





real-time delivery architecture

@raffi
jfokus 2013



no, this isn't @raffi on stage
@asz channeling him today

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Targeted

Pull

Targeted

Pull

Targeted

Pull

Targeted twitter.com
home_timeline API

Pull

Targeted twitter.com
home_timeline API

Queried

Pull

Targeted twitter.com
home_timeline API

Queried

Pull

Targeted twitter.com
home_timeline API

Queried Search API

Pull

Push

Targeted twitter.com
home_timeline API

Queried Search API

Pull

Push

Targeted

twitter.com

User / Site Streams

home_timeline API

Mobile Push (SMS, etc.)

Queried

Search API

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



Attila Szegedi @asz

16h

Wife & kids flew back to Hungary today. So far I had to remotely troubleshoot a boiler & restore our home Minecraft server world from backup

[Expand](#)



Attila Szegedi @asz

1 Feb

Reddit AMA request for Tommy Wiseau:
reddit.com/r/IAmA/comment... Somebody make that happen.

[Expand](#)



Attila Szegedi @asz

31 Jan

In icon visual language "productivity" == "a checkbox", apparently.
twitpic.com/bzsyy7

[View photo](#)



Mattias Karlsson @matkar

9h

Good mooorning [#Jfokus](#) week

Expand



Mattias Karlsson @matkar

15h

Getting in to second breathing here... Guess I will pay for that tomorrow morning and the rest of the week! [#Jfokus](#) week

Expand



Mattias Karlsson @matkar

3 Feb

RT @headius And yes, I will be personally offended if you are at [#FOSDEM](#) Java room and aren't at my talk. Consider yourself notified. :-)

Expand



[twitpic.com/bzsy7](https://twitter.com/bzsy7)

[View photo](#)

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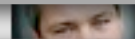


Jfokus @Jfokus

34m

We are waiting for you. Come by today to fetch your badge and skip the queue tomorrow! pic.twitter.com/fmpKiDYV

[View photo](#)



Good morning! [#Jfokus](#) week

9h

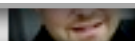


Jfokus @Jfokus

2h

A true super hero! RT @kohsukekawa I AM DA JMAN [#jfokus](#)
pic.twitter.com/E3sFICII

[View photo](#)



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15h

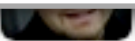


Jfokus @Jfokus

3h

Great! RT @kohsukekawa I'll be at [#JFokus](#) today & tomorrow, spreading more [#JenkinsCI](#) love

[Expand](#)



[#FOSDEM](#) Java room and aren't at my talk. Consider yourself notified. :-)

[Expand](#)

3 Feb

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Attila Szegedi @asz

1 Feb

What's happening?

speaking at @jfokus → “real-time delivery architecture at @twitter”

68

Tweet

What's happening?

speaking at @jfokus → "real-time delivery architecture at @twitter"

68

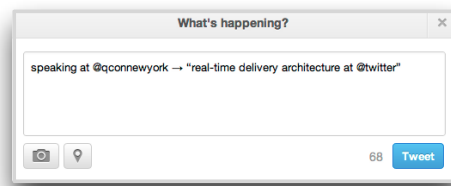
Tweet

What's happening?

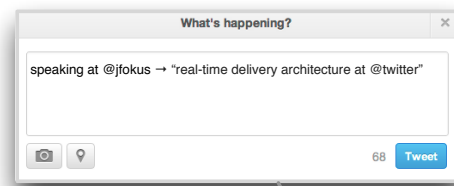
speaking at @jfokus → "real-time delivery architecture at @twitter"

68

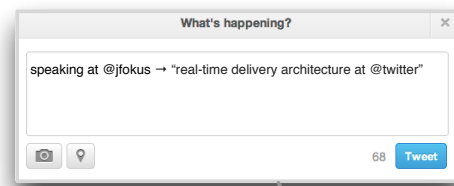
Tweet



Write API

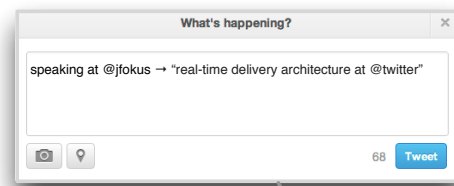


Write API



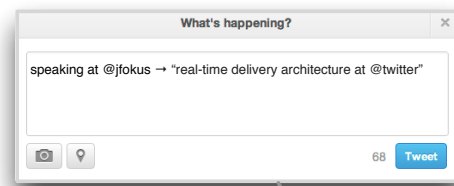
Write API

Fanout



Write API

Fanout

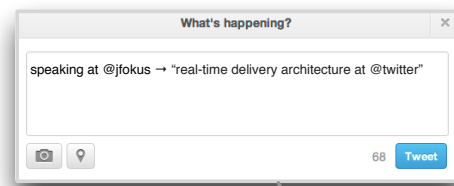


Write API



Fanout

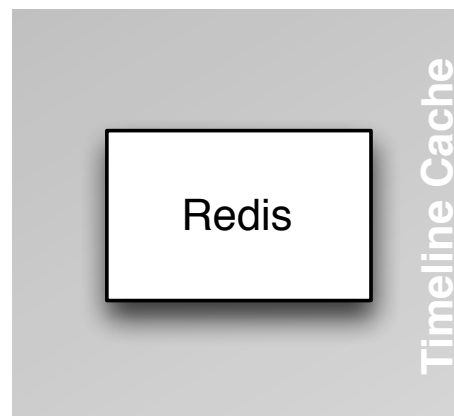


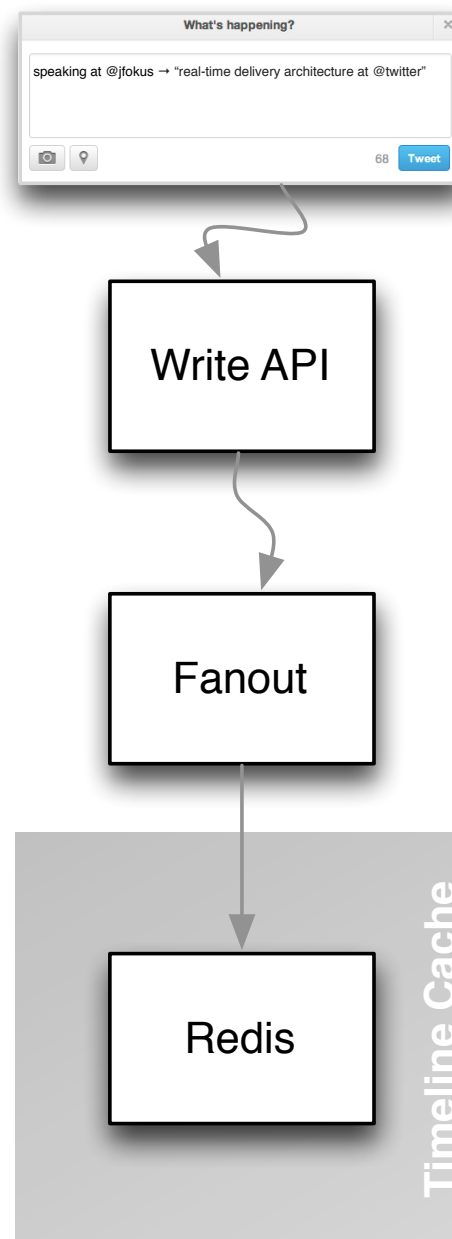


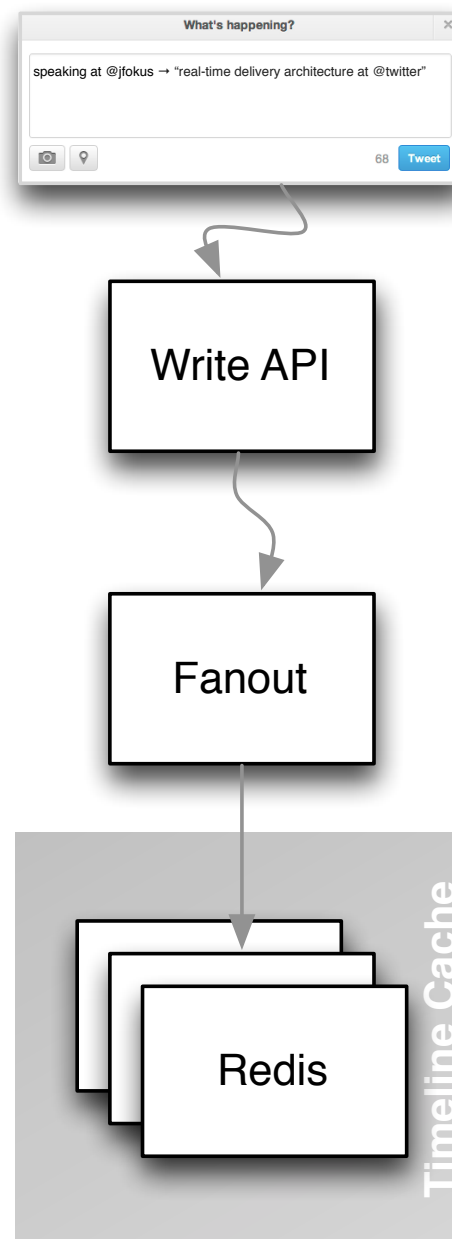
Write API

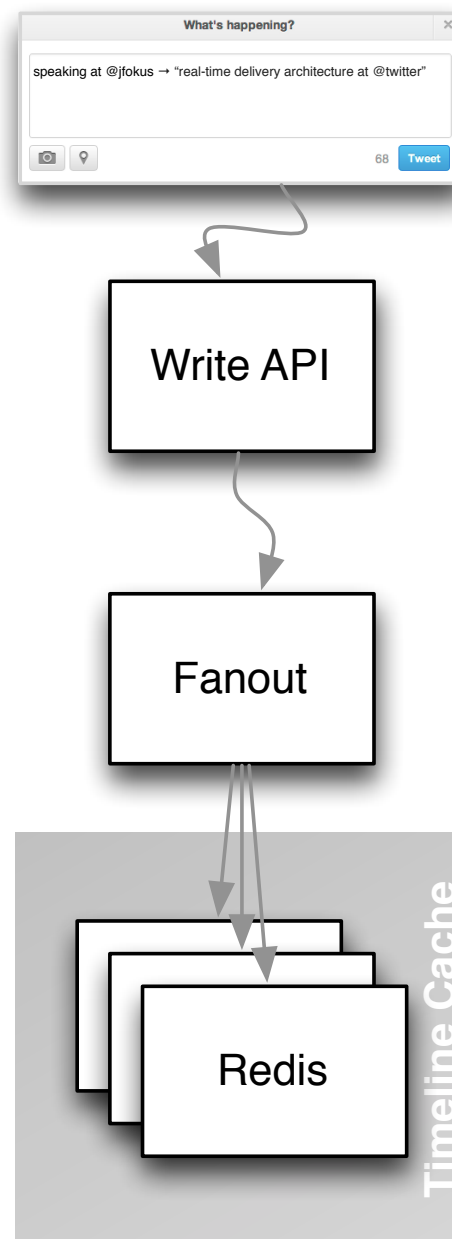


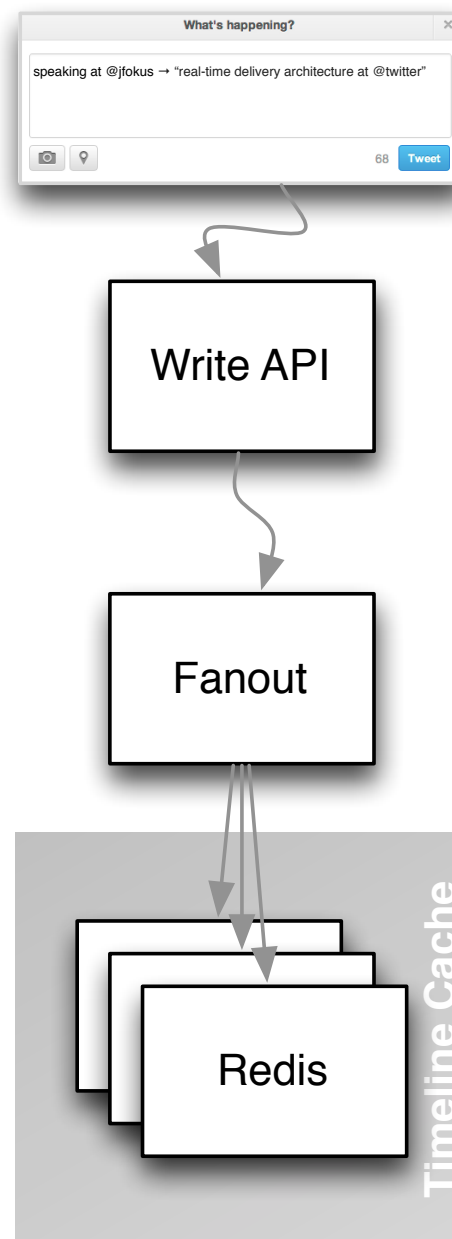
Fanout



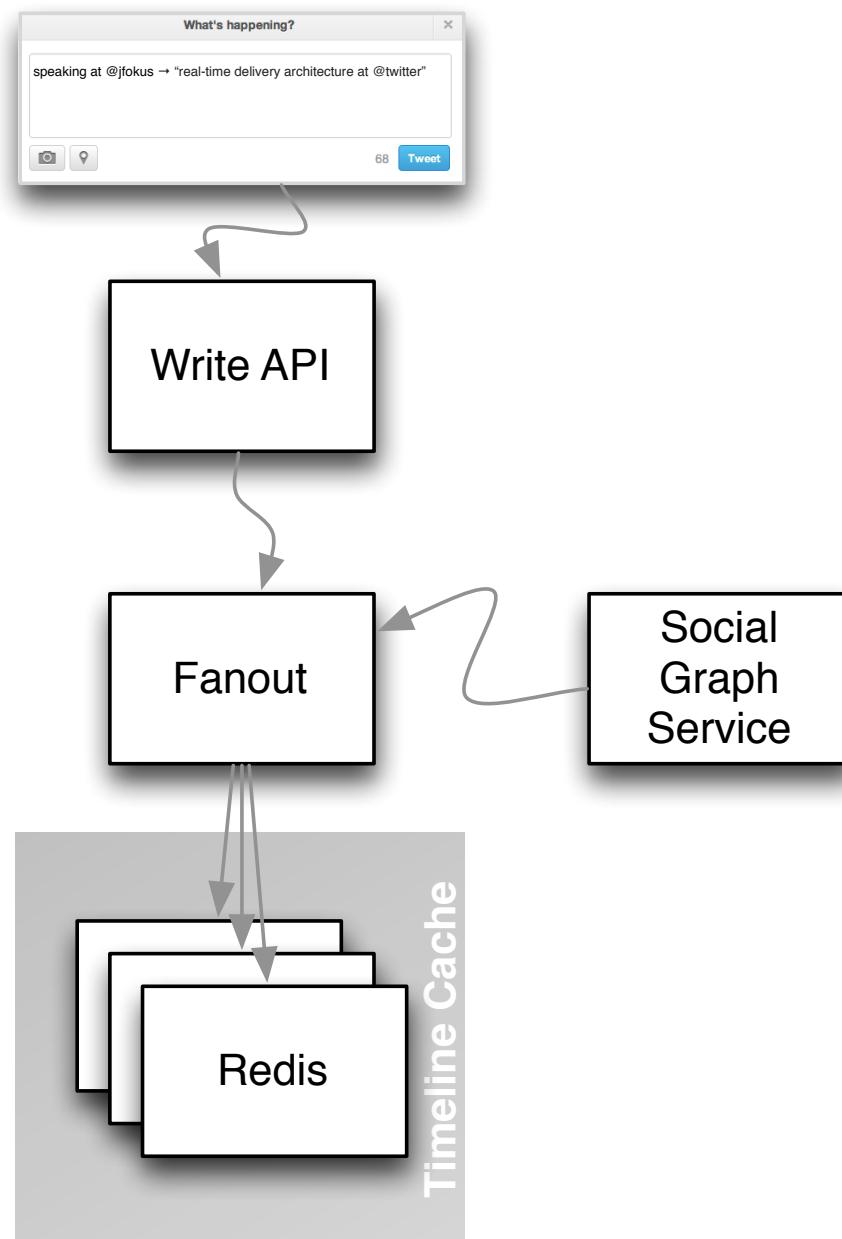






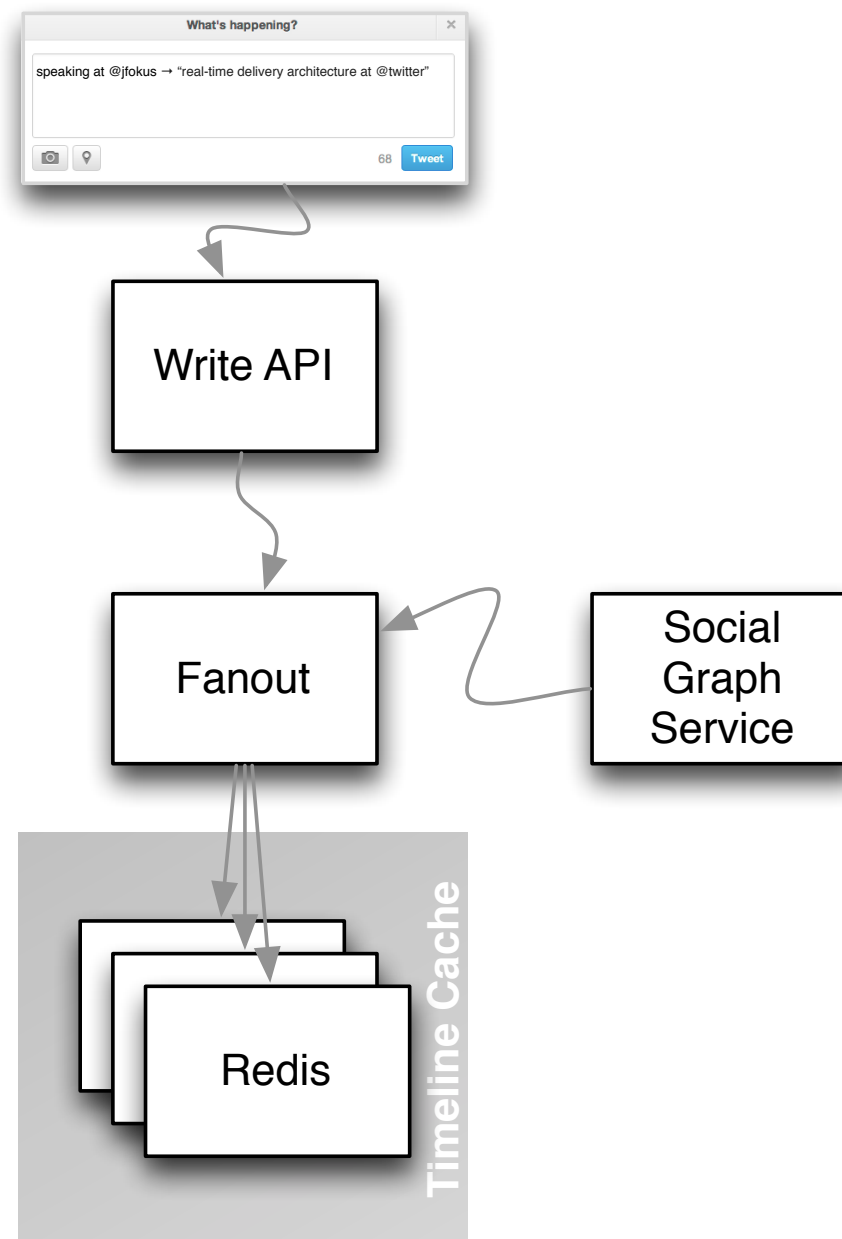


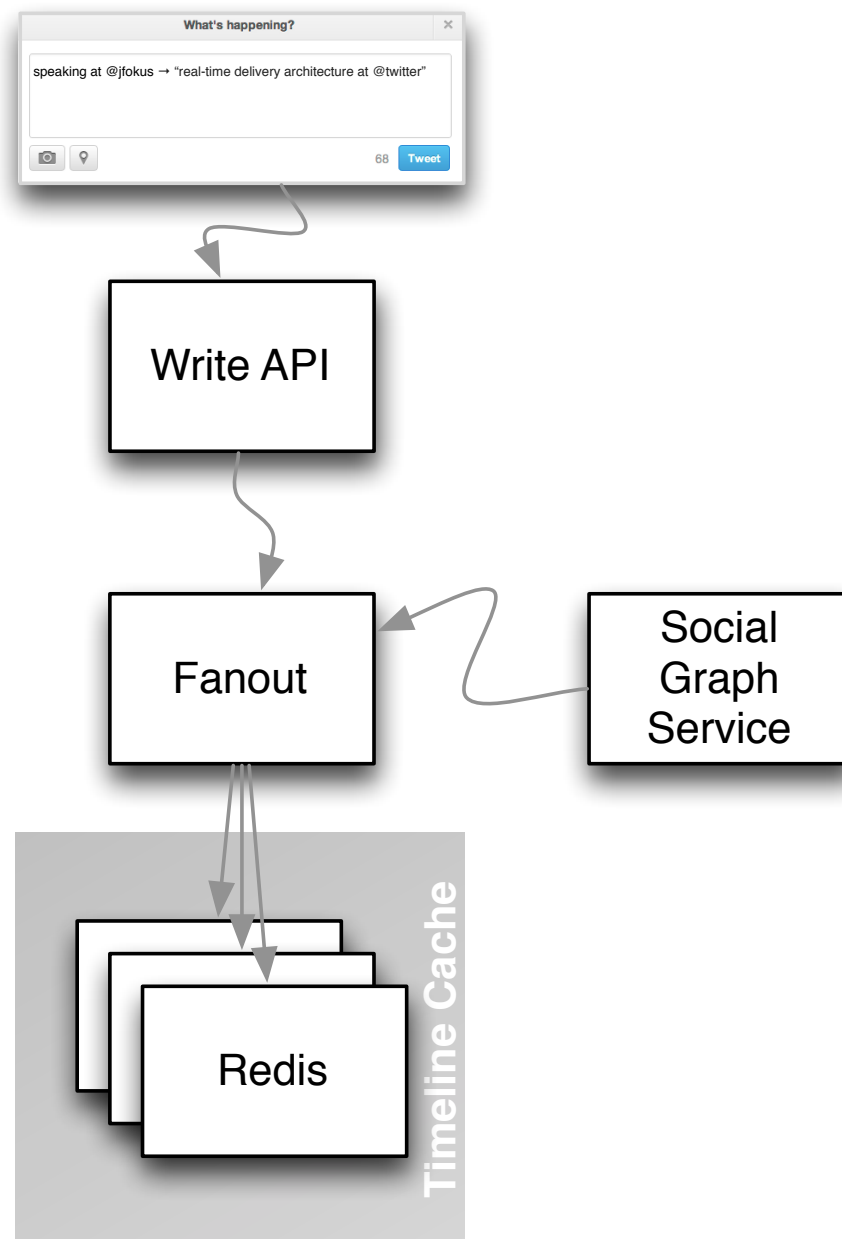
Social
Graph
Service

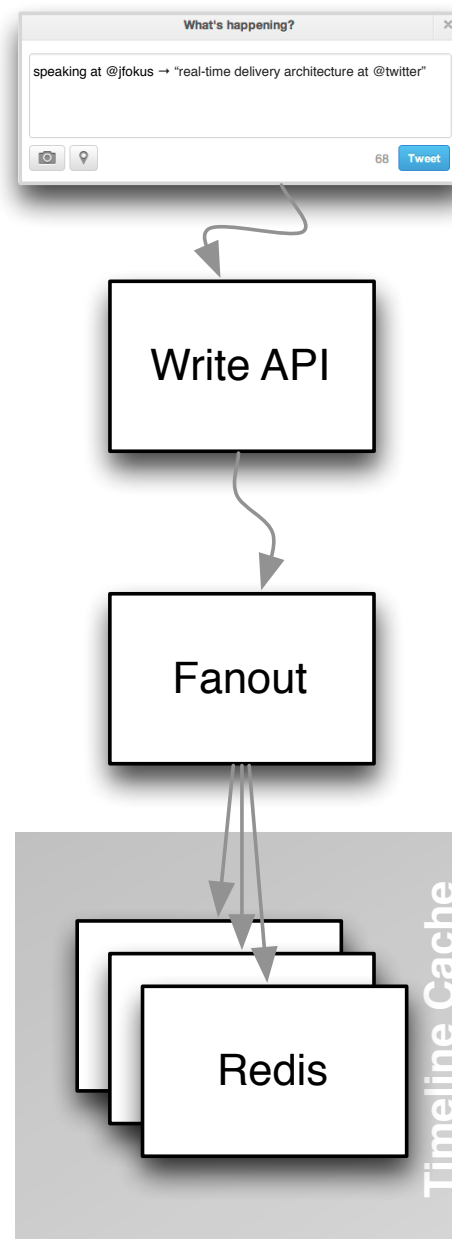


insert

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



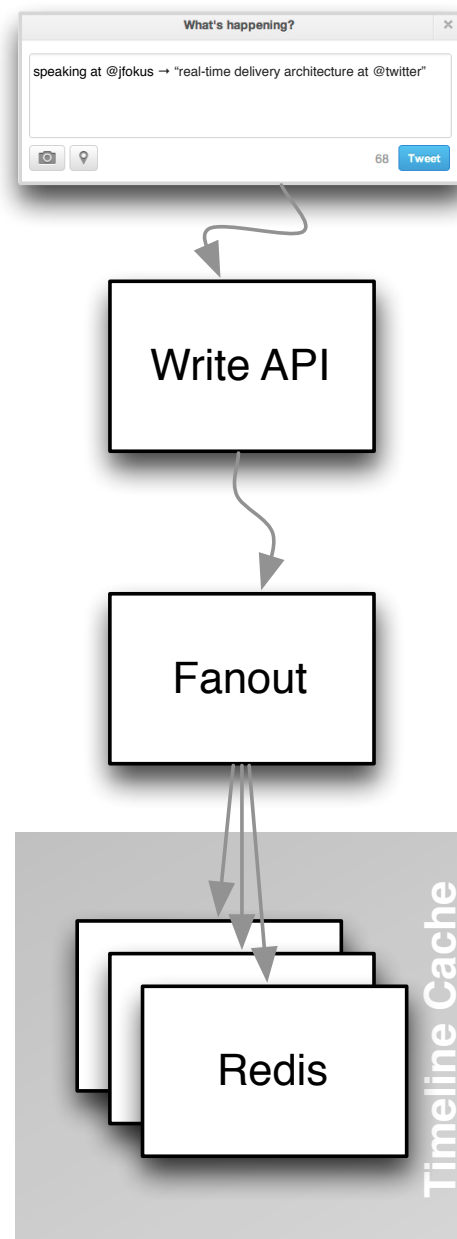




using redis

→ native list structure

→ RPU SHX to only add to cached timelines

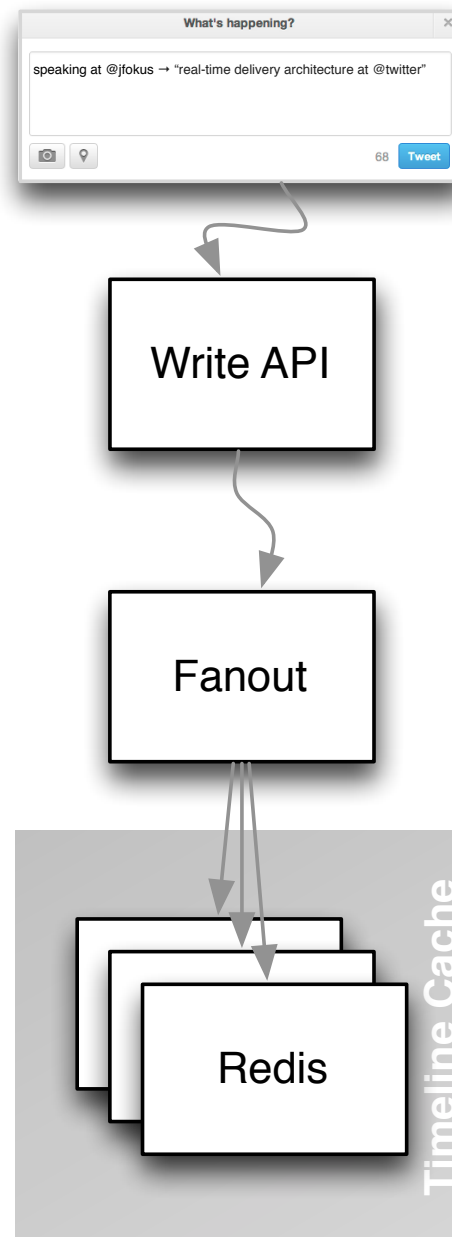


Tweet ID	User ID	Bits
8 bytes	8 bytes	4 bytes

using redis

→ native list structure

→ RPU SHX to only add to cached timelines

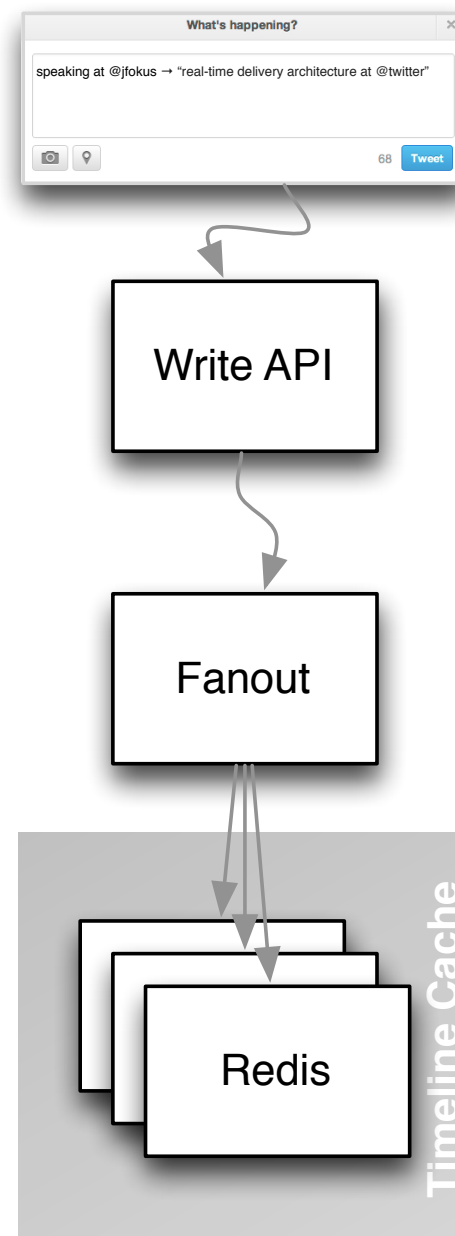


Tweet ID	User ID	Bits
Tweet ID	User ID	Bits
Tweet ID	User ID	Bits
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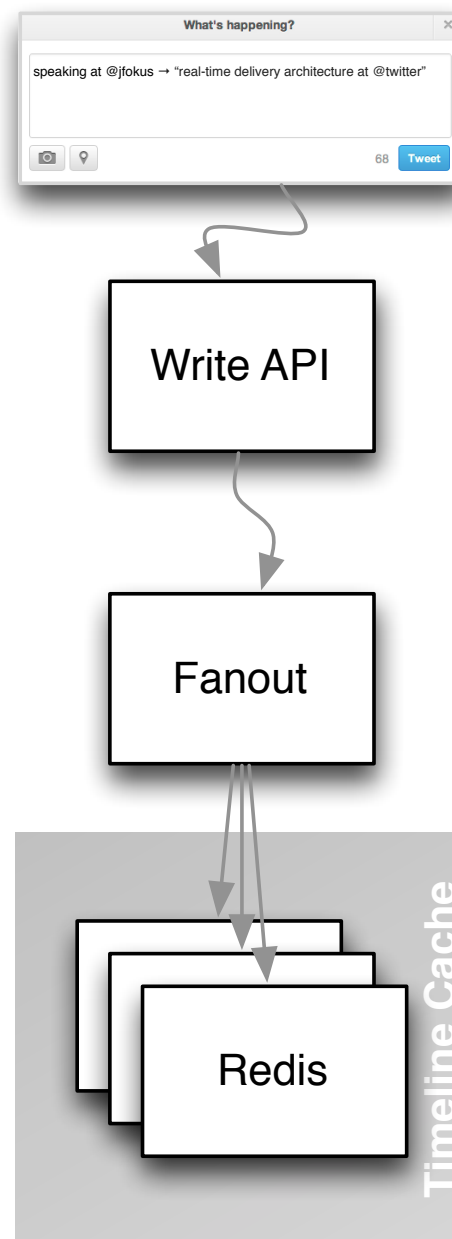
using redis

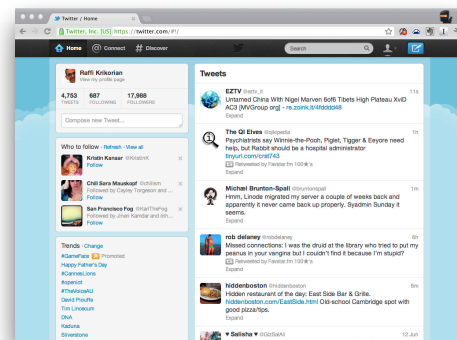
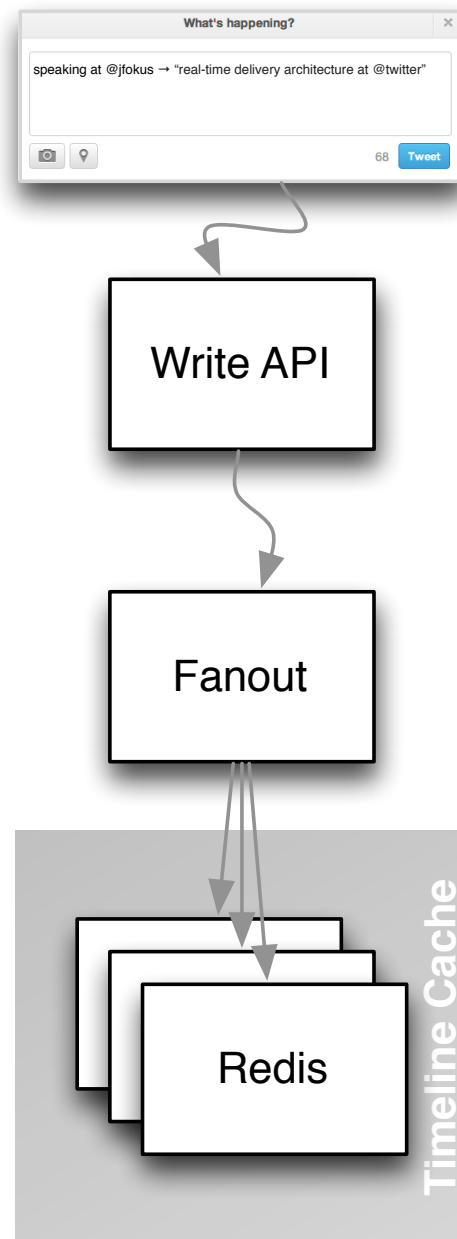
→ native list structure

