

# Towards Exascale/Post Moore Era

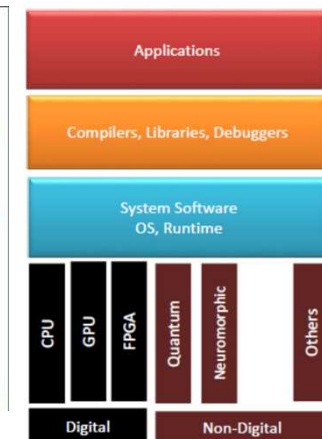
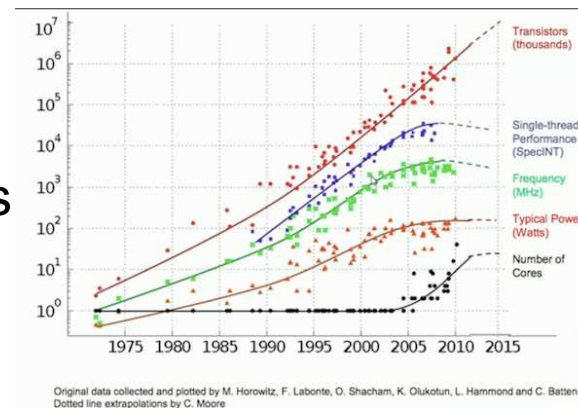
- First Exascale System (A21, US-DOE) in 2021 ?
- Supercomputing is changing NOW
  - More “Intelligent & Sophiscated” Supercomputing by integration of (Simulation + Data + Learning)
    - S+D+L
    - A+B+C: AI, Big Data, Computing
- Power Consumption
  - Important Issue in the Post Moore Era
  - Heterogeneous Architecture
    - Various types of HW for Various types of Workload
    - CPU, GPU, FPGA, Quantum/Neuromorphic, Custom Chips

## ALCF 2021 EXASCALE SUPERCOMPUTER – A21

Intel/Cray Aurora supercomputer planned for 2018 shifted to 2021  
Scaled up from 180 PF to over 1000 PF



Support for three “pillars”

