# Introduction to MRDIMM Memory Technology
## Article

Memory bandwidth is one of the biggest challenges facing modern servers. CPU speeds and core count keep increasing, and that requires more data to be fed to those CPUs at a higher rate. Memory improvements have not kept pace with these increases in CPU speed.

Server designers using the next generation of CPUs are implementing Multiplexed Rank DIMMs (MRDIMMs) to help solve current memory bandwidth constraints. Let's take a look at this new technology.

### What are MRDIMMs?

DIMMs are organized into ranks, with a DDR5 rank loosely defined as two sets of memory chips which are accessed simultaneously as 32-bit wide data structures in a sub-channel to achieve a 64-bit wide data structure. Each rank consists of multiple in-chip banks which can be accessed sequentially at high speed. This allows a processor like the Intel Xeon or AMD EPYC to quickly retrieve 64 bytes of data from a DIMM that is 64 data bits wide.

By allowing the operation of two ranks simultaneously, MRDIMMs can feed 128 bytes of memory data to the CPU, twice as many as with regular DDR5 DIMMs.

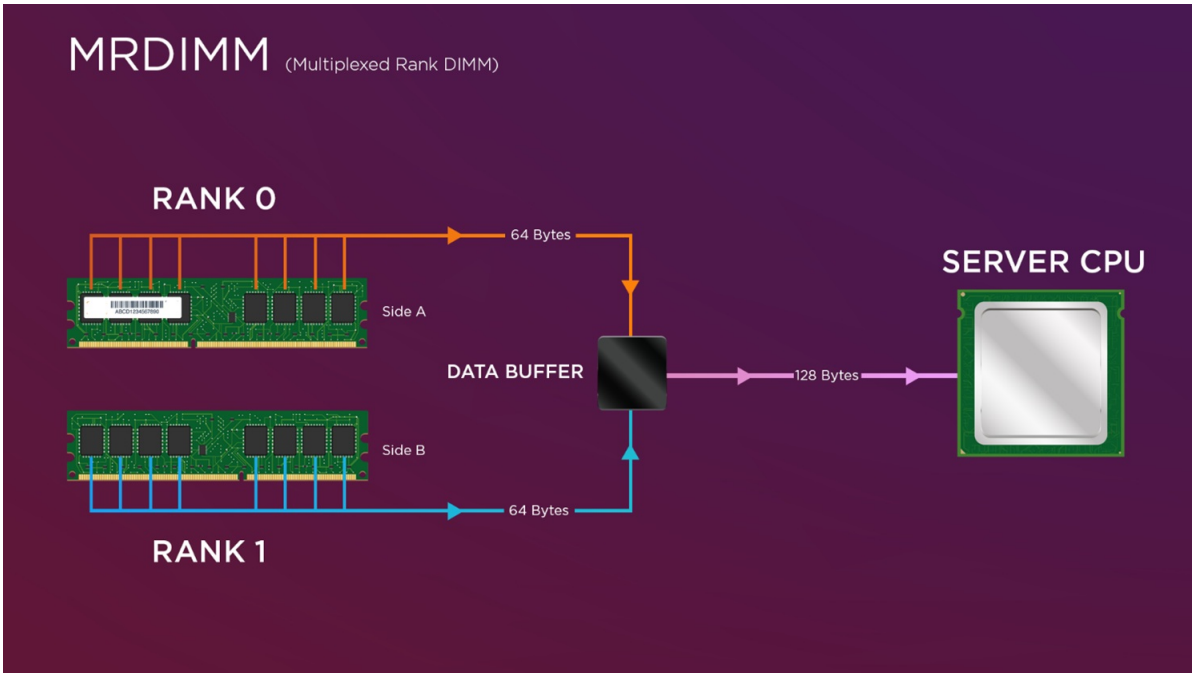


Figure 1. MRDIMM operation

This increases DRAM speed from the 4,800 MT/s* of common current DDR5 implementations to 8,800 MT/s. Of course, this number will increase, just as DDR5 numbers will increase, and should remain close to double the DDR5 speed. JEDEC expects Gen1 MRDIMMs to deliver 8,800 MT/s, Gen2 to deliver 12,800 MT/s, and Gen3, only likely to be released in the next decade, to deliver 17,600 MT/s.

In addition, tall form-factor, or TFF, MRDIMMs keep the same pinouts and width as standard MRDIMMs, but are taller to accommodate more memory chips. Memory capacity can be increased without requiring extra memory slots. Note that the TFF MRDIMMs can only fit in servers with a 2U or greater form factor.

