App. Specific DRAMs

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Roadmap

- Introduction
- High-Speed DRAMs
- Fast DRAMs using Multi Banks
- Graphics DRAMs
- Pseudo-SRAMs

Introduction

- DRAM, **D**ynamic **R**andom **A**ccess **M**emory
- Historically been high volume, standard memory
- Many DRAM applications differing in requirements
- Many types of DRAMs

High-Speed DRAMs

- DRAMs were asynchronous with processor ....
  - Sometimes processor access while refreshing
  - Processor has to wait for interrupt req. from memory

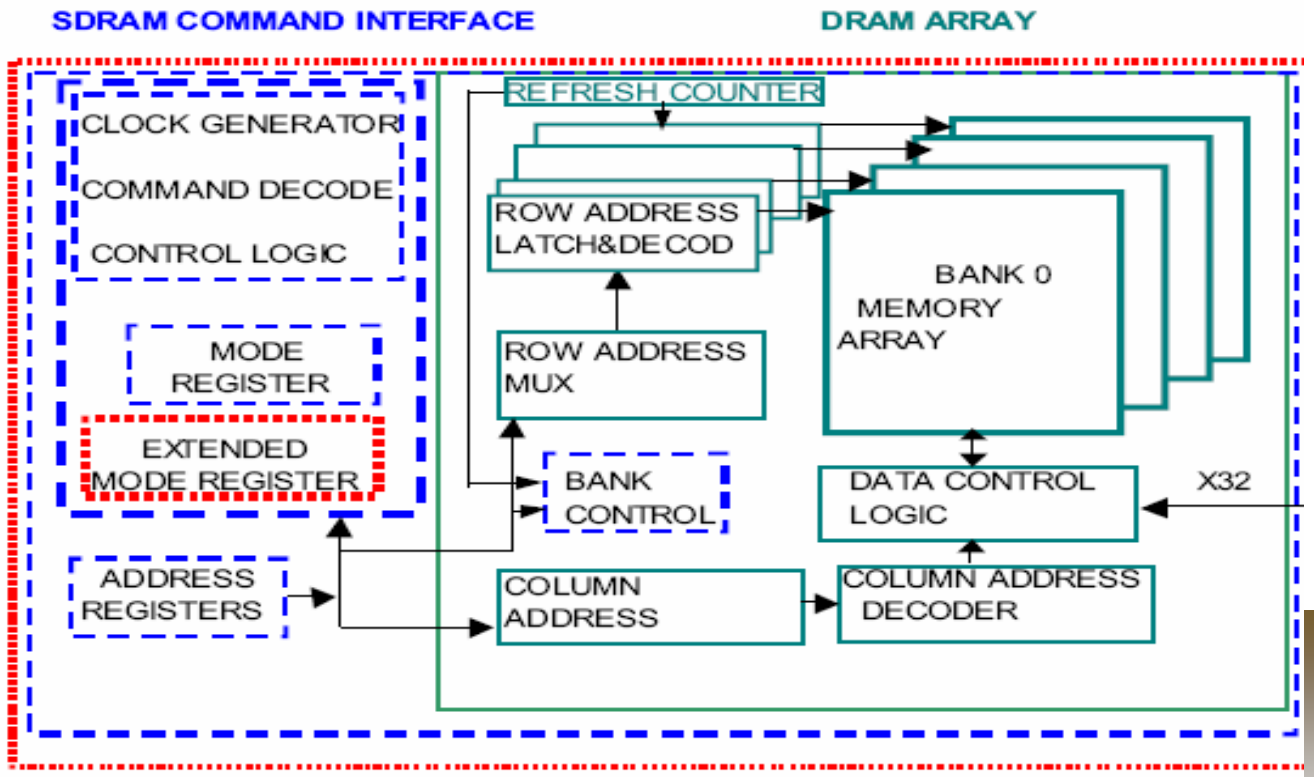
TOTAL WASTE OF TIME !!!

