



timelines at scale

Nelson Minar @nelson 36m That part of the hip hop record where a recording of someone urinating. [Expand](#)

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

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](#) [Expand](#)

Nelson Minar @nelson @kvox awesome photo, dapper man vintage airplane? [View conversation](#)

Tim O'Reilly @timoreilly What's the craziest thing your dad ever did? [Expand](#)

QCon New York @qconnewyork 14 Jun "Spring Data - NoSQL, NoProblems" talk by **@PeterBell** at QCon New York. **#springframework #nosql #mongodb #neo4j** [qconnewyork.com/qcon-nyc-2012/...](#) [Expand](#)

Nelson Minar @nelson @bookscout oh bullshit, merlot is a lousy wine. Ch. Petrus, for instance. [View conversation](#)

Tim O'Reilly @timoreilly Potentially wonderful. Also very scary. A banker in Spain bit.ly/KExVdk Funded [View media](#)

QCon New York @qconnewyork 13 Jun 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/...](#) [Expand](#)

Nelson Minar @nelson Yesterday was South Park, today is Area startup tour? Go kart track? Sunburn? from Woodside, CA [View conversation](#)

Tim O'Reilly @timoreilly Old friend selling beautiful cottage on ridge garden hot in Bayside, Queens, NYC: bit.ly/KEvKqf [Expand](#)

QCon New York @qconnewyork 12 Jun Creating maintainable, sustainable software can be hard but not impossible-Alexander von Zitzewitz **#qconnewyork** [goo.gl/o3Dy7](#) [Expand](#)

Nelson Minar @nelson @skatterbean Harris Ranch is a fun place to go. Narrow. Don't count on the fuel world. [View conversation](#)

Ivan Tarradellas @itarradellas @deepakmohoni @timoreilly @quixotic "Go to the edge of the cliff and jump down" [Retweeted by Tim O'Reilly](#) [View conversation](#) [Reply](#) [Retweet](#)

QCon New York @qconnewyork 11 Jun don't miss your chance to save \$200 for **#qconnewyork!** early bird expires Friday 6/15/2012! [secure.trifork.com/qcon-nyc-2012/...](#) [Expand](#)

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

**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/KEln4D 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

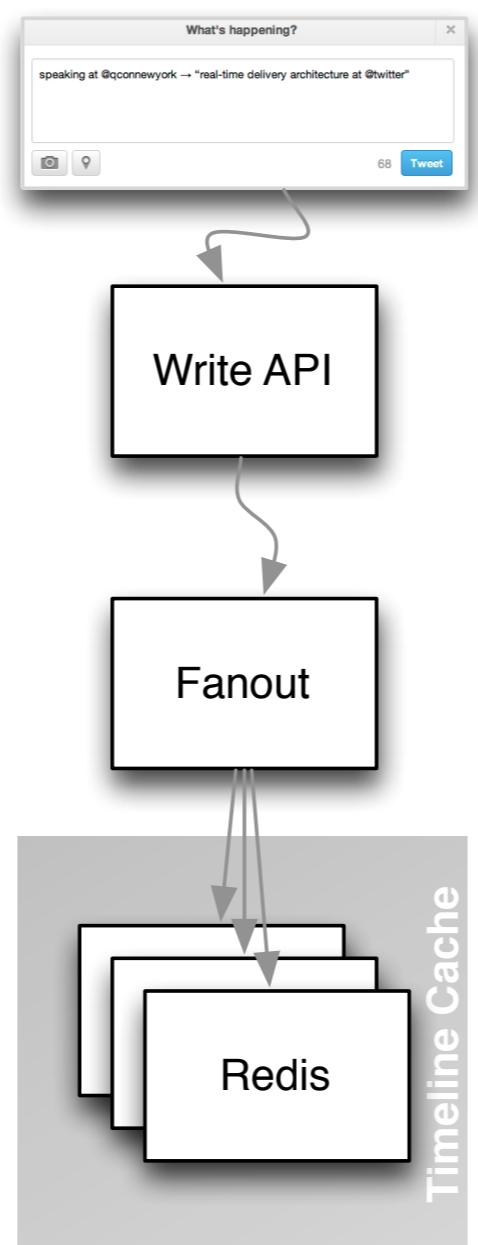
Looking forward to [#QCONNewYork](#) on Monday. Talking about Lazy Learner. The other the "Agile Individuals track" speakers are most [#awesome!](#)

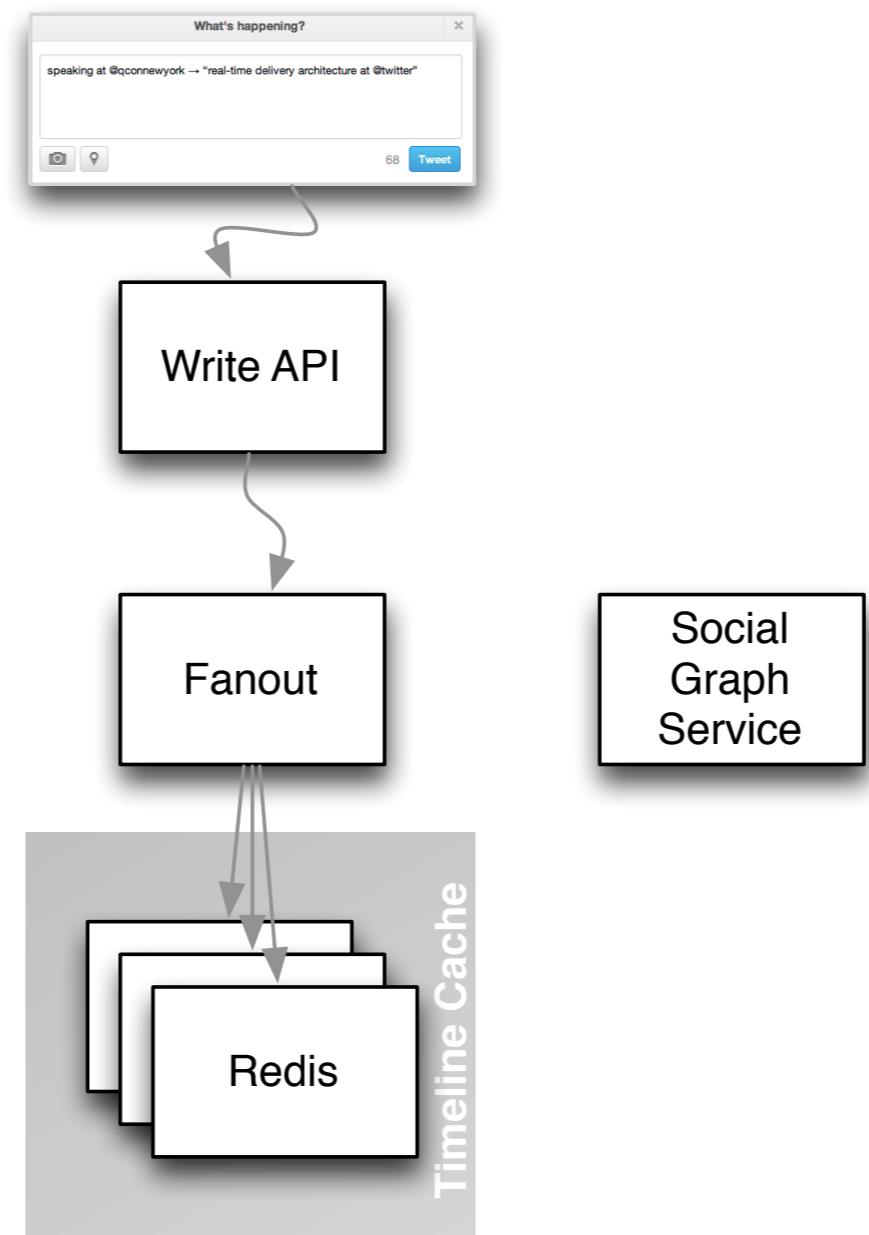
🕒 Retweeted by QCon New York

	Pull	Push
Targeted	twitter.com home_timeline API	User / Site Streams Mobile Push (SMS, etc.)
Queried	Search API	Track / Follow Streams

the challenge

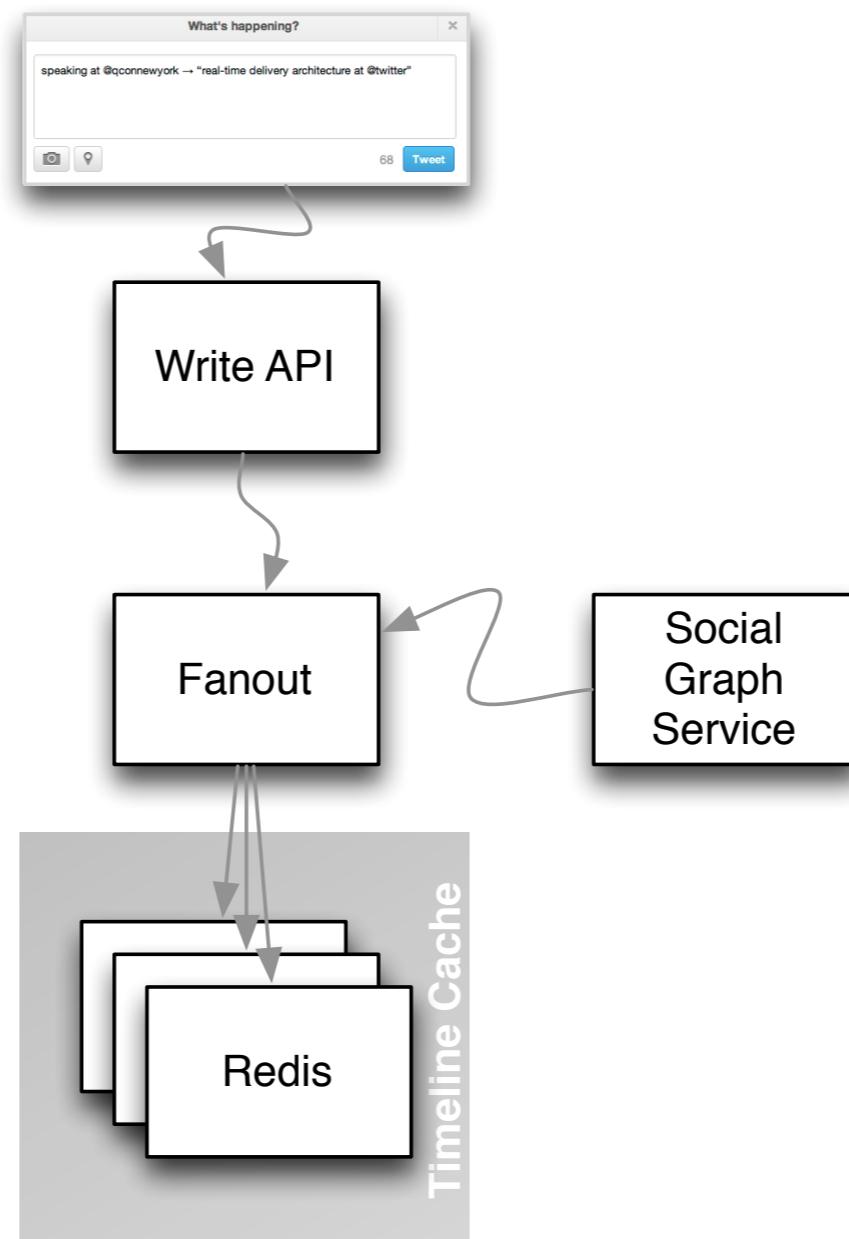
- > 150M world wide active users
- > 300K QPS for timelines
- naïve timeline “materialization” can be slow





