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

MegaScale

Objective

Our research targets future computing systems with numerous computing elements, up to those that embody more that one million processing elements in total. Because of the sheer 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 nowathesedays 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   =   1TFlops / rack
 - Power Consumption   =   10kW / rack
 - Performance / Power   =   100MFlops / W

Crusoe (TM-5800)
   Peak performance / Power   =   124MFlops / W
Efficeon (TM-8800)
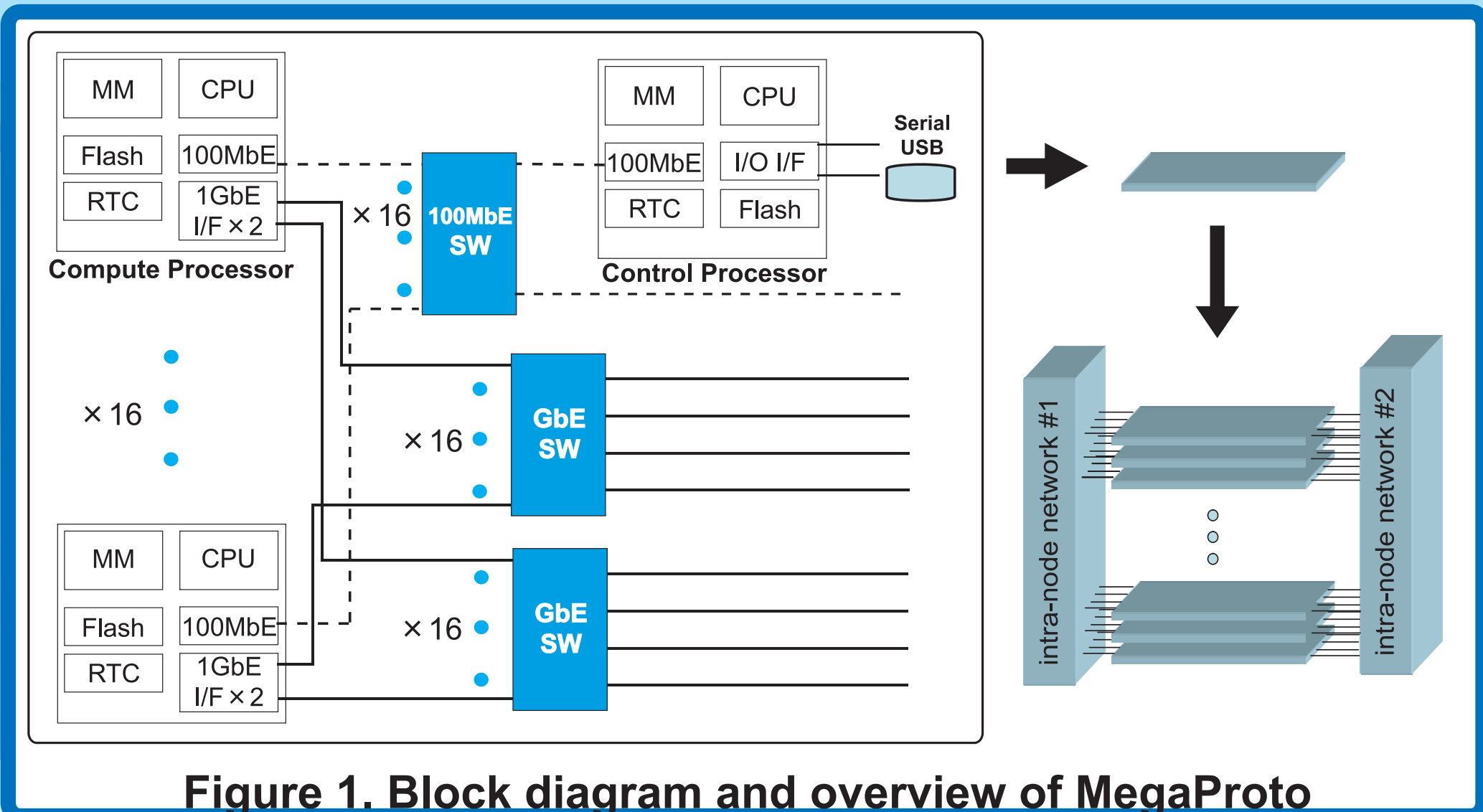   Peak performance / Power =   480MFlops / W

