

# Apache Cassandra

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## Apache Cassandra

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<b>Developer(s)</b>	Apache Software Foundation
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<b>Development status</b>	Active
<b>Written in</b>	Java
<b>Operating system</b>	Cross-platform
<b>Available in</b>	English
<b>Type</b>	key-value store
<b>License</b>	Apache License 2
<b>Website</b>	<a href="http://cassandra.apache.org">cassandra.apache.org</a> <sup>[1]</sup>

**Apache Cassandra** is an open source distributed database management system. It is an Apache Software Foundation top-level project<sup>[2]</sup> designed to handle very large amounts of data spread out across many commodity servers while providing a highly available service with no single point of failure. It is a NoSQL solution that was initially developed by Facebook and powered their Inbox Search feature until late 2010.<sup>[3][4]</sup> Jeff Hammerbacher, who led the Facebook Data team at the time, has described Cassandra as a BigTable data model running on an Amazon Dynamo-like infrastructure.<sup>[5]</sup>

Cassandra provides a structured key-value store with tunable consistency.<sup>[6]</sup> Keys map to multiple values, which are grouped into column families. The column families are fixed when a Cassandra database is created, but columns can be added to a family at any time. Furthermore, columns are added only to specified keys, so different keys can have different numbers of columns in any given family.

The values from a column family for each key are stored together. This makes Cassandra a hybrid data management system between a column-oriented DBMS and a row-oriented store.<sup>[7]</sup> Additional features include: using the BigTable way of modeling, eventual consistency, and the Gossip protocol, a master-master way of serving read and write requests inspired by Amazon's Dynamo.<sup>[8]</sup>

## History

Apache Cassandra was developed at Facebook to power their Inbox Search feature by Avinash Lakshman (one of the authors of Amazon's Dynamo) and Prashant Malik. It was released as an open source project on Google code in July 2008.<sup>[5]</sup> In March 2009, it became an Apache Incubator project.<sup>[9]</sup> On February 17, 2010 it graduated to a top-level project.<sup>[2]</sup>

Facebook abandoned Cassandra in late 2010 when they built the Facebook Messaging platform on HBase.<sup>[4]</sup>

## Licensing and support

Apache Cassandra is an Apache Software Foundation project, so it has an Apache License (version 2.0).

There are professional grade support available from a few companies. In the official wiki of Apache Cassandra's project<sup>[10]</sup> the following ones, which collaborate with developers to the project, are mentioned

- Acunu <sup>[11]</sup>
- Datastax <sup>[12]</sup>

## Main features

### Decentralized

Every node in the cluster has the same role. There is **no single point of failure**. Data is distributed across the cluster (so each node contains different data), but there is no master as every node can service any request.

### Supports replication and multi data center replication

Replication strategies are configurable.<sup>[13]</sup> Cassandra is designed as a distributed system, for deployment of large numbers of nodes across multiple data centers. Key features of Cassandra's distributed architecture are specifically tailored for multiple-data center deployment, for redundancy, for failover and disaster recovery.

### Scalability

Read and write throughput both increase linearly as new machines are added, with no downtime or interruption to applications.

### Fault-tolerant

Data is automatically replicated to multiple nodes for fault-tolerance. Replication across multiple data centers is supported. Failed nodes can be replaced with no downtime.

### Tunable consistency

Writes and reads offer a tunable level of consistency, all the way from "writes never fail" to "block for all replicas to be readable", with the quorum level in the middle.

### MapReduce support

Cassandra has Hadoop integration, with MapReduce support. There is support also for Apache Pig <sup>[14]</sup> and Apache Hive <sup>[15]</sup> <sup>[16]</sup>.

### Query language

CQL (Cassandra Query Language) was introduced, an SQL-like alternative to the traditional RPC interface. Language drivers are available for **Java** (JDBC) and **Python** (DBAPI2).

## Data model: keys, row keys, columns and column families

Cassandra is essentially a hybrid between a key-value and a row-oriented (or tabular) database.

Each key in Cassandra corresponds to a value which is an object. Each key has values as columns, and columns are grouped together into sets called column families. Also, each column families can be grouped in super column families.

So each key identifies a row of a variable number of elements. This column families could be considered then as tables. A table in Cassandra is a distributed multi dimensional map indexed by a key.

Furthermore, applications can specify the sort order of columns within a Super Column or Simple Column family.

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## Clustering

When the cluster for Apache Cassandra is designed, an important point is to select the right partitioner. Two partitioners exist:<sup>[17]</sup>

1. RandomPartitioner (RP): This partitioner randomly distributes the key-value pairs over the network, resulting in a good load balancing. Compared to OPP, more nodes have to be accessed to get a number of keys.
2. OrderPreservingPartitioner (OPP): This partitioner distributes the key-value pairs in a natural way so that similar keys are not far away. The advantage is that fewer nodes have to be accessed. The drawback is the uneven distribution of the key-value pairs.

