

# ExaScaler PEZY Computing

## ZettaScaler - 2.0

Configurable Liquid Immersion Cooling System

Scalable Energy Efficient HPC / Data Center Solution

### Introducing ZettaScaler Core Technologies

#### Unique liquid immersion cooling technology

All circuits are fully immersed and cooled by 3M™ Fluorinert™ inert liquid circulation  
Operating temperature is under 30°C ( equal to 86°F ).  
Safe, no need for sealing, highly-efficient cooling solution.  
Easy to maintain with much less failure rate.

#### Our proprietary many-core MIMD processor, PEZY-SC2

Overwhelming computing power  
4.1 TeraFLOPS ( Rpeak ) at 1GHz  
2,048 cores of original design and 6 MIPS64® cores  
16nm FinFET process  
56MB of cache memory  
TCI 3D stacked memory with bandwidth of 2.0TB/sec  
DDR4 memory with bandwidth of 153.6GB/sec  
PCI-Express Gen4 with I/O bandwidth 64GB/sec  
Significantly reduced transmission power loss using 48V DC input.

#### Sufficient interconnect bandwidth

32 processors are connected using twelve hierarchical PCI-Express fabric switches to form a Brick.  
Every link between two processors in a Brick is PCI-Express Gen3 x16.  
Bricks are interconnected with high-speed InfiniBand EDR, etc.

#### Ultra-high-density modules

Extreme densities realized by liquid immersion cooling.  
Short-distance signal transmission allows for high-speed circuit operation.  
Over one million processing cores in one cubic meter ( 1m<sup>3</sup> ).  
Able to select a variety of high density modules, PEZY-SC2 module, All FLASH-SSD module, Intel® Xeon® module, etc.

### Value provided by these technologies

#### High performance

One immersion tank with 16 Bricks/512 processors delivers 2.1 PetaFLOPS ( Rpeak ), 1.4 PetaFLOPS ( Rmax )

#### High energy-efficiency

World top class efficiency with over 10GFLOPS/W

#### Compact and silent

Compact size, silent, no air blow, no temperature nor moisture control required.  
Can be installed in a laboratory office and even in a private researcher office.

#### Scalable

A system with multiple immersion tanks  
Configuration example:  
Connecting 16 immersion tanks can create 30 PetaFLOPS ( Rpeak ), 20 PetaFLOPS ( Rmax ) system

#### Configurable

An immersion tank can be configured with a variety of modules  
Configuration example:  
The system can be configured 256 Xeon® processors/Brick with 2PB of SSD storage/Brick in a tank.

# Configurable Liquid Immersion Cooling System

ZettaScaler is an extensible system that adopts ExaScaler's unique liquid immersion cooling technology. In conventional systems, the equipment along with the entire room has to be cooled through air conditioning, but air conditioning is not necessary for this liquid immersion cooling system. It is a very small and silent supercomputer, it can be even installed in laboratories or offices.

The basic block of our system is called a brick, mounted with ultra-high density processor modules. These extremely dense bricks are installed in the immersion tanks and are efficiently cooled in our immersion cooling system.

The inside of the immersion tank is filled with fluorine inert liquid exhibiting excellent thermal characteristics. By circulating this liquid, it is possible to efficiently cool all immersed electronic circuits. It provides excellent electrical insulation and it is a highly safe liquid with non-combustibility, non-toxic, odorless and zero ODP ( Ozone Depletion Potential ) characteristics.

