

# Information Technology Center (ITC), Nagoya University

## Performance Evaluation of New Supercomputer System

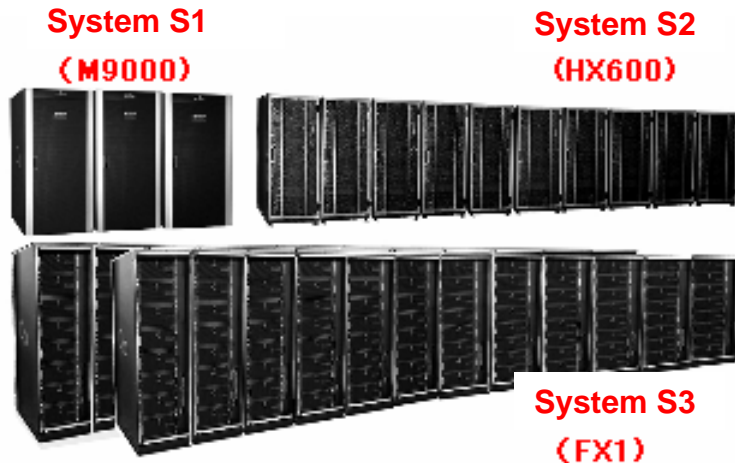
Tatsuki Ogino (Solar Terrestrial Environment Laboratory, Nagoya Univ.)

June 2, 2009

- How do we use three Kinds of supercomputers (Fujitsu M9000, HX600, FX1) efficiently?
- How do we choose HX600 and FX1 practically?
- How fast can FX1 called Pre-PetaComputer compute?  
**JAXA's FX1 resulted in 13-14% absolute performance.**
- Which is fast, between Flat MPI and Hybrid (process parallel + automatic parallel)?  
**Flat MPI has always resulted in highest performance in the past.**

# ITC's New Supercomputers

Two Phase Procurement (May 18 FX1:256 nodes, October 1 FX1:768 nodes)



## System S1

M9000 x 3 nodes (SPARC)

Large shared memory

3 nodes x 128 cores (1 node is FX1's front-end)

Per node: Performance: 1.28TFlops, memory: 1TB

**For analyses of simulation results and graphics**

## System S2

HX600 x 160 nodes (Opteron)

Cluster type computer, node uses shared memory.

160 nodes x 16 cores

Per node: Performance: 160GFlops, memory: 64GB

**For middle scale simulation**

## System S3

FX1 x 768 nodes (SPARC)

Large distributed memory computer in connection with Next Generation Supercomputer

