TÉCNICO LISBOA

Computer Electronics

Lecture 23: Memory Organization

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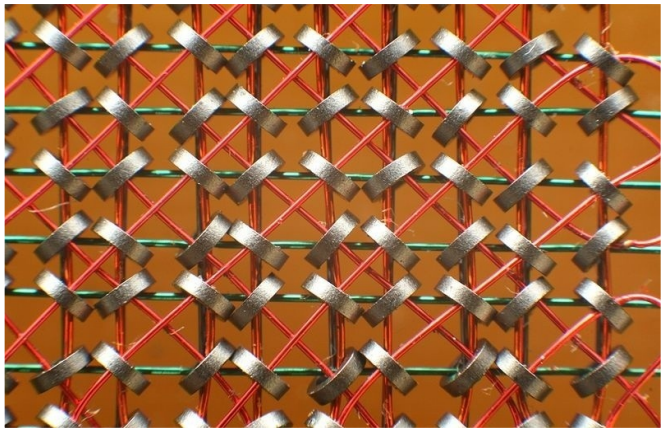
Outline

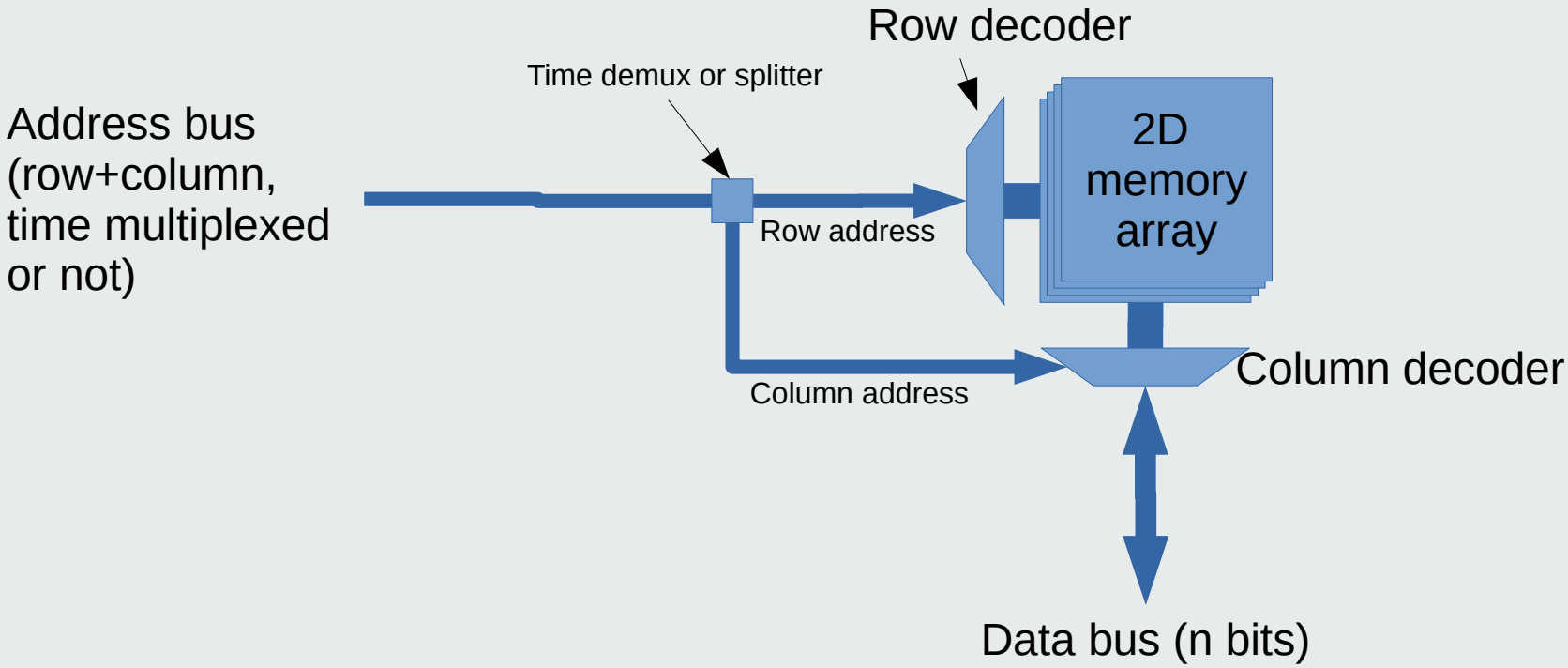
- Organization of memory cells
- Address and data busses
- Memory hierarchy
- DRAM devices revisited
- Bank interleaving
- SIMM and DIMM
- Combining memory chips for width and depth
- Rank, bank, row, column

