proportion of AI R&D

Computation

Big Data

- **Partnering Over hundred of Research Institutes, Universities, Industries**
- **Collaborating with Over thousand of research scientists, engineers, developers**

Grand Challenge Outcome

Fujitsu Lab., Sony and ABCI/AIST achieve "World's Fastest Deep Learning speeds through distributed learning"

ImageNet / ResNet-50 (Relative speedup & Accuracy)

ImageNet/ ResNet-50 are a widely-used data for image recognition and model for image recognition, respectively.
We utilized the ImageNet data set and carried out learning of the ResNet-50 model.

GLOBIS-AQZ Project: Aiming to be the world's best Go AI and train younger players

Joint project including:

GLOBIS corp., Yamaguchi-san (ex-AIST famous Go AI developer), Nihon-Kiin (Japanese Professional Go Association), Triplize (Japanese start-up), AIST, and U-Tokyo

- AQ, the 2nd place in the last World AI Go Open, is being further strengthened using ABCI, and aiming to be the best in the world of Go AI
- After the tournament, the results will be made available openly and used to train younger players
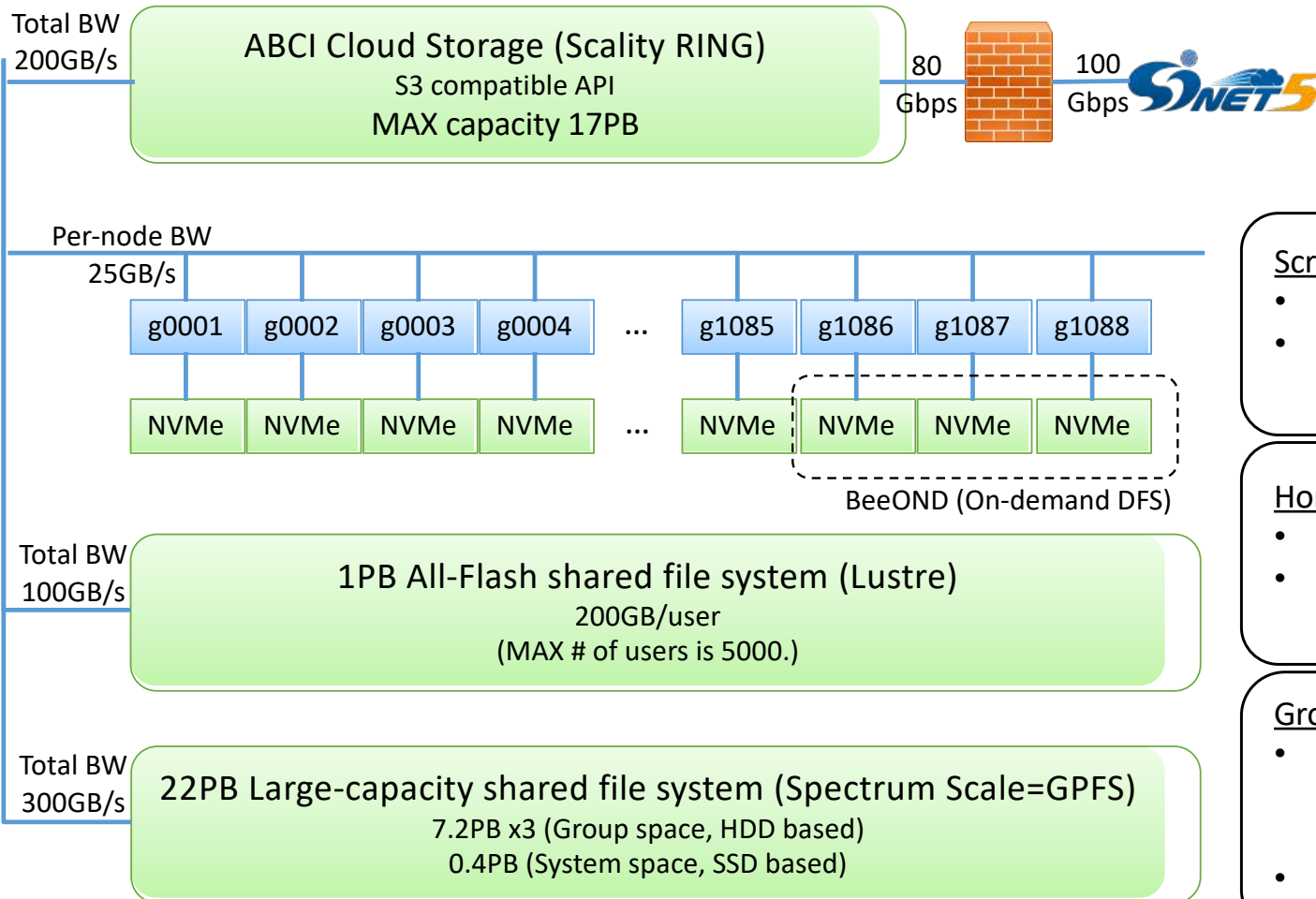
Learning Day 1 vs Nakamura, 1st grade   https://abema.tv/channels/shogi/slots/Bwd1UYnNfezt1V