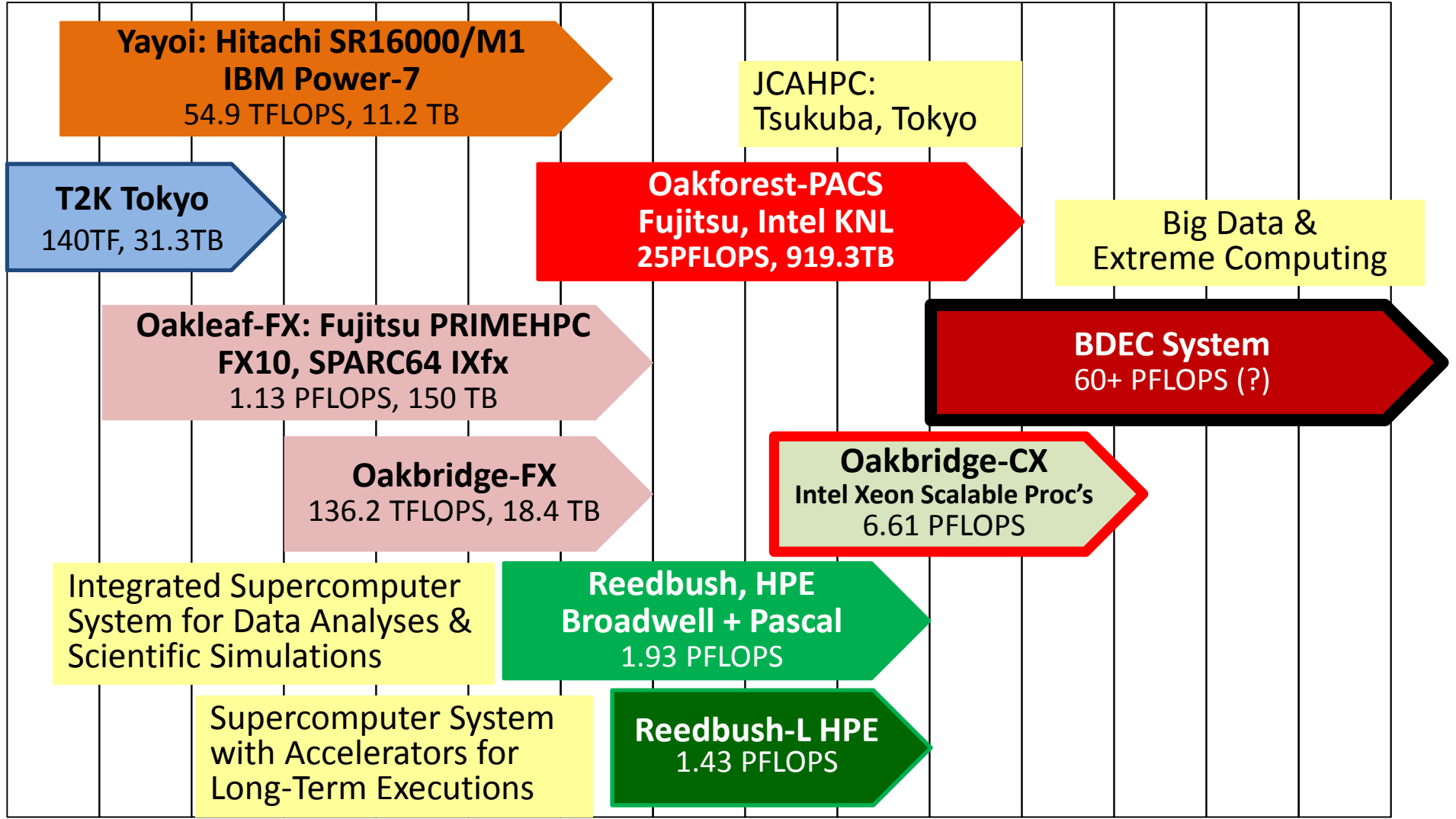


# Supercomputers in ITC/U.Tokyo

2 big systems, 6 yr. cycle

FY

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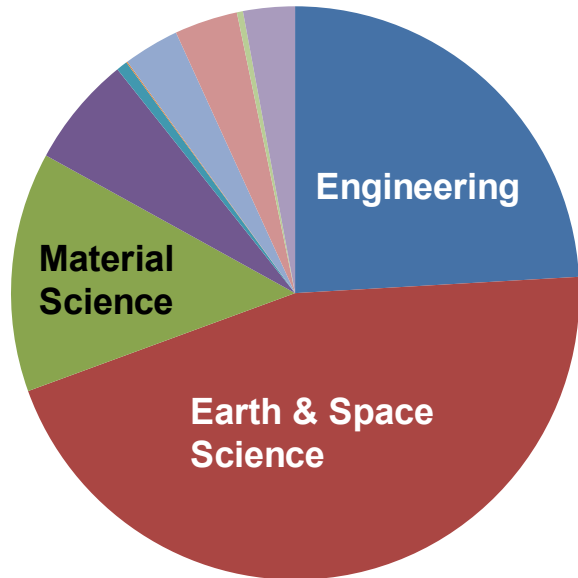


# New Types of Users

- Mostly CSE, so far