Memory cell organization

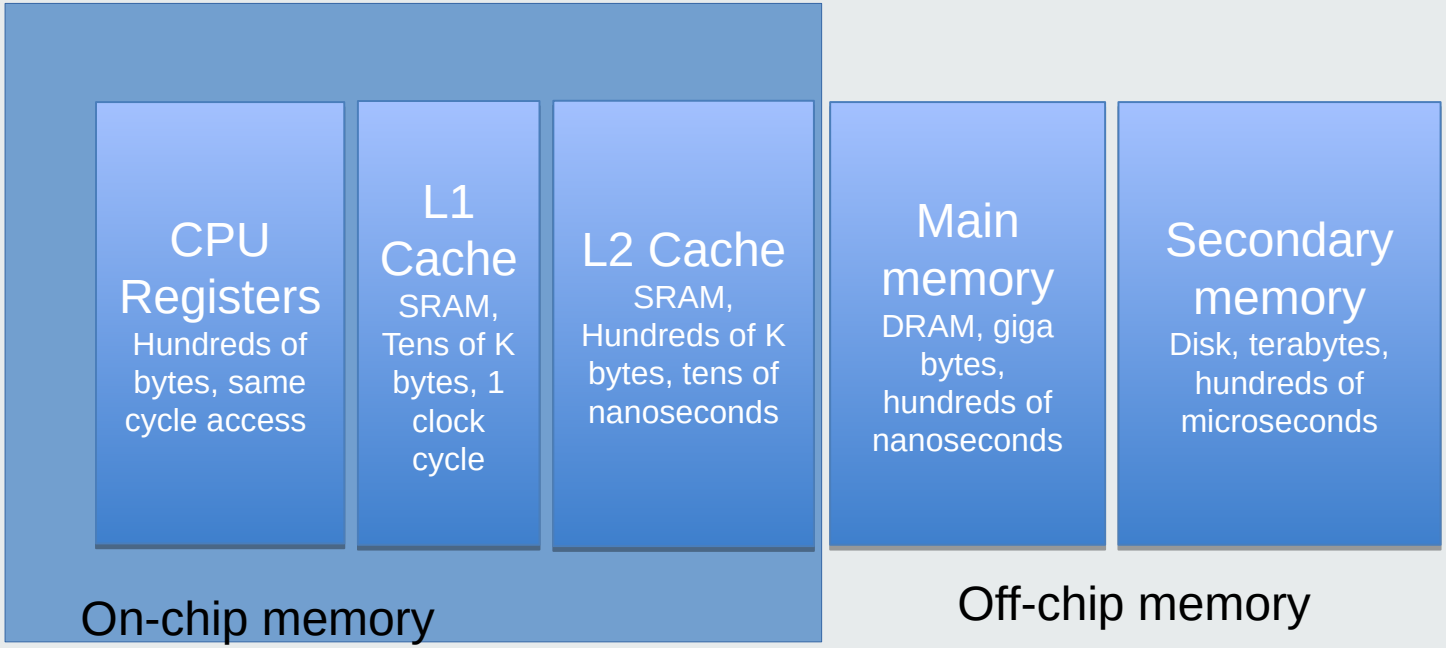
- Matrix organization since ferrite memories
- Optimal 2D organization
- Future
  - 3D organization (layer, row, column)
  - nD organization with quantum memories



