SOLUTION BRIEF

Big Data / Analytics

Retail, Financial Services, Telecommunications, and More

On-Demand Scalability for Real-Time Internet Applications

The Intel® Xeon® processor E5-2699 v4 boosts performance by up to 29 percent for Aerospike* NoSQL Database*.[1]

"Aerospike is the database of choice for operational, real-time systems. The Intel® Xeon® processor E5-2699 v4, combined with the Intel® Ethernet Converged Network Adapters X540-T2, provides our customers with a fast, flexible foundation for meeting the ever-growing data demands of Internet applications—with on-demand scalability and mission-critical reliability."

- Brian Bulkowski, Cofounder and CTO, Aerospike

Retailers, financial service organizations, content providers, and other businesses face increasing infrastructure pressures as their online markets continue to expand. Traffic for Internet applications can be volatile and unpredictable. A new product launch, a successful advertisement, or an unexpected market shift can lead to massive surges that can potentially overwhelm infrastructure and bring down applications, right when responsive user experiences are most important to the business.

The Aerospike in-memory NoSQL Database running on the Intel Xeon processor E5-2600 v4 product family is built to handle such massive workloads cost-effectively. This operational Key Value Store has proven its ability to process terabytes of data and billions of transactions per day in mission-critical production environments.

Many of the world's most successful Internet businesses, including Adform, Appnexus, BlueKai, and Kayak, rely on Aerospike to support critical online applications.[2] According to Geir Magnusson, Chief Technology Officer for Appnexus, "We run Aerospike heavily, peaking at 3 million reads per second and well over 1-1/2 million writes a second in a very cost effective way. There isn't any technology we've run into that even comes close."[3]

With Aerospike NoSQL Database* and Intel® architecture, you can:

- **Provide great customer experiences** by maintaining low latency under extreme loads.
- **Scale almost without limit** as your workloads and data sets grow.
- **Protect your business** with mission-critical reliability and uptime.
- **Contain your costs** with powerful performance per server.

Aerospike is ideal for Internet applications that require relatively simple database functionality with low-latency, high throughput, and massive scalability, such as:

- **Fraud prevention** applications that identify questionable transactions in real time.
- **Financial services** applications that allow users to track the status of their investments in real time.
- **Dynamic advertising**, which uses real-time auctions to broker online ads, so the right ad can be presented to the right visitor within a fraction of a second.

Aerospike can scale up or out on any number of Intel® Xeon® processor-based servers to address extreme latency, throughput, and data capacity requirements. All data can be held in memory to provide an unprecedented combination of speed, scale, and reliability.

Alternatively, data capacity can be increased substantially on each server node using the Intel® Solid-State Drive (Intel® SSD) Data Center Family. The Intel® SSD DC P3608 Series, for example, provides up to 4 TB of data capacity per PCIe 3.0 slot and supports data transfer rates of up to 5 GB/s with up to 850,000 random read IOPS.[4] It offers a powerful resource for scaling data capacity without sacrificing performance.

Aerospike also supports automatic data replication and failover across clusters, racks, and data centers to help ensure that data is reliable, consistent, and always available. By combining exceptional performance with end-to-end resilience, Aerospike provides a solid foundation for supporting customer-facing, revenue-critical applications that require high availability.

Up to 2.9 Million Transactions Per Second Per Server[1]

Recent performance tests by Aerospike and Intel demonstrate that a server based on the latest Intel Xeon processor E5-2699 v4 can boost Aerospike performance by as much as 29 percent versus a prior-generation server based on the Intel® Xeon® processor E5-2697 v3.[1] (To provide additional context, Intel estimates that a new-generation Intel Xeon processor E5-2697 v4 would boost performance by up to 14 percent versus that same prior-generation Intel Xeon processor E5-2697 v3.)

These gains are enabled, in part, by higher core counts and faster memory. The Intel Xeon processor E5-2600 product family provides up to 22 cores and 44 threads and supports new DDR4 memory options that are up to 12.5 percent faster than previous-generation DDR4 memory.[5] With these advances, a single two-socket server based on the Intel Xeon processor E5-2699 v4 can process up to 2.9 million transactions per second,[1] with transaction latencies so small they are negligible compared with typical network latencies.