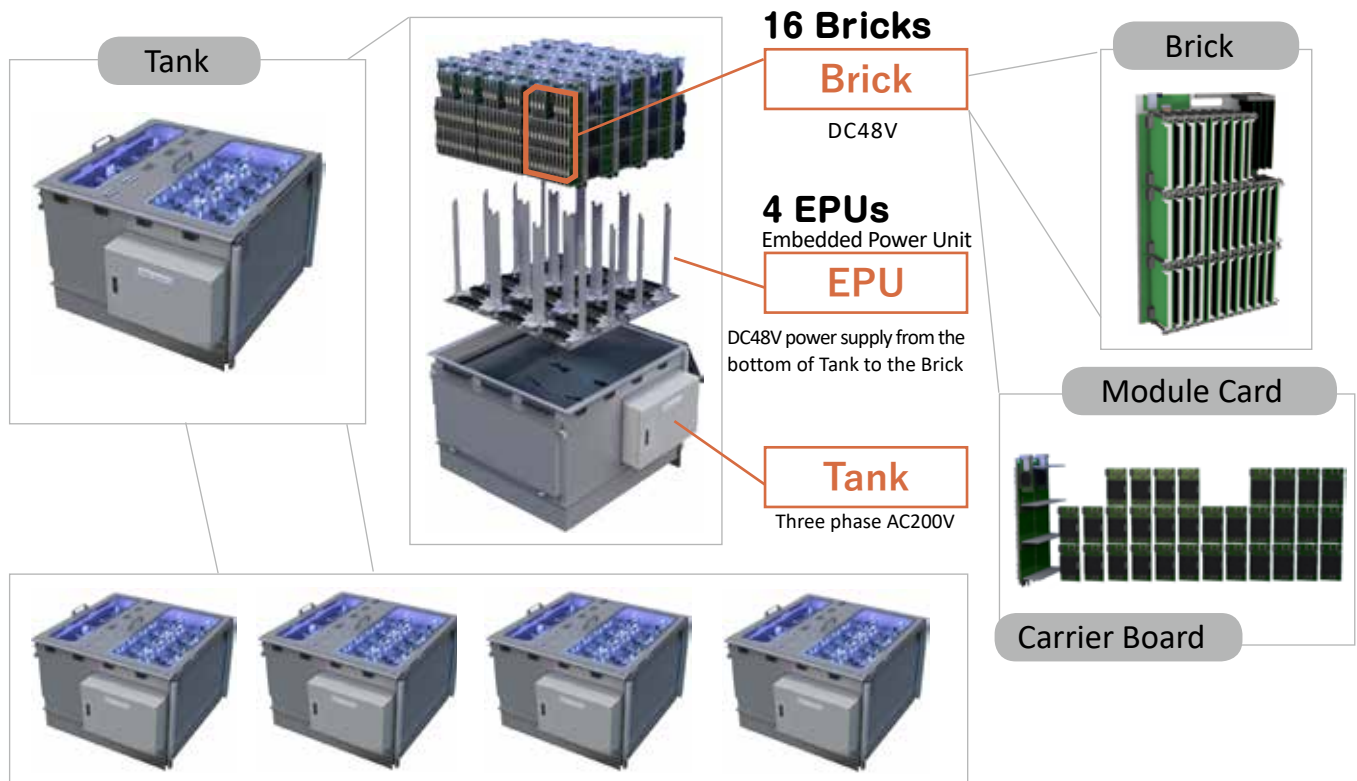
Furthermore, it has a high boiling point and hardly evaporates, so sealing is not necessary. This simplicity of our system structure along with the ease of use of our cooling system simplifies maintenance.

ZettaScaler is also extremely extensible and scalable. By connecting the immersion tanks in tandem, it is possible to scale to the desired performance level. For example, with 16 immersion tanks, the system can be configured to reach 30 PetaFLOPS ( Rpeak ) / 20 PetaFLOPS ( Rmax ).

## ZettaScaler-2.0 system configuration

### Tank / EPU / Brick / Module Card

( A prototype image. This prototype has 24 bricks and the final product has 16 bricks. )



### Scalable

( Multiple Tanks Interconnected )

32 module cards, 4 network cards and 1 control card ( optional ) are mounted on the carrier board ( backplane ) and are connected to each other using twelve hierarchical PCI-Express fabric switches interconnect.

Inter-Brick connections are facilitated using high-performance interconnects such as InfiniBand.

All features and specification are subject to change without prior notice.

# ZettaScaler - 2.0

## PEZY-SC2 Module

Our high-performance compute nodes are equipped with PEZY-SC2, the successor to the PEZY-SC many-core processor developed by PEZY Computing K.K.

Its predecessor PEZY-SC is the Green500 Top 1-3 awarded processor used in the systems Shoubu, Sui ren, Sui renBlue and Satsuki.

PEZY-SC2 doubles the number of cores compared to PEZY-SC. Also, significantly reduces transmission power loss using 48V DC input.



