





timelines at scale

 **Nelson Minar** @nelson
That part of the hip hop record where
a recording of someone urinating.
Expand

 **Nelson Minar** @nelson
@kvox awesome photo, dapper man
vintage airplane?
View conversation

 **Nelson Minar** @nelson
@bookscout oh bullshit, merlot is a
Ch. Petrus, for instance.
View conversation


 **Nelson Minar** @nelson
Yesterday was South Park, today is
Area startup tour? Go kart track? Still
from Woodside, CA

 **Nelson Minar** @nelson
@skatterbean Harris Ranch is a fun
narrow. Don't count on the fuel work
View conversation

 **Nelson Minar** @nelson
@bradfordcross no worries, thanks!
stopped using Techmeme. Just make scrolling work consistently! :-)
View conversation

36m

 **Tim O'Reilly** @timoreilly
"online messages that evoke feelings
unintentionally joy!)...a poetry of the
Expand

 **Tim O'Reilly** @timoreilly
What's the craziest thing your dad
results from @make's homage to Facebook
Expand

 **Tim O'Reilly** @timoreilly
Potentially wonderful, Also very scary
banker in Spain bit.ly/KExVdk Fund
View media

 **Tim O'Reilly** @timoreilly
Old friend selling beautiful cottage on
Queens, NYC: bit.ly/KEvKqf
Expand

 **Ivan Tarradellas** @itarradellas
@deepakmohoni @timoreilly @quixote
"Go to the edge of the cliff and jump
down"
Retweeted by Tim O'Reilly
View conversation Reply Retw

 **Chris Matts** @PapaChrisMatts
Looking forward to #QCONNewYork on Monday. Talking about Lazy
Learner. The other the "Agile Individuals track" speakers are most
#awesome!
Retweeted by QCon New York
Expand

 **QCon New York** @qconnewyork
"Spring Data - NoSQL, NoProblems" talk by @PeterBell at QCon
New York. #springframework #nosql #mongodb #neo4j
[qconnewyork.com/qcon-nyc-2012/...](http://qconnewyork.com/qcon-nyc-2012/)
Expand

 **QCon New York** @qconnewyork
Want to learn how #APM can help you get the most out of your
#bigdata application? See @mikopp's session at #qconnewyork
[qconnewyork.com/qcon-nyc-2012/...](http://qconnewyork.com/qcon-nyc-2012/)
Expand

 **QCon New York** @qconnewyork
Creating maintainable, sustainable software can be hard but not
impossible-Alexander von Zitzewitz #qconnewyork goo.gl/o3Dy7
Expand

 **QCon New York** @qconnewyork
don't miss your chance to save \$200 for #qconnewyork! early bird
expires Friday 6/15/2012! [secure.trifork.com/qcon-nyc-2012/...](http://secure.trifork.com/qcon-nyc-2012/)
Expand

15 Jun

14 Jun

13 Jun

12 Jun

11 Jun



Tim O'Reilly @timoreilly

31m

"online messages that evoke feelings of despair (and, often and unintentionally joy!)...a poetry of the New Aesthetic" bit.ly/NlePmd

Expand



Nelson Minar @nelson

36m

That part of the hip hop record where they think it's funny to include a recording of someone urinating.

Expand



Tim O'Reilly @timoreilly

2h

What's the craziest thing your dad ever made? bit.ly/KEIn4D Some results from @make's homage to Father's Day

Expand



Tim O'Reilly @timoreilly

4h

Potentially wonderful, Also very scary: crowdfunded lawsuit against banker in Spain bit.ly/KExVdk Funded 24 hrs bit.ly/KExSOG

[View media](#)



Tim O'Reilly @timoreilly

4h

Old friend selling beautiful cottage on huge garden lot in Bayside, Queens, NYC: bit.ly/KEvKqf

Expand



Nelson Minar @nelson

23h

Yesterday was South Park, today is Buck's. What's next on my Bay Area startup tour? Go kart track? Suburban garages?

[from Woodside, CA](#)



Ivan Tarradellas @itarradellas

16 Jun

@deepakmohoni @timoreilly @quixotic @dpatil Yes, Ray Bradbury "Go to the edge of the cliff and jump off. Build your wings on the way down"

[Retweeted by Tim O'Reilly](#)

[View conversation](#) [Reply](#) [Retweet](#) [Favorite](#)



Chris Matts @PapaChrisMatts

15 Jun

Looking forward to #QCONNewYork on Monday. Talking about Lazy Learner. The other the "Agile Individuals track" speakers are most [#awesome!](#)

[Retweeted by QCon New York](#)

Pull

Push

Targeted

twitter.com

User / Site Streams

home_timeline API

Mobile Push (SMS, etc.)

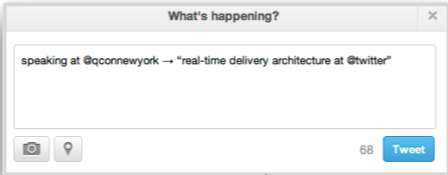
Queried

Search API

Track / Follow Streams

the challenge

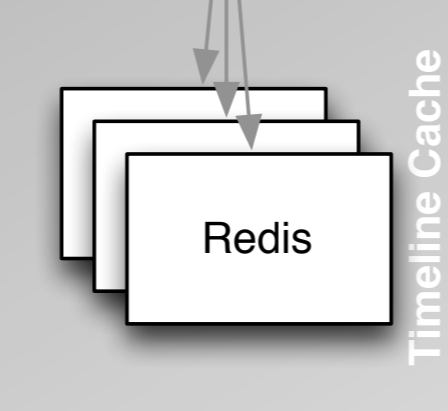
- > 150M world wide active users
- > 300K QPS for timelines
- naïve timeline “materialization” can be slow

