



# How to design Feed/Chat System

CS103 系统设计

Producer: 冯沁原

1.00



课程咨询



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# Part 1, Feed

**Read More**

Novice, <http://url.cn/faa4ko>

Novice, <http://url.cn/1ob37A>

Novice/Expert, <http://url.cn/eKslAK>

Novice/Expert/Master, <http://url.cn/cinh36>

Expert, <http://url.cn/g4JSMc>

Expert, <http://url.cn/ayEgtO>

Expert, <http://url.cn/efdJnC>

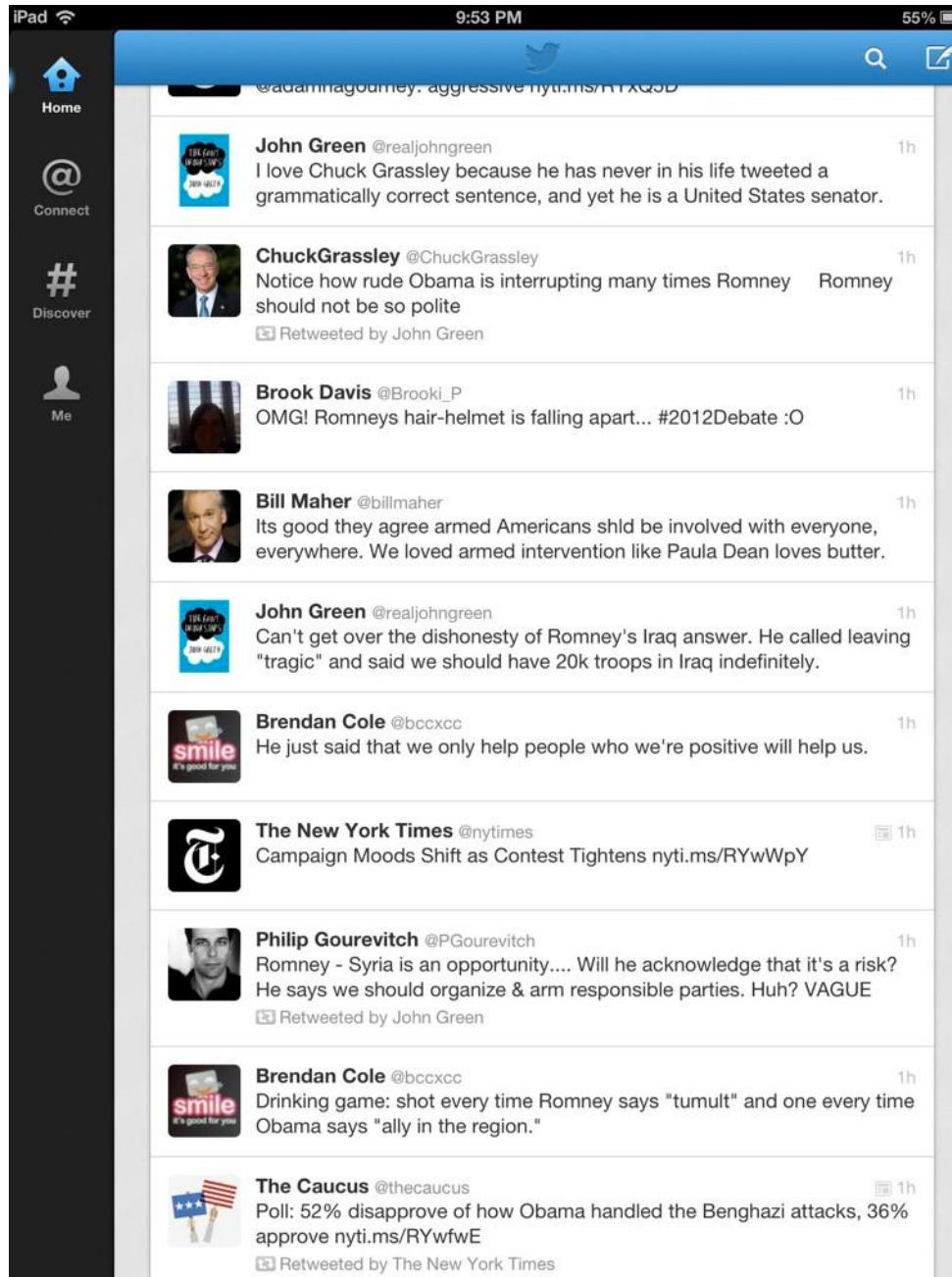
Expert/Master, <http://url.cn/fr44T4>

Expert/Master, <http://url.cn/H2CLaU>

Expert/Master, <http://url.cn/RXRa8P>

Expert/Master, <http://url.cn/hWVvmn>

Master, <http://url.cn/ULnxoG>



# Interviewer: design Twitter

## Scenario: three feed lists

<p><b>Nelson Minar</b> @nelson That part of the hip hop record where there's a recording of someone urinating. <a href="#">Expand</a></p>	<p>36m</p>	<p><b>Tim O'Reilly</b> @timoreilly "online messages that evoke feelings of unintentional joy!...a poetry of the web" <a href="#">Expand</a></p>	<p><b>Chris Matts</b> @PapaChrisMatts Looking forward to <b>#QCONNewYork</b> on Monday. Talking about Lazy Learner. The other the "Agile Individuals track" speakers are most <b>#awesome!</b>  Retweeted by QCon New York <a href="#">Expand</a></p>	<p>15 Jun</p>
<p><b>Nelson Minar</b> @nelson @kvox awesome photo, dapper man in vintage airplane? <a href="#">View conversation</a></p>	<p>36m</p>	<p><b>Tim O'Reilly</b> @timoreilly What's the craziest thing your dad ever did? Results from <b>@make</b>'s homage to Father's Day. <a href="#">Expand</a></p>	<p><b>QCon New York</b> @qconnewyork "Spring Data - NoSQL, NoProblems" talk by <b>@PeterBell</b> at QCon New York. <b>#springframework #nosql #mongodb #neo4j</b> <a href="#">qconnewyork.com/qcon-nyc-2012/...</a> <a href="#">Expand</a></p>	<p>14 Jun</p>
<p><b>Nelson Minar</b> @nelson @bookscout oh bullshit, merlot is a wine Ch. Petrus, for instance. <a href="#">View conversation</a></p>	<p>36m</p>	<p><b>Tim O'Reilly</b> @timoreilly Potentially wonderful. Also very scary. A banker in Spain <a href="http://bit.ly/KExVdk">bit.ly/KExVdk</a> Funded <a href="#">View media</a></p>	<p><b>QCon New York</b> @qconnewyork Want to learn how <b>#APM</b> can help you get the most out of your <b>#bigdata</b> application? See <b>@mikopp</b>'s session at <b>#qconnewyork</b> <a href="#">qconnewyork.com/qcon-nyc-2012/...</a> <a href="#">Expand</a></p>	<p>13 Jun</p>
