

# **NEC HPC Strategy and Products**

**31 October 2006  
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NEC Corporation**

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**NEC's HPC Activity**

**NEC's HPC Strategy and Products**

**Toward the Future of HPC**

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**NEC's HPC Activity**

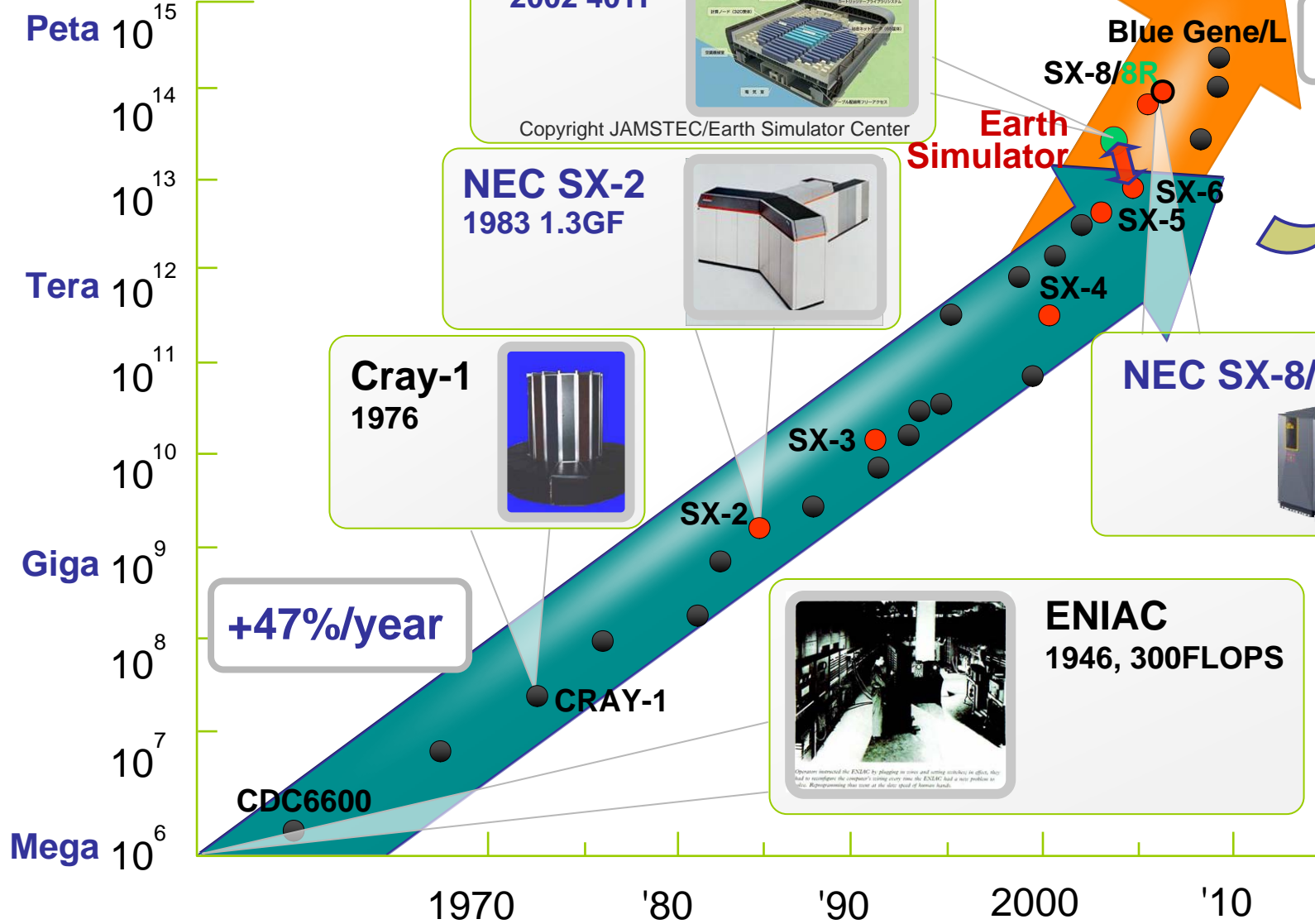
NEC's HPC Strategy and Products

Toward the Future of HPC



# Supercomputer Performance Gains

FLOPS (Peak)



