



A Prototype of Ultra Low-Power Mega-Scale System :

MegaProto

MEGASCALE

<http://www.para.tutics.tut.ac.jp/megascale/>

Objective

Our research targets future computing systems with numerous computing elements, up to those that embody more than one million processing elements in total. Because of the gigantic number, the overall packaging must be extremely compact and dense, and as a result, components should emit as little heat as possible. Such characteristics however must be implemented using commodity components, especially for the processing element that usually dominate power usage nowadays for any high-performance computing systems. The question then is, will the use of low-power processors serve as building blocks to accommodate such packaging, and at the same time exhibit superior density/performance and power/performance ratio compared to high power-consuming processors that are more common in performance-oriented clusters today? MegaProto was designed and built in collaboration with IBM Japan to investigate and demonstrate such feasibility.

Design Target and System Overview

To achieve high performance and low power consumption...

- High-density packaging by adopting low-power CPU

Design target

- Peak performance \Rightarrow 1TFlops / rack
- Power consumption \Rightarrow 10kW / rack
- Performance / Power \Rightarrow 100MFlops / W

Efficeon (TM-8820)

- Peak performance / Power = 667MFlops / W

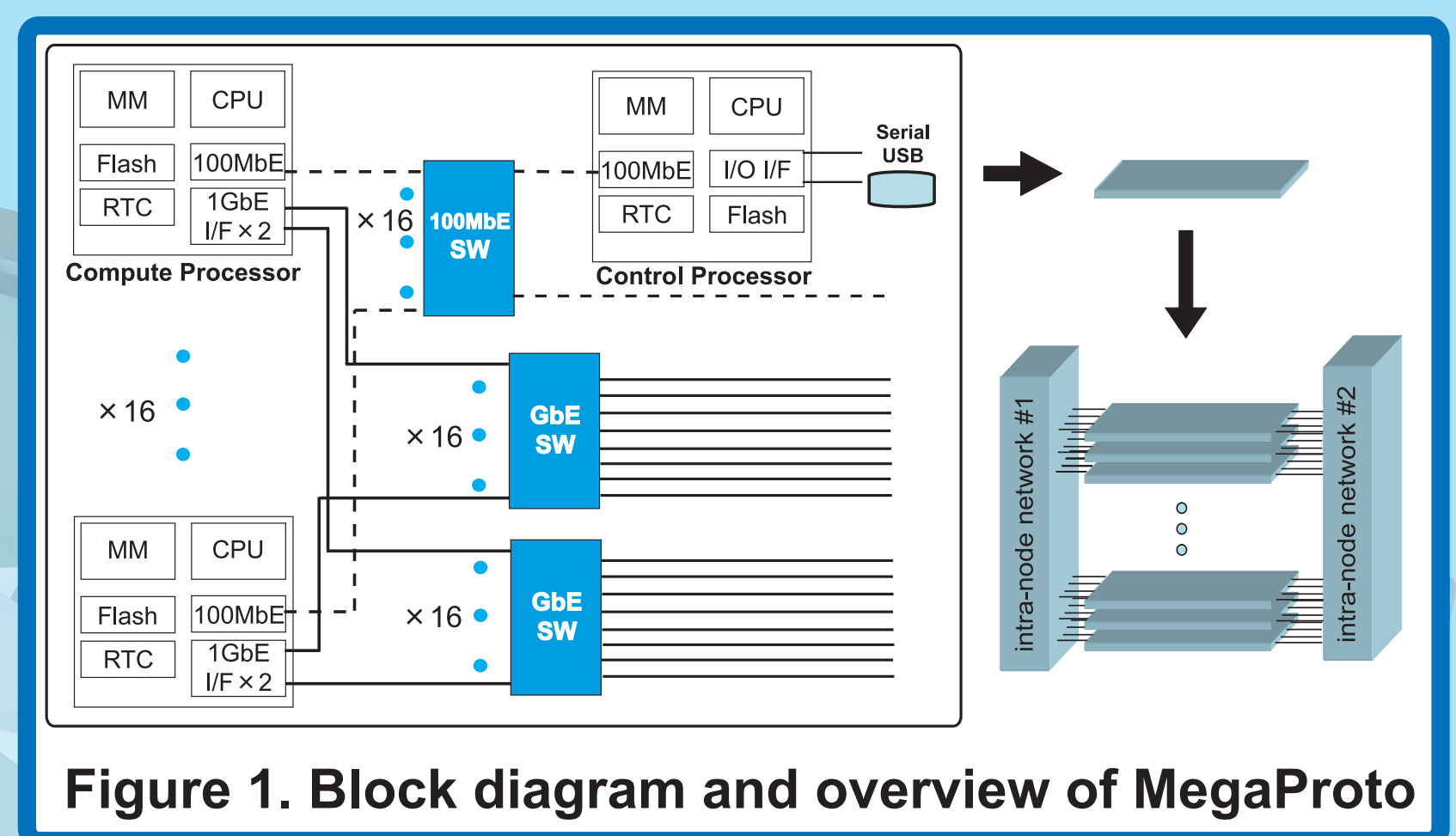


Figure 1. Block diagram and overview of MegaProto

Feature of MegaProto 1U Cluster Unit

Diskless CPU card for reducing power consumption

- Sharing a disk in the control CPU card by NFS
- High-density packaging : 16 CPUs per 1U cluster unit

Two types of networking

- Dual Gigabit Ethernet for data transfer
- Fast Ethernet for control

Dollar-bill size CPU card

- TM-8820@1.0GHz+512MB memory

Low power consumption

- 10W per CPU card
- 320W per 1U cluster unit

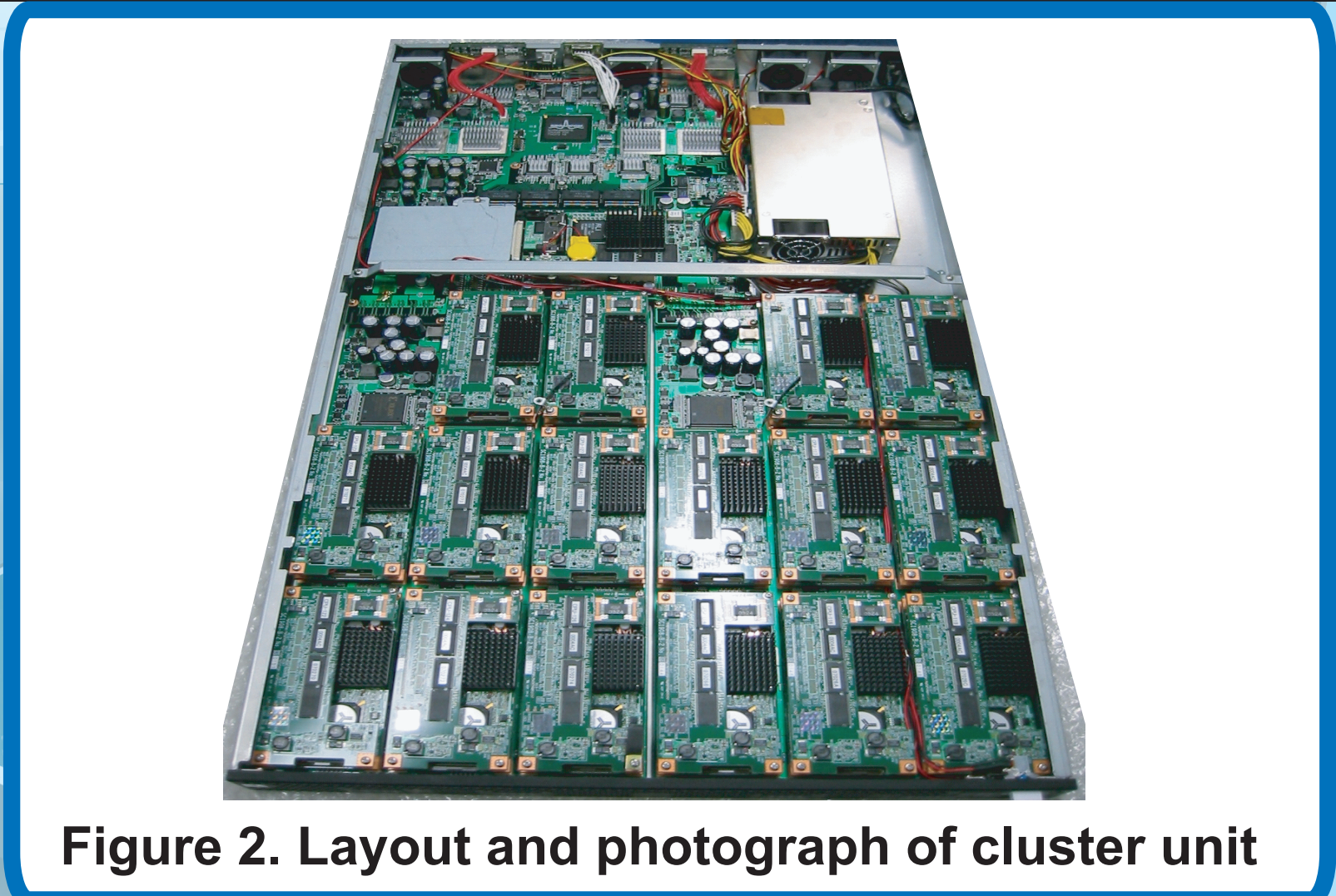


Figure 2. Layout and photograph of cluster unit

Performance of MegaProto vs Dual Xeon Server

Benchmark programs

- NPB 3.1 CLASS A
- HPL 1.0a with ATLAS 3.6.0 size = 10000

	dual Xeon	MegaProto
Processor	Xeon 3.06GHz	TM-8820 1.0GHz
Num. of proc.	2	16
Memory	1GB/proc	512MB/proc
Power	400W	320W