<p><b>Nelson Minar</b> @nelson Yesterday was South Park, today is Area startup tour? Go kart track? Sun from Woodside, CA </p>	<p>20m</p>	<p><b>Tim O'Reilly</b> @timoreilly Old friend selling beautiful cottage in Queens, NYC: <a href="http://bit.ly/KEvKqf">bit.ly/KEvKqf</a> <a href="#">Expand</a></p>	<p><b>QCon New York</b> @qconnewyork Creating maintainable, sustainable software can be hard but not impossible-Alexander von Zitzewitz <b>#qconnewyork</b> <a href="http://goo.gl/o3Dy7">goo.gl/o3Dy7</a> <a href="#">Expand</a></p>	<p>12 Jun</p>
<p><b>Nelson Minar</b> @nelson @skatterbean Harris Ranch is a fun place, but narrow. Don't count on the fuel world. <a href="#">View conversation</a></p>	<p>16 Jun</p>	<p><b>Ivan Tarradellas</b> @itarradellas @deepakmohoni @timoreilly @quixote "Go to the edge of the cliff and jump down"  Retweeted by Tim O'Reilly <a href="#">View conversation</a>  Reply  Retweet</p>	<p><b>QCon New York</b> @qconnewyork don't miss your chance to save \$200 for <b>#qconnewyork!</b> early bird expires Friday 6/15/2012! <a href="http://secure.trifork.com/qcon-nyc-2012/">secure.trifork.com/qcon-nyc-2012/...</a> <a href="#">Expand</a></p>	<p>11 Jun</p>
<p><b>Nelson Minar</b> @nelson @bradfordcross no worries, thanks! I stopped using Techmeme. Just make scrolling work consistently. :-) <a href="#">View conversation</a></p>	<p>16 Jun</p>			

## Scenario: one timeline

 **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](http://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](http://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](http://bit.ly/KExVdk) Funded 24 hrs [bit.ly/KExSOG](http://bit.ly/KExSOG)  
[View media](#)

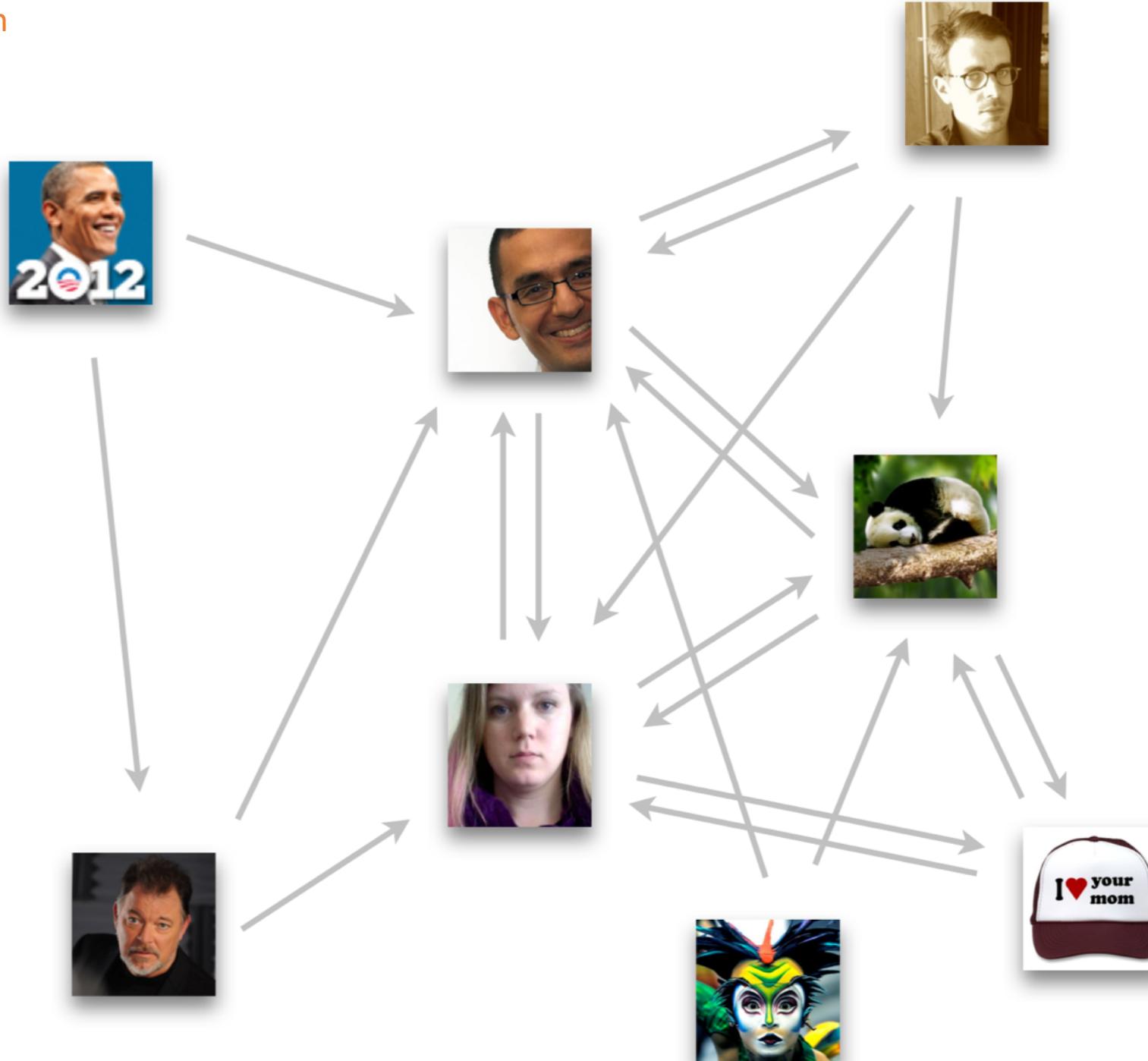
 **Tim O'Reilly** @timoreilly 4h  
Old friend selling beautiful cottage on huge garden lot in Bayside, Queens, NYC: [bit.ly/KEvKqf](http://bit.ly/KEvKqf)  
[Expand](#)