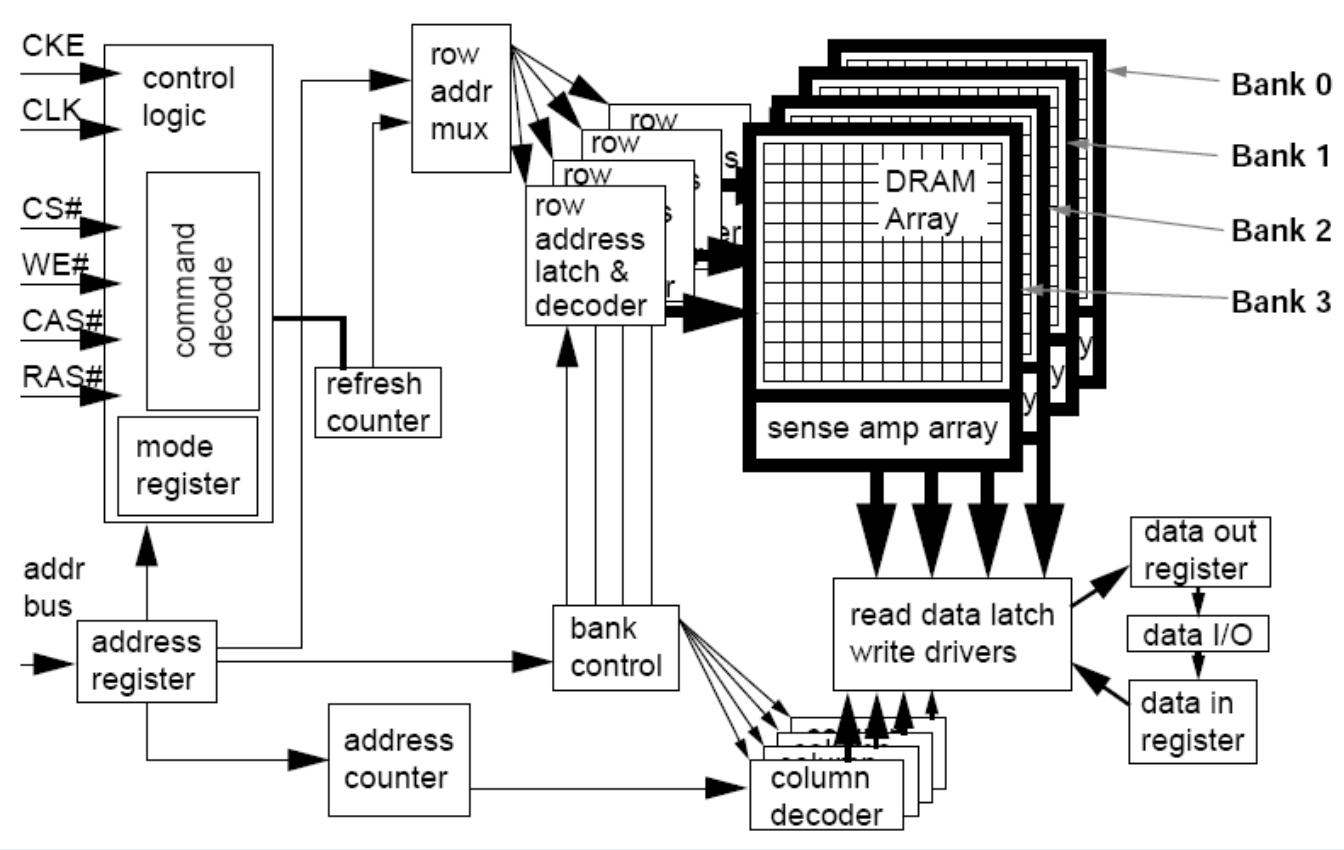
Address and data busses



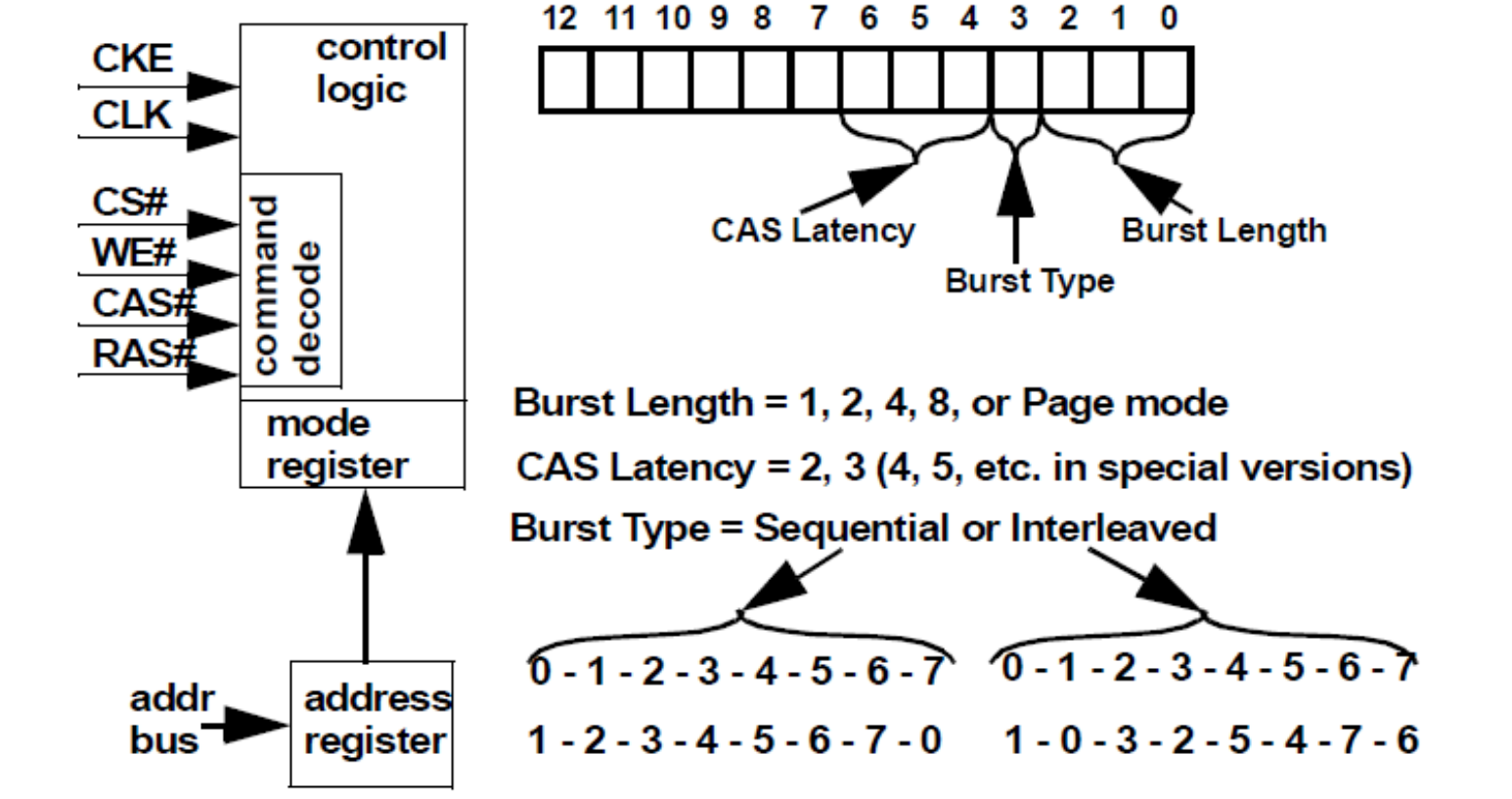
Memory hierarchy



SDRAM chip example architecture



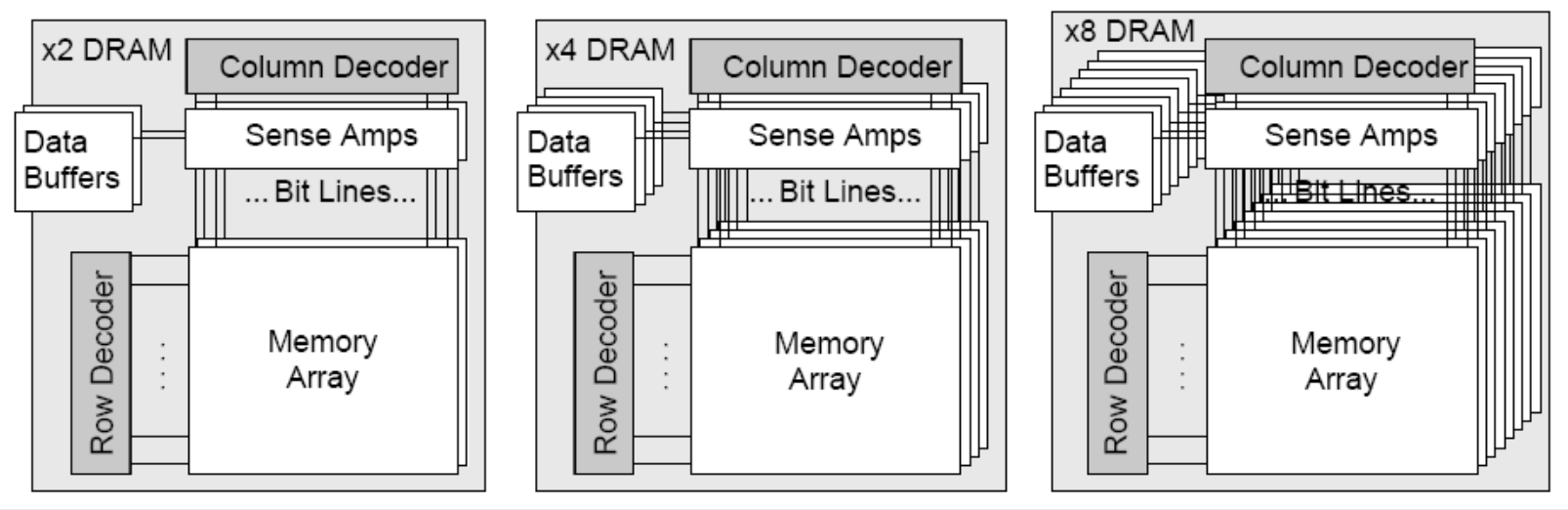