The Aerospike and Intel performance tests were designed to reflect real-world conditions. The workload was composed of 560 concurrent threads issuing queries and updates against an Aerospike database composed of 200 million objects on a single two-socket server. Transactions were 95 percent reads and 5 percent updates, which is consistent with a typical Internet application delivering personalized content or services.

In most cases, IT organizations have no control over how much traffic hits their Internet applications. If the supporting infrastructure is overwhelmed by excessive traffic, business success can quickly turn into failure. With nearly 30

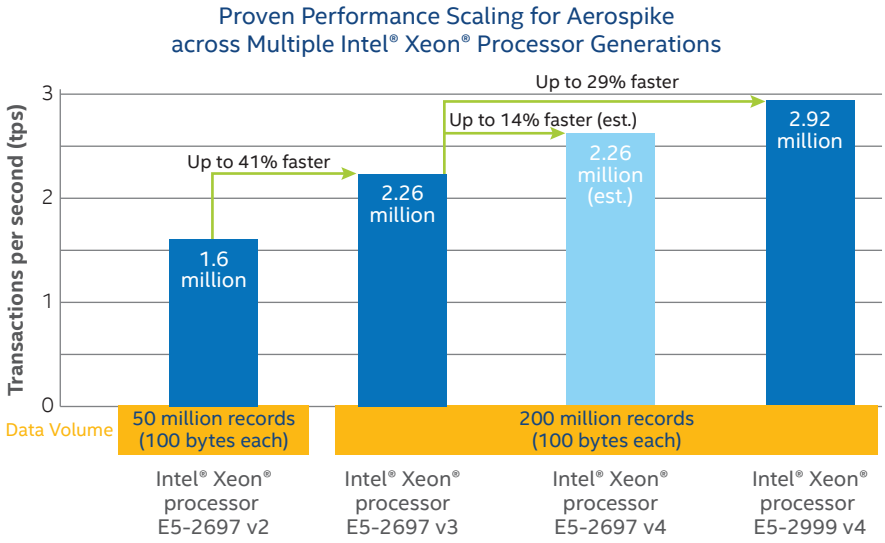


Figure 1. With its ability to execute efficiently across large numbers of processor cores, Aerospike continues to deliver substantial performance gains with every new Intel® Xeon® processor generation.[1,6]

percent higher performance per server than previous-generation servers,[1] the Intel Xeon processor E5-2600 v4 product family provides cost-effective headroom that can be instrumental in maintaining high performance and uptime when traffic peaks. Customers can be served, advertisements placed, and fraud detected without impairing the customer experience through service interruptions or sluggish performance.

Cost-Effective Scalability for Growing Demands

Most database applications cannot take advantage of the full parallelism available on today's multi-core processors. In contrast, Aerospike is highly optimized for parallel execution at every scale, from individual processors to servers, clusters, and data centers.

The combination of high single-server performance and many-node scalability provides the foundation for handling massive workloads cost-effectively. Businesses can support growth in data and transaction volumes while maintaining smaller clusters that help to reduce capital and operational costs and conserve data center space.

As verified by tests across several Intel Xeon processor generations,[6] the efficient parallelism of Aerospike also provides near-linear scalability with rising core counts. As a result, customers can be confident that Aerospike will continue to scale as core densities increase in future Intel Xeon processor generations.

Making Sure Your Network Is up to the Challenge

To sustain fast, uninterrupted transaction rates, the network must be as powerful as the server cluster and capable of handling large numbers of simultaneous transactions. Because of the high throughput of servers based on the Intel Xeon processor E5-2600 v4 product family, this requires network adapters that can provide a separate request queue for every processor core.

Many of today's network adapters, including many 40 Gigabit Ethernet solutions, cannot meet this need. For example, an adapter with only 18 queues (a typical number) could support full utilization for only 18 processor cores, potentially leaving as many as 26 cores nearly idle on a two-socket server.

10 Gigabit Intel® Ethernet Converged Network Adapters provide up to 128 queues per adapter,[7] and automatically adjust the number of queues to match the number of processor cores in the server. Transactions are automatically balanced across queues to optimize latency and throughput so the network does not become a bottleneck and servers can operate at full capacity.

According to Young Paik, performance lab director for Aerospike, "In our initial performance tests, the limited number of queues in the network adapter significantly limited performance. Replacing the adapter with a 10 Gigabit Intel Ethernet Adapter, specifically the Intel® Ethernet Converged Network Adapter X540, solved the problem, enabling us to fully utilize all the processor cores in the server. The bottleneck was eliminated."

