

DDR5: High Momentum Standards for the Next Generation of DRAM

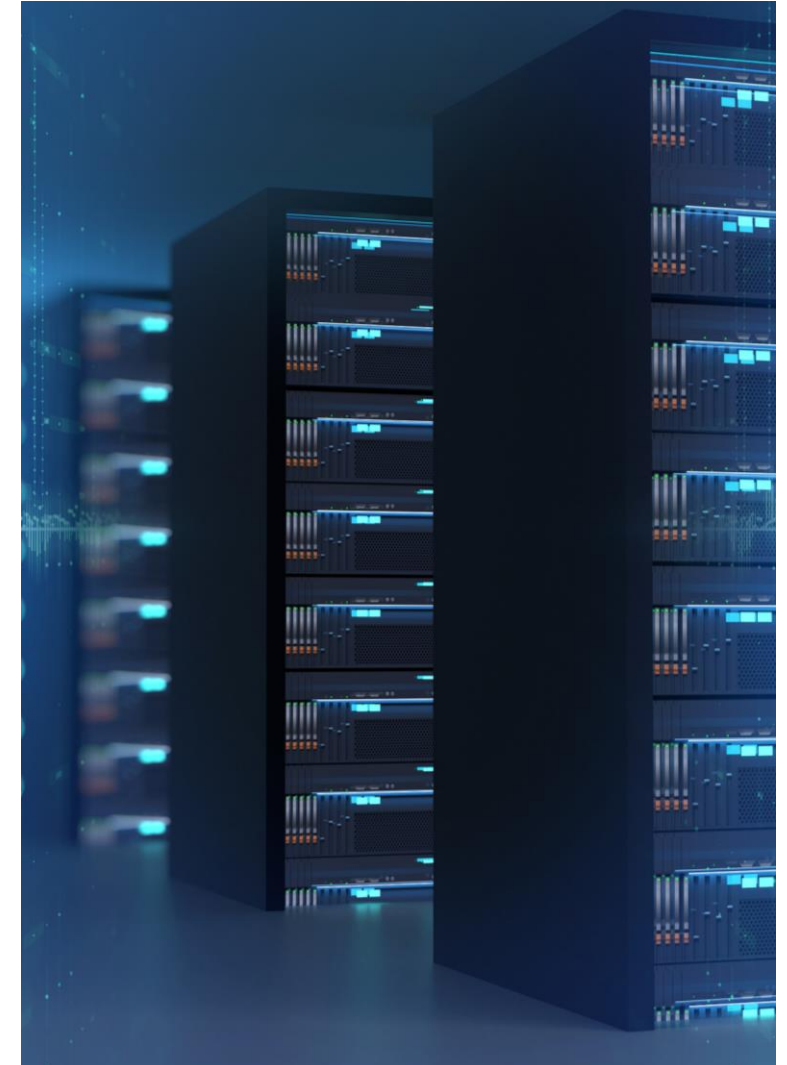
Presenter:

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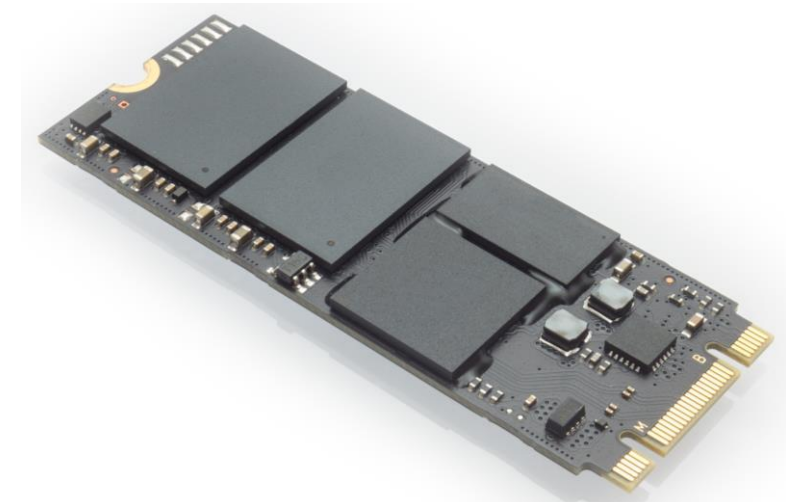
DRAM Needs for Storage Devices

