NoSQL Applications Take Flight With Aerospike Flash-Optimized Database, Fueled by Micron SSDs

About Aerospike
Mountain View, California-based Aerospike offers an open-source, Flash-optimized NoSQL database that demonstrates 10X better performance, better reliability, and lower total cost of ownership (TCO) than other NoSQL databases. It enables customers to process big data in real time and deliver instant, intuitive, and consistent experiences for multichannel marketing e-commerce/retail, banking, and telecommunications applications. They enable one customer’s work in digital video advertising that targets devices like computers, smartphones, and tablets. This customer says that thanks to Aerospike’s solution, they are able to build out the largest video advertising network in the world—with more than 155 million users—and service 35 billion requests per month. Aerospike says that Micron’s enterprise PCIe solid state drives (SSDs) are key to enabling this customer experience.

The Challenges

Meeting the Needs of a Rapidly Evolving Industry
In the early days of digital video advertising, Aerospike’s customer observed that while users quickly and easily adopted new content display devices, the content itself could often not keep pace—and monetizing that content proved equally difficult because no consolidated, trustworthy advertising platform was available to engage these potential customers.

Initial advertising platforms failed to scale and were cost-prohibitive and fragile. In order to succeed, a platform needed interoperability, broad appeal, and precise metrics. To distinguish their offering, Aerospike’s client had to empower their customer base, execute quickly, attract and retain the best development talent, and show their dedication to precision and real business value.

Traditional Databases and Hardware Platforms Couldn’t Keep Up
“Our customer had some pretty steep requirements,” explained Brian Bulkowski, founder of Aerospike. “We knew that in order for them to really deliver value, they needed unfailing reliability without the high capital expense that traditional systems required. They also needed to build applications and code fast, without the legacy requirements of traditional databases.”

To ensure smooth, consistent content delivery, Aerospike’s customer also wanted to do everything in-house—including design, host, and service. At peak periods, they

“To power a new generation of Internet-scale applications, we needed to provide a half million IOPS and full failover—and do so with a minimum investment in hardware and support costs. We found an ideal match in Micron's PCIe SSDs, which, coupled with the Aerospike database, showed the same level of performance as an all-DRAM NoSQL solution—at a much lower price.”

Brian Bulkowski
Founder and CTO of Aerospike
needed to service more than 20 million requests per hour, supporting over 600 million direct observations per hour. Bulkowski noted that, “99.99% of those requests had to be completed in less than 5 milliseconds. They looked at DRAM-resident databases, but those just weren’t viable due to their high cost. They needed a better solution.”

The Solution

Real-Time Database for Real-Time Big Data

While the demanding requirements of video advertising caused most database providers to walk away, the Aerospike team was confident that their Flash-optimized database solution would deliver. “Big data isn’t just about analytics and the archive data store—that perspective misses a key element,” Bulkowski said. “You must also consider a high-performance, real-time data store. After all, you want to do something useful with your data, right? Aerospike is focused on enabling millisecond-by-millisecond decisions and optimizations to make real-time interactions a reality.”

“Our customer looked at DRAM-resident databases, but they just weren’t viable due to their intense cost. This customer could not be in business without SSDs—and Micron’s are some of the best in the market.”

BRIAN BULKOWSKI

<table>
<thead>
<tr>
<th>LARGE VIDEO AD PLATFORM</th>
<th>DRAM + SSDs (Aerospike)</th>
<th>DRAM ONLY (other NoSQL)</th>
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<tr>
<td>Storage per server</td>
<td>2.8TB (4 x 700GB)</td>
<td>180GB (196GB server)</td>
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<tr>
<td>TPS per cluster</td>
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<tr>
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<td>Second data center</td>
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<td>Spares/test</td>
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<td>80</td>
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<tr>
<td>Total server count</td>
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<td>186</td>
</tr>
<tr>
<td>Server costs</td>
<td>$154,000</td>
<td>$1,488,000</td>
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</tbody>
</table>

*Figure 1: Aerospike Database With Micron SSDs vs. NoSQL With DRAM*

Selecting the Right Storage Solution

Aerospike’s client looked at several storage options—from DRAM to SSDs. They knew that spinning drives—even thousands of the largest, highest-performance disk arrays—couldn’t offer the low latency and consistent performance required to deliver full-motion video advertising—hence their relentless focus on Flash. “Flash has many advantages,” said Bulkowski, “our patented log structure file system and hybrid approach, with indexes in DRAM and data in Flash, give the ability to map reduce-style queries in milliseconds instead of hours, record click streams for every website that customers visit, and perform real-time data flow analytics and fraud detection pattern matching over ever-increasing data sets. With the help of Flash, Aerospike can scale our customers’ ambitions and results for the same dollars spent.”

