Fresh Breeze Status

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Architecture and Programming Models for High Performance Interactive Computation

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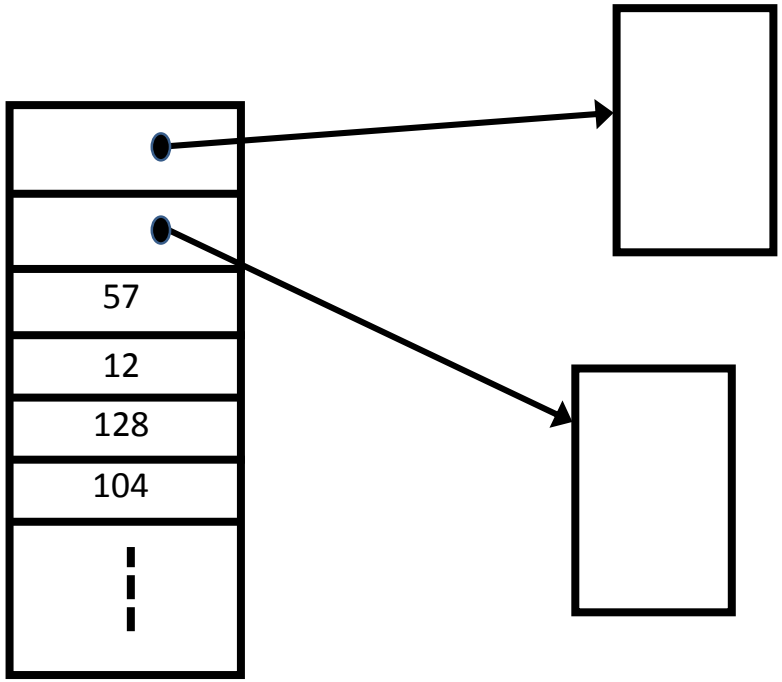
The Fresh Breeze Project

- Co-design of Programming Model and System Architecture.
- Goal: Support Dynamic Resource Management.
- Goal: Support Interactive Real Time Computation.

Flexibility of resource management requires choice of a unit of exchange for memory and for processing

- **Unit of Memory – Fixed Size Memory Chunk**
- **Unit of Processing – Execution of a Codelet**

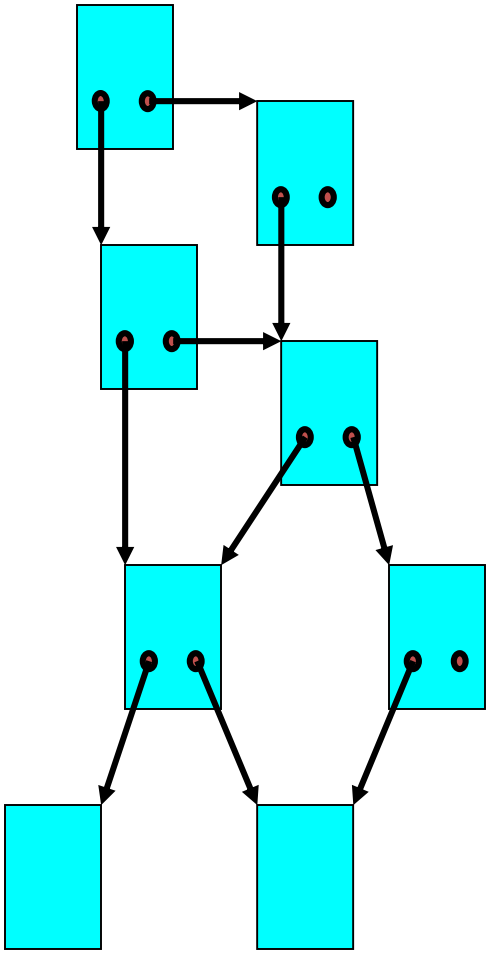
What is a Memory Chunk ?