768 nodes x 4 cores

Per node: Performance: 40GFlops, memory: 32GB

memory bandwidth : 40GB/s

**For large scale simulation**

## System S3 (FX1) for large scale simulation

Total nodes / cores: 768 / 3072

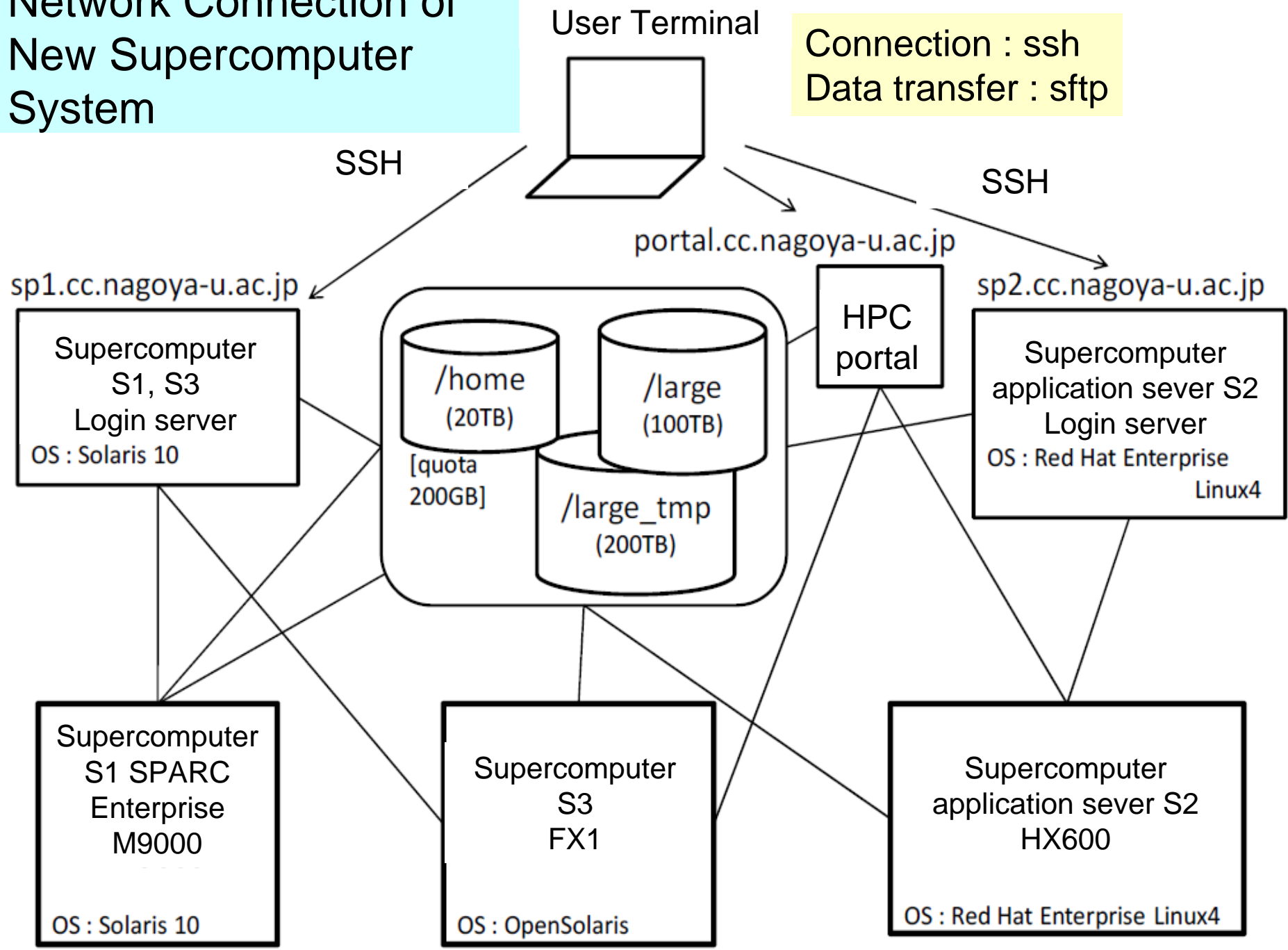
Total performance: 30.72TFlops

Total memory: 24TB

### Simulation Scale of FX1

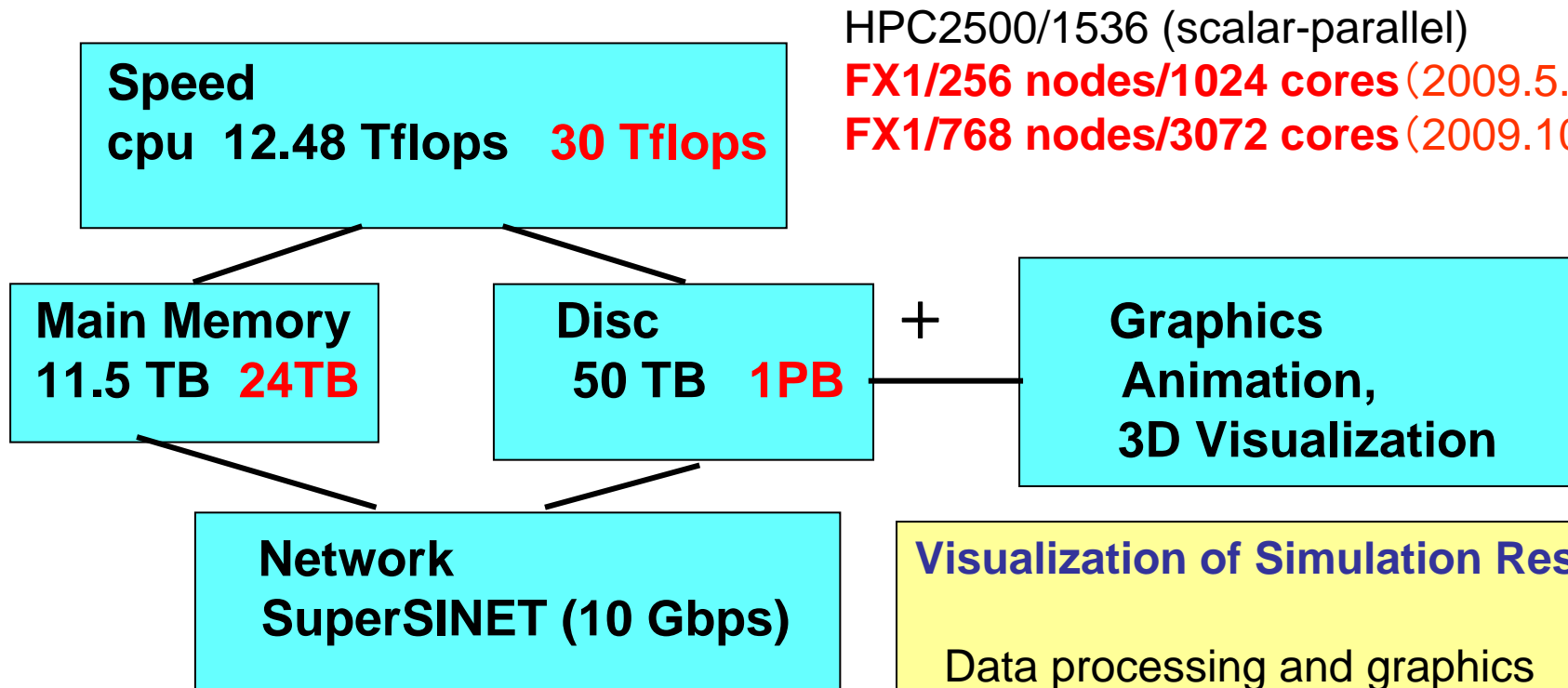
cores	256	512	1024
memory (TB)	2	4	8
performance (Tflops)	2.56	5.12	10.24

# Network Connection of New Supercomputer System



# Four Key Functions of Supercomputer

Partial operation from May 18th and full operation from October 1<sup>st</sup>, 2009



HPC2500/1536 (scalar-parallel)

**FX1/256 nodes/1024 cores** (2009.5.18)

**FX1/768 nodes/3072 cores** (2009.10.1)

Realization of efficient computation  
Development of program to obtain maximum performance