Learning Day 5 vs Shibano, 7th grade   https://abema.tv/channels/shogi/slots/ARbB2vVhrVBbUj

ABCI Storage Overview

AIST

Total BW 200GB/s

ABCI Cloud Storage (Scality RING)
S3 compatible API
MAX capacity 17PB

80 Gbps | 100 Gbps | **SINET5**

Per-node BW 25GB/s

| g0001 | g0002 | g0003 | g0004 | ... | g1085 | g1086 | g1087 | g1088 |

| NVMe | NVMe | NVMe | NVMe | ... | NVMe | NVMe | NVMe | NVMe |

BeeOND (On-demand DFS)

Total BW 100GB/s

1PB All-Flash shared file system (Lustre)
200GB/user
(MAX # of users is 5000.)

Total BW 300GB/s

22PB Large-capacity shared file system (Spectrum Scale=GPFS)
7.2PB x3 (Group space, HDD based)
0.4PB (System space, SSD based)

ABCI Cloud Storage
- Amazon S3 compatible API
- Support in-transit and at rest encryption

Scratch Space
- Fast SSD (1.6TB) on every compute node
- Allow scale-out in capacity and performance (read/write) with BeeOND

Home Directories
- 200GB workspace per user
- Tuned for low latency and high IOPS to handle many small I/Os

Group and System directories
- Tuned for aggregation of both capacity and performance to support Big Data and archiving applications
- Storing essential system data

Key Features of ABCI Cloud Storage

- **"Data Harbor" connected to SINET5**
  - Fast and safe data collection and accumulation from organizations through SINET5
  - Sharing and distribution of advanced AI and machine learning models trained on ABCI
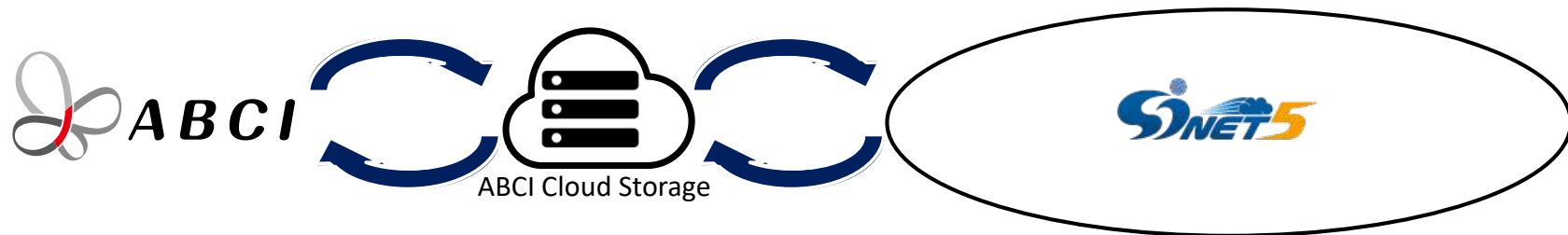
ABCI Cloud Storage

- **Amazon S3 compatible API**
  - Take advantages of the de facto standard API of cloud storage and its software eco system
    - Oracle Cloud, IBM Cloud, IIJ, SAKURA internet, etc.
    - It is possible to port various software and services for S3, to ABCI.
  - Unlike shared file system, fine-grained and flexible access control is possible with Bucket.