SDRAM chip control



Possible device configurations

Device configuration	64 Meg x 4	32 Meg x 8	16 Meg x 16
Number of banks	4	4	4
Number of rows	8192	8192	8192
Number of columns	2048	1024	512
Data bus width	4	8	16
Super cell size	1	2	4

DRAM: different data widths



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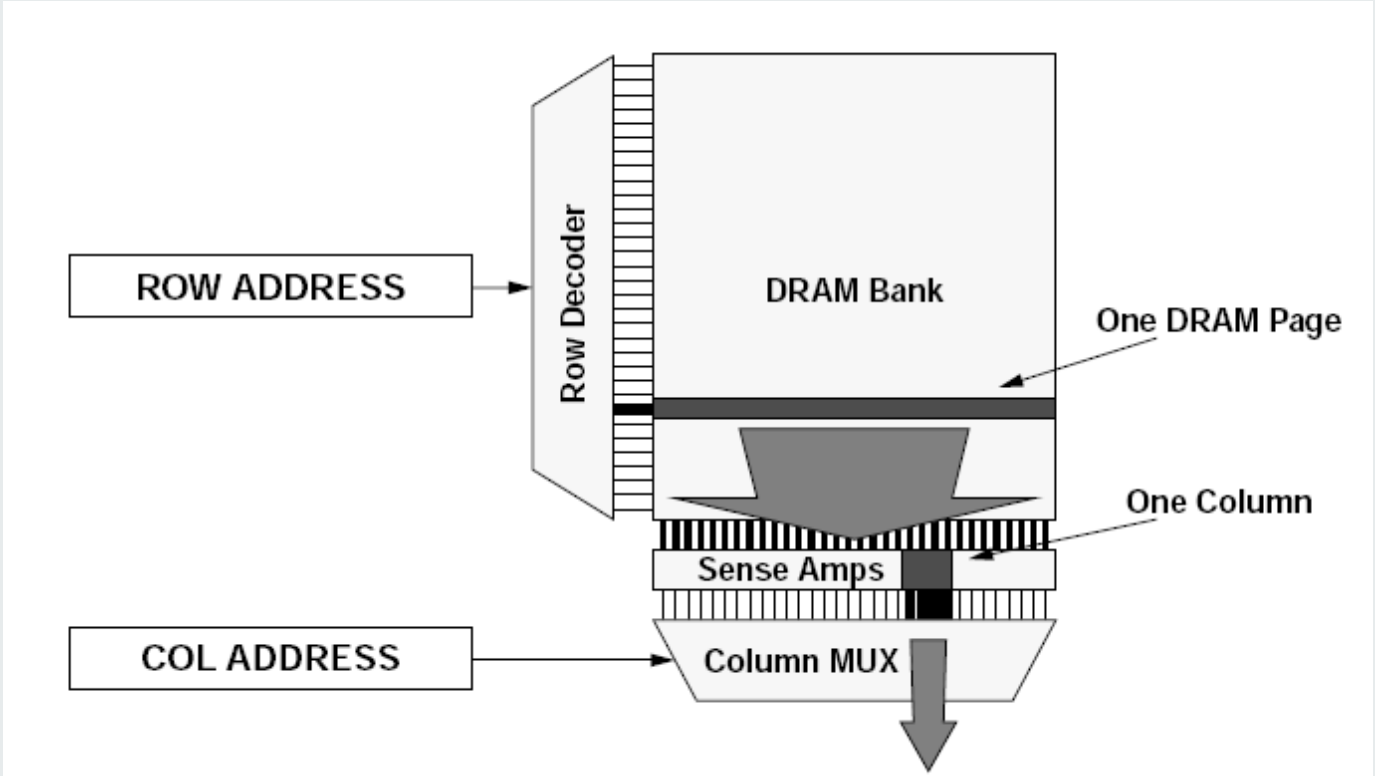
DRAM page