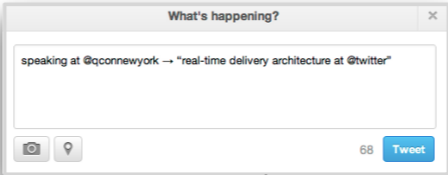


Write API



Fanout

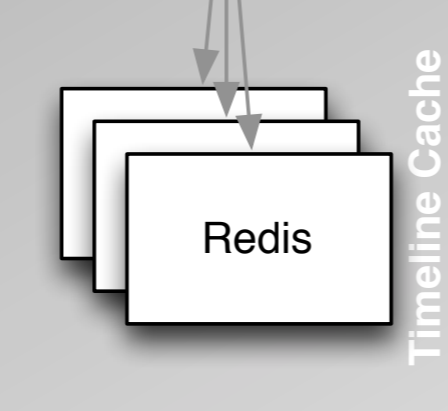




Write API



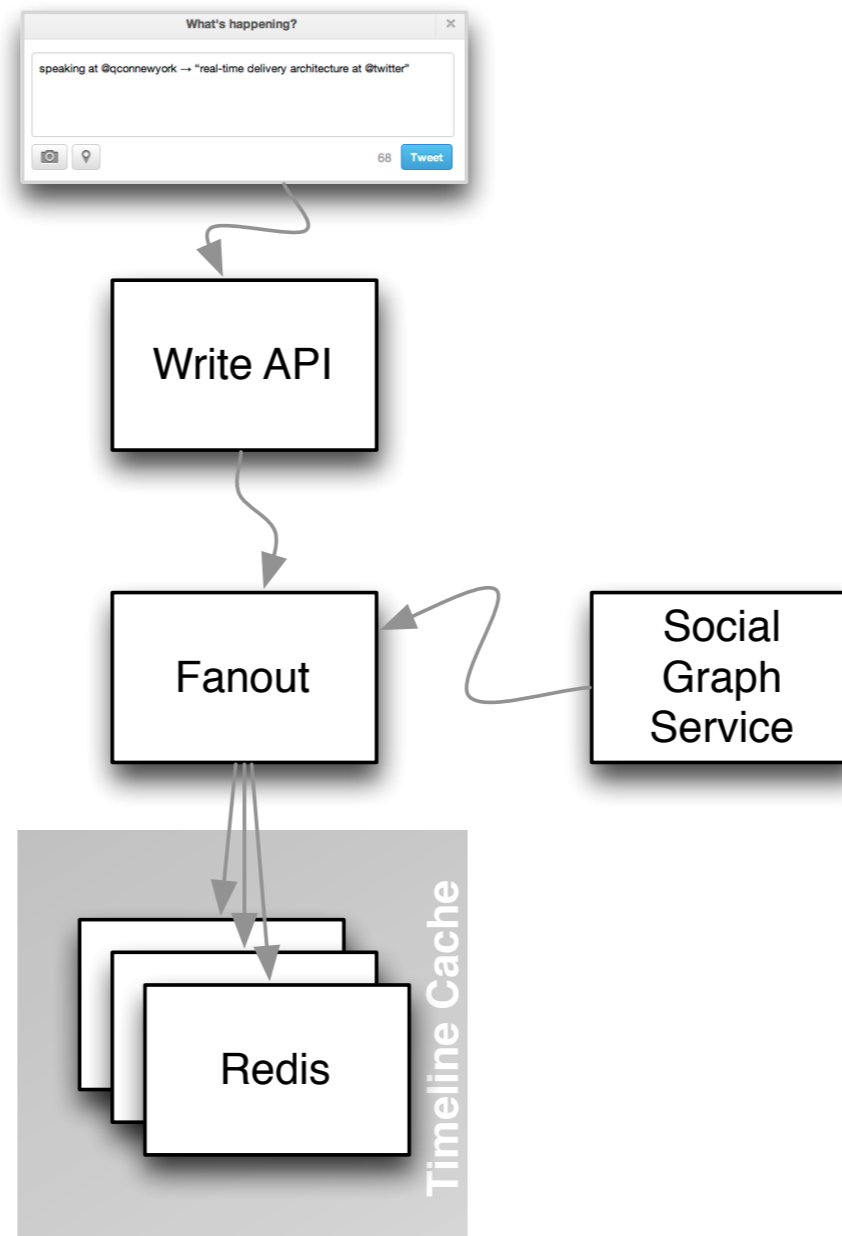
Fanout



Social Graph Service

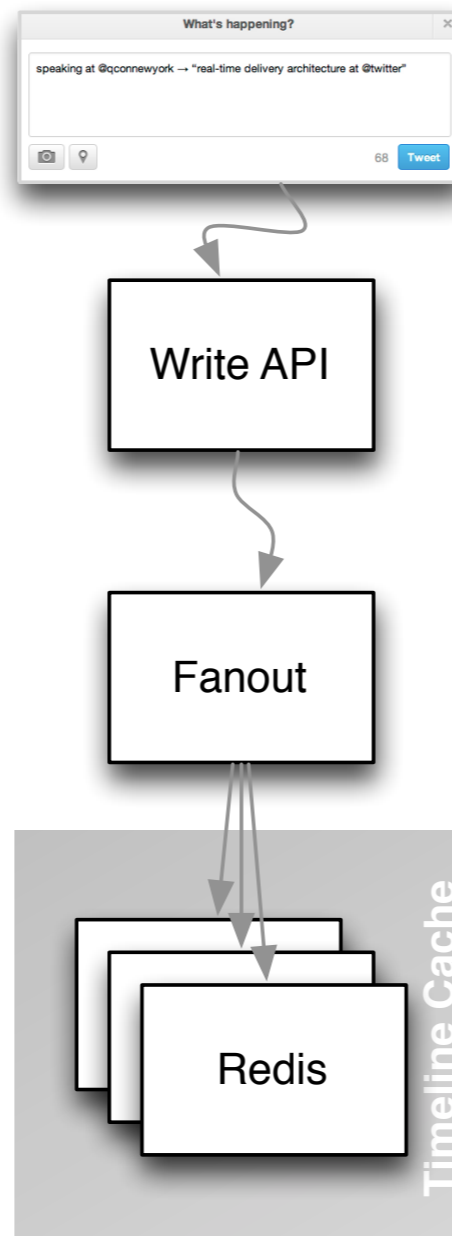
insert

- keyed off “recipient”
- pipelined 4k “destinations” at a time
- replicated



using redis

→ native list structure

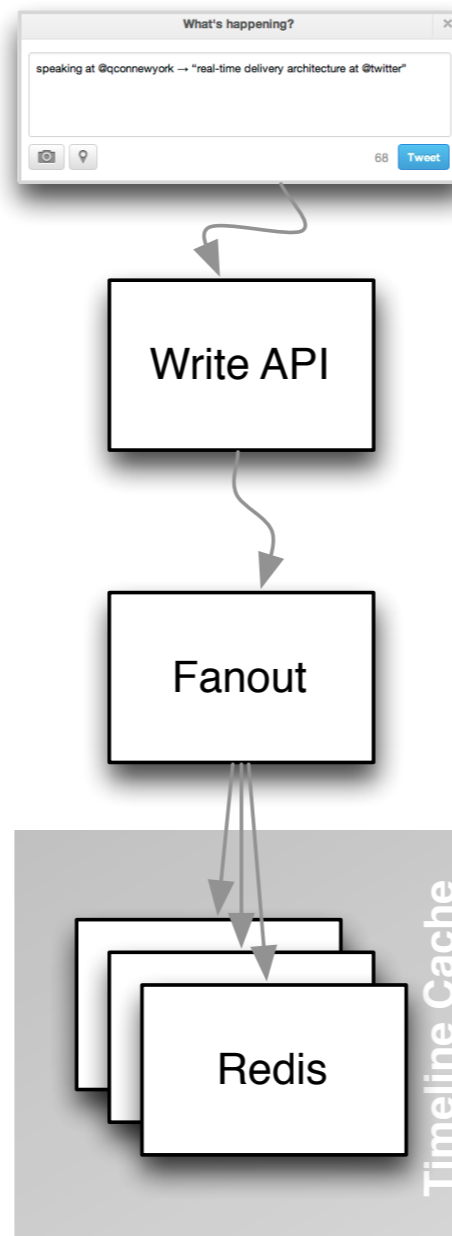


Tweet ID	User ID	Bits
8 bytes	8 bytes	4 bytes

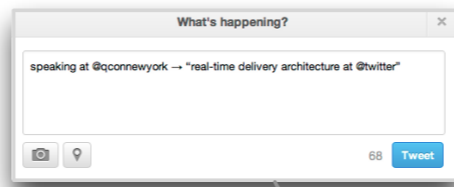
using redis

→ native list structure

→ RPU SHX to only add to cached timelines

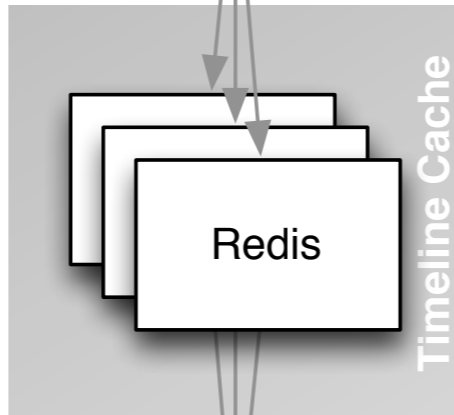


Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	