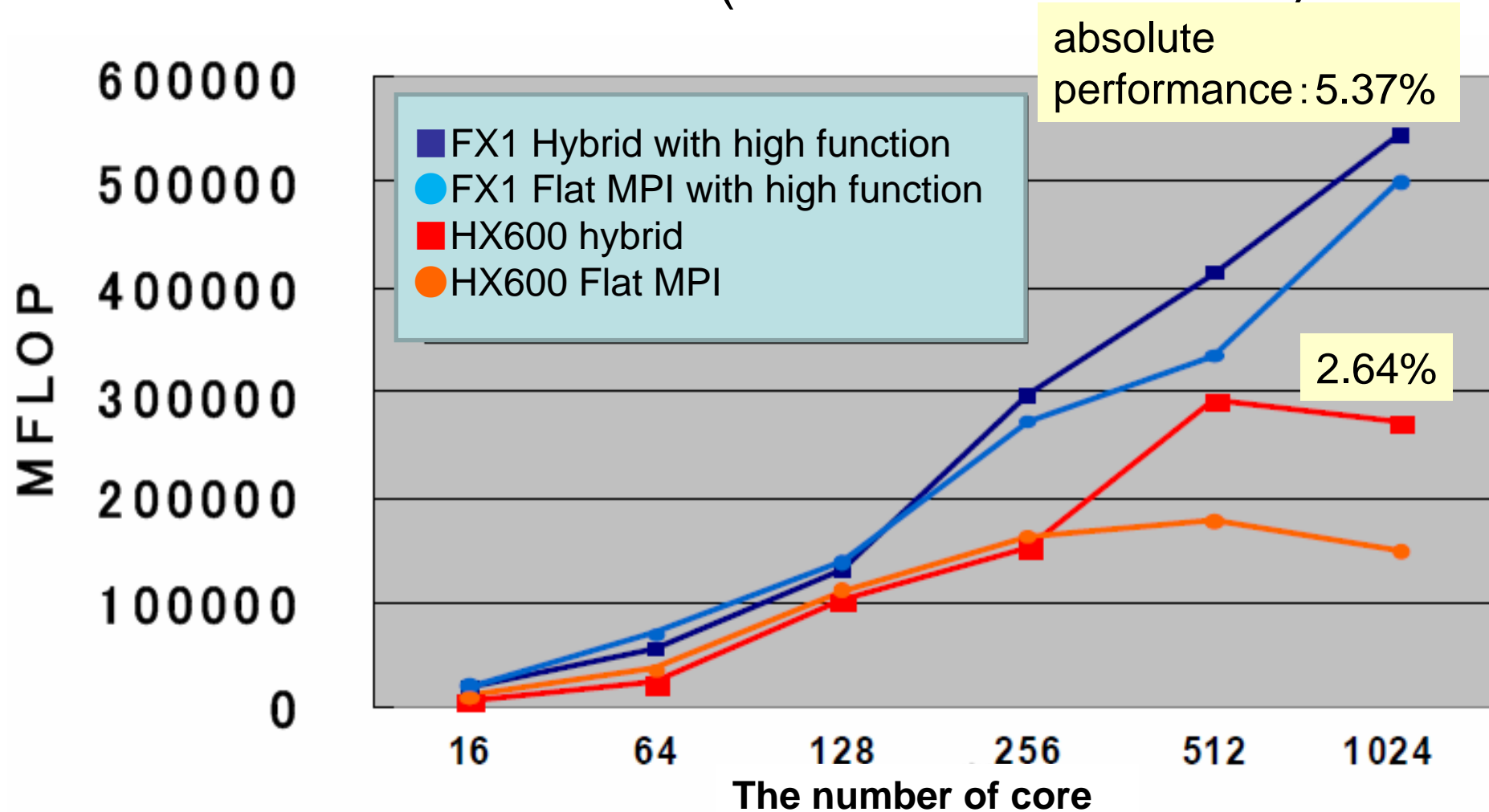
**Absolute efficiency more than 10-20%**  
**Good scalability for increase of CPUs**

## Visualization of Simulation Results

Data processing and graphics  
Animation movie  
3D Visualization (VRML)  
VR (Virtual Reality)