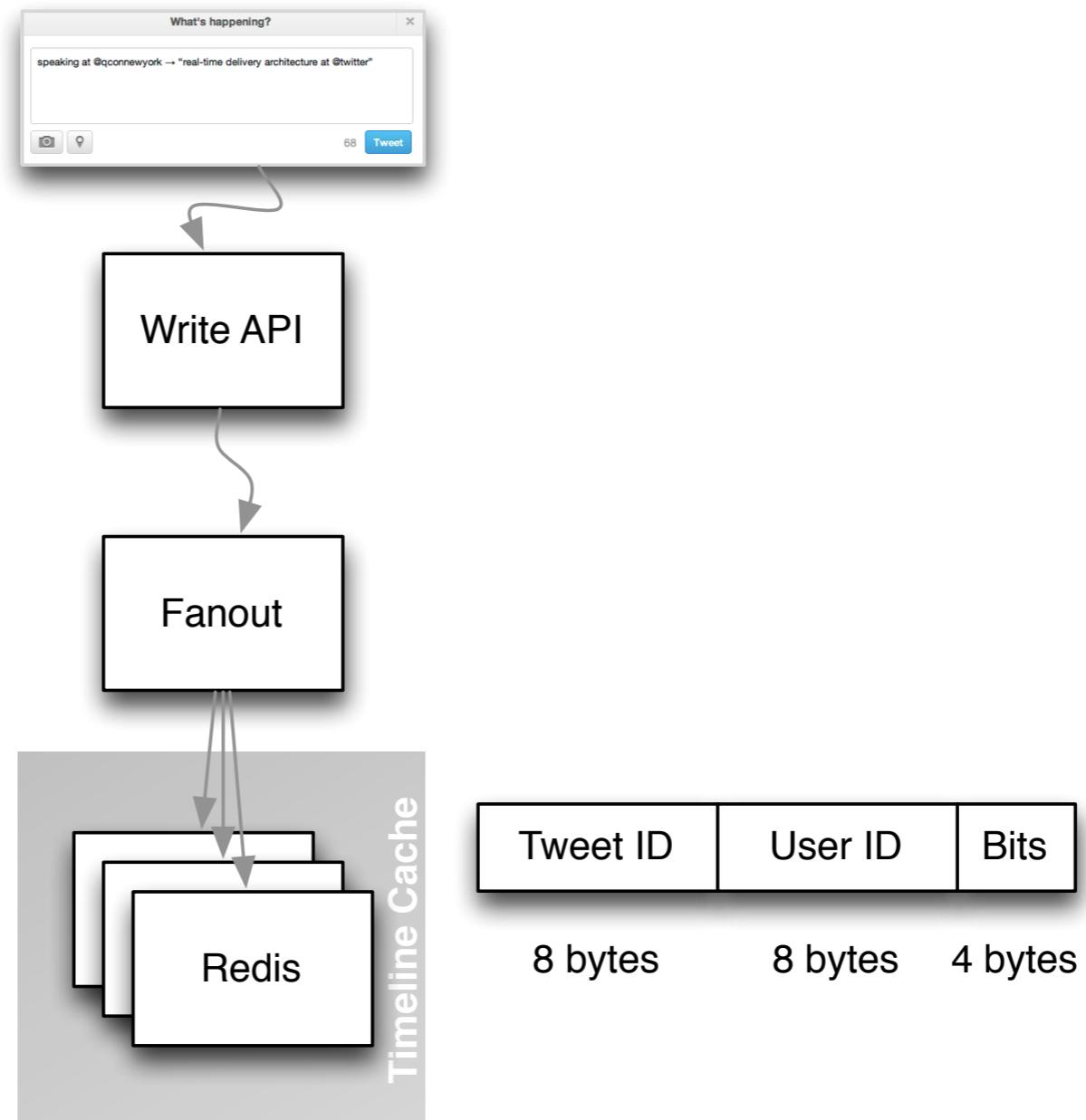
insert

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



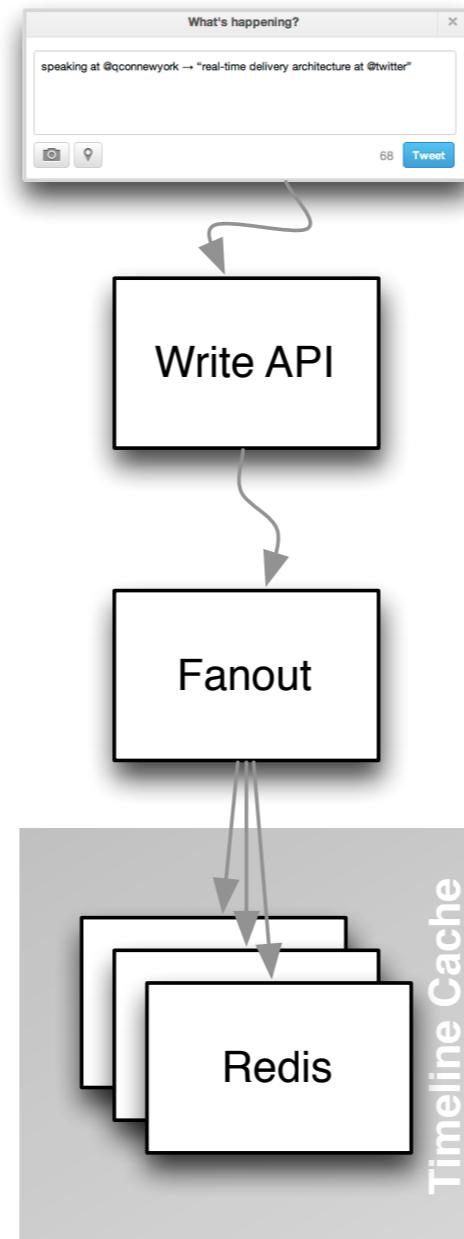
using redis

→ native list
structure

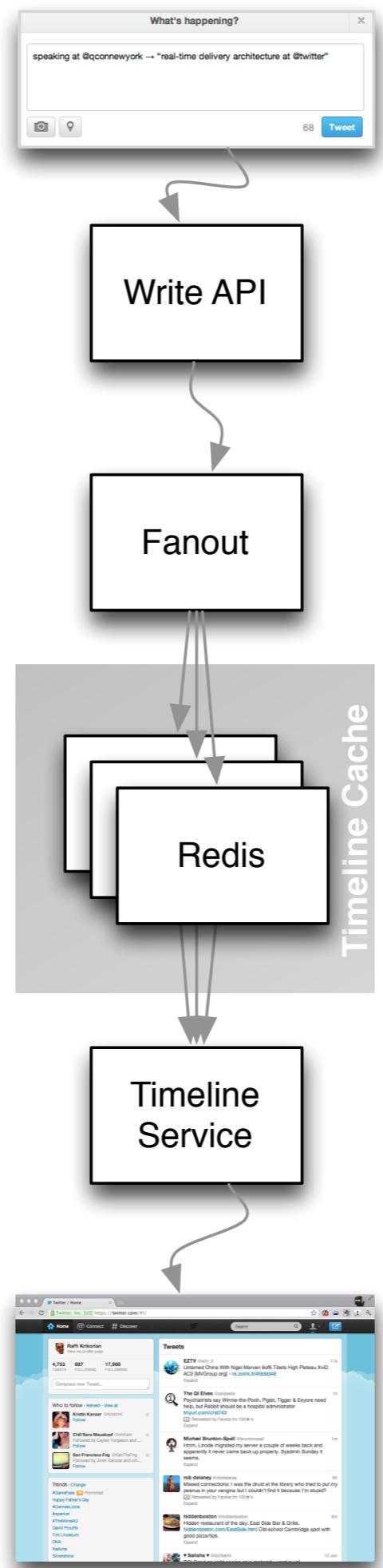


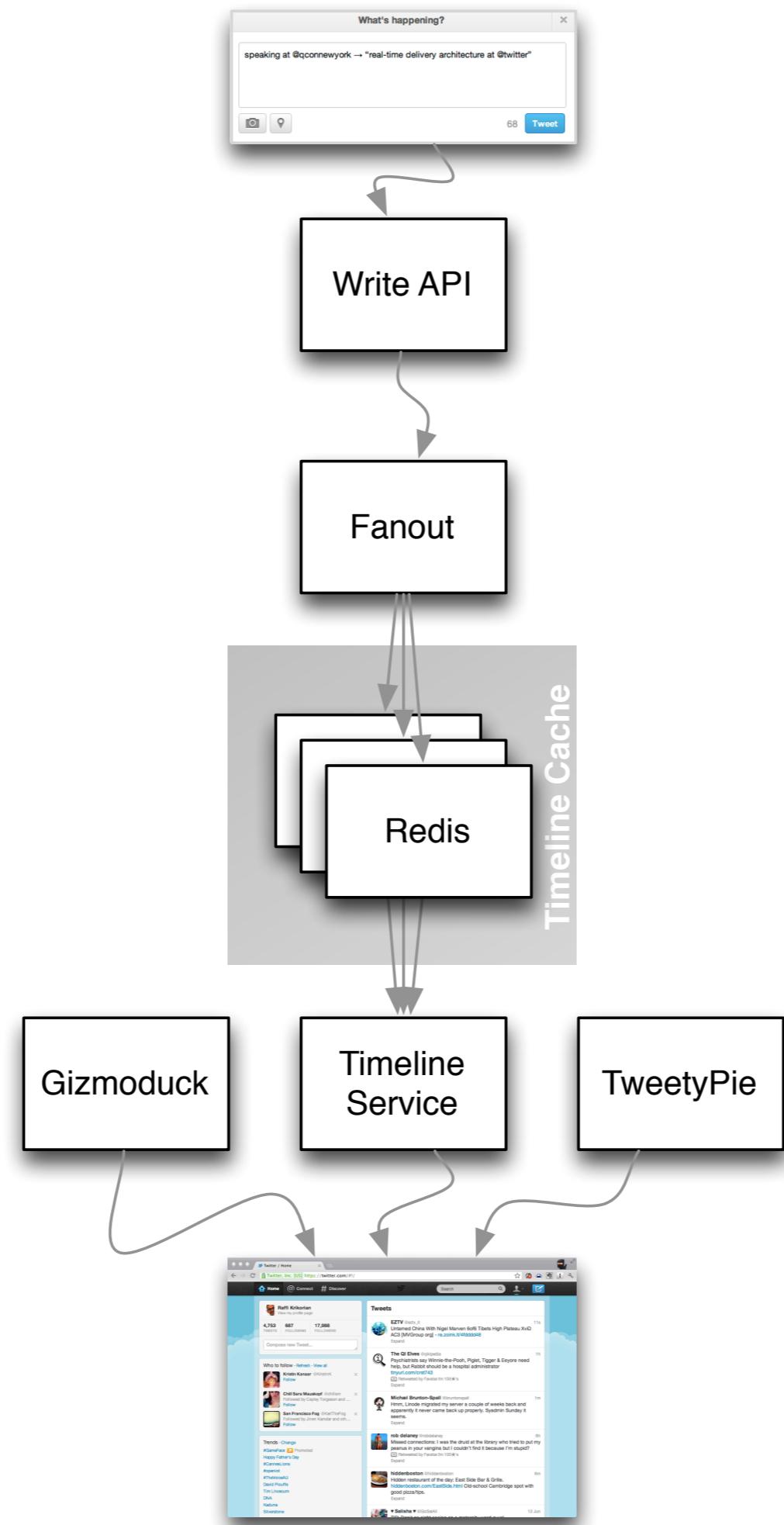
using redis

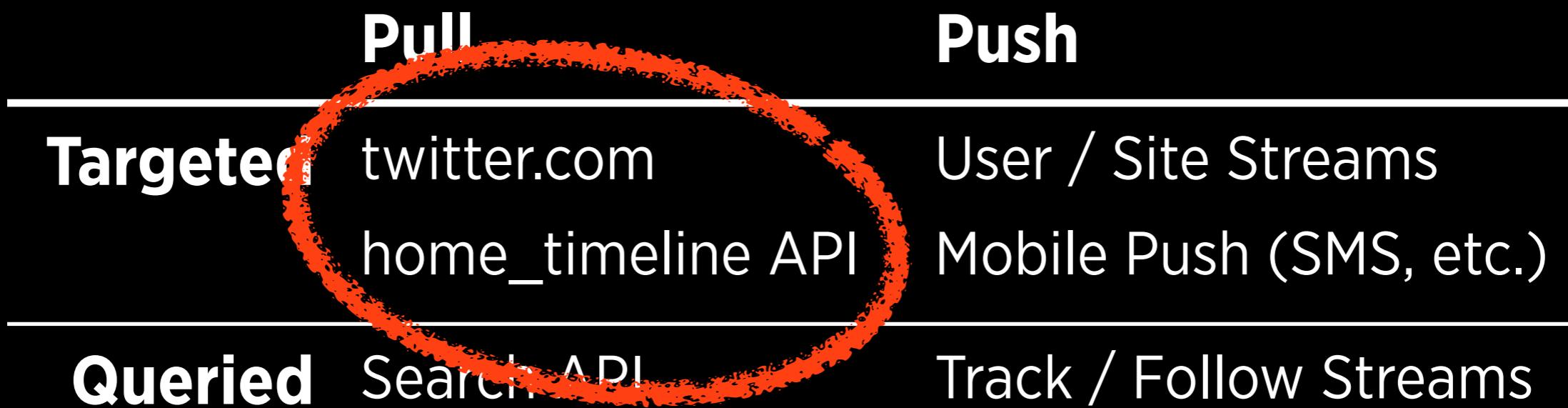
- ➡ native list structure