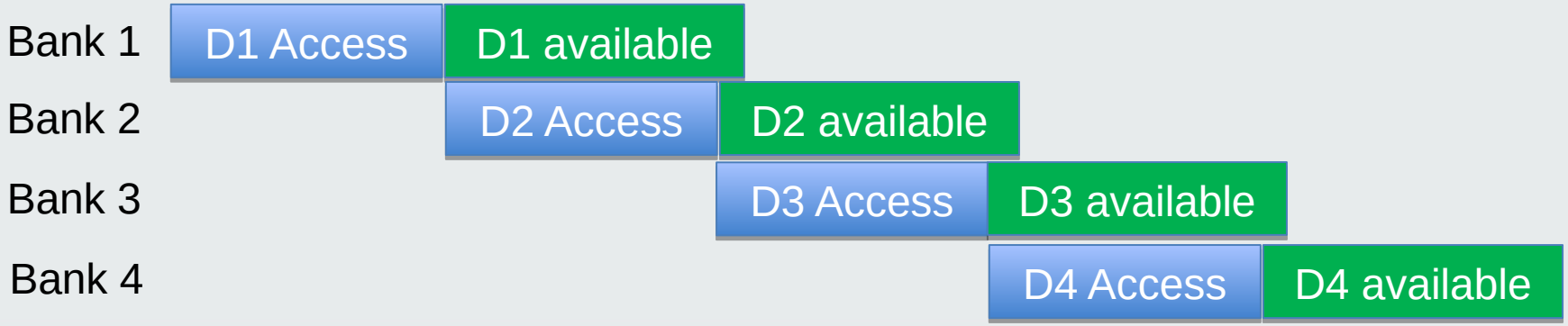


Bank interleaving

- Increase bandwidth by interleaving

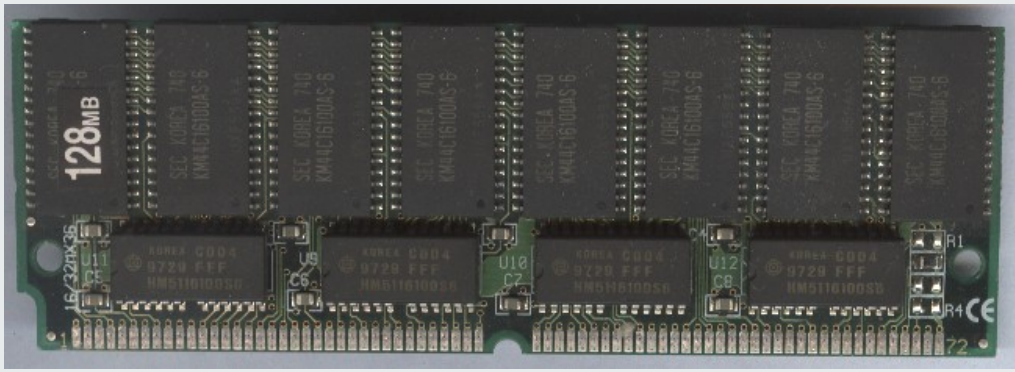
Without interleaving – slower

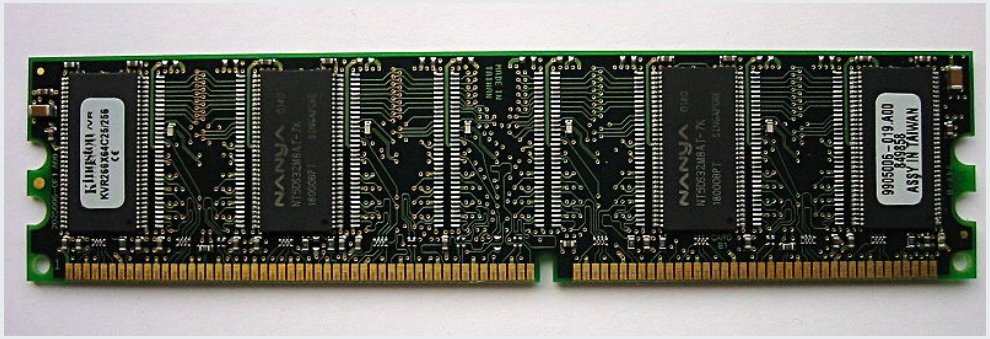
With interleaving – faster, pipelined



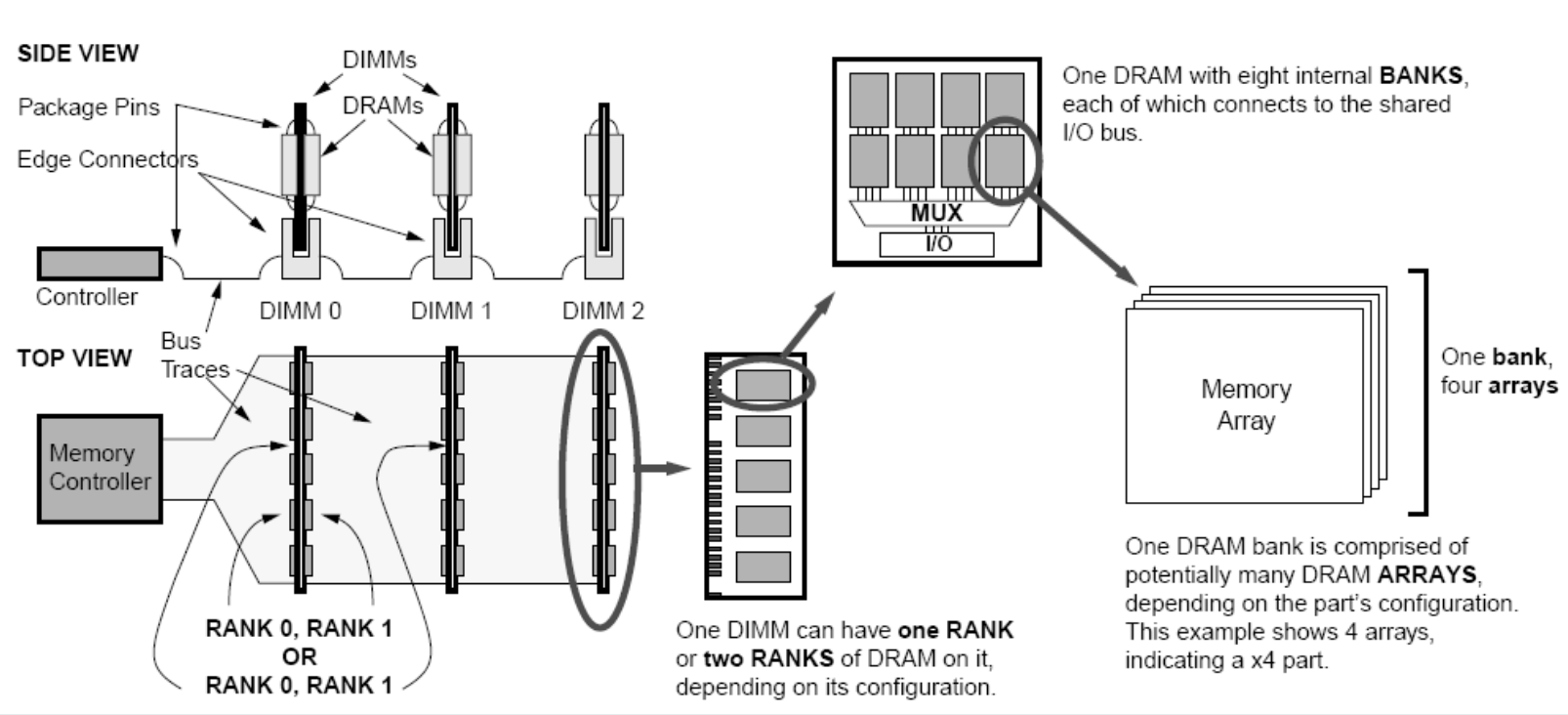
SIMM and DIMM

- Single Inline Memory Module
  - Same connectors on both sides
  - Obsolete
- Dual Inline Memory Module
  - Different connectors on either side