- Data, ML, AI etc.
  - Genome Analysis
  - Medical Image Recognition

# New Methods towards Society 5.0

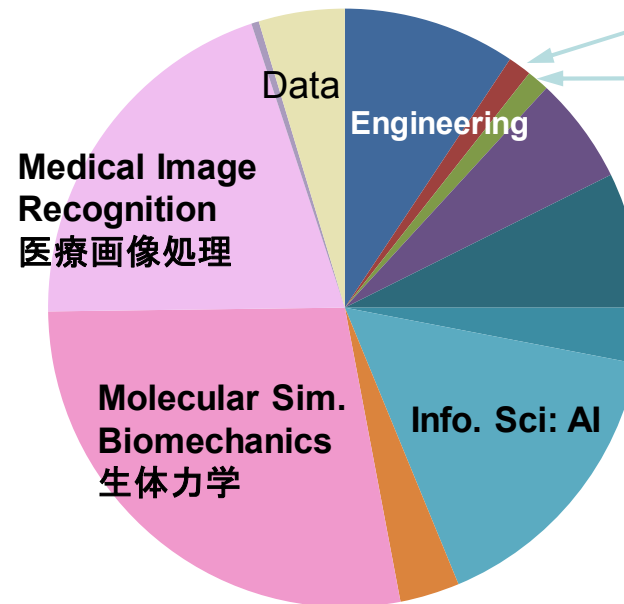
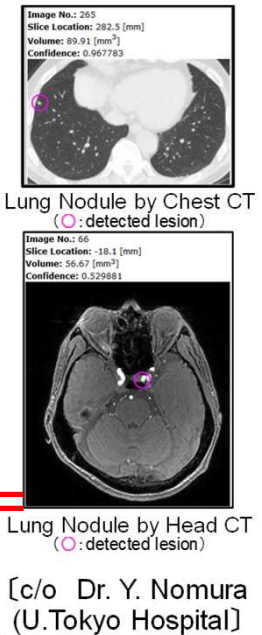
- Integration of Simulations + Data + Learning



