KEY TAKEAWAYS

NoSQL Key-Value Offers Simplified Databases That Any Scale-Out Application Can Benefit From

NoSQL database technology has gained significant momentum thanks to its innovation, higher performance, scale, and its low cost compared to traditional database solutions. NoSQL key-value has the highest adoption in the NoSQL category thanks to its ease-of-use, horizontal scale-out architecture, and simplified access using popular programming languages.

Amazon Web Services, Oracle, Aerospike, DataStax, And MapR Lead The Pack

Forrester’s research uncovered a market in which Amazon Web Services, Aerospike, Oracle, MapR Technologies, and DataStax lead the pack. Couchbase and Basho Technologies offer competitive options.

Innovation, Performance, Scale, And Ecosystem Distinguish NoSQL Key-Value Leaders

The Leaders we identified offer high-performance, scalable, flexible, secure, and robust NoSQL key-value databases solutions that are enterprise ready today. Strong Performers offer a good alternate option to enterprises that need to support moderate-to-large-sized key-value applications and don't need comprehensive data management features.

Access The Forrester Wave Model For Deeper Insight

Use the detailed Forrester Wave model to view every piece of data used to score participating vendors and create a custom vendor shortlist. Access the report online and download the Excel tool using the link in the right-hand column under “Tools & Templates.” Alter Forrester’s weightings to tailor the Forrester Wave model to your specifications.
The Forrester Wave™: NoSQL Key-Value Databases, Q3 2014

An Evaluation Of Seven Enterprise-Class NoSQL Key-Value Database Vendors

by Noel Yuhanna
with Leslie Owens, Emily Jedinak, and Abigail Komlenic

WHY READ THIS REPORT

NoSQL continues to gain strong momentum as organizations look at supporting more complex data structures, scale applications to support unpredictable workloads, and support larger volumes of data that need sub-second response times. NoSQL key-value databases address these requirements by allowing data to be stored in a schema-less model, with simple key-value pair to store, access, and manage data. Key-value databases can handle web scale — thousands of servers and millions of users — with extremely fast, optimized storage and retrieval. Top use cases for key-value database include social and mobile apps, scale-out apps, Web 2.0, line-of-business (LOB) apps, big data apps, and operational and analytical apps. To assess the state of the NoSQL key-value database market, Forrester evaluated the strengths and weakness across 57 criteria of seven leading solutions: Amazon Web Services, Aerospike, Basho Technologies, Couchbase, DataStax, MapR Technologies, and Oracle. This report details our findings on how well each solution fulfills the criteria and where it stands in relation to other offerings to help enterprise architects select the right NoSQL key-value database solution for their business needs.

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Forrester conducted product evaluations in Q2 2014 and interviewed seven vendor companies: Aerospike, Amazon Web Services, Basho Technologies, Couchbase, DataStax, MapR Technologies, and Oracle.

Related Research Documents

The Forrester Wave™: NoSQL Document Databases, Q3 2014
September 30, 2014

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NOSQL CONTINUES TO GAIN STRONG, UNSTOPPABLE MOMENTUM

We're confident there is a NoSQL database strategy in your future. Forrester estimates the current adoption of NoSQL is at 20% and is likely to double by 2017. Enterprise architects consider NoSQL for one or all of the following reasons: 1) to support complex business applications that require transactional and operational databases in order to support next-generation operational analytics, real-time analytics, and predictive analytics; 2) to process data faster with an engine that can horizontally scale across many nodes in a clustered configuration; 3) to support low latency ad hoc queries for mission-critical applications; 4) to manage and store increasing volumes of structured and unstructured data; and 5) to support next-generation business applications such as mobile, Web 2.0, and cloud applications.

Forrester defines NoSQL as:

“A non-relational database management system that provides storage, processing, and accessing of complex data structures and support for large volumes of polystructured data. It supports a horizontal, on-demand, extreme scale-out database platform that delivers a schema-less and flexible data model, and is optimized for high performance.”

NoSQL solutions can be categorized mainly into three groups — key-value store, document database, and graph database. However, we find that vendors are blurring the lines between the three categories as they seek to create database platforms that can satisfy the broader needs of enterprises and widen their appeal to application developers. Forrester sees NoSQL as a complementary database management solution that fills the gaps found in traditional database systems. Relational database management system (RDBMS) vendors, such as Oracle, IBM, Microsoft, and SAP, will broaden their current relational database products to include key-value, graph, and document features and functionality to deliver more comprehensive data management platforms in the coming years. NoSQL will emerge as an independent category as organizations look for specialized databases to support their complex business needs.

