Brand-New Vector Supercomputer

NEC Corporation
IT Platform Division

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SC13
NEC Released A Brand-New Vector Supercomputer, SX-ACE Just Now.

Vector Supercomputer for Memory Bandwidth Intensive Applications

Sustained performance

Usability

Productivity
NEC has always provided the high sustained performance by Vector Super-Computer SX series.
Trend of TOP500 (1st ~ 10th system)

- Growing of LINPAC performance has been provided by system enlarging
- User must spend their time to extract massively parallelism
- Smaller # of cores with big cores can reduce the difficulty
Required Byte/Flop in Real Applications

According to Japanese Government (MEXT) working group report of wide variety of strategic segment applications, diverse characteristics are observed.

MEXT: Ministry of Education, Culture, Sports, Science & Technology

B/F requirement from each application is differ greatly. Only one architecture cannot cover all application areas.

Concepts of SX-ACE

**Big Core**
Providing higher sustained performance
The highest single core performance: 64GF
The largest single core memory bandwidth: 64~256GB/s

**Inherit SX-DNA**

**Low Power Consumption**
Higher power efficiency
Compared to SX-9

**Small Installation Space**
To reduce floor space cost
Compared to SX-9
Providing Big Core

The SX-ACE inherits SX-DNA and overwhelm other CPUs with its world's No.1 CPU core performance and word’s No.1 memory bandwidth.

Single core comparison

**SX-ACE**
- Peak performance: 2~4x performance compared to competitors
- Memory bandwidth: 4~13x performance compared to competitors

**Scalar A**
- Peak performance: 30
- Memory bandwidth: 16

**Scalar B**
- Peak performance: 24
- Memory bandwidth: 6

**Scalar C**
- Peak performance: 15
- Memory bandwidth: 5
Architecture
CPU Architecture (Big Core, Large memory bandwidth)

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Vector</th>
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<tbody>
<tr>
<td>CORE</td>
<td></td>
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<tr>
<td>Performance</td>
<td>64GFlops</td>
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<tr>
<td>ADB size</td>
<td>1MB</td>
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<tr>
<td>ADB bandwidth</td>
<td>256GB/s</td>
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<tr>
<td>Memory bandwidth</td>
<td>64GB/s~256GB/s</td>
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<tr>
<td>Memory Byte/Flop</td>
<td>1.0 ~ 4.0</td>
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<tr>
<td>CPU</td>
<td></td>
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<tr>
<td>Cores</td>
<td>4</td>
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<tr>
<td>Performance</td>
<td>256GFlops</td>
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<tr>
<td>Memory bandwidth</td>
<td>256GB/s</td>
</tr>
<tr>
<td>Byte/Flop</td>
<td>1.0</td>
</tr>
</tbody>
</table>
All-in-one Processor

- 4 powerful cores and each controller (memory, network, I/O) are integrated in one-CPU = Power saving
- Compact card design = Space saving

**SX-ACE CPU**

- **I/O Controller**: Connection to storage device, Ethernet
- **Network controller**: 8GB/s/direction, Fat-tree
- **Powerful core**: World’s fastest CPU core
  - 64GF x 4 cores
  - 1MB ADB/core

**Node card**

- **Performance**: 256GF
- **Memory bandwidth**: 256GB/s

**Memory Controller**

- 256GB/s BW control
- **Very large memory BW**: World’s largest BW 256GB/s

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Node Card

**CPU**
- 4 cores
- 256GF
- 256GB/s

**Memory**
- 4GB x 16DIMMs
- DDR3 2000MHz
Each node is connected with 2 stages full Fat-tree network
Implementing global communication function into HW

- Fat-tree
- HW function of global communication

512 nodes, 2048 cores, 131TFlops, 1B/F
Configuration

Node Card
1 CPU, 256GF, 256GB/s

2-Node Module
2 nodes = 2 CPUs

16-Node Cage
8 modules = 16 nodes = 16 CPUs

16-Node Cage x4
4 cages = 32 modules = 64 nodes = 64 CPUs

Rack
64 nodes = 16TF, 16TB/s

Rack Specifications
16TF, 16TB/s, 64 CPUs
0.75m x 1.5m x 2.0m
30KW

System

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Detail of Rack Implementation

16-node cage

2-node module

42U

network switch

 coolant pipe (inlet)

 coolant pipe (outlet)

OS disk

rack manager

power junction

2 nodes

2 nodes

node manager

2 nodes

2 nodes

2 nodes

2 nodes

2 nodes

2 nodes

node manager

2 nodes

2 nodes

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node manager

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node manager

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2 nodes

2 nodes

2 nodes

node manager

2 nodes

2 nodes

2 nodes

2 nodes

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Providing 5x smaller space and 10x lower power consumption compared to SX-9 by power saving design and compact implementation.

Comparison with same performance (131TF)

**SX-9**
- 80 nodes
- 24m x 12m
- 25m swimming pool size
- 131TF
- 288m²
- 2.4MW

**SX-ACE**
- 512 nodes
- 7m x 8m
- Meeting room size
- 131TF
- 56m²
- 0.24MW

**Power Saving**
- Space: 1/5
- Power: 1/10
NEC's Exhibitor Forum is Today!

Exhibitor Forum
Nov. 19th (Tue), 15:30 – 16:00
Room 501/502
NEC's Brand-New Vector Supercomputer and HPC Roadmap
Empowered by Innovation

NEC