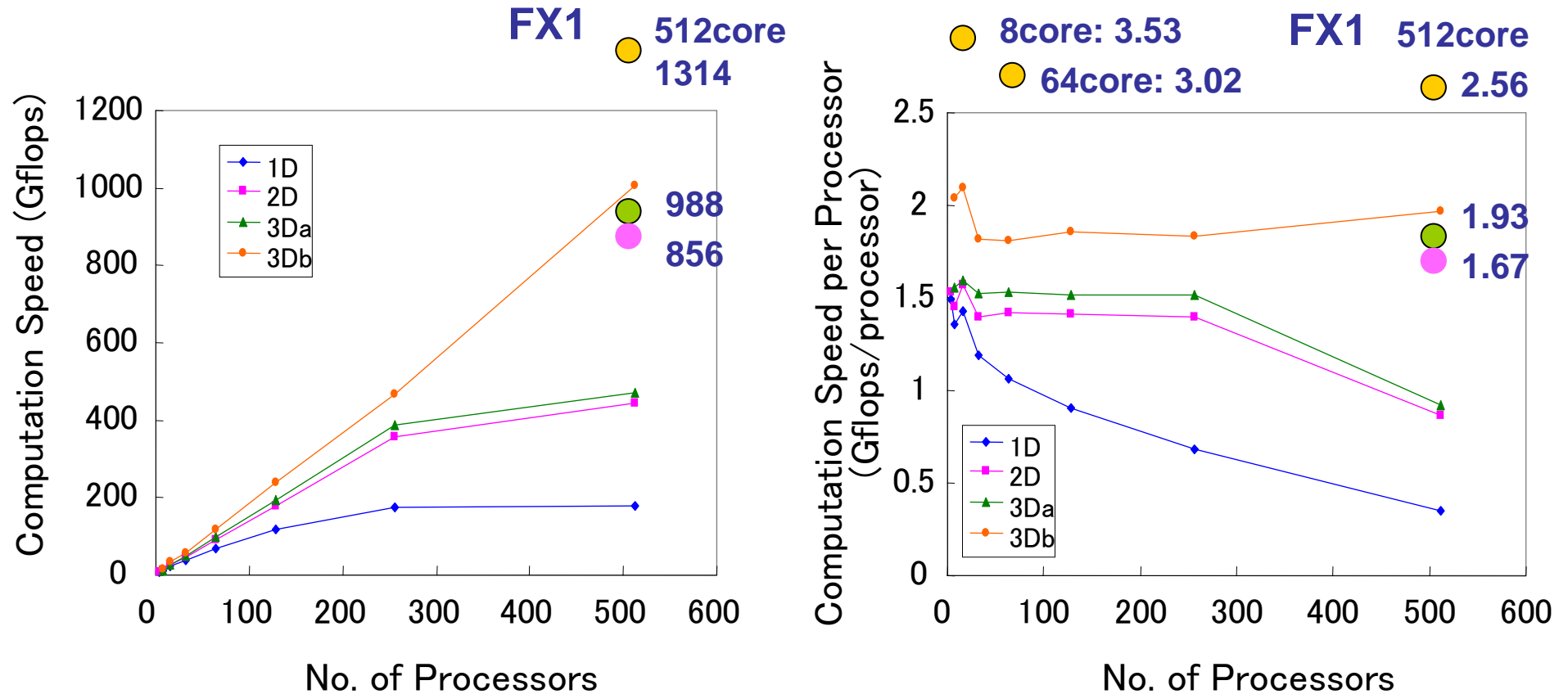
**Which computer need we use for huge visualization?**

# Parallel Performance (HIMENO benchmark)



In the case of increasing the number of core, both FX1 and HX 600, which used hybrid parallel recommend by Fujitsu, resulted in better performance than flat MPI.