**+47%/year**

**+75%/year**

**NEC Earth Simulator**  
2002 40TF

Copyright JAMSTEC/Earth Simulator Center

**NEC SX-2**  
1983 1.3GF

**Cray-1**  
1976

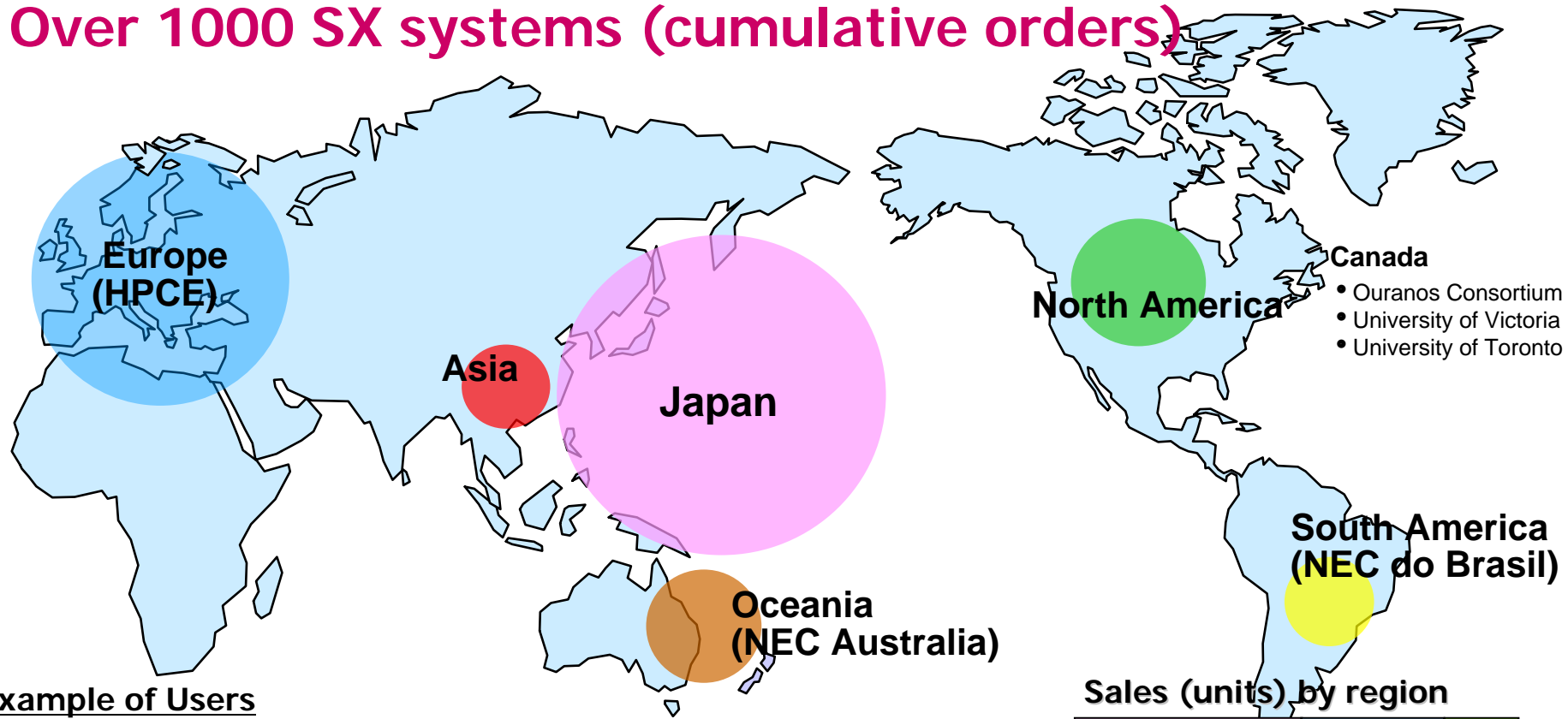
**ENIAC**  
1946, 300FLOPS

Oppenheimer instructed the ENIAC by plugging in wires and setting switches in effect. This had to be repeated the computer's setting every time the ENIAC had a new problem to solve. Reprogramming that time at the slow speed of human hands.

**NEC SX-8/SX-8R**

# No.1 Vector Supercomputer in the World

Over 1000 SX systems (cumulative orders)



- Canada**
- Ouranos Consortium
  - University of Victoria
  - University of Toronto

## Example of Users

### Europe

- The Met Office (United Kingdom)
- Meteo France (France)
- Danish Meteorological Institute (Denmark)
- German Climate Computing Center (Germany)
- CHMI (Czech)
- University of Stuttgart/HLRS (Germany)
- CNRS/IDRIS (France)
- Swiss Center for Scientific Computing (Switzerland)
- Aerospace Laboratories (Netherlands, Germany, France, Italy)

### Japan

- Tohoku University Information Synergy Center
- Osaka University Cyber Media Center
- National Institute for Environmental Studies
- National Institute for Fusion Science
- Meteorological Research Institute - JMA
- Central Research Institute of Electric Power Industry
- Japan Aerospace Exploration Agency
- Toyota Central R&D Labs., Inc.
- Nissan Motors

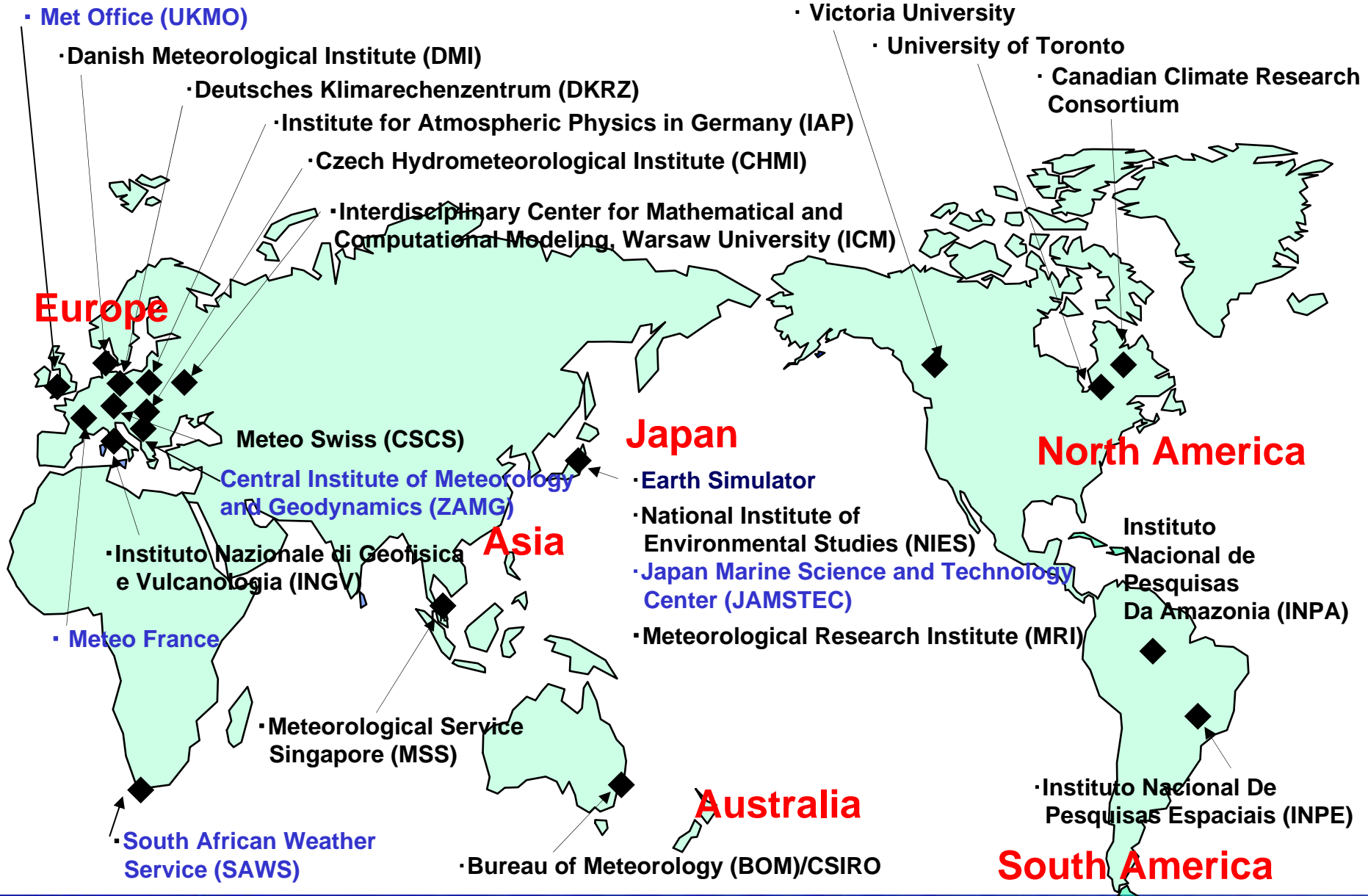
## Sales (units) by region



### Asia Pacific/South America

- Bureau of Meteorology / CSIRO (Australia)
- Korea Institute of Science, Technology and Information (Korea)
- Meteorological Services of Singapore (Singapore)
- National Institute for Space Research (Brazil)

# SX Series in Weather/Climate Community



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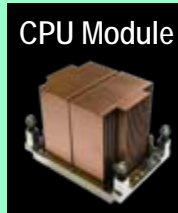
# NEC's Computer Product Strategy

*Leveraging two key technologies:  
High performance technology and Highly reliability technology*

## High Performance Technology

### ◎ Most advanced technology

- High-speed/high-density VLSI
- High-density packaging
- High-efficiency cooling
- High-speed interconnect



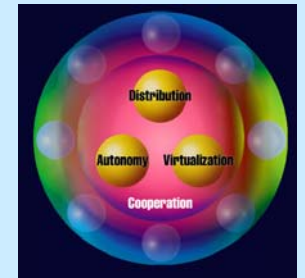
### ◎ Parallel processing technology

### ◎ Cluster control technology

## High Reliability Technology

### ◎ VALUMO (Platform Technology)

- Autonomy/Virtualization
- Fault-tolerance
- Continuous operation



VALUMO

Technology leader products



U can change.