W160mm, D100mm, H28mm

## PEZY-SC2 Processor

- 2,048 MIMD cores / 16,384 Thread / 1GHz
  - L1 12MB / L2 12MB / L3 40MB
  - Theoretical performance : 4.1TFLOPS ( DP ) / 8.2TFLOPS ( SP ) / 16.4TFLOPS ( HP ) ( Rpeak )
  - MIPS64R6 ( P6600 ) 6Cores / L1 I:64KB+D:64KB ( each core ) / L2 2MB
  - Coming soon : Near Field Wireless Communication between Processor-Memory link with TCI\* Technology
- \*ThruChip Interface

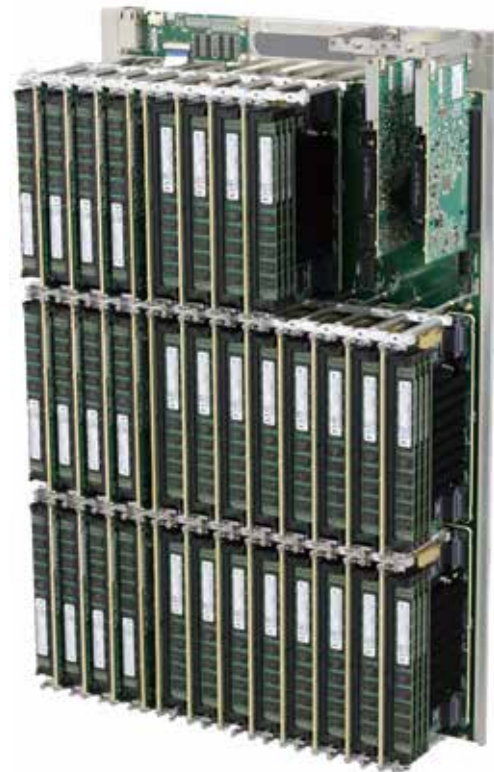
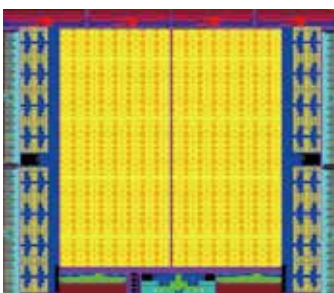
PCIe Gen3/4 x16 \* 2CH ( x8 \* 4CH )

DDR4 64bit ( ECC ) \* 4CH / 3,200Mbps

BW=100GB/sec Up to128GB

Power Consumption : 130W ( Average at standard load )

### Die Plot



A Brick with 32 PEZY-SC2 modules

4 slots ( top right ) for 100Gbps high speed interconnecting cards

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Photo courtesy of JAMSTEC

## Intel® Xeon® E5-2600 v3/v4 Module

Dual processor node for high-performance computing and virtual machine services equipped with two QPI connected Intel® Xeon® processors



W160mm, D115mm, H60mm

A Brick with 16  
Xeon® E5 modules  
32 Xeon® E5 processors

4 slots ( top-right )  
for 100Gbps  
high speed interconnecting cards



## Dual Xeon® D Module

One module contains two Xeon®D nodes for high-performance computing and storage control



W160mm, D100mm, H28mm

A Brick with 32 Xeon D modules  
64 Xeon® D processors

4 slots ( top-right ) for 100Gbps  
high speed interconnecting cards



## ALL FLASH - High capacity SSD module

Storage module with 16 NVMe M.2-2280 SSDs  
32TB with 2TB SSDs



W160mm, D100mm, H14mm

A Brick with 64  
ALL FLASH modules  
Capacity up to 2PB

4 slots ( top-right ) for 100Gbps  
high speed interconnecting cards



## High capacity FPGA Module

Compute node with Xilinx's highest capacity FPGA  
Virtex UltraScale XCVU440



PCIe Gen3 x8\* 4CH  
DDR4 SO-DIMM 64bit\* 1CH/2,400Mbps  
BW=19.2GB/sec, 16GB memory ( max )

W160mm, D100mm, H28mm

A Brick with 32 High  
capacity FPGA modules

4 slots ( top-right ) for 100Gbps  
high speed interconnecting cards



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