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
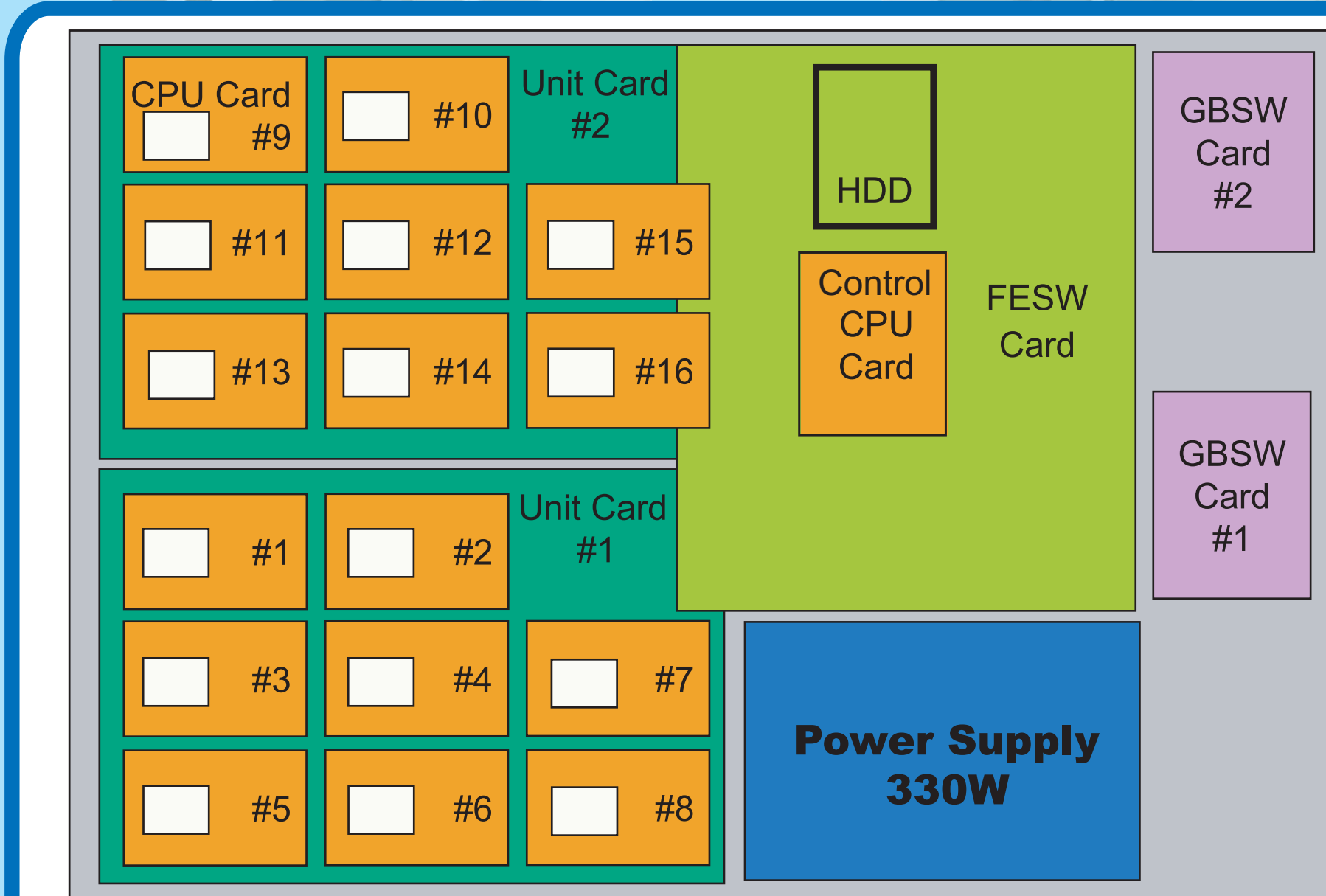Two types of networking
 - Dual Gigabit Ethernet for data transfer
 - Fast Ethernet for control

Upgradable CPU card
 - Crusoe version : TM-5800@933MHz+256MB memory
 - Efficeon version : TM-8800@1.2GHz+512MB memory
Low power consumption
 - 8-10W per CPU card
 - 300-330W per 1U Cluster unit

Development Schedule

May 2004: 32 processors (2 cluster units, Crusoe version)
 1Q 2005: 96 processors (6 cluster units, Efficeon version)
 2Q 2005: 256 processors (16 cluster units, Efficeon version)