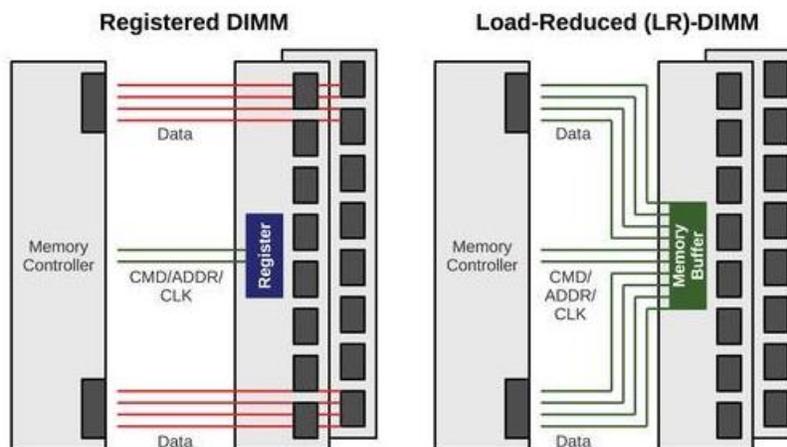


LRDIMM Overview

LRDIMMs, or Load Reduced DIMMs, are a new type of industry standard memory module for servers. They are supported on the 2012 server platforms using Intel Xeon E5 processors and AMD Opteron 6200 processors.

LRDIMMs are similar to Registered DIMMs that are used in the vast majority of servers today. They are built on a memory module Printed Circuit Board that fits the same server memory sockets and use the same type of DRAM chips. That's where the similarities end, as LRDIMMs function differently from Registered DIMMs.

Whereas Registered DIMMs plug directly into the parallel memory bus that is connected to the memory controllers in the Xeon E5 or Opteron 6200 series processors, LRDIMMs add a special Memory Buffer chip to the bus, affixed to each module:



When a server is configured with Registered DIMMs, the memory bus functions in parallel mode, and all DRAMs are controlled by the processor's memory controller. As more and more DRAMs are built onto a Registered DIMM, the electrical loading of the memory module increases (these are known as Ranks – memory modules come as Single Rank, Dual Rank, and Quad Rank). As more Ranks are installed in a memory channel, memory speed drops and/or the use of additional memory sockets is restricted.

Using RDIMMs on Intel Xeon 5500, 5600 and E5 processor-based platforms, users are restricted to a maximum of 2 DIMMs per Channel configurations as memory speed decreases with the use of the third bank. Today, Dual Rank modules are available in 16GB capacities, but 32GB RDIMMs are Quad Rank, which are limited to 2 DIMMs per Channel at much slower speeds.

LRDIMMs can navigate outside of these restrictions through the use of the Memory Buffer chips. When a server is exclusively configured with LRDIMMs, the memory controllers in the processors automatically shift to Serial Mode – all data, command and control signals become packetized and transmitted to the Memory Buffer on the LRDIMMs. The Memory Buffer then handles all the Reads and Writes to the DRAM chips.

LRDIMMs greatly reduce the electrical loading of the DRAM chips onto the memory bus, and through a process called "Rank Multiplication," transform a Quad Rank LRDIMM into a Dual Rank memory module for the memory controller. Through the reduction of the electrical Ranks of the LRDIMM, the server is then able to support LRDIMMs at higher speeds than RDIMMs, and with fewer restrictions on

sockets. For example, at 1.5V per memory module, a Xeon E5 processor can support up to 12 LRDIMMs, or up to 768GB per 2-way server, at memory speeds of 1066MHz. Comparatively, since 32GB RDIMMs are only available as Quad Rank, there is a limit of 8 modules per Xeon E5 processor limited to 800MHz speeds.

The chart below shows the memory configuration options for an Intel Xeon E5 v2 server (Ivy Bridge) with up to three DIMMs per Channel (3DPC) using standard and low-voltage modules.

DIMM Type	Standard Voltage 1.5V			Low Voltage 1.35V		
	1 DPC	2 DPC	3 DPC	1 DPC	2 DPC	3 DPC
Single-Rank RDIMM	1866	1600	1066	1600 1333	1333	800
Dual-Rank RDIMM	1866	1600	1066	1600	1333	800
Quad-Rank RDIMM	1066	800		800	800	
Quad-Rank LRDIMM	1866	1600	1066	1600	1600	1066

DPC = DIMM(s) per Channel

Table 1: Maximum memory speeds per memory configuration. A platform's effective memory speed (also called Data Rate) is a factor of the processor's rated memory speed, the memory modules' Ranks and speed, and the platform's configuration in 1DPC, 2DPC and 3DPC.

The majority of Intel E5 platforms can support 2 LRDIMMs per Channel at up to 1333MHz at 1.5V, and 3 LRDIMMs per Channel at 1066MHz, resulting in 12 LRDIMM per processor configurations; when Quad Rank RDIMMs are used, only 8 sockets per processor are used with a resulting memory speed of 800MHz.

Comparing 32GB LRDIMMs and 32GB Quad Rank RDIMMs, we can see that a two-way E5-2600 v2 server with 24 memory sockets can be configured as follows:

- **LRDIMMs:** 32GB x 24 = 768GB at 1066MHz and 1.5V and 1.35V
- **RDIMMs:** 32GB x 16 = 512GB at 800MHz at 1.5V

LRDIMMs deliver higher speeds at higher capacities for users that cannot meet their requirements using 16GB Dual Rank or 32GB Quad Rank RDIMMs.

To determine if you need LRDIMMs for high-capacity servers:

- Look at the configuration of your specific server platform with 16GB Dual Rank memory modules or 32GB Quad Rank modules
- Determine the effective memory speed for your capacity
- If you require more than 8 x 32GB per processor, then LRDIMMs will be required; otherwise 32GB QR RDIMMs would work if 800MHz is sufficient. If you require 1066MHz or 1333MHz speeds, only LRDIMMs will do.

Ready to upgrade?

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