 **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](#) [RT](#) [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!**  
[📍 Brooklyn, NY, USA - New York](#)

## Scenario: social graph



# Necessaries

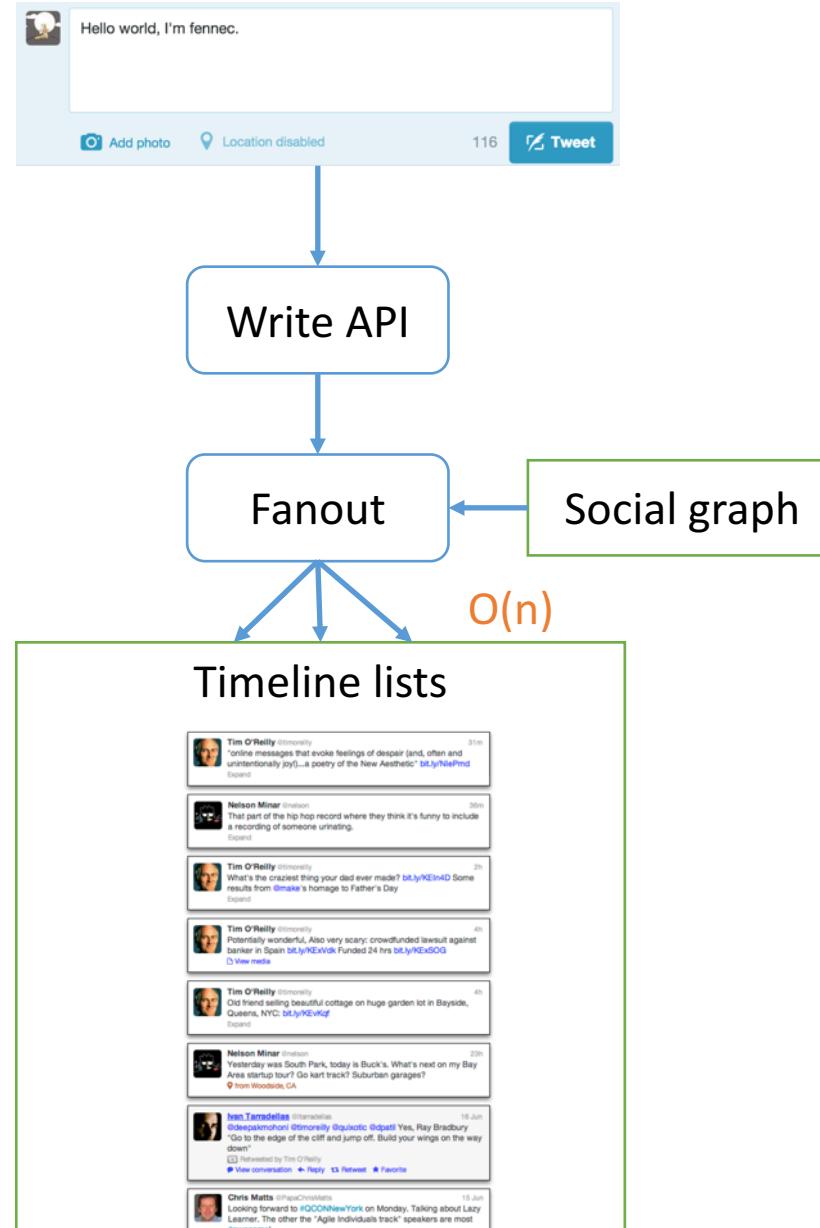
- Read timeline  
QPS = 300K
- Write tweet  
QPS = 5K
- Notify
  - 1million followers within 1s
- Concurrent users  
= 15m
- Daily tweets  
= 400m

# PUSH MODEL



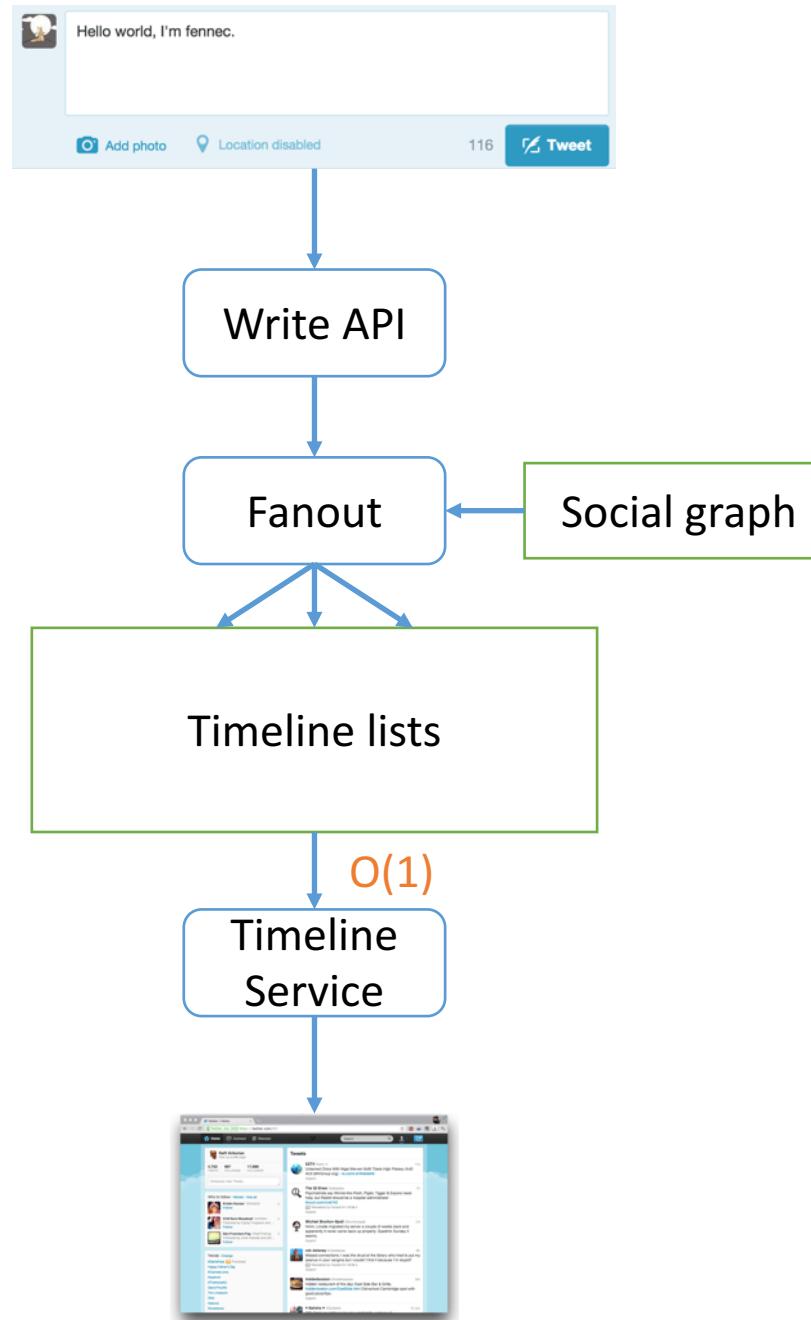
# Interviewer: How to write a tweet?