- ➡ RPUSHX to only add to cached timelines

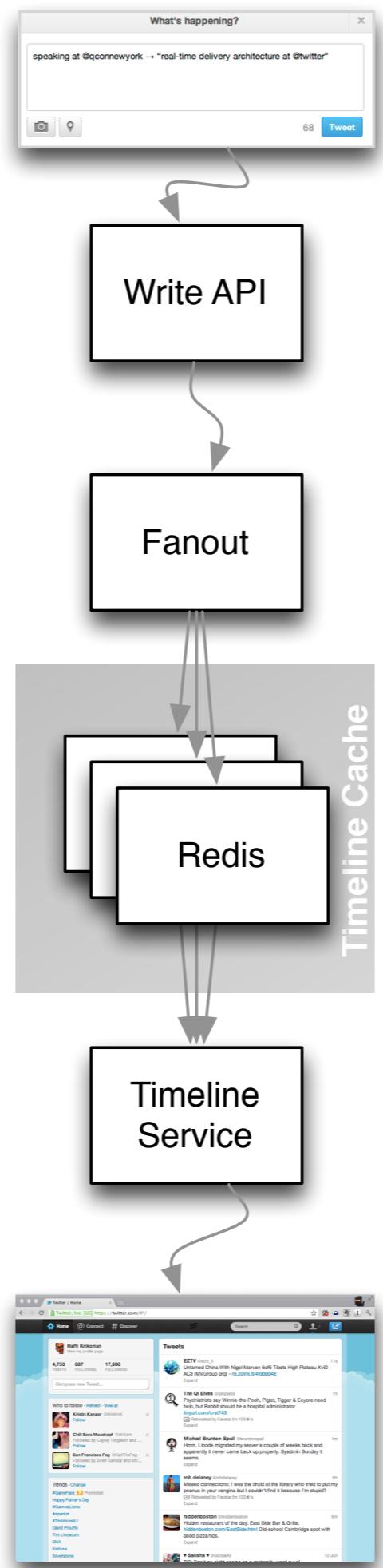


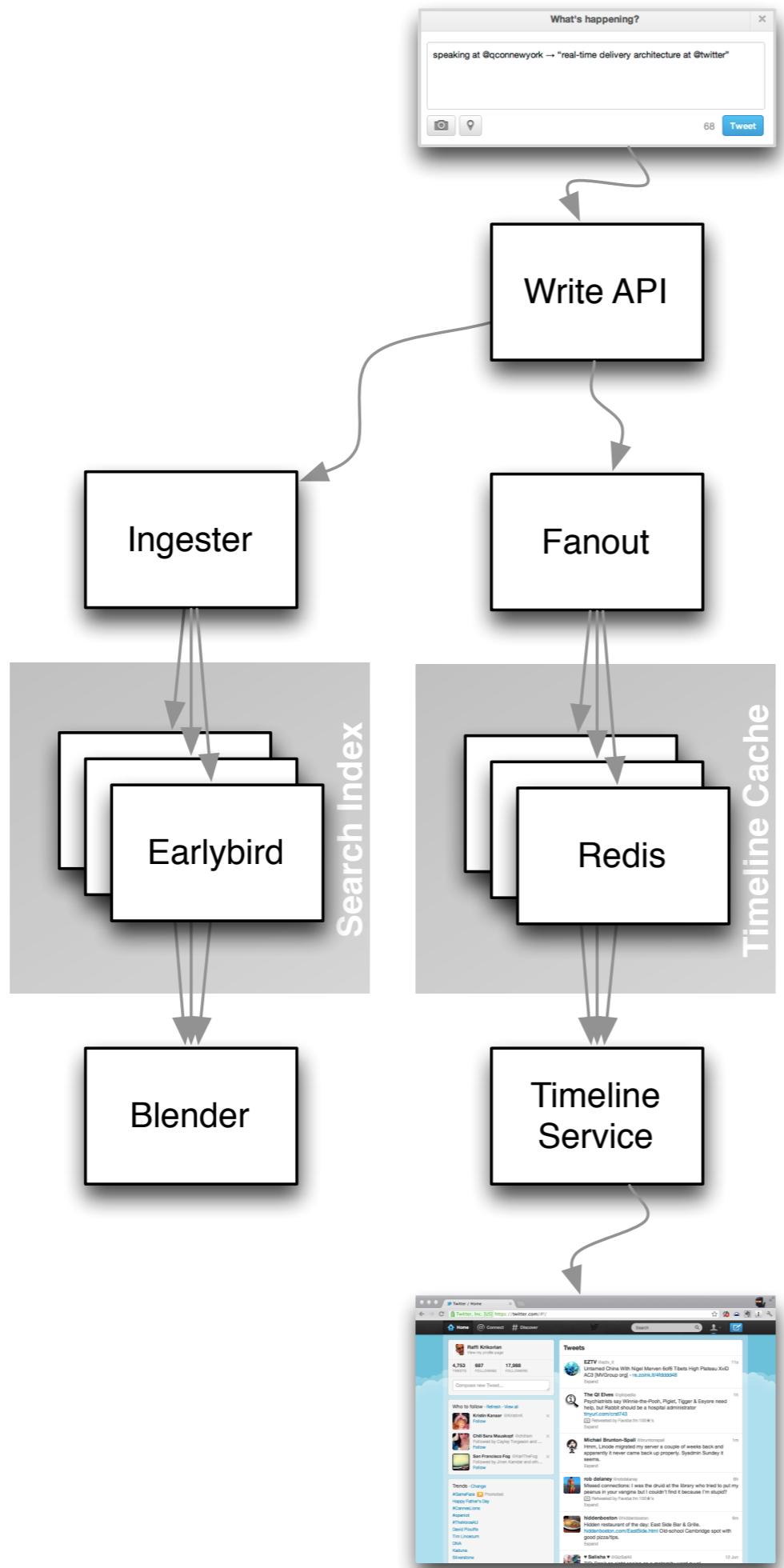
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
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Tweet ID	User ID	Bits	Tweet ID
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Tweet ID	User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