## Prominent users

- Talentica Software uses Cassandra as a back-end for Analytics Application with Cassandra cluster of 30 nodes and inserting around 200GB data on daily basis.<sup>[18]</sup>
- AppScale uses Cassandra as a back-end for Google App Engine applications<sup>[19]</sup>
- Cisco's WebEx uses Cassandra to store user feed and activity in near real time.<sup>[20]</sup>
- The CERN ATLAS experiment uses Cassandra to archive its online DAQ system's monitoring information<sup>[21]</sup>
- Clearspring<sup>[22]</sup> uses Cassandra "[keep] track of how many times a URL is shared and serves over 200M view requests daily."<sup>[23]</sup>
- Cloudkick uses Cassandra to store the server metrics of their users.<sup>[24]</sup>
- CloudeTalk<sup>[25]</sup>'s Platform contains APIs for users to create messaging apps with Cassandra as its data store.<sup>[26]</sup>
- connex.io<sup>[27]</sup>'s database of user contacts is stored completely in a Cassandra cluster.<sup>[28]</sup>
- Constant Contact uses Cassandra in their social media marketing application.<sup>[29]</sup>
- Digg, a large social news website, announced on Sep 9th, 2009 that it is rolling out its use of Cassandra<sup>[30]</sup> and confirmed this on March 8, 2010.<sup>[31]</sup> TechCrunch has since linked Cassandra to Digg v4 reliability criticisms and recent company struggles.<sup>[32]</sup> Lead engineers at Digg later rebuked these criticisms as red herring and blamed a lack of load testing.<sup>[33]</sup>
- Digital Reasoning<sup>[34]</sup>'s Synthesys application with potential scale to over a 400-node Cassandra database was rolled out in late 2010.<sup>[35]</sup>
- Facebook used Cassandra to power Inbox Search, with over 200 nodes deployed.<sup>[3]</sup> This was abandoned in late 2010 when they built Facebook Messaging platform on HBase.<sup>[4]</sup>
- IBM has done research in building a scalable email system based on Cassandra.<sup>[36]</sup>
- Isidorey<sup>[37]</sup> is the creator of Cloudsandra: a multi-tenant platform built on Brisk (Hadoop + Cassandra).<sup>[38]</sup>
- Martini Media Network<sup>[39]</sup> moved from MySQL to Cassandra.<sup>[40]</sup>
- Mollom<sup>[41]</sup> uses Cassandra to track reputations from IP data<sup>[42]</sup>
- Netflix uses Cassandra as their back-end database for their streaming services<sup>[43][44]</sup>
- Formspring uses Cassandra to count responses, as well as store Social Graph data (followers, following, blockers, blocking) for 26 Million accounts with 10 million responses a day<sup>[45]</sup>
- Mahalo.com uses Cassandra to record user activity logs and topics for their Q&A website<sup>[46][47]</sup>
- Ooyala Built a scalable, flexible, real-time analytics engine using Cassandra<sup>[48]</sup>
- At Openwave, Cassandra acts as a distributed database and serves as a distributed storage mechanism for Openwave's next generation messaging platform<sup>[49]</sup>
- OpenX is running over 130 nodes on Cassandra for their OpenX Enterprise product to store and replicate advertisements and targeting data for ad delivery<sup>[50]</sup>
- Outbrain<sup>[51]</sup> uses Cassandra as a semi-persistent cache of recommendations.<sup>[52]</sup>
- Plaxo has "reviewed 3 billion contacts in [their] database, compared them with publicly available data sources, and identified approximately 600 million unique people with contact info."<sup>[53]</sup>
- PostRank uses Cassandra as their backend database<sup>[54]</sup>