“Aerospike was built to take advantage of the latest in processor and Flash storage technologies—but not all technologies perform the same. Aerospike tested and found Micron’s SSDs to be one of the best,” Bulkowski said. “We wondered how could we provide a large, scale-out video ad delivery platform with half a million IOPS and full failover—and do so with a minimum investment
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in hardware and support costs?” What Aerospike found was surprising: “Our Flash-optimized database coupled with Micron’s PCIe SSDs performed at the same, stellar level as an all-DRAM NoSQL solution—but at a far more economical price.”

**All-DRAM Solution Not Cost-Effective**

Aerospike did the research and found that to achieve 500,000 IOPS, an all-DRAM NoSQL instance would require 53 physical servers at each of two sites (primary and failover), with each server containing 196GB of DRAM. Each site could generate 500,000 IOPS in a steady state—but at a cost of about $1,488,000 total. Their customer knew it was very good performance—but pretty pricey. Aerospike’s valuation showed that the total system cost of an all-DRAM implementation, including spares, would have been just short of $1.5 million.

**The Aerospike Database/Micron PCIe SSD Solution**

To get the same performance as an in-memory NoSQL solution with DRAM, Aerospike had a very different solution: four physical servers at each site (primary and failover)—each server containing four of Micron’s 700GB P320h PCIe SSDs. According to Aerospike, “At about $11,000 per system, the reduction in system count really makes the Aerospike/Micron solution stand out.” The entire setup only costs $154,000 to deploy.

Aerospike’s customer gave them a performance, latency, and consistency target that they knew would exceed their current needs. When they read Aerospike’s proposal that outlined the need for just 14 servers instead of the nearly 200 that were expected—and a total deployed price that was well within budget—they were pleasantly surprised.

**Selecting the Right SSD Partner**

Bulkowski noted that Aerospike’s database is specifically Flash-tuned and is designed from the ground up to run at a blistering pace when paired with the right SSDs. “Finding the right SSD partner was key for us,” he added.

“We looked at several PCIe SSDs and found that some of them fell on their faces under load. The workload isn’t for the faint of heart. Aerospike provides 150,000 read IOPS per PCIe SSD, while also ingesting write data at 225 MB/s. Micron’s PCIe drives will do that all day, every day.”

What distinguished Micron’s PCIe was their “secret sauce”: their internally developed controller and their driver expertise. “In Micron’s PCIe SSDs, one controller does it all—there are no aggregated smaller controllers. Instead, all the I/O and management is handled locally, on a single ASIC. That, combined with a tailored Linux driver that greatly improves native interrupt handling, efficient logical-to-physical mapping, and a non-uniform memory access (NUMA)-aware driver provided stellar performance without significant host requirements, letting Aerospike’s database reach its full performance potential.

“Micron’s Flash expertise and tuning enables us to deliver the performance our customers require—and their SSDs happen to be some of the best in the market,” said Bulkowski. “Our customers shine on Aerospike, and Aerospike runs circles around any other option. To achieve 500,000 IOPS, a choice must be made: go with a conventional all-DRAM NoSQL database, or go Flash with Aerospike and Micron. The decision is easy, and the results speak for themselves.”

**The Results**

By integrating Aerospike’s Flash-tuned database with Micron’s PCIe SSDs, Aerospike says that their video advertising customer reduced their server count by 96%—and with a corresponding reduction in spares and support cost, total deployment cost was reduced by 94%. And the company still has room to grow.

“Aerospike’s Flash-tuned database coupled with Micron’s PCIe SSDs, is the market-leading solution for real-time processing of big data,” added Bulkowski. “The point of big data isn’t just to store it; the point is to use it to make business-critical decisions quickly and accurately—and that’s exactly what the Aerospike/Micron solution enables.”
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Fast Facts

- **Customer:** Aerospike
- **Industry:** Online, real-time big data processing
- **Primary Contact:** Brian Bulkowski, Founder and CTO, Aerospike
- **Challenges:** Enable sub-millisecond and real-time analytics on big data to provide consistent and reliable recommendations at the lowest possible price point without sacrificing reliability, stability, or granular performance analysis
- **Solution:** Aerospike’s open-source, Flash-tuned NoSQL database and Micron’s PCIe SSDs
- **What Made the Difference:** The consistent and reliable performance of the Aerospike database running on Micron’s PCIe SSDs
- **Result:** A 96% reduction in server count and a 94% reduction in deployment costs at the exact same performance as an all-DRAM NoSQL implementation—supporting 20 million+ requests per hour with 600 million+ viewers*

* Test results based on data provided by Aerospike, Inc., and their customer.

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