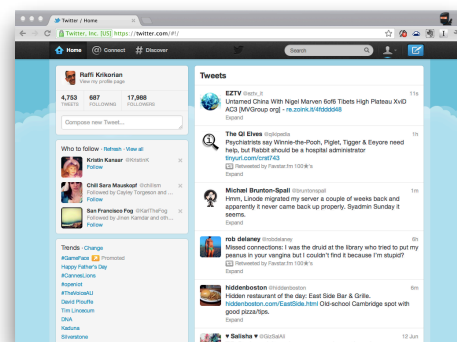
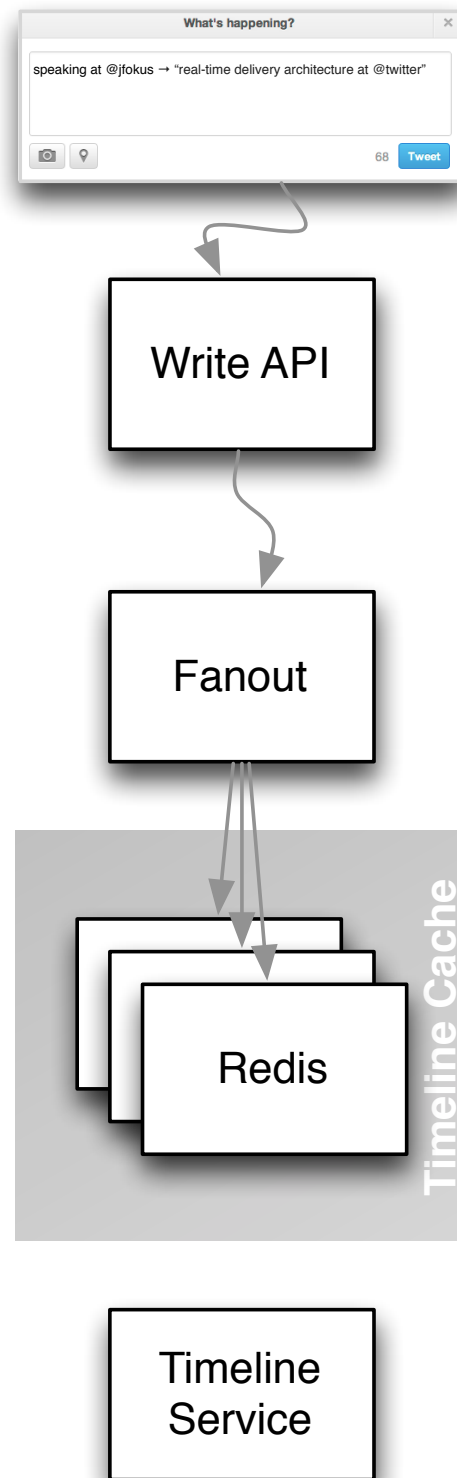
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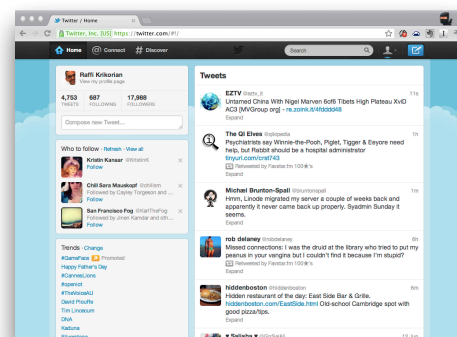
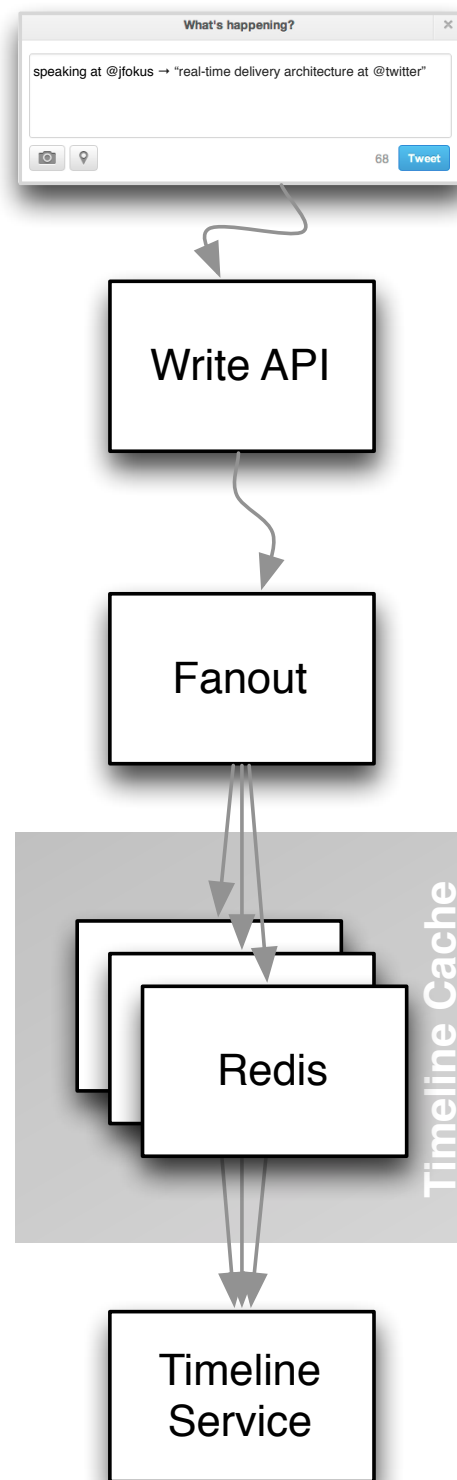


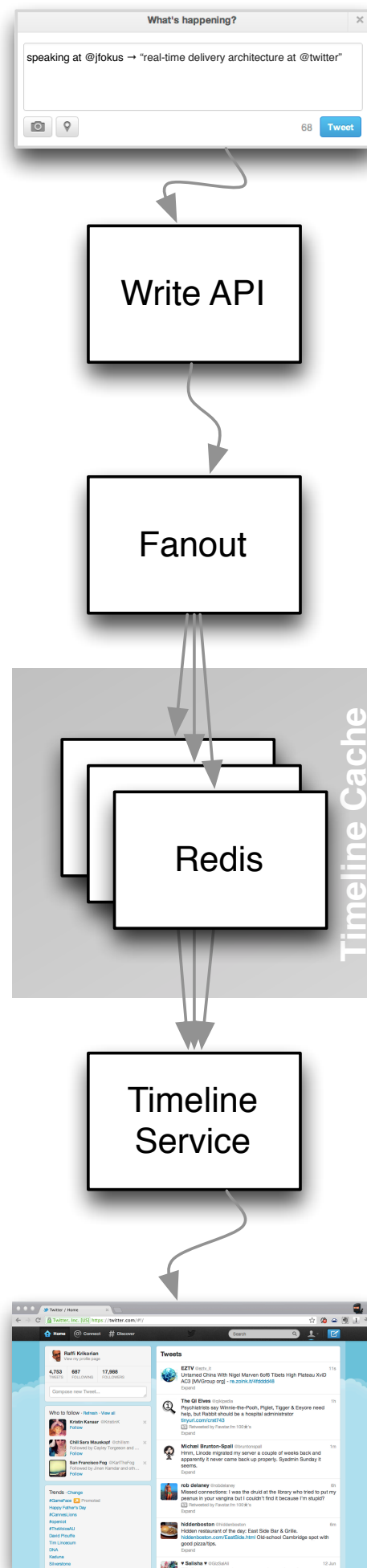
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	Tweet ID
Tweet ID	User ID	Bits	
Tweet ID	User ID	Bits	











Pull

Push

Targeted

twitter.com

User / Site Streams

home_timeline API

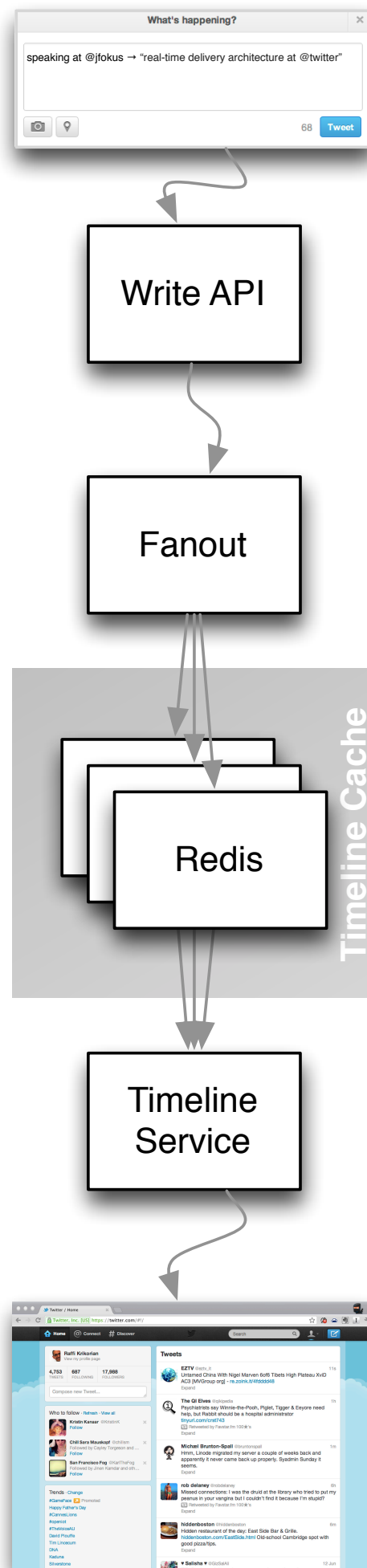
Mobile Push (SMS, etc.)

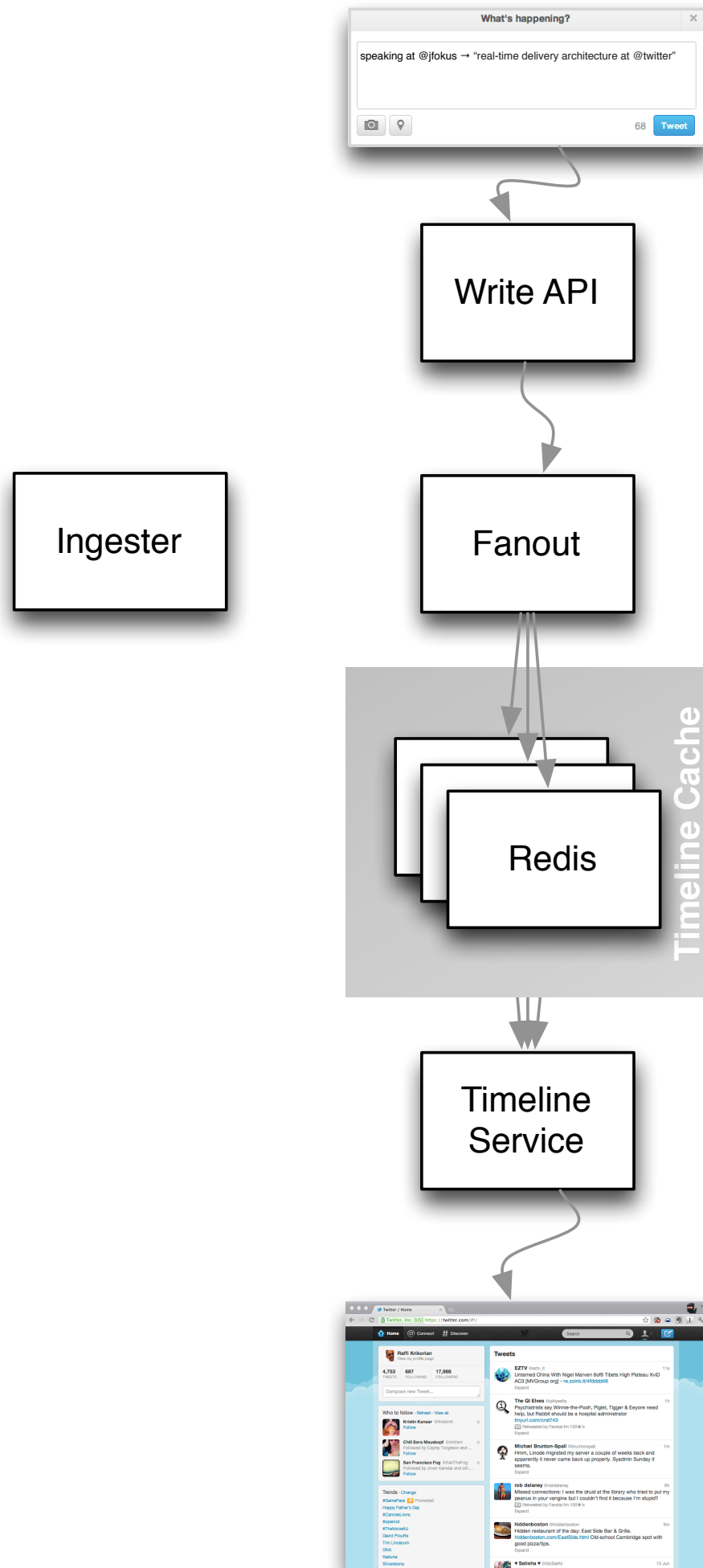
Queried

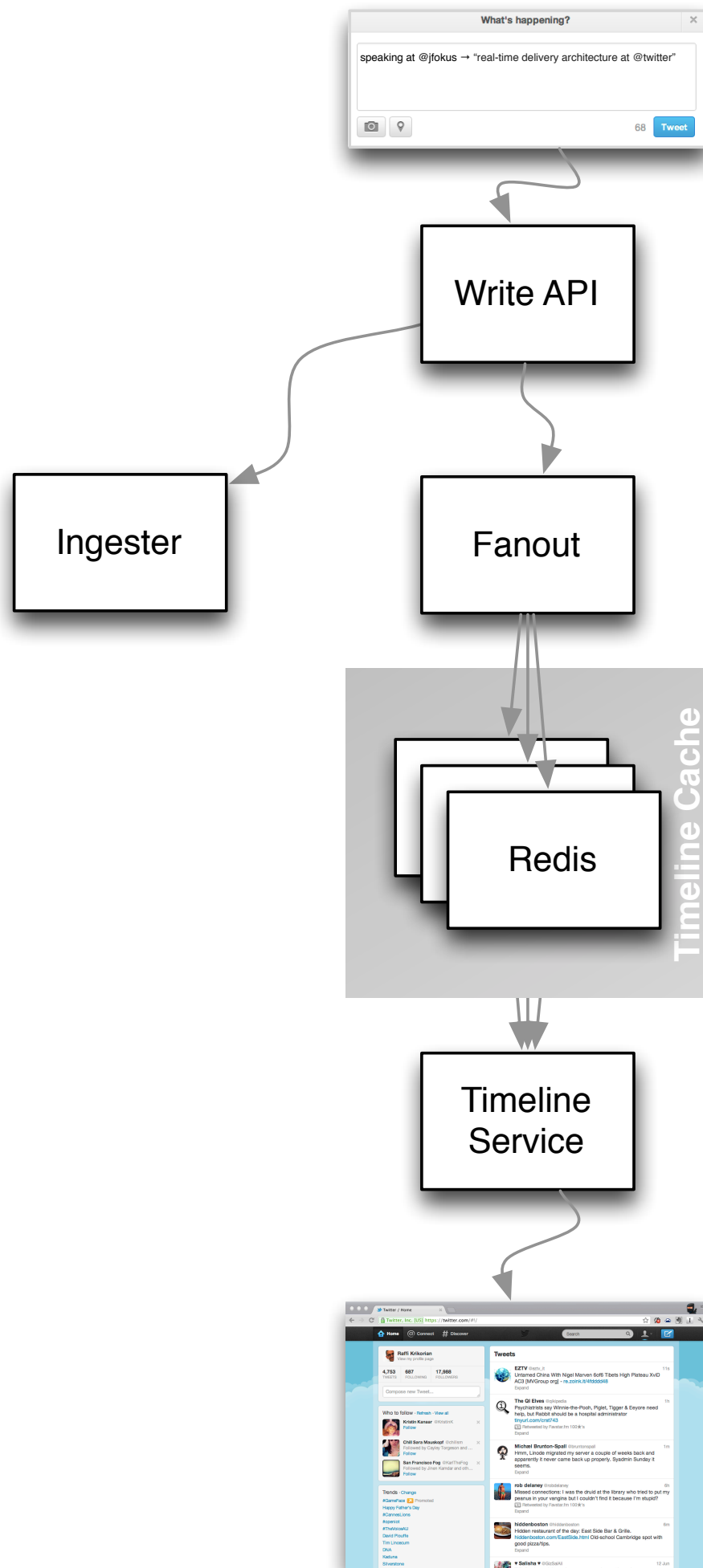
Search API

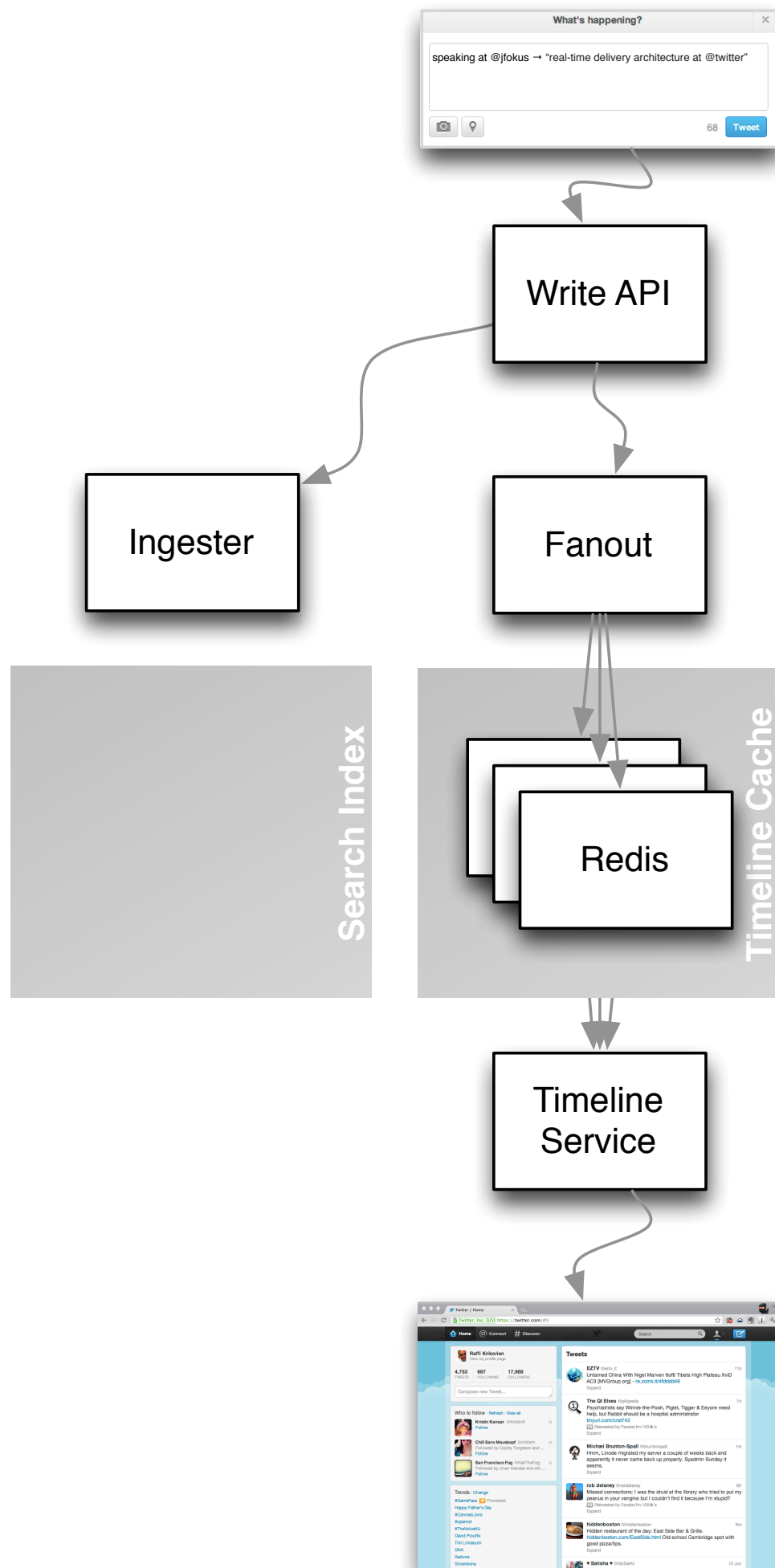
Track / Follow Streams

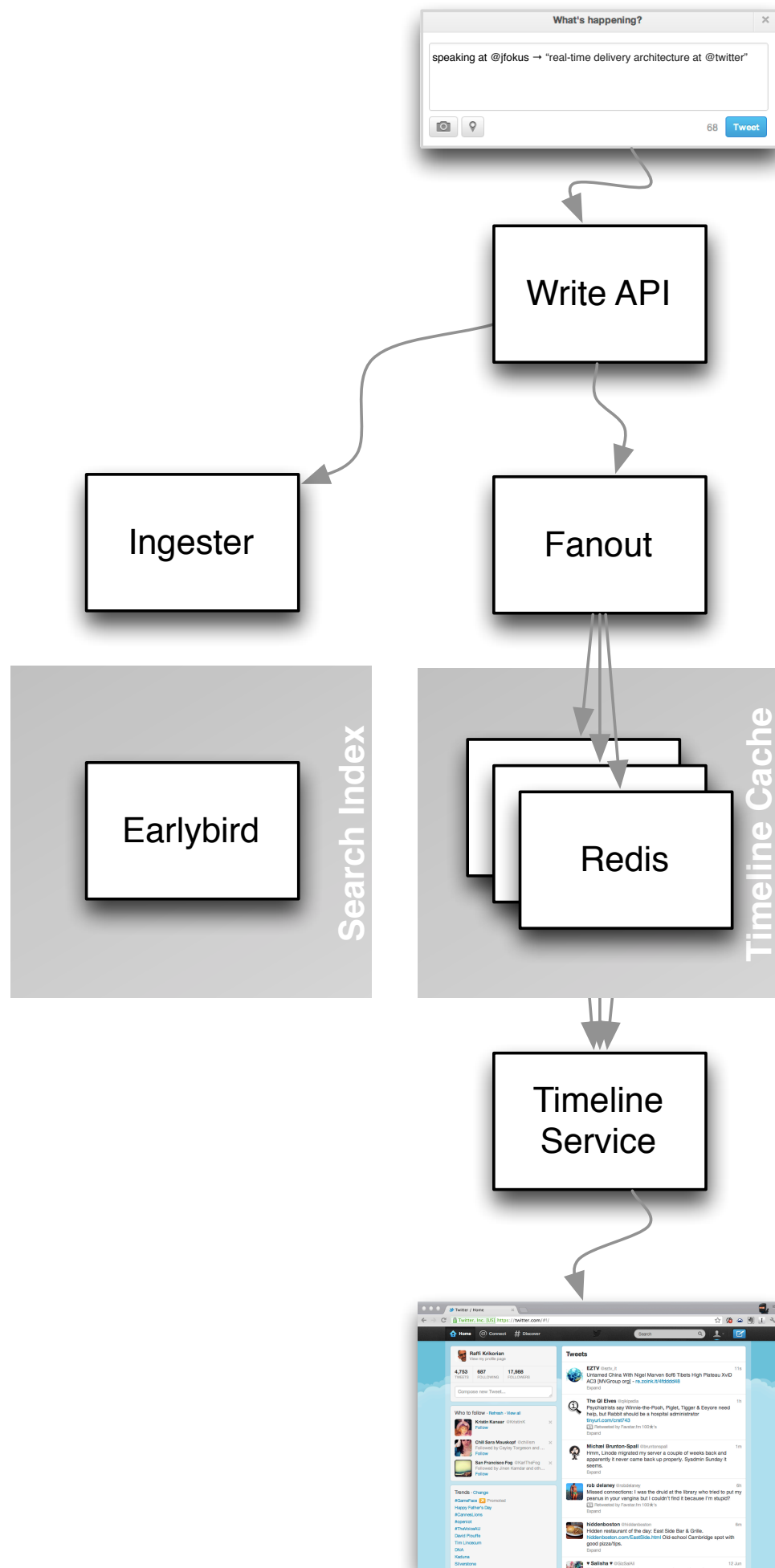
	Pull	Push
Targeted	twitter.com home_timeline API	User / Site Streams Mobile Push (SMS, etc.)
Queried	Search API	Track / Follow Streams