# NEC's Strategy on HPC

## ■ SX: Vector supercomputer based HPC system

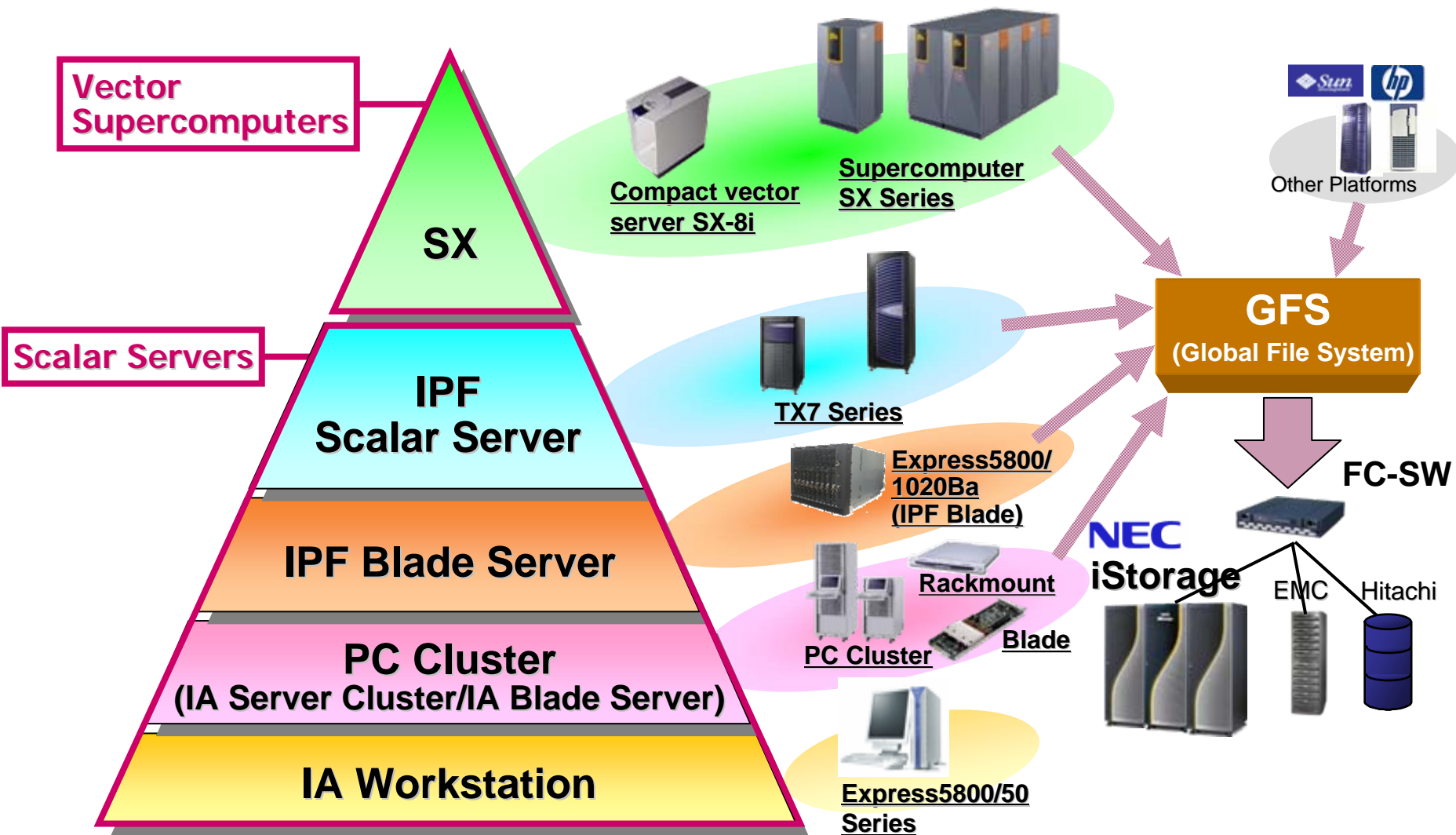
- ✚ Overwhelming sustained performance and high reliability with NEC original cutting edge technologies
- ✚ Ever-increasing per Core(CPU) performance
- ✚ Seamless connection with other servers