Write a tweet with push



# Interviewer: How to read timeline?

# Read a timeline with push

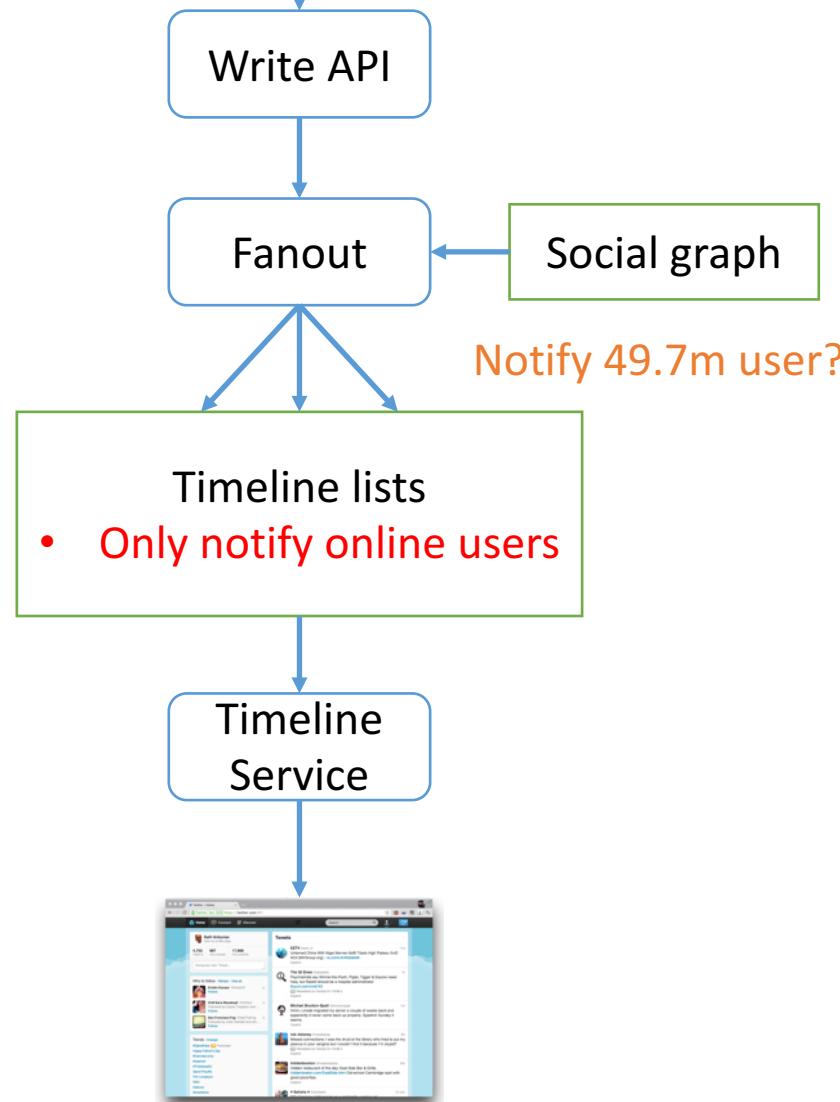


# Interviewer: How to deal with the storm of Lady Gaga