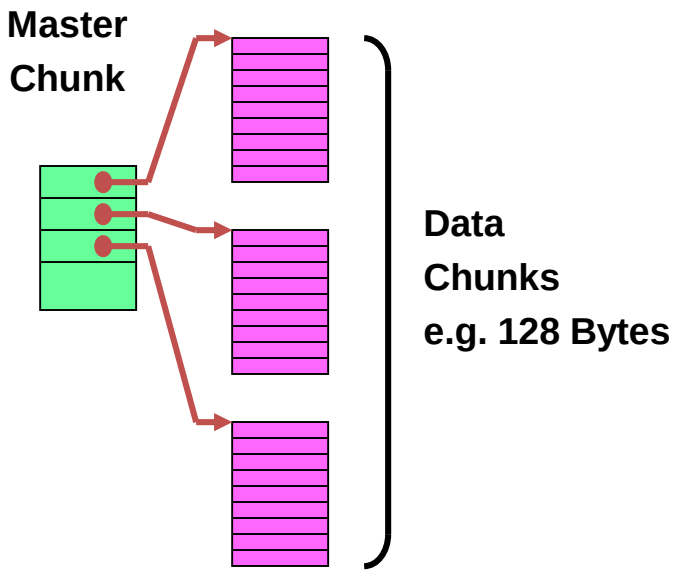
A chunk holds sixteen data items that may be data values or pointers to other memory chunks

Data Structures as Trees of Chunks

Cycle-Free Heap



Arrays as Trees of Chunks

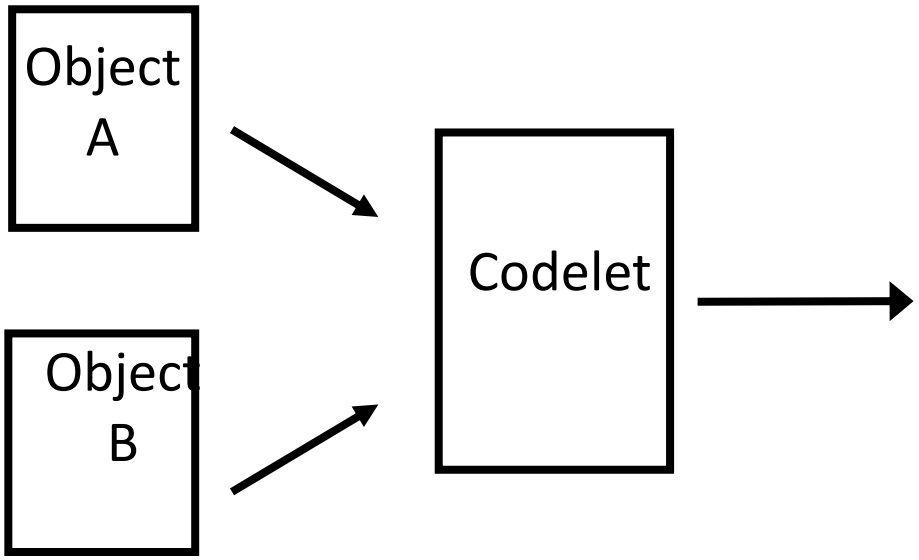


- **Fan-out as large as 16**
- **Arrays: Three levels yields 4096 elements (longs or doubles)**
- **Write-Once then Read Only**