Table: Specification of the systems

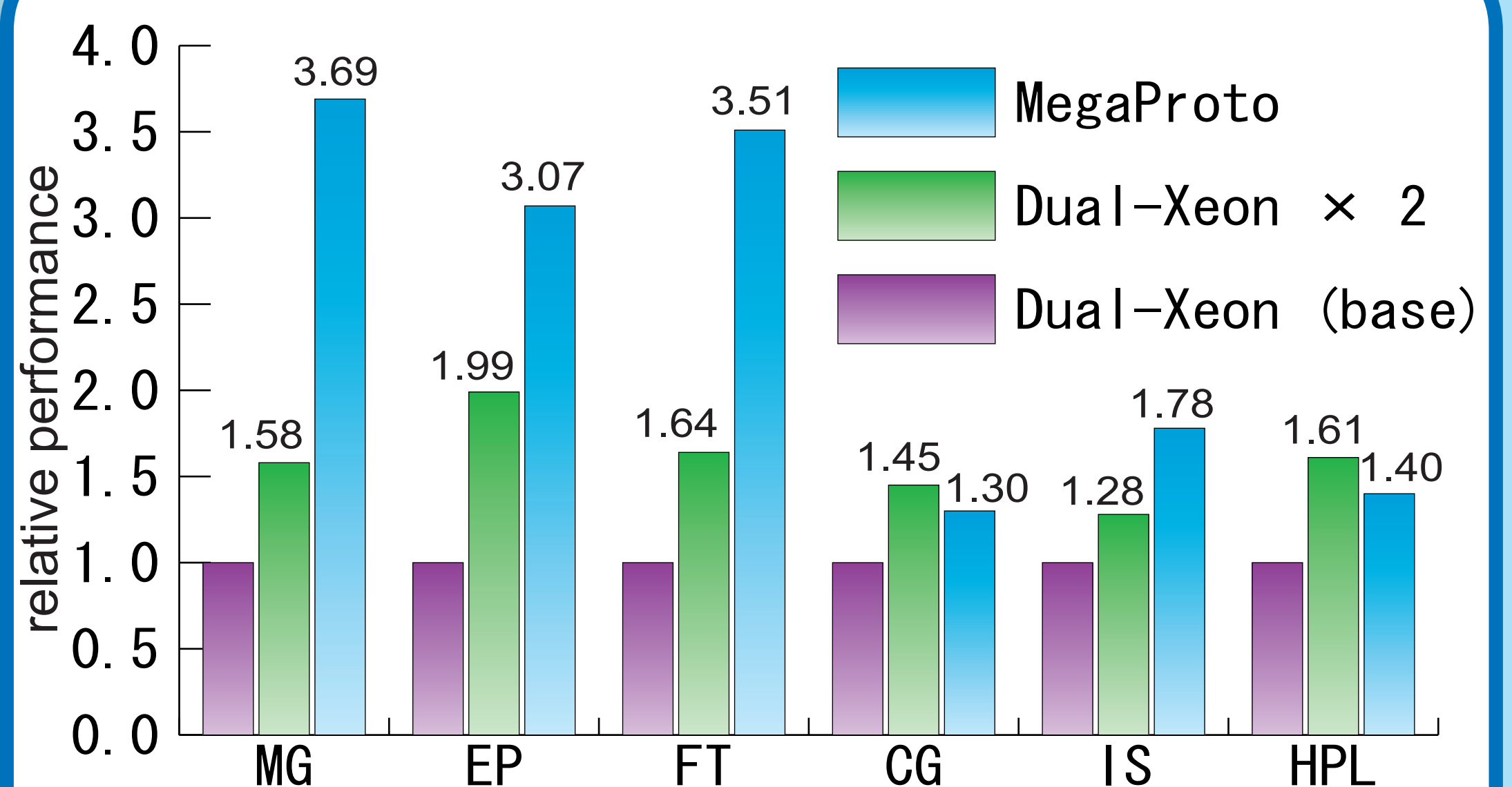


Figure 3. Performance relative to Dual-Xeon server