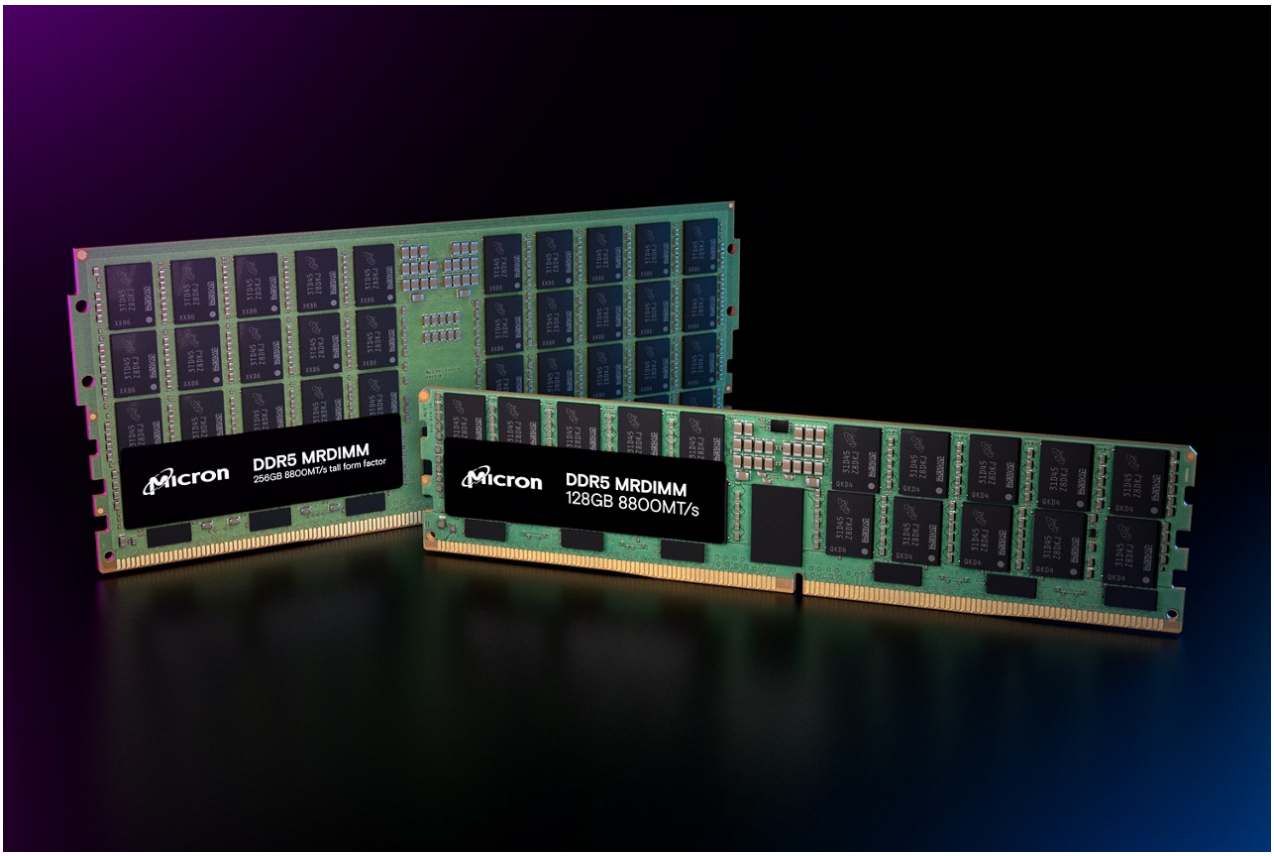


Figure 2. Standard height MRDIMM and TFF MRDIMM. Image courtesy of Micron Technology, Inc.

* MT/s (mega transfer per second), is one million transfers of 8 bytes – because DDR5 memory is 64 bits wide - in a second. 4,800 MT/s memory can therefore transfer around 36 GB/s, while 8,800 MT/s memory transfers around 67 GB/s.

## Processor support

It is important to note that the processor must support MRDIMMs if they will be supported in a server.

Lenovo V4 servers that use Intel Xeon 6 processors with P-cores, for example the ThinkSystem SC750 V4, support MRDIMMs. It is expected that future AMD processors will also support MRDIMMs.

## How do MRDIMMs differ from memory interleaving?

You might ask how this is different to memory interleaving. Interleaving performs part of the addressing process on multiple DIMMs simultaneously to save time, but reads or writes must still complete the second part of the addressing cycle on each individual DIMM.

A 4-way interleaved 64-bit wide memory system, for example, can read or write four 64-bit wide pieces of data, one from each of 4 DIMMs, in quick succession – but it's still sequential. MRDIMMs read banks simultaneously and send the data to the CPU through a high-speed multiplexer, also referred to as a data buffer. Though this operation is still performed sequentially, it is appreciably faster than a standard DDR5 DIMM transfer.

## Summary

In summary, MRDIMM memory offers the increased performance needed to keep modern systems running at optimum speed.

## Author

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This document, LP2028, was created or updated on October 15, 2024.

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