- Examples: FPM DRAM

High-Speed DRAMs Cont.

- A synchronous interface was added to DRAM
  - DRAM is under system clock control
  - Permits adding control features behind it
- Made a huge improvement in speed
- Examples: SDRAM (speed = 133 MHz, Operating voltage = 3.3 V)

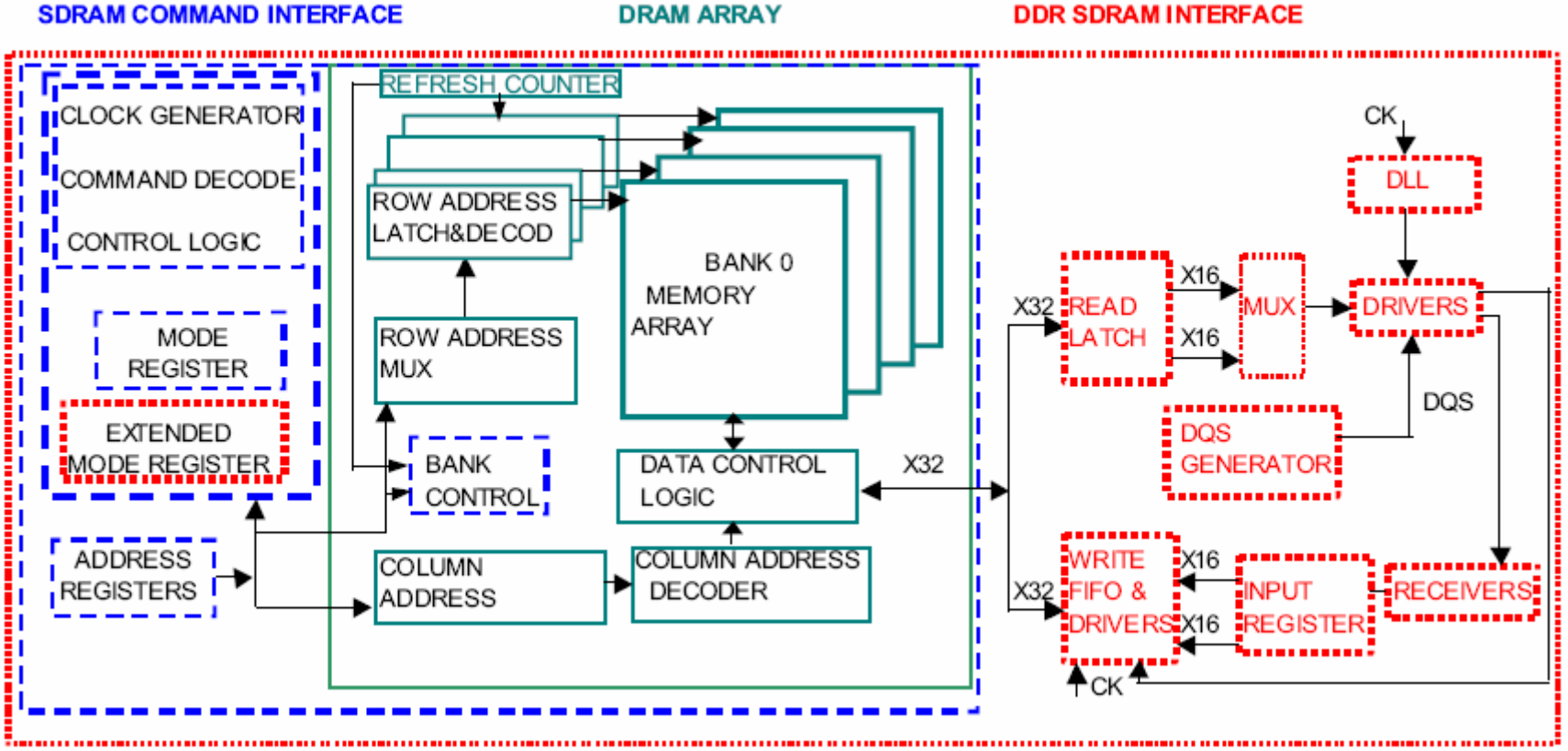
High-Speed DRAMs Cont.