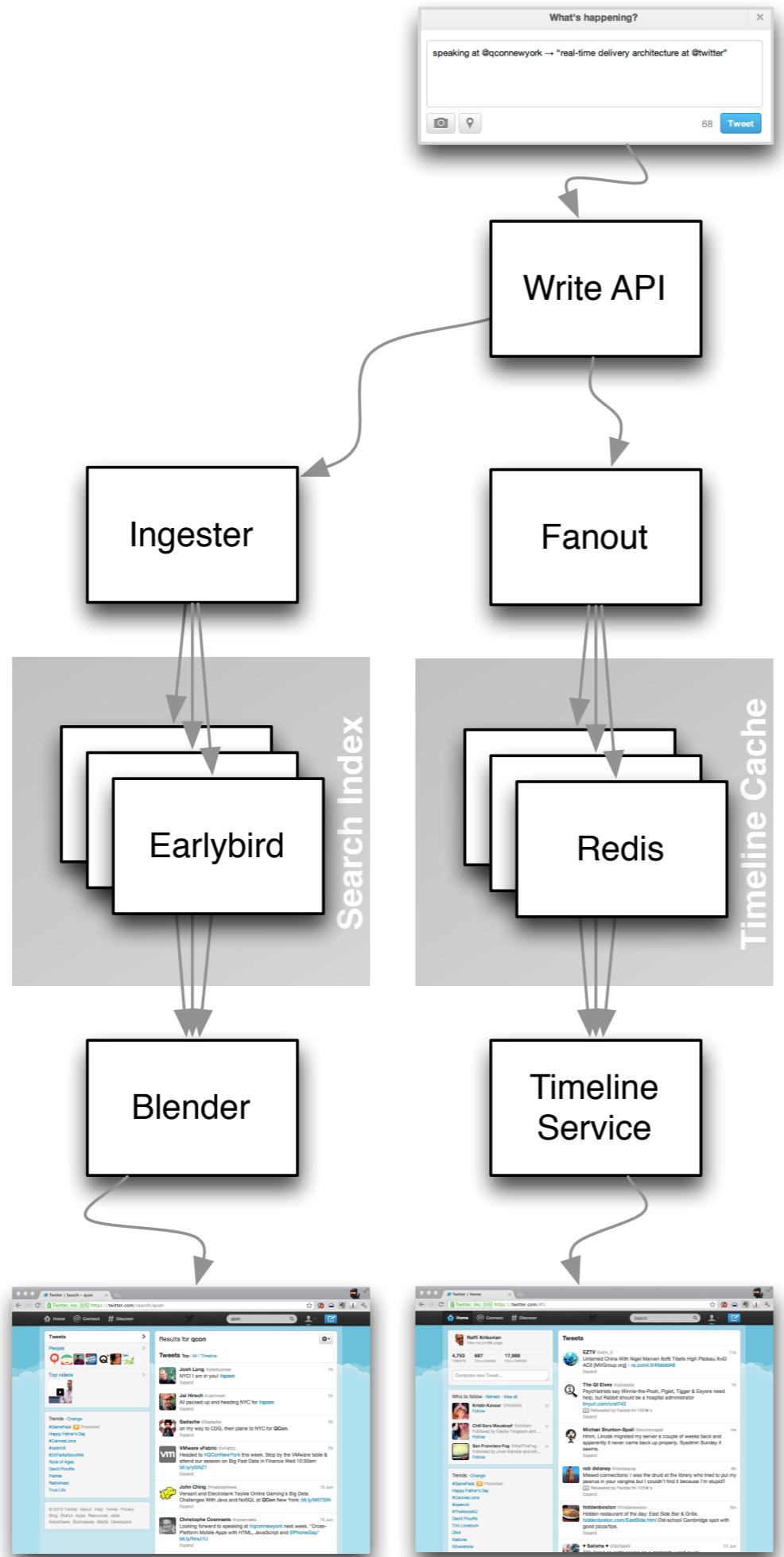




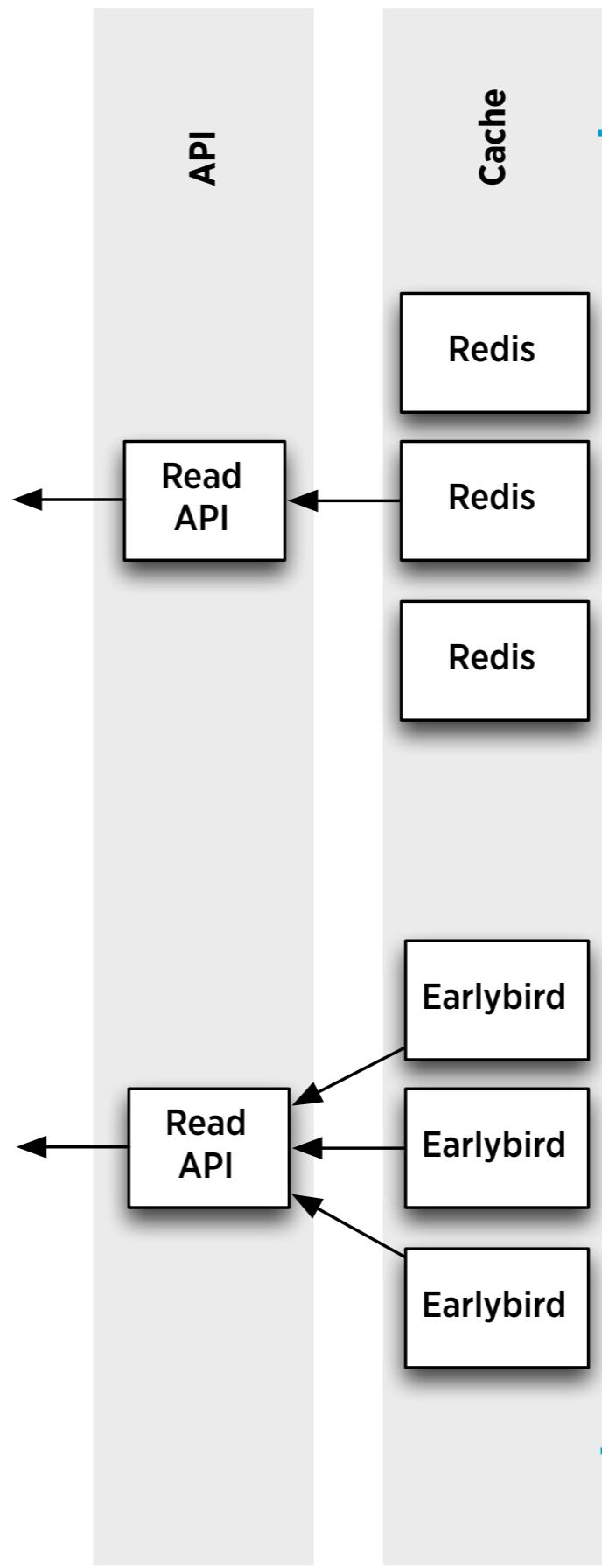
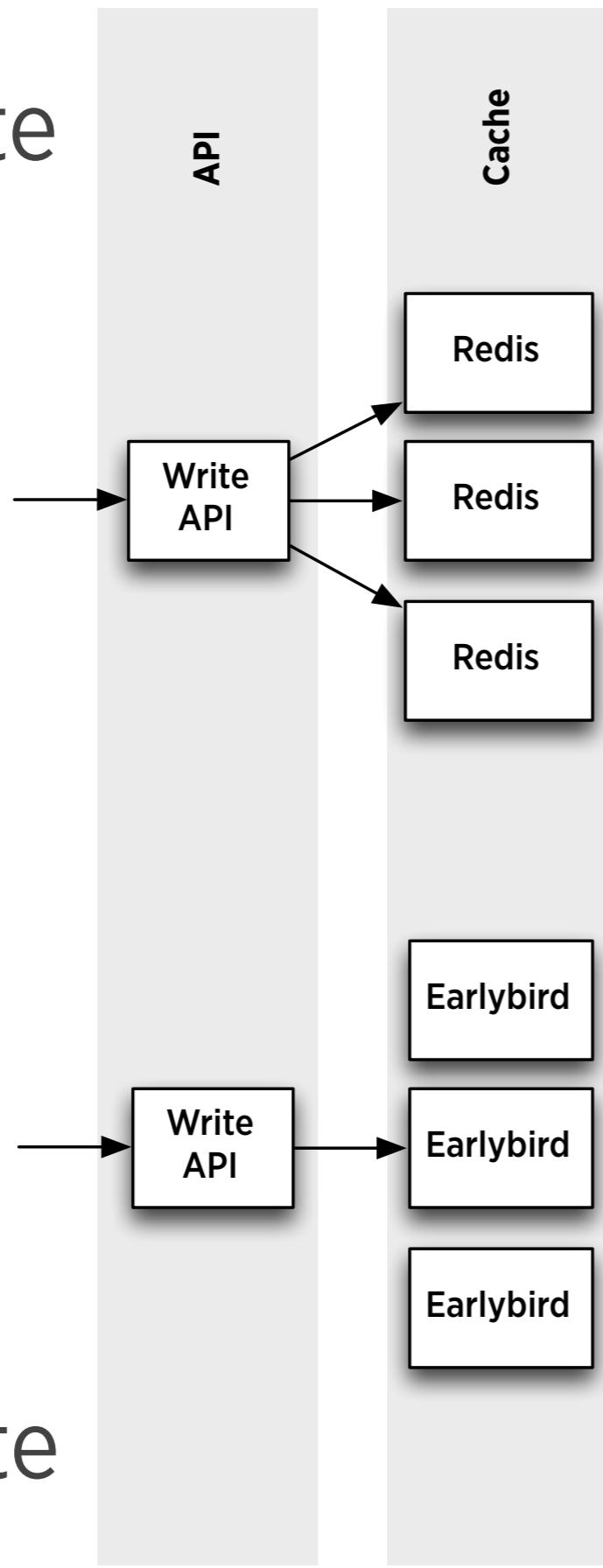
blender