Benefits of the Memory Model

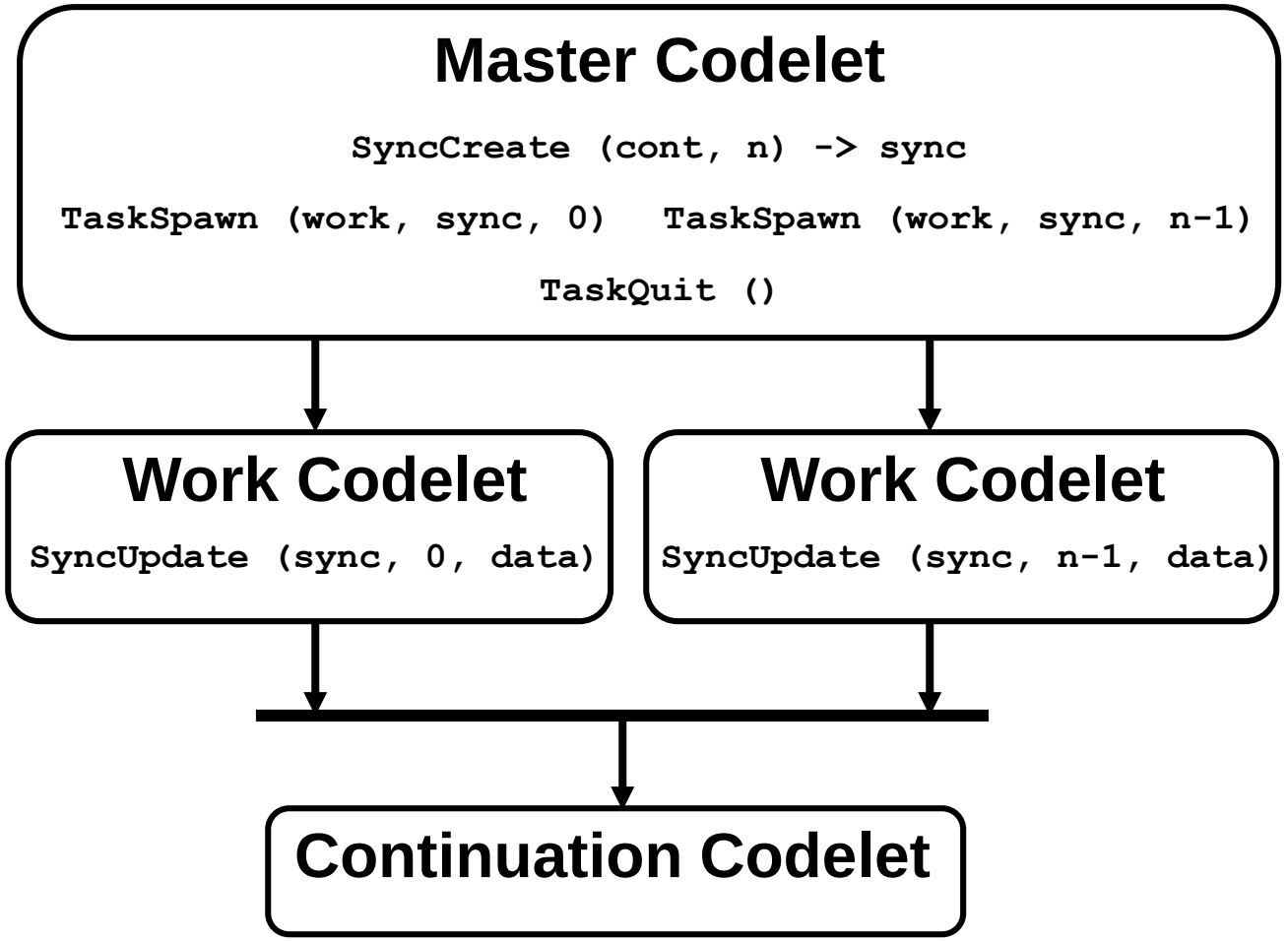
- **Uniform representation scheme for all data objects**
- **Ease of selecting components of a data object.**
- **Simplified memory management.**
- **Write-once policy eliminates coherence issues**

What is a Codelet ?

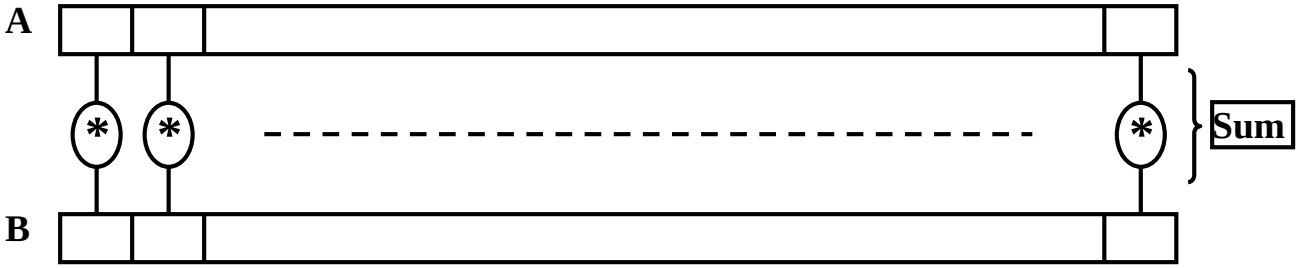


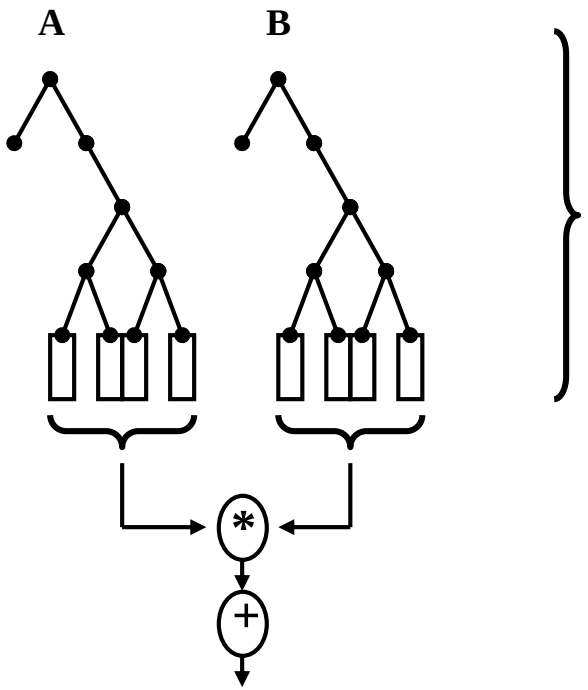
- A block of Instructions scheduled for execution when needed data objects are available.
- Results made available to successor codelets.
- Data objects are trees of chunks.

