**SMART**
Modular Technologies ®

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.
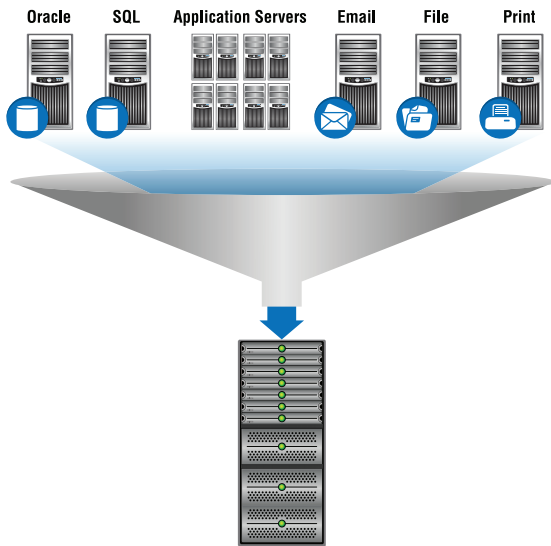
The main bottlenecks in servers have always been processing, data input/output (I/O) and memory. Typical servers have two CPU sockets, which has remained constant for the past decade. Newer processors have faster clock speeds, dual QPI interconnects and larger caches as well as other enhancements to 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**
16GB to 128GB	2, 4, 8	1.2	2133 / 2400
DDR3 LRDIMM			
Capacities	**Ranks**	**Voltage**	**Speeds**
32GB	4	1.35 / 1.5	1333 / 1886
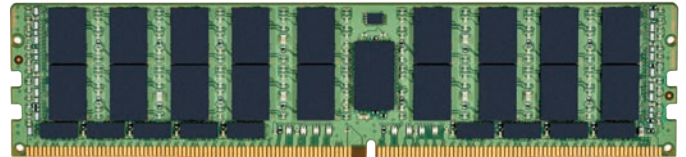
Applications and Platforms

- 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
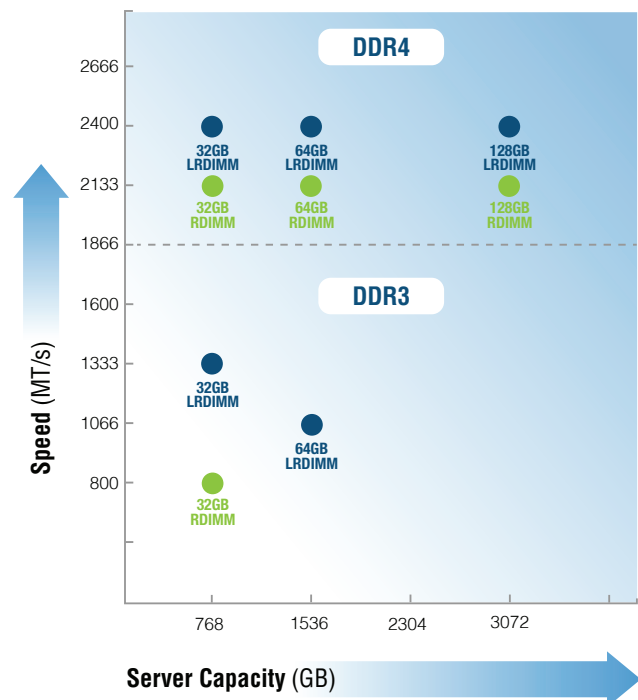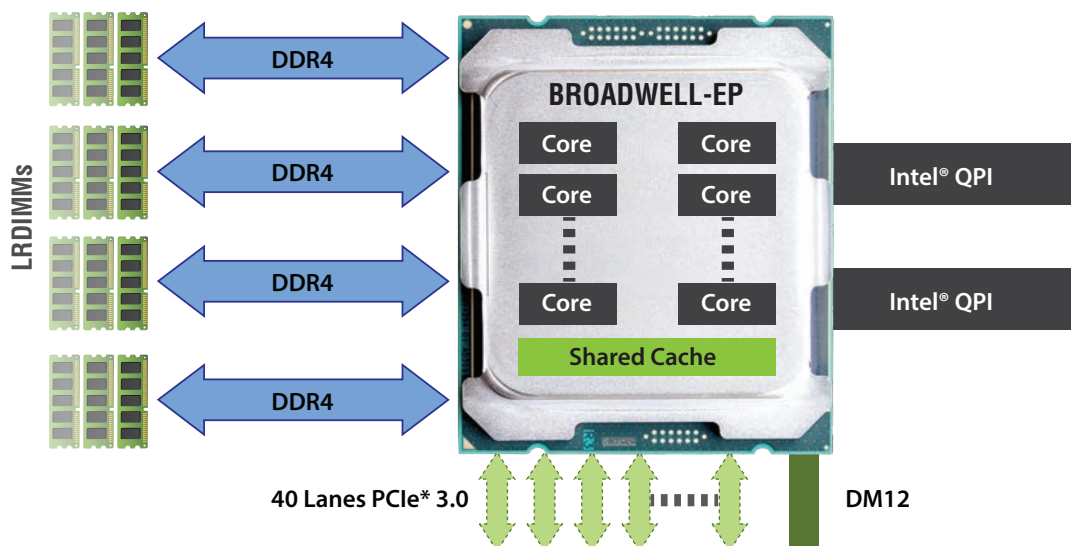
DDR4
- Data rates up to 2400MT/s