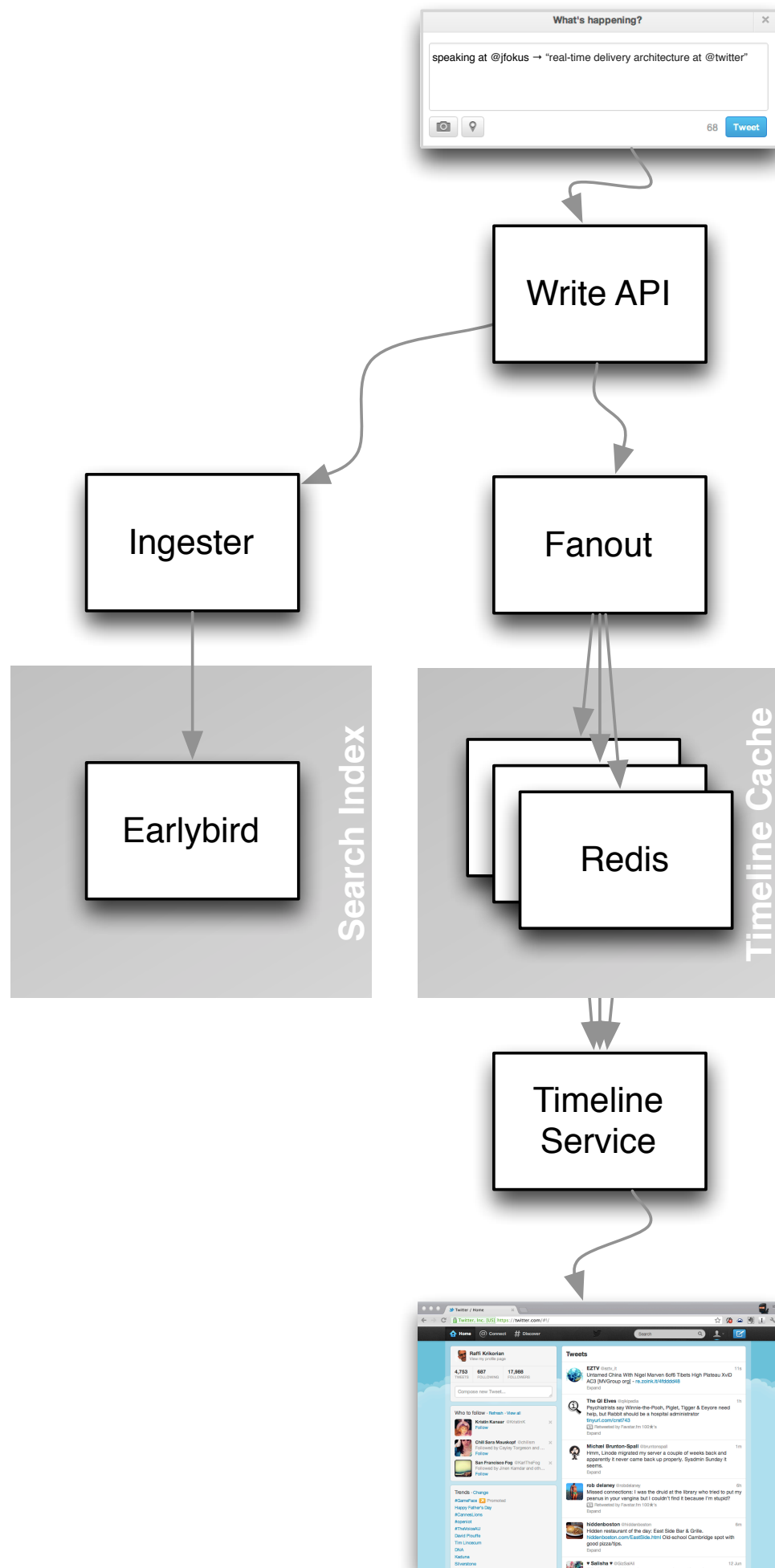


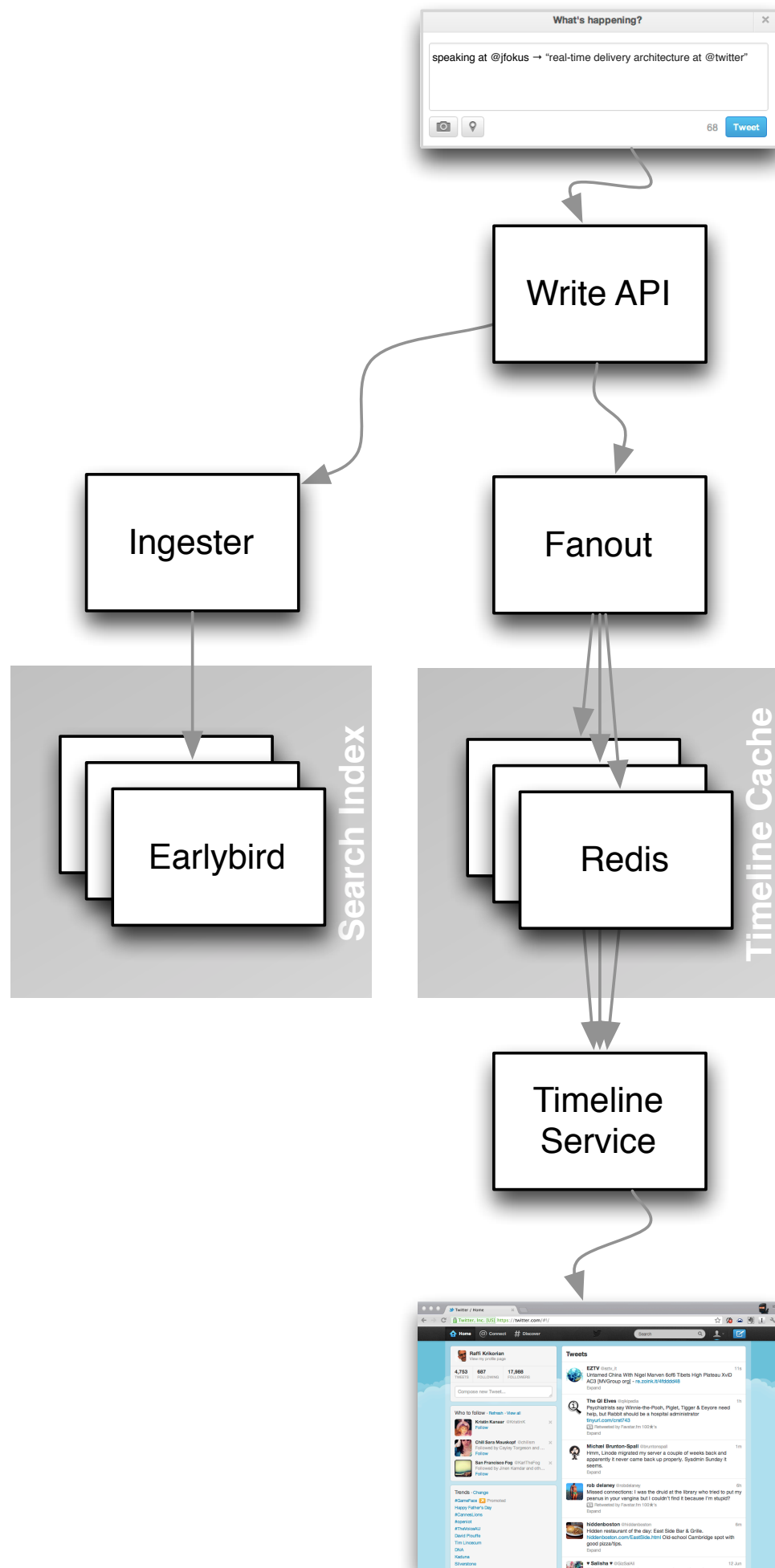


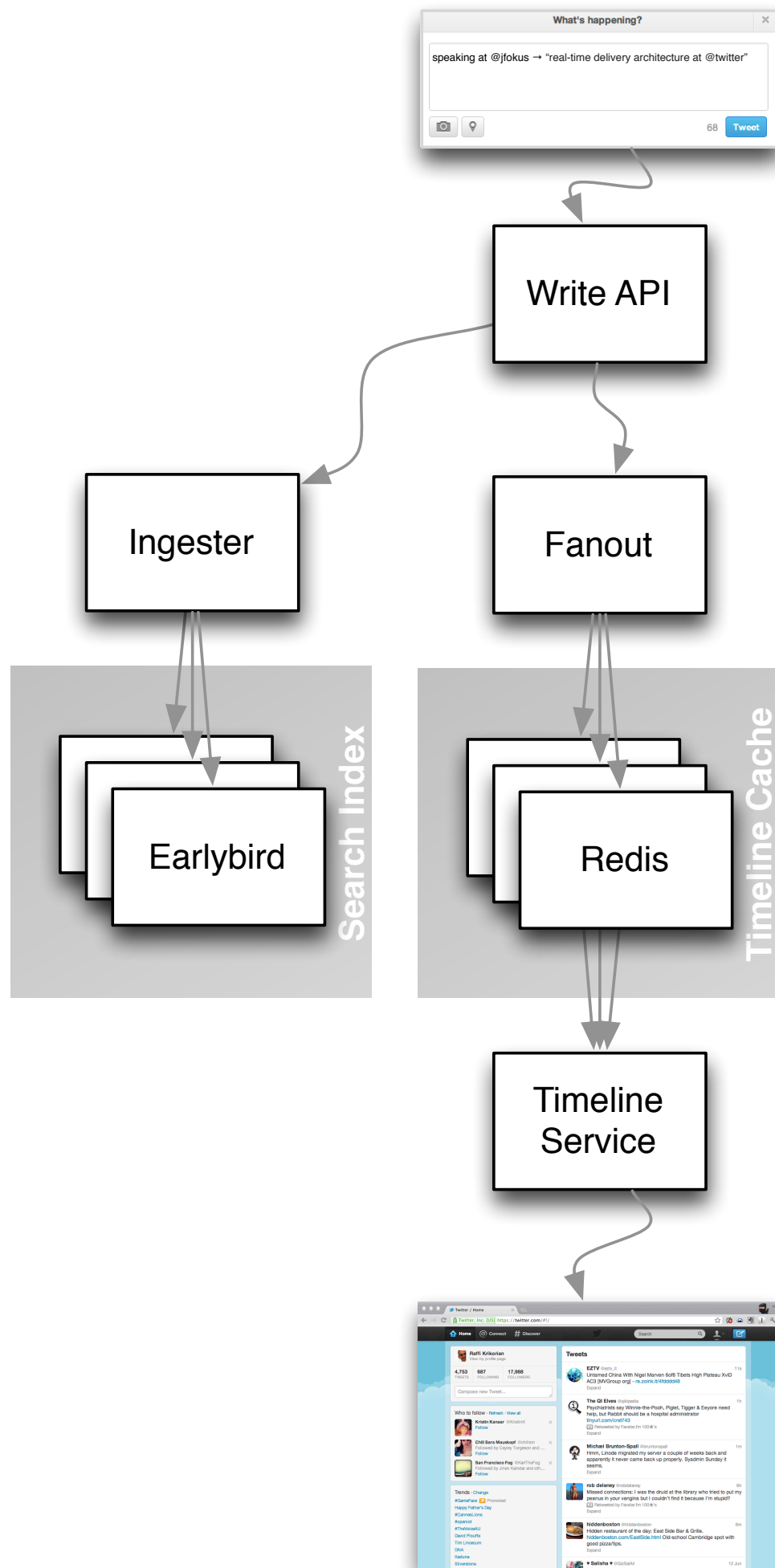


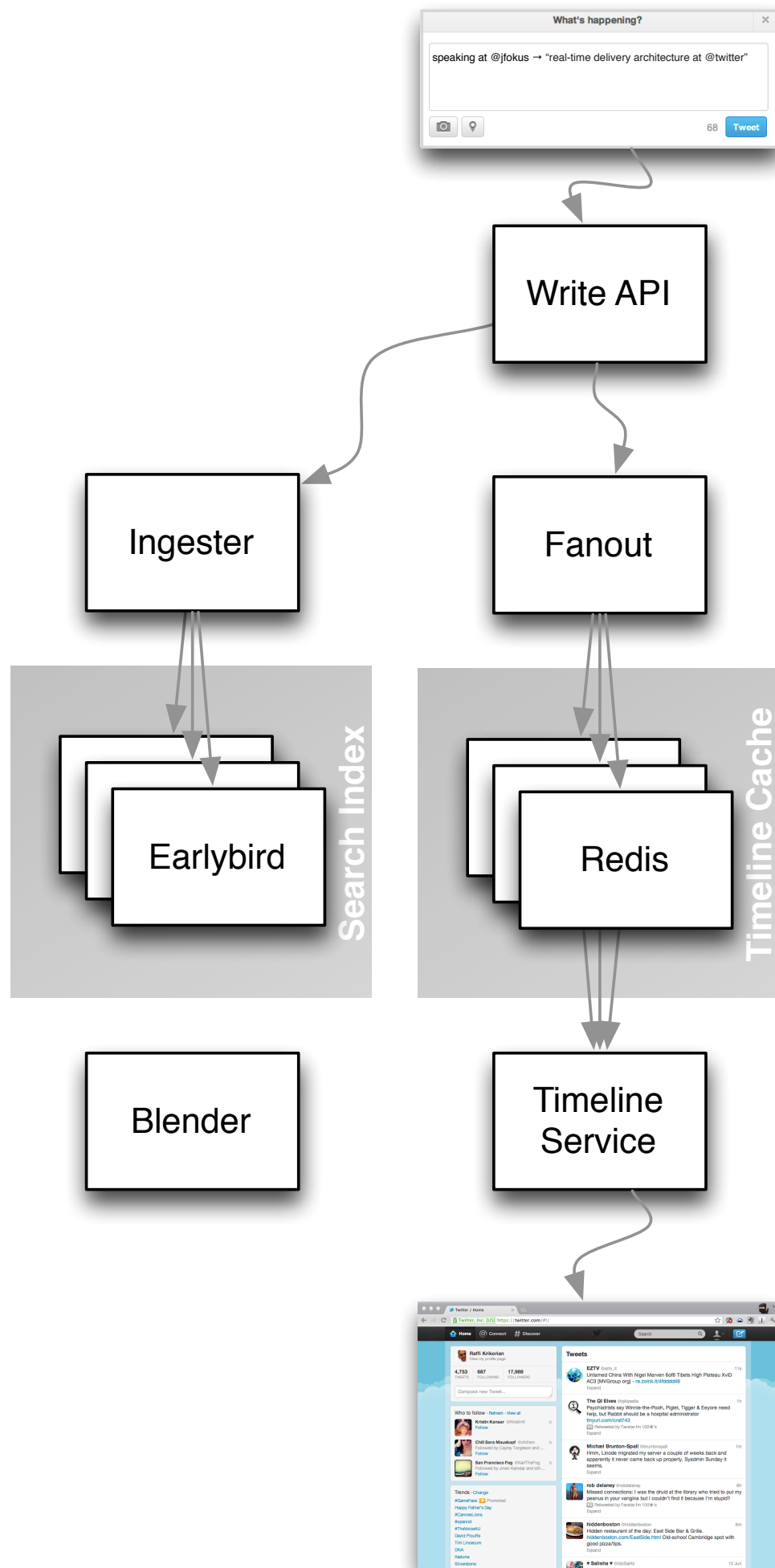


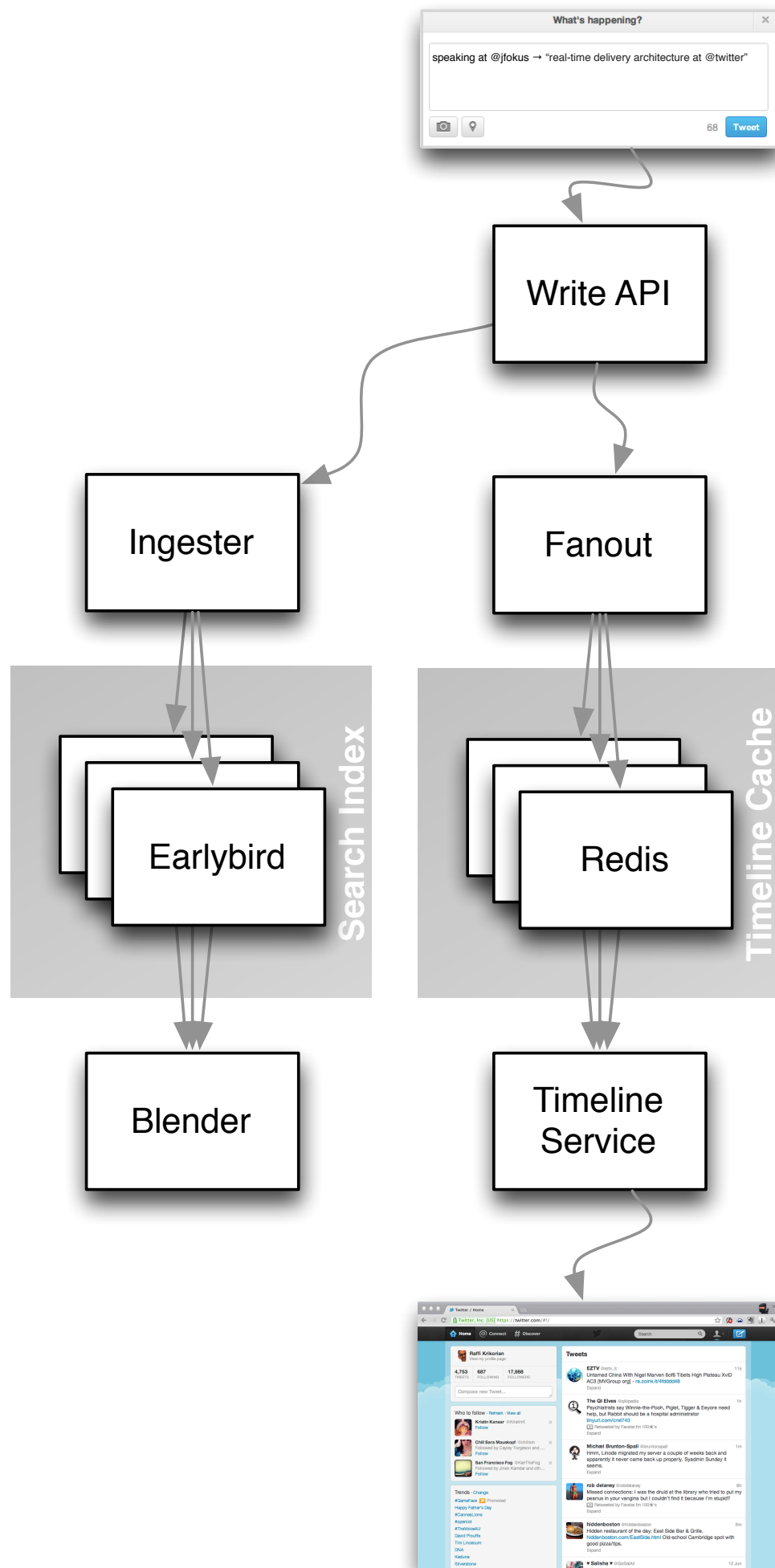


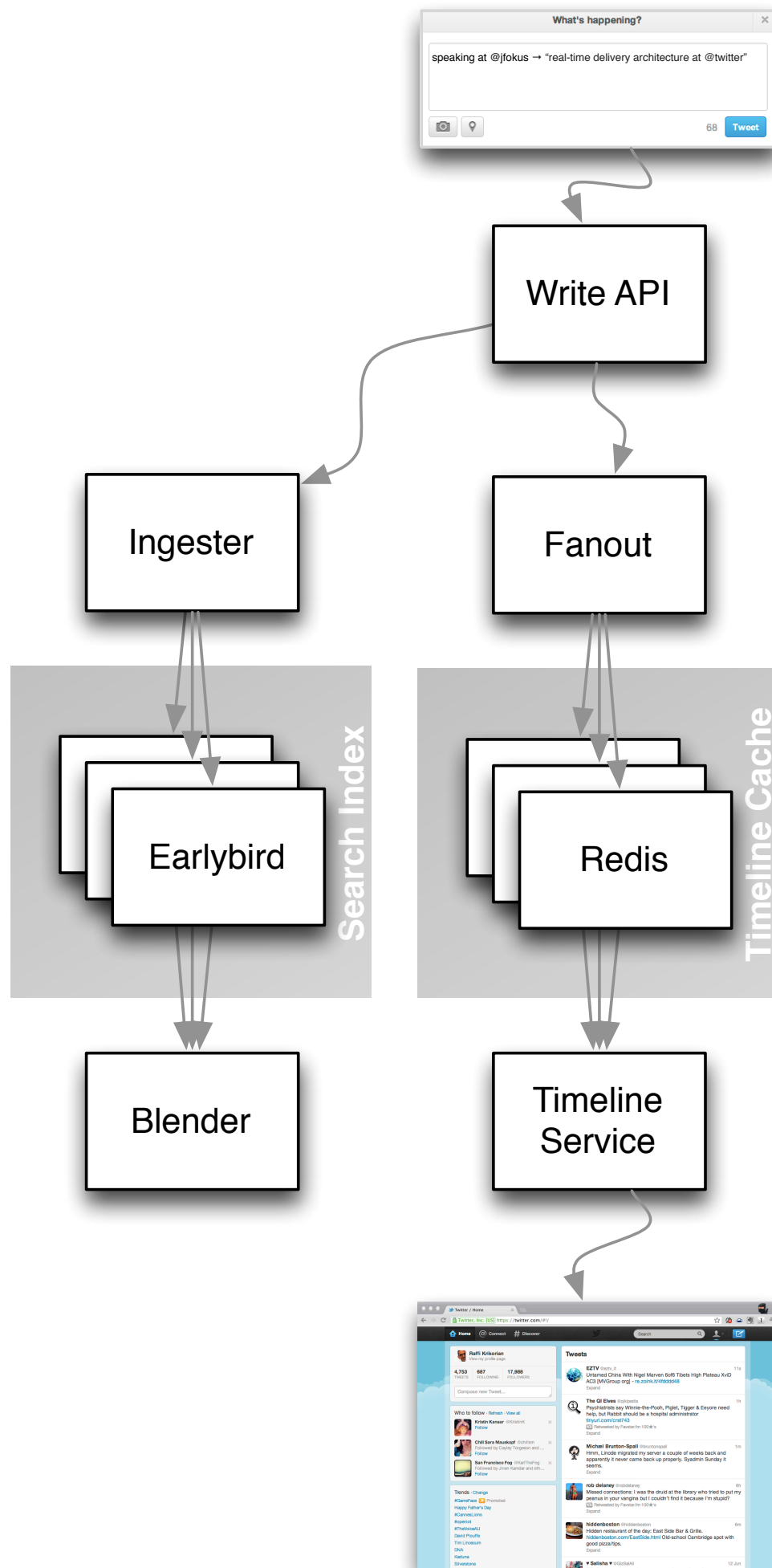








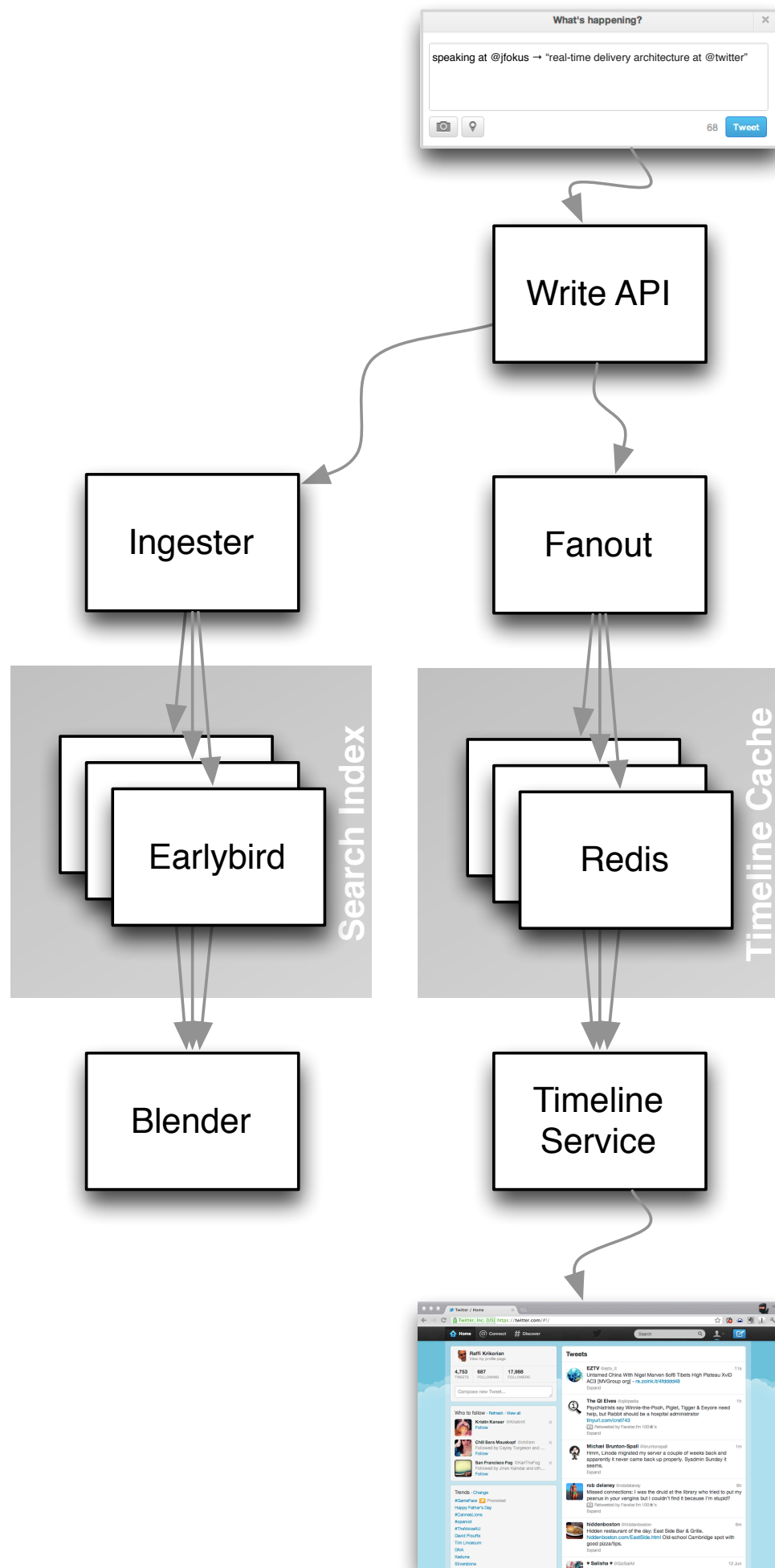


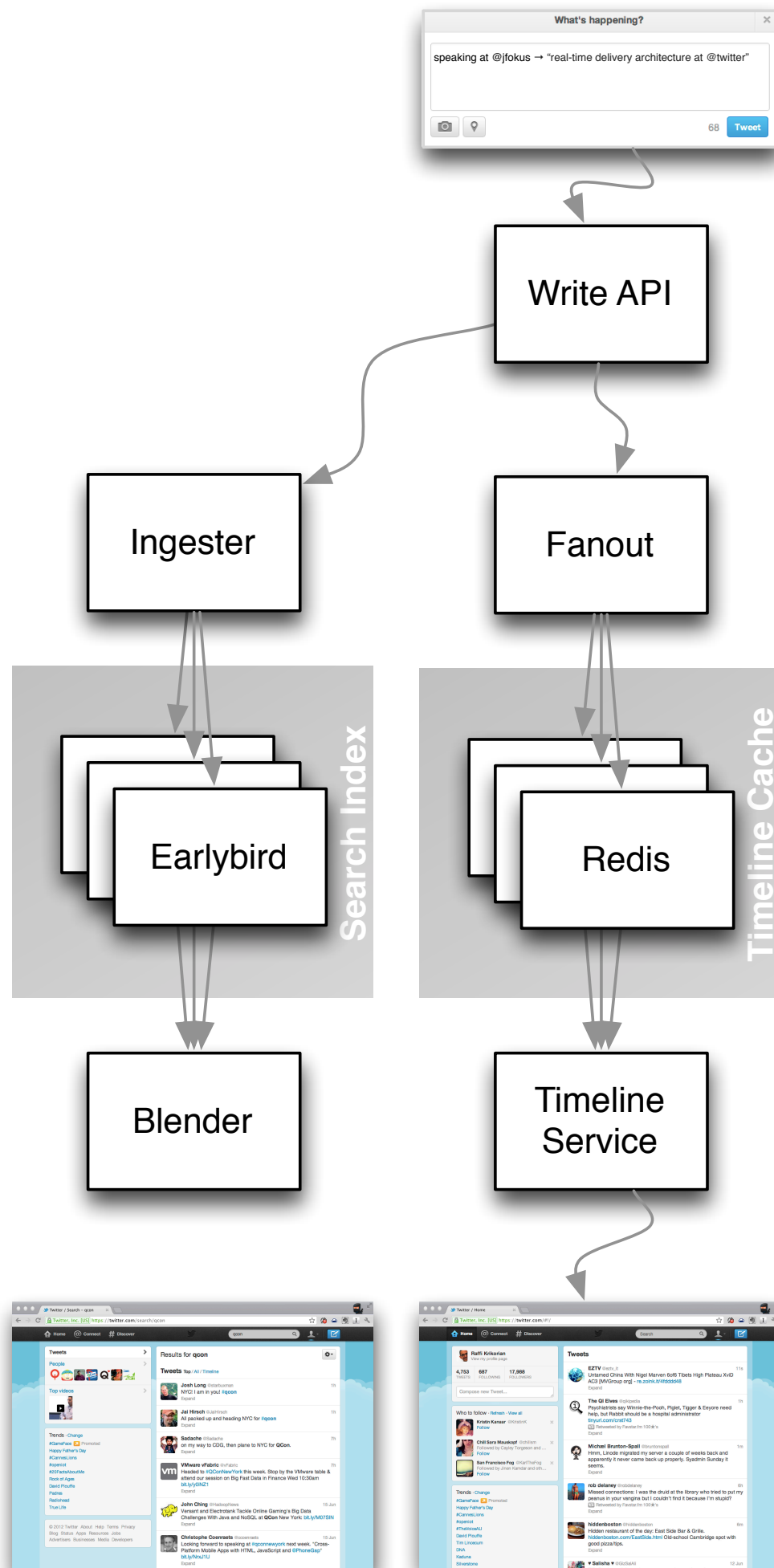


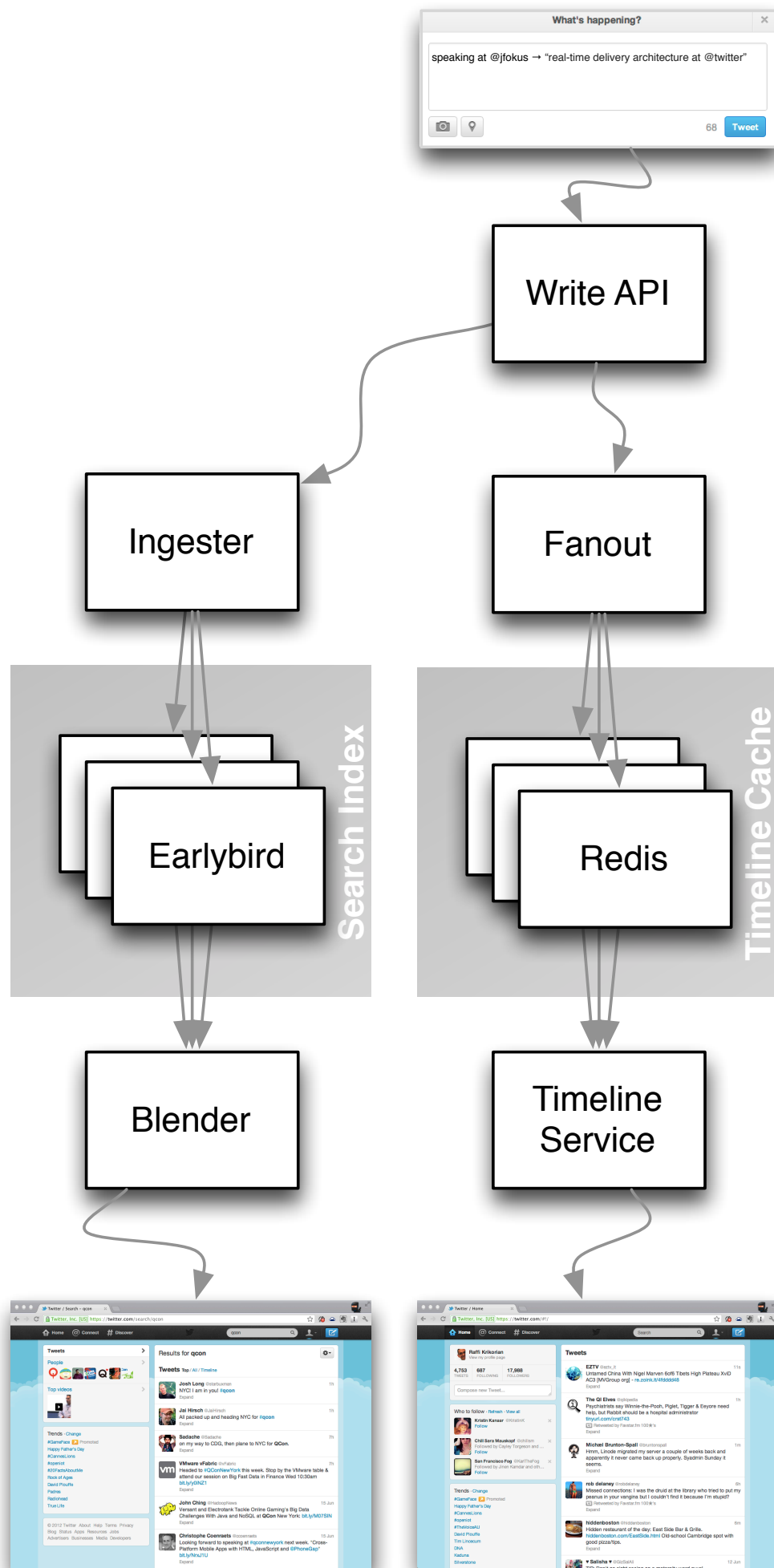
blender

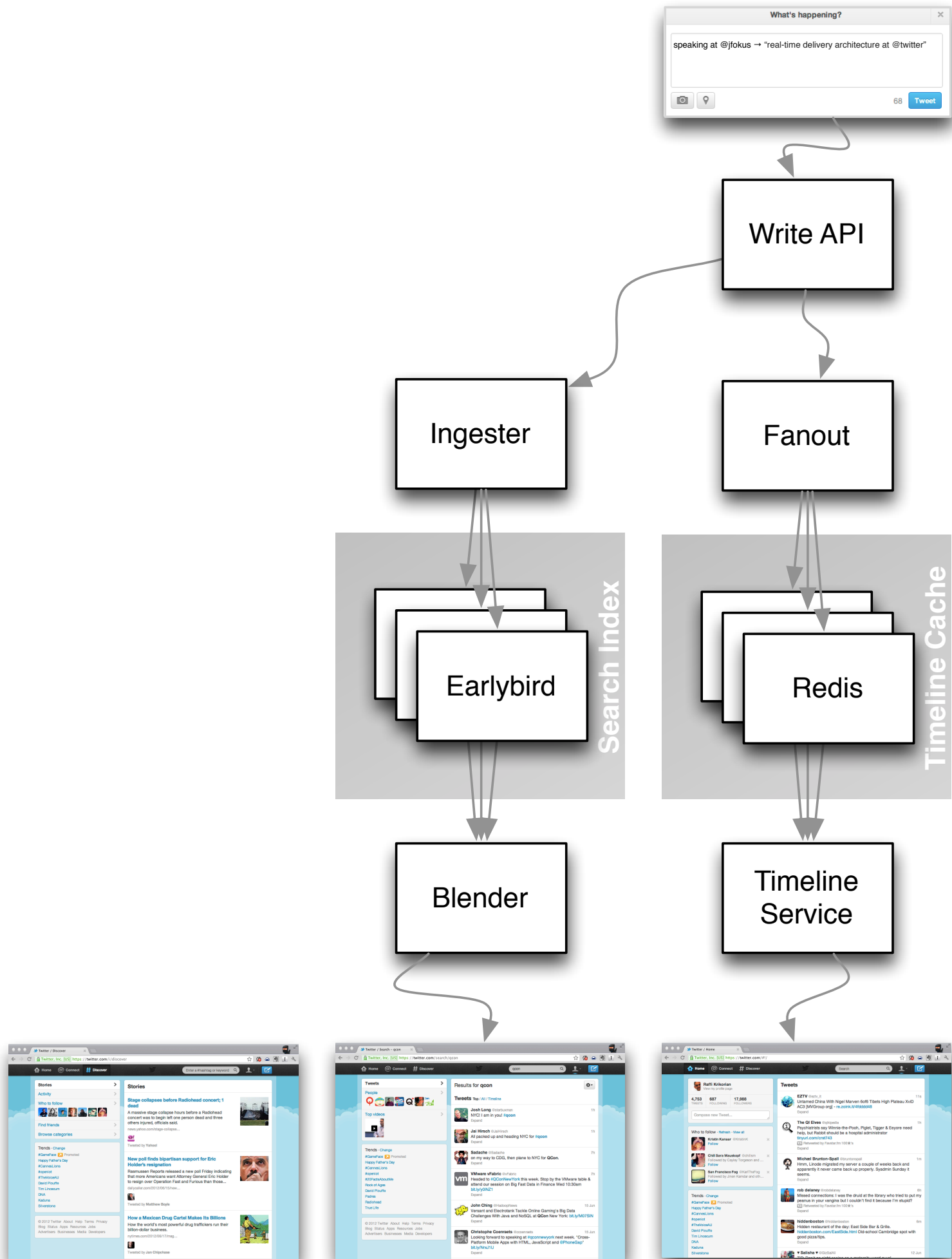
→ queries one replica of all indexes

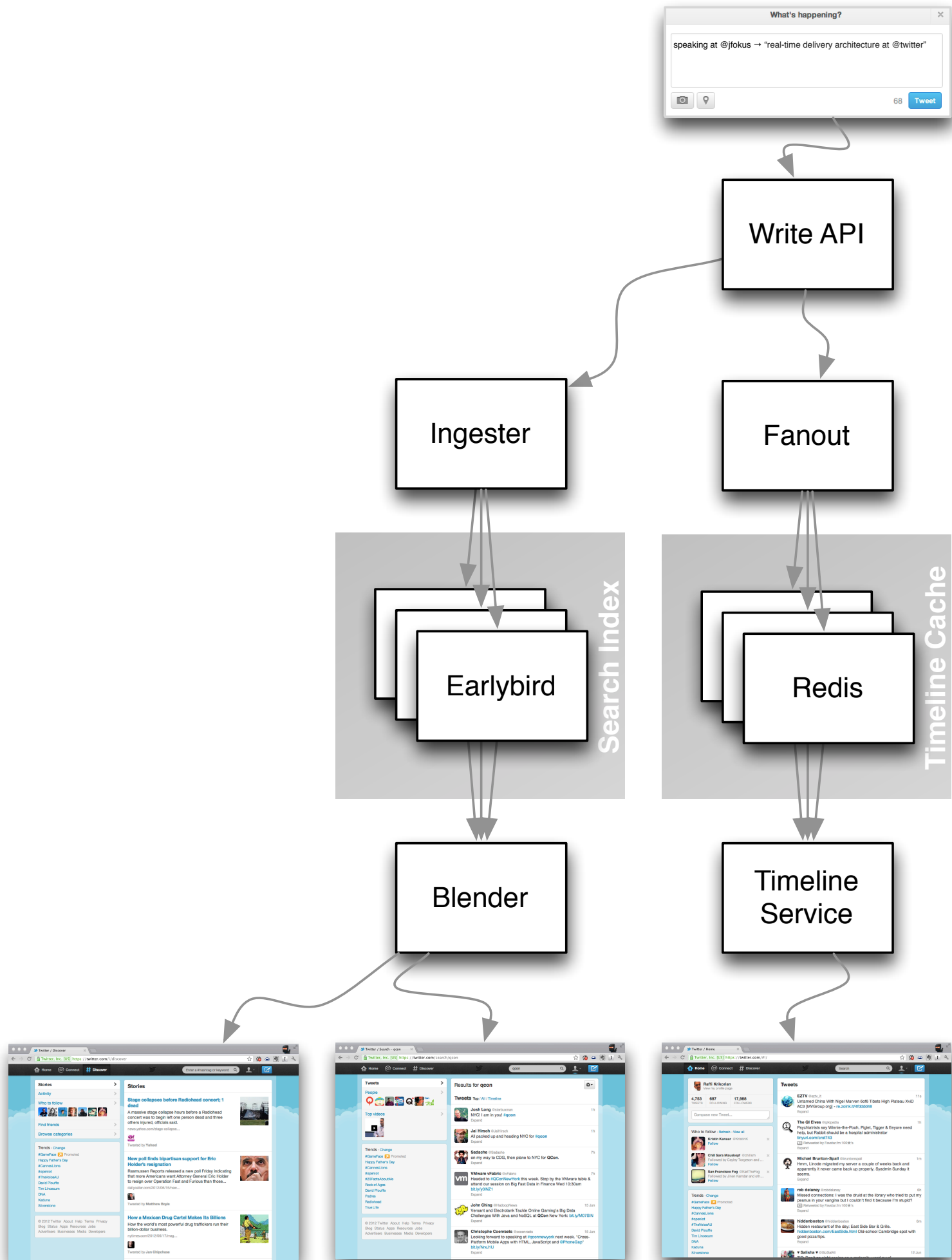
→ merges & ranks results











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

Pull

Push

Targeted

twitter.com

User / Site Streams

home_timeline API

Mobile Push (SMS, etc.)

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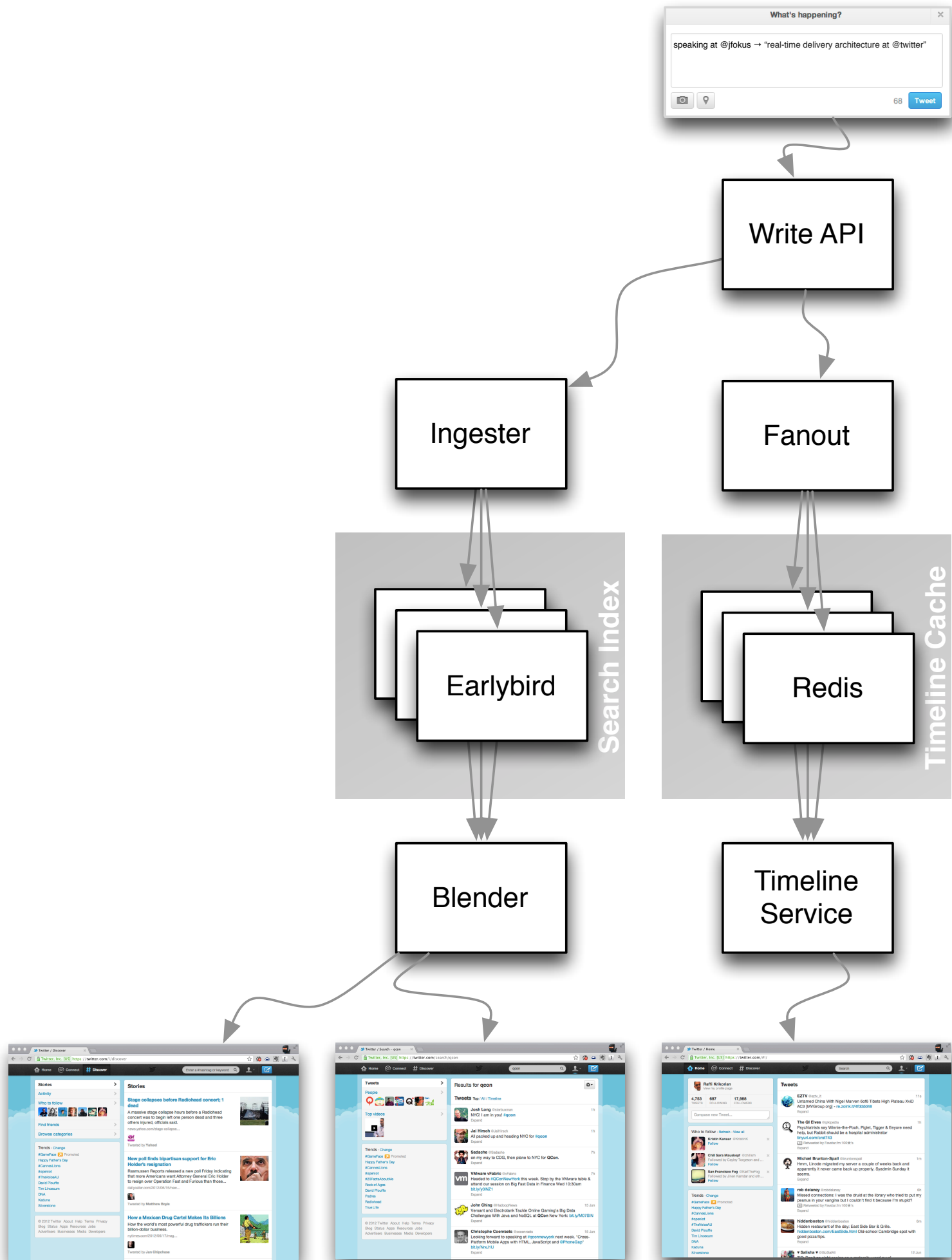
Mobile Push (SMS, etc.)