## ■ Right platform for right application, which best fits the customers' needs

- ✚ SX
- ✚ SX+Scalar
- ✚ Scalar
  - ✚ IPF scalar server
  - ✚ PC cluster

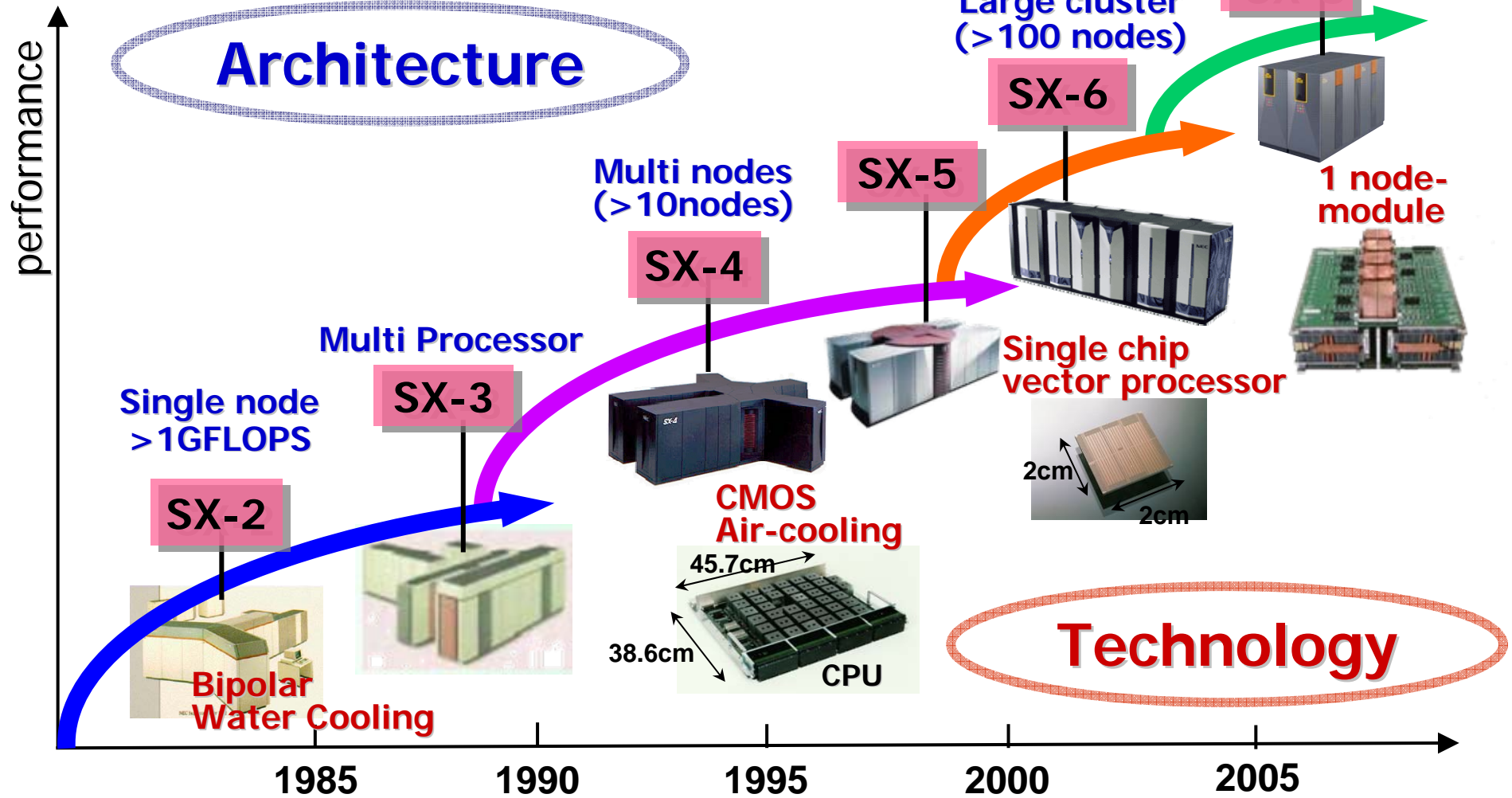
## ■ Integrated NEC HPC solution

# NEC's HPC Products Lineup



# SX Innovation

Continual Break-Through Achieved  
in both Technology and Architecture



# SX-8R Product Highlights



## 1. World's fastest vector supercomputer with maximum performance of 144 TFLOPS

- Very large scale : Up to 512 nodes, 4,096 CPUs
- Very large memory / memory bandwidth: 256TB / 288TB/s
- High speed data transfer between nodes : 8TB/s in total

## 2. High-density packaging with state-of-the-art technology

- Single-chip vector processor with 35.2GFLOPS performance
- Leading-edge CMOS technology with 90-nanometer process /copper interconnects
- Single-module node with 281.6GFLOPS performance

## 3. Enhanced SUPER-UX / Tuned applications

- Proven operating system for SX series enhanced to expand scalability
- A lot of ISV application programs tuned for SX series available

# SX-8R Enhancement

## ■ Vector adder and multiplier **doubled**

■ SX-8 : (Multiply + Add) x 4pipes x 2GHz = 16GF

■ SX-8R: (Multiply + Add) x **2sets** x 4pipes x 2.2GHz = 35.2GF

## ■ Memory capacity is **doubled**

SX-8      SX-8R

■ 128GB  $\Rightarrow$  256GB/node (DDR2 RAM)

■ 64GB  $\Rightarrow$  128GB/node (FCRAM)

## ■ Clock-up

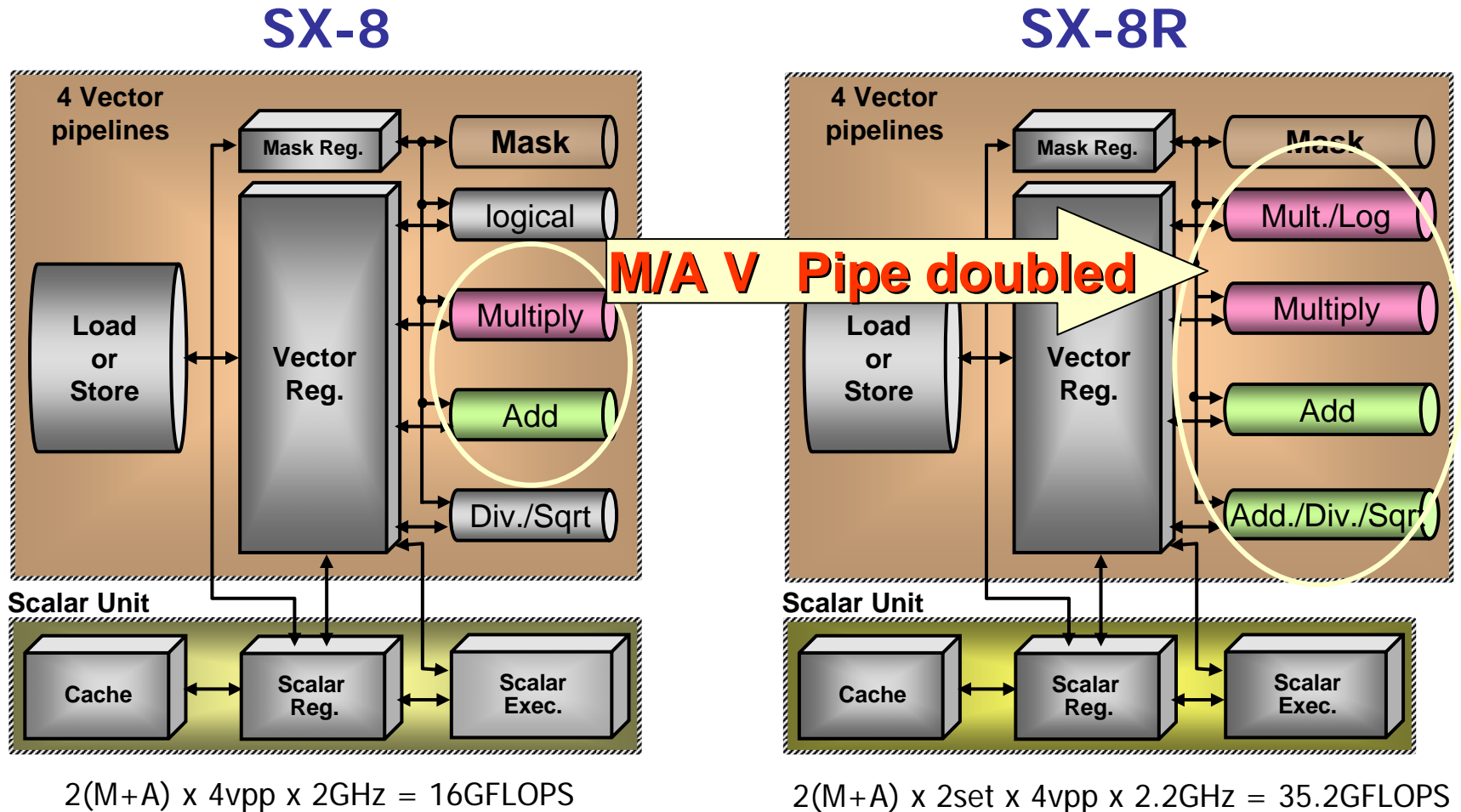
■ 2.2GHz (10% up)

note: ONLY FOR DDR2 models

FCRAM model's clock cycle remains with 2GHz.



