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## Building Timeline: Scaling up to hold your life story

By [Ryan Mack](#) on Thursday, January 5, 2012 at 1:05pm

Timeline isn't just a bold new look for Facebook—it's also the product of a remarkably ambitious engineering effort. While our earlier profile pages surfaced a few days or weeks of activity, from the onset we knew that with Timeline we had to think in terms of years and even decades. At a high level we needed to scan, aggregate, and rank posts, shares, photos and check-ins to surface the most significant events over years of Facebook activity.

The schedule for Timeline was very aggressive. When we sat down to build the system, one of our key priorities was eliminating technical risk by keeping the system as simple as possible and relying on internally-proven technologies. After a few discussions we decided to build on four of our core technologies: [MySQL/InnoDB](#) for storage and replication, Multifeed (the technology that powers News Feed) for ranking, Thrift for communications, and memcached for caching. We chose well-understood technologies so we could better predict capacity needs and rely on our existing monitoring and operational tool kits.

### Denormalizing the data

Before we began Timeline, our existing data was highly normalized, which required many round trips to the databases. Because of this, we relied on caching to keep everything fast. When data wasn't found in cache, it was unlikely to be clustered together on disk, which led to lots of potentially slow, random disk IO. To support our ranking model for Timeline, we would have had to keep the entire data set in cache, including low-value data that wasn't displayed.

A massive denormalization process was required to ensure all the data necessary for ranking was available in a small number of IO-efficient database requests

Once denormalized, each row in the database contained both information about the action and enough ranking metadata so it could be selected or discarded without additional data fetches. Data is now sorted by (user, time) on disk and InnoDB does a great job of streaming data from disk with a primary key range query.

Some of our specific challenges of the denormalization process were:

1. Dozens of legacy data formats that evolved over years. [Peter Ondruška](#), a Facebook summer intern, defined a custom language to concisely express our data format conversion rules and wrote a compiler to turn this into runnable PHP. Three "data archeologists" wrote the conversion rules.
2. Non-recent activity data had been moved to slow network storage. We hacked a read-only build of MySQL and deployed hundreds of servers to exert maximum IO pressure and copy this data out in weeks instead of months.
3. Massive join queries that did tons of random IO. We consolidated join tables into a tier of flash-only databases. Traditionally PHP can perform database queries on only one server at a time, so we wrote a parallelizing query proxy that allowed us to query the entire join tier in parallel.
4. Future-proofing the data schema. We adopted a data model that's compatible with Multifeed. It's more flexible and provides more semantic context around data with the added benefit of allowing more code reuse.

### Timeline aggregator

We built the Timeline aggregator on top of the database. It started its life as a modified version of the Multifeed Aggregator that powers News Feed, but now it runs locally on each database box, allowing us to max out the disks without sending any data over the network that won't be displayed on the page.

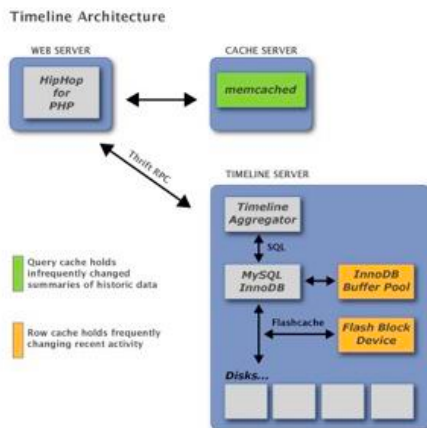
The aggregator provides a set of story generators that handle everything from geographically clustering nearby check-ins to ranking status updates. These generators are

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implemented in C++ and can run all these analyses in a few milliseconds, much faster than PHP could. Much of the generator logic is decomposed into a sequence of simple operations that can be reused to write new generators with minimal effort.

Caching is an important part of any Facebook project. One of the nice properties of Timeline is that the results of big queries, such as ranking all your activity in 2010, are small and can be cached for a long period without cache invalidations. A query result cache is of huge benefit and memcached is an excellent solution.