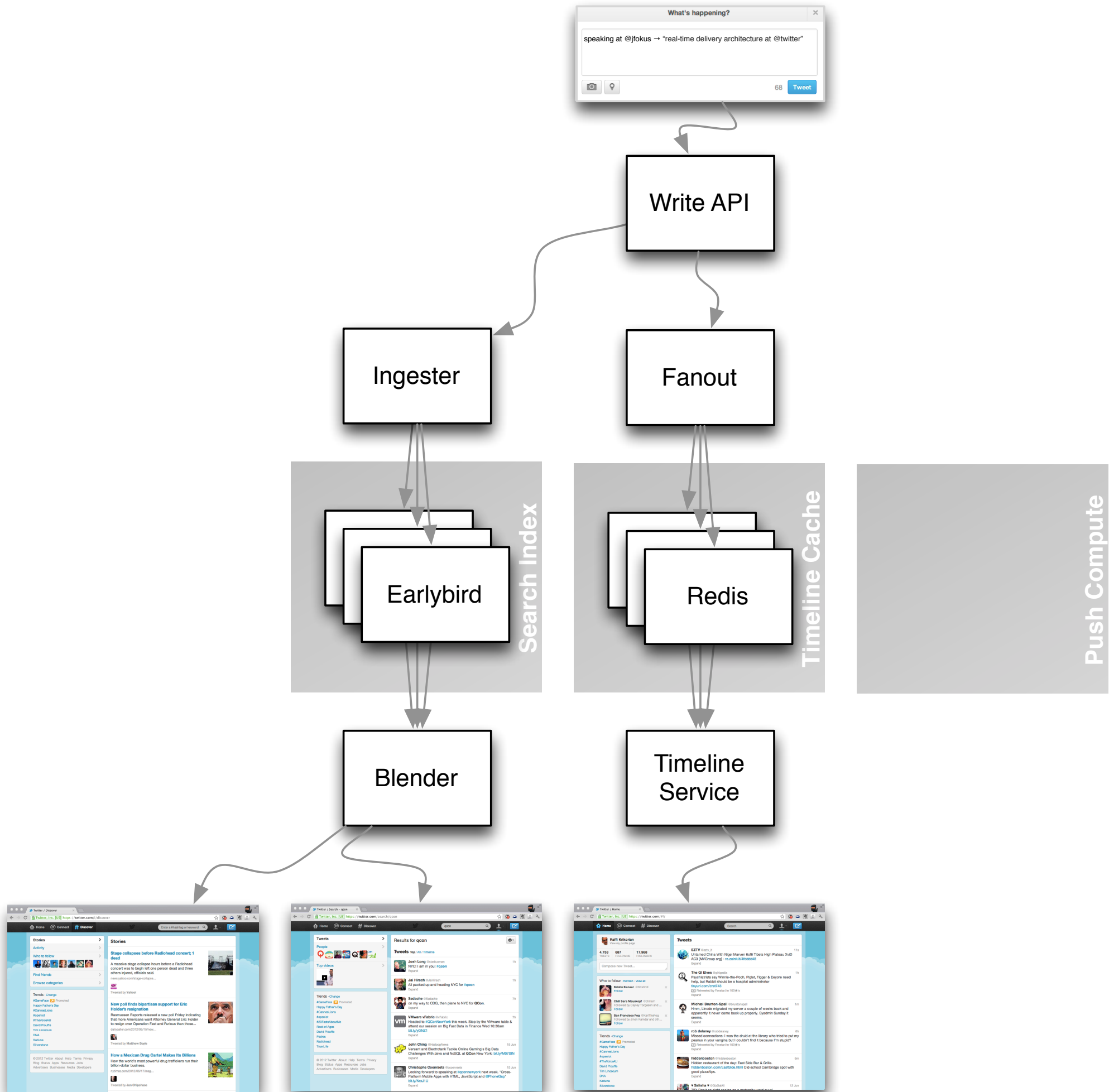
Queried

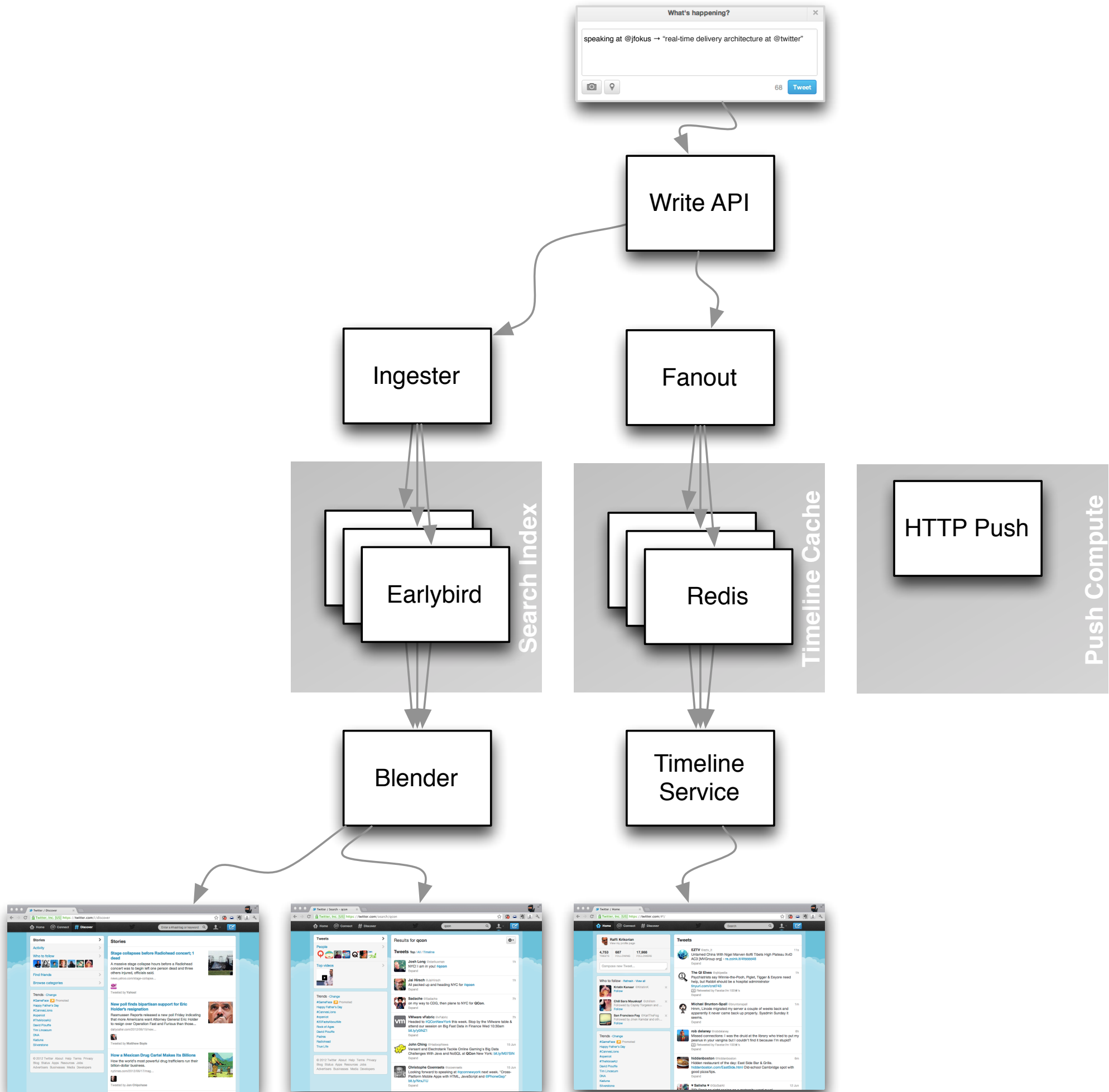
Search API

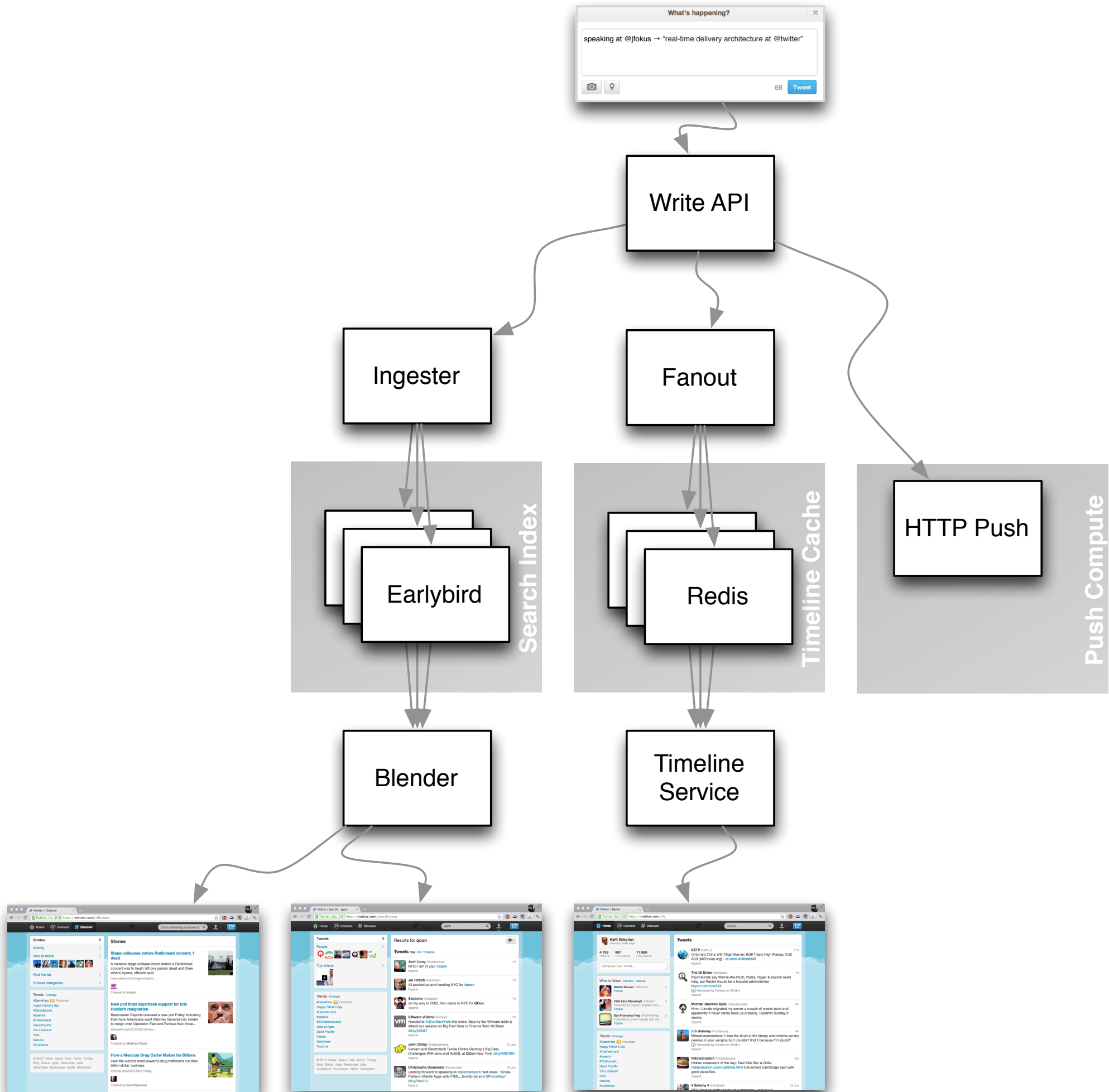
Track / Follow Streams

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










```
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```

http push / hosebird

maintains persistent connections with
end clients

processes tweet & social graph events

event-based "router"

Write API

Write API

Hosebird

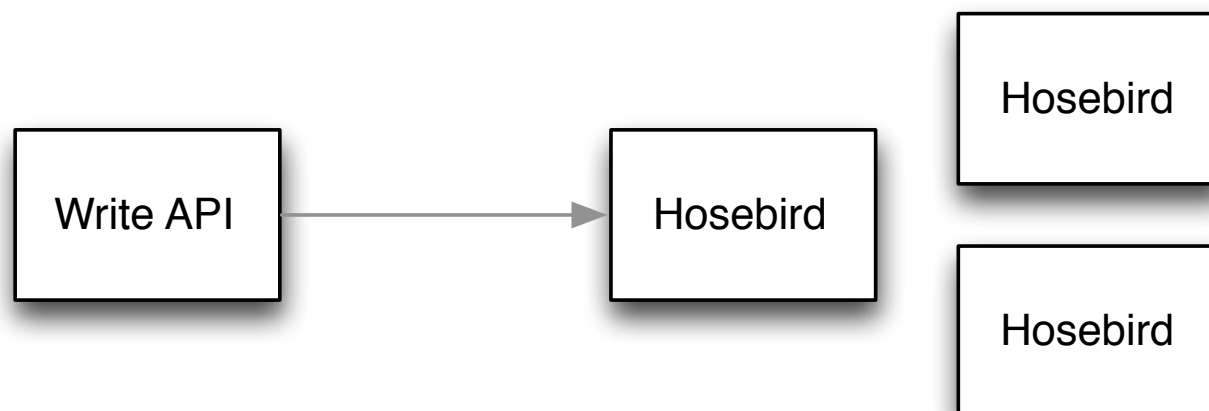


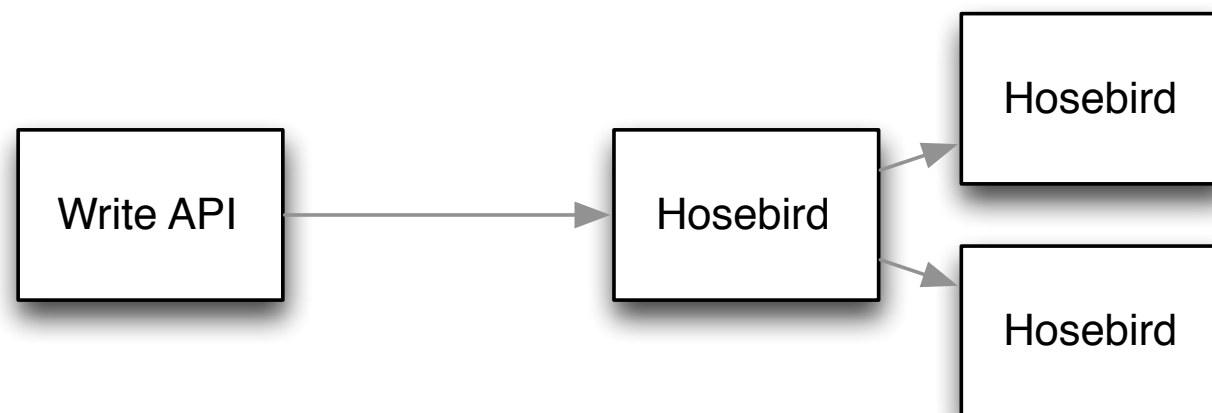


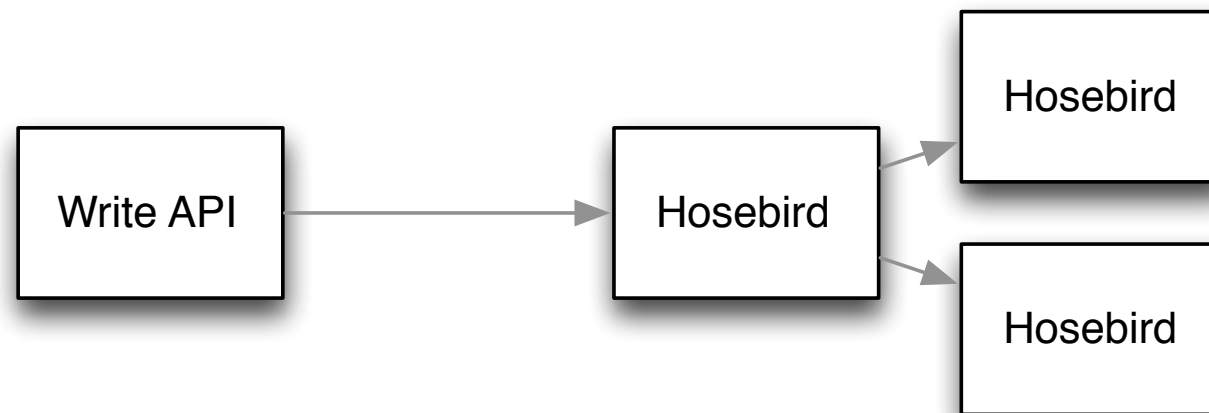
event propagation

- write API sends all events into hosebird; sees content creation events, social graph changes, etc.
- different queues for public tweets, protected tweets, social events, etc.



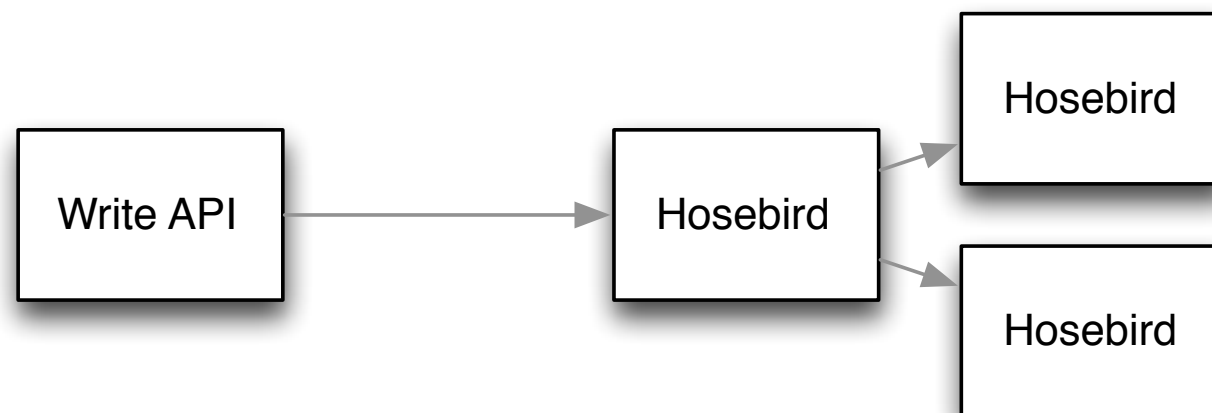


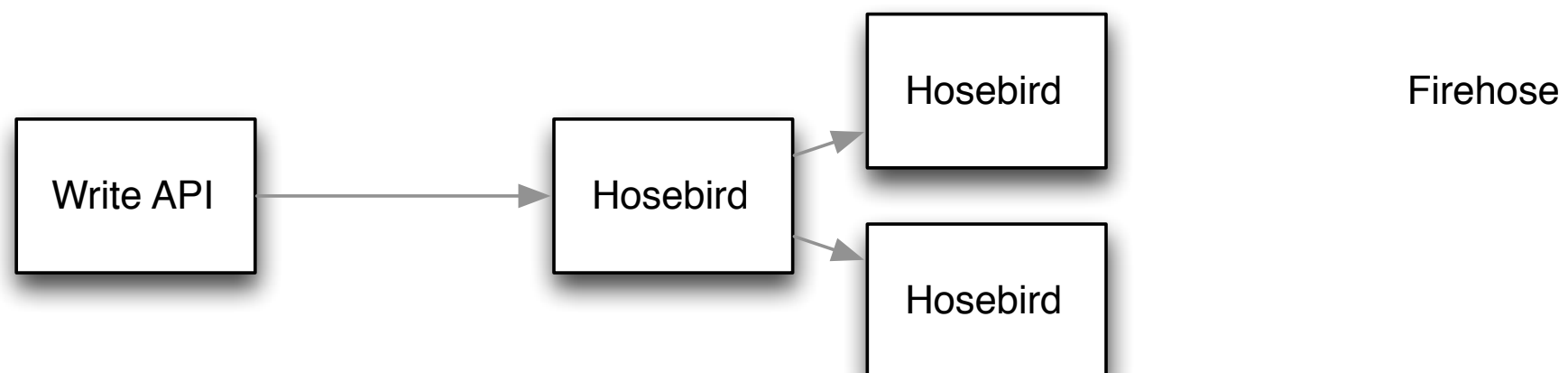


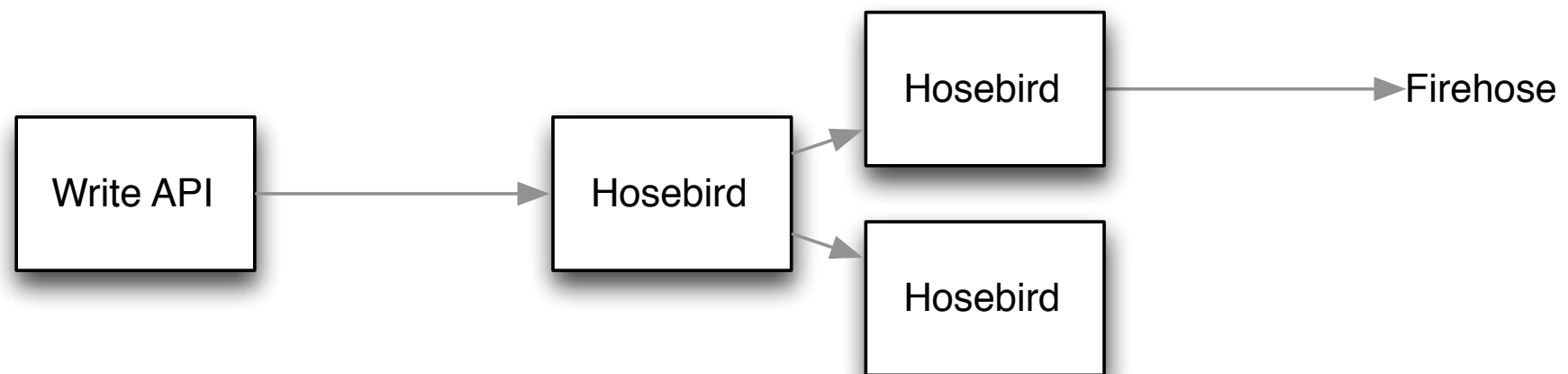


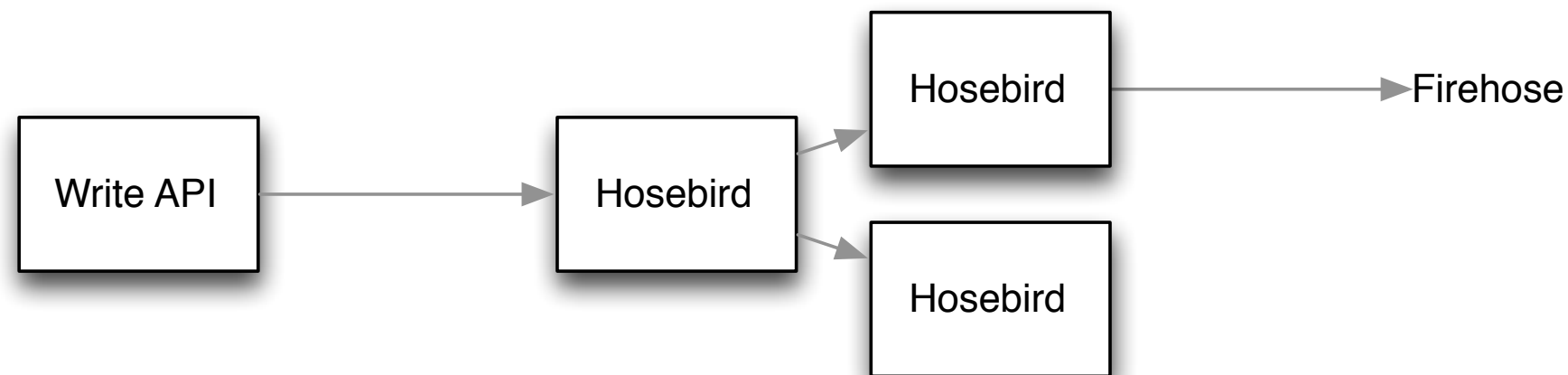
event cascading

- bandwidth management
- simultaneous connection management
(~1m long lived & open connections to this cluster)



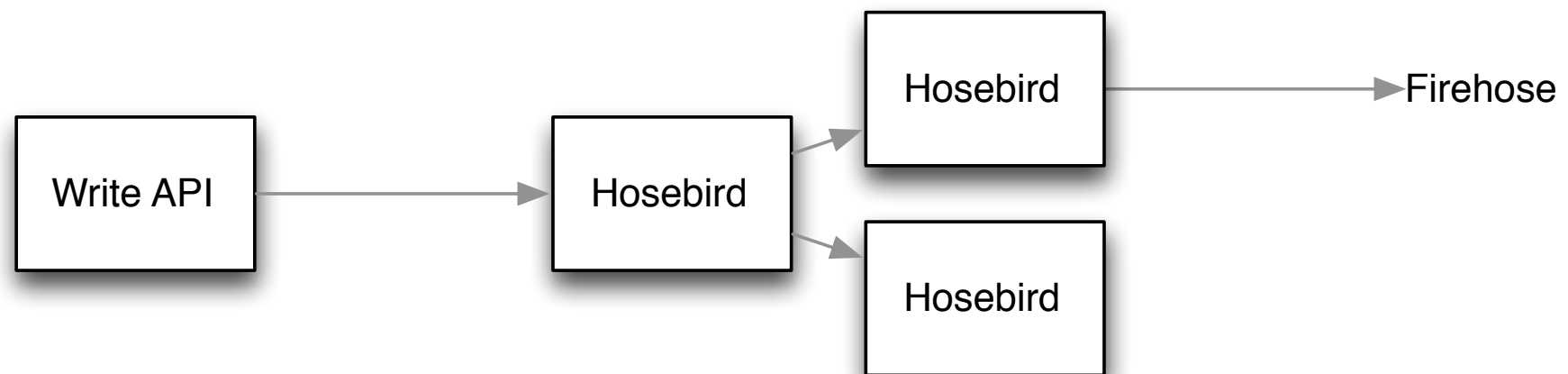


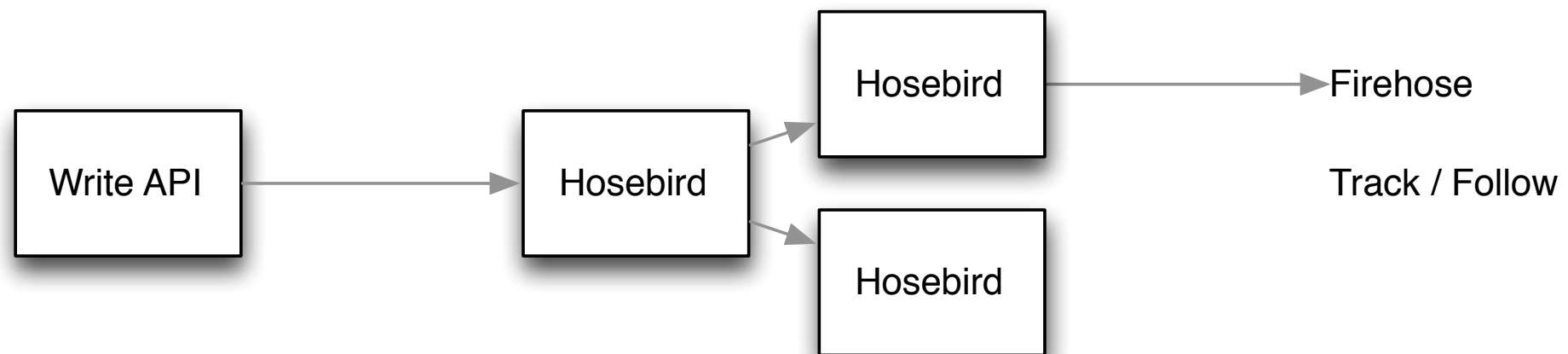


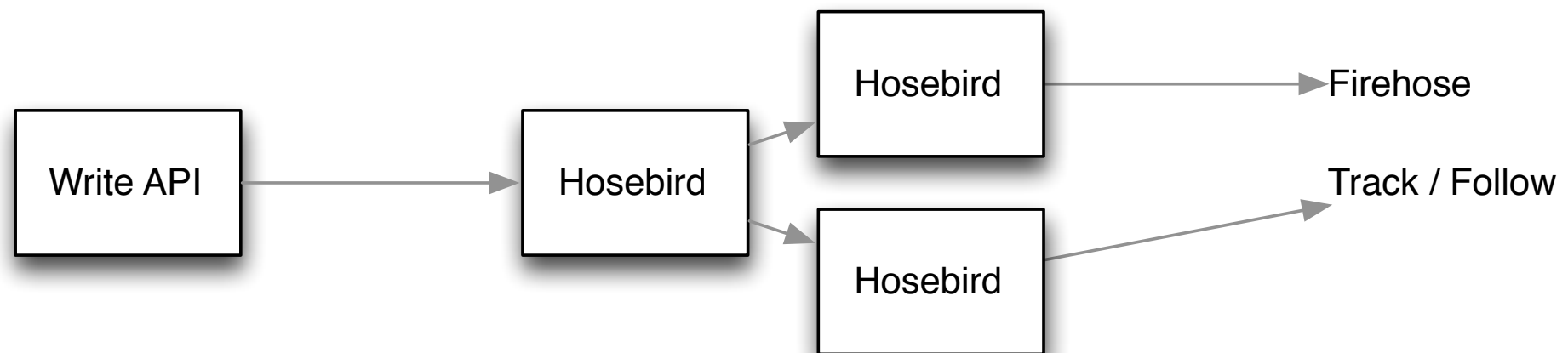


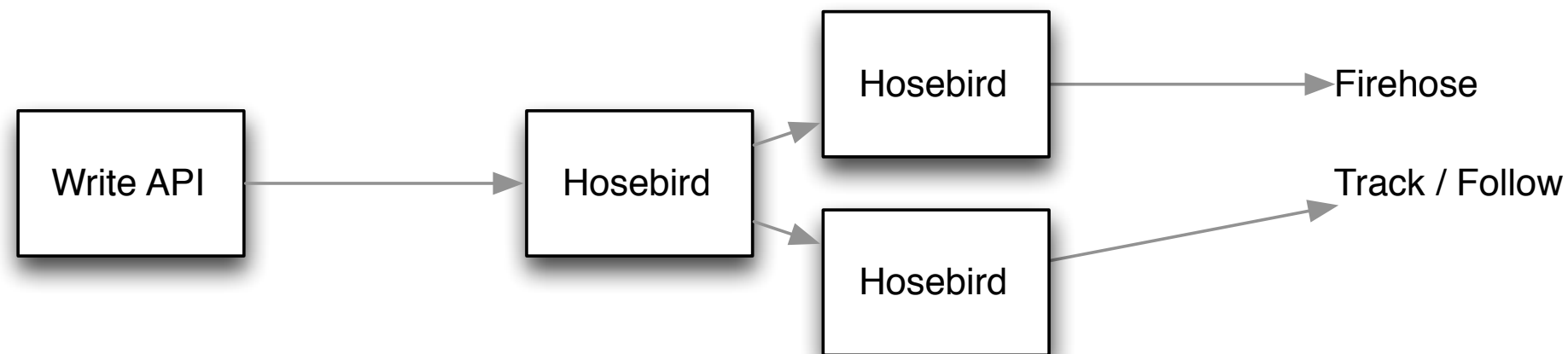
firehose