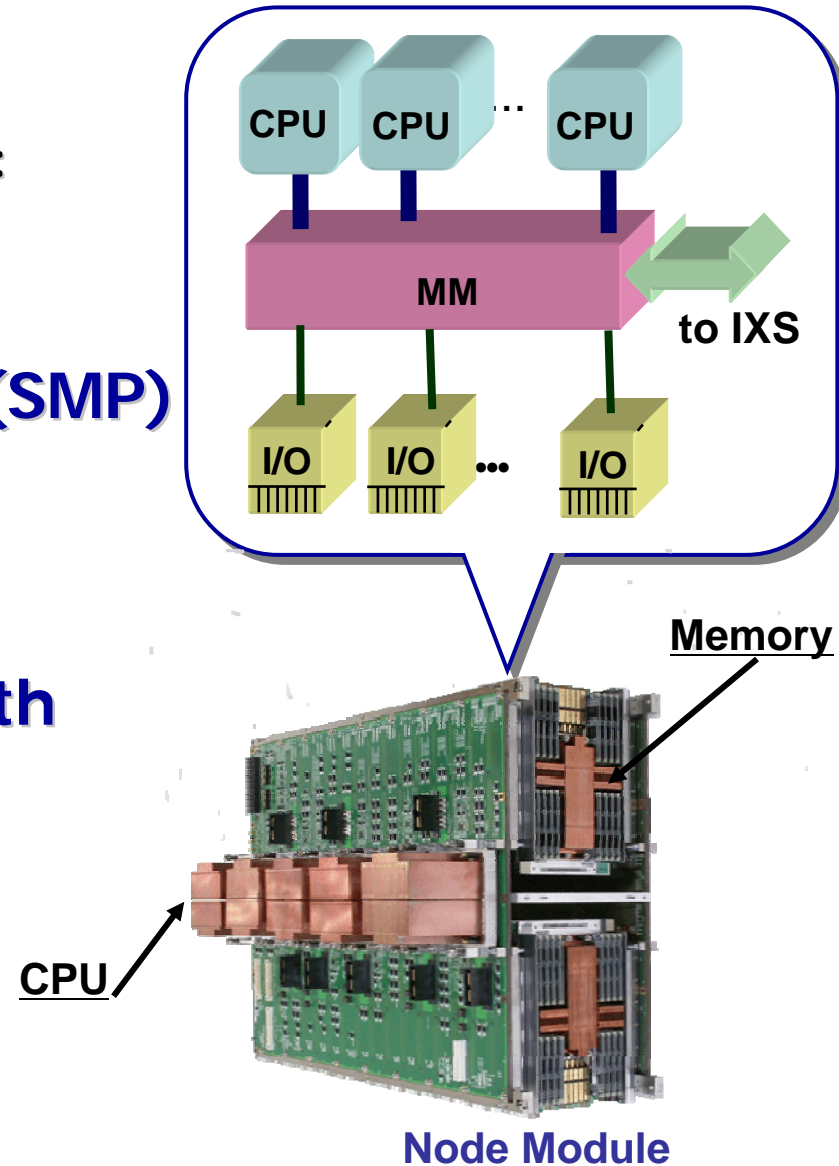
# Comparison of CPUs (SX-8, SX-8R)



Note: One vector instruction occupies one vector pipeline on SX-8R.  
e.g.) The peak performance of one VFAD (vector FP add) Op. is 8.8GFLOPS

# SX-8R Single Node Module (DDR2 model)

- **Up to 8 CPUs/node**
  - Peak Vector Performance(PVP):  
35.2 GFLOPS/CPU  
281.6 GFLOPS/node
- **Symmetric multiprocessing (SMP)**
- **Large Capacity Memory**
  - Up to 256GB
- **Ultra-high memory bandwidth**
  - 70.4GB/s per CPU
  - Total 563.2GB/s per node
- **Large I/O throughput**
  - 12.8GB/s per node



# Large Scale Multi Node System

High speed processing of large data with high performance single node, large number of nodes, and high speed interconnects among nodes

