SV2 Programming Models and Compiler Performance

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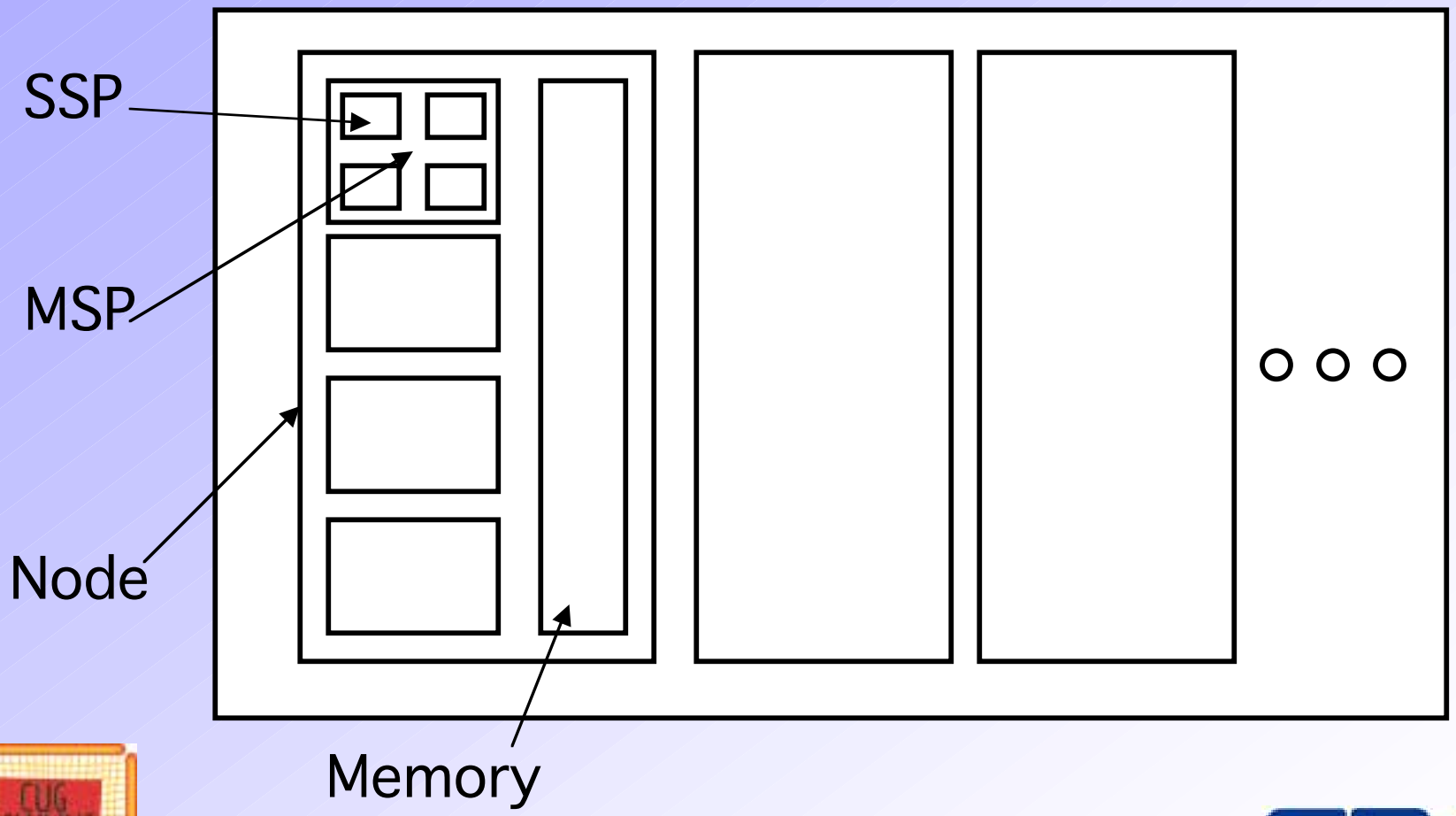
SV2 Architecture



