Large Scale Website Facebook Infrastructure Scalability Facebook Engineering

Software Architecture Social Media Software Engineering Facebook (product)

What is Facebook's architecture?

21 Answers

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At the scale that Facebook operates, a lot of traditional approaches to serving web content break down or simply aren't practical. The challenge for Facebook's engineers has been to keep the site up and running smoothly in spite of handling close to **half a billion active users**. This article takes a look at some of the software and techniques they use to accomplish that.

Facebook's scaling challenge

Before we get into the details, here are a few factoids to give you an idea of the scaling challenge that Facebook has to deal with:

- Facebook serves **570 billion page views per month** (according to Google Ad Planner).
- There are more photos on Facebook than all other photo sites combined (including sites like Flickr).
- More than **3 billion photos** are uploaded every month.
- Facebook's systems serve **1.2 million photos per second**. This doesn't include the images served by Facebook's CDN.
- More than **25 billion pieces of content** (status updates, comments, etc) are shared every month.
- Facebook has more than **30,000 servers** (and this number is from last year!)

Software that helps Facebook scale

In some ways Facebook is still a LAMP site (kind of), but it has had to change and extend its operation to incorporate a lot of other elements and services, and modify the approach to existing ones.

For example:

- Facebook still uses PHP, but it has built a compiler for it so it can be turned into native code on its web servers, thus boosting performance.
- Facebook uses Linux, but has optimized it for its own purposes (especially in terms of network throughput).
- Facebook uses MySQL, but primarily as a key-value persistent storage, moving joins and logic onto the web servers since optimizations are easier to perform there (on the "other side" of the Memcached layer).

Then there are the custom-written systems, like Haystack, a highly scalable object store used to serve Facebook's immense amount of photos, or Scribe, a logging system that can operate at the scale of Facebook (which is far from trivial).

But enough of that. Let's present (some of) the software that Facebook uses to provide us all with the world's largest social network site.

MEMCACHED

Memcached is by now one of the most famous pieces of software on the internet. It's a distributed memory caching system which Facebook (and a ton of other sites) use as a caching layer between the web servers and MySQL servers (since database access is relatively slow). Through the years, Facebook has made a ton of

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Facebook runs thousands of Memcached servers with tens of terabytes of cached data at any one point in time. It is likely the world's largest Memcached installation.

HIPHOP FOR PHP

PHP, being a scripting language, is relatively slow when compared to code that runs natively on a server. HipHop converts PHP into C++ code which can then be compiled for better performance. This has allowed Facebook to get much more out of its web servers since Facebook relies heavily on PHP to serve content.

A small team of engineers (initially just three of them) at Facebook spent 18 months developing HipHop, and it is now live in production.

HAYSTACK

Haystack is Facebook's high-performance photo storage/retrieval system (strictly speaking, Haystack is an object store, so it doesn't necessarily have to store photos). It has a ton of work to do; there are more than 20 billion uploaded photos on Facebook, and each one is saved in four different resolutions, resulting in more than 80 billion photos.

And it's not just about being able to handle billions of photos, performance is critical. As we mentioned previously, Facebook serves around 1.2 million photos *per second*, a number which doesn't include images served by Facebook's CDN. That's a staggering number.

BIGPIPE

BigPipe is a dynamic web page serving system that Facebook has developed. Facebook uses it to serve each web page in sections (called "pagelets") for optimal performance.

For example, the chat window is retrieved separately, the news feed is retrieved separately, and so on. These pagelets can be retrieved in parallel, which is where the performance gain comes in, and it also gives users a site that works even if some part of it would be deactivated or broken.

CASSANDRA

Cassandra is a distributed storage system with no single point of failure. It's one of the poster children for the NoSQL movement and has been made open source (it's even become an Apache project). Facebook uses it for its Inbox search.

Other than Facebook, a number of other services use it, for example Digg. We're even considering some uses for it here at Pingdom.

SCRIBE

Scribe is a flexible logging system that Facebook uses for a multitude of purposes internally. It's been built to be able to handle logging at the scale of Facebook, and automatically handles new logging categories as they show up (Facebook has hundreds).

HADOOP AND HIVE

Hadoop is an open source map-reduce implementation that makes it possible to perform calculations on massive amounts of data. Facebook uses this for data analysis (and as we all know, Facebook has massive amounts of data). Hive originated from within Facebook, and makes it possible to use SQL queries against Hadoop, making it easier for non-programmers to use.

Both Hadoop and Hive are open source (Apache projects) and are used by a number of big services, for example Yahoo and Twitter.

THRIFT

Facebook uses several different languages for its different services. PHP is used for the front-end, Erlang is used for Chat, Java and C++ are also used in several places (and perhaps other languages as well). Thrift is an internally developed crosskeep up its cross-language development.

Facebook has made Thrift open source and support for even more languages has been added.

VARNISH

Varnish is an HTTP accelerator which can act as a load balancer and also cache content which can then be served lightning-fast.

Facebook uses Varnish to serve photos and profile pictures, handling billions of requests every day. Like almost everything Facebook uses, Varnish is open source.

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