Oakleaf/Oakbridge-FX (FY.2017)  
Commercial Version of K

# BDEC (Big Data & Extreme Computing)

- 60+PF starting in April 2021
- Platform for (S+D+L) towards Society 5.0
- **Reedbush/Oakbridge-CX= prototype of the BDEC System**



Reedbush-H (FY.2018)  
Intel BDW + NVIDIA P100

- Engineering
- Earth/Space
- Material
- Energy/Physics
- Info. Sci. : System
- Info. Sci. : Algorithms
- Info. Sci. : AI
- Education
- Industry
- Bio
- Bioinformatics
- Social Sci. & Economics
- Data

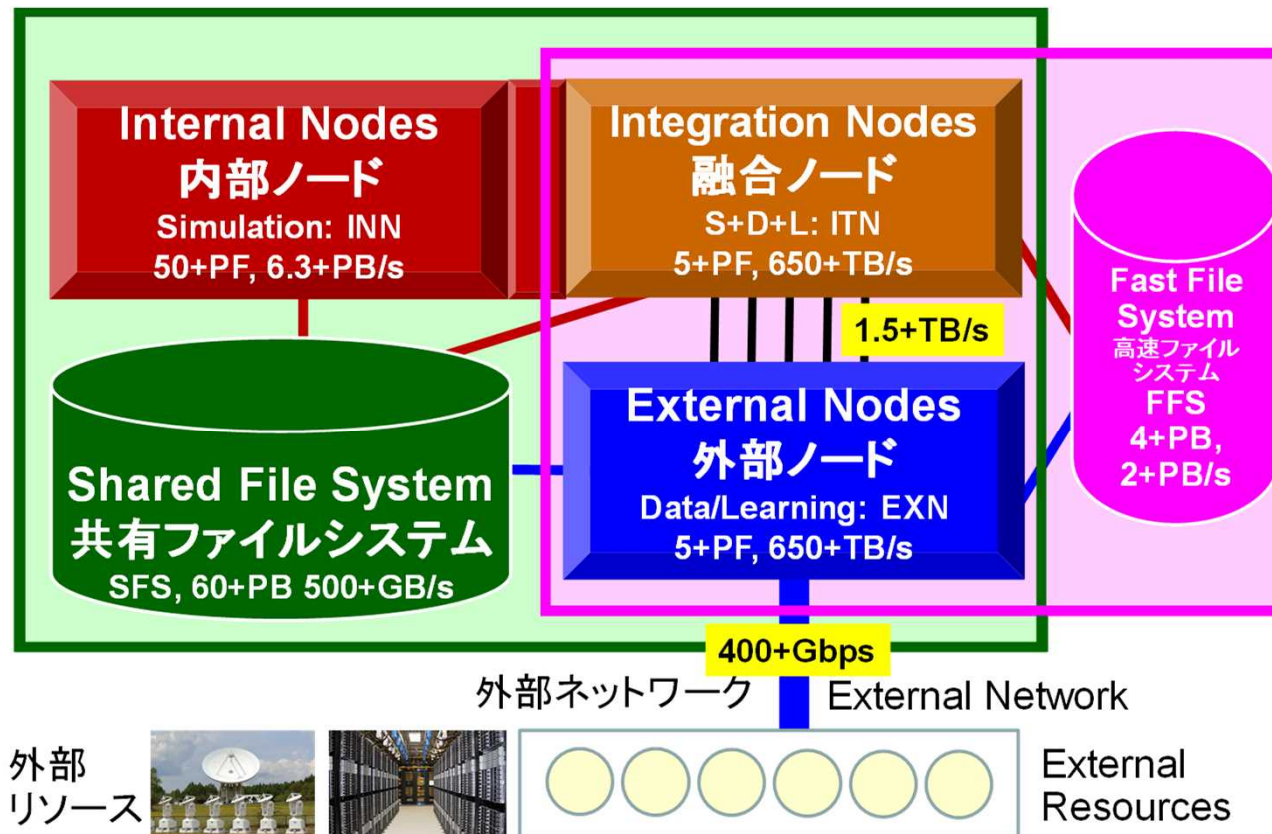
# Buildings

- Asano/Hongo Campus
  - Reedbush (will be retired in March 2021)
- Kashiwa Campus: Research Complex Building II
  - 1F: Oakbridge-CX (Operation starts in July 2019)
  - 2F: Oakforest-PACS
- Kashiwa II Campus
  - New Research Facility for Integration of Large-Scale Network & Supercomputing by U.Tokyo and NII will be constructed by Fall 2020
    - BDEC (Operation will start in April 2021)
    - Data Platform (U.Tokyo-NII Project)
  - ABCI by AIST (Fastest Linpack system in Kashiwa, Japan) is in the same campus



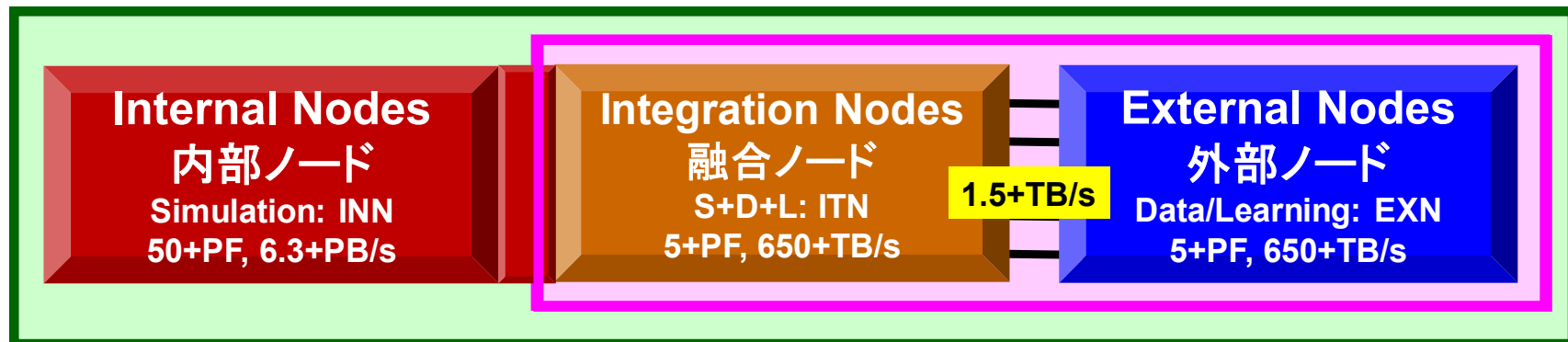
# BDEC System (1/4): April 2021

- 60+ PF, 3.5-4.5 MW including Cooling, ~360 m<sup>2</sup>
  - External Nodes for Data Acquisition/Analysis (EXN)
  - Internal Nodes for CSE/Data Analysis (INN)
  - Integration Node for (S+N+L) (ITN)
  - Shared File System (SFS) + Fast File System (FFS)