NoSQL Key-Value Databases Are Simple And Powerful To Support Large Applications

NoSQL key-value databases can handle web scale — thousands of servers in a cluster and millions of users — with extremely quick and optimized retrieval. Key-value stores accomplish this by leaving out many features of relational databases, implementing only features that extreme web apps need — especially around performance, scale, query optimization, availability, and security. An important feature found in NoSQL key-value database is the sharding of data that delivers scale-out architecture to support very large numbers of records, which has been problematic for traditional RDBMS vendors to deliver. Vendors that support key-value database include: Aerospike, Amazon Web Services (Amazon DynamoDB), Basho Technologies, Couchbase, DataStax, MapR Technologies, and Oracle.

Applications and use cases suitable for NoSQL key-value databases include:
- **Applications that need horizontal scale-out across many servers.** Storing data across servers has always been challenging with traditional database management systems (DBMSes). NoSQL key-value overcomes this by offering a scale-out platform to scale applications to support millions of users and hundreds of terabytes of data. Enterprises can take advantage of NoSQL key-value to build social media, web, mobile, and eCommerce applications to support Internet scale workloads. For example, a large retailer uses key-value to store all of its product information, suppliers, historical prices, description, images, videos, and inventory across all its stores in a scale-out architecture. Unlike relational database, key-value offers a simple store, manage, and access of key data, which makes retrieving millions of data points easy and fast.

- **Scalable business intelligence analytical workloads.** With data volume and velocity growing so dramatically in most enterprises, enterprise architects find it increasingly challenging to handle large analytical workloads using conventional data warehouses and data marts. Many enterprises today are spending countless hours loading, unloading, and querying warehouses to run analytics to support their business. Hadoop, Yarn, Hive, Pig, and MapReduce offer new possibilities to perform analytical queries using scale-out systems. With Hadoop Stack and NoSQL key value databases, analytical jobs can run 10 or even 50 times faster than with a traditional RDBMS or warehouses.

- **Synchronized online and offline data sets to support mobile apps.** Traditionally, applications were built to stay connected and access the database in real-time. However, with increased adoption of smart devices, tablet PCs, and smartphones, applications sometimes need to work offline. NoSQL key-value offers the ability to support disconnected clients, allowing mobile apps to run in offline mode and then sync with a database server when they are online.

- **Supported real-time analytics.** Accessing different pieces of information from multiple sources and performing business analysis and real-time analytics, such as fraud detection, stock market analysis, security threats, or risk analysis, can be very complex, especially when dealing with large amounts of data. NoSQL, such as key-value store, document, and graph databases, offers new possibilities to use commodity servers to quickly support very large amounts of information — multiple terabytes and petabytes. In addition, data can be cached in-memory to support faster access of active data.

- **Embedded database applications for independent software vendors and value-added resellers.** Many business applications don't need a comprehensive DBMS or the overhead of servers and SQL. They simply want basic data storage and retrieval. NoSQL offers independent software vendors (ISVs) and value-added resellers (VARs) the ability to embed a low-cost DBMS engine within their applications and solutions. End user companies can also take advantage of NoSQL as an embedded database to support small- to moderate-sized business applications.
NOSQL KEY-VALUE DATABASE EVALUATION OVERVIEW

Forrester evaluated the strengths and weaknesses of top NoSQL key-value database vendors. NoSQL key-value databases are becoming a critical category for enterprise database companies and database startups. Customers will benefit as the pace of innovation increases and vendors offer improved scale, performance, and integration.

Evaluation Criteria

After examining past research, user need assessments, and vendor and expert interviews, we developed a comprehensive set of evaluation criteria. We evaluated vendors against 57 criteria, which we grouped into three high-level buckets:

- **Current offering.** To assess the breadth and depth of each vendor’s NoSQL key-value database product set, we evaluated each solution’s architectural and operational functionality.

- **Strategy.** We reviewed each vendor’s strategy to assess how each vendor plans to evolve its NoSQL key-value database solution to meet emerging customer demands. We also evaluated each vendor’s go-to-market approach, commitment, and direction strategies.

- **Market presence.** To establish each NoSQL key-value database product’s market presence, we evaluated each solution provider’s company financials, adoption, and partnerships.