- edge machine simply outputs the public tweet queue
- only allow a limited number of firehoses per hosebird box for bandwidth management



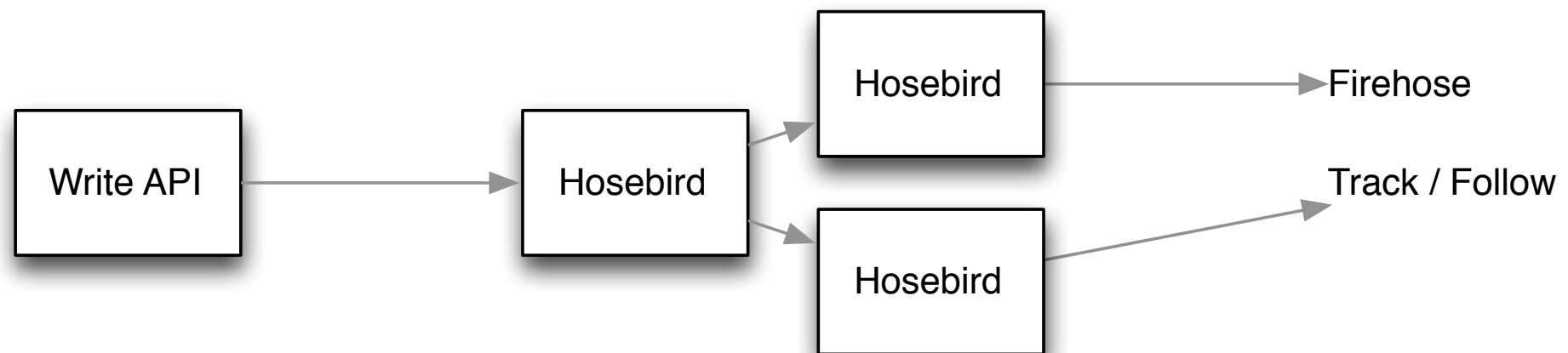


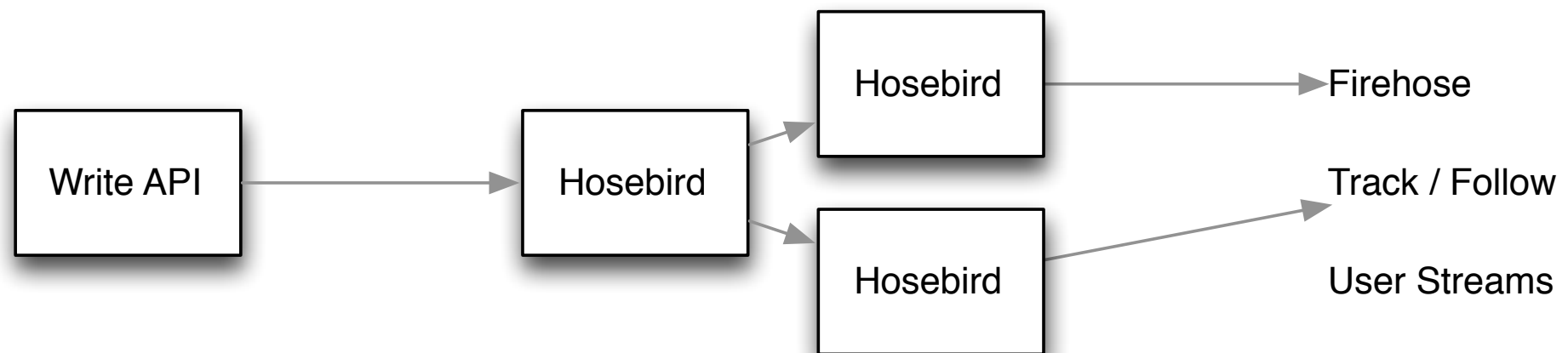


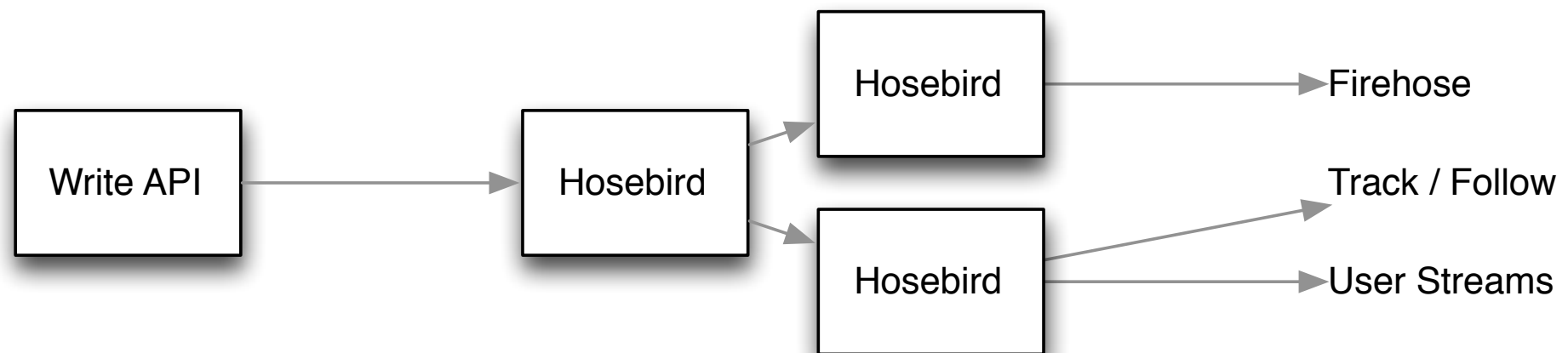


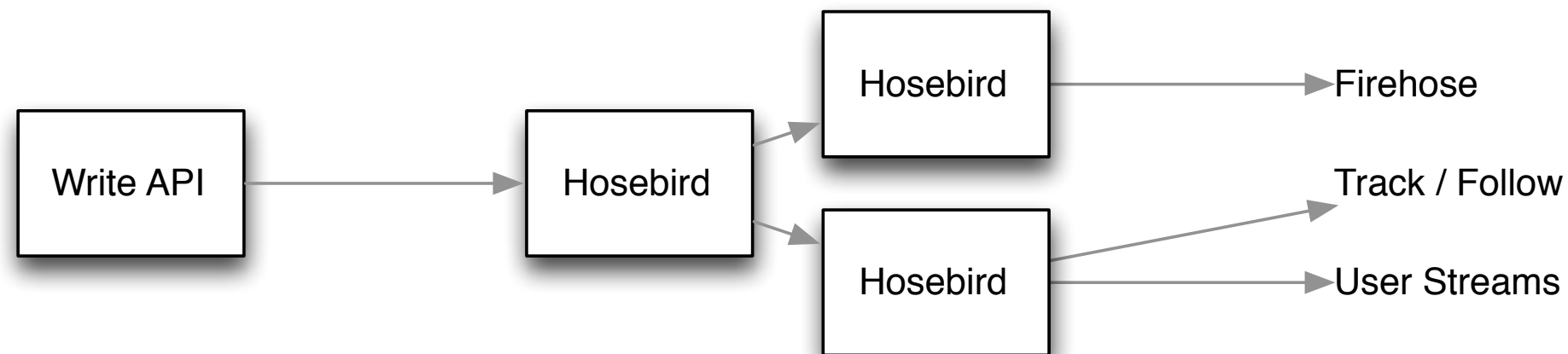
track / follow

- ...→ simple query based on tweet content
- ...→ keeps list of terms / users of interest
- ...→ parses public tweets at the edge, and if term matches a token, or user is of interest, then route





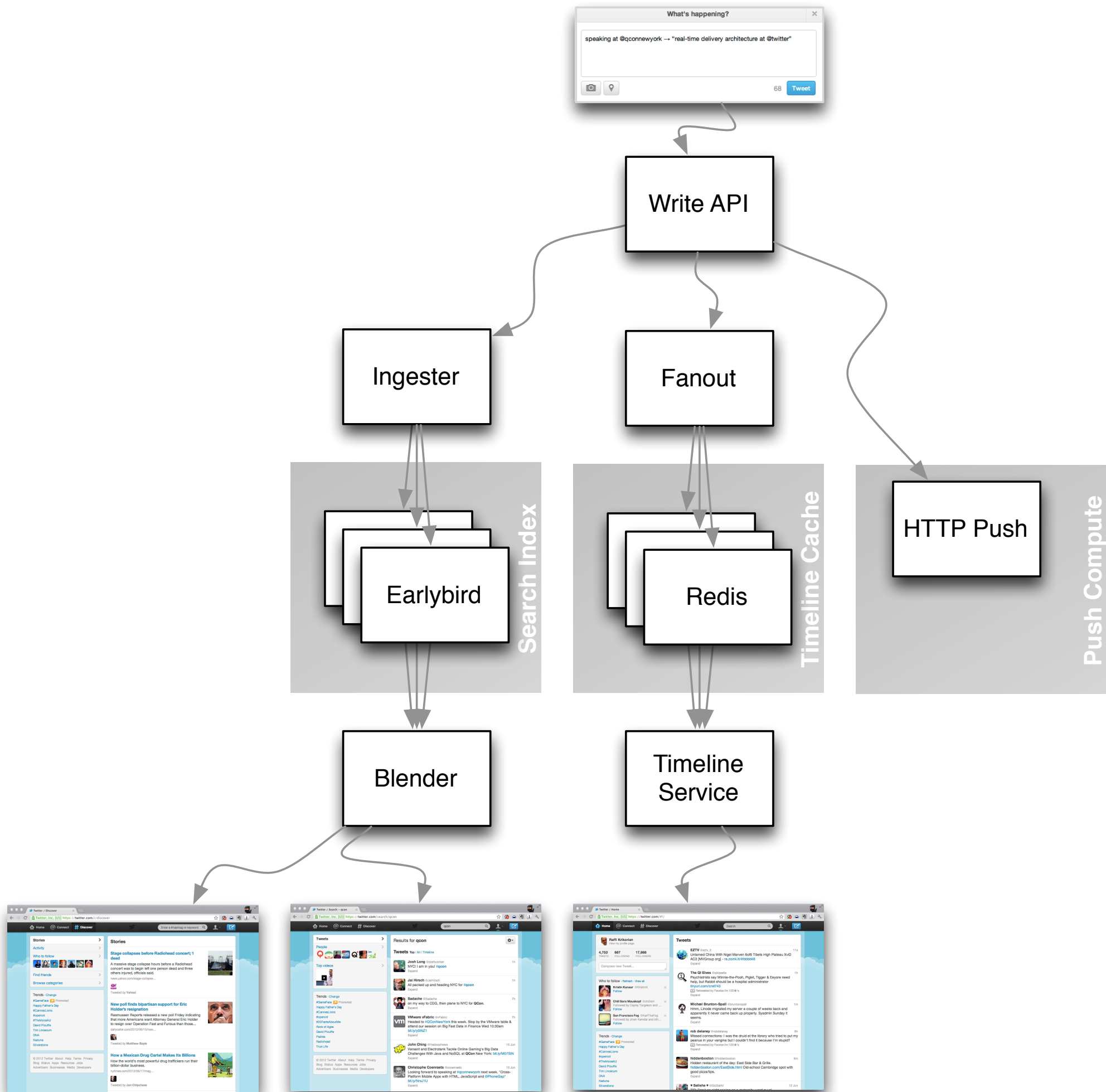


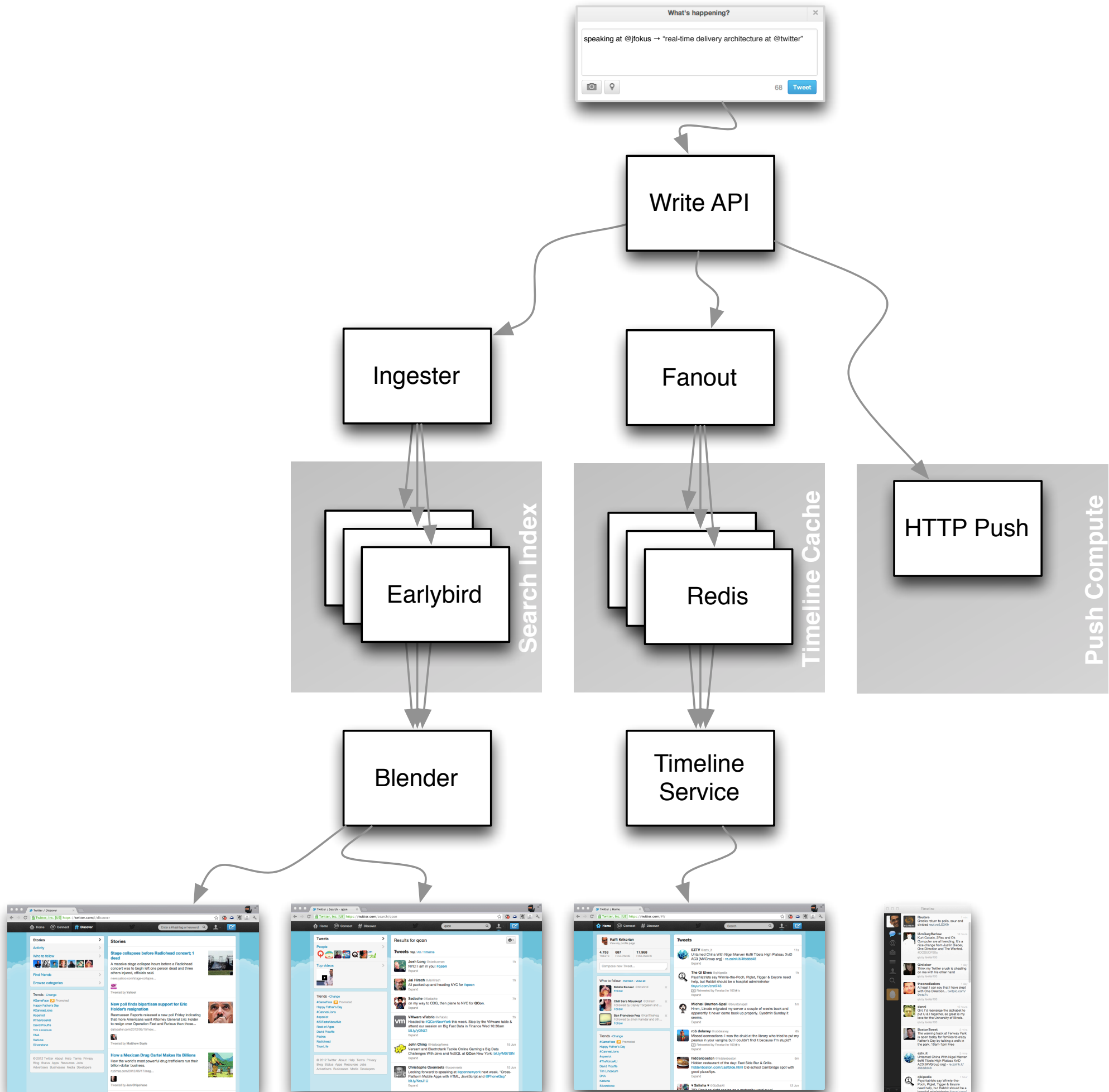


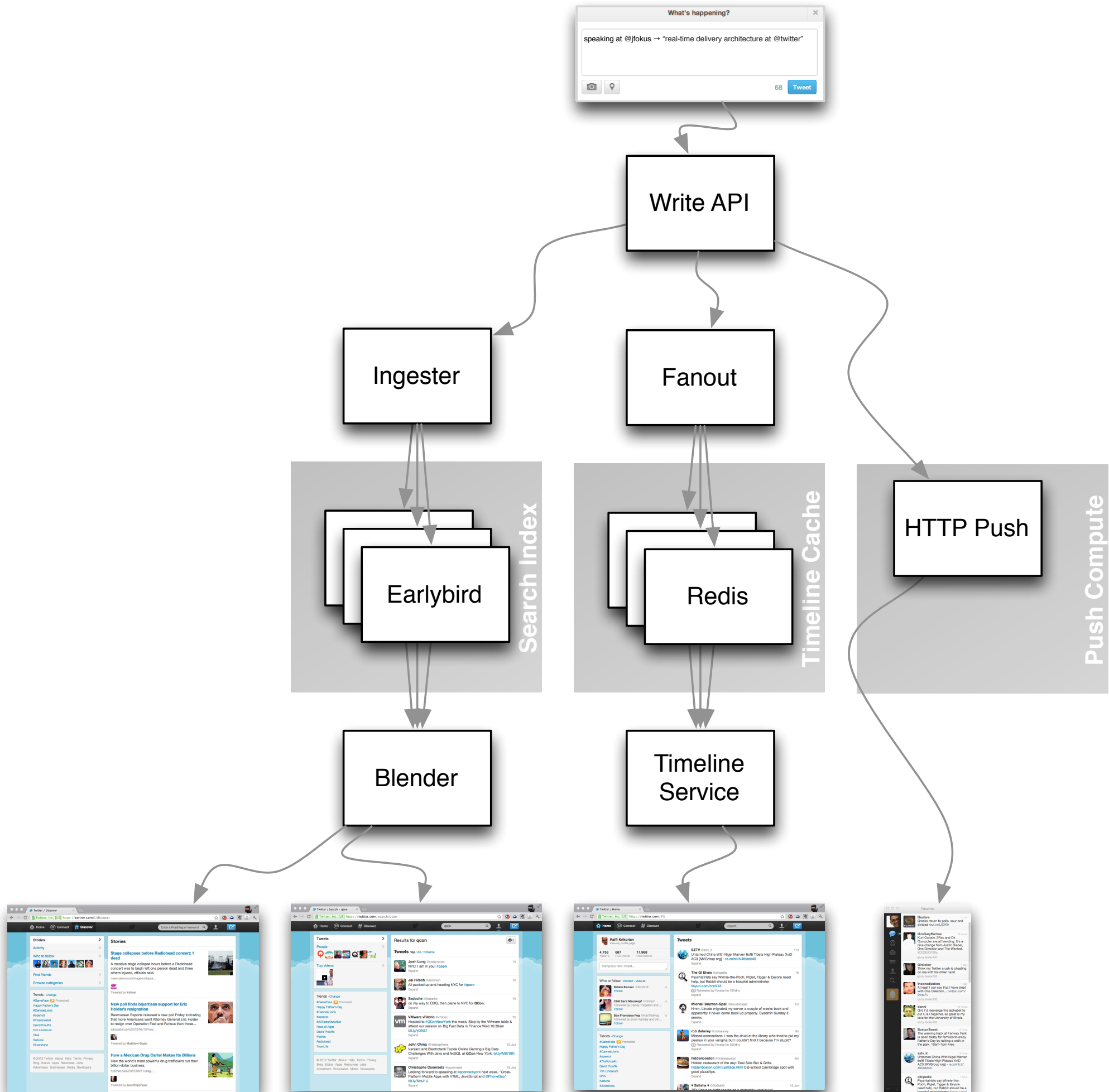
user streams

- ...→ replicate home timeline experience
- ...→ upon login, obtain “following” list
- ...→ keep cached following list coherent by seeing social graph updates
- ...→ route tweet if from a followed user

speaking at @jfokus → "real-time delivery architecture at @twitter"







Pull

Push

Targeted

twitter.com

User / Site Streams

home_timeline API

Mobile Push (SMS, etc.)

Queried

Search API

Track / Follow Streams

Pull

Push

Targeted

twitter.com

home_timeline API

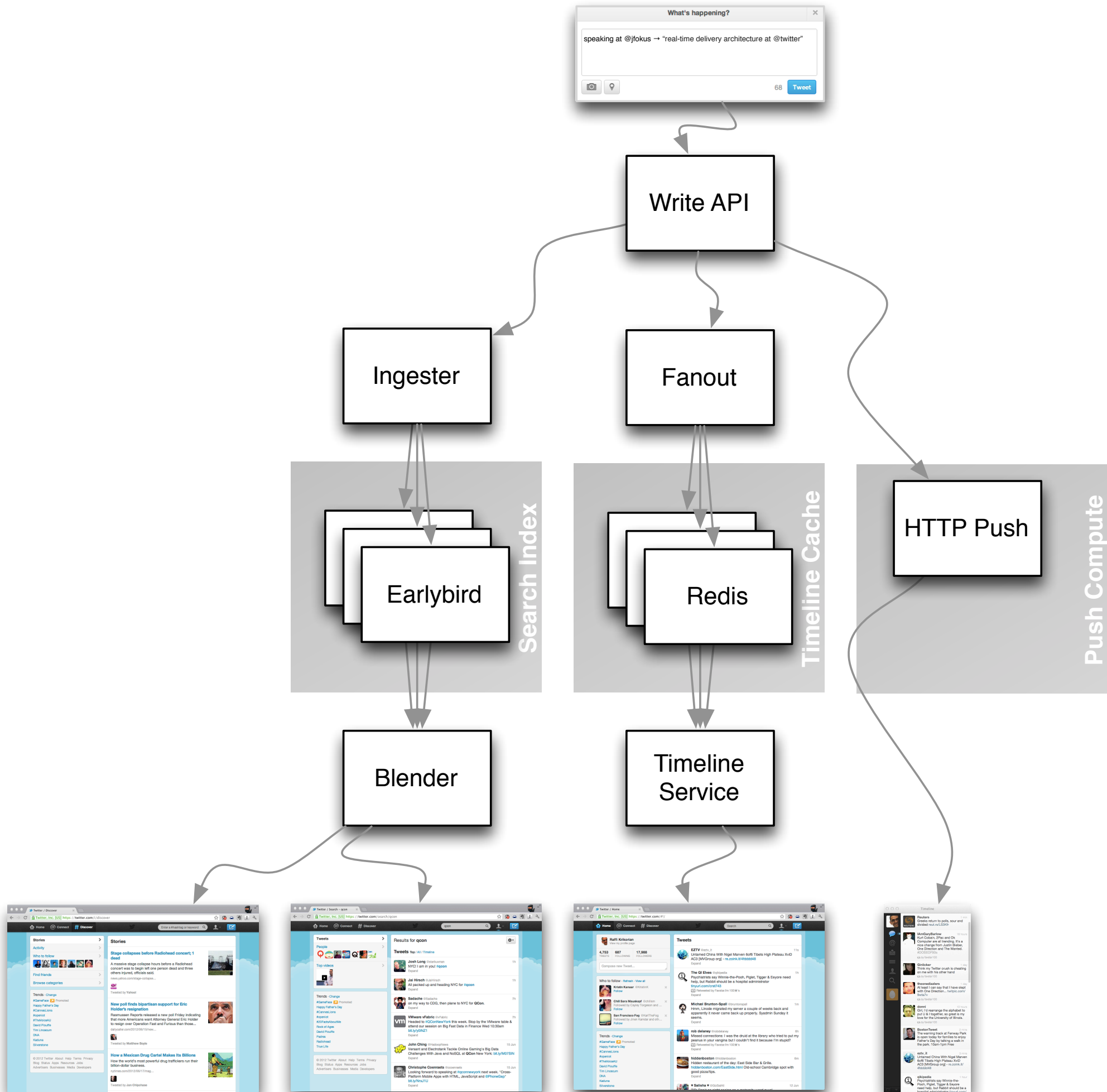
User / Site Streams

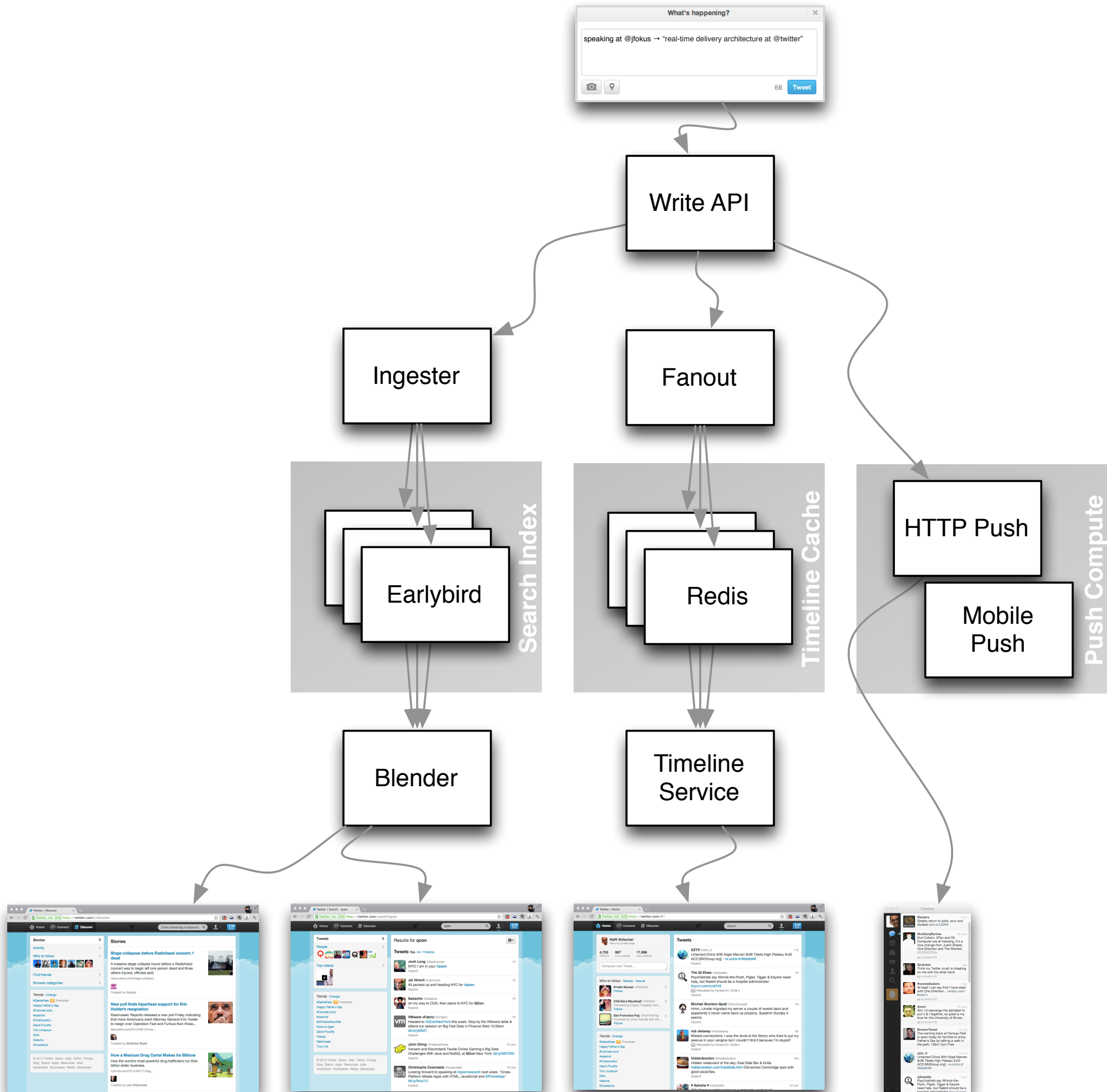
Mobile Push (SMS, etc.)

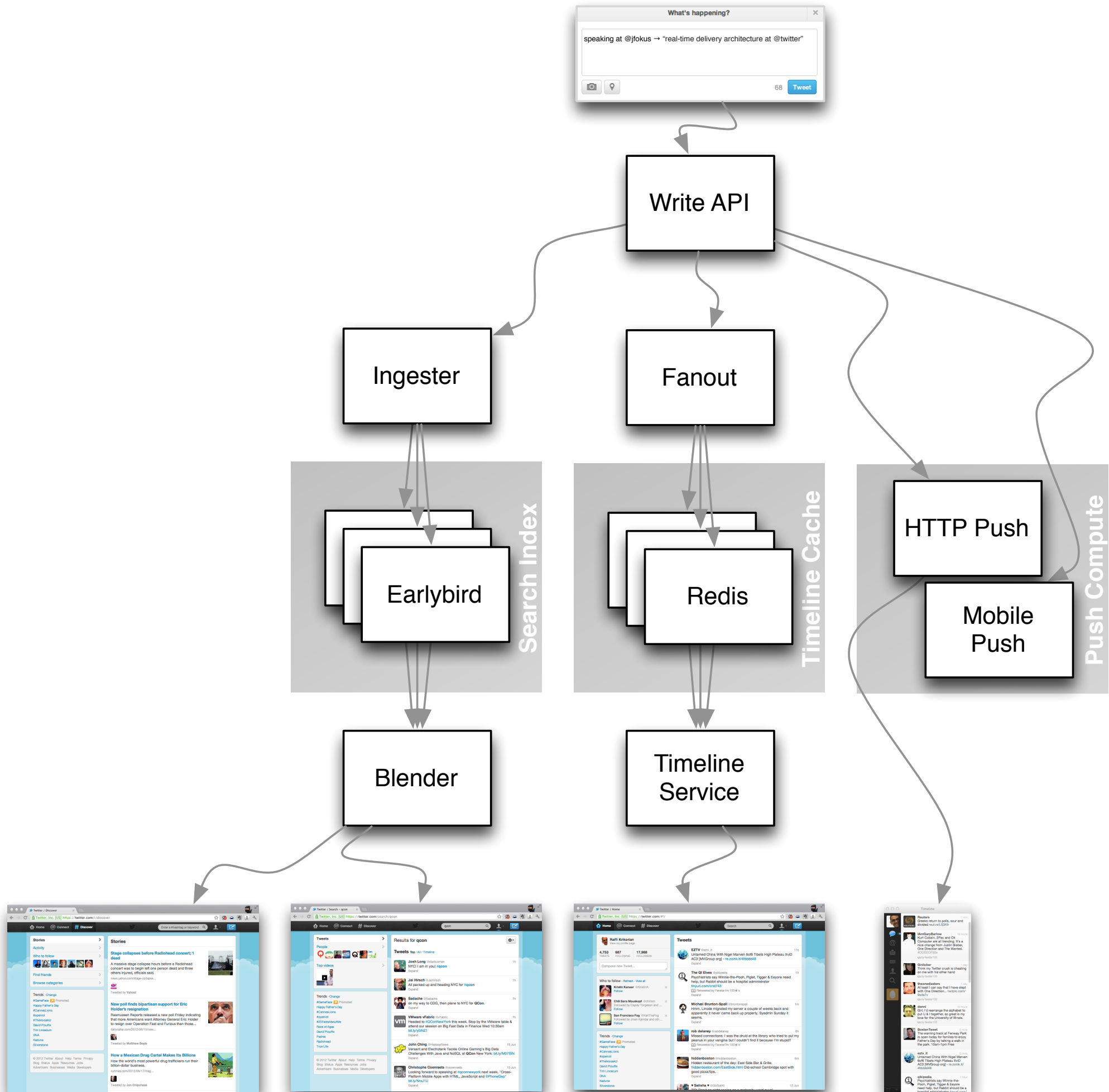