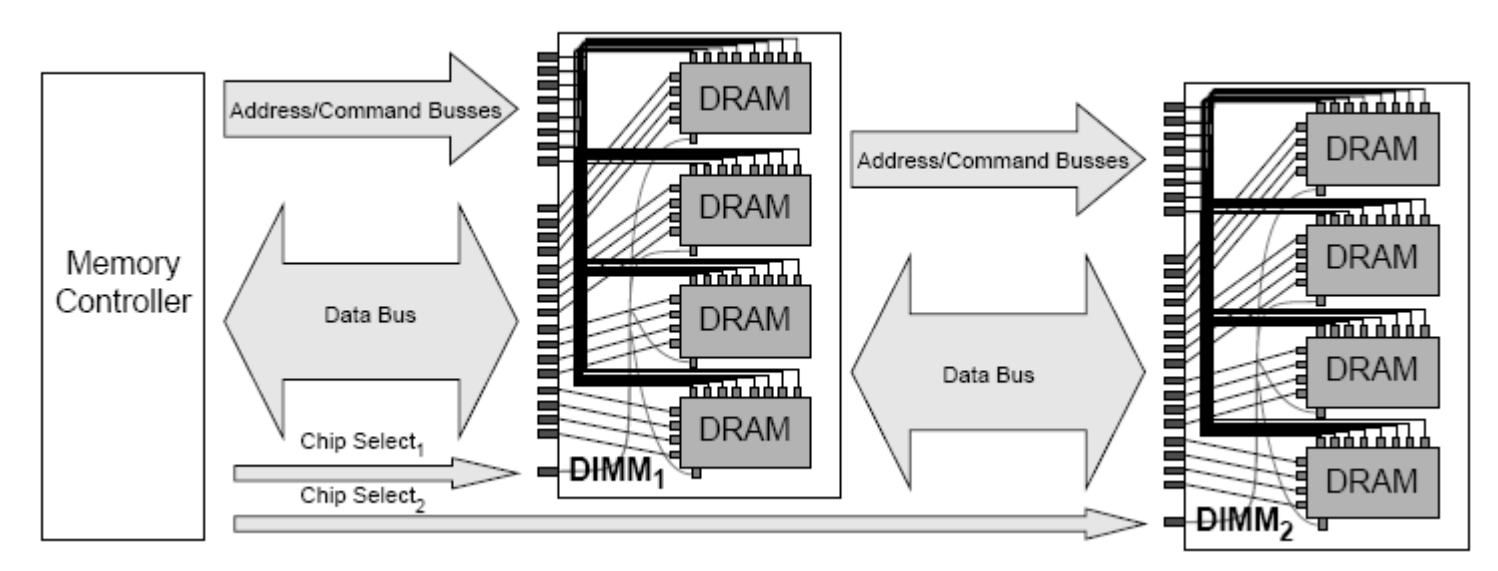




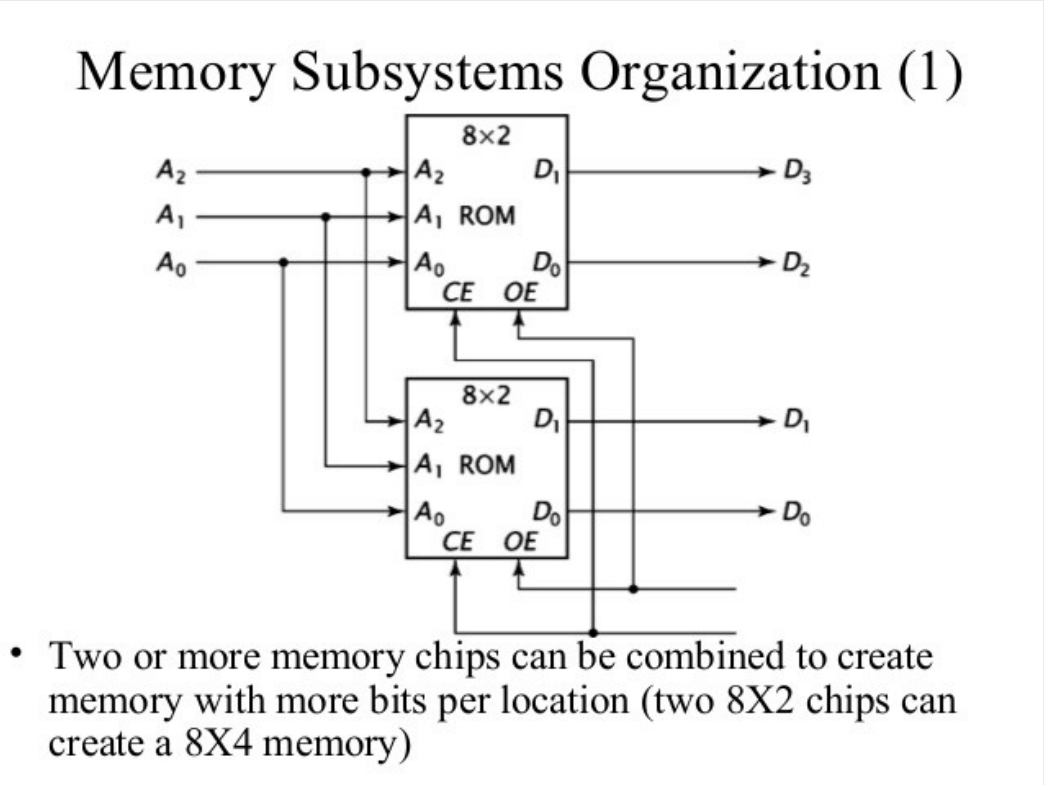
Dual Inline Memory Module (DIMM)