Inclusion Criteria

The vendors included in this evaluation offer (see Figure 1):

- **An established, enterprise-class NoSQL key-value database technology.** Each vendor offered the following core NoSQL key-value database functional components, tools, and features: 1) supports core NoSQL key-value database features and functionality, including high availability, security, performance, scalability, and management; 2) supports data storage for persistence, integrity, and access; 3) provides native tools or integrates with third-party vendors to support data loading, unloading, administration, security, integration, data quality, archiving etc.; 4) supports multiple concurrent queries, transactions, reports, or data access patterns; 5) can be deployed on-premises, in the public cloud, or both; and 6) is marketed as a NoSQL key-value database.

- **A publicly available NoSQL key-value database release.** The participating players actively market an enterprise NoSQL key-value database solution. The vendors initially released the product versions included in the evaluation prior to April 8, 2014.

- **A referenceable installed base.** All of the evaluated NoSQL key-value database vendors have 20 or more enterprise customers using their products that span more than one major geographical region.
■ **A standalone NoSQL key-value database solution.** We included NoSQL key-value database products that were not technologically tied to any particular applications, such as enterprise resource planning (ERP) or customer relationship management (CRM), or particular business intelligence (BI), business performance solution (BPS), predictive analytics, extract, transform & load (ETL), or middleware stack, which also do not require embedding in other applications. It should be supported in a standalone environment to support generalized application usage.

■ **Customer interest.** Each vendor’s solutions must generate interest from Forrester’s client base via our inquiry process or other interaction channels.

### Figure 1 Evaluated Vendors: Product Information And Selection Criteria

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Product</th>
<th>Product version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospike</td>
<td>Aerospike Database</td>
<td>3</td>
</tr>
<tr>
<td>Amazon Web Services (AWS)</td>
<td>Amazon DynamoDB</td>
<td>N/A</td>
</tr>
<tr>
<td>Basho Technologies</td>
<td>Riak</td>
<td>1.4.8</td>
</tr>
<tr>
<td>Couchbase</td>
<td>Couchbase Server</td>
<td>2.5</td>
</tr>
<tr>
<td>DataStax</td>
<td>DataStax Enterprise</td>
<td>4.0</td>
</tr>
<tr>
<td>MapR Technologies</td>
<td>MapR Enterprise Database</td>
<td>3.1</td>
</tr>
<tr>
<td>Oracle</td>
<td>Oracle NoSQL Database</td>
<td>3.0.5</td>
</tr>
</tbody>
</table>

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### ENTERPRISES HAVE LOTS OF CHOICES FOR NOSQL KEY-VALUE SOLUTIONS

Forrester’s evaluation of NoSQL key-value database solutions reveals five Leaders and two Strong Performers.

The evaluation uncovered a market in which (see Figure 2):

■ **Aerospike, Amazon Web Services, DataStax, MapR Technologies, and Oracle lead.** The NoSQL key-value database Leaders — Aerospike, Amazon Web Services, DataStax, MapR Technologies, and Oracle — support the NoSQL key-value database needs of large enterprises. All offer proven NoSQL key-value solutions that often combine mixed-workload management, are scalable and high performing, are optimized data platforms, and are supported for managing complex data sets. Oracle leverages its database ubiquity to expand its NoSQL key-value database offering. MapR Technologies provides a comprehensive NoSQL key-value offering that integrates tightly with Hadoop and HBase big data environments. Aerospike leverages
distributed in-memory architecture to deliver extreme performance and scale. Amazon Web Services dominates the NoSQL key-value cloud database market with Amazon DynamoDB, supporting an on-demand scalable solution. DataStax continues to focus on making key-value database platforms simpler and easier to develop and deploy.

- **Couchbase and Basho Technologies offer competitive functionality.** Couchbase offers a broad set of key-value database use cases that span both key-value and document databases. Basho Riak offers a scalable key-value database that can span across data centers and has simplified administration.

This evaluation of the NoSQL key-value database market is intended to be a starting point only. We encourage clients to view detailed product evaluations and adapt criteria weightings to fit their individual needs through the Forrester Wave Excel-based vendor comparison tool on Forrester.com.