# The storm of lady gaga



FOLLOWERS  
**49.7M**

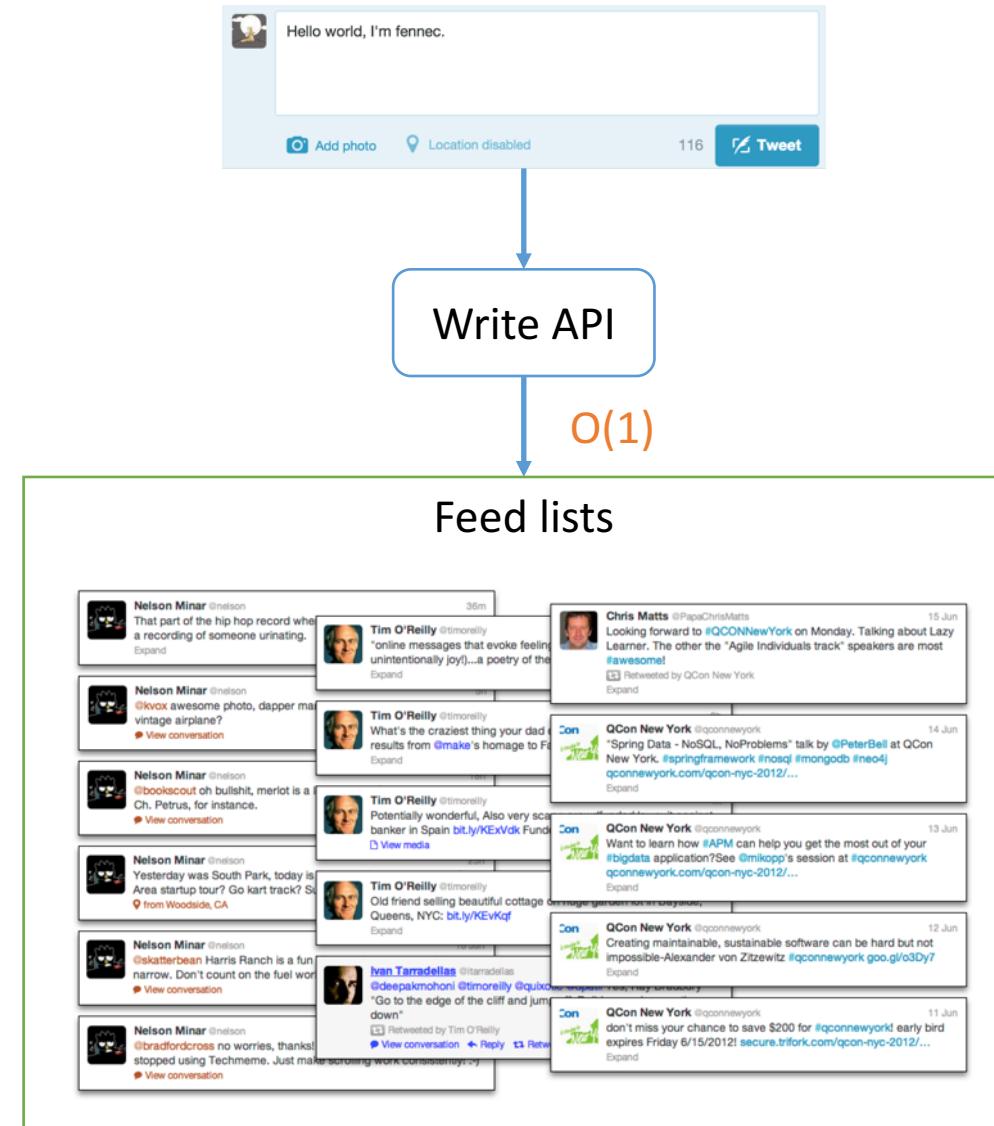


# PULL MODEL



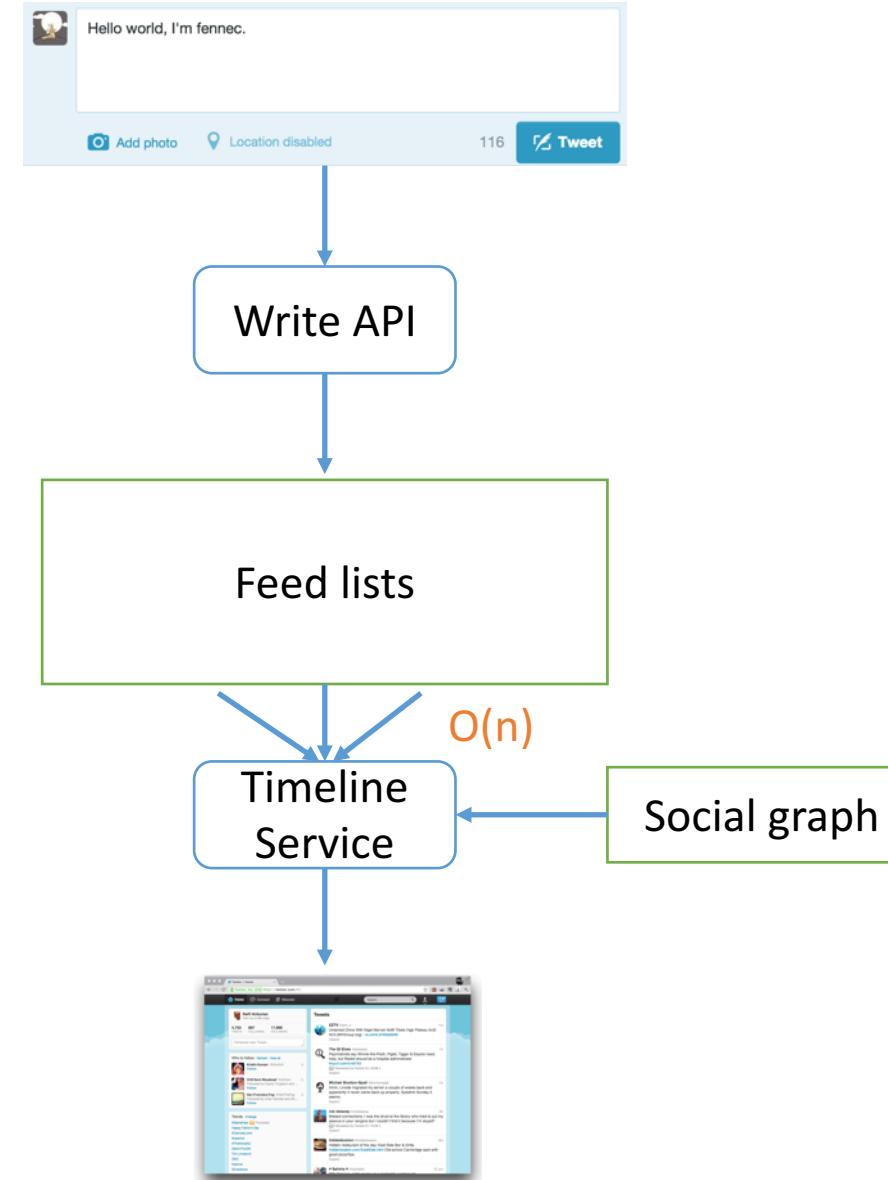
# Interviewer: How to write a tweet?