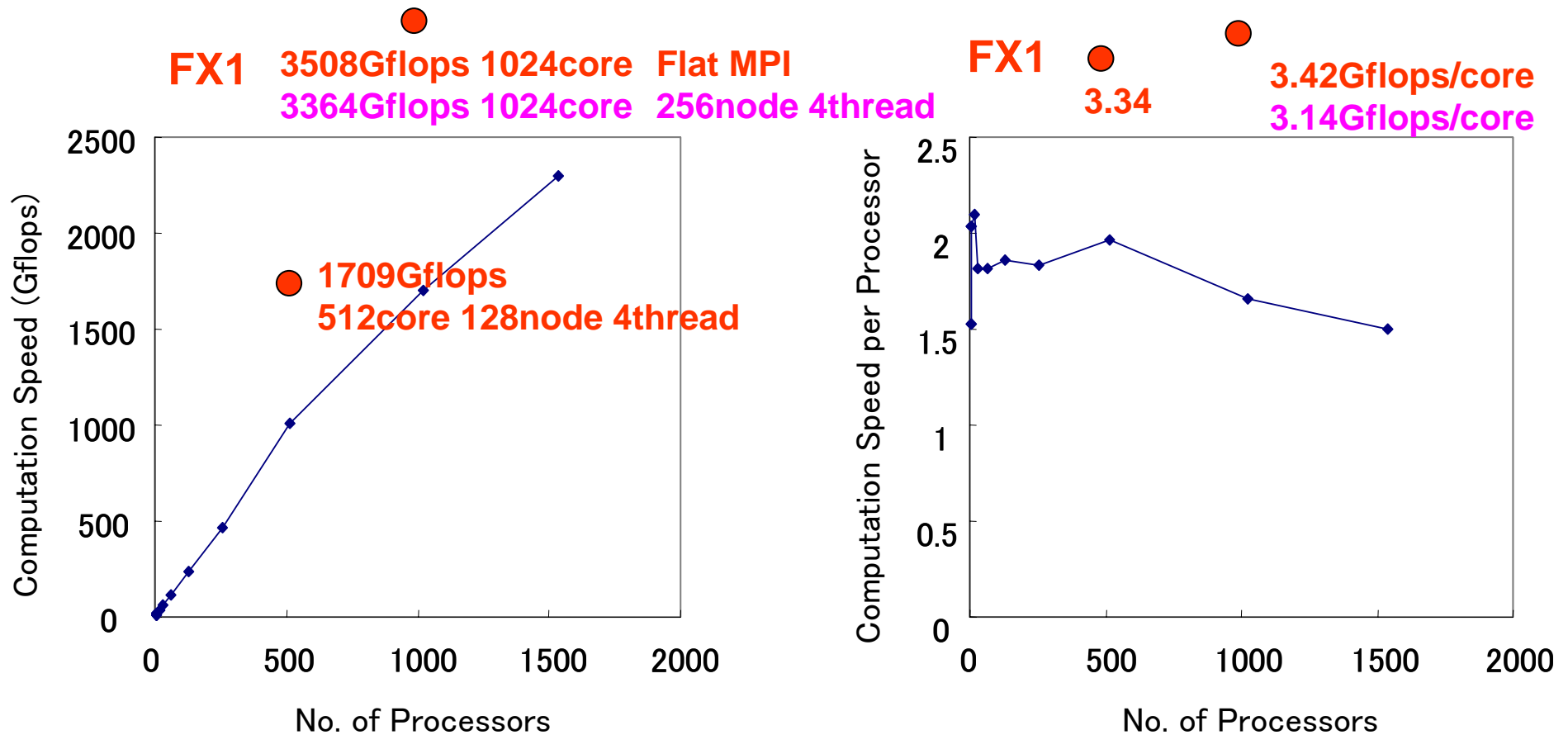
# Comparison of HPC2500 (scalar parallel) and FX1



These figures show HPC2500's computation speed and computation speed per processor when 1D ,2D and 3D domain decomposition methods are used. 3Da is 3-dimensional domain decomposition with array,  $f(nx2, ny2, nz2, nb)$  and 3Db is that with array,  $f(nb, nx2, ny2, nz2)$ .

Moreover, FX1's computation speed and computation speed per processor are also shown. (MPI parallel with 4thread). Compile: `mpifrt mhd.f -o mhd.fx1 -Kimpact -Z mpilist`

# Comparison of HPC2500 (scalar parallel) and FX1



These figures show HPC2500's computation speed and computation speed per processor. Scalability is very good until 1536 cpu.

By using 3D MHD code with 3D domain decomposition and higher cache hit, Fujitsu FX1 resulted in 31.4-33.4% absolute efficiency with 128 nodes and 512 cores and 31.2-32.9% with 256 nodes and 1024 cores.

**We achieved the highest efficiency 34.26% with 1024 cores by Flat MPI.**

# Summary

- For practical 3D MHD codes, new supercomputer system in Information Technology Center, Nagoya University have demonstrated high efficiency expected.

- FX1, which is only one of pre-peta supercomputer in the supercomputer centers of university cooperation, have demonstrated the maximum speed, 3,508Gflops (absolute efficiency, 34.26%) for 1024 cores by Flat MPI. And maximum speed for 512 cores is 1,838 Gflops (absolute efficiency, 35.90%).

```
mpifrt progmpi.f -o progmpi -Kprefetch_model=FX1 -Z mpilist
```

- Hybrid parallel (process and auto parallel) of FX1 obtained the maximum speed, 3,364 Gflops (absolute efficiency, 32.85%).

```
mpifrt progmpi.f -o progmpi -Kimpact -Kprefetch_model=FX1 -Z mpilist
```

- HX600 (Flat MPI with 512core) obtained maximum speed, 1,328Gflops (absolute efficiency, 25.94%).