**Figure 2** Forrester Wave™: NoSQL Key-Value Databases, Q3 ’14

![Forrester Wave Diagram](image-url)
VENDOR PROFILES

Leaders

Oracle’s NoSQL database, based on BerkeleyDB, has strong adoption and maturity. Despite pressure from startups offering NoSQL databases and big data solutions, as well as competition from IBM, Microsoft, SAP, and Teradata, Oracle continues to do well in the NoSQL category with a comprehensive solution to support most enterprise needs. The Oracle NoSQL database supports a key-value data model that uses the Berkeley DB storage engine, which is one of the most widely deployed embedded key-value stores, with over 1,500 customer deployments. Oracle NoSQL key-value database is a mature, high-performing, scale-out storage engine and provides transactional semantics, fine-grained concurrency, primary and secondary indexes, and high availability features. Oracle overall has executed well on its NoSQL strategy, which focuses on improved scale, performance, security, integration with traditional relational databases, and support for cloud, in-memory, and appliances. Oracle’s top management remains committed to NoSQL and plans to extend the product through enhancement, innovation, and understanding customer requirements. Many Oracle customers use Oracle NoSQL to balance...
the need for scale-out workloads of simpler key-value data, with the rich set of relational data management capabilities needed in their core business systems, or when supporting new applications that have frequently changing key-value data, such as profiles for fraud, personalization, and sensor data management.

- **DataStax leverages Apache Cassandra with additional enterprise features and tooling.**
  DataStax distributes, contributes, and supports an enterprise version of Apache Cassandra, an Apache open source project. Cassandra is a wide-row store, open source distributed key-value based on Google Bigtable. Its key features include: fault tolerance, scale-out architecture, low-latency data access, and simplified administration. Besides selling an enterprise version of Cassandra, DataStax provides additional commercial tools and features, such as analytics, search, monitoring, in-memory, and security to support mission-critical applications. DataStax Enterprise, commercial offering of Cassandra supports various types of business applications, including transactional, analytical, predictive analytics, and mixed workload. Cassandra is fast for writes with an append-only engine and very fast for reads with its column level-only access capabilities. DataStax provides DataStax DevCenter, a graphical integrated development environment (IDE) for creating Cassandra query language (CQL) statements. DevCenter provides an intelligent IDE with auto-correction, auto-suggestion, and syntax highlighting. Top use cases seen with Cassandra include: fraud detection, product catalogs, consumer personalization, recommendation engines, Internet of things, and analytics.

- **Amazon Web Services’ Amazon DynamoDB leads as the top NoSQL key-value database in the cloud offering.**
  Amazon DynamoDB is a fully managed NoSQL key-value cloud database platform that uses solid state drive (SSD) to store, process and access data delivering high performance and scale. It also offers automatic sharding of data to scale across servers to support larger high-performance application demands. A differentiating performance feature is that Amazon Web Services actively monitors the performance levels of the NoSQL database service and reacts to any sign that performance has degraded. Enterprises use Amazon DynamoDB to support advertising campaigns, drive Facebook applications, track gaming information, collect and analyze sensor and log data, and scale eCommerce applications. Amazon Web Services has tens of thousands of customers using Amazon DynamoDB, some with very large implementation like AdRoll’s, which serves over 100 billion ad impressions per day. Amazon DynamoDB’s road map focuses on security, ease-of-use, integration, and expanding query capabilities.

- **MapR Technologies offers broader NoSQL database capabilities.**
  MapR provides a native key-value storage engine based on Google Bigtable. The data model is known as “wide-column” and includes columns, timestamps, and column families. MapR provides both declarative and imperative languages for data query access. MapR-DB is an in-Hadoop database that integrates natively with Hadoop. It supports automatic sharding and re-balancing of the cluster to support broader scale. MapR customers have deployed all types of workloads including transactional, analytical, predictive analytics, and mixed. Since MapR provides NoSQL key-value integration
with Hadoop, MapR customers often deploy a mixed workload in a single cluster. MapR Technologies road map focuses the key-value store to be further integrated with the Hadoop ecosystem. In addition, it plans to further extend its features on ease-of-use, improve on performance and scale, and support a larger distributed in-memory data platform.

- **Aerospike leverages in-memory NoSQL to deliver extreme scale and performance.** Aerospike is the company behind the open source Aerospike NoSQL key-value distributed database that provides a horizontal scale across many nodes in a clustered configuration. Aerospike delivers a strong in-memory data platform to support low latency high scale applications. It supports hybrid in-memory — dynamic random-access memory (DRAM) and Flash — architecture and proprietary file system with native raw block access. The top use cases for Aerospike include operational, real-time analytics, and transactional that need to run at extreme speed. Aerospike can run completely in-memory or in a tiered data platform that is comprised of DRAM, SSD/Flash. Customers include eXelate, Chango, InMobi, and AppNexus, which process 90 billion ad impressions per day in data centers around the world and with each Aerospike server processing over 200 thousand transactions per second (TPS) with sub-millisecond latency on SSDs. Aerospike has a self-healing architecture with zero touch, zero downtime operations, which delivers continuous availability for mission-critical applications.