# Write a tweet with pull

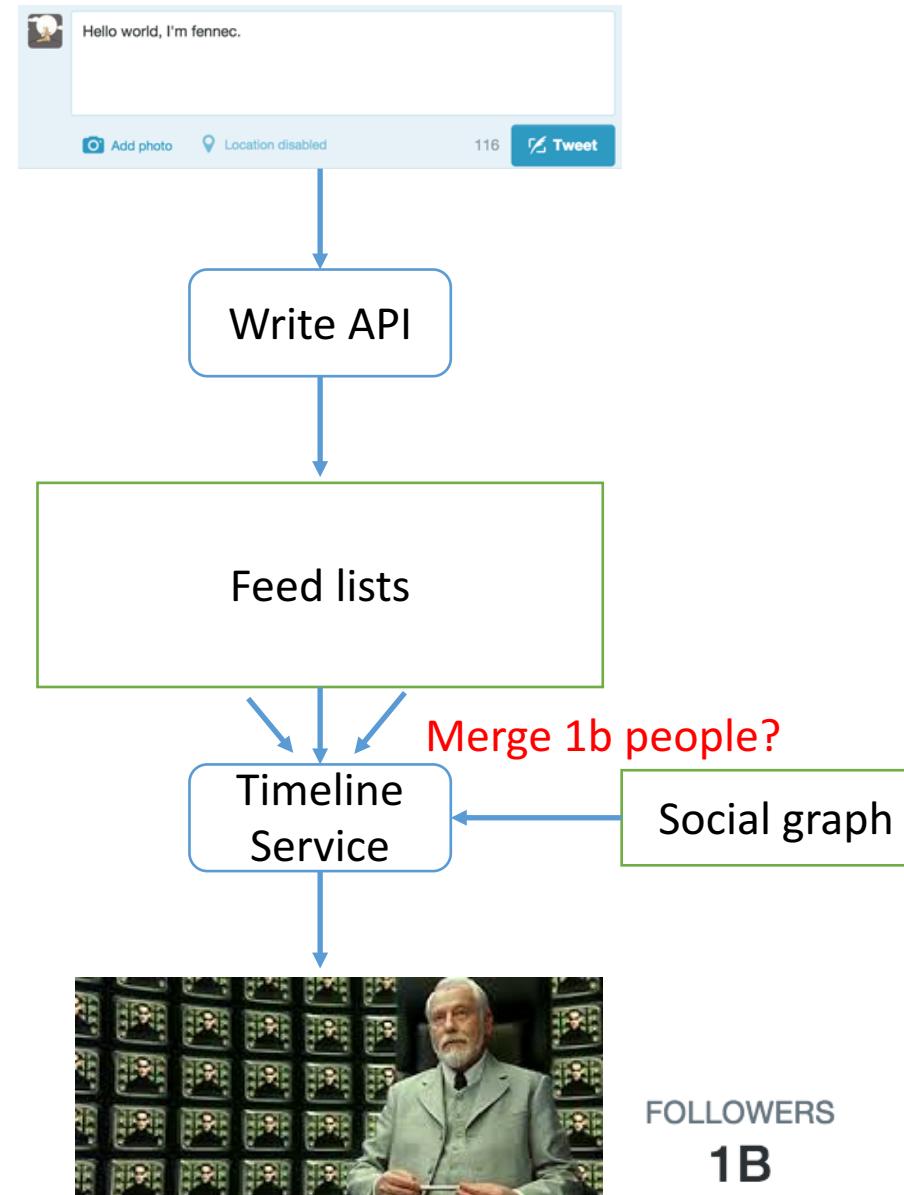


# Interviewer: How to read timeline?

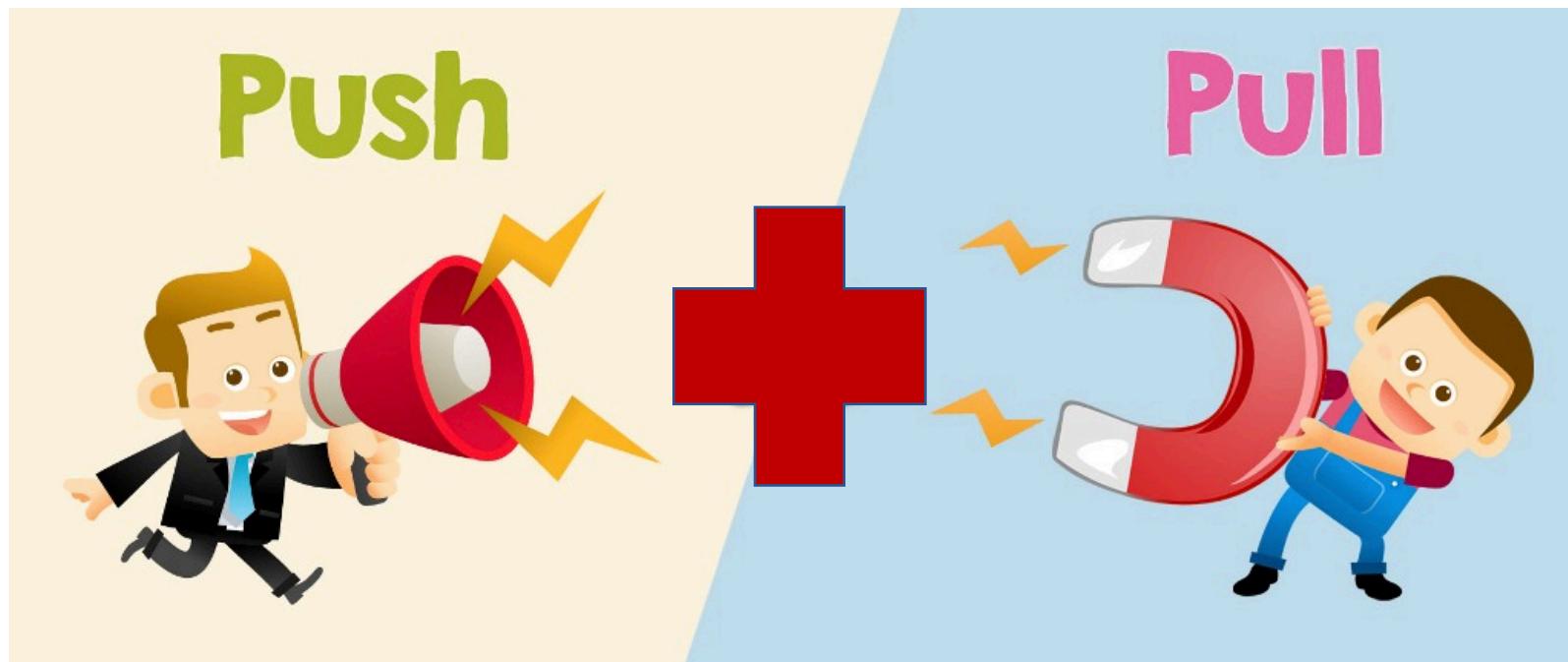