→ queries one replica of all indexes

→ merges & ranks results



→ O(n) write



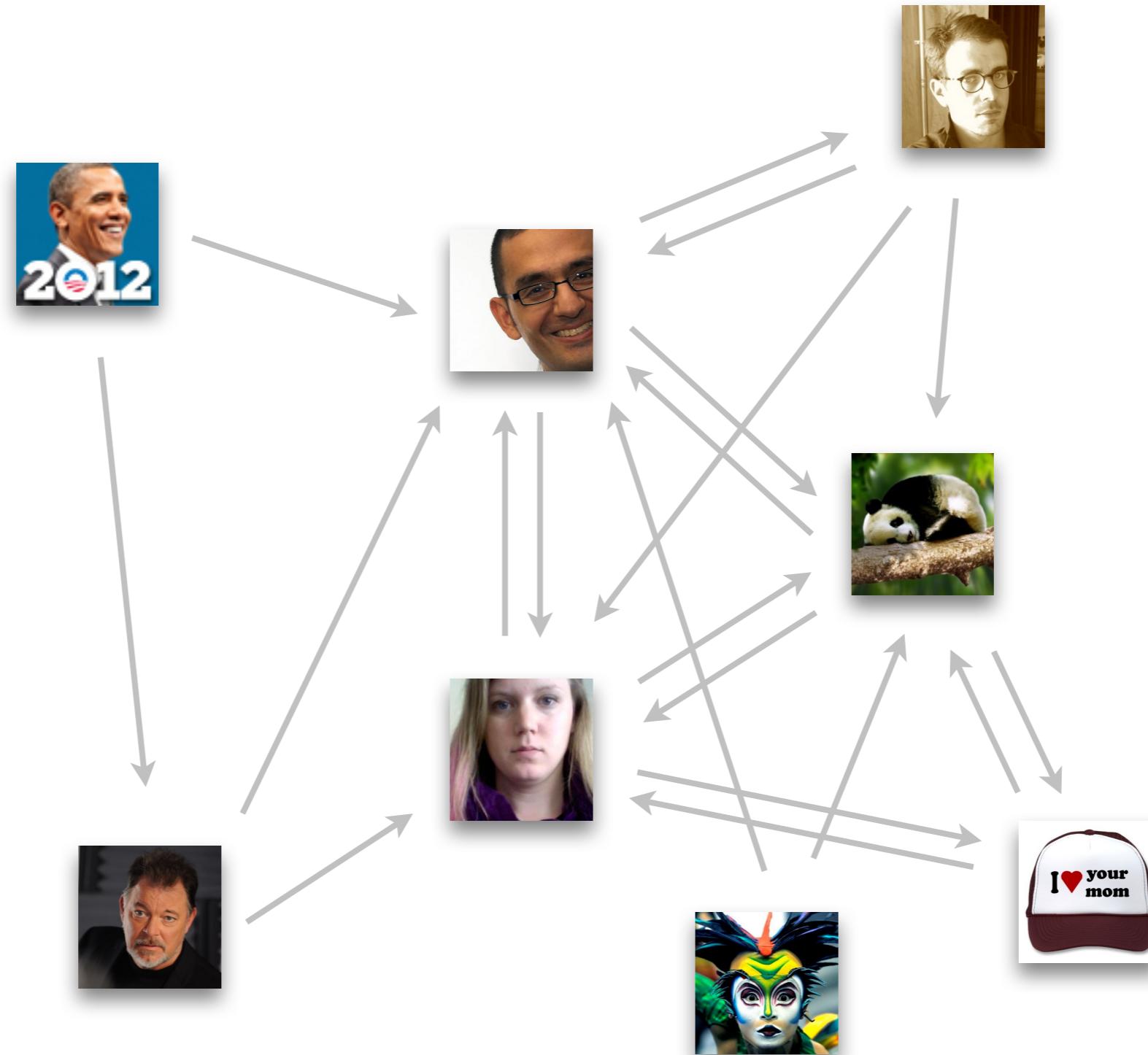
→ O(1) write

→ 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



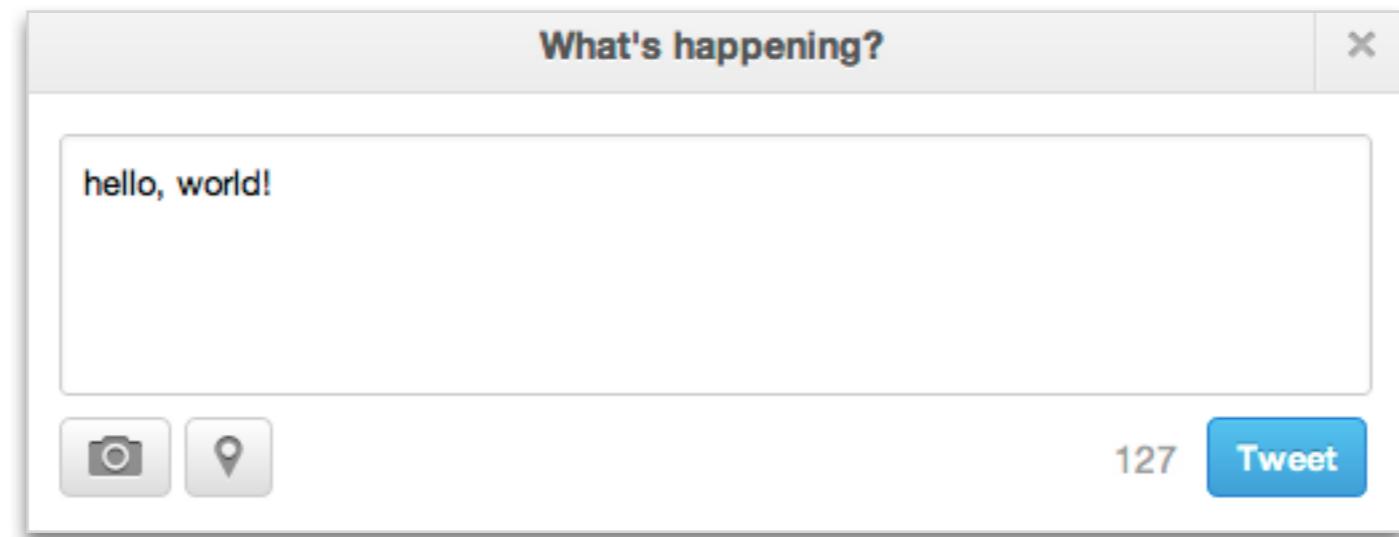
@barackobama ✅
23 million followers

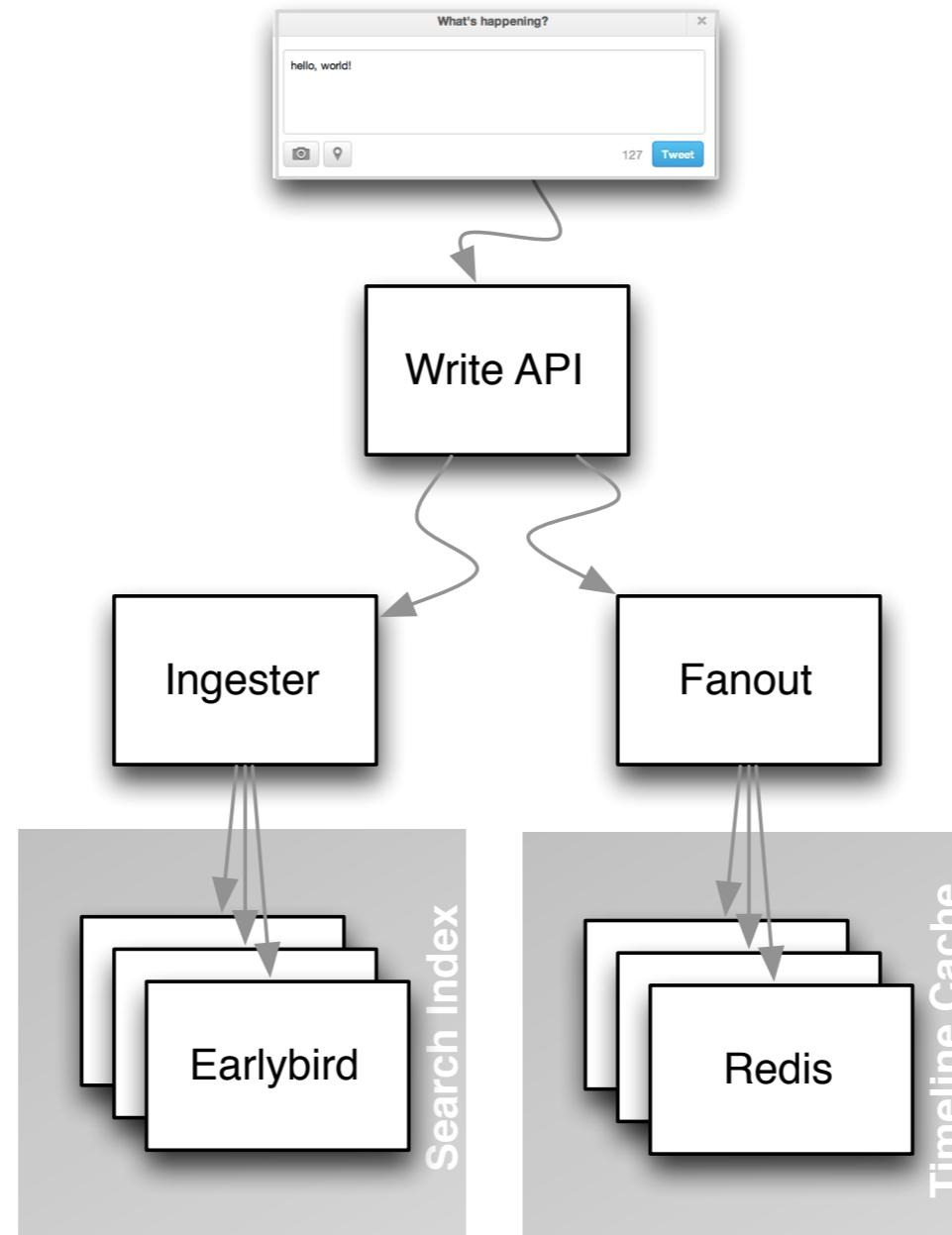


@raffi
0.019 million followers

there are over
400 million tweets
a day

4600 tweets
a second





search index

→ [‘hello’, ‘world’]

fanout index

→ [@danadanger, ...]