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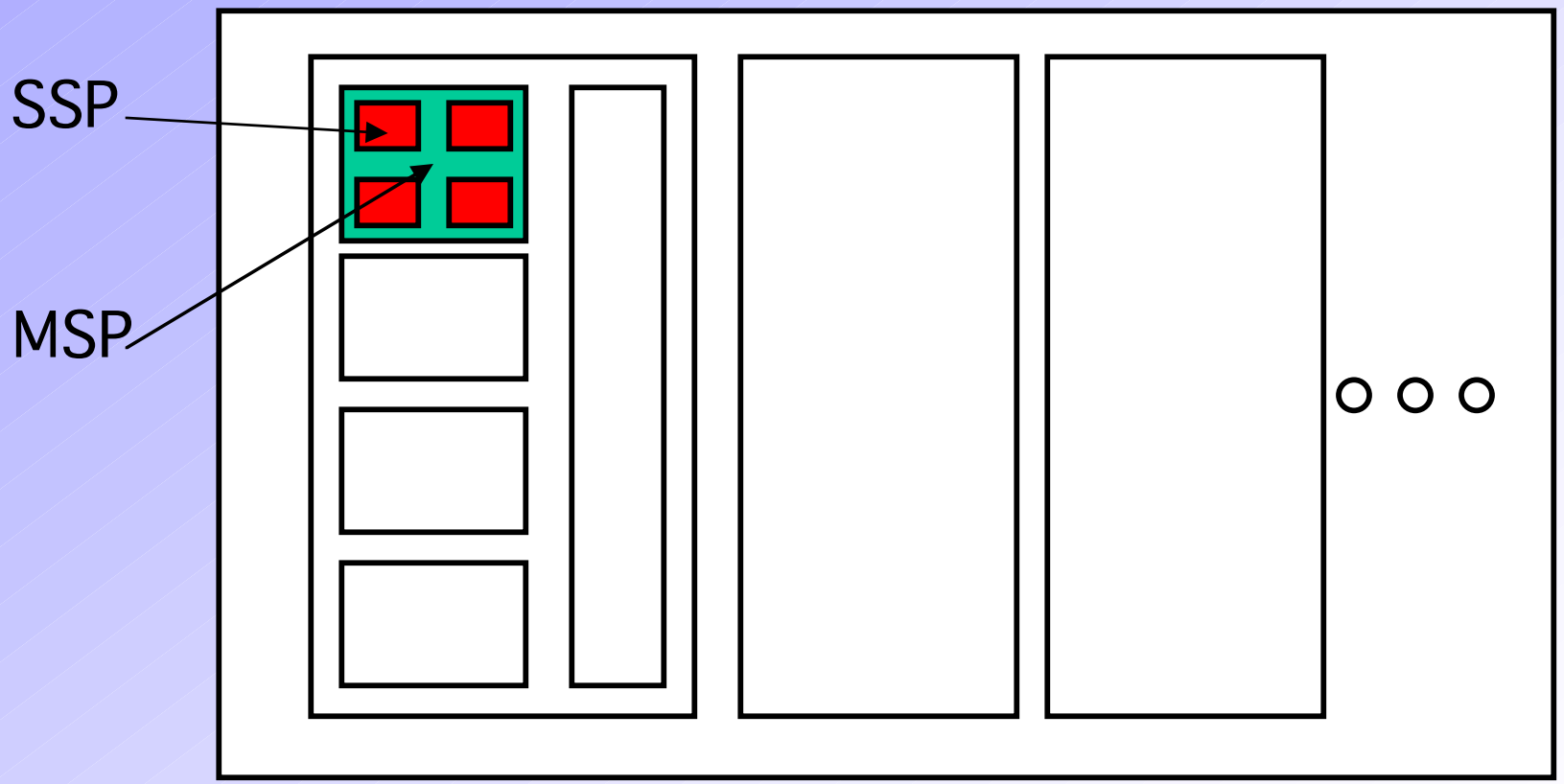
Multi-streaming Model



Multi-streaming Model

- Compiler-controlled
  - Primarily loop nest parallelization
  - No cross-iteration dependencies
  - No general user calls
  - Chooses loop to partition
  - Moves unpark to as outermost loop as possible
  - Restructures and vectorizes loop nest for SSP

Multi-streaming Model

- User-assisted
  - [NO]STREAM directives
  - PREFERSTREAM directive
  - CONCURRENT directive
    - Replace IVDEP (if safe)
    - SAFE_DISTANCE clause

Multi-streaming Model

- User-assisted
  - Infinite default safe vector length (VL) for IVDEP
    - Allows more efficient multi-streaming
    - Previous default was machine maximum
    - Can cause change in application behavior
    - Override with –O noinfinitevl, -h noinfinitevl
    - Explicit with !DIR$ IVDEP INFINITEVL