High-Speed DRAMs Cont.

- A DDR interface was added to DRAM
  - Allowing of fetching two words per one cycle
- Data rate = 2*Clock frequency
- Examples: DDR SDRAM, DDRII SDRAM

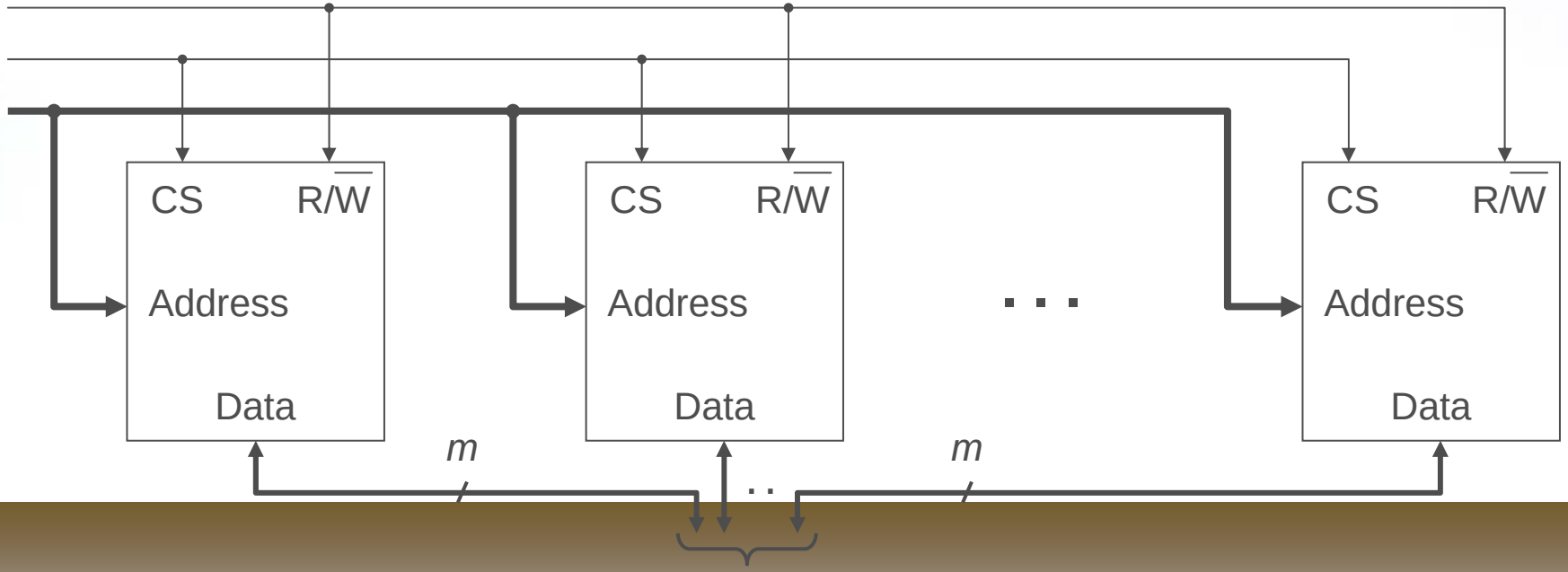
High-Speed DRAMs Cont.