User Intent

“Hello, world”

@raffi’s home timeline

Query Expansion

“Hello” AND “world”

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”

@raffi’s home timeline

Query Expansion

“Hello” AND “world”

home_timeline:raffi

User Intent

“Hello, world”

@raffi’s home timeline

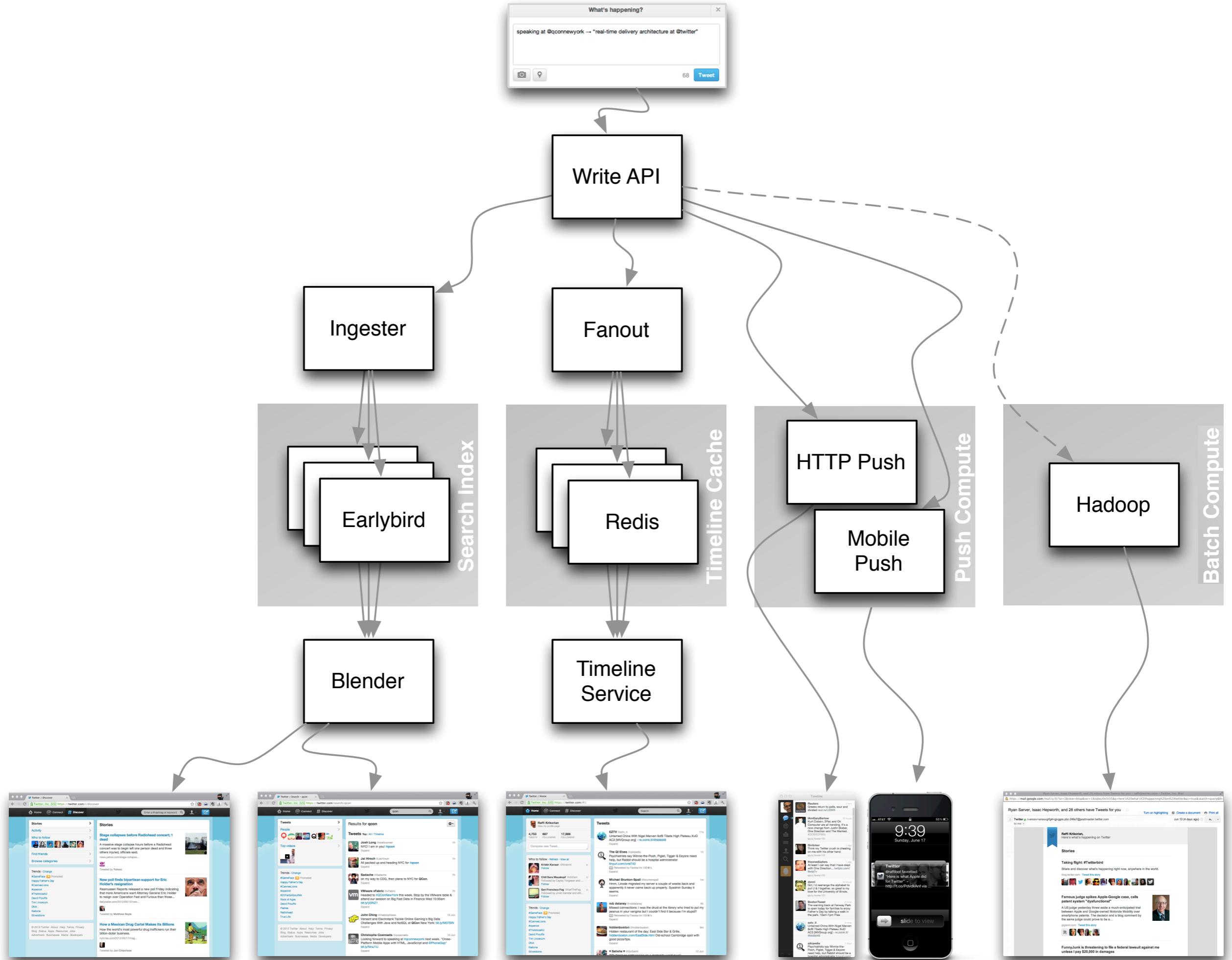
Query Expansion

“Hello” AND “world”

