A Case for Subarray-Level Parallelism (SALP) in DRAM

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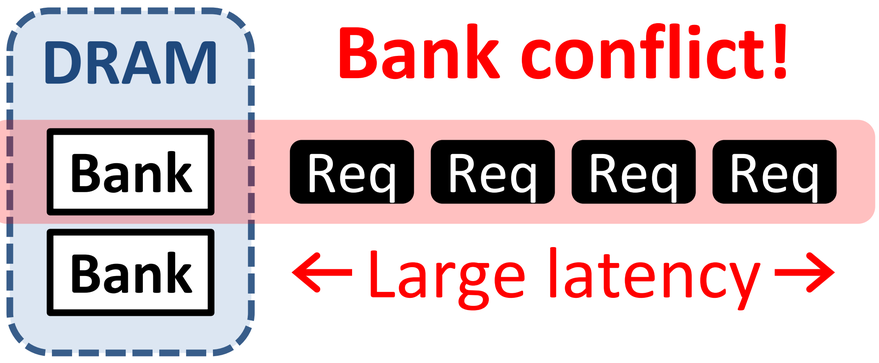
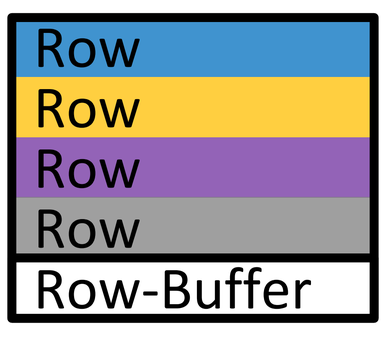
1. DRAM Bank Conflicts



2. Timeline of DRAM Bank Conflicts

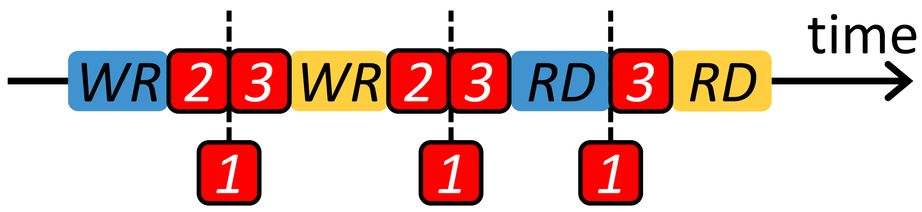


Four requests to **same** DRAM bank

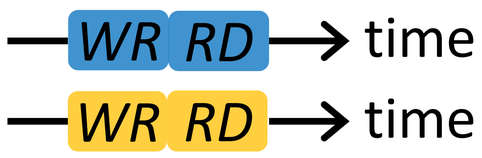
WR *WR* *RD* *RD*

Last accessed row is "cached"

Large latency due to 3 problems:



1. Serialization of requests
2. Write penalty after *WR* request
3. "Thrashing" of row-buffer



Short latency when four reqs are to **diff.** banks

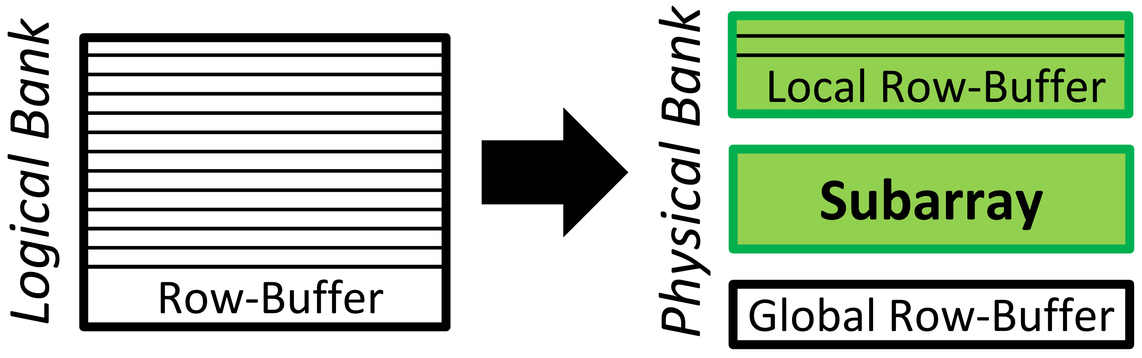
3. Our Goal

- Goal: Cost-effectively mitigate the detrimental effects of bank conflicts
- Naïve Solution: Simply add more banks
  - Very expensive

4. Two Key Observations

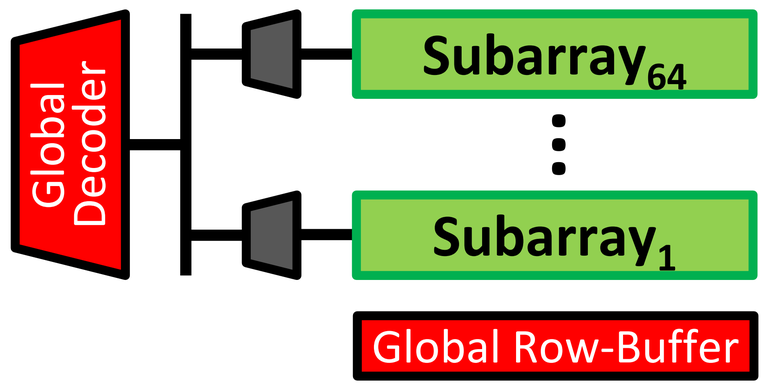
1. A DRAM bank is divided into subarrays

*- Each subarray has a **local row-buffer***



2. Subarrays are mostly independent…

*- Except when sharing **global structures***



5. Key Idea

Reduce the sharing of…

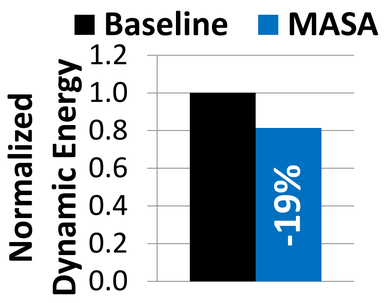
1. Global decoder: enable parallel access to multiple subarrays
2. Global row-buffer: utilize multiple local row-buffers concurrently

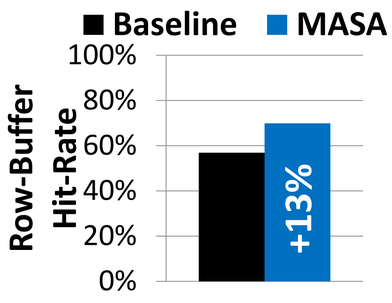
6. Mechanism: MASA

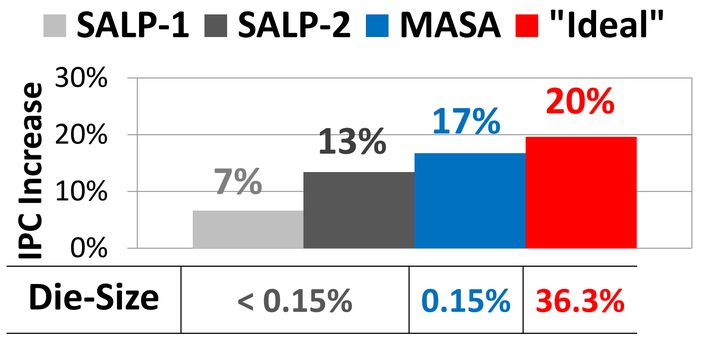
Multitude of Activated Subarrays

Add two latches to each subarray

1. Subarray Address Latch
   - Stores per-subarray row-address
2. Designated-Bit Latch
   - Connects one subarray's local row-buffer to global row-buffer







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