- **Enterprise data encryption**
  - SSL encryption in communication with ABCI Cloud Storage from everywhere
 - Support Server-Side Encryption (SSE) as at rest encryption

Use Cases

Data supply chain with S3 API

- Generate AI trained models by using ABCI computing power, after loading data stored on commercial cloud, etc.
- Deploy AI trained models to the edge environment via ABCI Cloud Storage
- A data supply chain can be created only by the de facto standard API
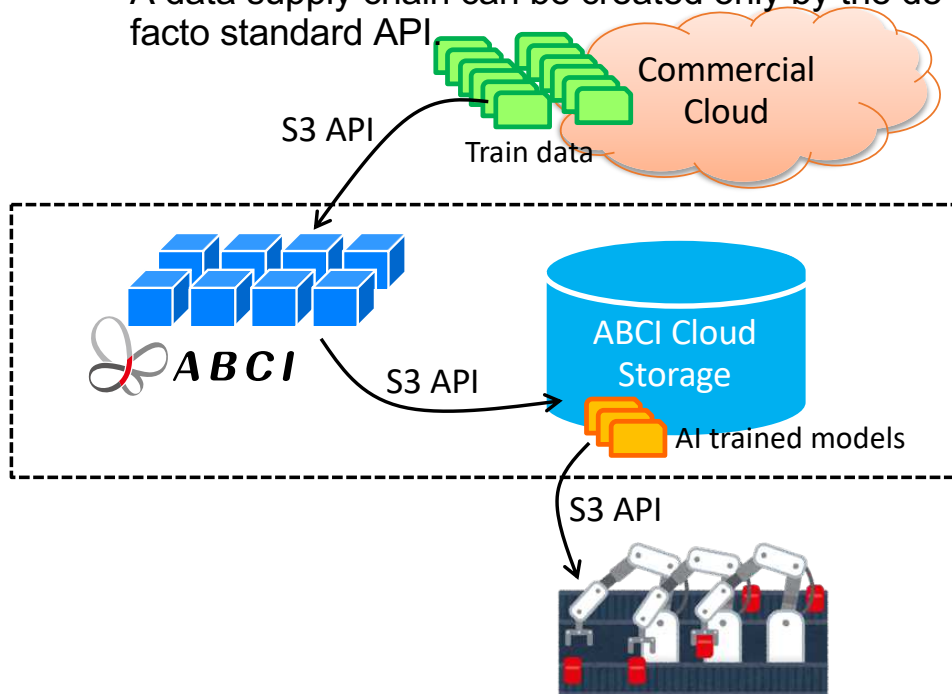
Secure use of sensitive data on ABCI

- When importing data on On-premise to ABCI Cloud Storage:
  - SSL encryption between On-premise and ABCI Cloud Storage
  - Encrypting data when writing to disks
- When retrieving data from ABCI Cloud Storage:
  - Decrypting data when reading from disks
  - SSL encryption inside of ABCI
  - For further protection, data access can be restrictive or exclusive to allocated nodes and loaded data can be stored in scratch (volatile) space only.
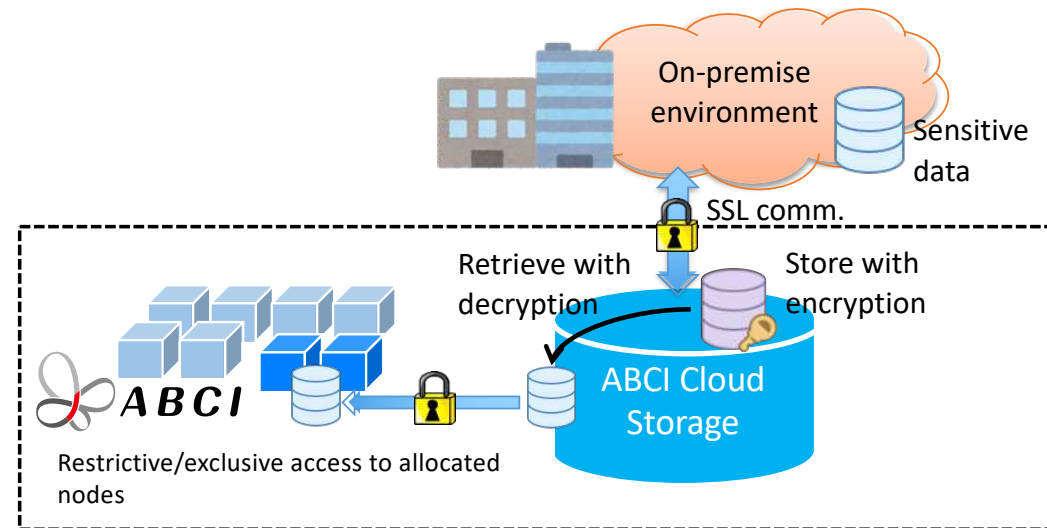
Summary

- ABCI was created to address specific needs in Japanese society.
- ABCI has been used as a focal point of Academia-Industry-Gov., as well as HPC-AI convergence
- ABCI has been operated to supply on-demand AI computing service to those who need this power.
- ABCI uses HPC technology to manage the computing resources for AI users.

ABCI

AIST

Thank you for your attention