Work and Continuation Codelets



Example: The Dot Product

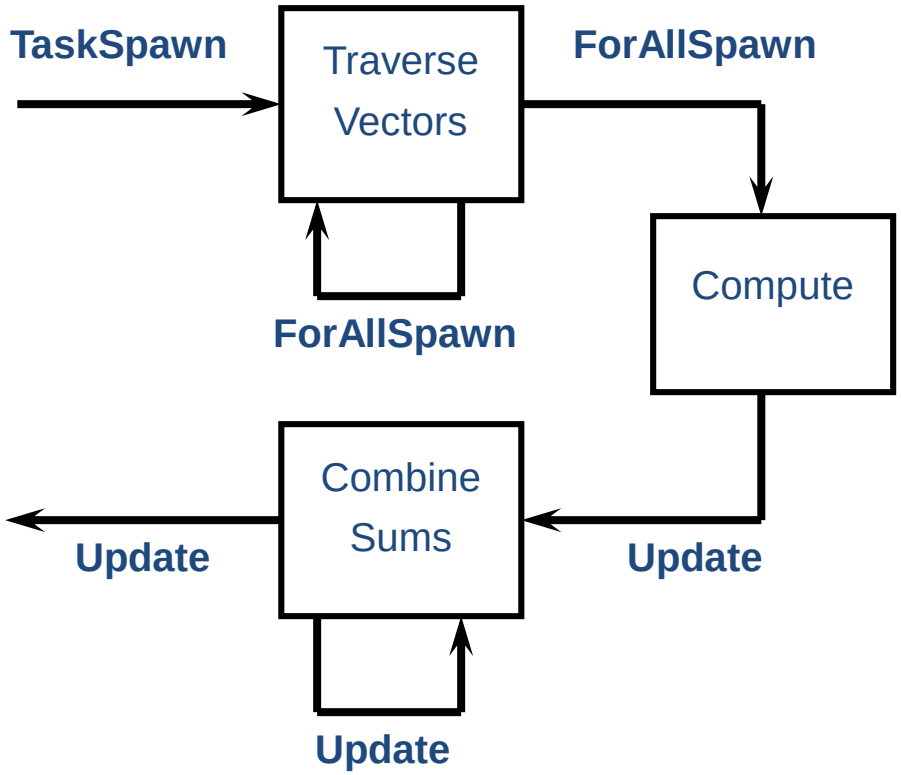




5 levels:
Vector length =
16^5 = 1,048,576

Each of 65536 Leaf Tasks:
Dot Product of two
16-element vectors:
16 multiplies; 15 adds