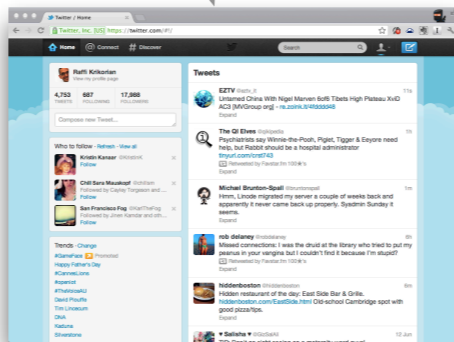


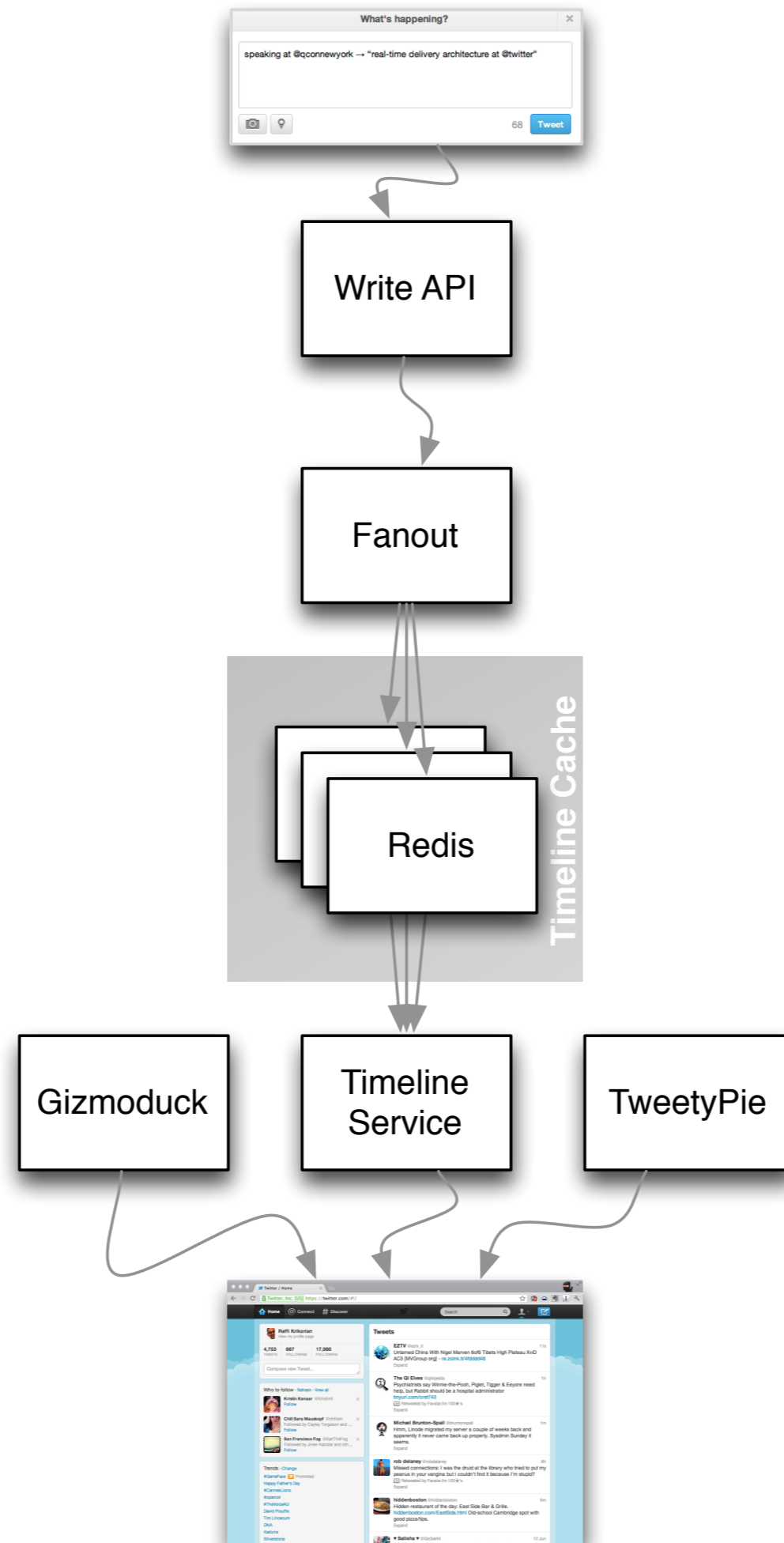
Write API

Fanout



Timeline Service





Pull

Push

Targeted

twitter.com

User / Site Streams

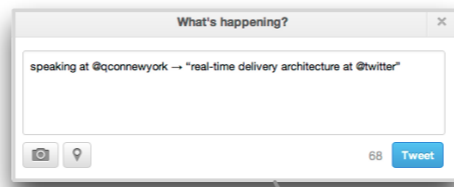
home_timeline API

Mobile Push (SMS, etc.)

Queried

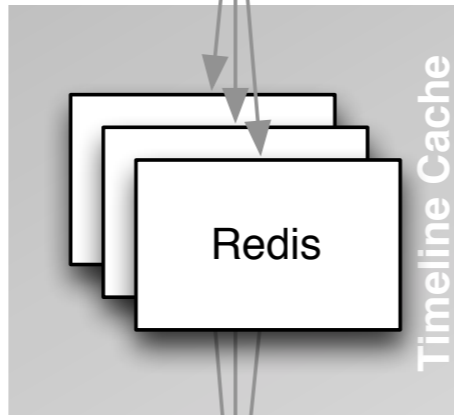
Search API

Track / Follow Streams

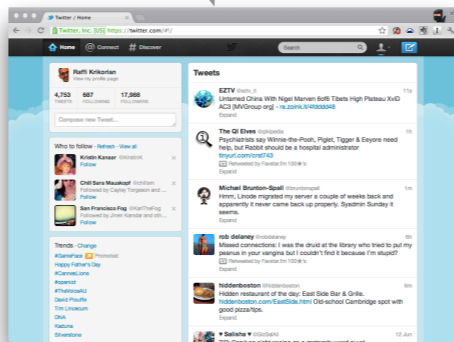


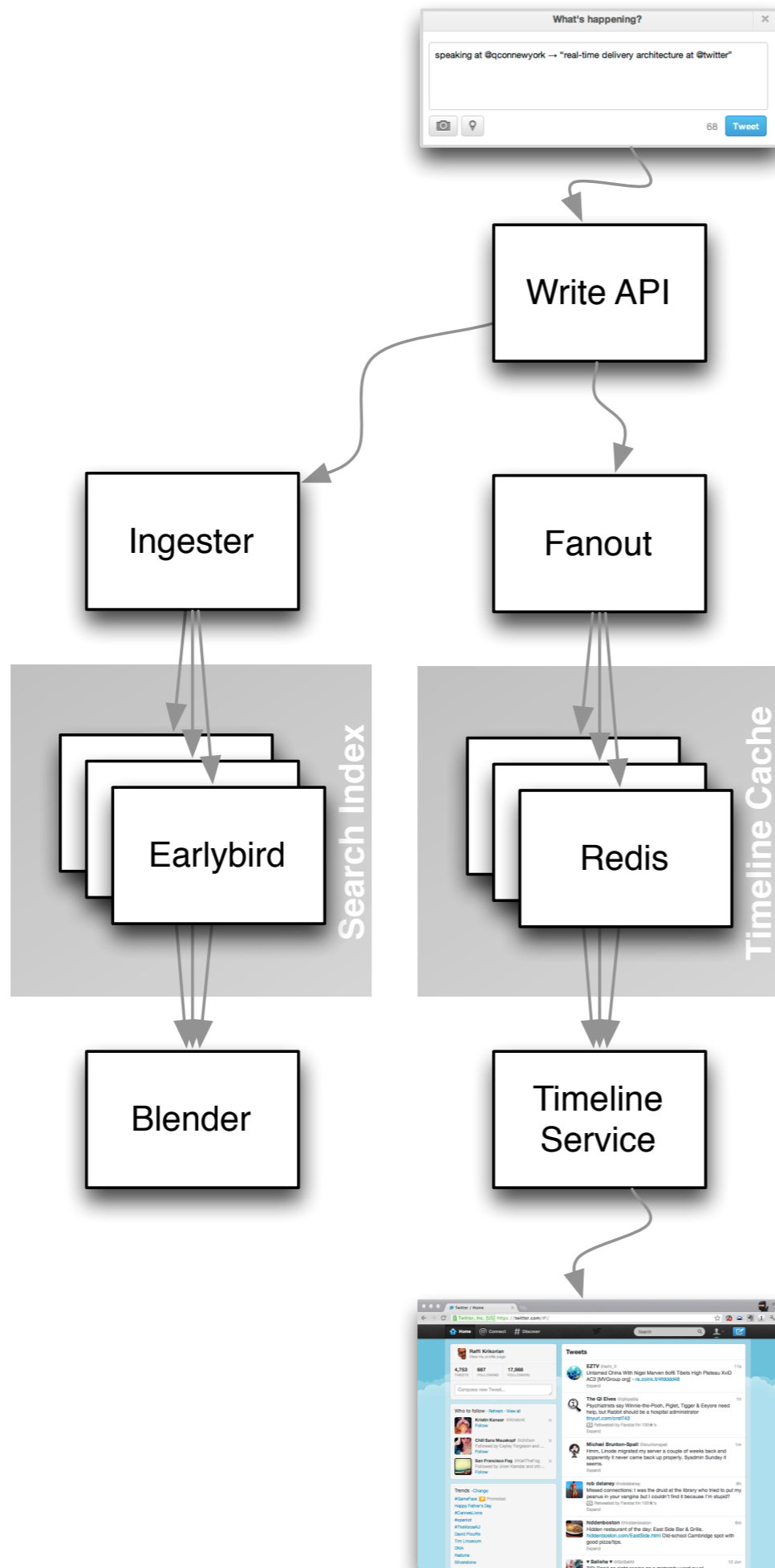
Write API

Fanout



Timeline Service

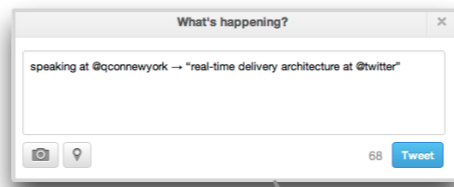




blender

...queries one replica of all indexes

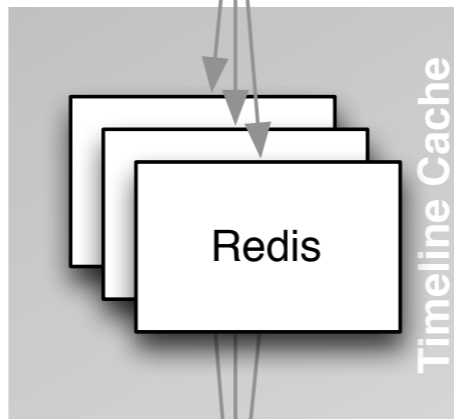
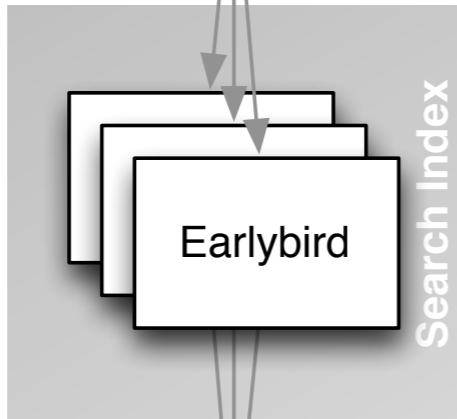
...merges & ranks results