Recent Activity changes frequently so a query cache is frequently invalidated, but regenerating the summary of Recent Activity is quite fast. Here a row cache helps further boost query performance. We rely on the InnoDB buffer pool in RAM and our own [Flashcache](#) kernel driver to expand the OS cache onto a flash device.



### Developing in parallel

Timeline started as a [Hackathon](#) project in late 2010 with two full-time engineers, an engineering intern, and a designer building a working demo in a single night. The full team ramped up in early 2011, and the development team was split into design, front-end engineering, infrastructure engineering, and data migrations. By doing staged and layered prototyping, we achieved an amazing amount of development parallelism and rarely was any part of the team blocked by another. Early on in the project we were simultaneously:

1. Designing UI prototypes with our pre-existing but non-scalable backend,
2. Building production frontend code on a simulation of the scalable backend,
3. Building the scalable backend using samples of de-normalized data from a prototype of denormalization migration,
4. Building the framework to run the full-scale denormalization process,
5. Collecting and copying the data necessary for the denormalization,
6. Performing simulated load testing to validate our capacity planning estimates.

In retrospect, that's pretty crazy. We had to move a lot of mountains to go from the initial infrastructure review meeting to successfully turning on the 100% backend load test in just six months. Done another way, this project could have taken twice as long - and that's being generous.

Timeline has been a wonderful opportunity to work closely with the product team. Our constant collaboration was critical to ensuring the infrastructure we built supported their product goals while simultaneously guiding the product toward features that we could implement efficiently.

As millions of users enable Timeline, it is wonderfully exciting to see all the positive feedback and even more exciting to see our performance graphs look just like our simulations.

*Ryan Mack, an infrastructure engineer, looks forward to rediscovering this blog post on his timeline a decade from now.*

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**Kenneth V-Eight Mutombo** Is it MySQL then? forgive my ignorance of data centers technologies but how does Hadoop fit in Timeline?  
January 18, 2012 at 3:46pm



**Marlin Ouversen** Dear Facebook: when I hide something or delete something from my Timeline (or Wall), I expect it to \_stay\_ hidden or deleted and not keep re-appearing! This recurring problem in your system needs to be fixed ASAP, there are serious ramifications.  
January 19, 2012 at 11:03am · 3



**Mary Kay Erwin** Where can I find the answer to Gerry Corbin's question "HOW DO WE GET RID OF TIMELINE AND GO BACK TO THE ORIGINAL?"  
January 21, 2012 at 9:39pm · 5



**Starrbwoy Maxwell** How did u get it on i want it  
January 22, 2012 at 5:33am



**Francesca Maritato** off timeline please ...  
January 23, 2012 at 2:11am · 1



**Narendra Dhami** Great! but not working smoothly ... had few bugs and need to be fixed first.  
January 23, 2012 at 4:49pm



**Anna Savvides** Sounds a lot like "Inception" minus the plot and sub-text.  
January 24, 2012 at 9:10pm



**Raheel Khan** Time line Failed....  
January 25, 2012 at 10:17am



**Cassandra Da'Boss** How do I get the timeline  
January 25, 2012 at 3:20pm



**Rodick Andirodick** timeline please .....,  
January 25, 2012 at 8:22pm



**Barbara Harling** why can't we have a option to have timeline or keep it like it is why do we have to have it? I like it like it is.  
January 25, 2012 at 9:07pm · 3



**Barbara Harling** another thing u could have explain it so we could understand it. And why r people saying we have 7 days to make changes? And what changes am I suppose to be making? Just don't understand it!!!!!!  
January 25, 2012 at 9:12pm



**Mary Fowler** Please at the very least make it optional  
THE FORMAT IS HORRIBLE! Everything Facebook is not supposed to be – cluttered and confusing. Facebook's formula to success was clean – easy on the eyes and easy to use format. Another former social networkin... [See More](#)  
January 26, 2012 at 3:36am · 2



**Elbaz El Baz** cool i lik it  
January 29, 2012 at 4:34pm



**Elbaz El Baz** verry good  
January 29, 2012 at 4:34pm



**Mohan Radhakrishnan** Where can I look for sample Thrift services code ? I am getting the utility of Thrift but I don't have highly scalable ideas or examples. Documentation about scalable Thrift seems to be scarce.  
January 29, 2012 at 9:37pm · 1



