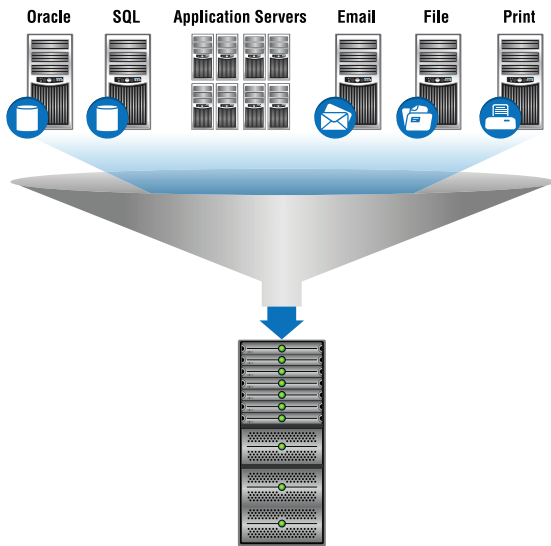


SMART Technical Brief

LRDIMM: The Ultimate Memory for Virtual Servers

LRDIMM - Load Reduced DIMM

Virtualization has revolutionized the server: improved utilization and allocation of resources, saved space, increased reliability and power efficiency, dramatically improved server management and disaster recovery. Sure, server virtualization has achieved all that, however, placing many virtual servers into a single physical server has exponentially increased the workload on the physical server hardware and the demand for resources within the server. Many servers are severely challenged to meet the increased workload required by virtualization.



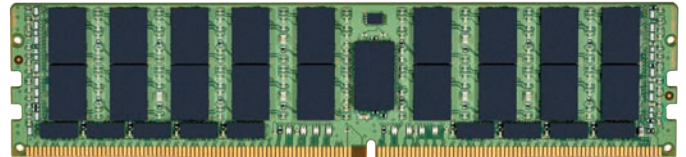
The main bottlenecks in servers have always been processing, data input/output (I/O) and memory. Typical servers have two CPU sockets, which has remained constant for the past decade. Newer processors have faster clock speeds, dual QPI interconnects and larger caches as well as other enhancements to help alleviate the performance deficit created by virtualization. But the big answer to the need for greater compute power is the multi-core processor. Now, instead of a single processing core in each CPU socket, multi-core processors pack six, eight or ten CPU cores into a single CPU socket. Compute power in Xeon based servers has risen ten-fold in the past few years, allowing the CPU to keep pace with the demands of virtualization.

Meanwhile, the I/O subsystem has made its own advances to keep the CPU fed with data. The Romley server platform ushered in a doubling of PCIe bandwidth with PCIe Gen 3, a significant boost to the number of PCIe lanes to 40 per CPU socket (Socket-R servers), and a 10x increase in networking speed with integrated 10Gb Ethernet. All these major improvements in CPU and I/O architecture would do little to improve overall system performance if not paired with comparable advances in memory technology.



Product Family At-A-Glance

DDR4 LRDIMM			
Capacities	Ranks	Voltage	Speeds
32GB to 128GB	2, 4, 8	1.2	2666/2933
DDR3 LRDIMM			
Capacities	Ranks	Voltage	Speeds
32GB	4	1.35 / 1.5	1600



Applications and Platforms

- Cloud-computing
- Server-virtualization applications

Key Features and Specs

- JEDEC® compliant and widely supported by the industry
- LRDIMMs allow servers to be fully populated and run at the highest possible speed for maximum server capacity and bandwidth