Codelets for the Dot Product



Fresh Breeze Multicore Chip

S - Scheduler

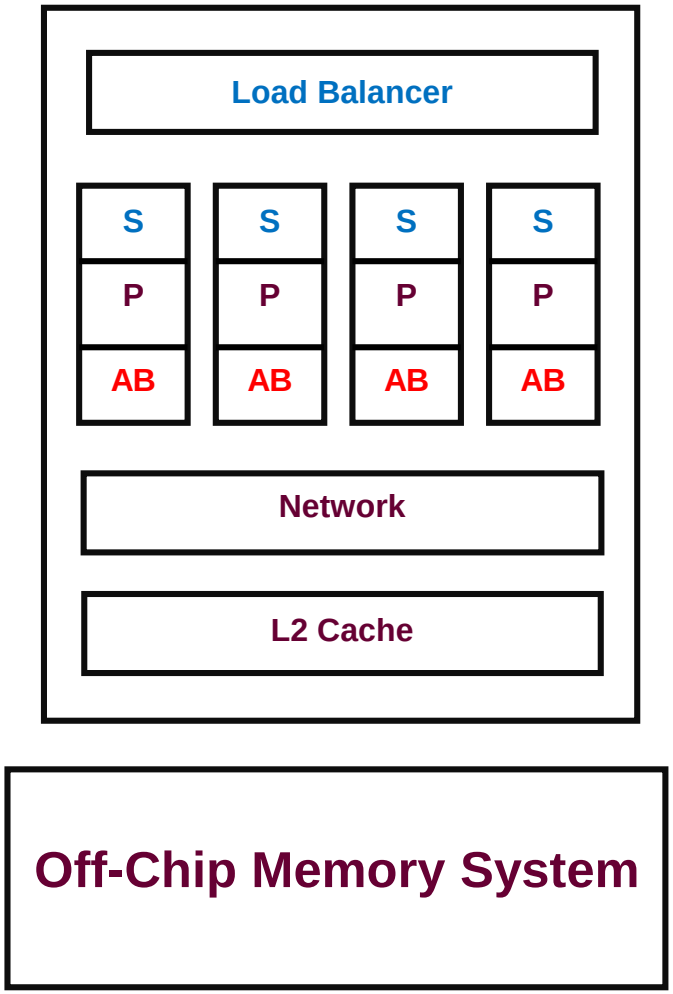
P - Processor Core

AB - AutoBuffer

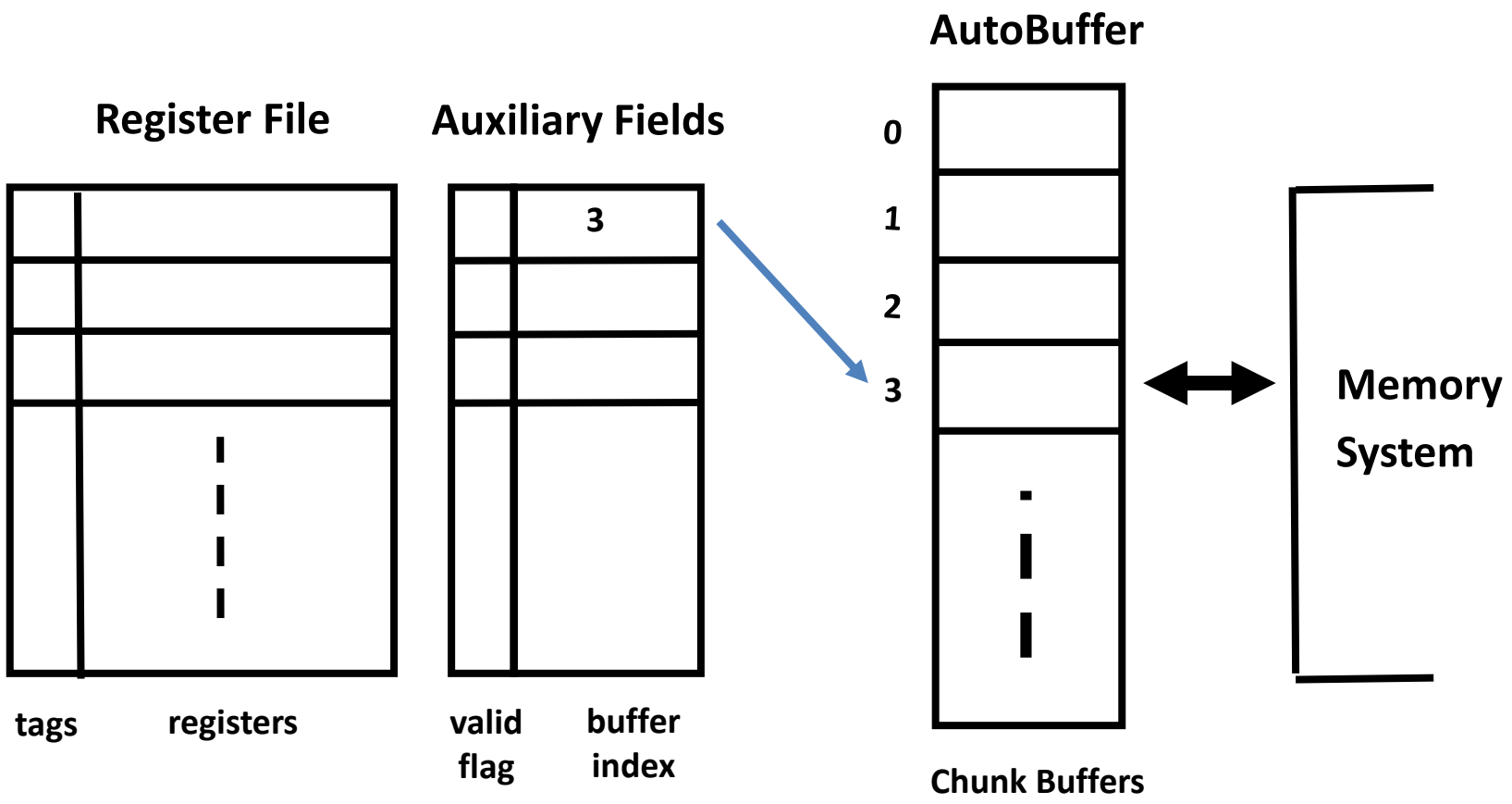
Innovations:

AutoBuffer - AB

Load Balancer

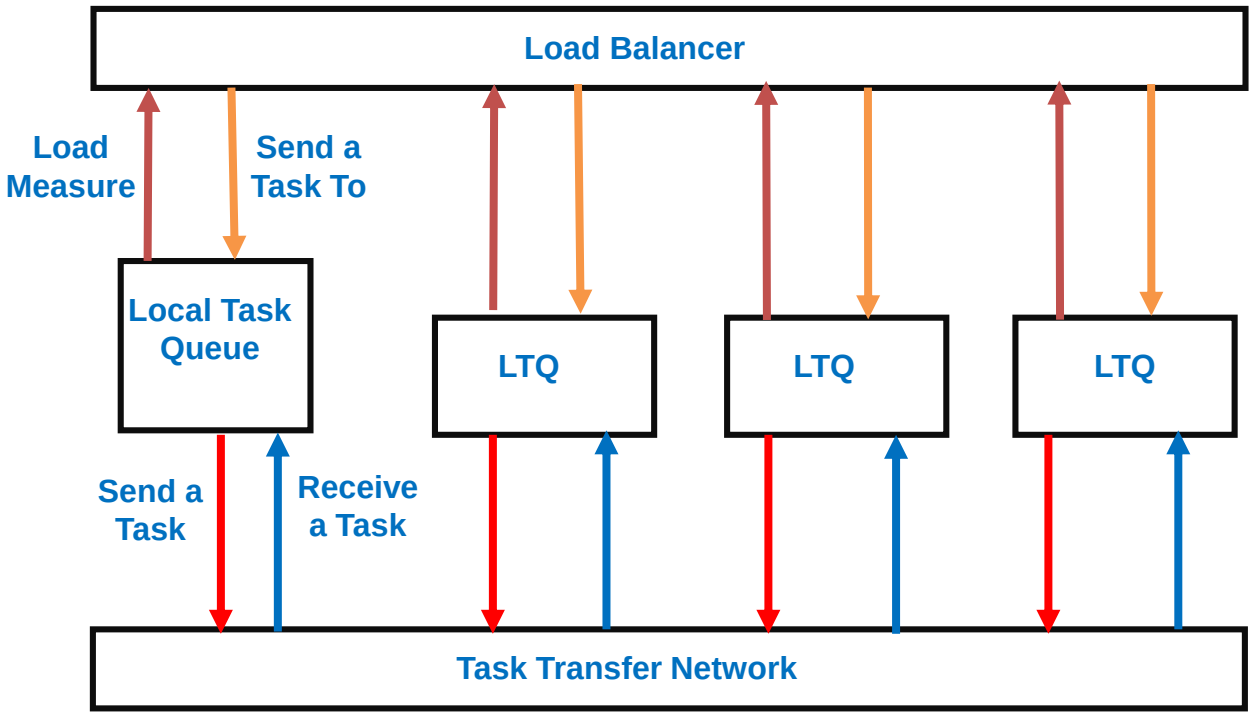


Principle of the Auto Buffer



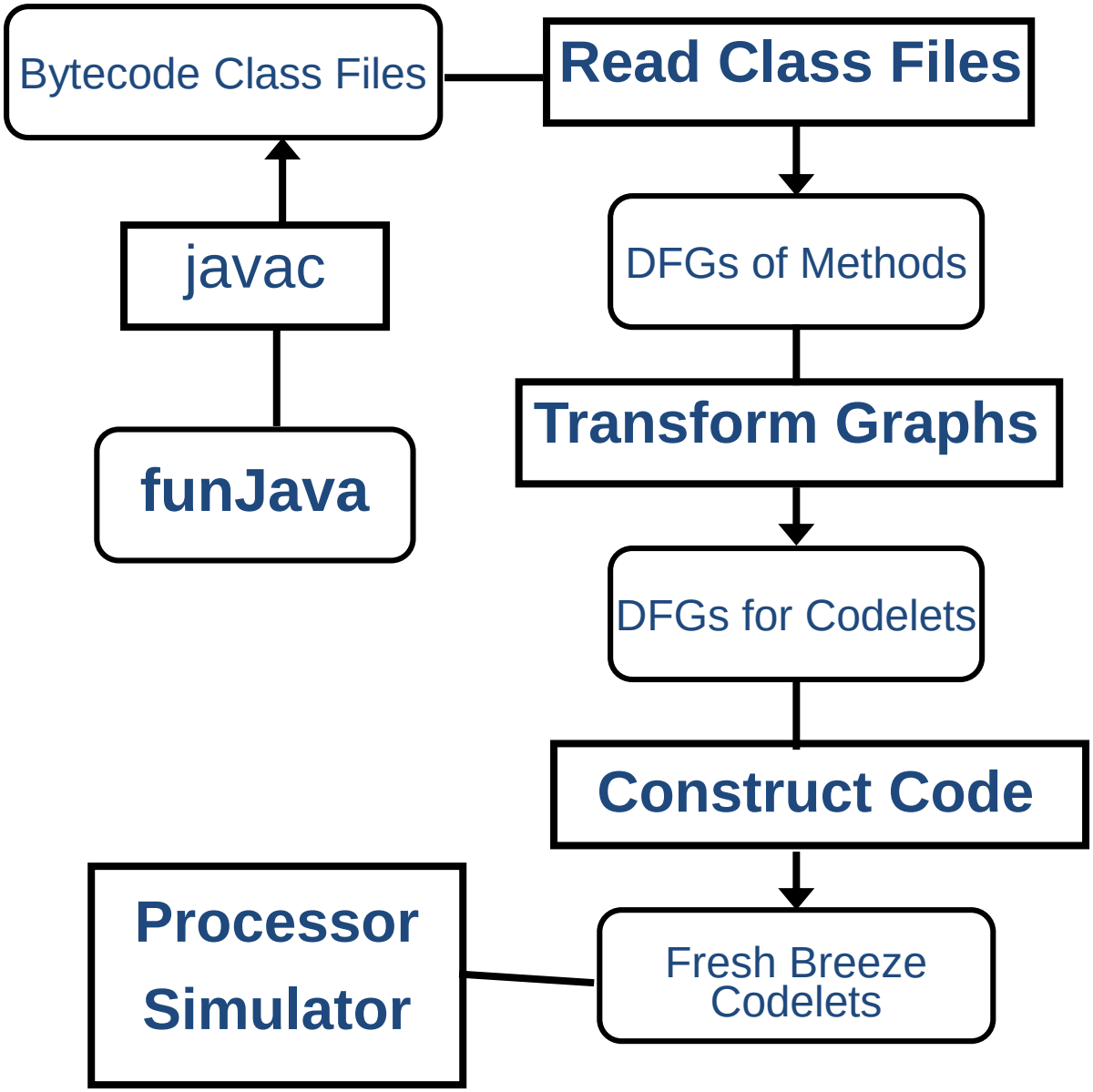
Codelets access chunks using chunk handles held in processor registers. Once a chunk is assigned a buffer, its index is held by the register containing the handle, providing direct access to the chunk.