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Multi-streaming Model

- User-assisted
  - SSP_PRIVATE directive
    - Applied to subroutine/function names
    - Allows loops with calls to multi-stream
    - Declared by caller
    - Callee must be compiled –Omsp_ssp or –hmsp_ssp to create SSP version
    - Asserts no data overlap for life of calling loop

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Multi-streaming Model

- User-controlled
  - Cray Streaming Directives (CSD)
  - OpenMP-like directives, spellings
    - !CSD$ PARALLEL DO ...
  - Static loop scheduling only
  - Interim model, no guaranteed life beyond SV2

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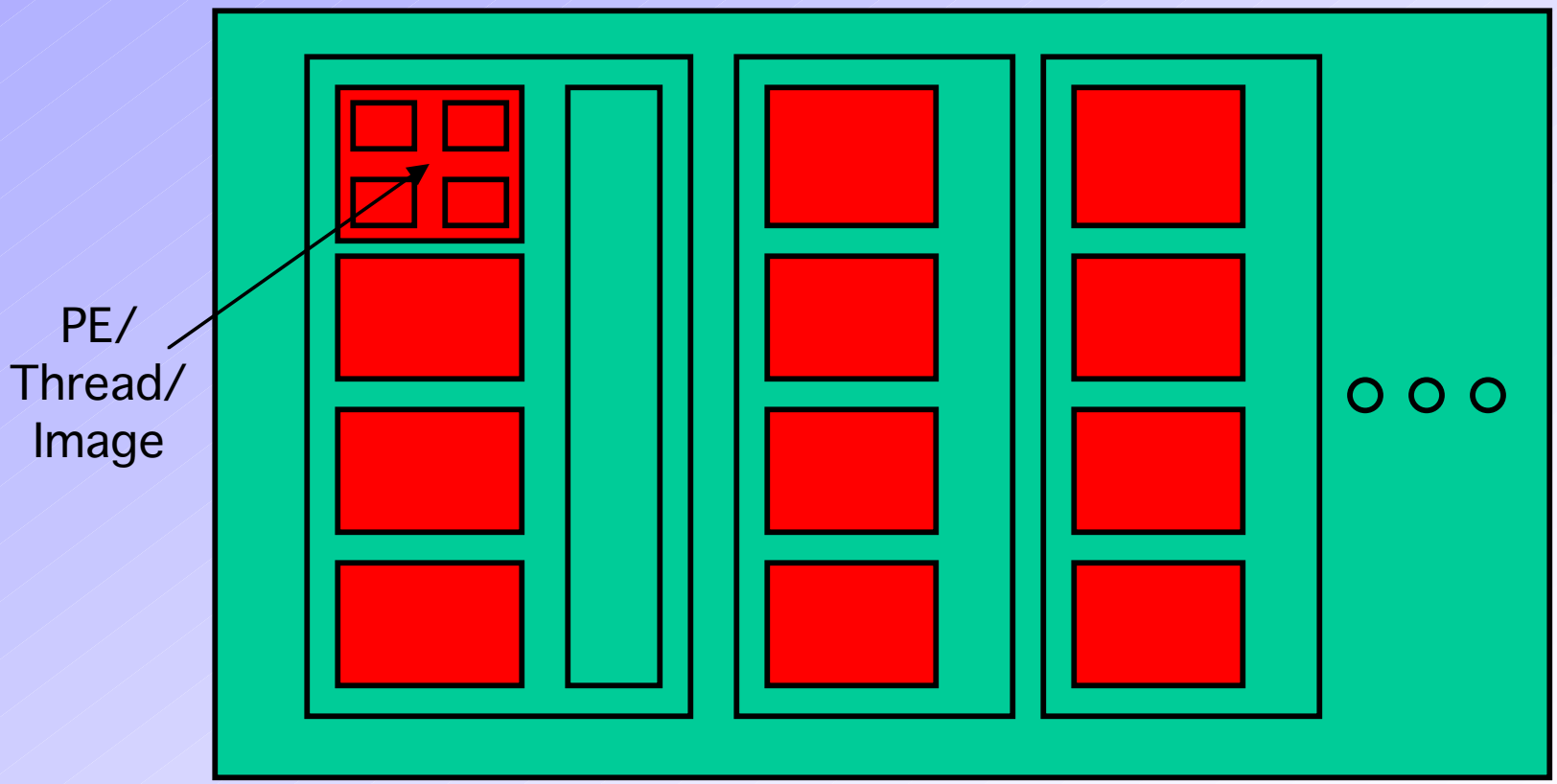
Distributed Memory Models