DDR3
- Data rates up to 1866MT/s

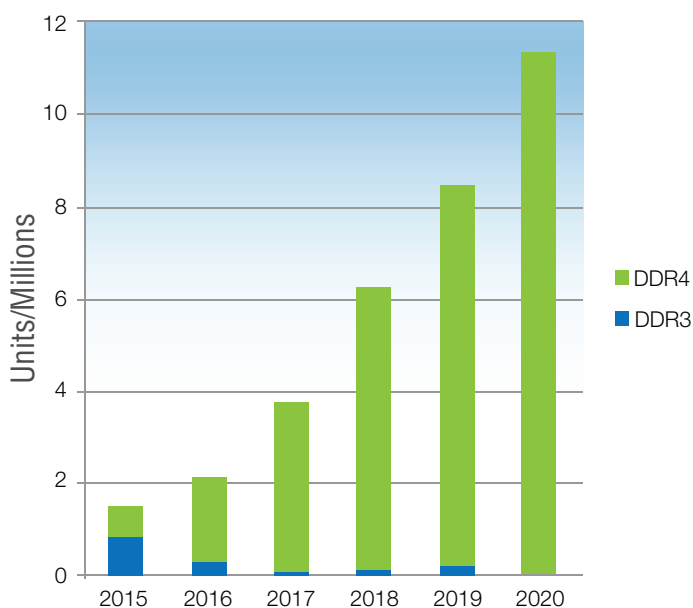### LRDIMM Provide Faster Speeds and Higher Densities

Braodwell 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.

LRDIMM Forecast (DDR3/DDR4)

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.

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

All Data, Address & Command lines are single–load to the Host

Memory Buffer drives all signals to each DRAM chip on the LRDIMM
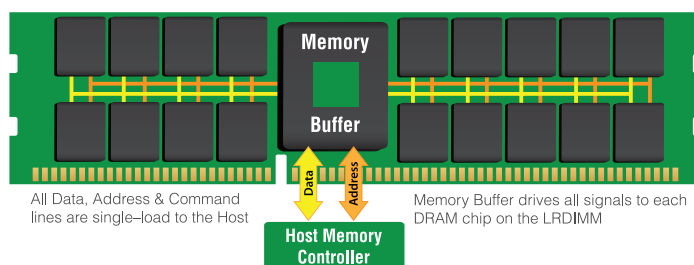
DDR4 Memory Modules

288-PIN - DDR4 LRDIMM							
SMART Part Number	Density	Height (mm)	Module Config	Device Config	Speed	Voltage	Temp
SH1637LR420402-SB	128GB	31.25	16G x72	2G x4	2400 MT/s	1.2V	0°C to +70°C
SH8197LR420472-SB	64GB	31.25	8G x72	2G x4	2400 MT/s	1.2V	0°C to +70°C
SH8197LR420472-HM	64GB	31.25	8G x72	2G x4	2400 MT/s	1.2V	0°C to +70°C
SH4097LR420472-SB	32GB	31.25	4G x72	2G x4	2400 MT/s	1.2V	0°C to +70°C
SH4097LR420451SB	32GB	31.25	4G x72	2G x4	2133 MT/s	1.2V	0°C to +70°C
SH4097LR410472-HA	32GB	31.25	4G x72	1G x4	2400 MT/s	1.2V	0°C to +70°C
SH2047LR410451SE	16GB	31.25	2G x72	1G x4	2133 MT/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
SH8197LR310416-SD	64GB	30.00	8G x72	1G x4	1600 MT/s	1.5V	0°C to +70°C
SH4097LR310438-HD	32GB	30.00	4G x72	1G x4	1866 MT/s	1.5V	0°C to +70°C

VM *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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