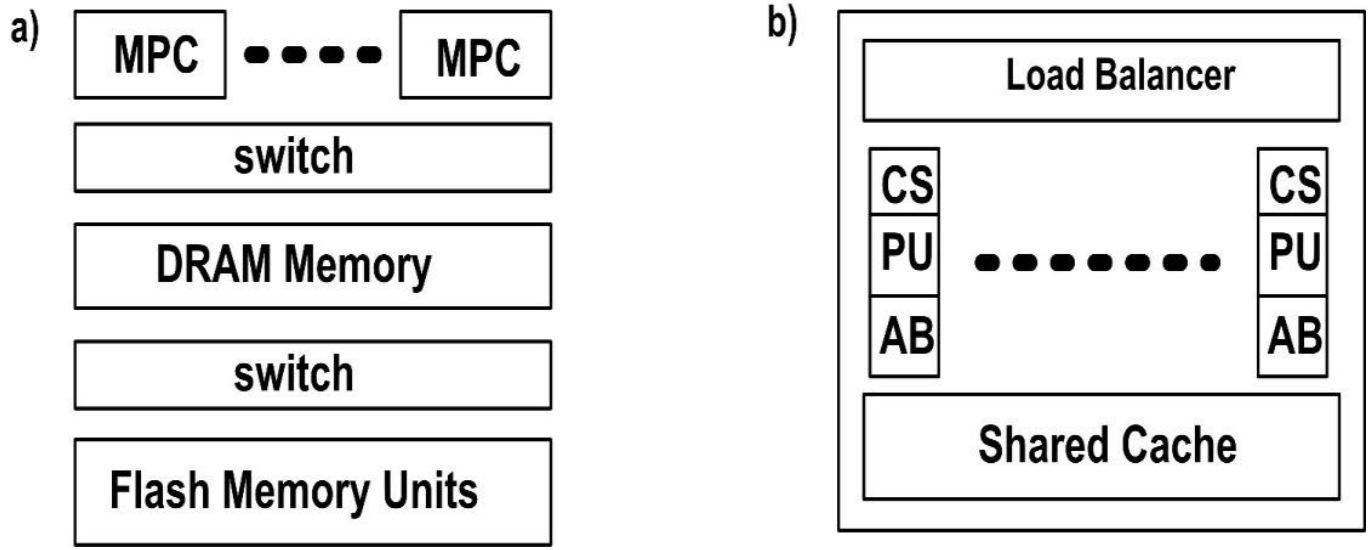
Dynamic Load Balancing



The load Balancer monitors the number of tasks queued at each processor and instructs each local scheduler to send a task from a processor with high load to a processor with low load.

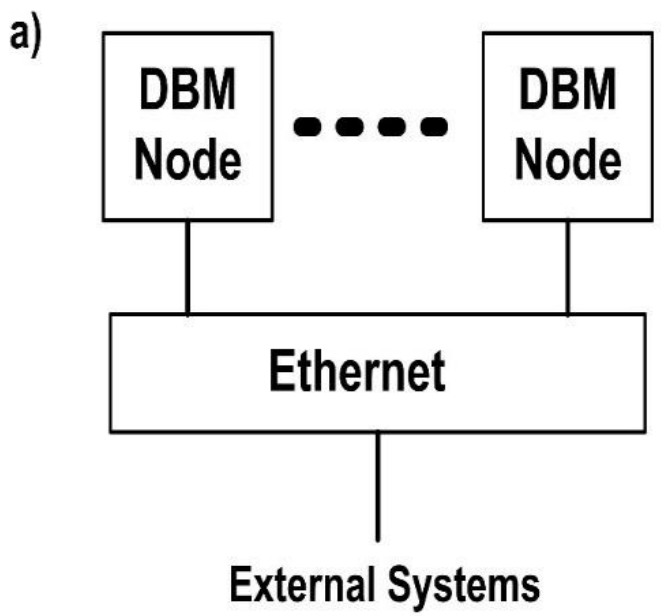
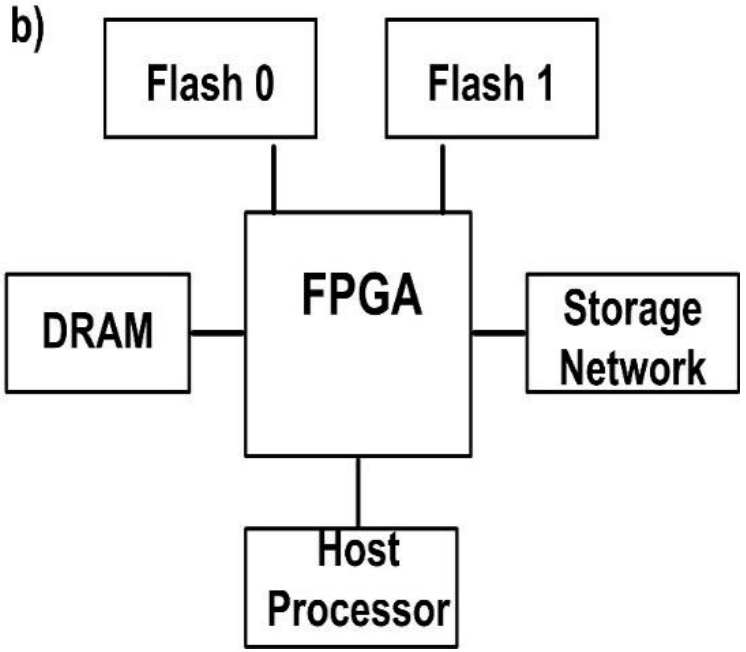
Fresh Breeze Compiler




a)
MPC
MPC
switch
DRAM Memory
switch
Flash Memory Units
b)
Load Balancer
CS
PU
AB
CS
PU
AB
Shared Cache

BlueDBM: A Data Base Machine

DBM Structure



One DBM Node