Key points for high performance

1. Single node performance
2. Maximum number of node
3. Data transfer rate among nodes

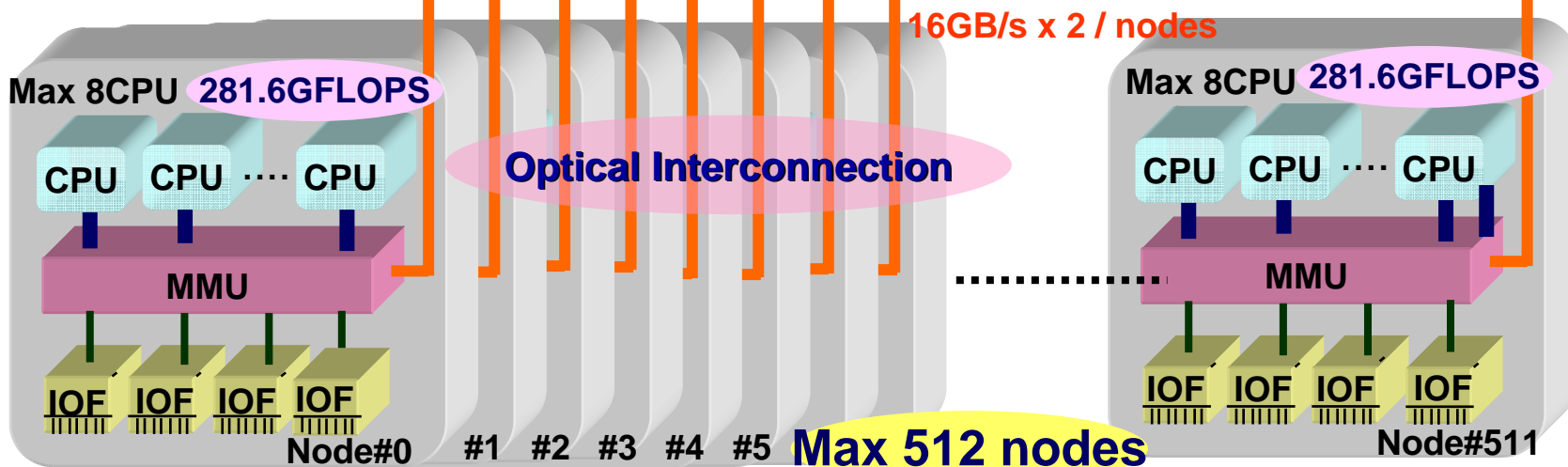
Max 281.6GFLOPS

Max 512 nodes

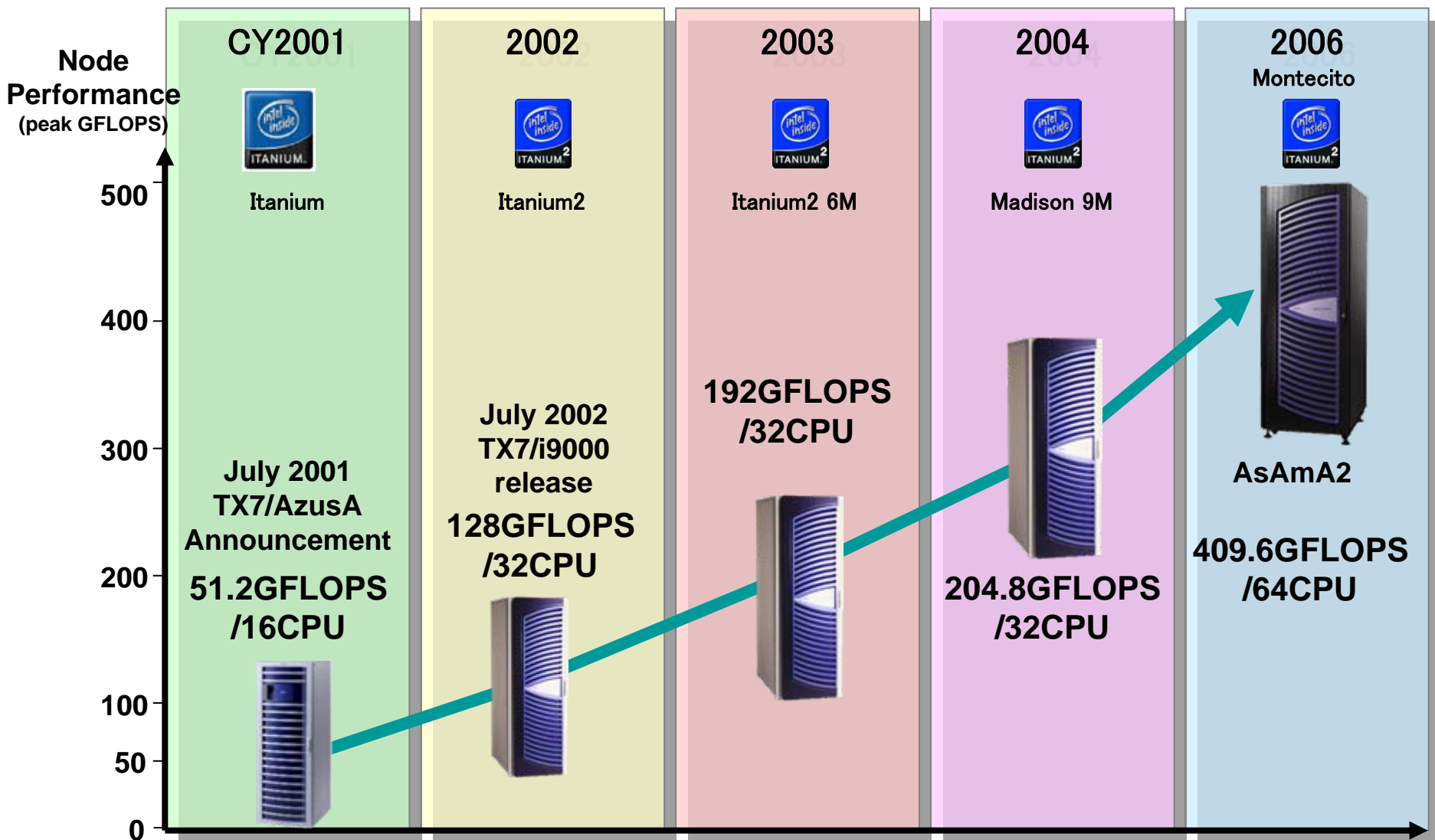
Max 8TB/s  
(Peak data transfer rate)

Very efficient non-blocking switch

High speed inter-node switch (IXS)



# IPF Server Roadmap



# Platform for PC Cluster

Enable to choose Optimized server depending on usage and budget

## Opteron/Xeon Rack



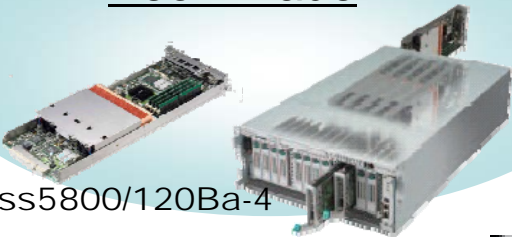
Express5800/T220Rc-1 (Opteron)  
Express5800/T120Rb-1 (Xeon)

## Express5800/100 series, Opteron server

Cost performance Opteron/Xeon server

Good price/performance ratio.  
More memory slots achieve system cost reduction.

## Xeon Blade

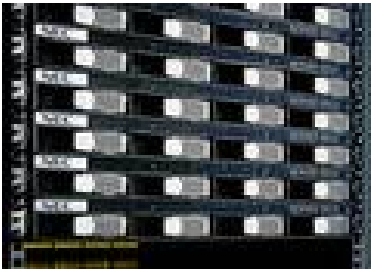


Express5800/120Ba-4

## Express5800/BladeServer

High density & Cost performance Xeon blade

Higher density than competitors.  
PCI slots achieve expandability.



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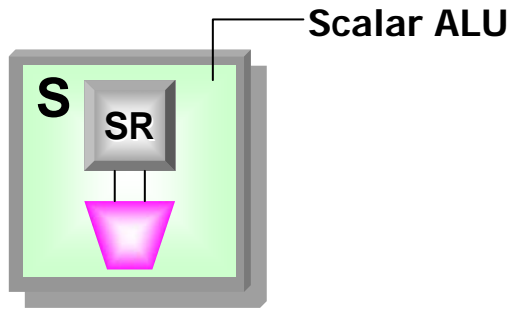
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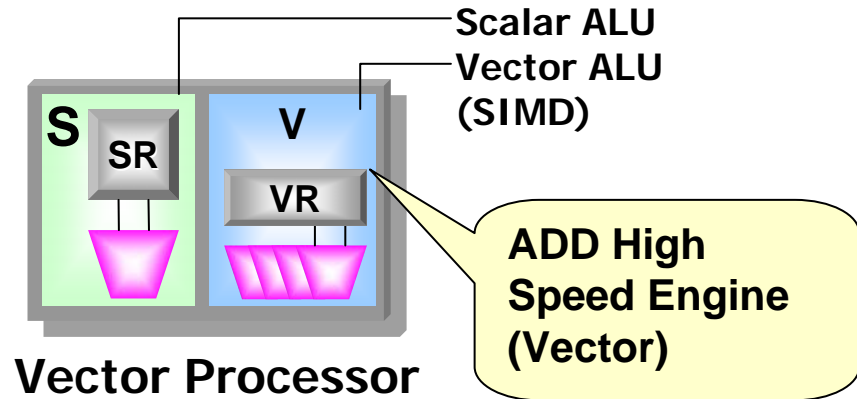
**Toward the Future of HPC**