Write API

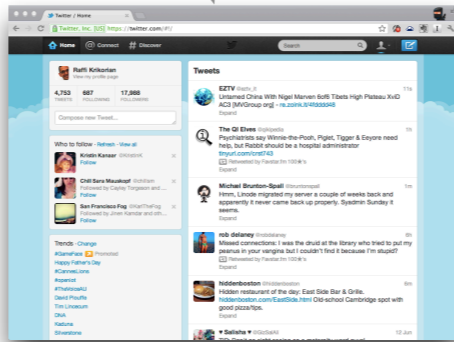
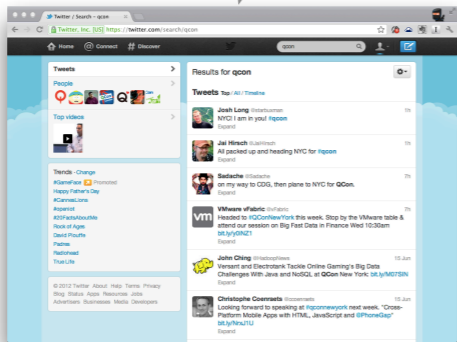
Fanout

Ingester

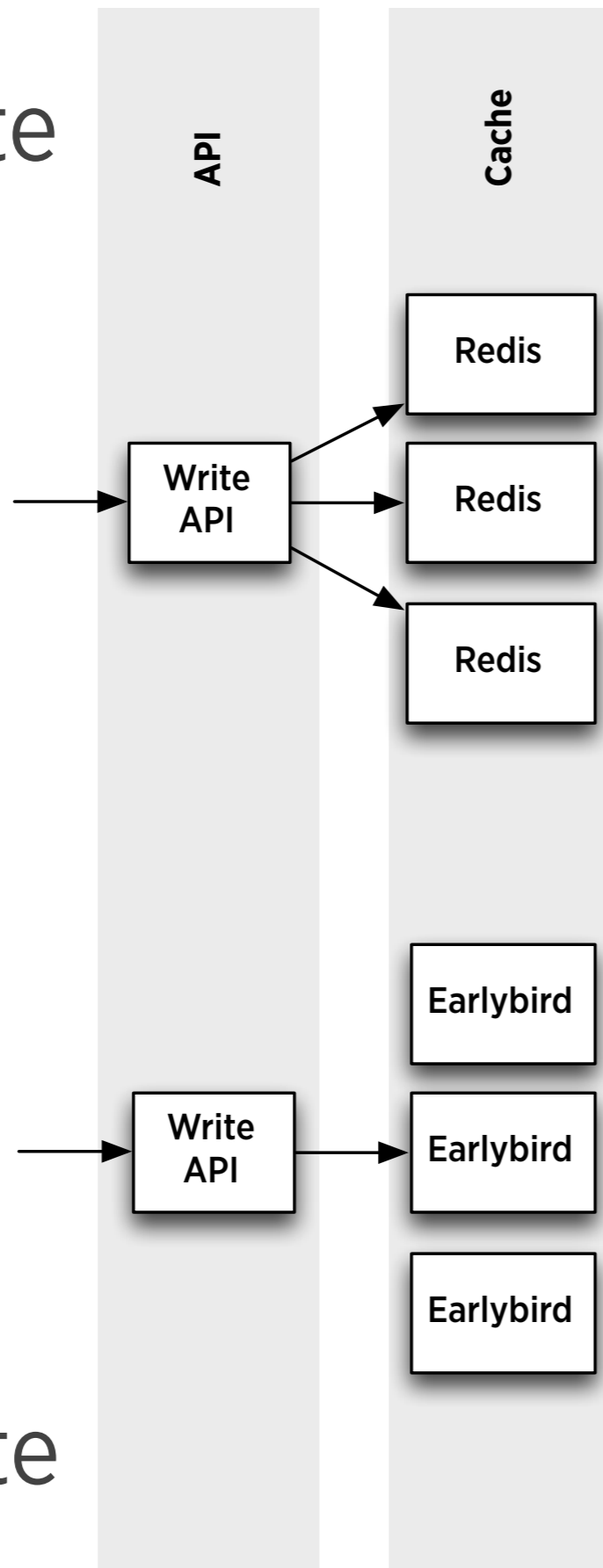


Blender

Timeline Service

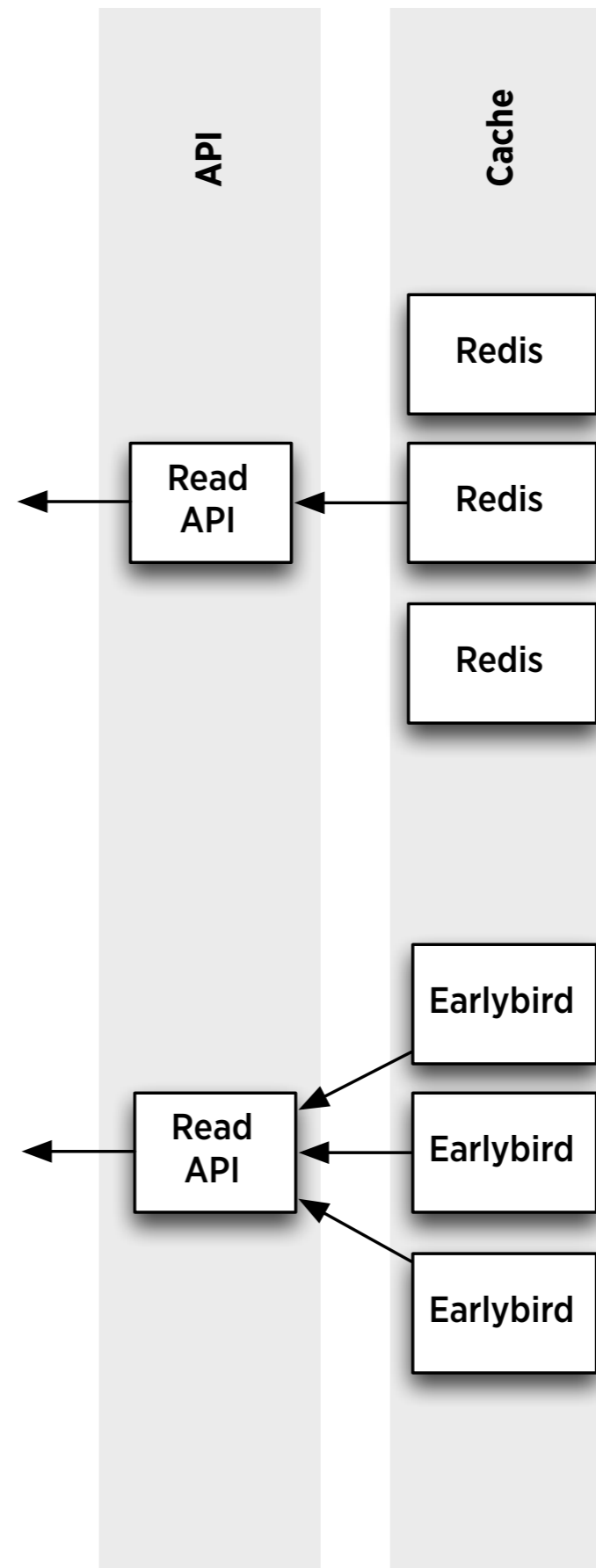


→ $O(n)$ write



→ $O(1)$ write

→ $O(1)$ read

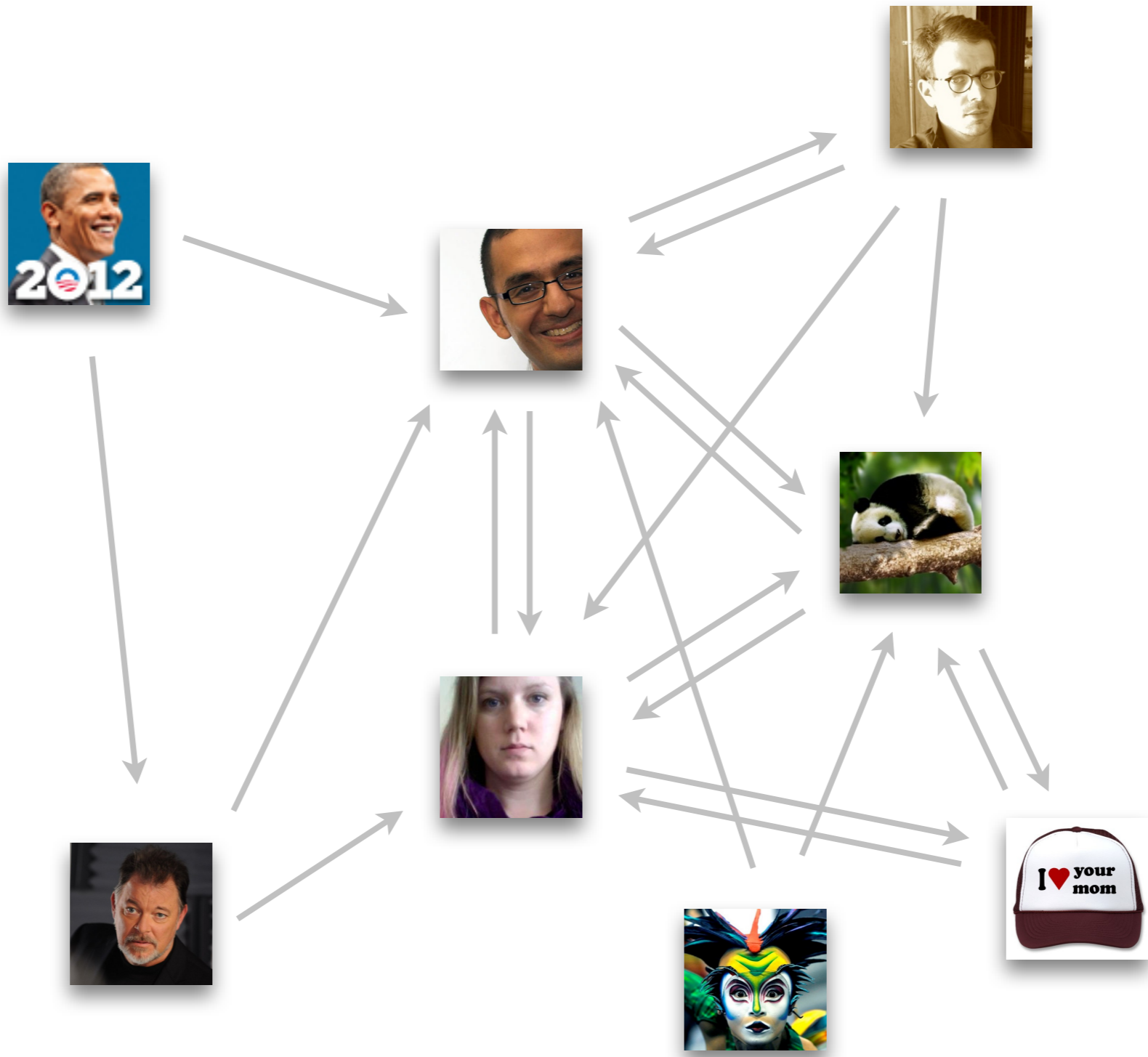


→ $O(n)$ read

the challenge (part #2)

→ fanout can be really slow!

→ ...especially for high follower counts





@ladygaga ✓
31 million followers



@katyperry ✓
28 million followers



@justinbieber ✓
28 million followers



@barackobama ✓
23 million followers



@raffi
0.019 million followers