The Right Foundation for Internet Applications

Aerospike running on the Intel Xeon processor E5-2600 v4 product family and 10 Gigabit Intel Ethernet Converged Network Adapters provides a fast, flexible foundation for meeting the data demands of mission-critical Internet applications. Whether you hold all data in memory or add Intel SSDs for increased data capacity, the server infrastructure can be scaled up or out to address increasing performance requirements in the most cost-effective manner. As a result, businesses can grow their database solutions without disruption, so they can continue to meet the unpredictable demands of today's increasingly global marketplace.

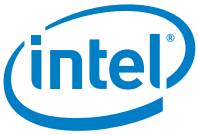
Learn More

Aerospike NoSQL Database

- Overview: http://www.aerospike.com/
- Customer success stories: http://www.aerospike.com/customers/

Intel Xeon processor E5-2600 v4 product family

- Overview: http://www.intel.com/content/www/us/en/processors/xeon/xeon-processor-e5-family.html
- Software solutions: www.intel.com/XeonE5SoftwareSolutions
- Intel® Ethernet Products: http://www.intel.com/content/www/us/en/ethernet-products/ethernet-products-overview.html



[1] Performance for Aerospike NoSQL Database* on the Intel® Xeon® processor E5-2600 v4 product family versus the previous-generation Intel® Xeon® processor E5-2600 v3 product family. Tests were performed during January 2016 by Intel using the Aerospike-specific client/benchmarking tool, which is publicly available at https://github.com/aerospike/aerospike-client-java. A simulated workload consisting of 95 percent database reads and 5 percent writes acted on a database consisting of 200 M records of 100 bytes each. Two Aerospike instances were launched on a single server forming a cluster. Each Aerospike instance was affinitized to a CPU socket and configured to use one of the 10GbE NICs. Each 10Gb NIC had its interrupt IRQs affinitized to a CPU socket. Baseline configuration and benchmark score: Single 2-socket server with 2 x Intel® Xeon® processors E5-2697 v3 (2.6 GHz, 14 cores), 128 GbE DDR4@1866 MT/s, regular DIMM, no disk used (in memory workload), 2 x Intel® Ethernet Converged Network Adapter X540-AT2 10 Gigabit, CentOS* 6.7 (kernel version 2.6.32-573.3.1.el6.x86_64). Score: 2.26 million transactions per second (Mtps). New configuration and baseline score: Single 2-socket server with 2 x Intel® Xeon® processor E5-2699 v4 (2.2 GHz, 22 cores), 128 GB DDR4@2134 MT/s, regular DIMM, no disk used (in memory workload), 2 x Intel Ethernet Converged Network Adapter X540-AT2 10 Gigabit, CentOS 6.7 (kernel version 2.6.32-573.3.1.el6.x86_64). Score: 2.92 Mtps.

[2] Read the Aerospike customer case studies at http://www.aerospike.com/customers/

[3] Source: Aerospike website, March 9, 2016. http://www.aerospike.com/why-appnexus-uses-aerospike/

[4] Source: Intel SSD DC P3608 product specifications. http://www.intel.com/content/www/us/en/solid-state-drives/ssd-dc-p3608-brief.html

[5] The Intel® Xeon® processor E5-2600 v4 product family supports memory speeds up to 2400 MT/s versus maximum memory speeds of 2133 MT/s for the Intel® Xeon® processor E5-2600 v3 product family.

[6] Performance for Aerospike NoSQL Database* on the Intel® Xeon® processor E5-2600 v2 product family was measured by Intel during August 2014 using the Aerospike-specific client/benchmarking tool. A simulated workload consisting of 95 percent database reads and 5 percent writes acted on a database consisting of 50 M records of 100 bytes each. Configuration and benchmark score: Intel production server with 2 x Intel® Xeon® processor E5-2697 v2 (2.7 GHz), 64 GB DDR3 @ 1600 MT/s memory, Intel® Solid-State Drive Data Center Family P3700, 10 GbE Intel® Ethernet, Aerospike v3.3.9, Red Hat Enterprise Linux* 6.5. Score: 1.6 Mtps.

[7] Source: Intel® Ethernet Controller X540 datasheet. http://www.intel.com/content/www/us/en/embedded/products/networking/ethernet-x540-datasheet.html

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