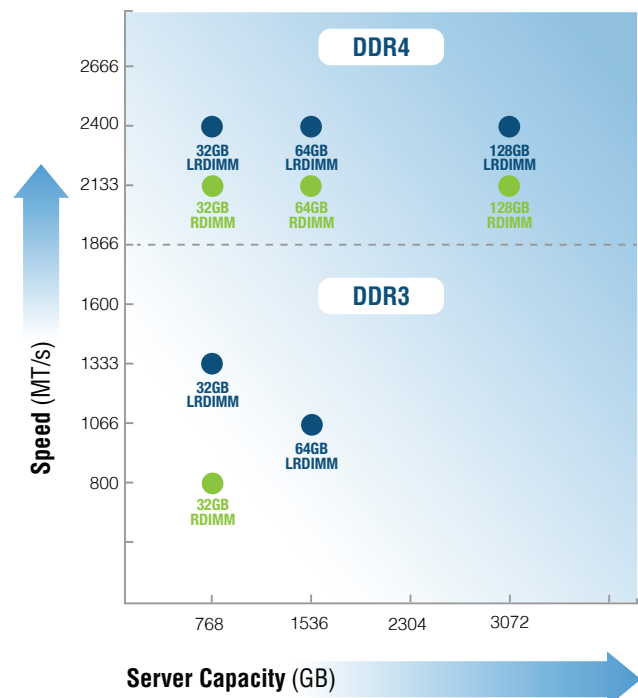
DDR4

- Data rates up to 2400MT/s

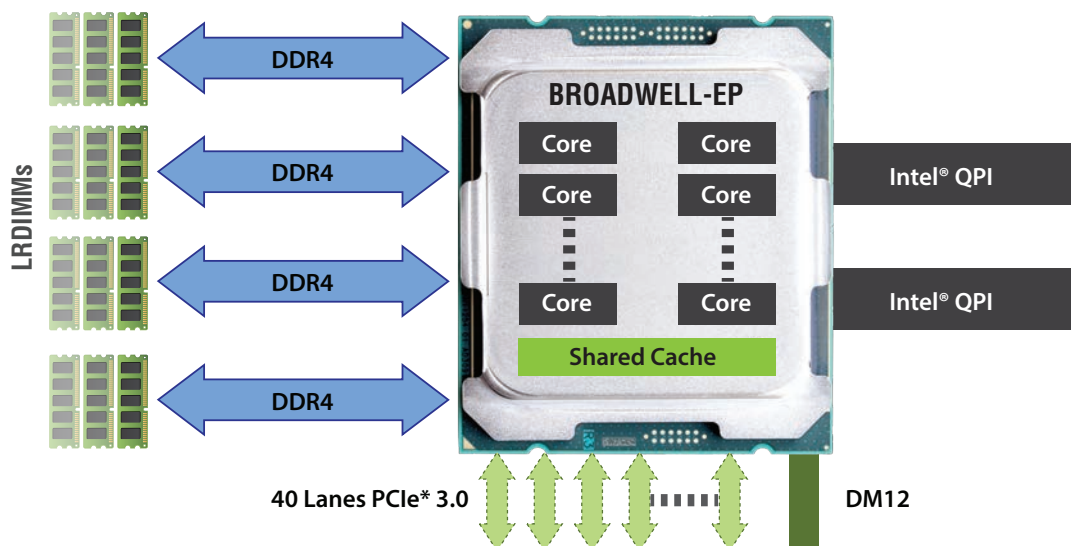
DDR3

- Data rates up to 1866MT/s

LRDIMM Provide Faster Speeds and Higher Densities



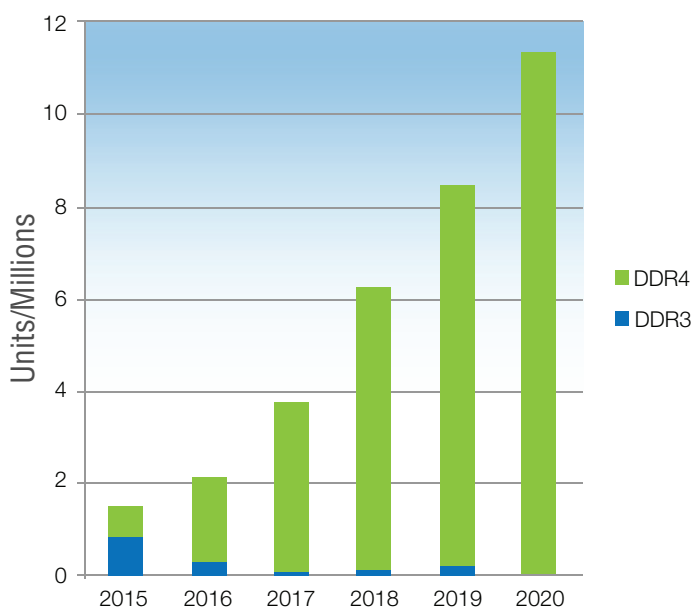
Broadwell Server Platform



There are three main areas of focus in maximizing memory performance: adding more memory channels, increasing memory clock speeds, and supporting larger memory arrays. Total memory bandwidth is directly proportionate to memory clock speed and to the number of memory channels. Having more main memory increases performance in servers, especially in virtual servers. This is because each virtual server requires its own memory to run applications.