# Read a timeline with pull



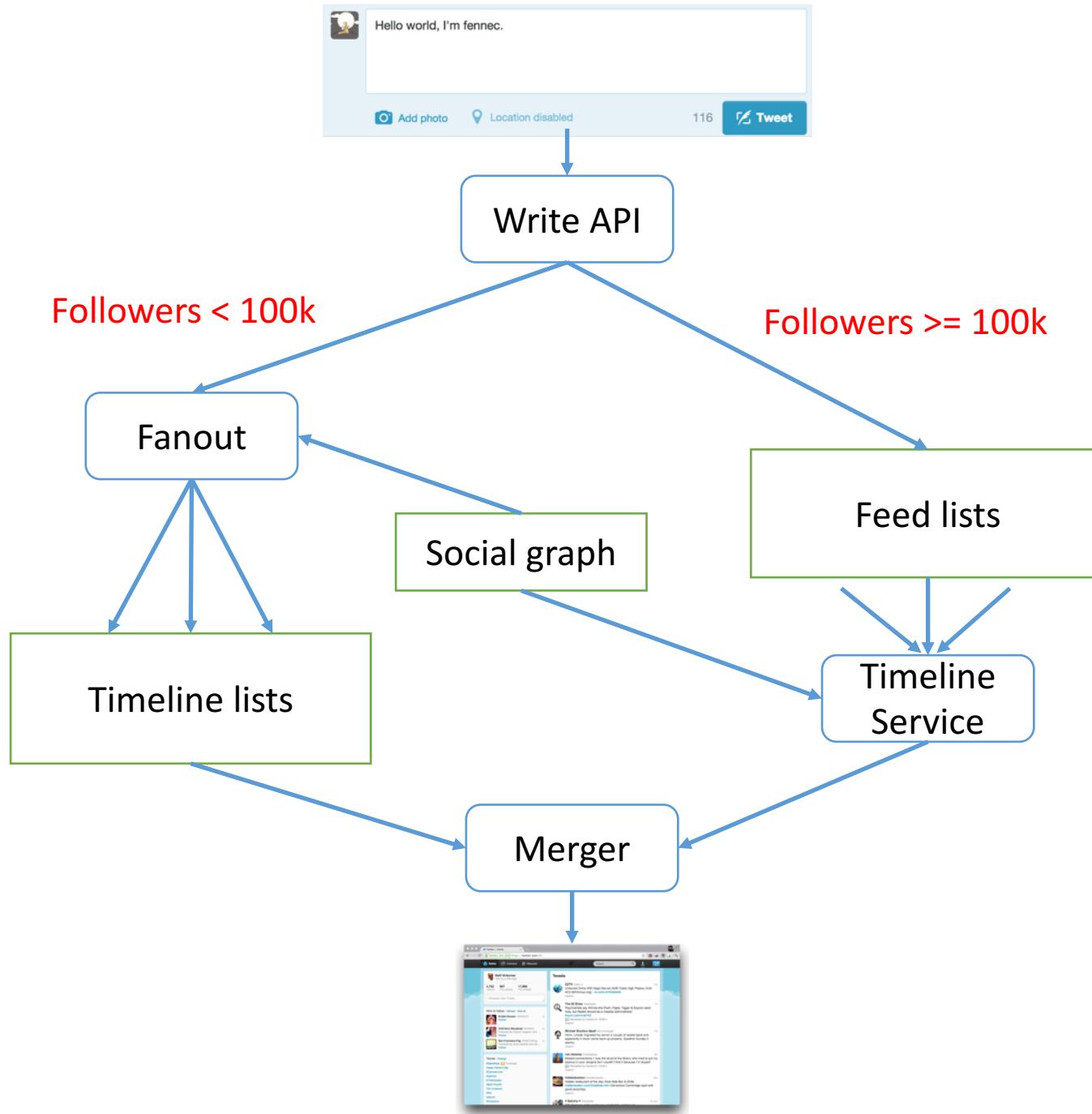
Interviewer: How to deal  
with the Architect of the  
MATRIX?