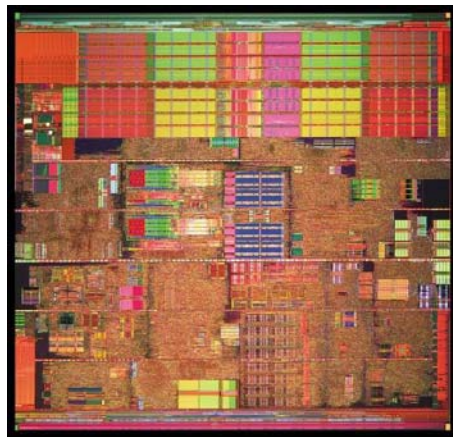
# Processor Architecture



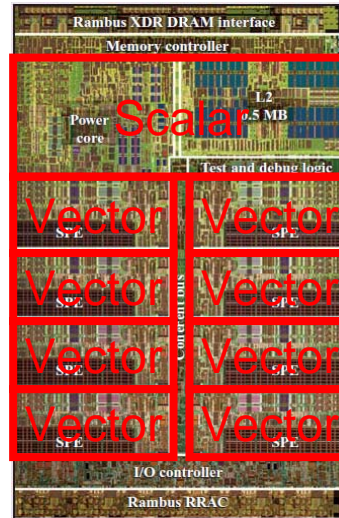
Scalar Processor



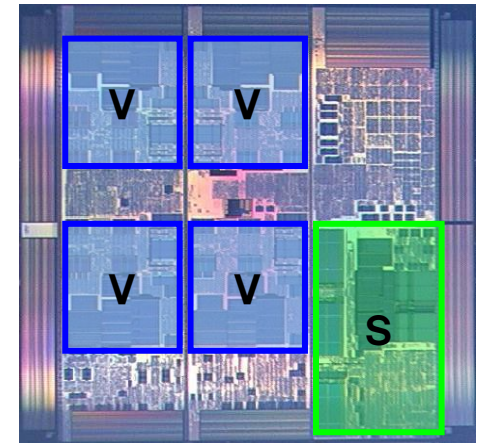
Vector Processor



Pentium 4



Cell

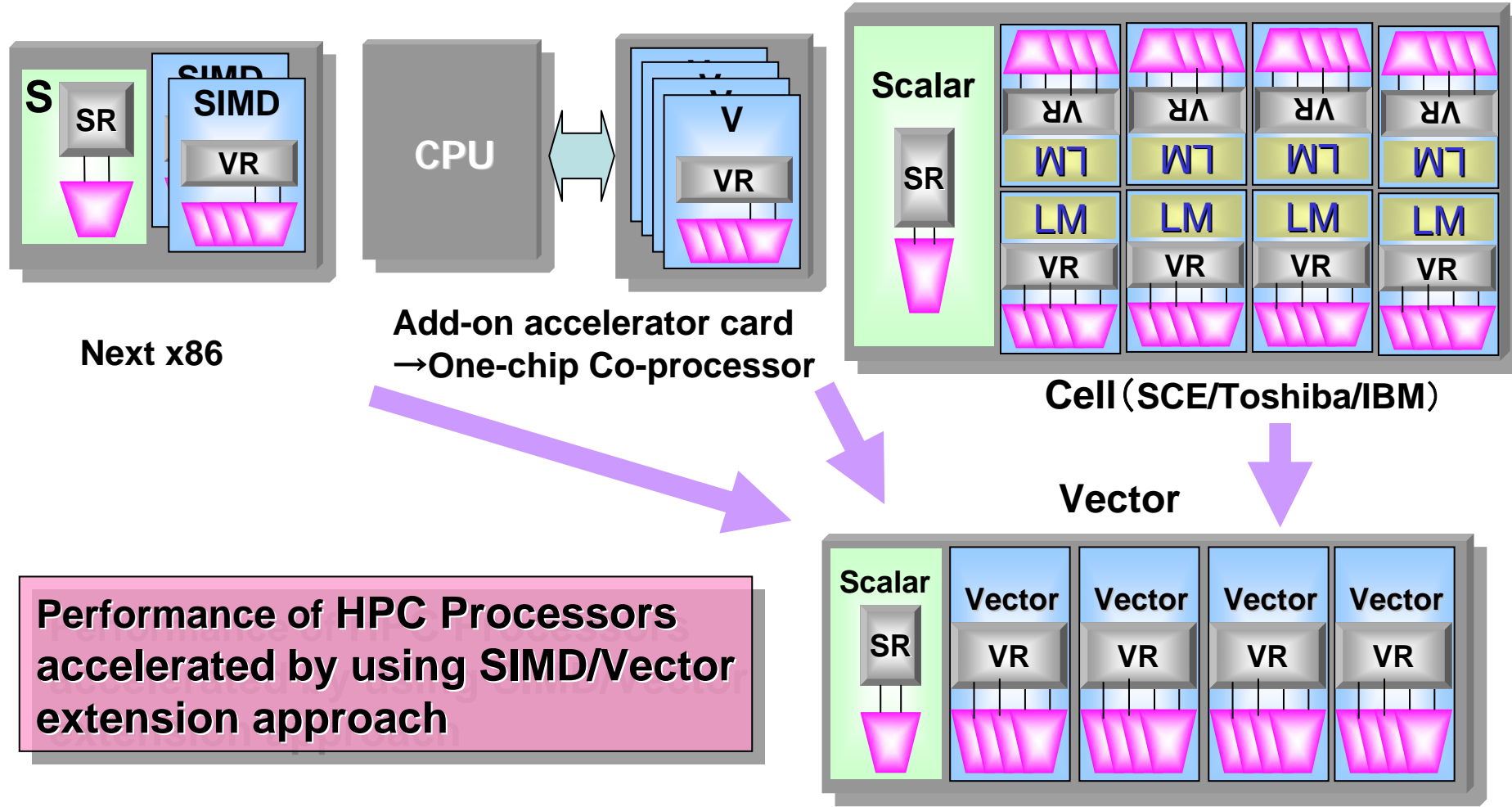


SX-8

# Performance acceleration trend

## Processor core architecture

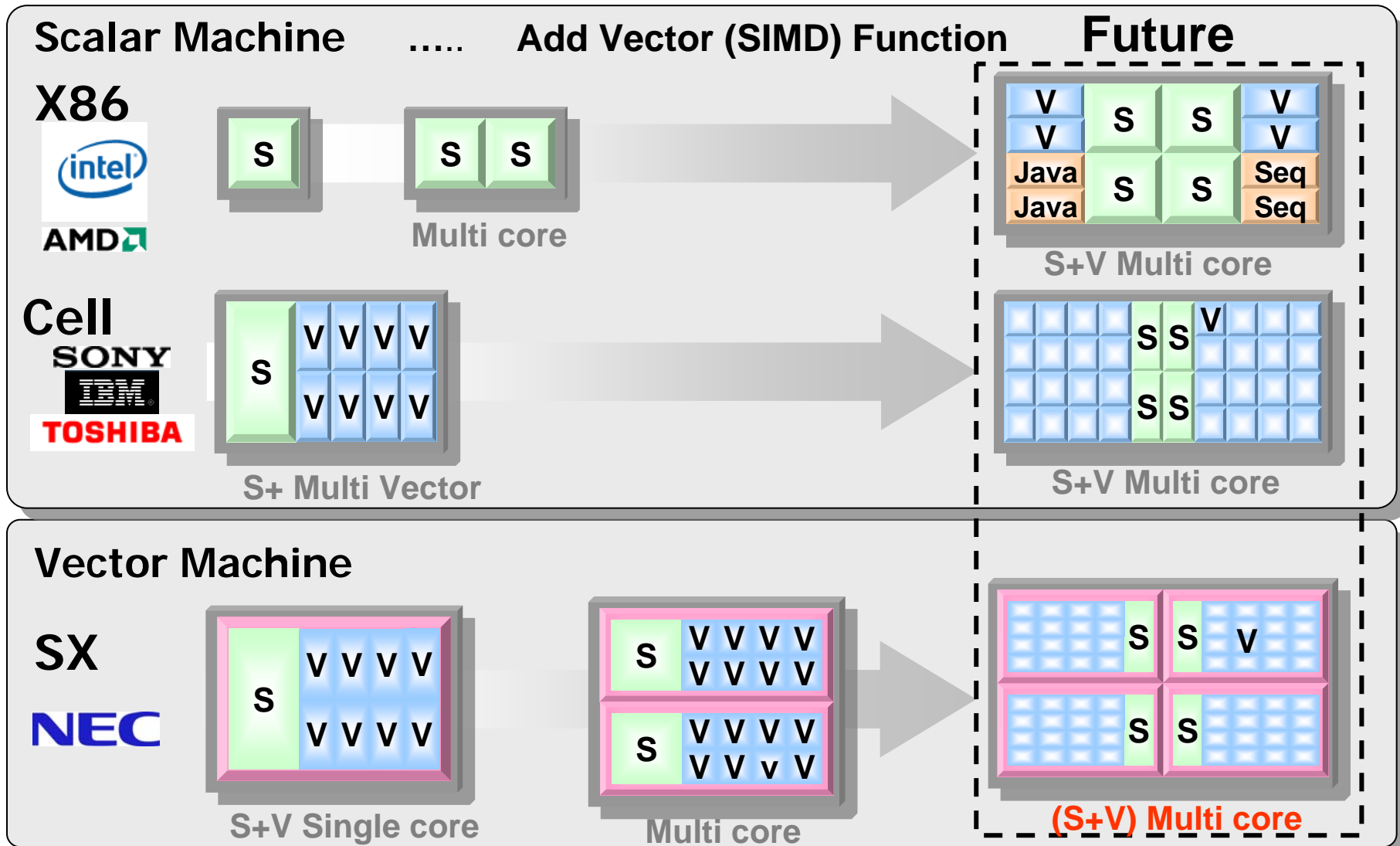
- ① Expand SIMD units
- ② Add-on Co-Processor
- ③ Heterogeneous multi-core



Performance of HPC Processors accelerated by using SIMD/Vector extension approach

# Trend of Processor Multi core Chip

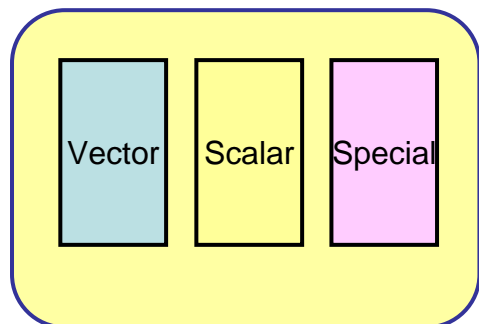
HPC Processors will take in Vector units on the CPU die.



U can change.

# Core Technologies for Future Supercomputer

## Hybrid System

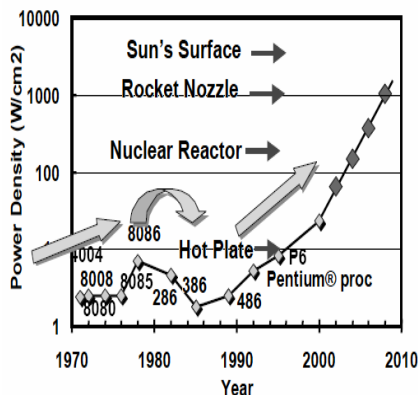