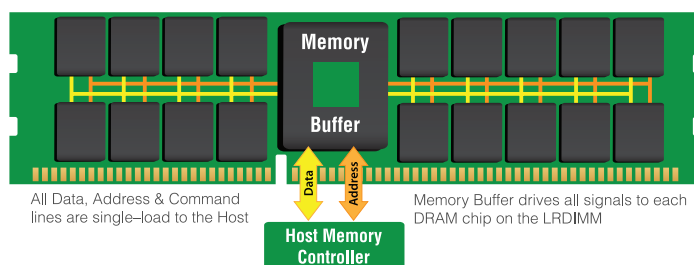
The Intel Broadwell-based server platform supports up to four channels of DDR4 memory and up to three DIMMs per channel with clock speeds up to DDR4-2400. That means dual socket Xeon 2600 V4 series servers can support up to 12 DIMM per CPU socket. A dual CPU server can be loaded with 12 128GB LRDIMMs (1.5TB) running at DDR4-2400 whereas using equivalent RDIMMs could only achieve 768GB (2DPC) running at a clocked down speed of DDR4-2133.

LRDIMM Forecast (DDR3/DDR4)



Registered memory is reaching the limits of its performance and capacity scalability due to the loading that is created by attaching up to 12 DIMM, each with up to 36 DRAM components, directly to the host memory controller. Unlike registered memory, LRDIMM use a memory buffer in place of the register, which electrically isolates the host memory interface from the DRAM components. All data, address and command lines to and from the DRAM components, are driven by the memory buffer. LRDIMM also incorporate a new feature called Rank Multiplication that allows a greater number of memory ranks to be supported on each memory module. LRDIMM support higher capacities and speeds than RDIMM, so the memory system can scale as needed to keep pace with the CPUs and I/O.

LRDIMM Provide Faster Speeds and Higher Densities



DDR4 Memory Modules

288-PIN - DDR4 LRDIMM*

SMART Part Number	Density	Height (mm)	Module Config	Device Config	Speed	Voltage	Temp
ST1637LR420414-SM	128GB	31.25	16Gb x72	4Gx4	2933MT/s	1.2V	0°C to +70°C
SH1637LR420423-HM	128GB	31.25	16Gb x72	2Gx4	2666MT/s	1.2V	0°C to +70°C
ST8197LR420414-SC	64GB	31.25	8Gb x72	2Gx4	2933MT/s	1.2V	0°C to +70°C
SH8197LR420493-SC	64GB	31.25	8Gb x72	2Gx4	2666MT/s	1.2V	0°C to +70°C
ST4097LR420493SC	32GB	31.25	4Gb x72	2Gx4	2666MT/s	1.2V	0°C to +70°C
ST2047LR410493SE	16GB	31.25	2Gb x72	1Gx4	2666MT/s	1.2V	0°C to +70°C

DDR3 Memory Modules

240-PIN - DDR3 LRDIMM*

SMART Part Number	Density	Height (mm)	Module Config	Device Config	Speed	Voltage	Temp
SH4097LV32D416TCN	32GB	30.35	4Gb x72	1Gx4	1600MT/s	1.35V	0°C to +70°C
SP4097LV32D416MPN	32GB	30.35	4Gb x72	1Gx4	1600MT/s	1.35V	0°C to +70°C



*The modules noted above are Value Memory parts. For DDR4 LRDIMM Value Memory, please visit smartm.com/DDR4valuememory. For DDR3 LRDIMM Value Memory, visit smartm.com/DDR3valuememory

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