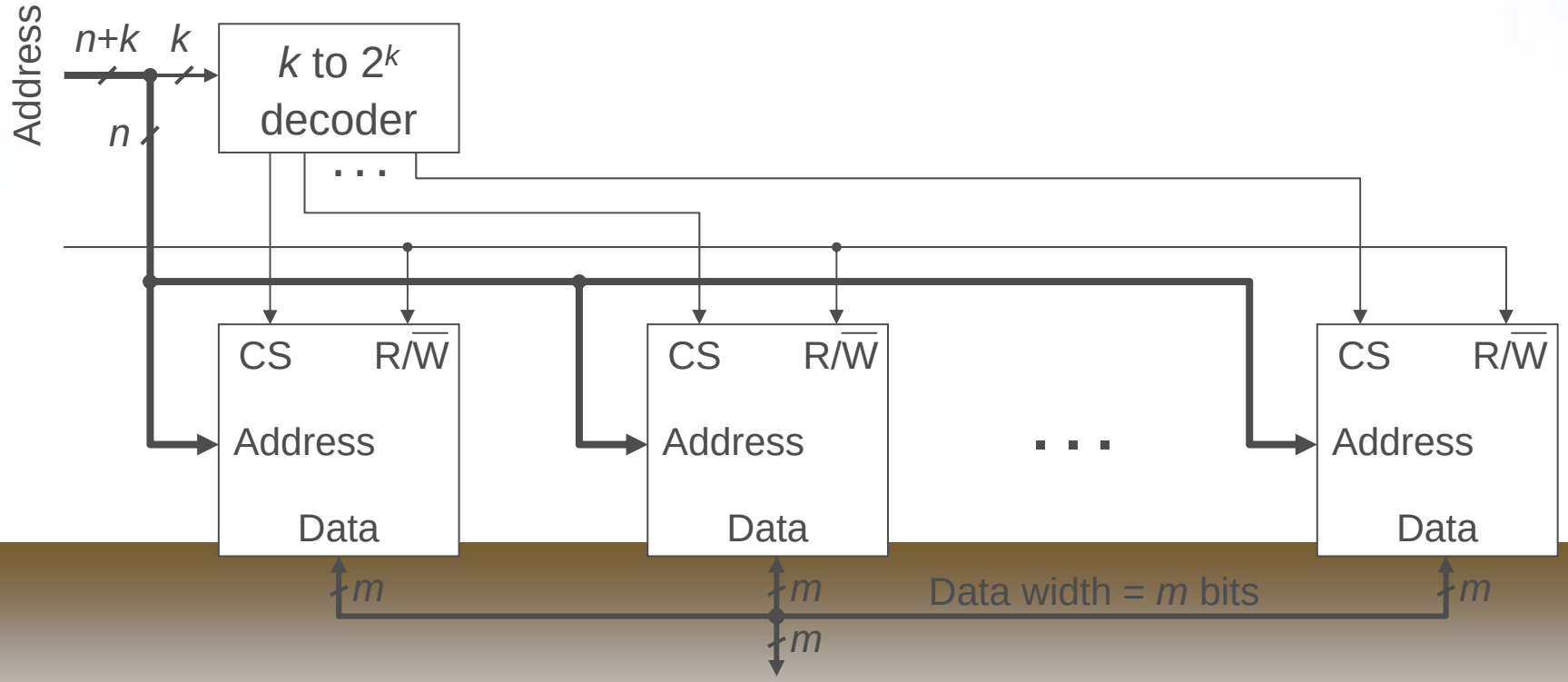
Fast DRAMs using Multi-Banks

- Reduces the capacitance of word lines
- Two Designs; Different characteristics
- Goal: Reduction of Read Latency

Fast DRAMs using Multi-Banks Cont.



Fast DRAMs using Multi-Banks Cont.



Graphics DRAM (VRAM)

- Requirements:
  - Lower memory system density
  - Higher speed than main memory applications
  - Wide I/O bus to match system bus
- Need for few DRAMs → DRAMs can be closer
- Uses point-to-point interface to increase I/O speed

Pseudo-SRAM (PSRAM)

- DRAM inside – SRAM outside (SRAM Interface)
- DRAMs with SRAM interfaces first appeared in 1980s
- High density and power requirements, motivation to make newer SRAM interface DRAMs, beginning of PSRAMs.

Summery

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Thank You...