Selection of the suitable platform by applications



Realize high sustained performance for various applications

## Low Power Consumption

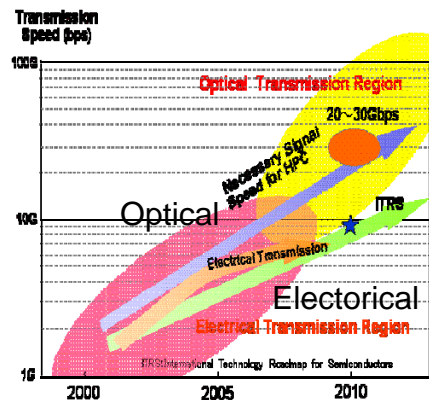


Power density will go up like Nuclear Reactor.



Low Power consumption and cooling technology will be required.

## Interconnect

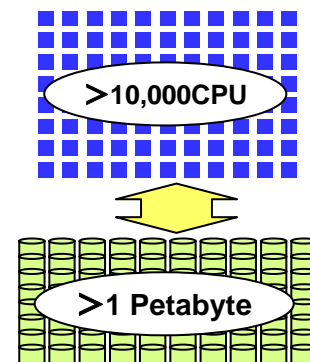


Transfer speed between LSIs will influence the sustained performance



Optical Transmission Technology between LSIs will be required.

## Software



- Super Parallel Software
- Super large data handling

**NEC continues to supply  
best product to customers  
through  
the ceaseless quest for technology  
and by  
Being a quality leader in the world**

**Thank you !!**

Empowered by Innovation

**NEC**