SMART Technical Brief
LRDIMMs: The Ultimate Memory for Virtual Servers
**DDR3 LRDIMMs - Load Reduced DIMMs**

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.

**LRDIMMs Provide Faster Speeds and Higher Densities**

<table>
<thead>
<tr>
<th>Capacities</th>
<th>Ranks</th>
<th>Voltage</th>
<th>Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 and 64GB</td>
<td>4</td>
<td>1.35 / 1.5</td>
<td>1333 / 1600</td>
</tr>
</tbody>
</table>

Applications and Platforms
- Cloud-computing
- Server-virtualization applications
- Intel Sandy Bridge and Ivy Bridge servers

Key Features and Specs
- JEDEC® compliant and widely supported by the industry
- Four times more server and storage system memory capacity
- Data rates up to 1866 MT/s
- Available in 1.5V and 1.35V
- LRDIMM uses off-the-shelf 4Gb DDR3 DRAM technology
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. So, increasing memory clock speed from DDR3-1066 to DDR3-1600 results in a 50% increase in memory bandwidth. Increasing the number of memory channels from three to four increases memory bandwidth by 33%. 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 Romley server platform supports up to four channels of DDR3 memory and up to three DIMMs per channel (DPC), with clock speeds up to DDR3-1600. That means dual socket Xeon® 2600 series servers can support up to 12 DIMMs per CPU socket. Older RDIMM technology, however, is unable to capitalize on these advances. New LRDIMMs are designed to take full advantage of the Romley platform, allowing much higher speeds and capacities than those attainable with standard RDIMMs.

Registered memory is reaching the limits of its performance and capacity scalability due to the loading that is created by attaching up to 12 DIMMs, each with up to 36 DRAM components, directly to the host memory controller. Unlike registered memory, LRDIMMs 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. LRDIMMs also incorporate a new feature called Rank Multiplication that allows a greater number of memory ranks to be supported on each memory module. LRDIMMs support higher capacities and speeds than RDIMMs, so the memory system can scale as needed to keep pace with the CPUs and I/O.
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DDR3 Memory Modules

240-PIN – DDR3 LRDIMM

<table>
<thead>
<tr>
<th>SMART Part Number</th>
<th>Density</th>
<th>Height (in.)</th>
<th>Module Config.</th>
<th>Device Type</th>
<th>Speed</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH4097LR310438-HA/SD</td>
<td>32GB</td>
<td>1.18</td>
<td>4Gx72</td>
<td>1Gx4</td>
<td>1866 MT/s</td>
<td>1.5V</td>
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<td>1.35V</td>
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<td>1.18</td>
<td>4Gx72</td>
<td>1Gx4</td>
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<td>SH8197LR310416-HA/SD</td>
<td>64GB</td>
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<td>8Gx72</td>
<td>1Gx4</td>
<td>1600 MT/s</td>
<td>1.5V</td>
</tr>
</tbody>
</table>

LRDIMM Mechanical Dimensions

64GB LRDIMM Mechanical Dimensions

Front

Back

Side

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