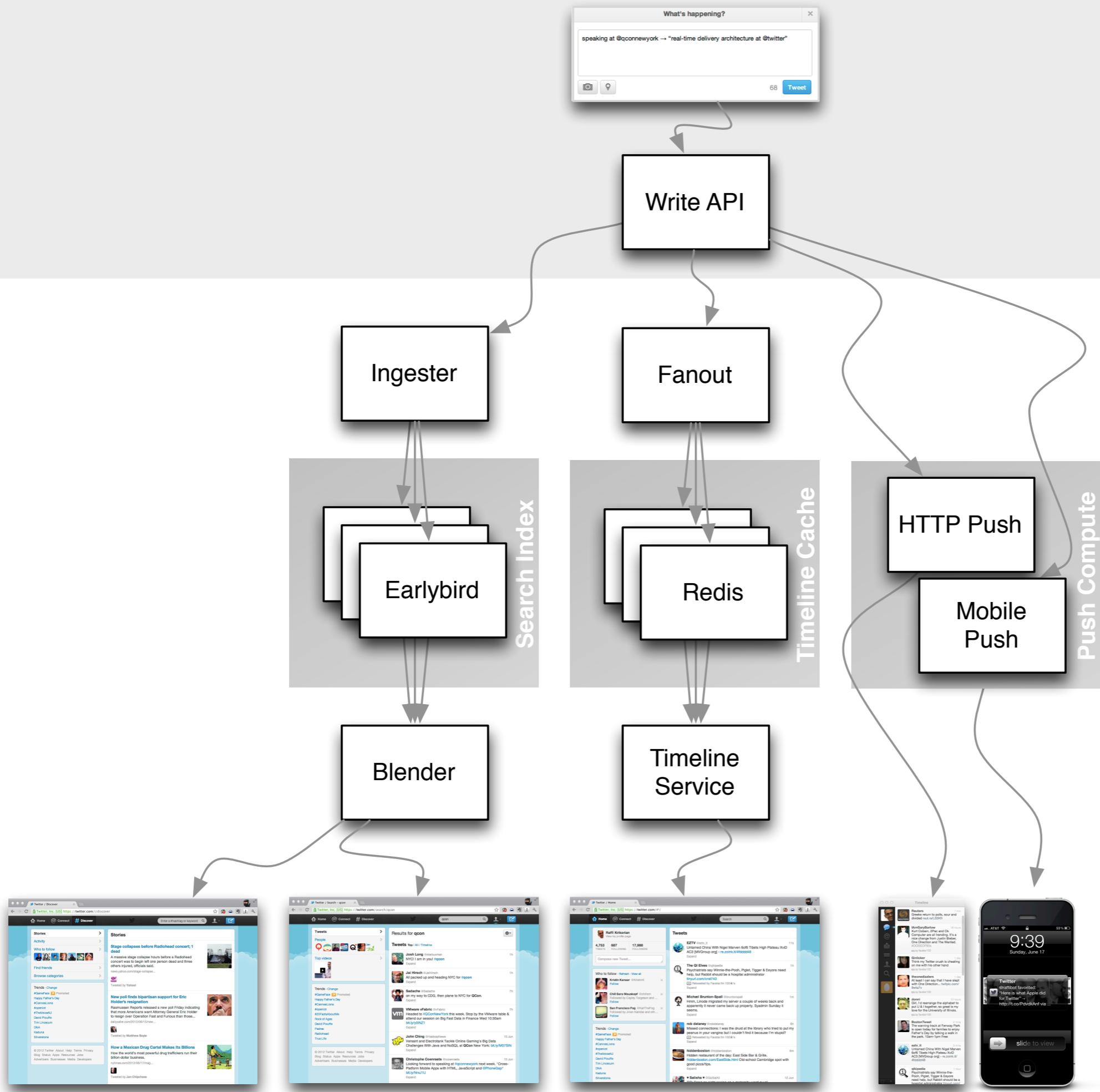
home_timeline:raffi

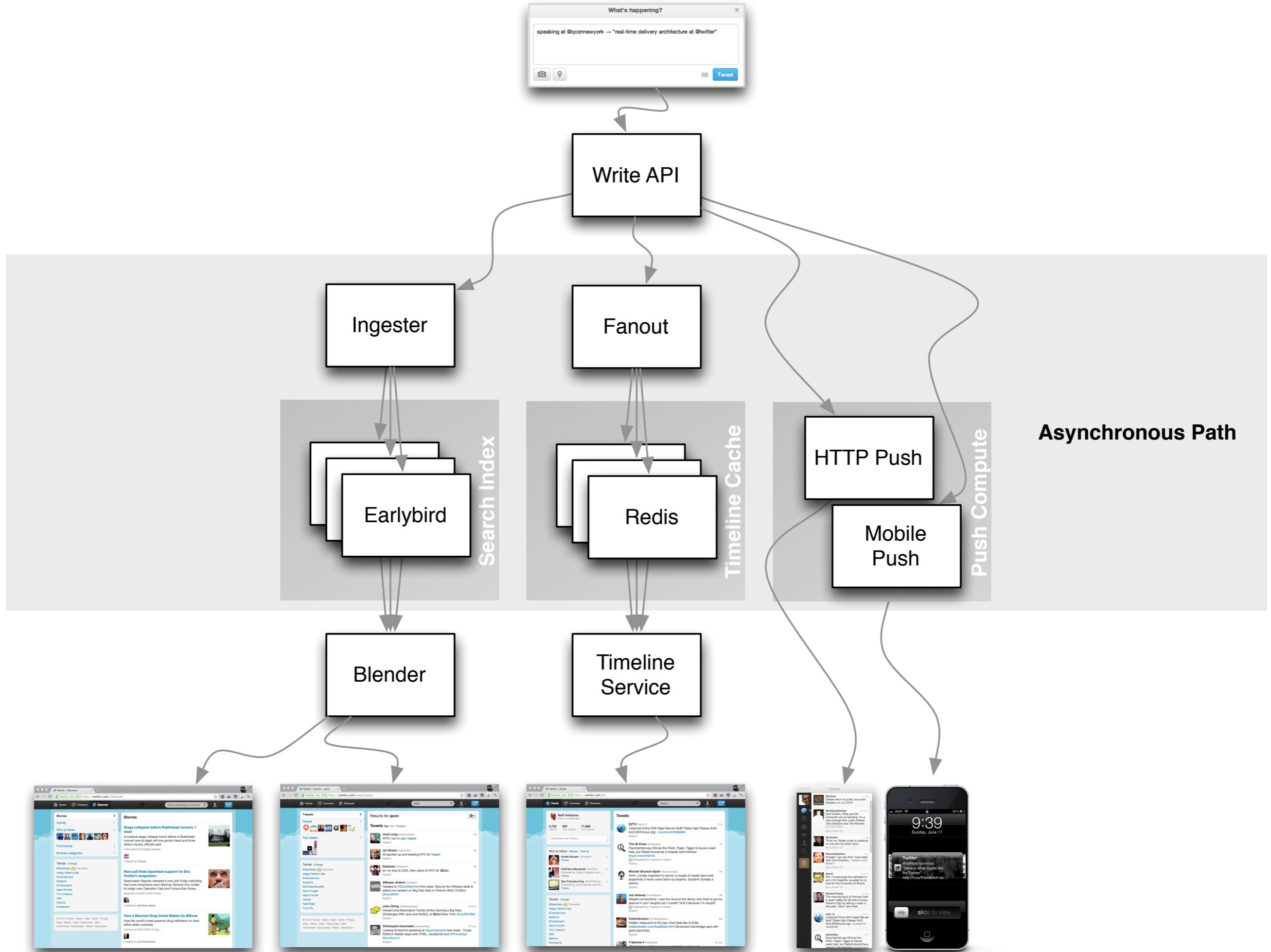
OR

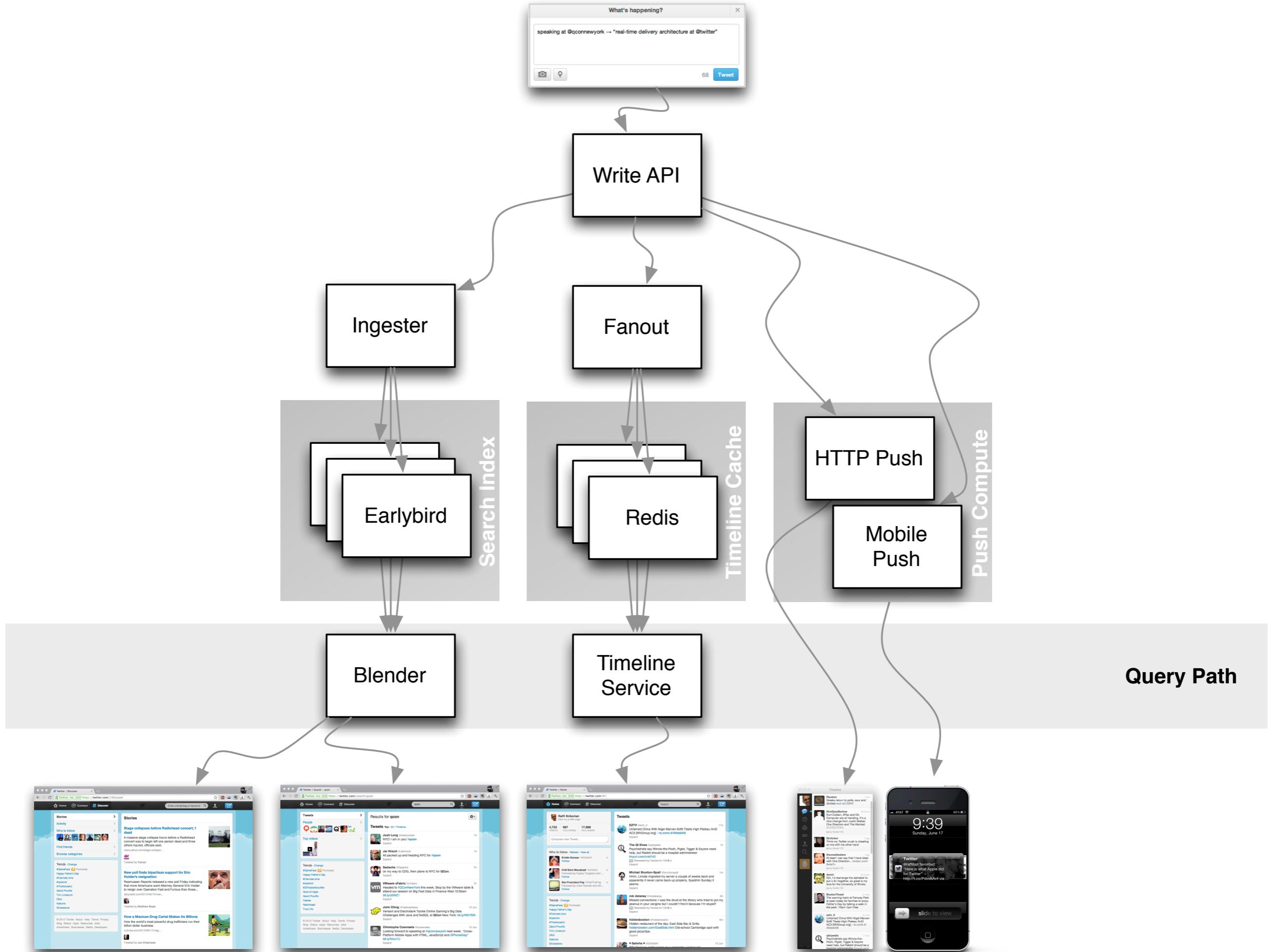
user_timeline:taylorswift13



Synchronous Path







timeline query statistics

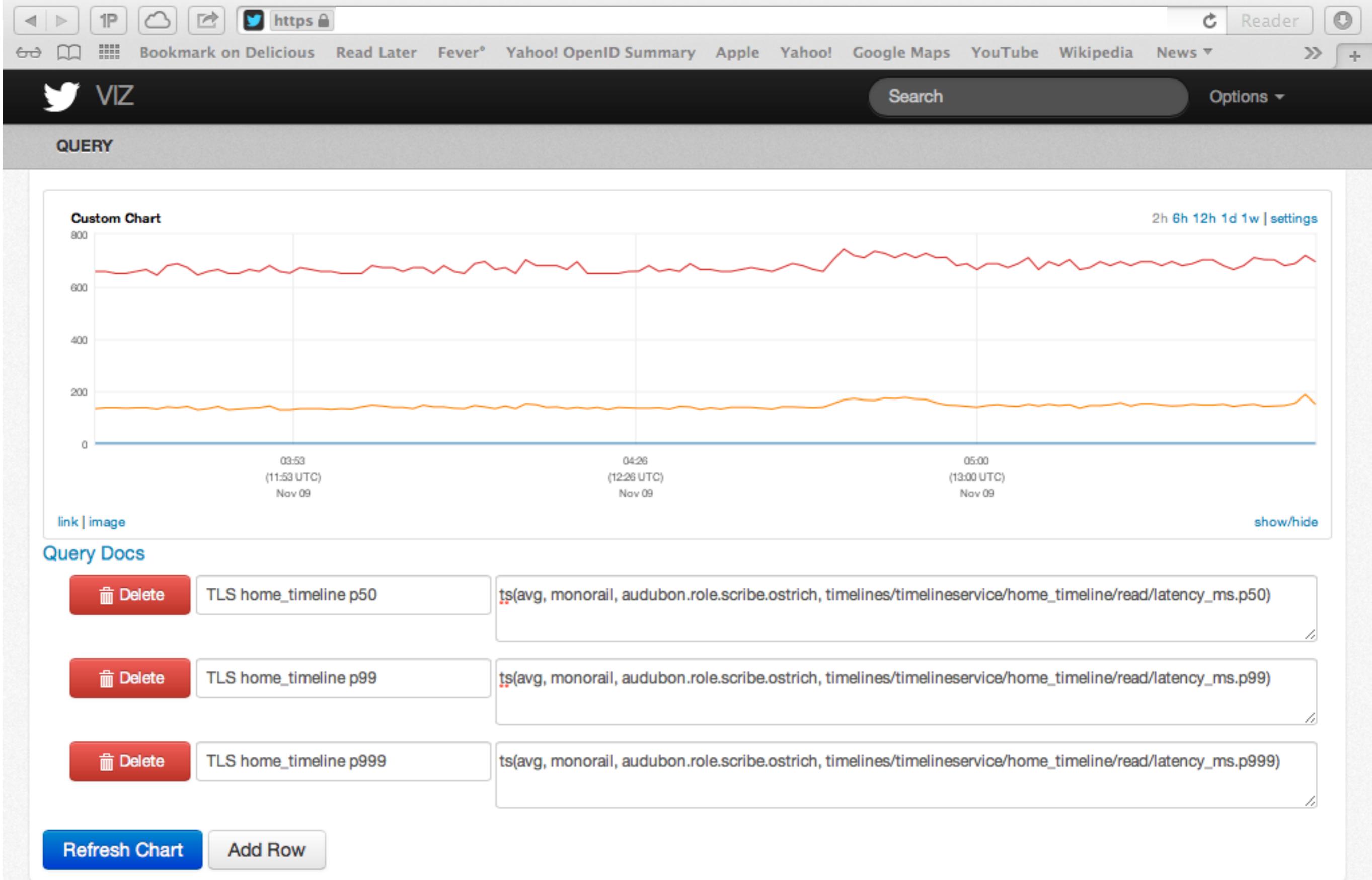
- >150m active users worldwide
- >300k qps poll-based timelines
@ 1ms p50 / 4ms p99
- >30k qps search-based timelines