DIMM connections



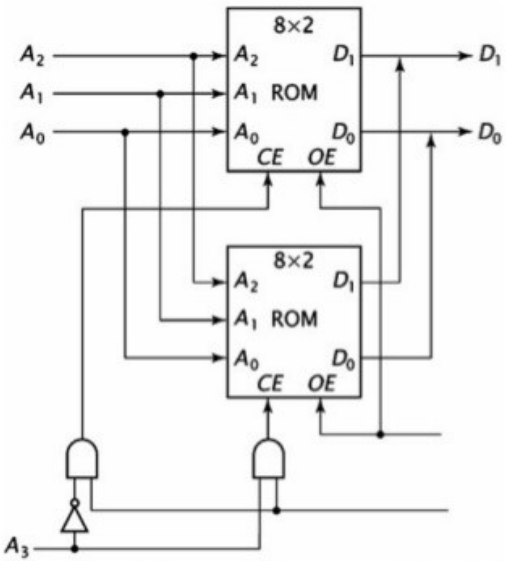
Combining memory chips to increase data width



- Two or more memory chips can be combined to create memory with more bits per location (two 8X2 chips can create a 8X4 memory)

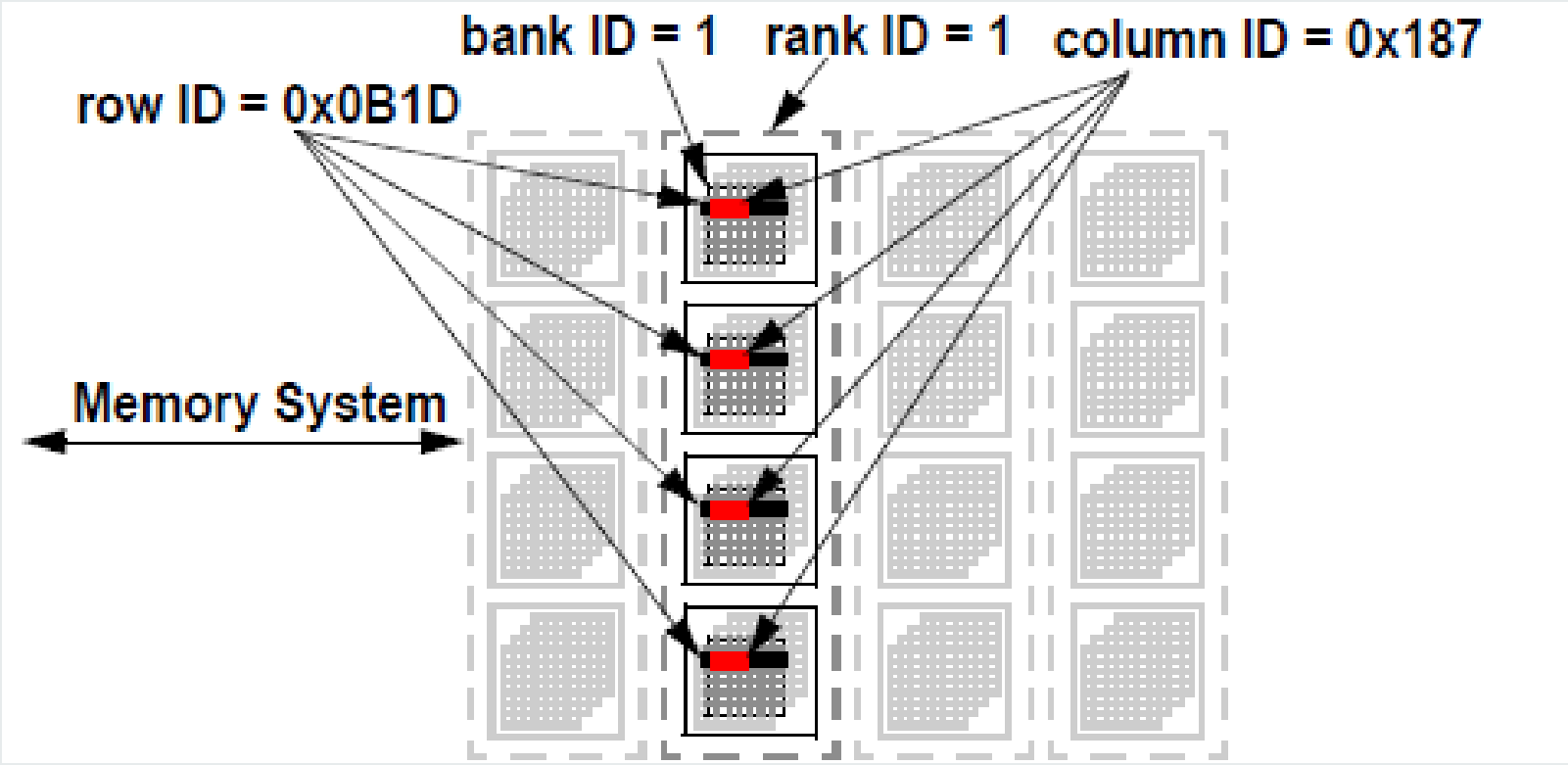
Combining memory chips to increase memory locations

Memory Subsystems Organization (2)



- Two or more memory chips can be combined to create more locations (two 8X2 chips can create 16X2 memory)

Rank, Bank, Column, Row



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128MB module example

Capacity	device density	number of ranks	devices per rank	device width	number of banks	number of rows	number of columns
128 MB	64 Mbit	1	16	x4	4	4096	1024
128 MB	64 Mbit	2	8	x8	4	4096	512
128 MB	128 Mbit	1	8	x8	4	4096	1024
128 MB	256 Mbit	1	4	x16	4	8192	512