- In the drive: DRAM provides buffer and cache for Flash devices to cover Flash latency
- In the server: DRAM provides operating RAM for compute and fast, deep coherent cache
- All storage devices need RAM that is:
 - Fast
 - Power Efficient
 - High Capacity
 - High Reliability
 - Long-term availability
 - Low cost



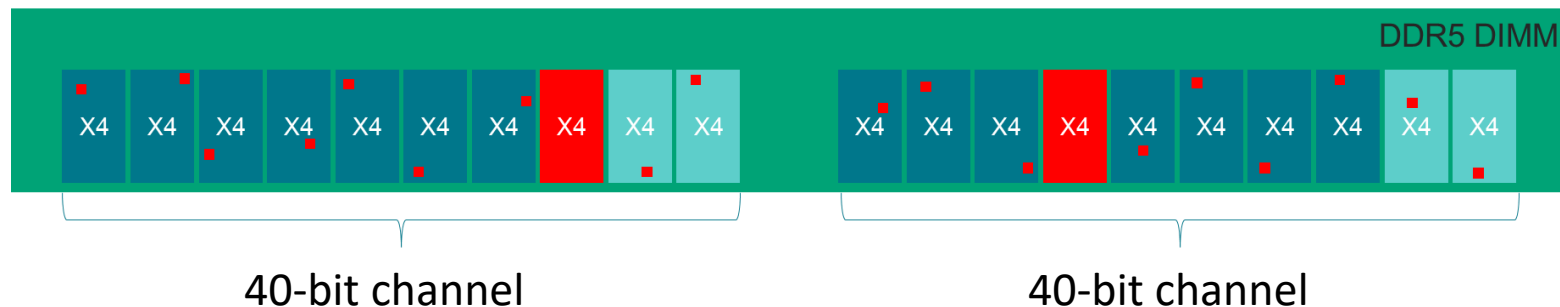
DDR5: The High-capacity, Reliable DRAM

- Speed: 6400Mbps data rate per pin provides 51.2 GByte/sec bandwidth per DIMM
- Power Efficiency: DDR5 consumes ~20% less energy per bit (pj/bit) of previous technologies
- High Capacity: Up to 256GByte per DIMM in the market today
- High Reliability: The most RAS features of any JEDEC DRAM standard
- Long-Term Availability and Cost: Very high volume manufacturing for several years with many design-ins including mainstream server



DDR5: Reliability Spotlight

- 80-bit DIMM supports “Single Device Data Correct” (SDDC)
 - System can continue to operate with completely failed DRAM device on the DIMM
- On-Die Error Correcting Codes (ECC)
 - Bounded Fault and Error Check and Scrub (ECS)
 - Corrects single-bit errors inside DRAM
 - Works with other ECC schemes for efficiency
- Memory Self-Test (mBIST) and Post-Package Repair (PPR)
- Optional CRC on Data
- Adaptive Refresh Management (ARFM)



Example DDR5 DIMM error correction
With SDDC and on-die ECC
Red indicates simultaneously correctable
bits or device within a burst

Future Directions for DDR5

- Speed Roadmap:
 - New DDR5 speed bins with placeholders up to 8400Mbps in JESD79-5A
- Capacity Roadmap:
 - Potential for 512GByte+ per DIMM
- Future DIMM Topologies:
 - Potential to increase both speed and maximum Capacity
 - Could further extend DDR5 lifetime
 - Watch George Vergis's presentation at 9:15!



Summary and Conclusion

- DDR5 is a high capacity, reliable DRAM choice
 - Also consider: LPDDR5x, GDDR6 or HBM3 for different tradeoffs of bandwidth, capacity, power, and RAS
- Widely used technology with multi-vendor DDR5 availability
- Active future roadmap for DDR5 supports long-term availability
- A robust ecosystem of DDR5 enabling technologies exists – Memory Controllers, PHYs, Verification tools, Signal Integrity Tools, Emulators, Scopes and Logic Analyzers, DIMMs and more