Queried

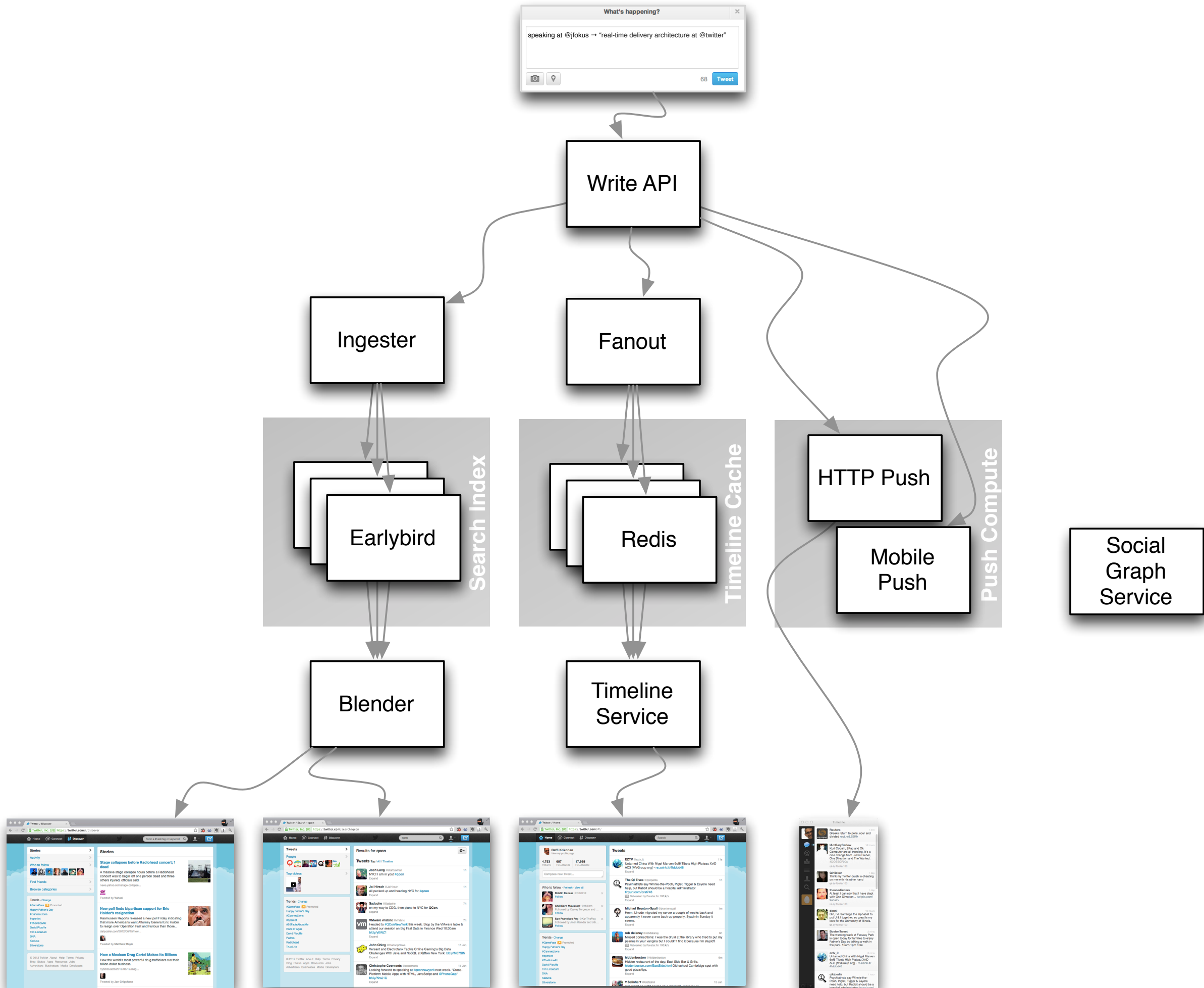
Search API

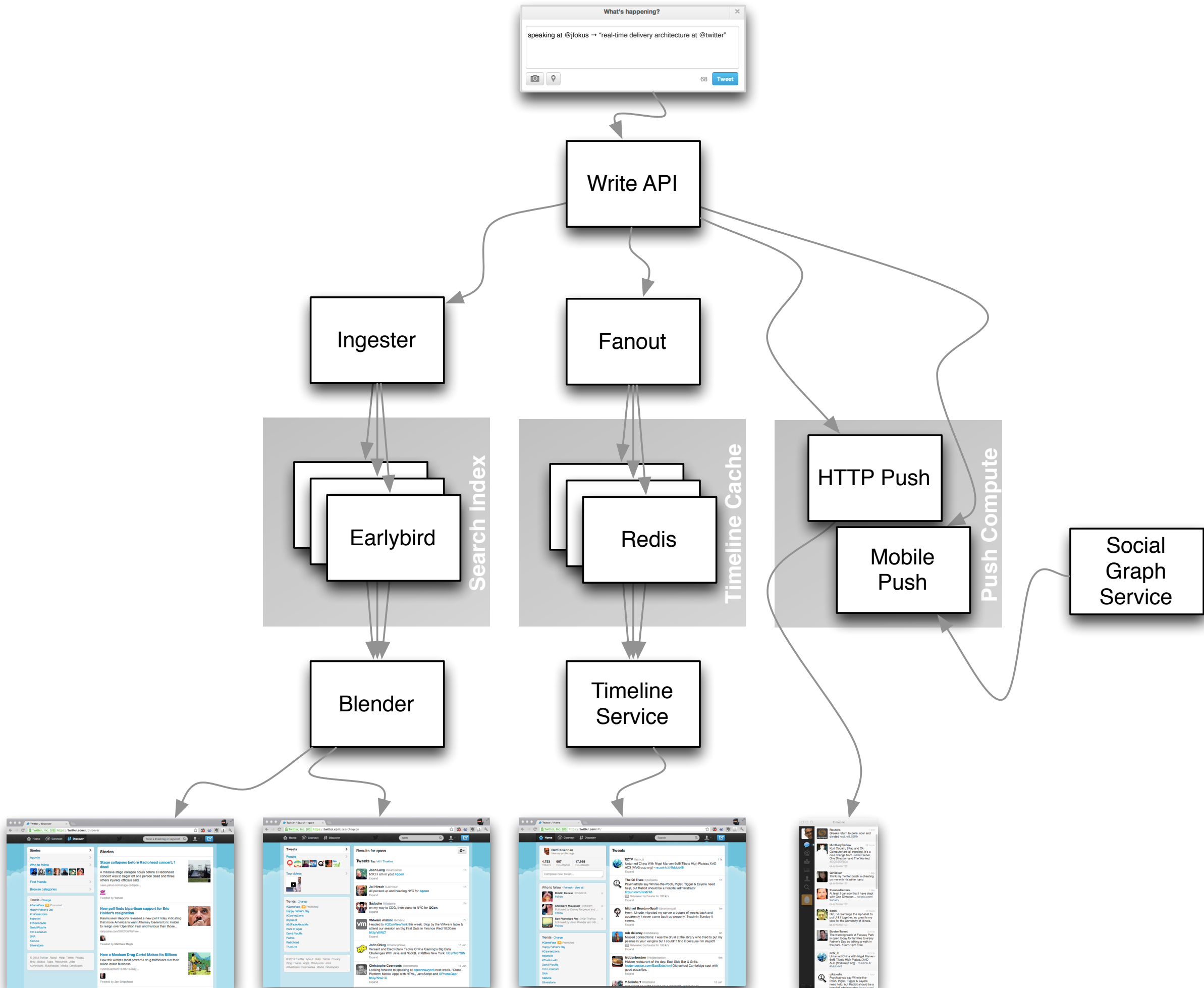
Track / Follow Streams

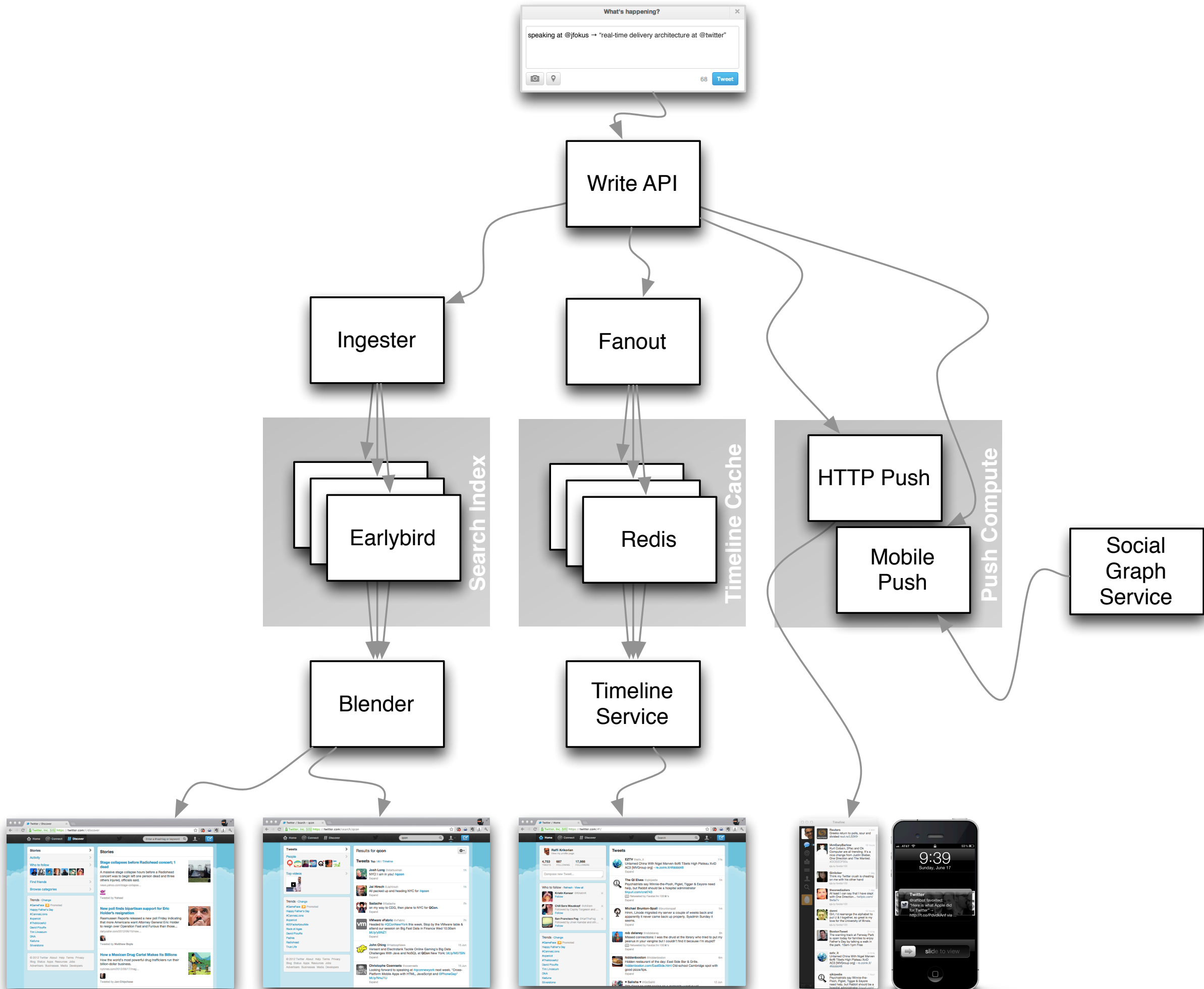


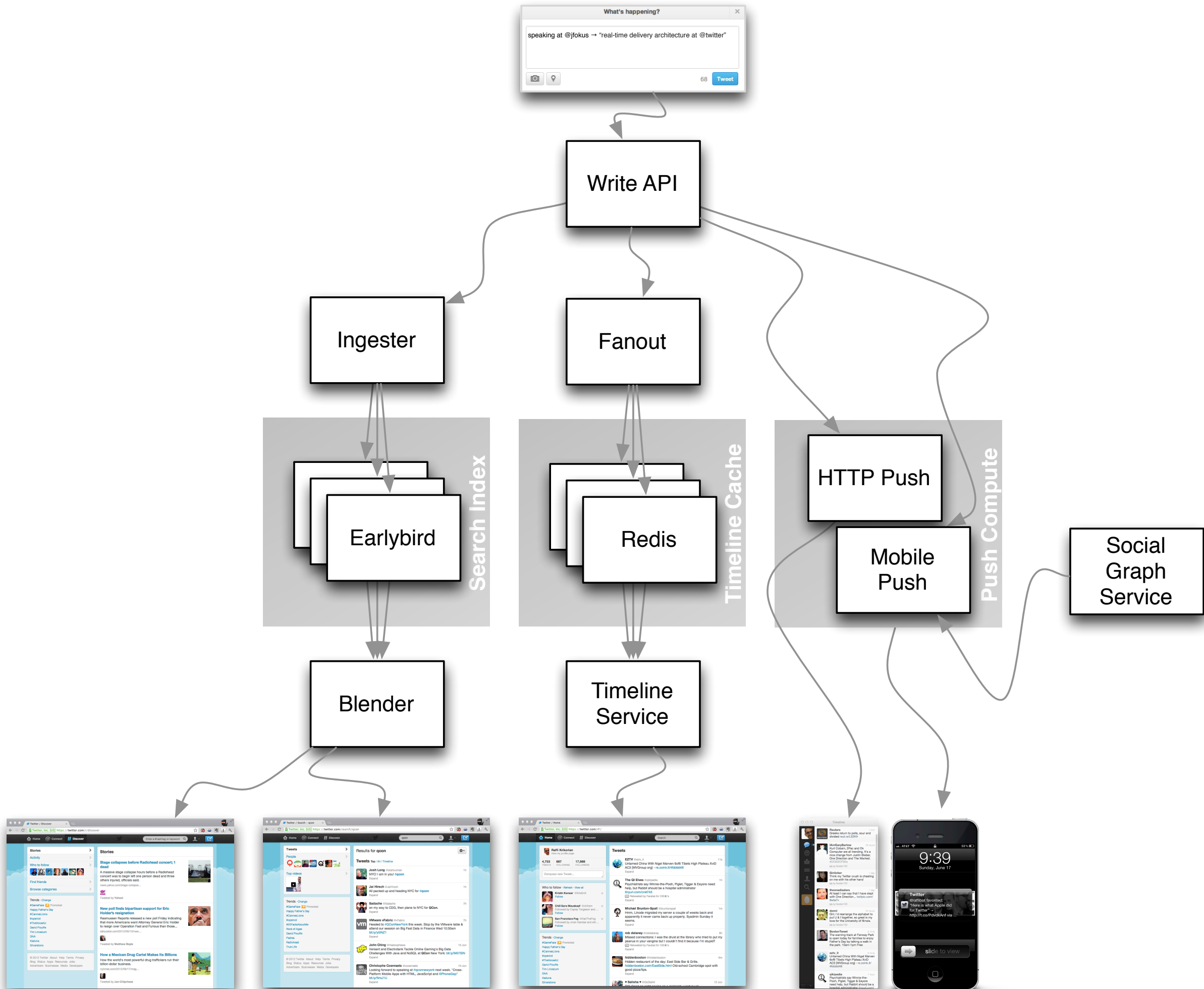


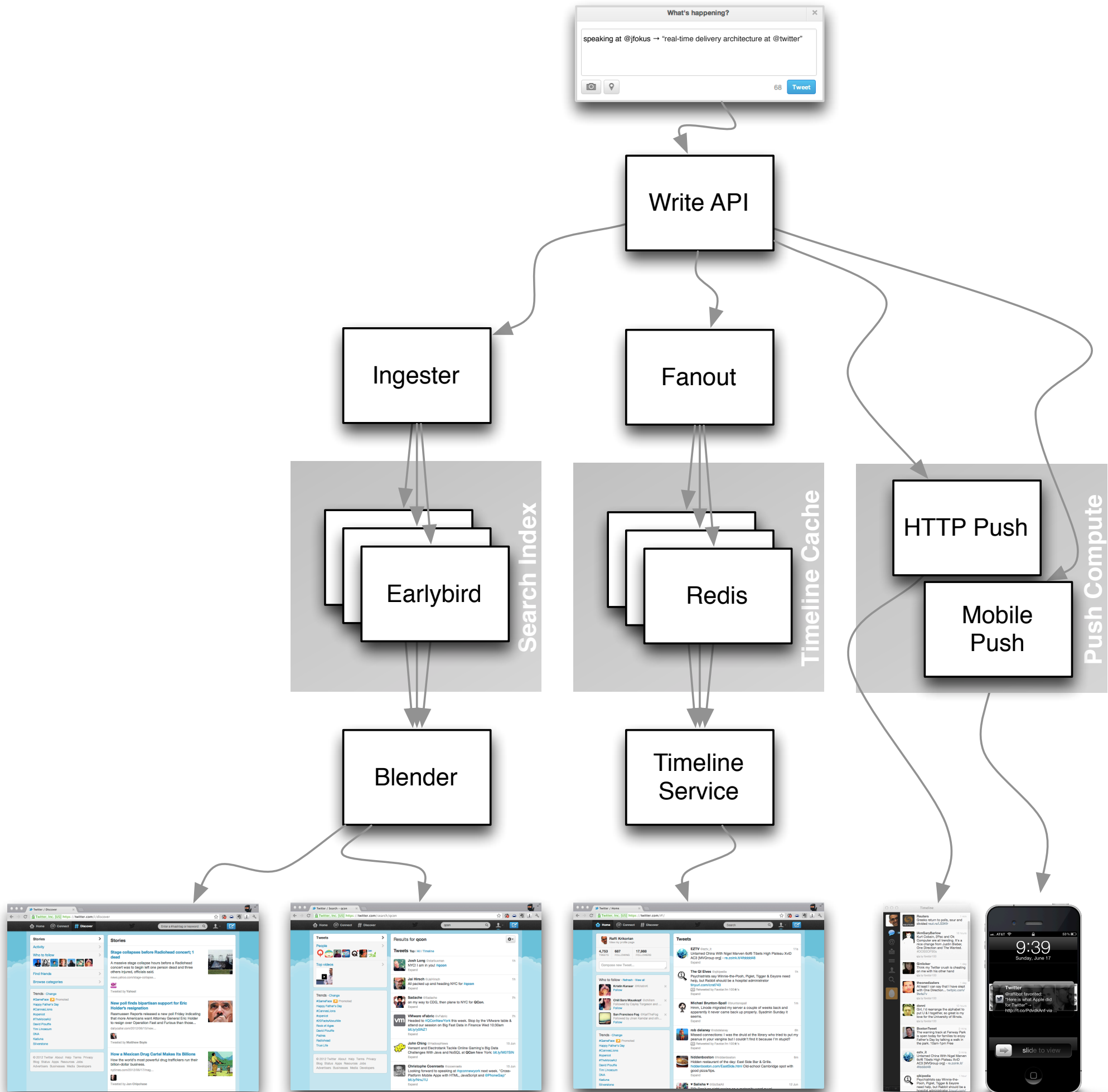












	Pull	Push
Targeted	twitter.com home_timeline API	User / Site Streams Mobile Push (SMS, etc.)
Queried	Search API	Track / Follow Streams

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

Pull

Push

Targeted

twitter.com

User / Site Streams

home_timeline API

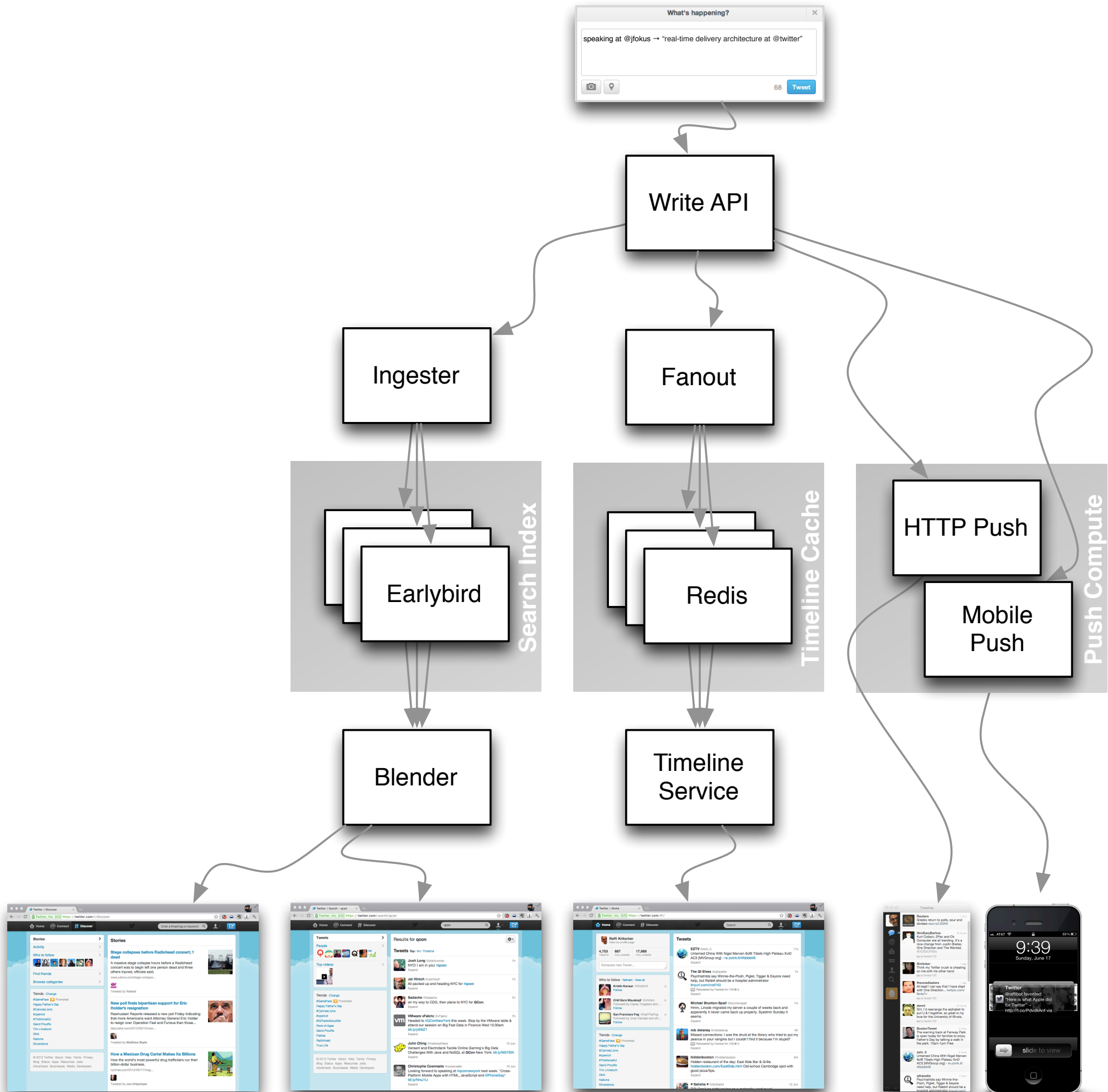
Mobile Push (SMS, etc.)

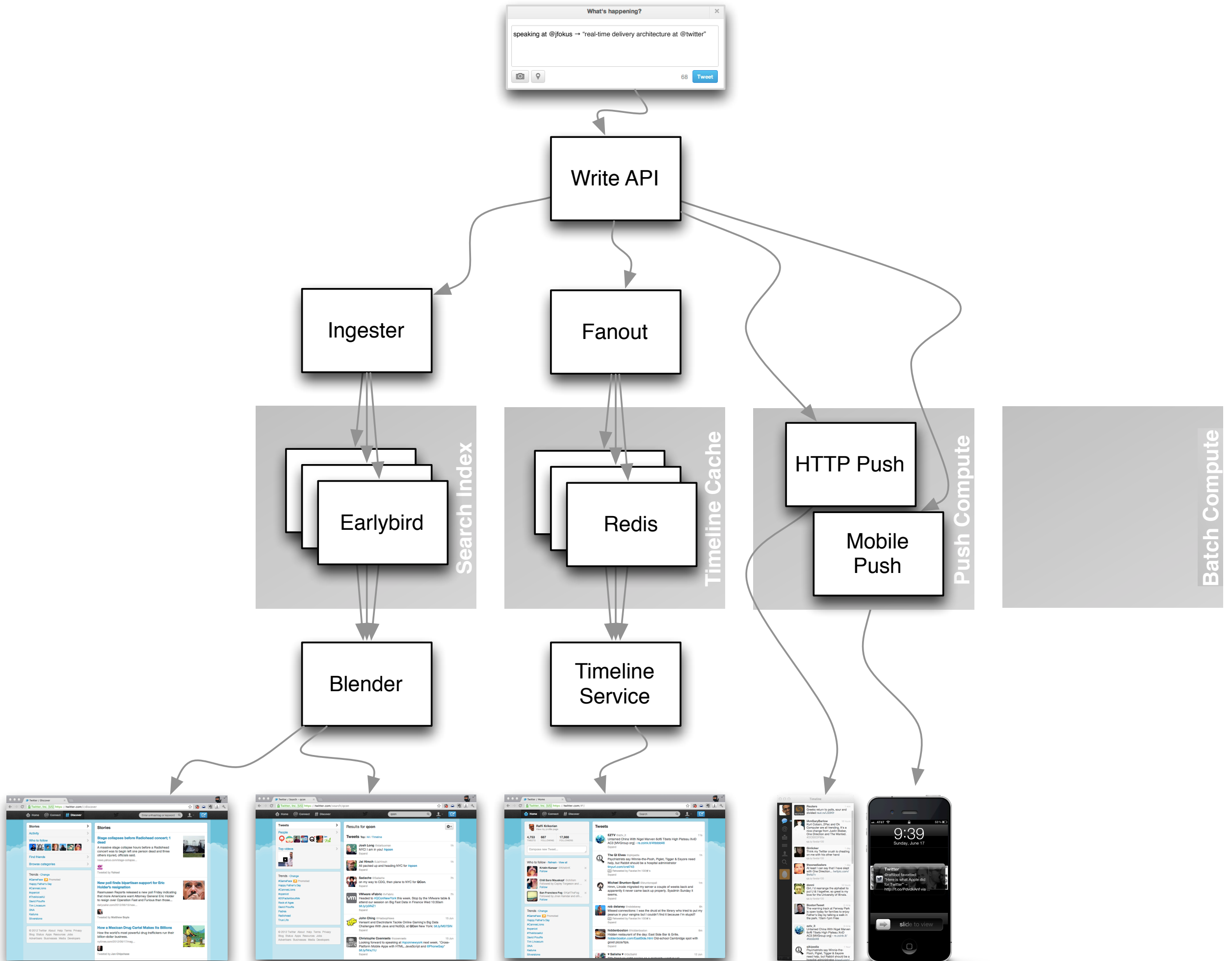
Queried

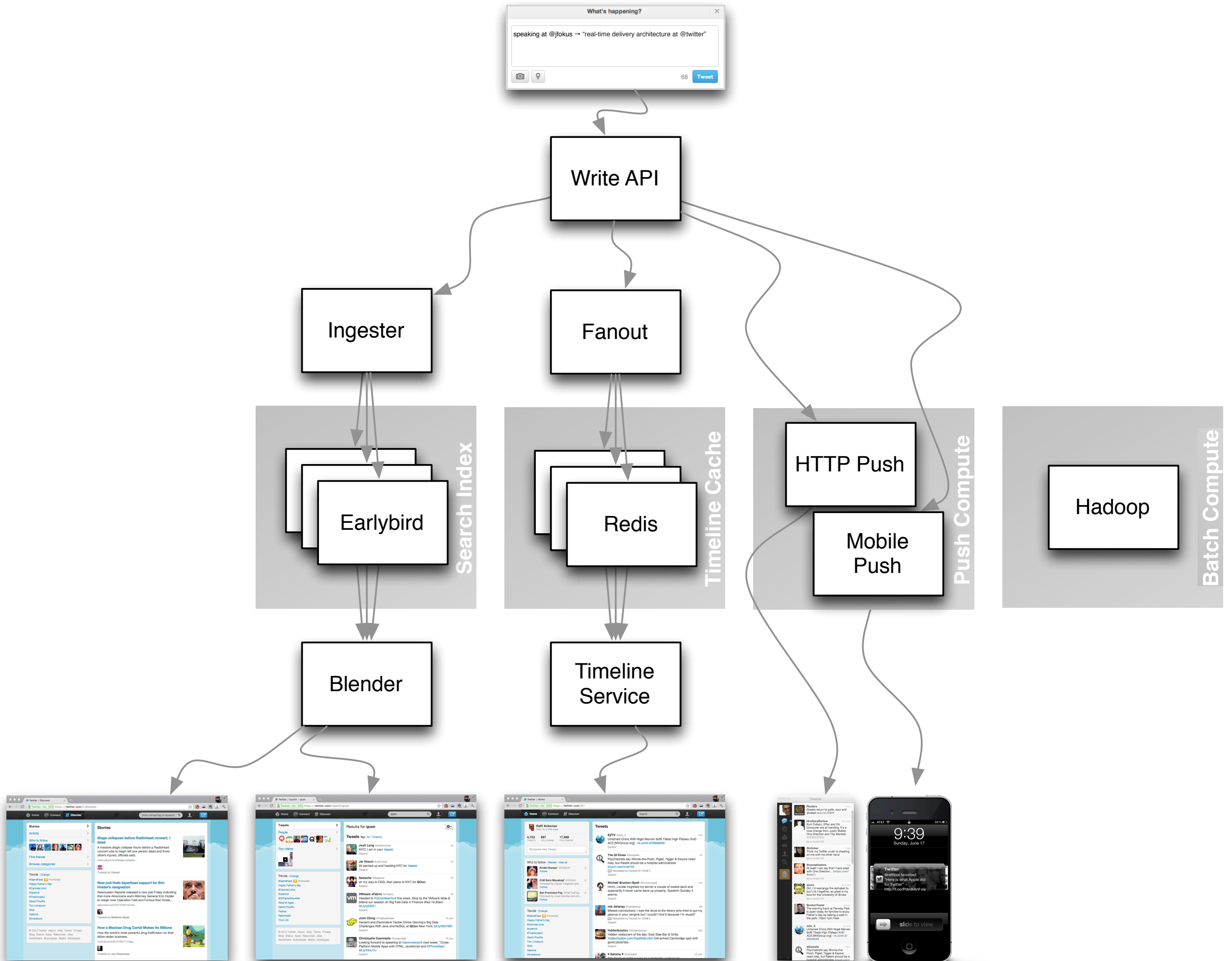
Search API

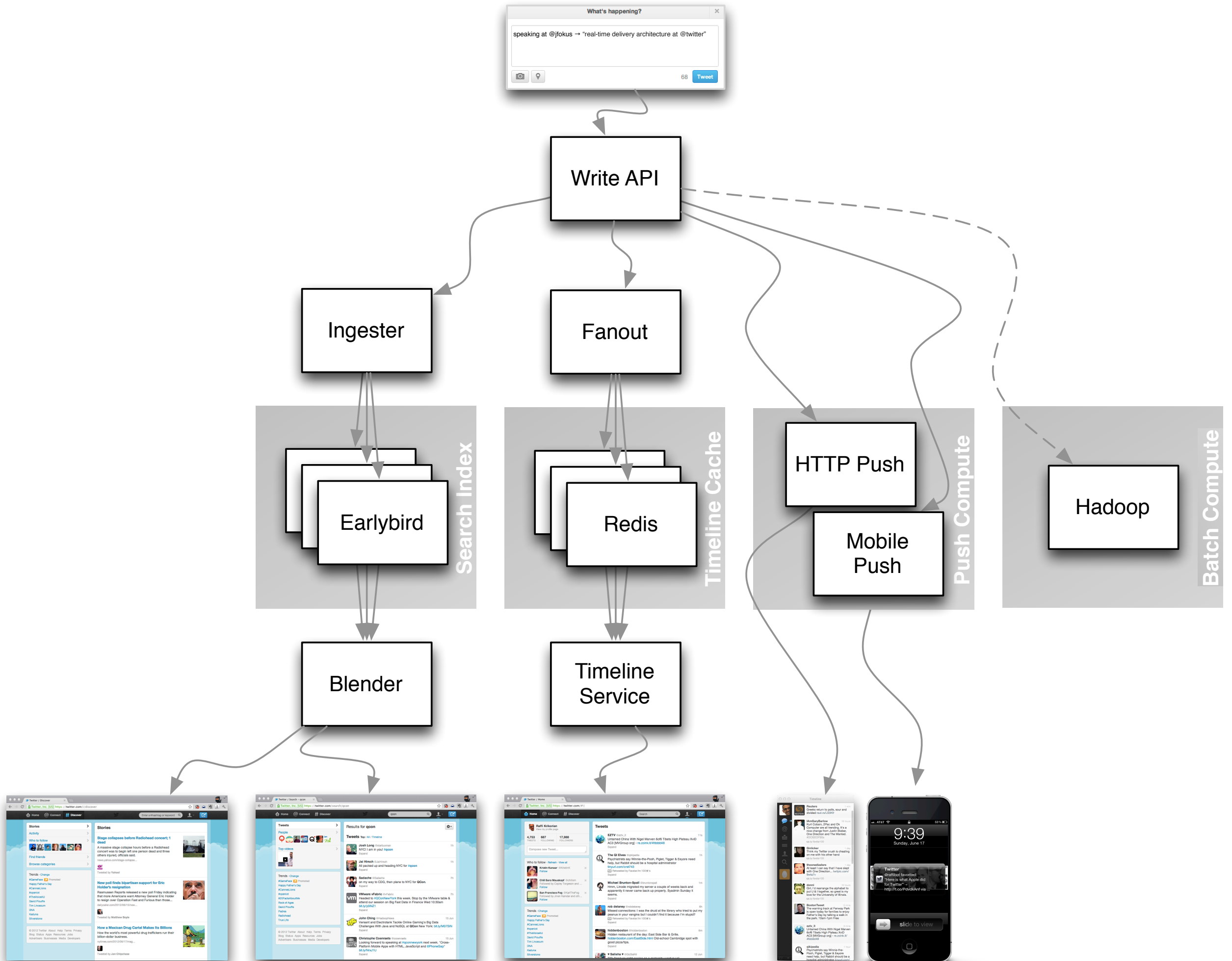
Track / Follow Streams

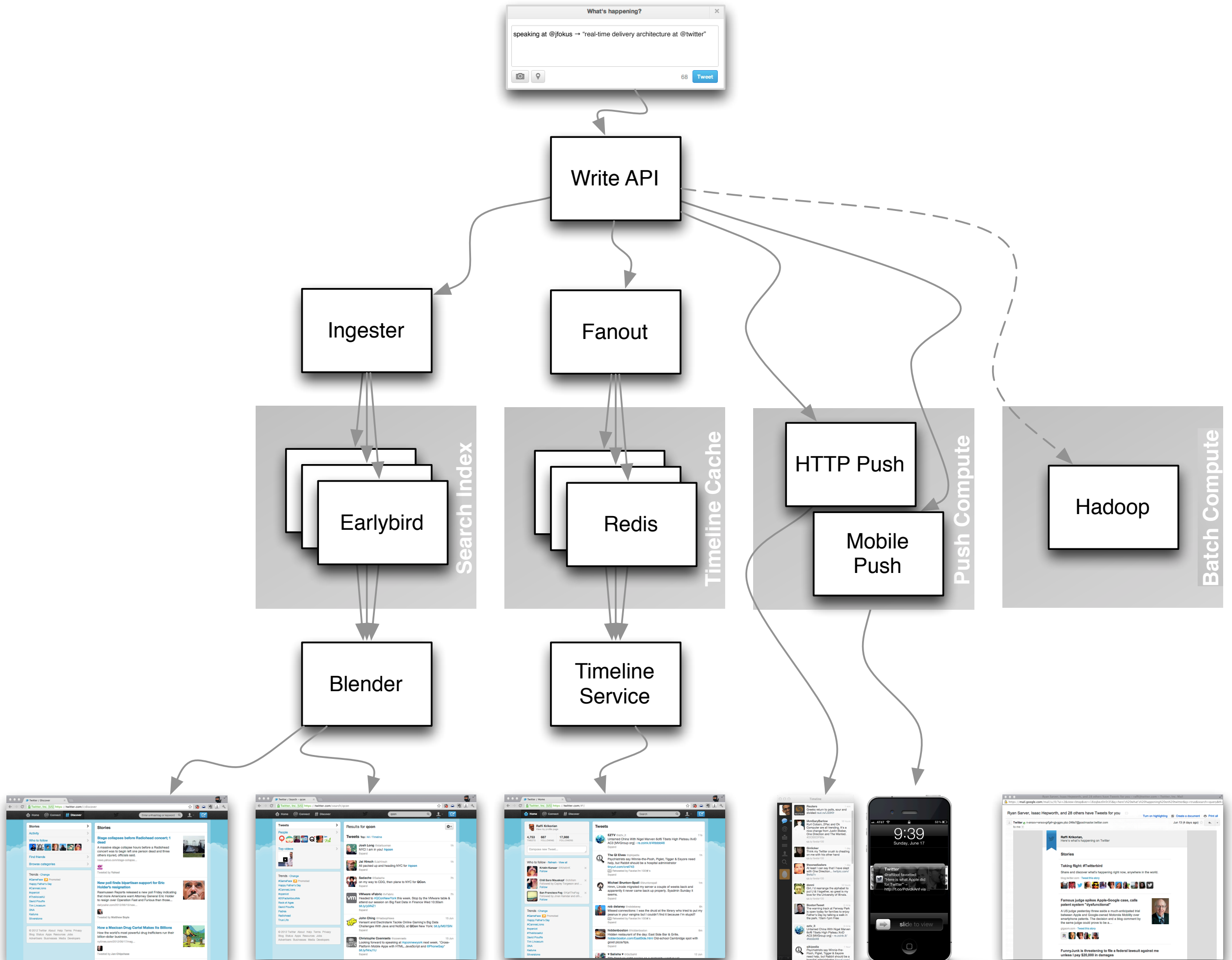
	Pull	Push
Targeted	twitter.com home_timeline API	User / Site Streams Mobile Push (SMS, etc.)
Queried	Search API	Track / Follow Streams

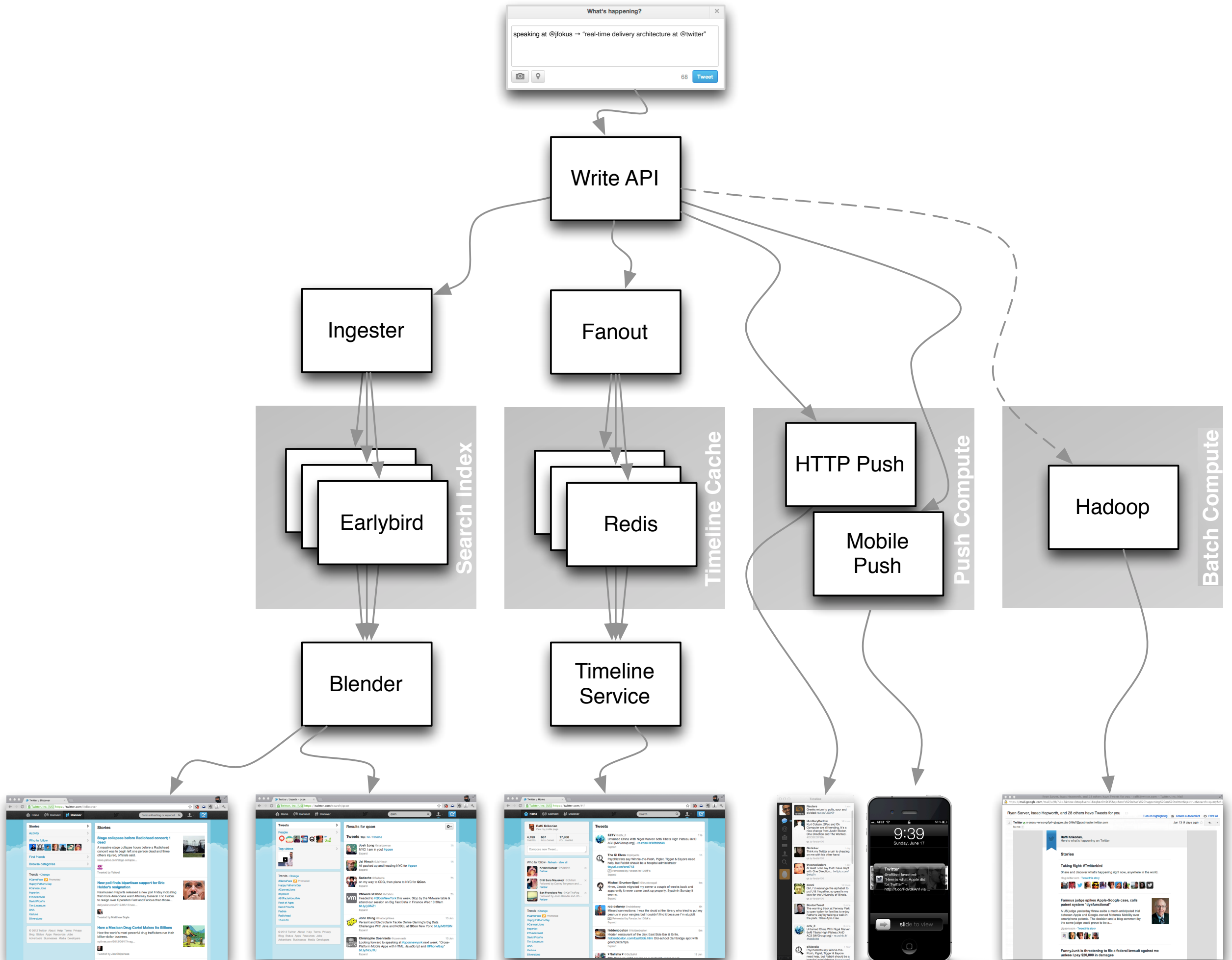


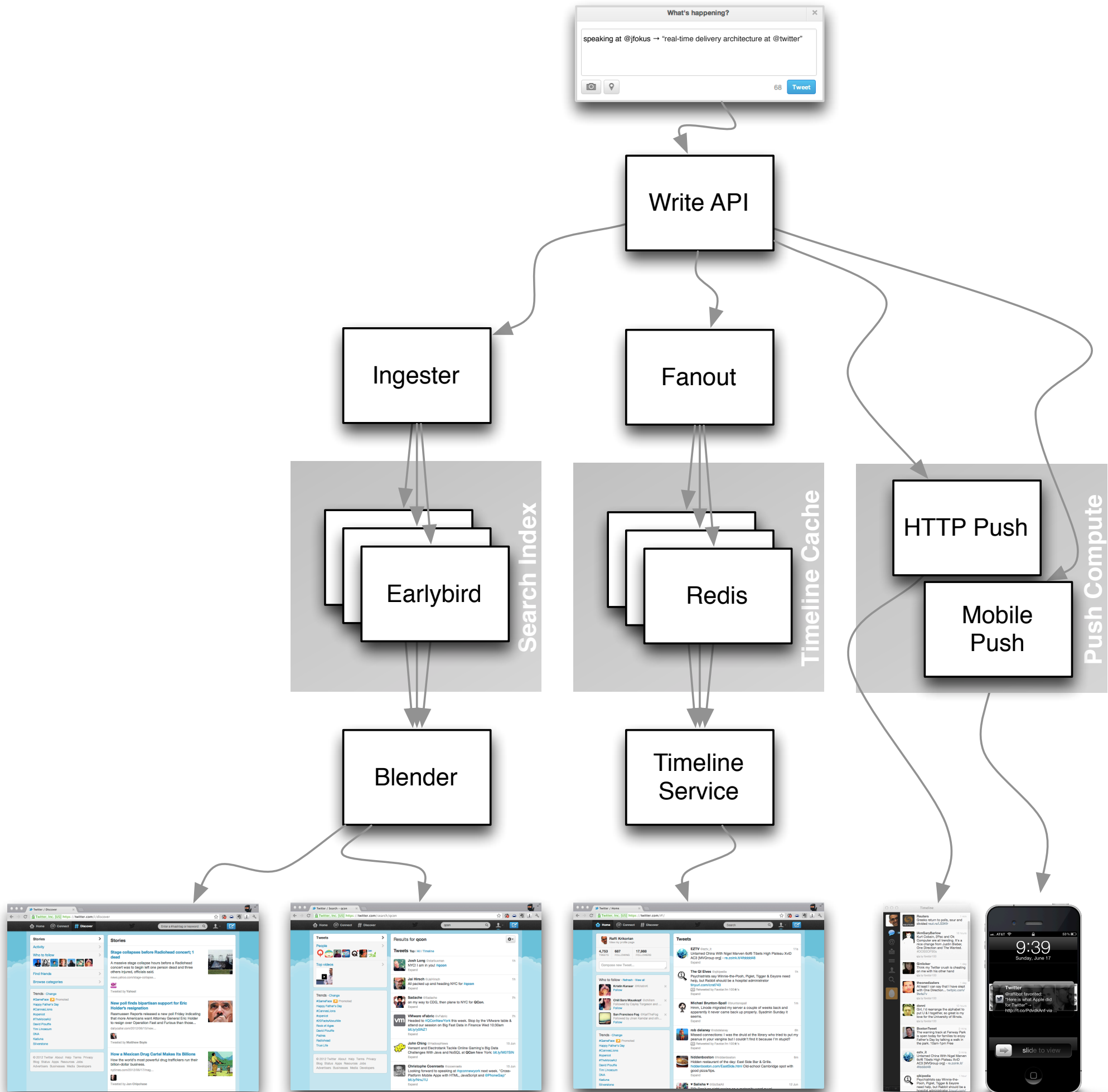




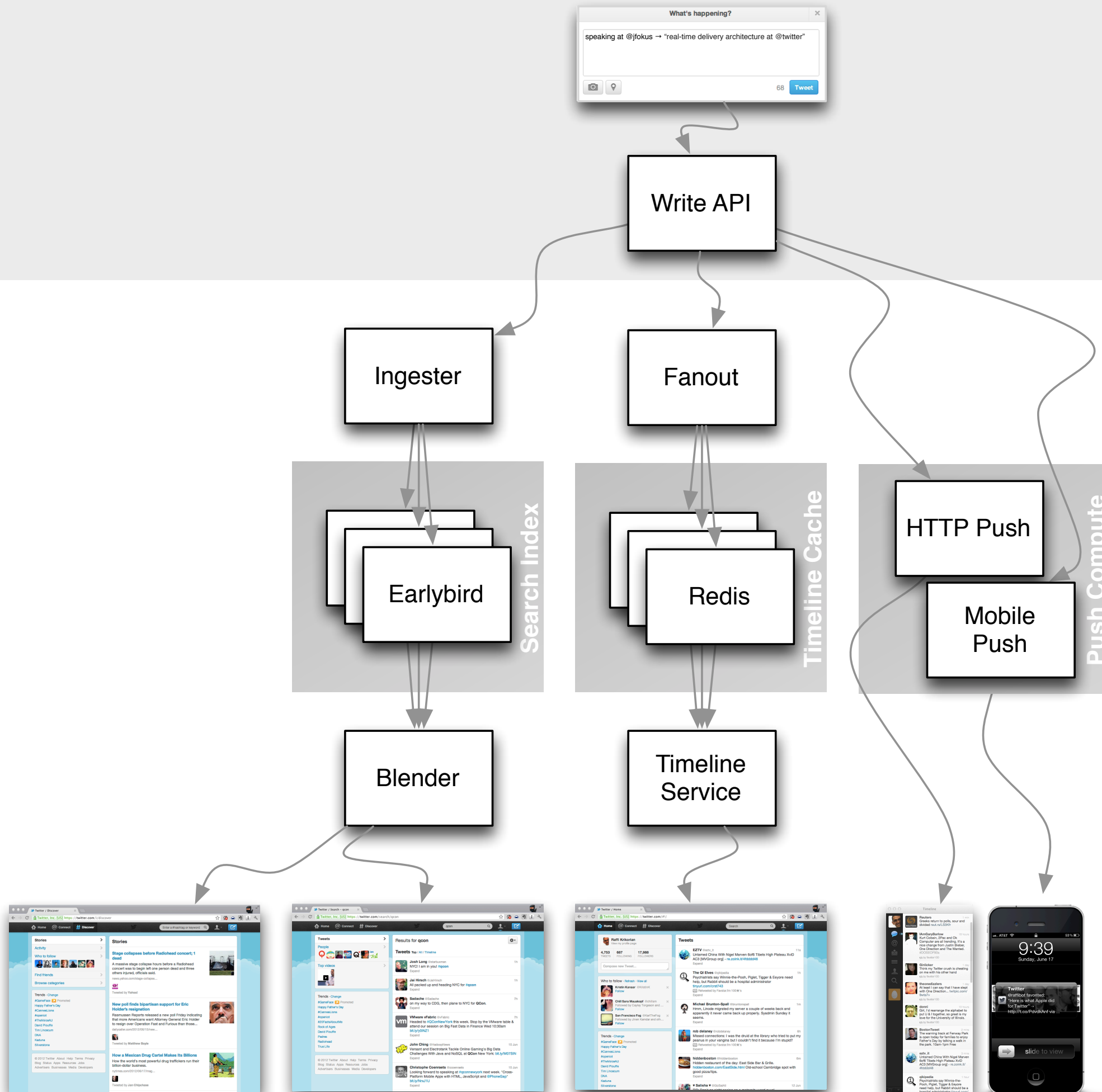


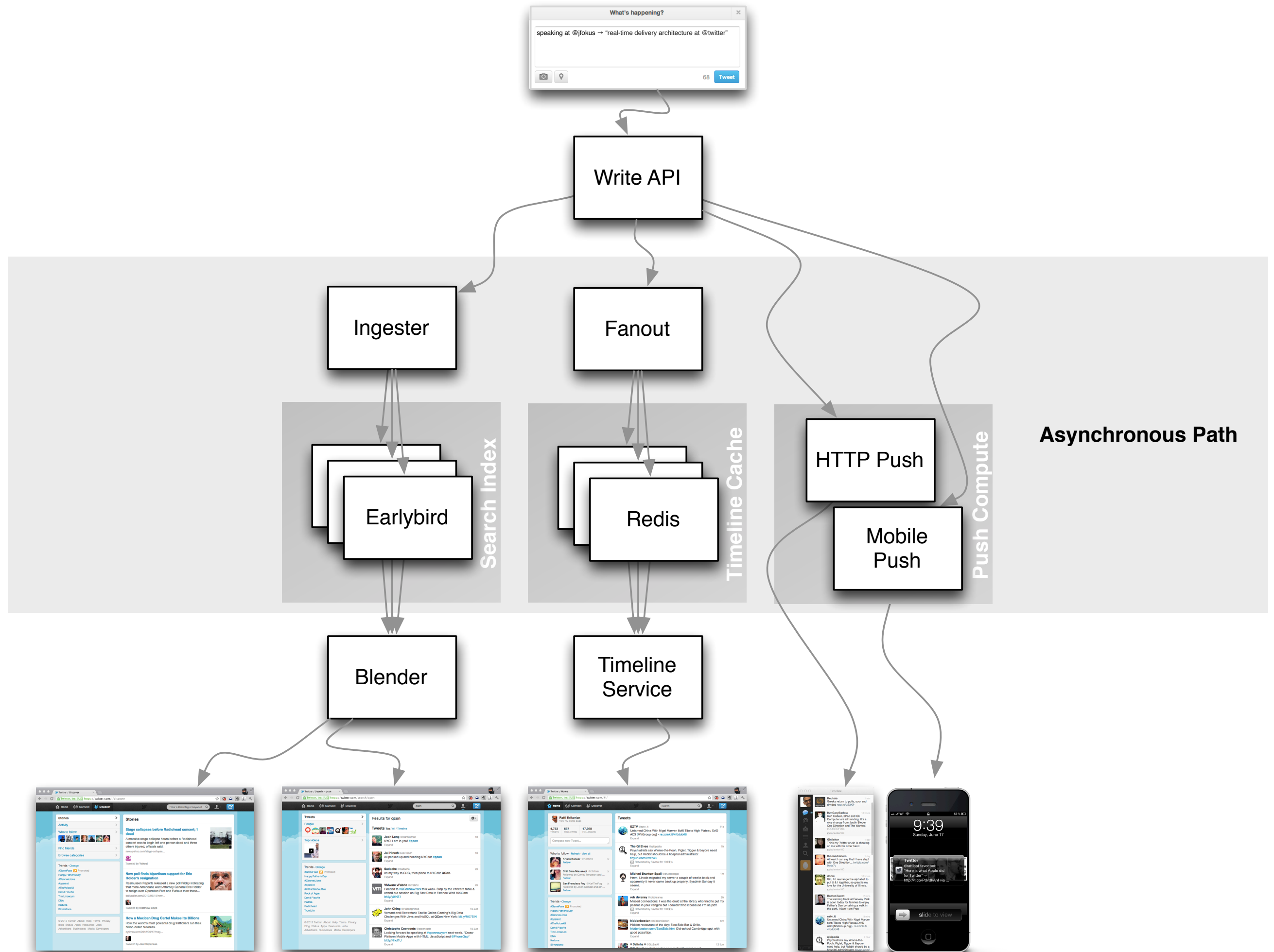


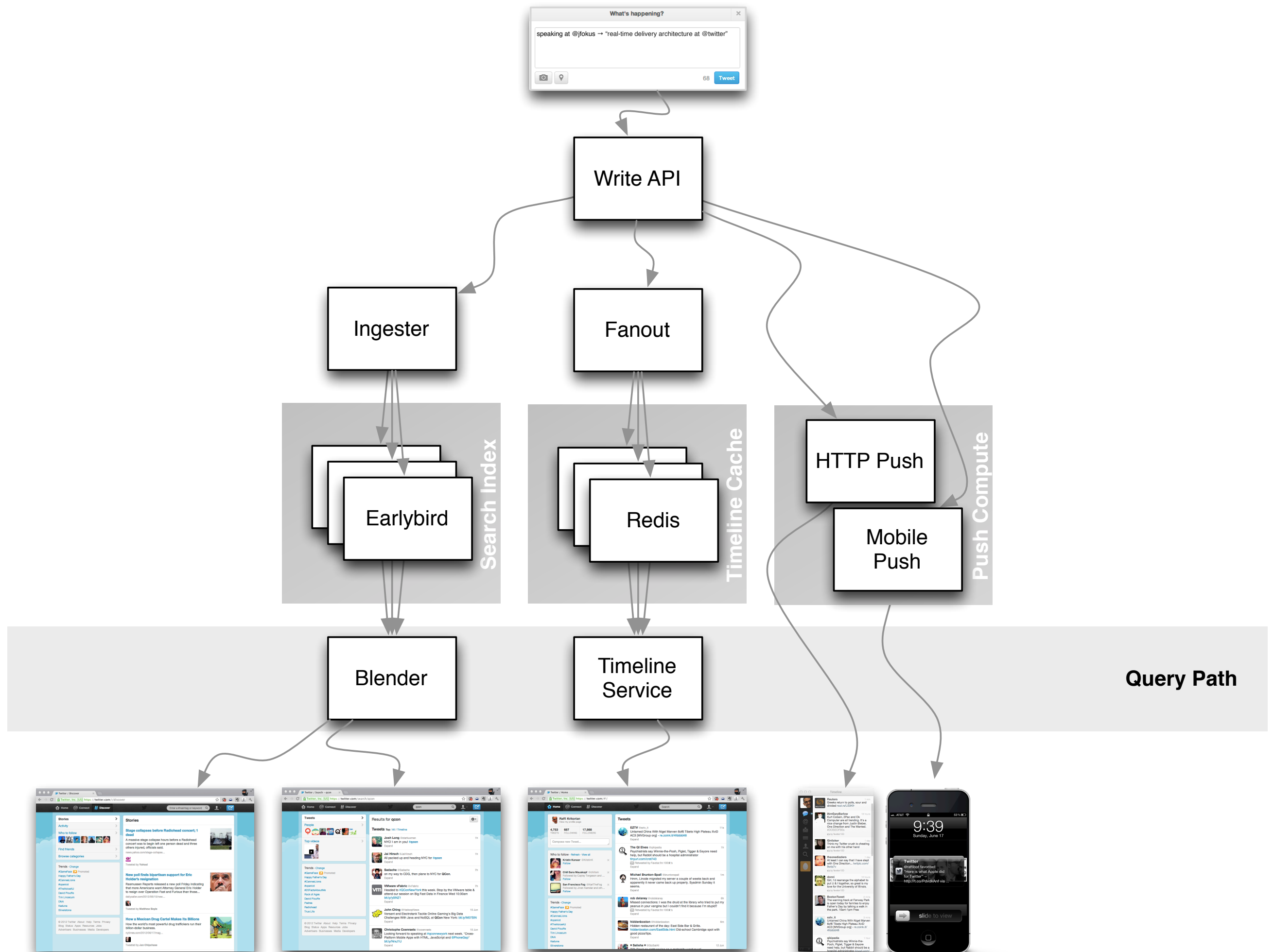


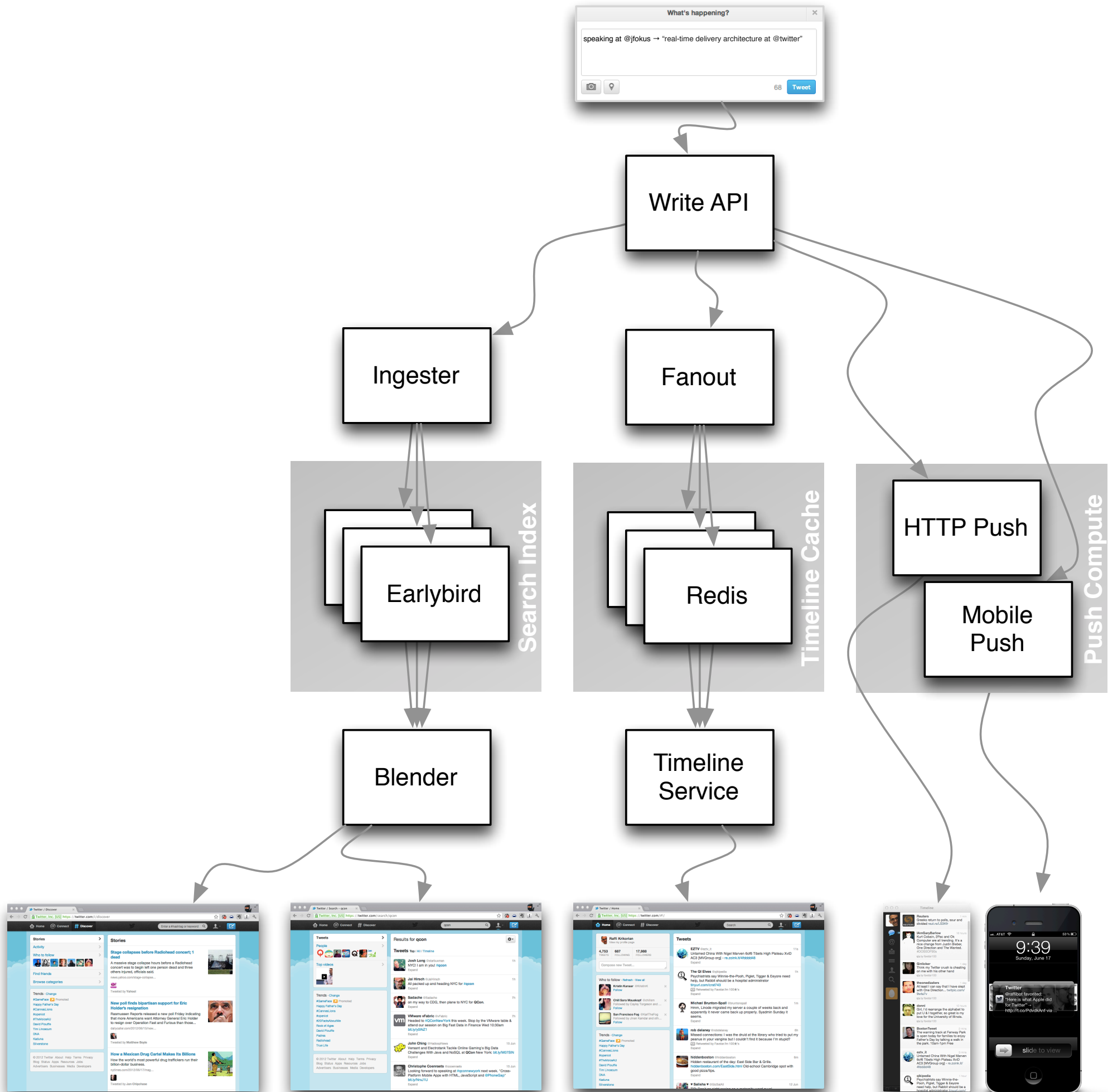


Synchronous Path











things we're trying...

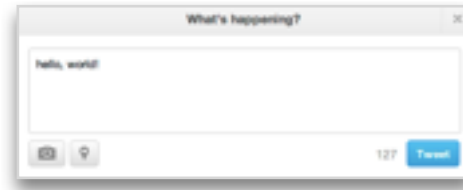