there are over
400 million tweets
a day

4600 tweets

a second

What's happening?

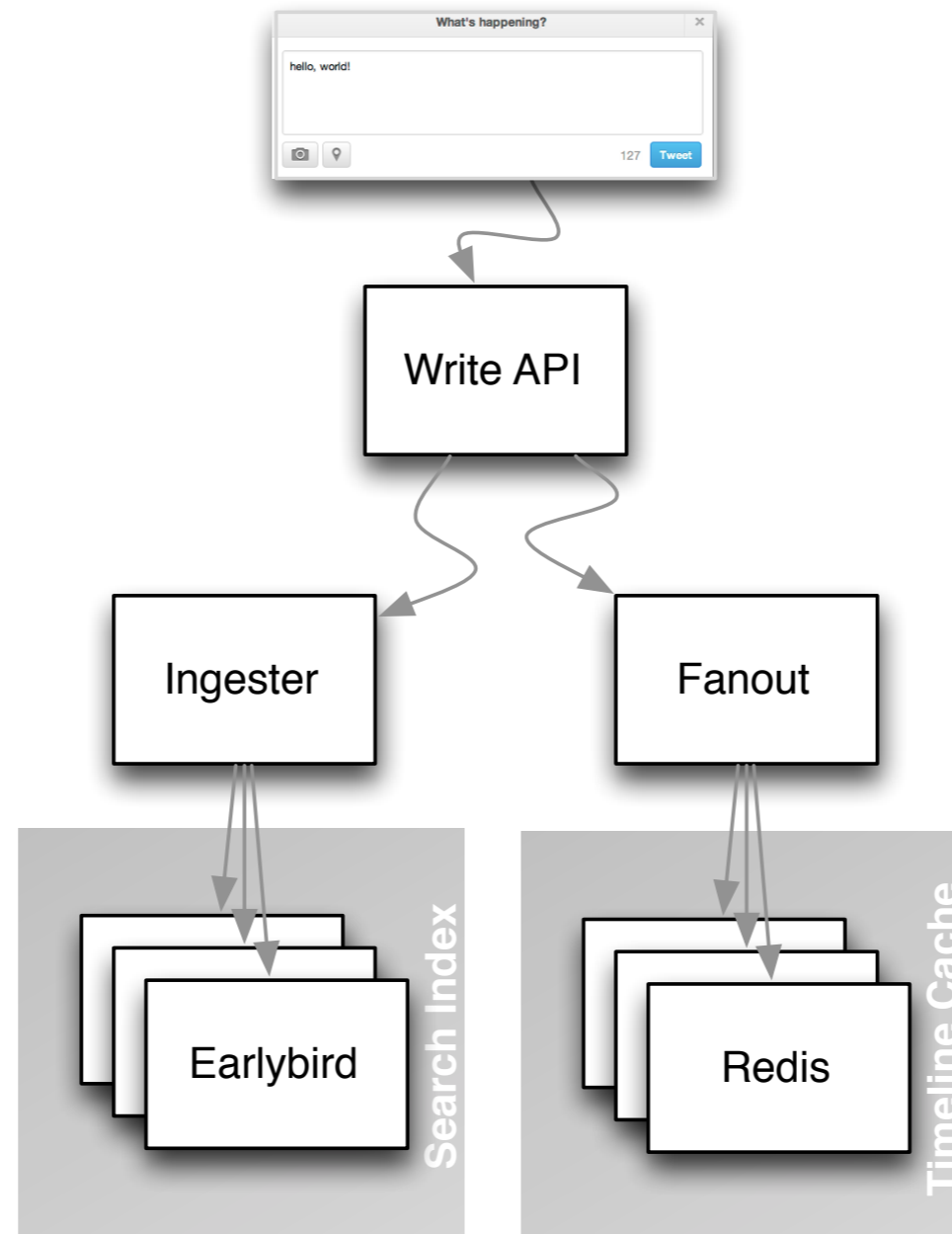


hello, world!



127

Tweet



search index

→ ['hello', 'world']

fanout index

→ [@danadanger, ...]

User Intent

“Hello, world”

Query Expansion

“Hello” AND “world”

@raffi's home timeline

home_timeline:raffi

User Intent

“Hello, world”

@raffi’s home timeline

Query Expansion

“Hello” AND “world”

user_timeline:nelson

OR

user_timeline:danadanger

User Intent

“Hello, world”

Query Expansion

“Hello” AND “world”

@raffi's home timeline

home_timeline:raffi

User Intent

“Hello, world”