Distributed Memory Models

- Co-operate with Multi-streaming
- MPI
  - Two-way, library-based
  - Standard
- SHMEM
  - One-way, library-based
  - De facto standard

Distributed Memory Models

- Co-array Fortran and UPC
  - One-way communication models
  - Syntax-based
    - eliminates subroutine call overhead
    - Allows compiler to overlap communication, computation
  - De facto standards
  - Open source in development (DOE grant, www.pmodels.org)

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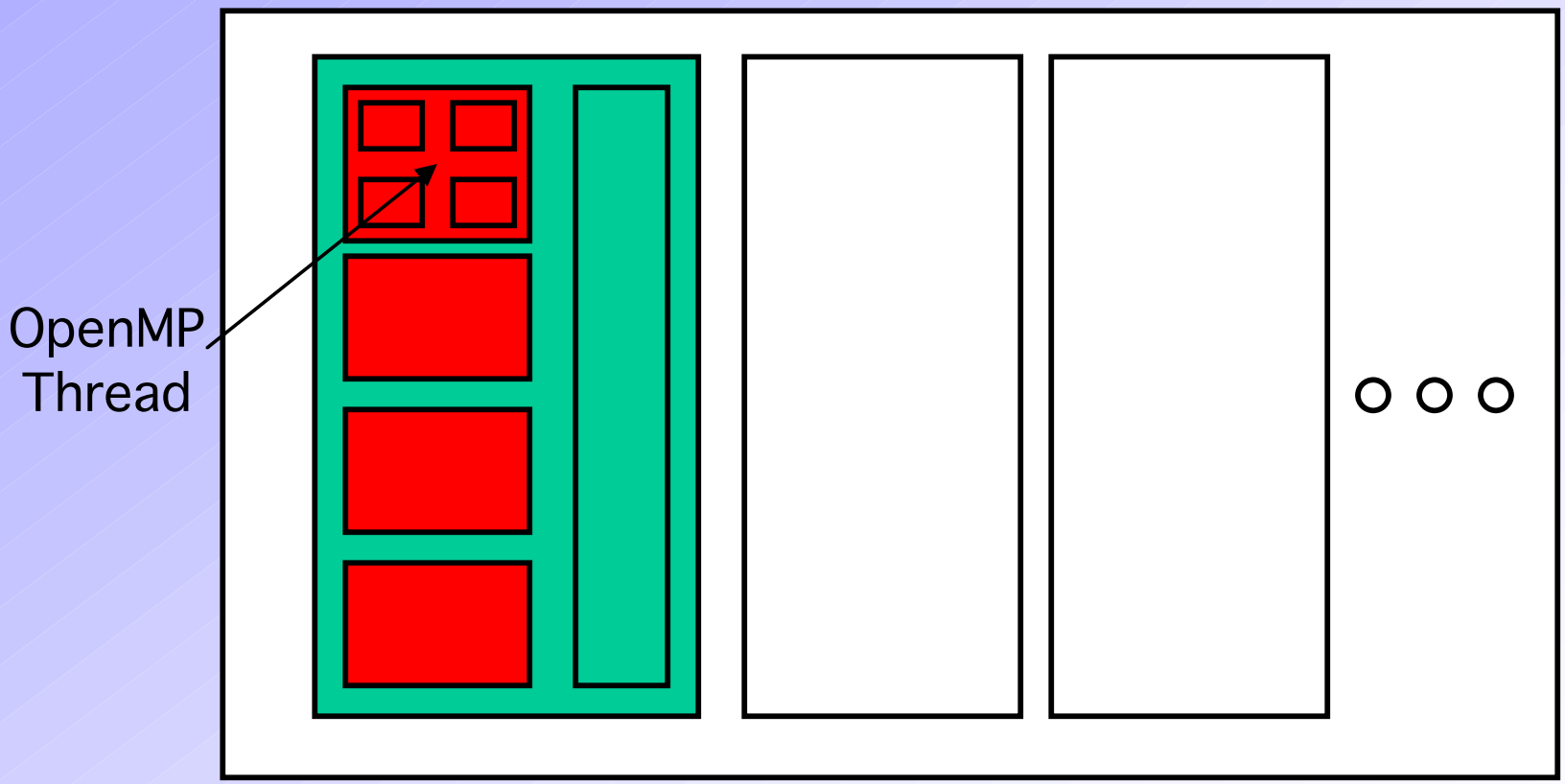
Shared Memory Model: OpenMP



Shared Memory Model: OpenMP

- Single node only
- Available post-FCS
- Co-operates with multi-streaming