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



Zipkin Investigate system behavior

Find a trace **Aggregates**

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

Service: api.twitter.com-s

Span: all

+ Annotation + Key-Value

End time: 11-09-2012
13:45:44

Limit: 100

Find traces i

Zipkin Investigate system behavior

 Find a trace AggregatesService

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

Span Annotation Key-
Value

End time

11-09-2012

13:46:32

Limit

100



Filter Showing: 100 of 100 Results

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 [ tweetypie 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

Zipkin Investigate system behavior

[Find a trace](#)[Aggregates](#)[Overview](#)[Timeline](#)[Dependencies](#)

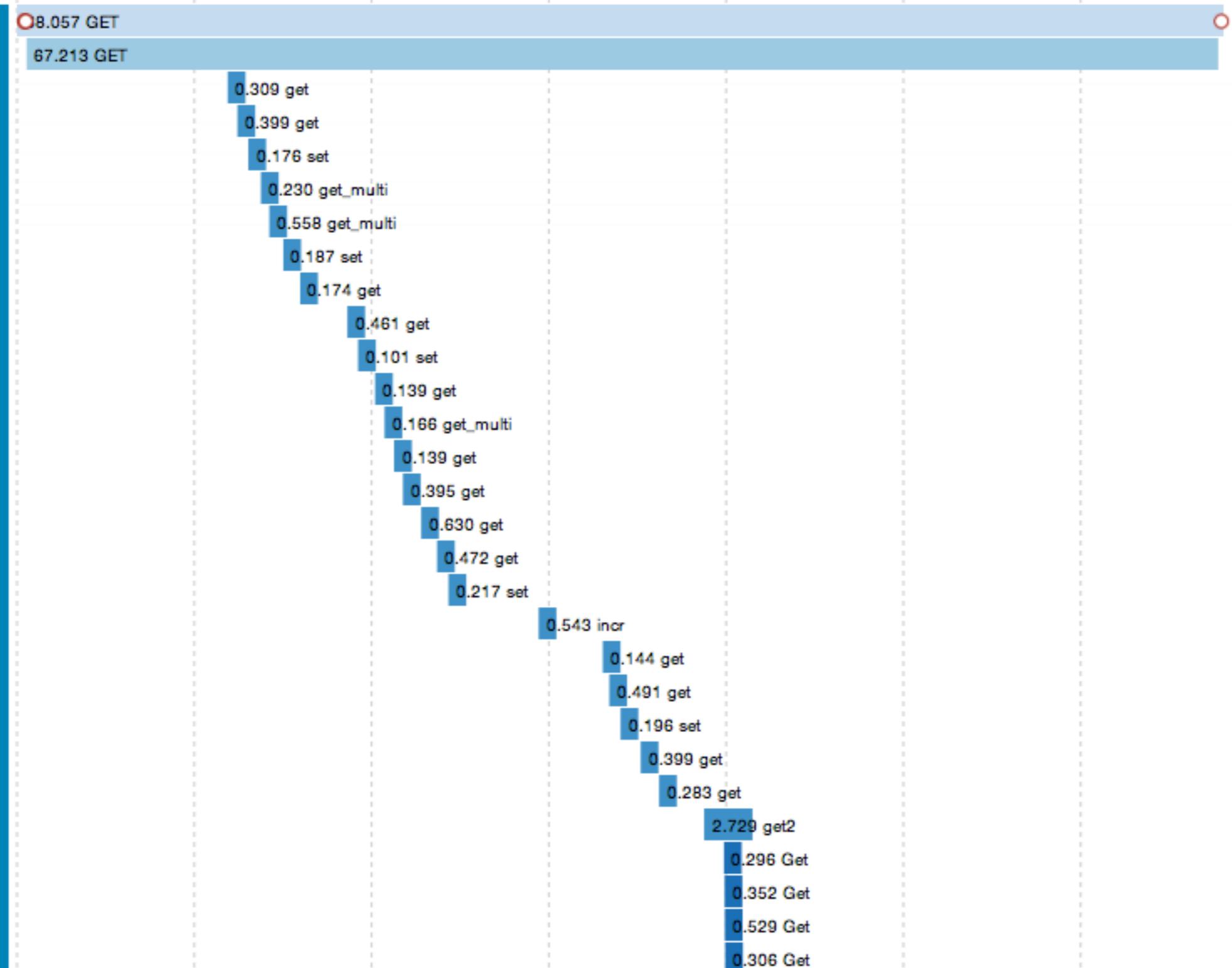
Search term (service)

**68.057 ms**

about 2 minutes ago

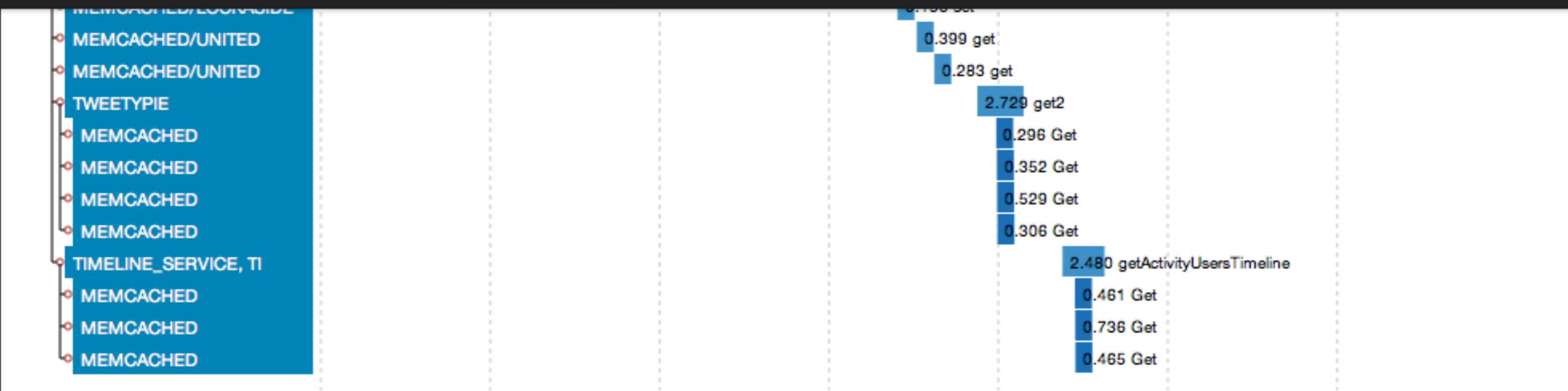
0ms 10ms 20ms 30ms 40ms 50ms 60ms

- o API.TWITTER.COM-SSL
- o CLUSTER_TWITTERWEB_U
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/OBJECT
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/OBJECT
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/USER
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/MAGIC
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/OBJECT
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/RATE
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/OBJECT
- o MEMCACHED/LOOKASIDE
- o MEMCACHED/UNITED
- o MEMCACHED/UNITED
- o TWEETYPYIE
- o MEMCACHED
- o MEMCACHED
- o MEMCACHED
- o MEMCACHED



Zipkin

Investigate system behavior

[Find a trace](#)
[Aggregates](#)


- Duplicate key/value annotations (6)

Key	Value	#	Spans
		↓	
memcached.keys	AccessToken:3:token:498750640-kjymc7qsfmtr8agjtmrrql1ayi70nzthavumiup	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_unicorn, monorail	55.195	12.018
memcached	3.145	0.000
memcached/lookaside	2.808	0.000
tweetypie	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

Zipkin Investigate system behavior Find a trace Aggregates

timeline_service, timelineservice: 2.480ms

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

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

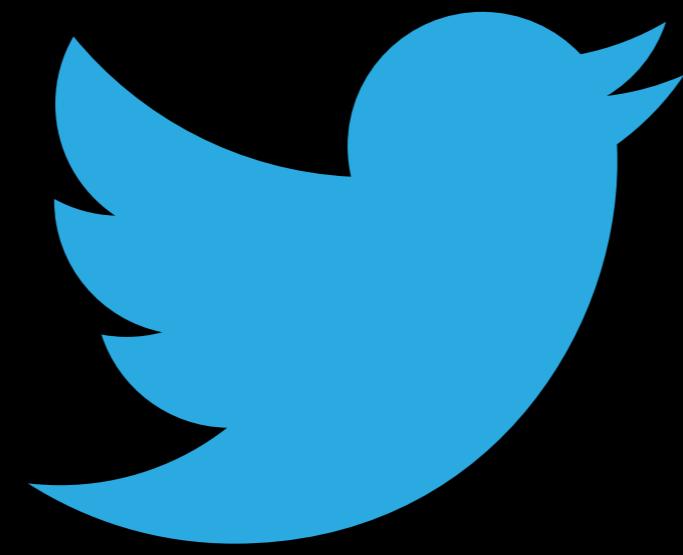
MEMCACHED/UNITSIDE
MEMCACHED/UNITED
MEMCACHED/UNITED
TWEETPIE
MEMCACHED
MEMCACHED
MEMCACHED
MEMCACHED
TIMELINE_SERVICE
MEMCACHED
MEMCACHED
MEMCACHED
Duplicate key/v
Key
memcached.keys
memcached.keys
memcached.keys
memcached.keys
memcached.keys
memcached.keys
memcached.keys
memcached.keys
memcached.keys
User:3:498750640
UnitedStatus:1:266895713768714241

Piggyback::GeneratedClasses::AccessToken::OauthAccessTok
ensXtra:1:829051188

3 get x2 set x1

2 get x1 set x1

2 get x2



thanks!