Citadel: Efficiently Protecting Stacked Memory From Large Granularity Failures

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Susceptible to new failure modes: TSV faults

Causes large granularity failures (e.g. Faulty Bank)

Striping data across banks ➔ high overheads

3D DRAM: Overcomes memory bandwidth wall

Courtesy MICRON, ExtremeTech
Susceptible to new failure modes: TSV faults
Causes large granularity failures (e.g. Faulty Bank)
Striping data across banks → high overheads

Goal: Tolerate TSV faults & Large faults at low cost
Citadel protects against TSV and Large Faults, while retaining line in the same bank.
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• Citadel employs a three-pronged approach
CITADEL FOR 3D DRAM

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1. Dynamic TSV SWAP

Diagram:
- DRAM Dies
- ECC Die
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1 Dynamic TSV SWAP

2 Tri Dimensional Parity

DRAM Dies

ECC Die
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1. Dynamic TSV SWAP
2. Tri Dimensional Parity
3. Dual Granularity Sparing
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Citadel has negligible overheads and still provides 700x higher resilience than the best ECC schemes