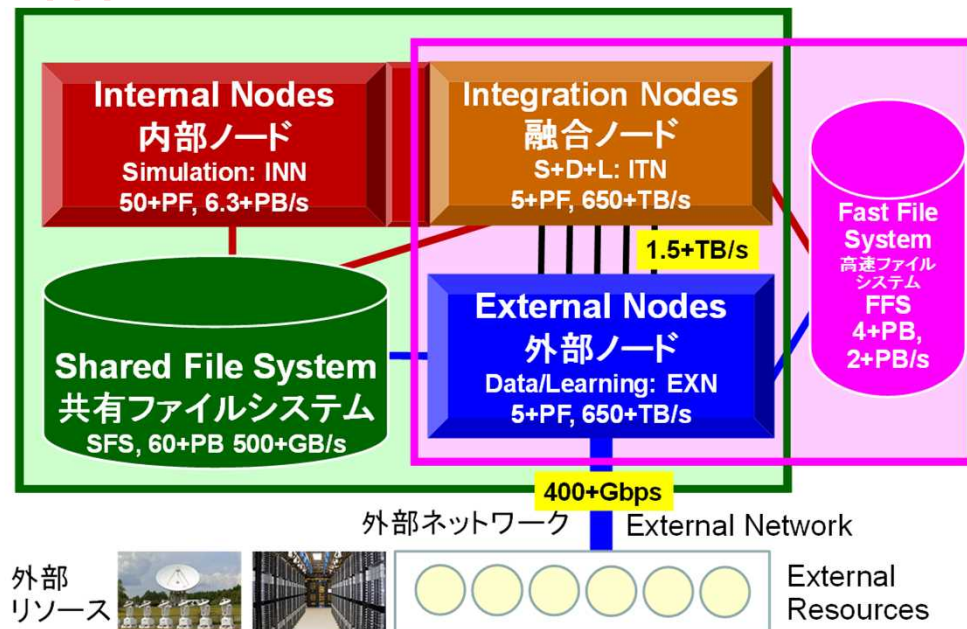
# BDEC System (2/4)

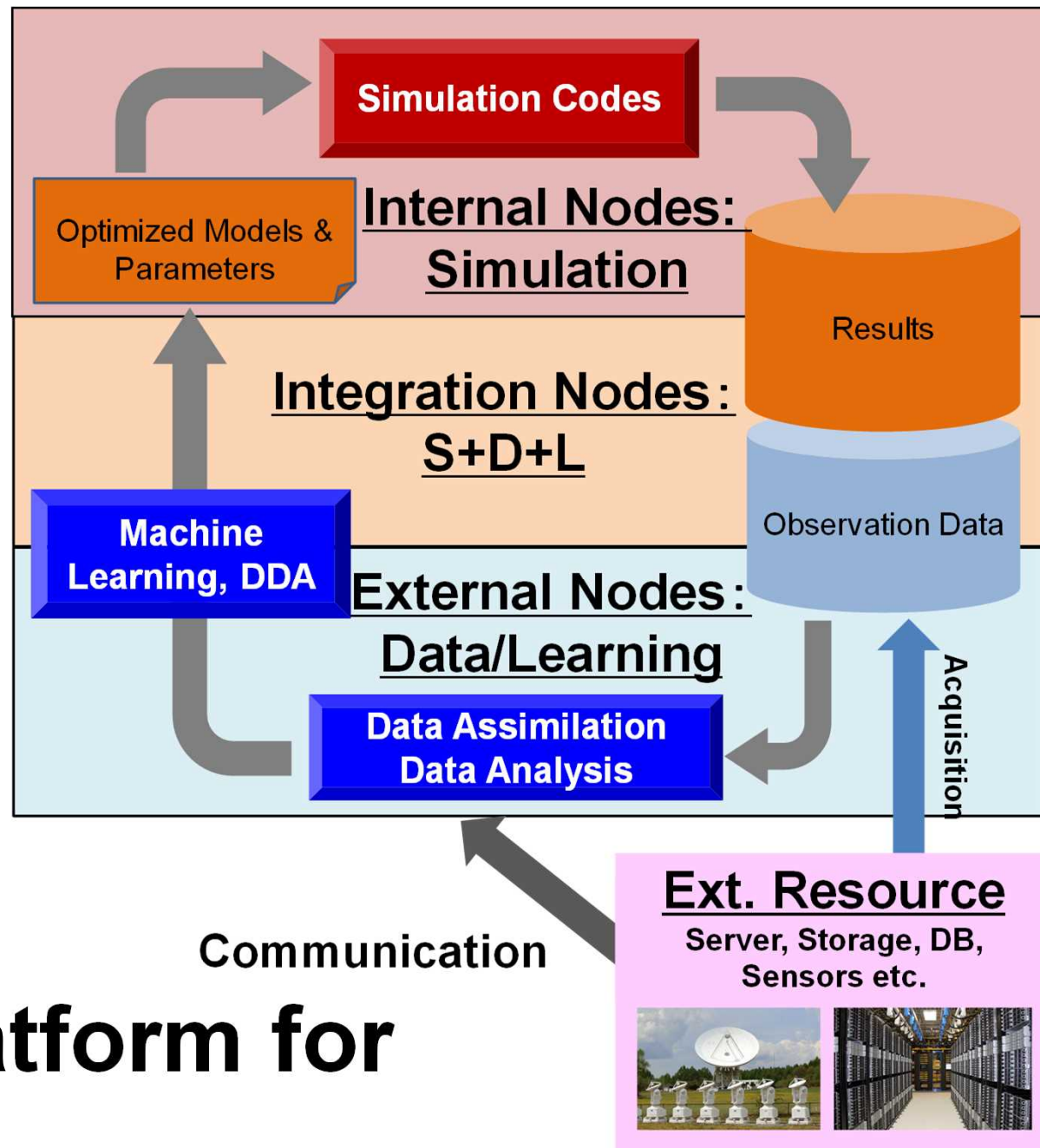
- Internal Nodes (INN): 50+PF, 6.3+PB/s
  - 90% of Total Resources
  - HPC Workloads (Simulations)
- External Nodes (EXN) : 5+PF, 650+TB/s
  - 5% of Total Resources
  - Connected to External Resources Directly: 400+Gbps
  - Architecture could be different from that of INN
- Integration Nodes (ITN): 5+PF, 650+TB/s
  - 5% of Total Resources
  - Same architecture as that of INN