What's happening?

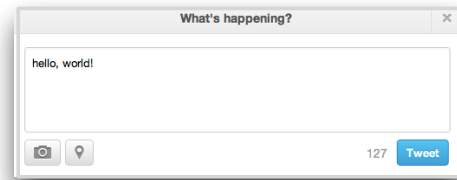
×

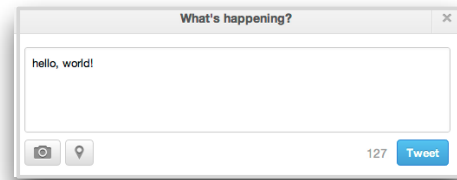
hello, world!

127

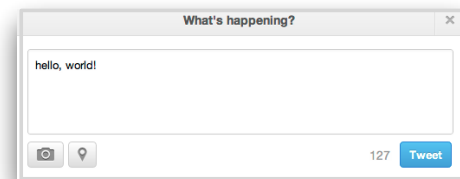
Tweet







Write API



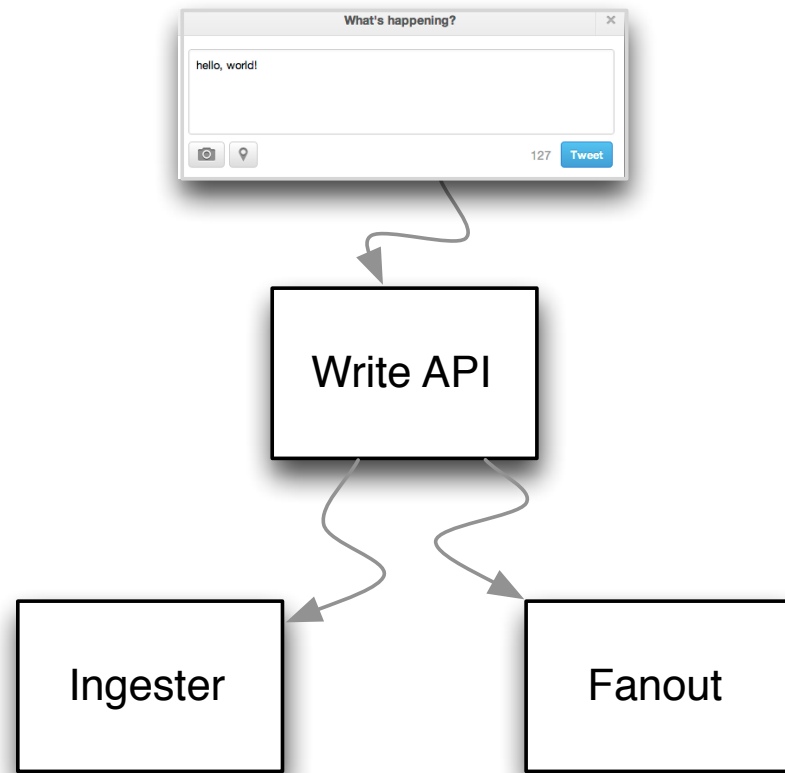
Write API

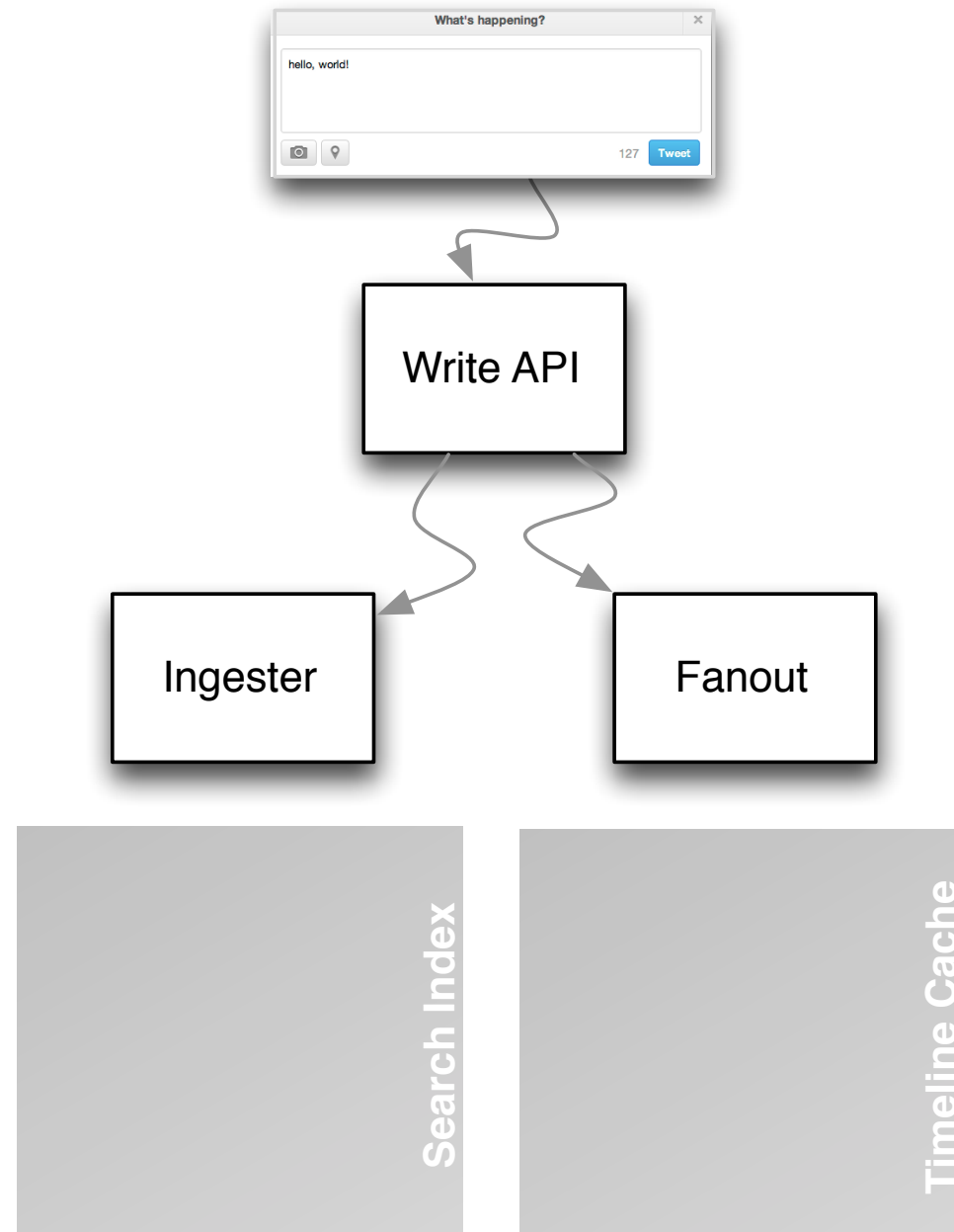


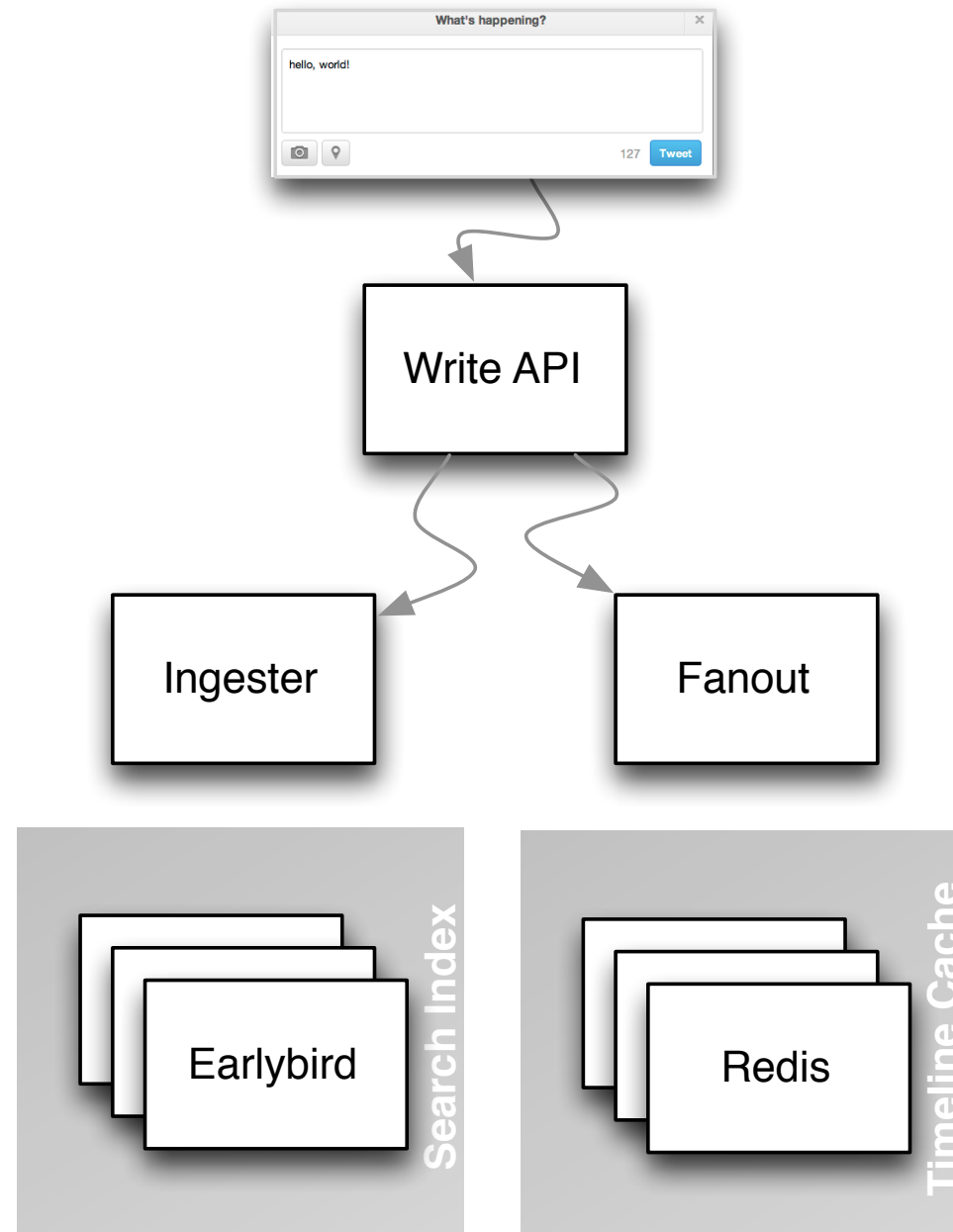
Write API

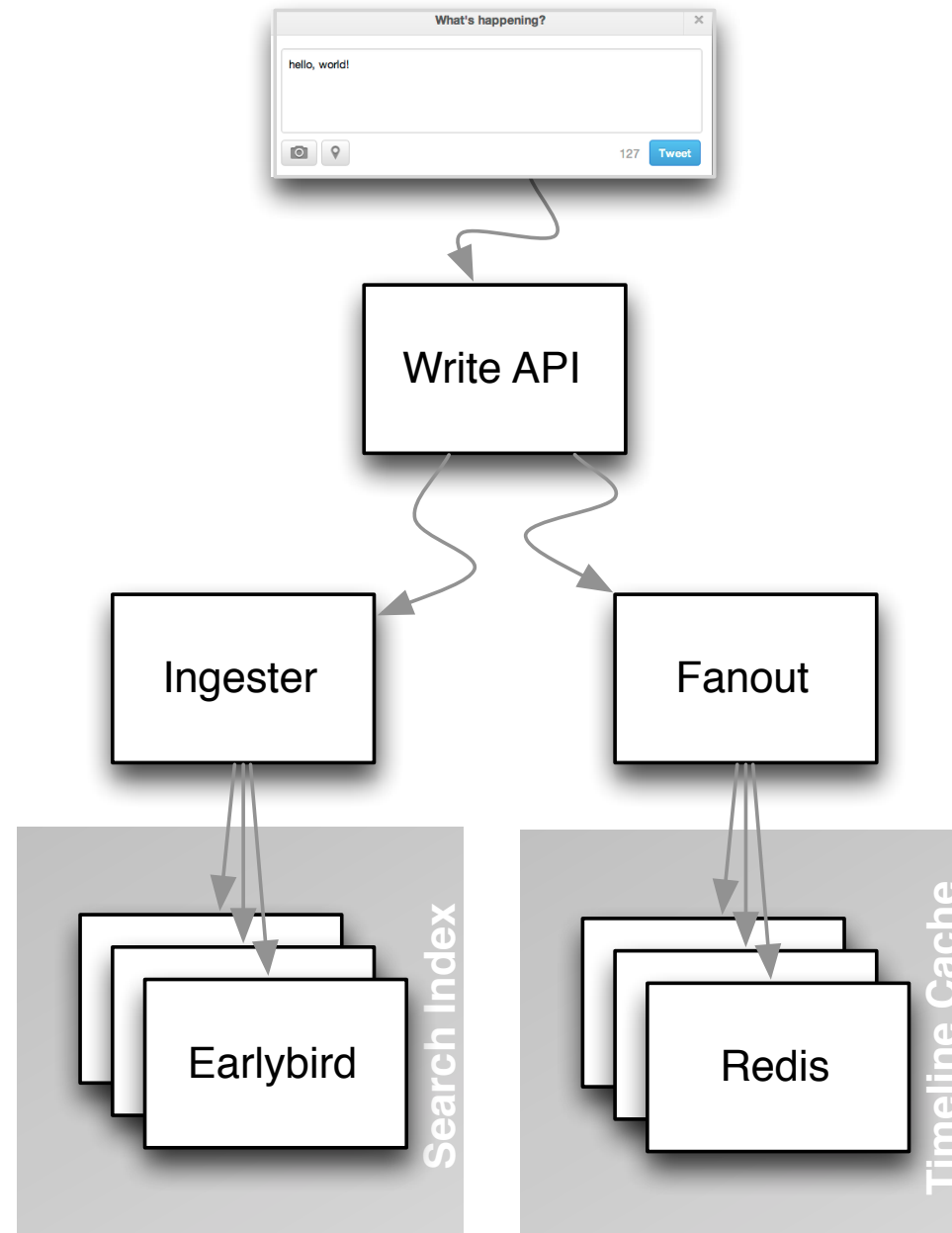
Ingester

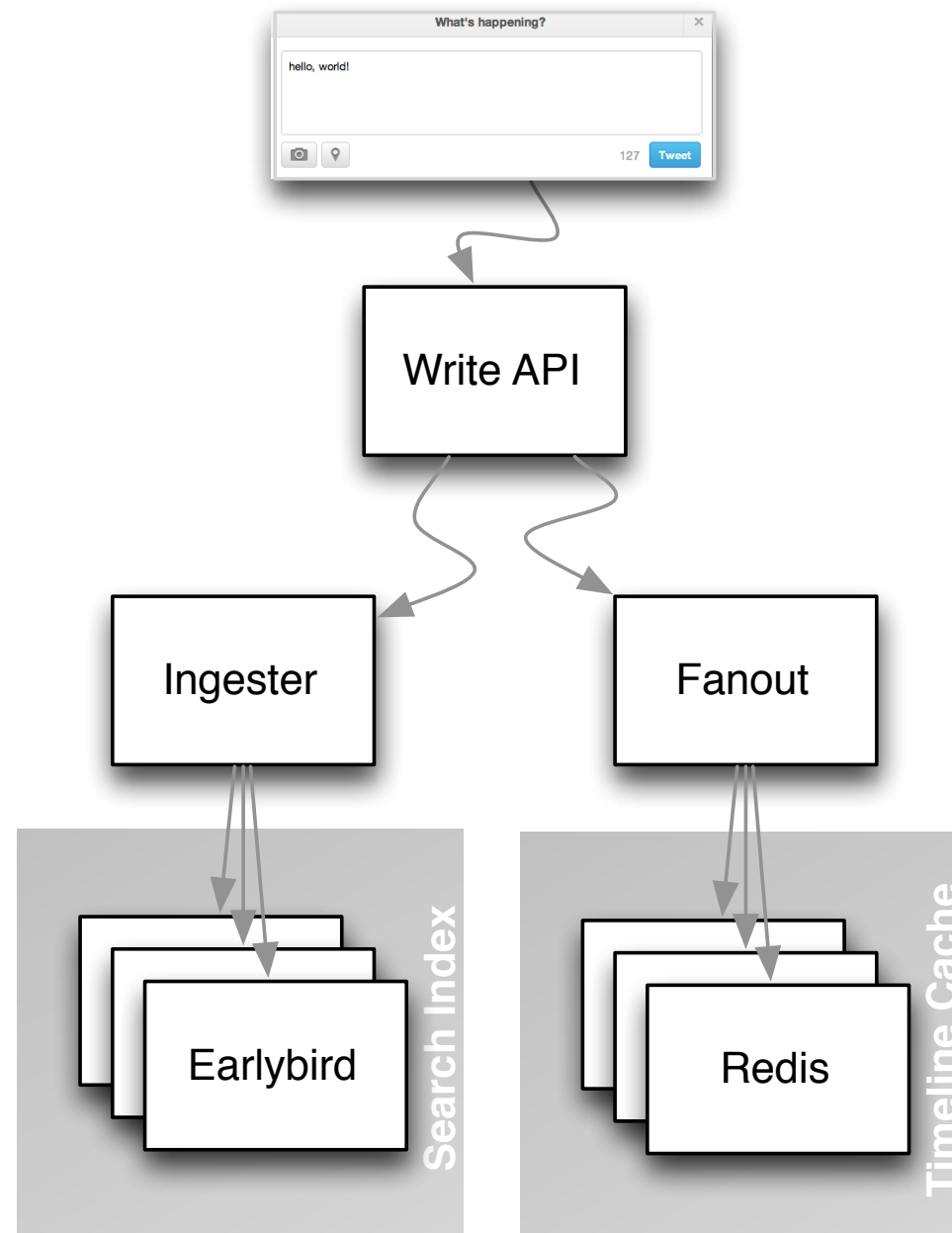
Fanout











search index

→ ['hello', 'world']

fanout index

→ [@danadanger, ...]

User Intent

Query Expansion

User Intent

Query Expansion

User Intent

Query Expansion

“Hello, world”

User Intent

“Hello, world”

Query Expansion

“Hello” AND “world”

User Intent

Query Expansion

“Hello, world”

“Hello” AND “world”

@raffi's home timeline

User Intent

“Hello, world”

Query Expansion

“Hello” AND “world”

@raffi's home timeline

User Intent

“Hello, world”

Query Expansion

“Hello” AND “world”

@raffi's home timeline

home_timeline:raffi

User Intent

Query Expansion

“Hello, world”

“Hello” AND “world”

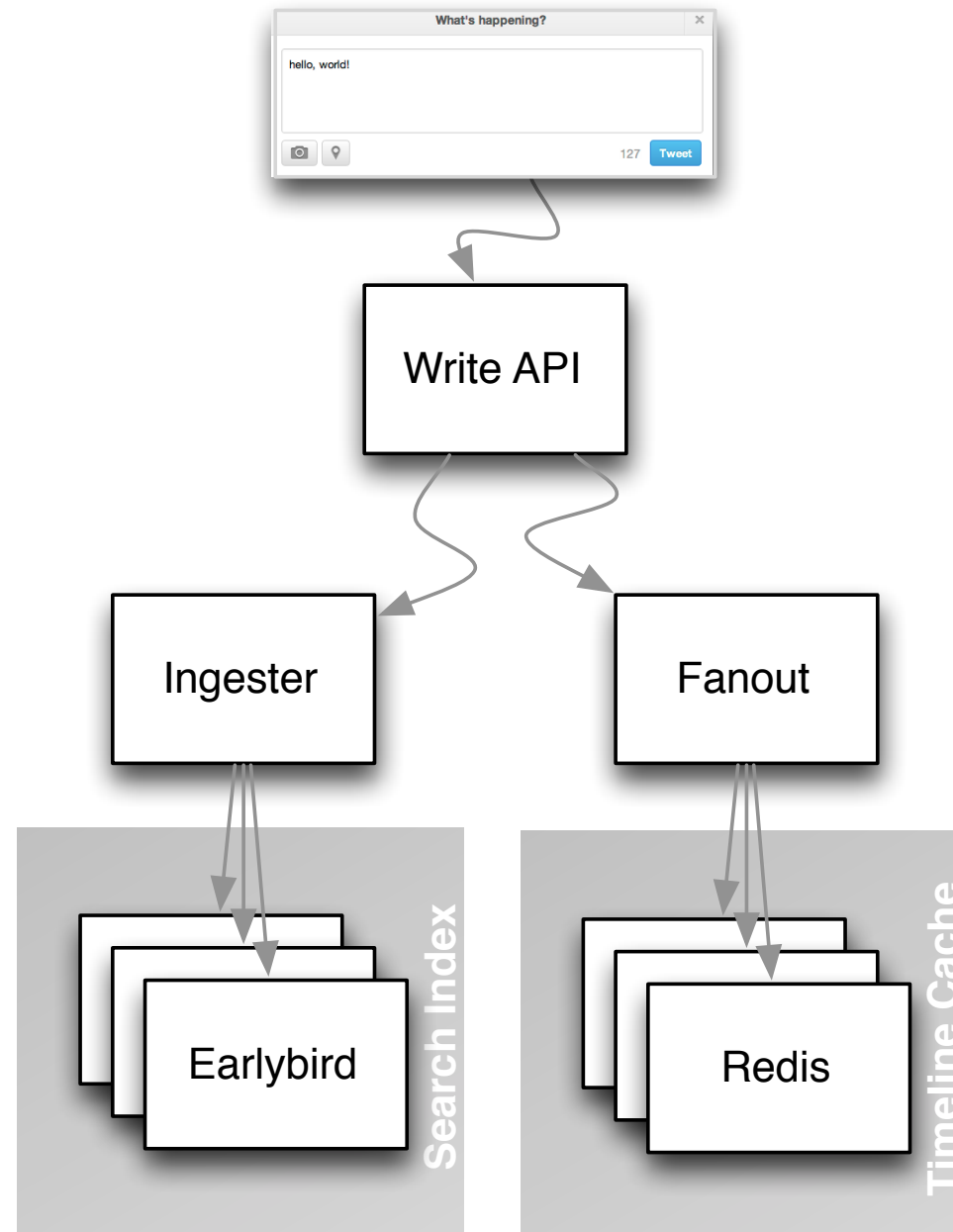
@raffi’s home timeline

user_timeline:nelson
OR
user_timeline:danadanger

fan-in

→ $O(1)$ write

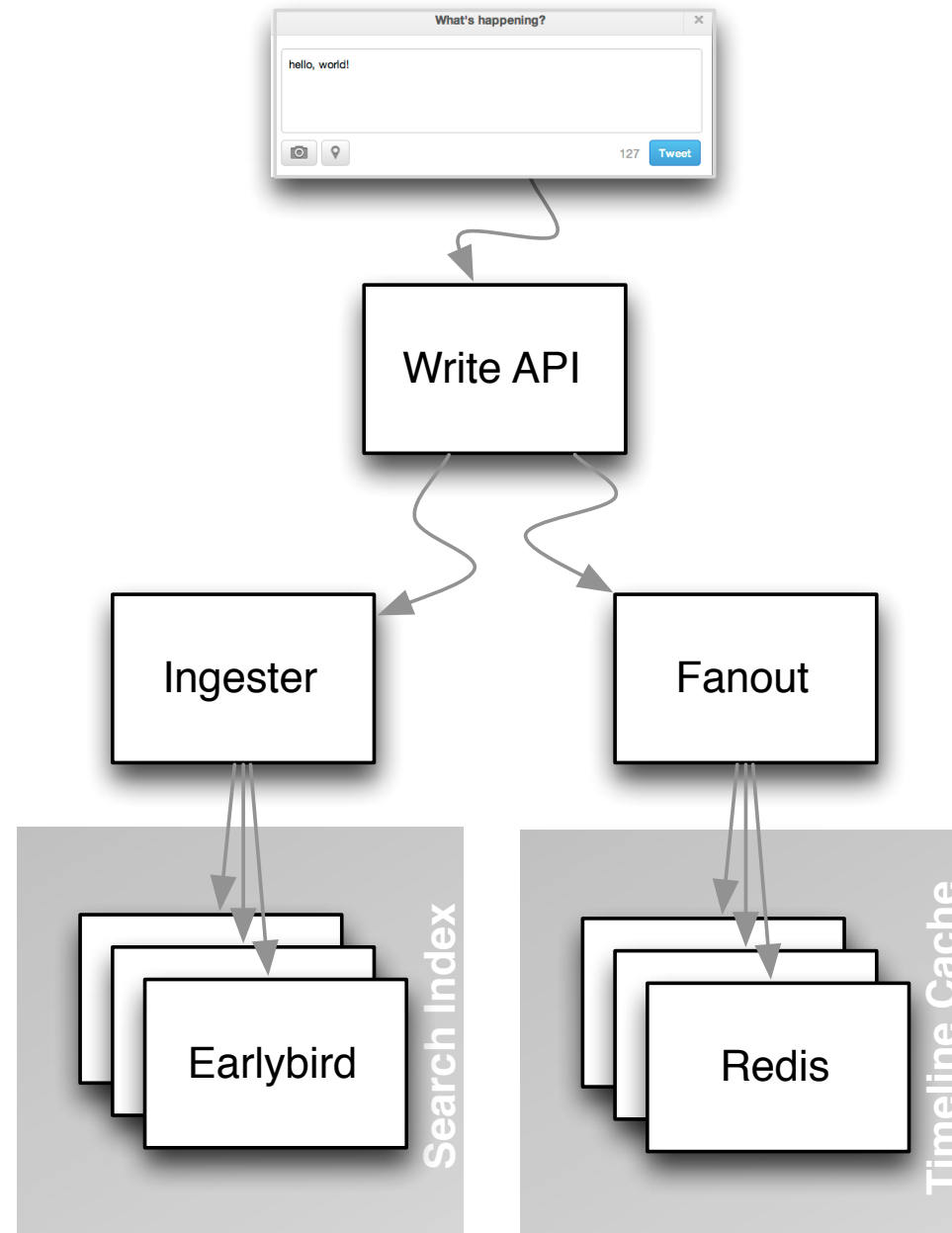
→ $O(n)$ read



fan-out

