NEC High Performance Computing Technology

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Outline

- SX Series Vector Supercomputers
- SX Performance Numbers
- Next Generation Technology
- Integrated Solutions
- Summary
NEC SX Vector
Supercomputer Series
SX Series Design Philosophy

- Tailor made computer systems for scientific and engineering users.
- Target the capability market, tackle grand challenge problems.
- Always among the world’s most powerful machines.
- The vector architecture allows for easy programming and highly efficient programs.
- Upward compatible between generations, customer investment in software development is preserved.
- Customers include universities, research centres, meteorological services, aerospace and automotive industry.
NEC’s SX Series is a consistent innovation driver and today’s leading high performance platform.

NEC uses latest manufacturing technology to build and develop new generations of supercomputers, while the customer investment in software is preserved.
SX-8 specifications

- 16 GF / CPU (vector)
- 64GB/s memory bandwidth per CPU
- 8 CPUs / node
- 512 GB/s memory bandwidth per node
- Maximum 512 nodes
- Maximum 4096 CPUs, max 65 TFLOPS
- Internode crossbar Switch
- 16 GB/s (bi-directional) interconnect bandwidth per node
- Maximum size SX-8 is among the most powerful computers in the world
SX-8 Technology

- Hardware dedicated to scientific and engineering applications
- CPU: 2 GHz frequency, 90nm-Cu technology
- 8,000 I/O per CPU chip
- Serial signalling technology to memory, about 2,000 transmitters work in parallel
- 64 GB/s memory bandwidth per CPU
- Multilayer, low-loss PCB board, replaces 20,000 cables
- Optical cabling used for internode connections
- Very compact packaging
Application Performance on SX-8
Climate Research / HadGEM

HadGEM Timings

Baseline run CSAR 64 CPUs

Unoptimized

Speedup SX-8 vs CSAR

Optimized

Runtime (s)

Factor

SX-8+ CPUs
Materials Science / Castep

CASTEP (small and large case)

Large Case Baseline Run 1024 CPUs HPCx

Large Case Speedup SX-8 vs HPCx

Small Case Speedup SX-8 vs HPCx

Large Case Runtime SX-8

Small Case Baseline Run 1024 CPUs HPCx

Small Case Runtime SX-8

Materials Science / Castep
CFD / Lattice Boltzmann (BEST)

Perfect scaling

62.5%

62.6%
Next Generation Technology
NEC’s contribution to Japanese PF Project

- Optical interconnections for ultra high-speed computers
  - Development of technology for optical signal transmission between CPU and memory, which is expected to replace current electrical signal transmission and realize a supercomputer having sustained performance exceeding Peta flops
- Performance Target: 20+ times higher transfer rate than conventional technology
  - Optical transmission speed 20TBits/s+ per CPU
  - 20GBits/s+ per signal
  - 1000 signals per chip
The Hybrid Vector Concept
Building Integrated Solutions
Enhance productivity thru combination of standard and custom technology

NEC Hybrid Systems integrate highest performance vector with industry standard scalar technologies
Tailored solution today: HLRS

Vector Compute Server
SX-8 72 nodes

Scalar Compute Server
Express5800 120Re-1

Highest performance vector with state-of-the-art industry standard scalar technologies
Tailored solution today: HLRS
Scalar Compute Server

SX-8
72nodes

GbEther SW
GbEther SW

IXS

PP
TX-7

Nocona
Nocona

Infiniband
288 ports

GFS
Server
Cluster

FC Switch 114ports
FC Switch 114ports
FC Switch 114ports
FC Switch 114ports

FC Disk
FC Disk
FC Disk
FC Disk

Scalar Compute Server

Tailored solution today: HLRS
Scalar Compute Server

SX-8
72nodes

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FC Disk
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FC Disk
FC Disk

Scalar Compute Server
Tailored solution today: DKRZ

Data Handling Example

Vector Compute Server

24 vector nodes

Complex Workflow mapped on custom solution.

Scalar / GFS Server

25 smp servers

HSM handles world largest Oracle database
DKRZ: Custom Solution for complex work flow

1. Climate Model writes raw output (GFS I/O)
2. PP reads raw data (GFS I/O)
3. OCI reads data (Local I/O)
4. OCI writes BLOB (via networks)
5. Data inquiry (OCI)

SX-6

GFS Environment

Oracle AS

Local disk

Users

Climate Model

Post Process Application

Post processing System (?)

META Data

Oracle Instance

GFS/Client

Oracle DB

BLOB

AP

GFS/Server

Oracle Instance

GFS/Server

Oracle DB

BLOB

Migration & Staging

DiskXtender Disk cache

AsAmA 16way

DXSM

AsAmA 4way

DXDB

DXDM

DXSN

DXSN

GE Network
Traditional Situation

User access

V cluster-wide FS (high performance)

Traditional Situation

- NEC provides all important technologies for a customer
- Homogenous uniform environments with few peripheral components all of which are certified
- Long product cycles allow routines for service to establish

Our strength

- Deep technological understanding
- Manage multi Million € projects
- Manage individualistic requirements in specification, design, development, deployment and testing
- Manage high availability environments
**Hybrid Solution**

**Today's Situation**
- Dependency on 3rd party technology at critical parts
- Heterogeneous environments with key components from suppliers
- Short product cycles require flexible service

**Our strength**
- Deep technological understanding
- Careful selection of partners
- Professional supplier management
- Keep control on the complete solution design
- Single point of contact
- Partners allow state-of-the-art solution design
NEC Hybrid Systems
NEC Solution Competency & Suppliers

NEC Solution Design
- Application
- Middleware
- OS
- Interconnect
- Hardware
- Storage

 Suppliers
- ISV/ Research
- Altair/Sun,...
- Novell/ RH
- Voltaire/ Brocade
- SUN/ ...
- DDN/CFS/Panasas
NEC Hybrid Systems

The NEC Value Proposition

- **Solution Competency**
  - 20 years continuous dedication to the HPC market
    - Excellent track record
  - Unchallenged in Intellectual Property …
    - Deep understanding of HPC application requirements
    - Deep understanding of state-of-the-art technologies
  - … and Technology Assets
    - Unparalleled vector technology
    - State-of-the-art industry standard scalar components

- **System Integration Processes**
  - General contractor
  - Careful selection of partners – best of breed technology
  - Best practice management processes

- **NEC Integration Technologies**
  - Global File System
  - Common user Interface
  - Cross environment
NEC Hybrid Systems
The Future

- Optimize level of integration of supplier products
- Faster adoption of new technologies
- Highest level of system reliability and availability

AND/OR

- Integrate Vector and Scalar on a hardware level
Summary

- NEC manufactures and develops the leading vector systems worldwide.
- Vector CPUs will continue to be performance leaders.
- The NEC roadmap envisions Petaflop scale systems.

But NEC offers more:

- Complete solutions based on a comprehensive product portfolio.
- Complex system integration.
Empowered by Innovation

NEC