- Rackspace is known to use Cassandra internally.<sup>[55]</sup>
- Reddit switched to Cassandra from memcachedDB on March 12, 2010<sup>[56]</sup> and experienced some problems with overload handling in Cassandra in May.<sup>[57]</sup>
- RockYou uses Cassandra to record every single click for 50 million Monthly Active Users in real-time for their online games<sup>[58]</sup>
- ShopSavvy uses Cassandra as their storage technology for their barcode scanning application<sup>[59]</sup>
- SimpleGeo<sup>[60]</sup> built a scalable geospatial database on top of Apache Cassandra<sup>[61]</sup>
- SoundCloud uses Cassandra to store user account information<sup>[62]</sup>
- Twitter announced it is planning to use Cassandra because it can be run on large server clusters and is capable of taking in very large amounts of data at a time.<sup>[63][64]</sup> Twitter continues to use it but not for Tweets themselves.<sup>[65]</sup>
- Urban Airship uses Cassandra with the mobile service hosting for over 160 million application installs across 80 million unique devices<sup>[66]</sup>
- Uti Labs<sup>[67]</sup> uses Cassandra for its Low Voltage Smart System for fine grained event / reading recording and analytics<sup>[68]</sup>
- Walmart Labs<sup>[69]</sup> (previously Kosmix) uses Cassandra with SSD<sup>[70]</sup>
- Yakaz uses Cassandra on a five-node cluster to store millions of images as well as its social data.<sup>[71]</sup>
- Viocom Hosting uses Cassandra for its email and smtp gateway called (SendCluster) for large volume senders. Storing from 40 million emails a day for email marketing. This is a private platform built with cassandra for large Email Senders<sup>[72]</sup>

## Tools for Cassandra

Cassandra has built in tools for accessing Cassandra from the direct download such cassandra-cli and node-tool.

There are third party tools available, as the following<sup>[73]</sup>:

### Data browsers

- chiton<sup>[74]</sup>, a GTK data browser.
- cassandra-gui<sup>[75]</sup>, a Swing data browser.
- Toad for Cloud Databases<sup>[76]</sup>, an Eclipse plug-in data browser

### Administration tools

- OpsCenter<sup>[77]</sup>, OpsCenter is a tool for management and monitoring of a Cassandra cluster. The Community Edition of OpsCenter is free for anyone to download and use. There is also an Enterprise Edition of OpsCenter that includes additional features.
- Cassandra Cluster Admin<sup>[78]</sup>, Cassandra Cluster Admin is a GUI tool to help people administrate their Apache Cassandra cluster, similar to PHPMysqlAdmin for MySQL administration.

## Client interfaces and language Support

Cassandra has a lot of high-level client libraries for Python, Java, .Net, Ruby, PHP, Perl, C++, etc.<sup>[79]</sup>

For a detailed list of client software go to "Client Options" article<sup>[80]</sup> on Cassandra Wiki

## Integration with other tools

There are other tools worth mentioning like **Solandra**,<sup>[81]</sup> a Cassandra backend for Apache Solr<sup>[82]</sup>, a web application built around Lucene, for full text indexing and search.

For monitoring purposes Cassandra is well integrated with Ganglia<sup>[83]</sup> and there are plugins for other monitoring system as, by example, Nagios.

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  - Cassandra @ Twitter: an Interview with Ryan King (<http://nosql.mypopescu.com/post/407159447/cassandra-twitter-an-interview-with-ryan-king>)
  - Presentation on RDBMS vs. Dynamo, BigTable, and Cassandra (<http://www.slideshare.net/jbellis/what-every-developer-should-know-about-database-scalability>)
  - RPM build for the apache cassandra project (<http://code.google.com/p/cassandra-rpm/>)
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# Article Sources and Contributors

**Apache Cassandra** *Source:* <http://en.wikipedia.org/w/index.php?oldid=511879100> *Contributors:* Acdx, Al3xpopescu, Alan Liefing, Andrewllavore, Andy Dingley, Anthony Appleyard, ArglebargleIV, Arthurjulian, Bearcat, Biktora, Billmantisco, Cander0000, Chris Chittleborough, ChrisGualtieri, Ciges, Cleduc, Clydewylam, Cybercobra, Dancraggs, DeansFA, Deineka, Driftx, Drmies, Dstainer, Ehn, Enchanter, Euphoria, FalconL, FrankTobia, Frap, Frecklefoot, Fyedernoggersnodden, Grafen, GreyTeardrop, Grossenhayn, Gstein, Hashar, JLaTondre, Jadave234, Jbryanscott, Jim1138, Jmhodges, Jncraton, Jweiss11, Kinglarvae, Kolyma, Krotty, Ksato9700, Kylemurph, Materialscientist, Maximgr, McSly, Midinastasurazz, Mmozum, Msiebuhr, Neilc, Nemnkim, Nmilford, OrangeDog, PatrickFisher, Pmiossec, Rich Farmbrough, Ronz, Runtime, Sae1962, SamJohnston, Samarthahire, Santiagobasulto, Slebresne, Swaroopch, Tas50, Tdmackey, TheJJJunk, Thumperward, Timendum, TimoeY, Tommymorgan, Vanger13, Vegaswikian, Viocomnetworks, Wainstead, YPavan, Yadavjpr, YogiWanKenobi, 128 anonymous edits

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