**Strong Performers**

- **Basho Riak is a viable NoSQL key-value database for scale-out implementation.** Created by Basho Technologies in 2008, Riak is an open source distributed NoSQL key-value database that focuses on high availability and scales on commodity hardware. Riak has more than 100 paying enterprises and has broad database management features, such as multi-data center replication, full-text search, secondary indexes, MapReduce, and a graphical admin tool called Riak Control. Riak written in Erlang can distribute data across nodes using consistent hashing in key-value architecture. Riak has seen some success in the mobile space leveraging HTTP representational state transfer (REST) application programming interfaces (APIs). Voxer (“walkie-talkie”) mobile app uses more than 100 Riak nodes and currently stores more than 200 terabytes of data that includes small to large audio data. Yahoo Japan (dominant portal site operator in Japan) has deployed more than 80 nodes of Riak to provide object storage to its user community and is designed to support multiple petabytes of data. Riak 2.0 integrates with Apache Solr search engine, which brings text search capabilities. Basho Technologies’ leading professional service partners include A-Trac, Cascerta Concepts, Cluster Technology, ePlus, Erlang Solutions, Lilien Systems, Redapt, Tokyo Electron Device, and Trifork.

- **Couchbase offers more use cases with its NoSQL key-value database.** Couchbase develops, contributes, and provides commercial release and support for Couchbase Server, an open source NoSQL key-value and document-oriented database. Couchbase customers use its technology to support use cases, such as user profiles stores, session stores, content aggregation for applications that span e-commerce, social, gaming, and multiple industries. Couchbase delivers
flexible data model features, querying and indexing, full-text search, and MapReduce for real-time analytics. It has some very large customers, such as AT&T, LinkedIn, eBay, McGraw Hill Education, Tesco, and Orbitz, which use the product to support various mission-critical workloads including operational, analytical, and mixed. Couchbase's road map is focused on enhanced performance, scale, replication, big data, mobile, and integrated data sets.

SUPPLEMENTAL MATERIAL

Online Resource
The online version of Figure 2 is an Excel-based vendor comparison tool that provides detailed product evaluations and customizable rankings.

Data Sources Used In This Forrester Wave
Forrester used a combination of two data sources to assess the strengths and weaknesses of each solution:

- **Product demos.** We asked vendors to conduct demonstrations of their product's functionality. We used findings from these product demos to validate details of each vendor's product capabilities.

- **Customer reference surveys.** To validate product and vendor qualifications, Forrester also conducted surveys with three of the vendor's current customers.

The Forrester Wave Methodology
We conduct primary research to develop a list of vendors that meet our criteria to be evaluated in this market. From that initial pool of vendors, we then narrow our final list. We choose these vendors based on: 1) product fit; 2) customer success; and 3) Forrester client demand. We eliminate vendors that have limited customer references and products that don't fit the scope of our evaluation.

After examining past research, user need assessments, and vendor and expert interviews, we develop the initial evaluation criteria. To evaluate the vendors and their products against our set of criteria, we gather details of product qualifications through a combination of lab evaluations, questionnaires, demos, and/or discussions with client references. We send evaluations to the vendors for their review, and we adjust the evaluations to provide the most accurate view of vendor offerings and strategies.

We set default weightings to reflect our analysis of the needs of large user companies — and/or other scenarios as outlined in the Forrester Wave document — and then score the vendors based on a clearly defined scale. These default weightings are intended only as a starting point, and we encourage readers to adapt the weightings to fit their individual needs through the Excel-based tool. The final scores generate the graphical depiction of the market based on current offering, strategy, and market...
presence. Forrester intends to update vendor evaluations regularly as product capabilities and vendor strategies evolve. For more information on the methodology that every Forrester Wave follows, go to http://www.forrester.com/marketing/policies/forrester-wave-methodology.html.

**Integrity Policy**

All of Forrester's research, including Forrester Waves, is conducted according to our Integrity Policy. For more information, go to http://www.forrester.com/marketing/policies/integrity-policy.html.

**ENDNOTES**

1 When asked “Which database management technologies have you deployed or are you planning to deploy?” Twenty percent of those surveyed responded that NoSQL databases were currently deployed and 26% were planning to deploy in less than three years. Base: 104 database management professionals. Source: February 2013 Global Database Management Online Survey.
Forrester Focuses On Enterprise Architecture Professionals

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« ERIC ADAMS, client persona representing Enterprise Architecture Professionals