# BDEC System (3/4)

- INN+ITN: 15+TB/s (Bisection Bandwidth)
  - Single Supercomputer System
  - A single MPI job should run across INN and ITN
- (INN+ITN)-EXN: 1.5+TB/s (Bisection BW)
  - A single MPI job on (INN+ITN+EXN): NOT required, Additional Points
- **Fast File System: FFS: 60+PB, 500+GB/s**
  - Only Shared by EXN and ITN
  - Could be SSD's
- **Shared File System: SFS: 4+PB, 2+PB/s**
  - Continuous Usage by Future Systems
  - 50+ PB, 1+TB/sec
  - All of EXN, ITN and INN can access SFS directly



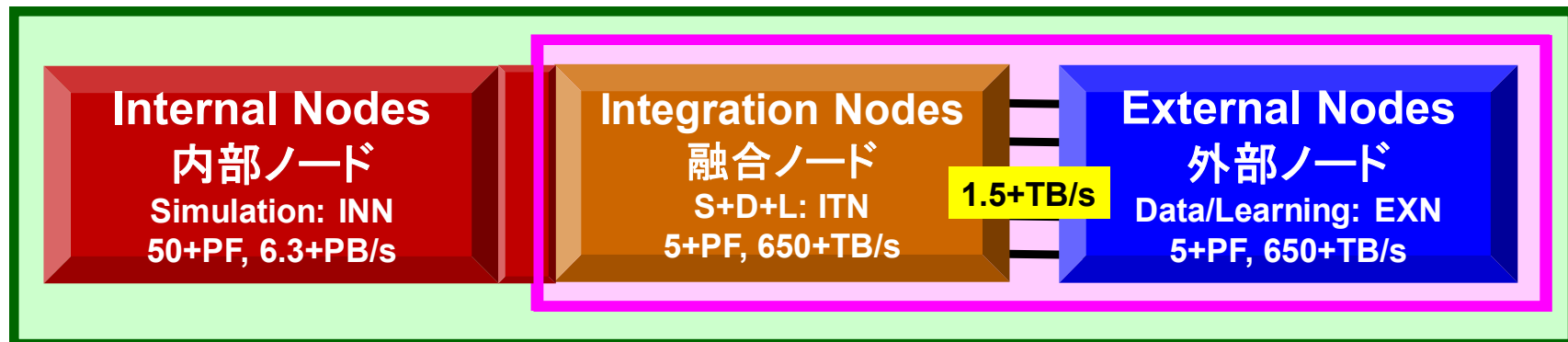


# BDEC: Platform for (S+D+L)



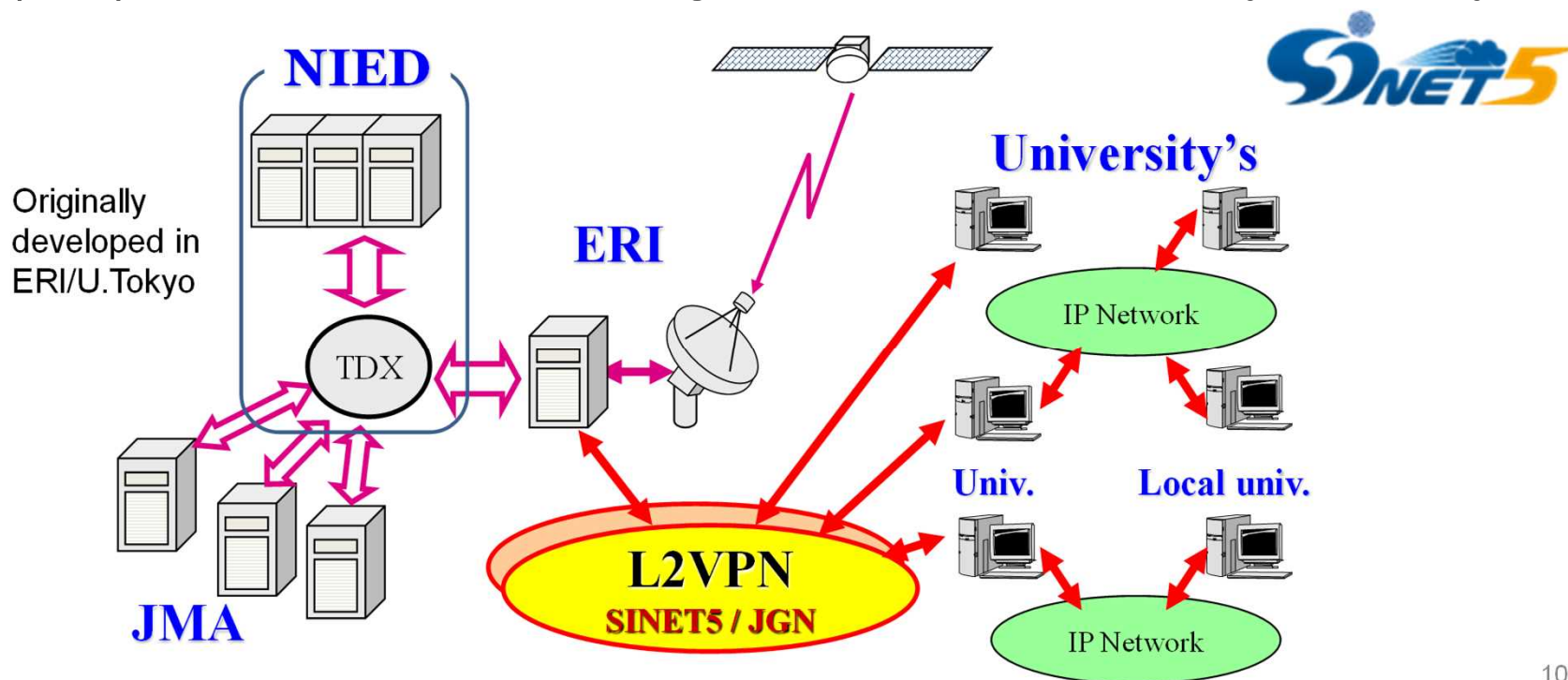
# BDEC System (4/4)

- **Possible Applications**
  - **Atmosphere-Ocean Simulations with Data Assimilation**
  - **Real-Time Disaster Sim. (e.g. Flood, Earthquakes, Tsunami)**
  - **Earthquake Simulations with Data Assimilation**



# Real-Time Sharing of Seismic Observation is possible in Japan by JDXnet with SINET

- Seismic Observation Data (100Hz/3-dir's/O(10<sup>3</sup>) pts) by JDXnet is available through SINET in Real Time
  - Peta Server in ERI/U.Tokyo: O(10<sup>2</sup>) GB/day ⇒ EXN of BDEC
  - O(10<sup>5</sup>) pts in future including stations operated by industry



# Real-Time Earthquake Simulation with Data Assimilation

- **EXN**: Real-Time Data Acquisition through JDXnet
- **ITN**: Real Time Data Analyses/Assimilation using Observed Data on the Fast File System & Control
- **INN**: Large-Scale Seismic Simulations
- Improvement of the UG Model in Normal Operations
  - Improvement of the Underground Model by Observations + Simulations + Assimilations + Machine Learning