@raffi’s home timeline

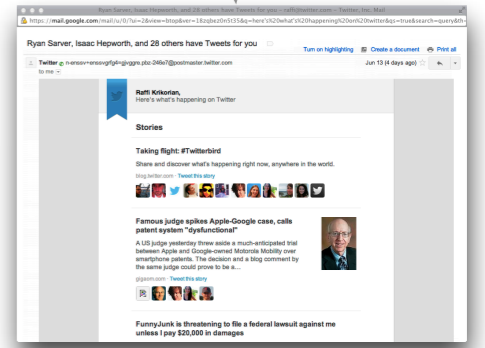
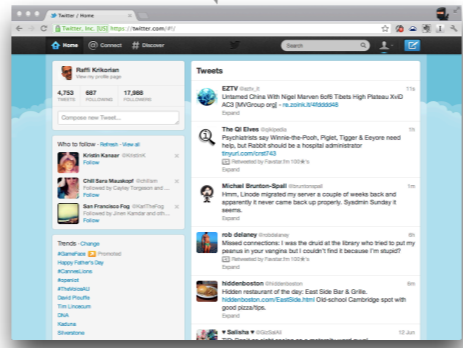
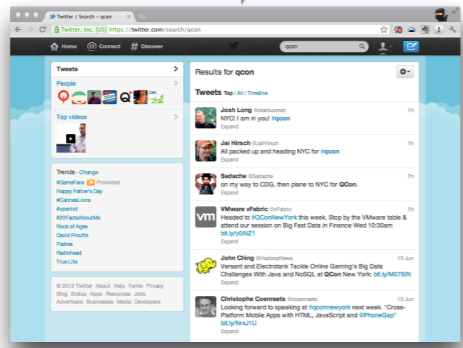
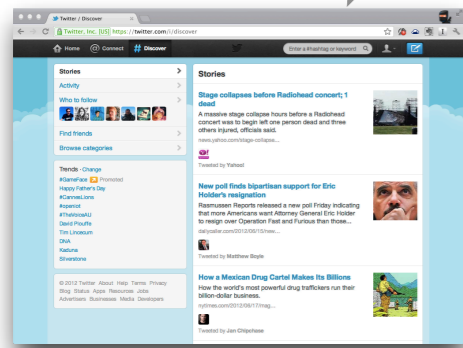
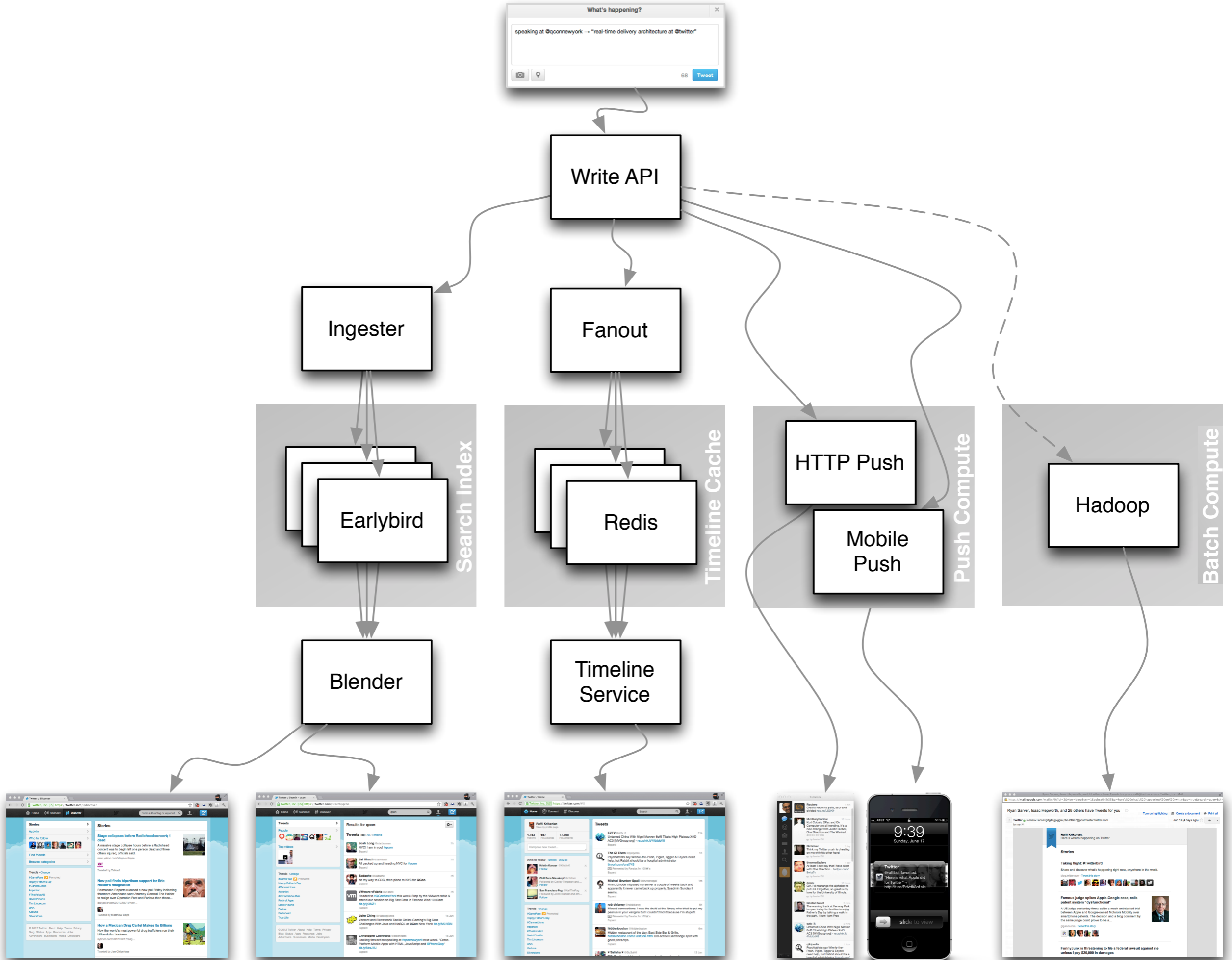
Query Expansion

“Hello” AND “world”

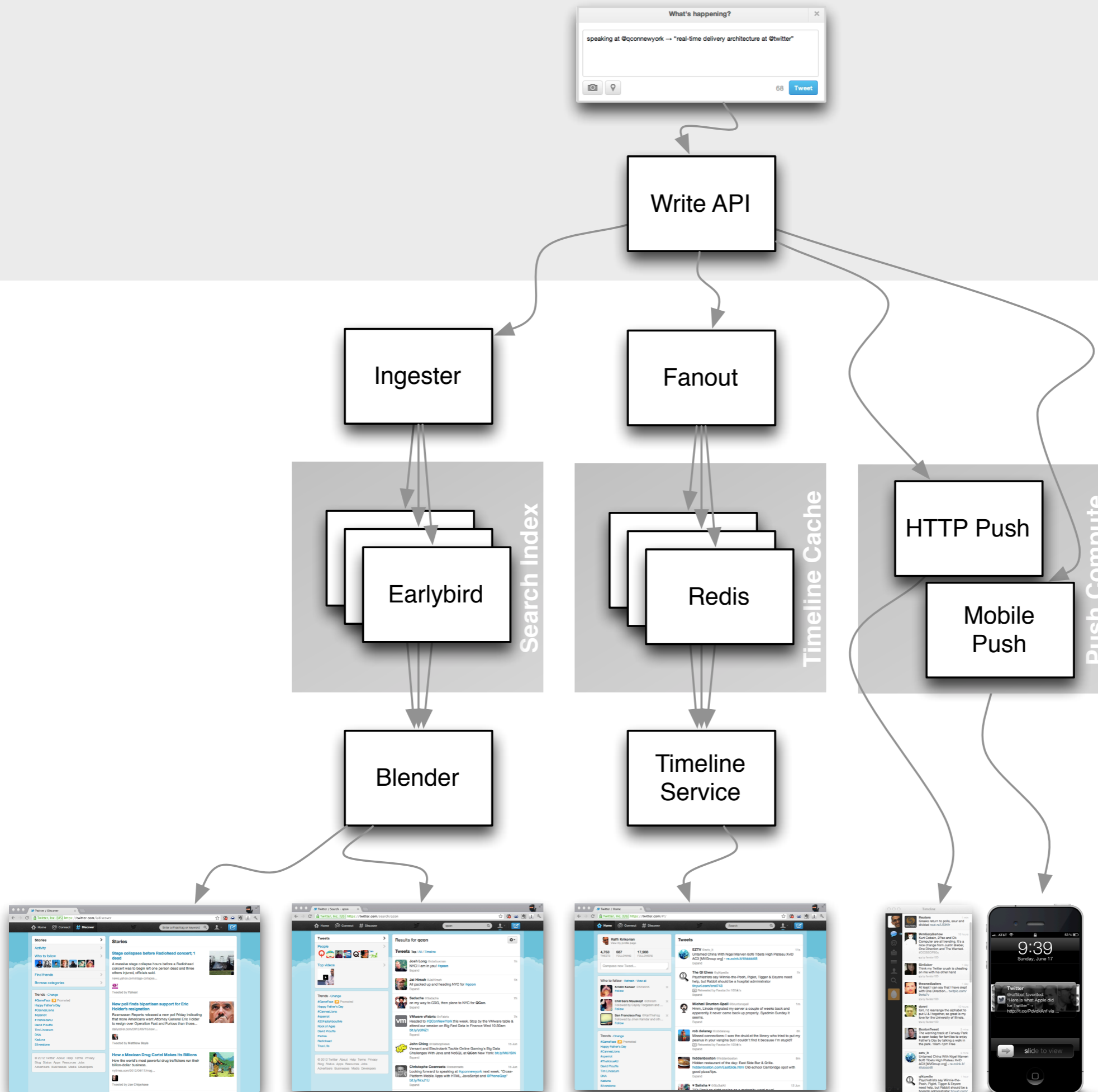
home_timeline:raffi

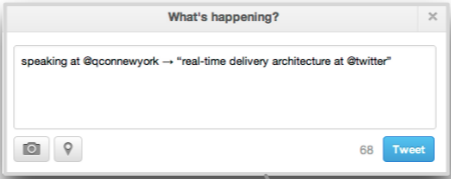
OR

user_timeline:taylorswift13



Synchronous Path





Write API

Ingestor

Fanout

Search Index

Earlybird

Timeline Cache

Redis

HTTP Push

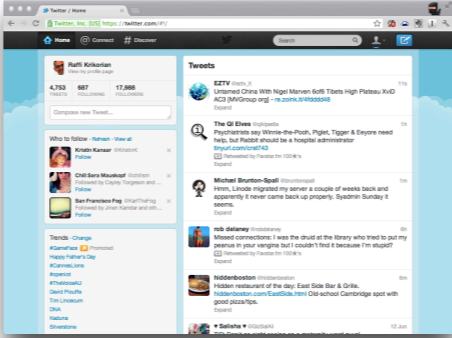
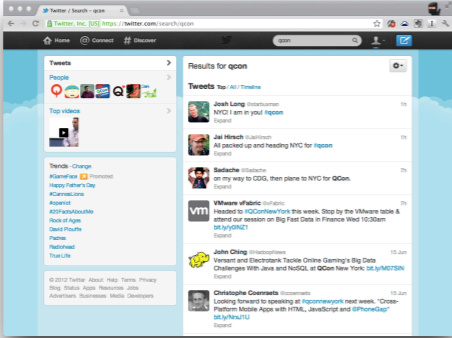
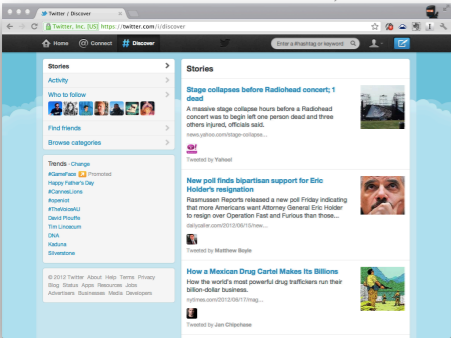
Mobile Push