→ $O(n)$ write

→ $O(1)$ read



User Intent

“Hello, world”

Query Expansion

“Hello” AND “world”

@raffi's home timeline

home_timeline:raffi

User Intent

Query Expansion

“Hello, world”

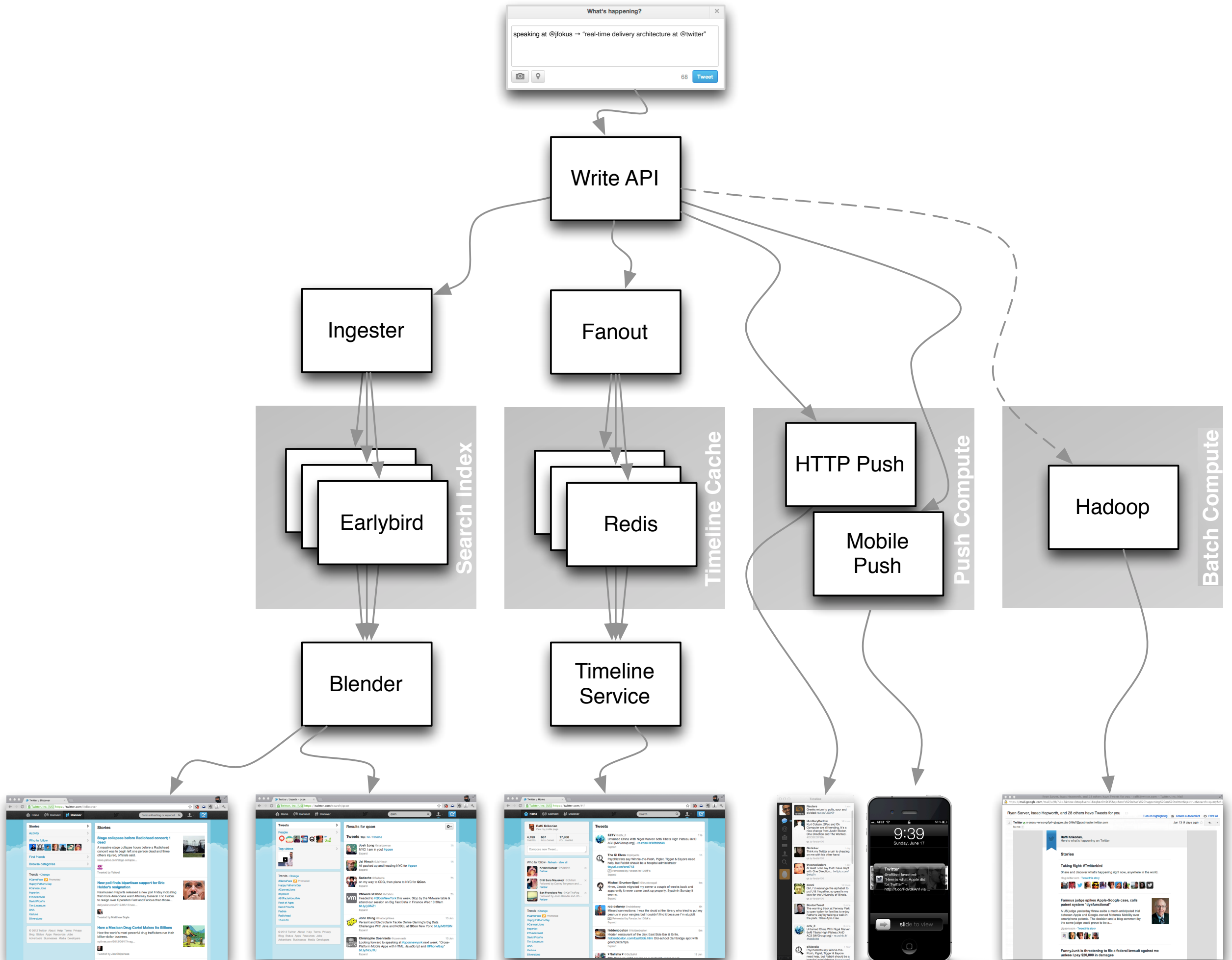
“Hello” AND “world”

@raffi's home timeline

home_timeline:raffi
OR
user_timeline:taylorswift13

streaming compute

- ...→ continuous computation
- ...→ driven by the events that come into twitter
- ...→ generalizing the push mechanism

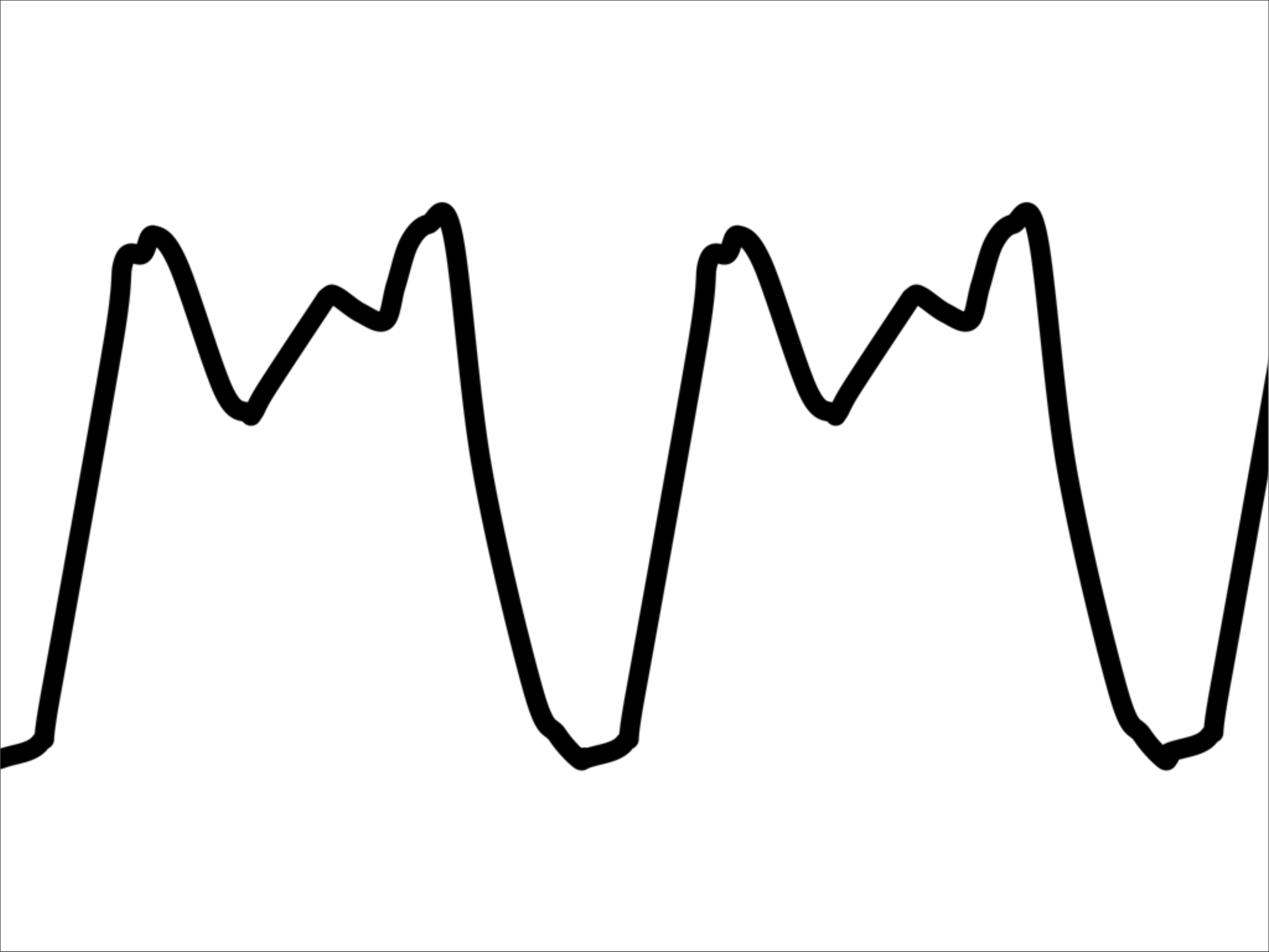


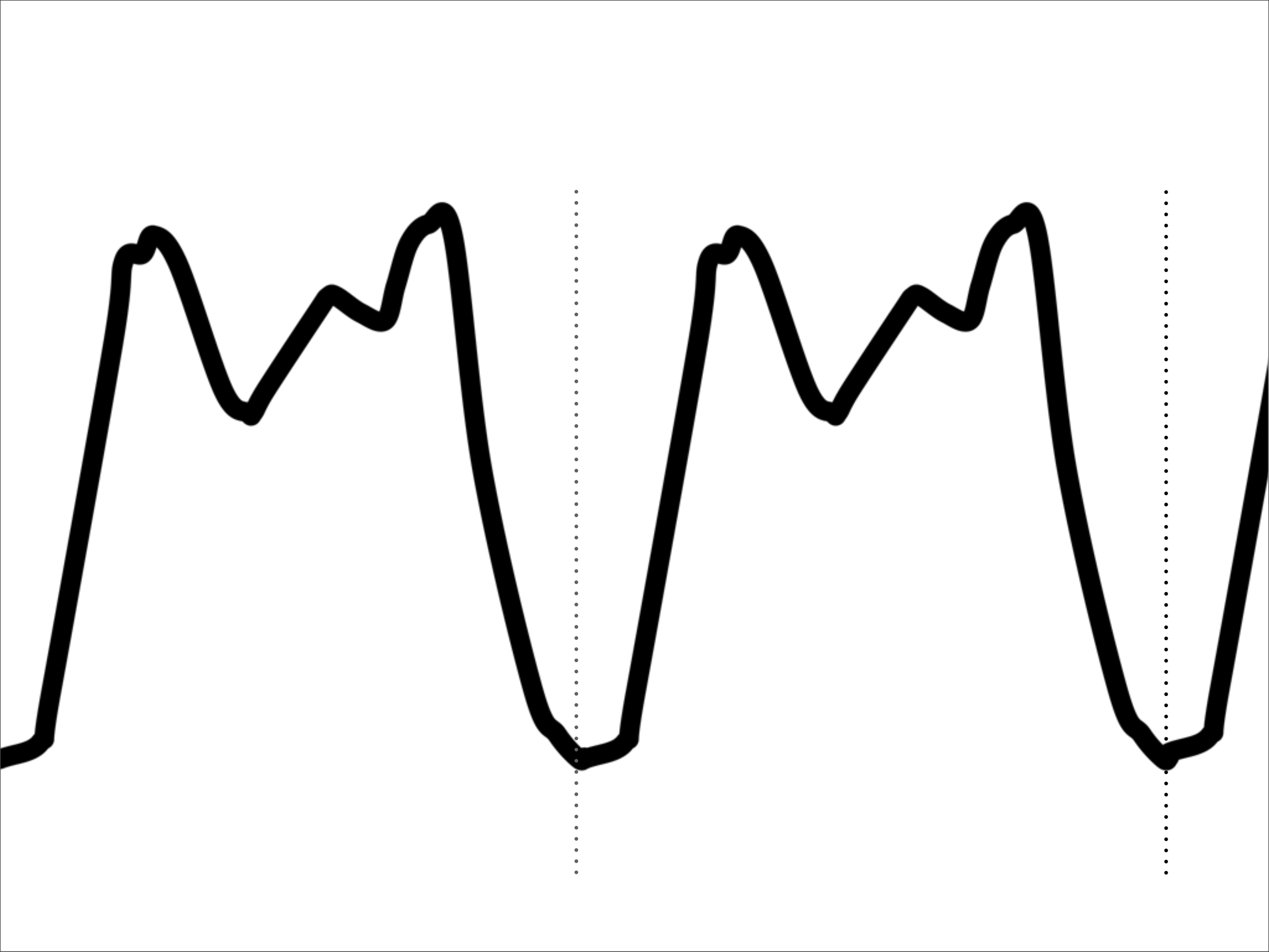
timeline query statistics

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

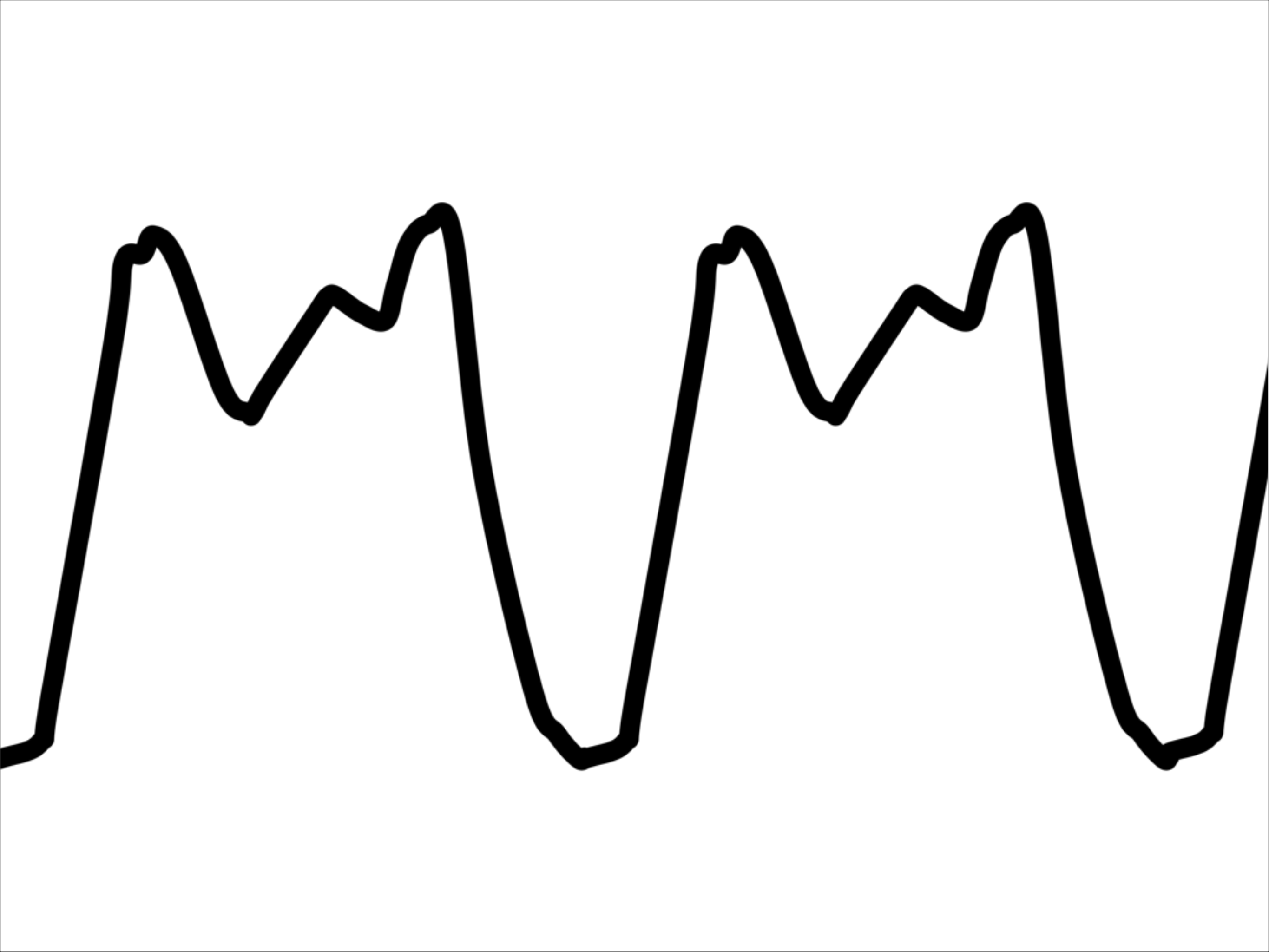
tweet input

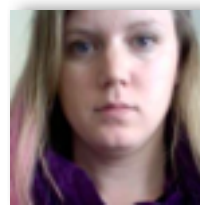
- ...→ ~340m tweets per day
- ...→ ~4K/sec daily average
- ...→ ~6K/sec daily peak
- ...→ >10K/sec during large events

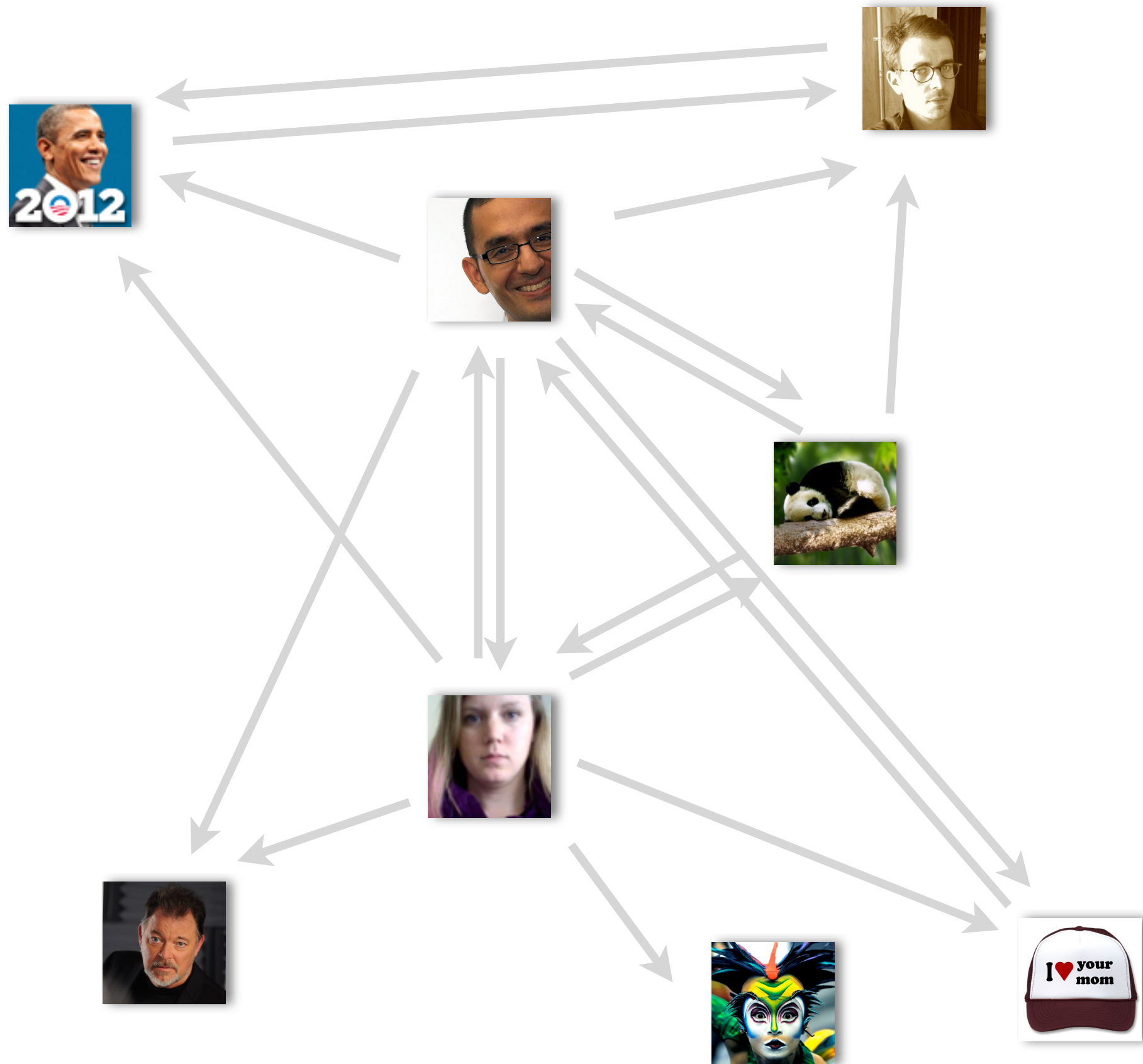


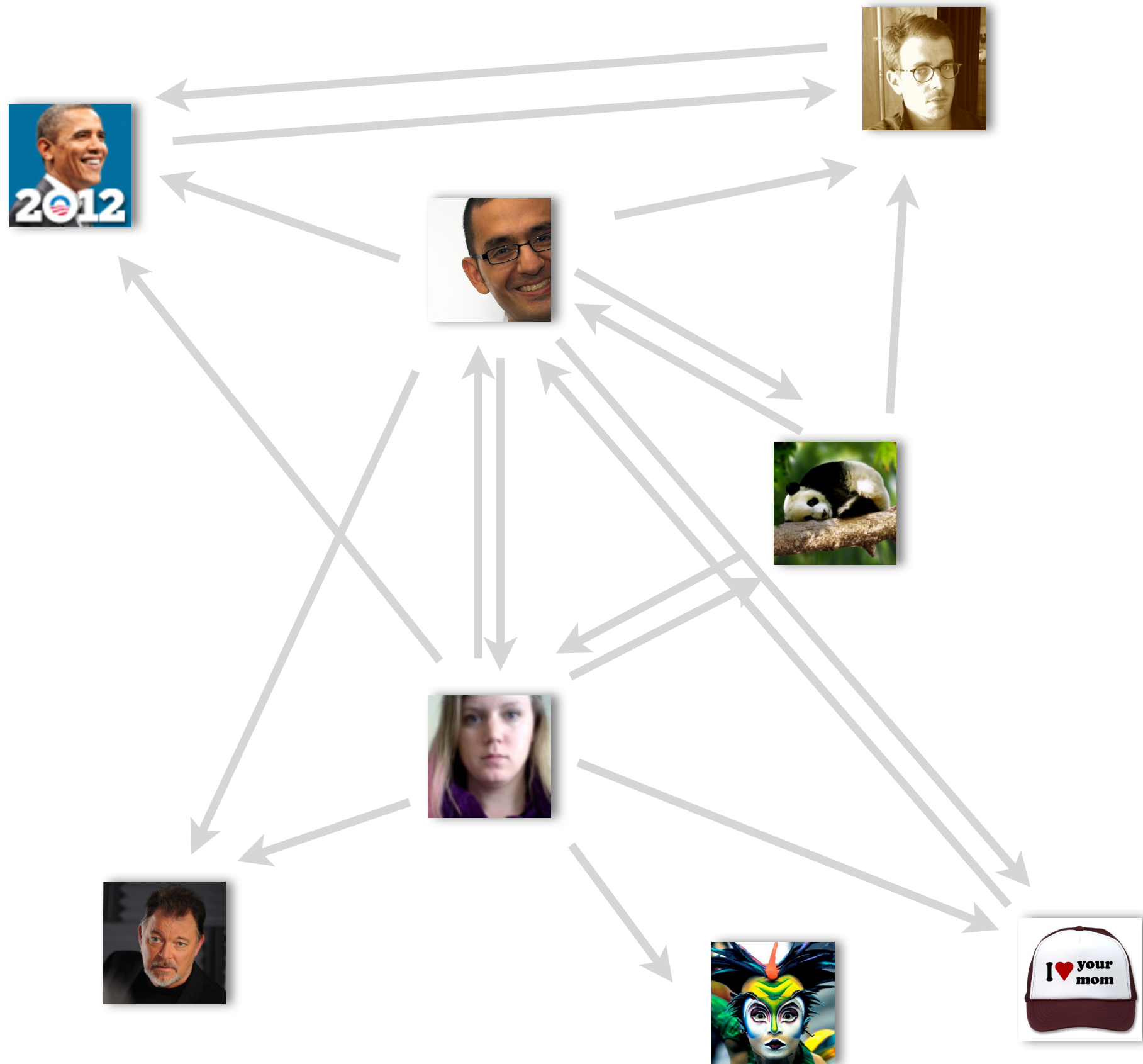


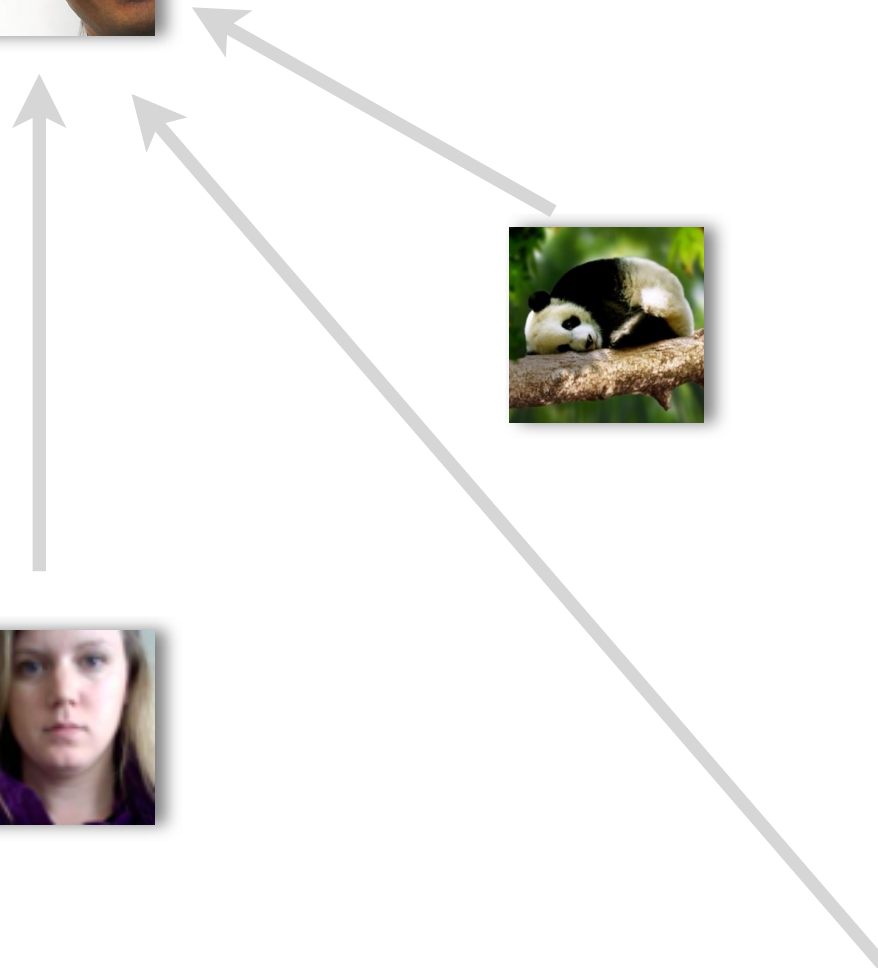
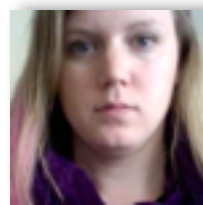
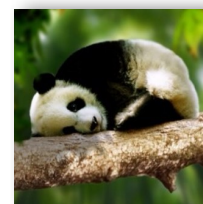






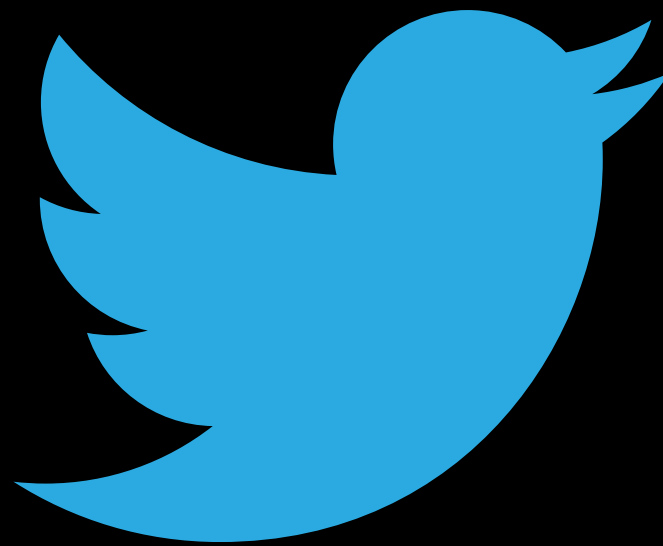


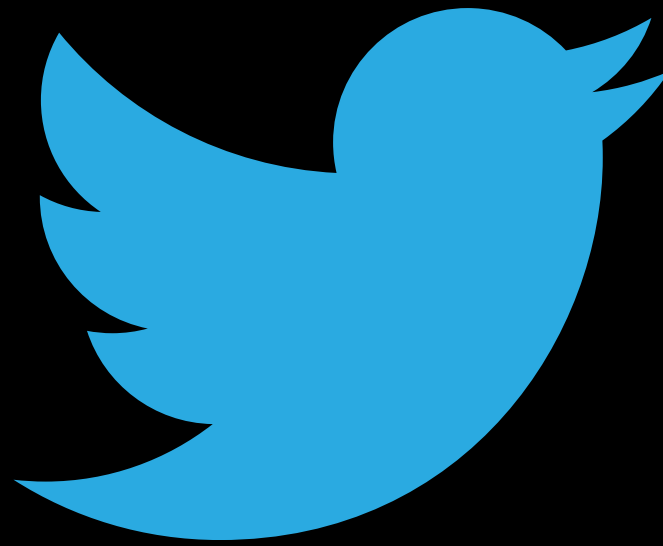




timeline delivery statistics

- 26b deliveries / day (~18m / min)
- 3.5 seconds @ p50 to deliver to 1m
- ~300k deliveries / sec





thanks!