**Gary Chen** Great!  
January 29, 2012 at 9:58pm · 1



**Ashish Khanal** How to get timeline?  
February 2, 2012 at 6:11am · 1



**Becky OtterBot** ^^ search for in under "help". It will walk you thru the process  
February 2, 2012 at 9:39am



**Joyce Camille Wann** I love the timeliness mobile  
February 3, 2012 at 12:40am · 1



**Nick Martin** Seems quite elegant, esp like the parallelism for the join queries and the aggregation generators.  
February 10, 2012 at 12:49pm · 1



**Seraj Ahmed** Why only image is in attach option in landscape size allowed in new Timeline, isn't a good idea to attach there small video/clip .  
February 14, 2012 at 10:31am · 1



**Albert Agbulos** Love timeline but HATE how there is no central location where all my videos are located on the MOBILE application on Android (not sure if other OS's have the same problem). HATE having to search my timeline wall to find my videos. Please consider a separate tab or link to videos? Thanks!  
February 21, 2012 at 7:46am · 1



**Lucy Mummy Lawton** How do I get timeline on my blackberry?  
February 23, 2012 at 2:30pm · 1

-  **Suzanne Lemire** cant get timeline.  
February 27, 2012 at 9:00pm · 1
-  **Xtoxiex Xtearzx** How can I get a timeline on my blackberry? And how do I get a timeline?  
February 29, 2012 at 1:20am · 1
-  **Rose Bright Boyd** You may think this is a bold now engineering effort, but people shouldn't be forced to have it.  
February 29, 2012 at 10:19am
-  **Jason Pemberton** I don't like you, much.  
March 25, 2012 at 1:33am · 1
-  **Tracy Price** y cant we get a choice...thr r manyyy who hate timeline,myself included  
March 30, 2012 at 12:55am · 1
-  **Kyon Anagata** i can't get an invaitaion in timeline on how to get it. plssssssss..... help me  
March 30, 2012 at 7:29pm
-  **Preethi Viswanathan** Great job !!!!  
April 4, 2012 at 12:00am · 2
-  **Amber Renai** Timeline is sooooo unnecessary, if I deleted something obviously I didn't want it on my wall anymore so why go even farther to when I first made it?! That makes NO sense!  
April 8, 2012 at 11:42am · 2
-  **Glen Flower** let us turn it off. Its crap  
May 10, 2012 at 6:11am · 2
-  **Stephen Hill-mends** Hwew  
July 11, 2012 at 2:16pm
-  **George Mejia** I feel comfortable, but I prefer to try something new for the other users !  
July 13, 2012 at 12:29pm
-  **Adem Adouli** ahla  
July 20, 2012 at 8:35am
-  **Arun Pandey** yeah we believe timeline was a very complex program but seriously annoyed one  
July 22, 2012 at 9:33am
-  **Ritagalih Dinda** :-Yukon  
[See Translation](#)  
July 23, 2012 at 12:47am
-  **Brian Handscorn** Timeline has always seemed a buggy system, and note the fact that to get it to work at all there is a distinct 'Timeline copy'... Well this just asking for trouble, and in fact I have someone on my friend list with a page with almost all the content su... [See More](#)  
August 19, 2012 at 1:40am
-  **Tatendar Gorah Liltat** Timeline sucks BIG time!!!!!!  
September 22, 2012 at 1:48pm
-  **Erme Caraballo** No entiendo ooo  
[See Translation](#)  
October 10, 2012 at 8:20pm
-  **Trương Hoàng Dũng** Timeline ? Nice idea but it's not for human. The timeline indeed does not get people together or understand more each other, it automatically makes the owner just sexier and more modern, it's useless completely. Anyway, timeline is good for marketing, and i think it's main purpose of the timeline, attract more marketers to deliver good pictures to customers.  
January 23, 2013 at 4:00pm
-  **SI MO** need to talk to you  
March 2, 2013 at 5:18pm

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