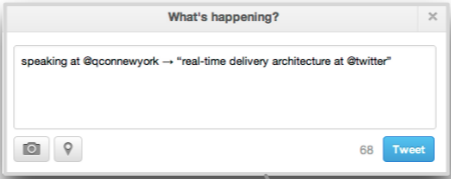
Push Compute

Asynchronous Path

Blender

Timeline Service





Write API

Ingestor

Fanout

Search Index

Earlybird

Timeline Cache

Redis

Push Compute

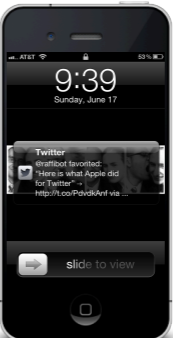
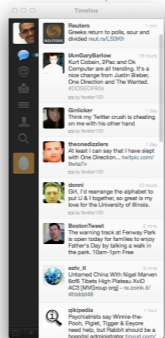
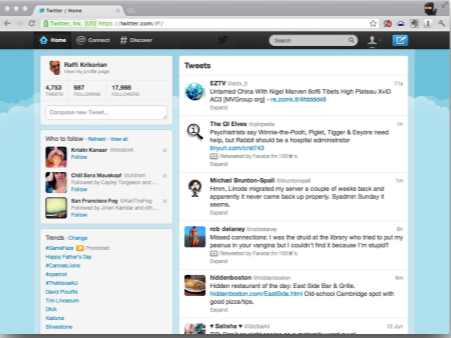
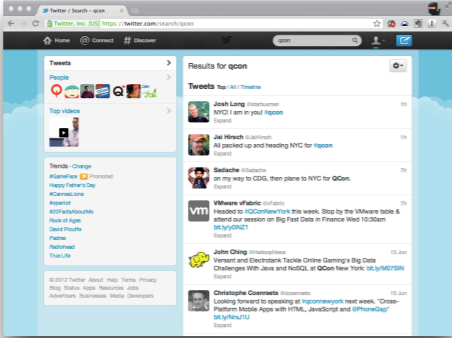
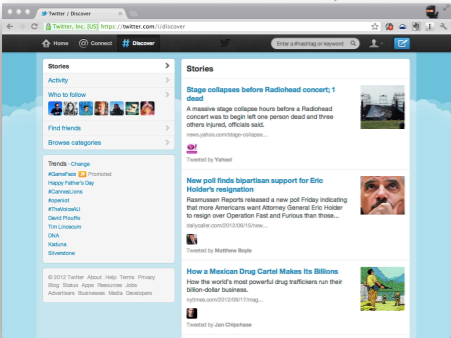
HTTP Push

Mobile Push

Query Path

Blender

Timeline Service



timeline query statistics

- >150m active users worldwide
- >300k qps poll-based timelines
@ 1ms p50 / 4ms p99
- >30k qps search-based timelines

tweet input

- ~400m tweets per day
- ~5K/sec daily average
- ~7K/sec daily peak
- >12K/sec during large events

timeline delivery statistics

- 30b deliveries / day (~21m / min)
- 3.5 seconds @ p50 to deliver to 1m
- ~300k deliveries / sec



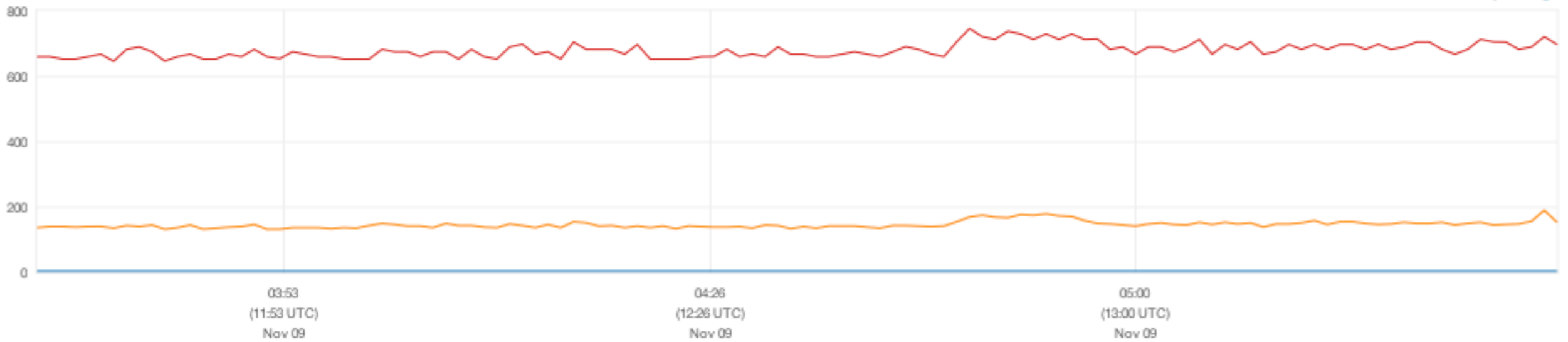
Search

Options

QUERY

Custom Chart

2h 6h 12h 1d 1w | settings



link | image

show/hide

Query Docs

Delete	TLS home_timeline p50	<code>ts(avg, monorail, audubon.role.scribe.ostrich, timelines/timelineservice/home_timeline/read/latency_ms.p50)</code>
Delete	TLS home_timeline p99	<code>ts(avg, monorail, audubon.role.scribe.ostrich, timelines/timelineservice/home_timeline/read/latency_ms.p99)</code>
Delete	TLS home_timeline p999	<code>ts(avg, monorail, audubon.role.scribe.ostrich, timelines/timelineservice/home_timeline/read/latency_ms.p999)</code>

Refresh Chart Add Row



Service

Span

+ Annotation

+ Key-Value

End time

Limit

Find traces



Please select the criteria for your trace lookup on the left.



Service

Span

+ Annotation **+** Key-Value

End time

Limit

Filter Showing: 100 of 100 Results

api.twitter.com-ssl

69.15 ms

memcached/object x3 | timeline_service x1 | memcached/lookaside x8 | timelineservice x1
 memcached/rate x1 | cluster_twitterweb_unicorn x1 | memcached x1 | monorail x1 | api.twitter.com-ssl x1 | memcached/user x1

about 1 minute ago

68.174 ms

memcached/object x3 | memcached/lookaside x11 | flockdb_edges x4
 cluster_twitterweb_unicorn x1 | limiter x1 | memcached x2 | monorail x1 | api.twitter.com-ssl x1
 memcached/user x2 | passbird x1 | gizmoduck x1 | tflock x4 | flock x4

about 1 minute ago

68.057 ms

memcached/object x4 | timeline_service x1 | memcached/lookaside x13 | timelineservice x1
 memcached/united x2 | memcached/rate x1 | cluster_twitterweb_unicorn x1 | memcached x7
 monorail x1 | api.twitter.com-ssl x1 | tweetyple x1 | memcached/user x1 | memcached/magic x1

about 1 minute ago

66.869 ms

memcached/object x3 | memcached/lookaside x11 | flockdb_edges x4
 cluster_twitterweb_unicorn x1 | limiter x1 | memcached x2 | monorail x1 | api.twitter.com-ssl x1
 memcached/user x2 | passbird x1 | gizmoduck x1 | tflock x4 | flock x4

about 1 minute ago

65.21 ms

cluster_twitterweb_aquila x1 | memcached/object x3 | proxyclient x1 | memcached/lookaside x8
 memcached/rate x1 | monorail x1 | api.twitter.com-ssl x1 | memcached/user x1 | haplo x2

about 1 minute ago

64.932 ms

cluster_twitterweb_apollo x1 | memcached/object x3 | timeline_service x1
 memcached/lookaside x8 | timelineservice x1 | memcached/rate x2 | memcached x1 | monorail x1
 api.twitter.com-ssl x1 | memcached/user x1 | memcached/magic x2

about 1 minute ago



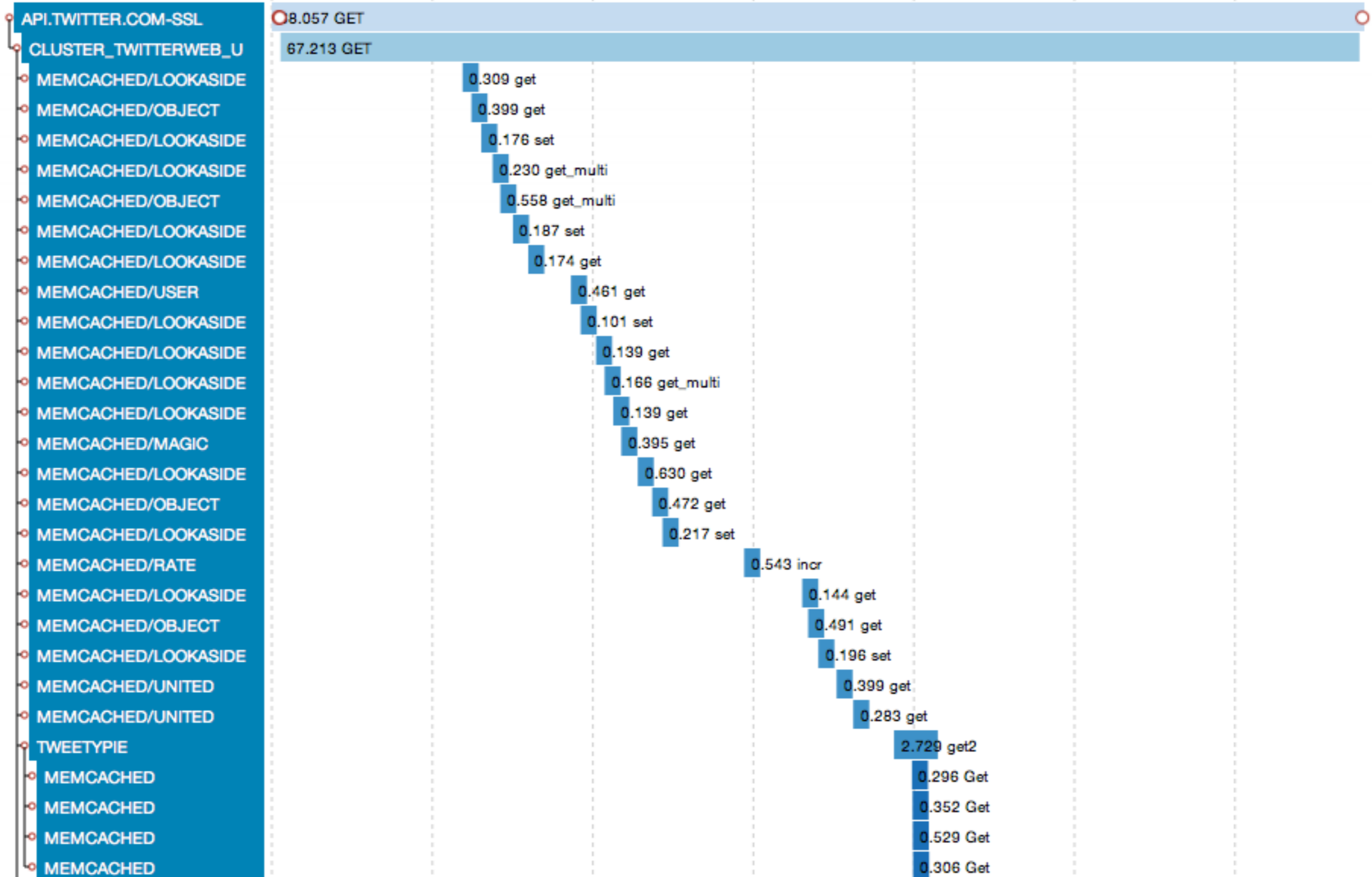
Overview Timeline Dependencies

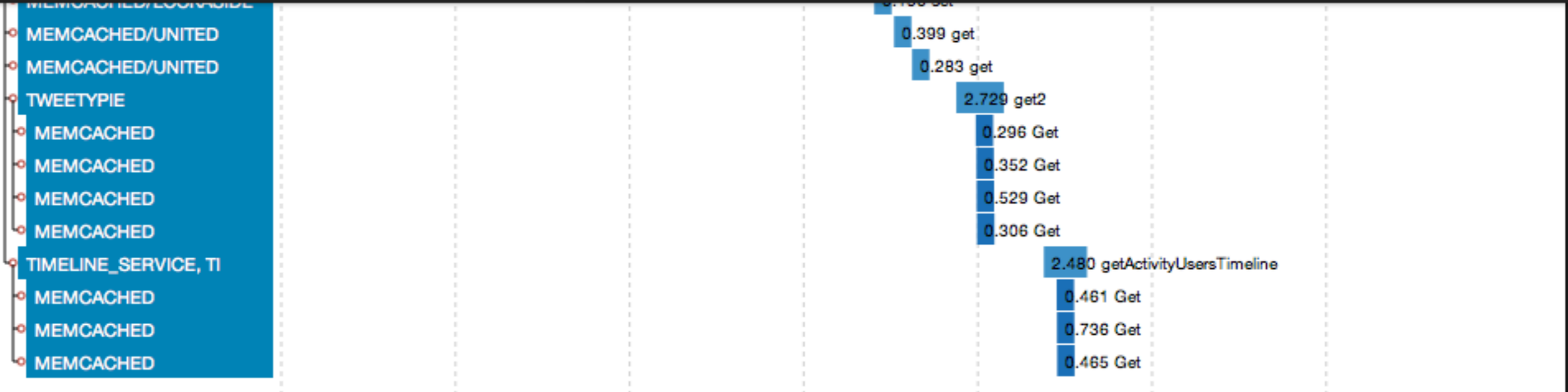
Search term (service)



68.057 ms about 2 minutes ago

0ms 10ms 20ms 30ms 40ms 50ms 60ms





- Duplicate key/value annotations (6)

Key	Value	#	Spans
memcached.keys	AccessToken:3:token:498750640-kjymc7qsfmtr8agjtmrrqtl1ayi7Onzthavumiup	3	get x2 set x1
memcached.keys	AccessToken:3:1064140483	3	get_multi x2 set x1
memcached.keys	AccessToken:3:829051188	3	get x2 set x1
memcached.keys	Piggyback::GeneratedClasses::AccessToken::OAuthAccessTokensXtra:1:829051188	3	get x2 set x1
memcached.keys	User:3:498750640	2	get x1 set x1
memcached.keys	UnitedStatus:1:266895713768714241	2	get x2

- Service summary

Service	CPU	Wait
cluster_twitterweb_unicom_monorail	55.195	12.018
memcached	3.145	0.000
memcached/lookaside	2.808	0.000
tweetyple	2.200	0.529
memcached/object	1.920	0.000
timeline_service, timelineservice	1.744	0.736
api.twitter.com-ssl	0.844	67.213
memcached/united	0.682	0.000
memcached/rate	0.543	0.000
memcached/user	0.461	0.000
memcached/magic	0.395	0.000

timeline_service, timelinesservice: 2.480ms

api.twitter.com-ssl.GET / cluster_twitterweb_unicorn,monorail.GET /
 timeline_service,timelinesservice.getActivityUsersTimeline

Relative time	Service	Span Name	Annotation	Host
43.8ms	timeline_service, timelinesservice	getActivityUsersTimeline	Client send	10.35.245.112:-9918
44.4ms	timeline_service, timelinesservice	getActivityUsersTimeline	Server receive	10.35.61.139:8287
45.6ms	timeline_service, timelinesservice	getActivityUsersTimeline	Server send	10.35.61.139:8287
46.3ms	timeline_service, timelinesservice	getActivityUsersTimeline	Client receive	10.35.245.112:-9918

CPU



Wait

55.195 12.018

3.145 0.000

2.808 0.000

2.200 0.529

1.920 0.000

1.744 0.736

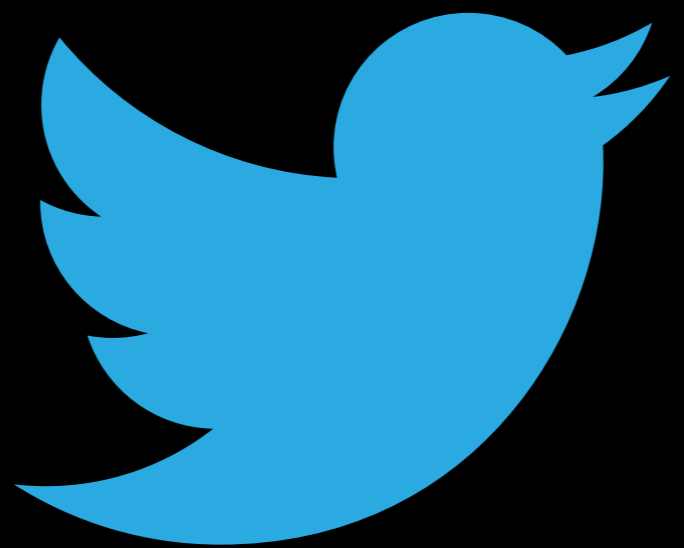
0.844 67.213

0.682 0.000

0.543 0.000

0.461 0.000

0.395 0.000



thanks!