# Push & Pull MODEL

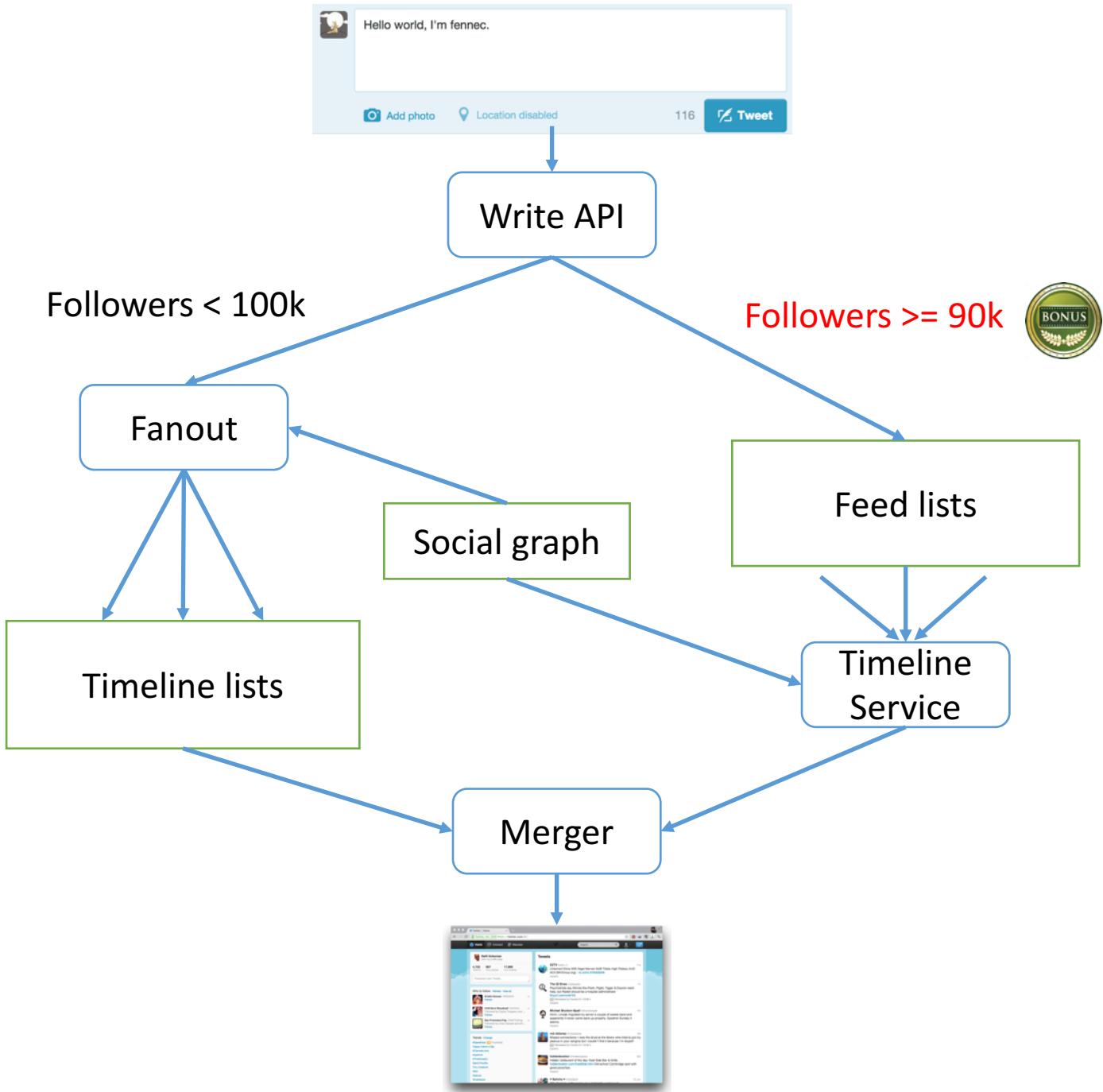


# Push & pull



# Interviewer: the challenge of vacillation?





Interviewer: How to choose  
between push and pull?

# How to choose pull and push



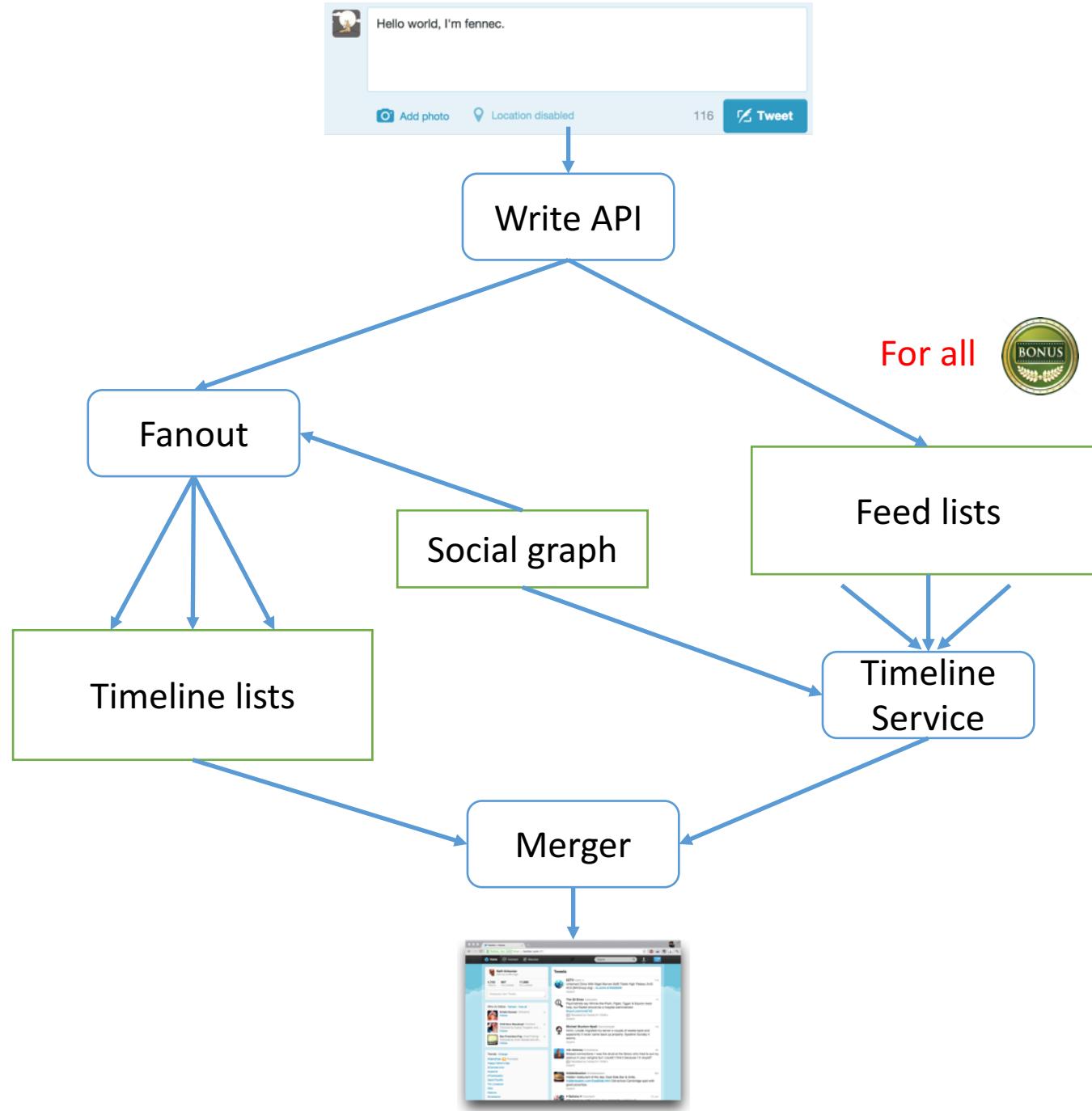
- Understand your specific scenario
- Balance between latency, computation & storage
- $O(n)$  is not workable
- **Simplicity asks for focusing on one**

## Magic number you can know (2015)

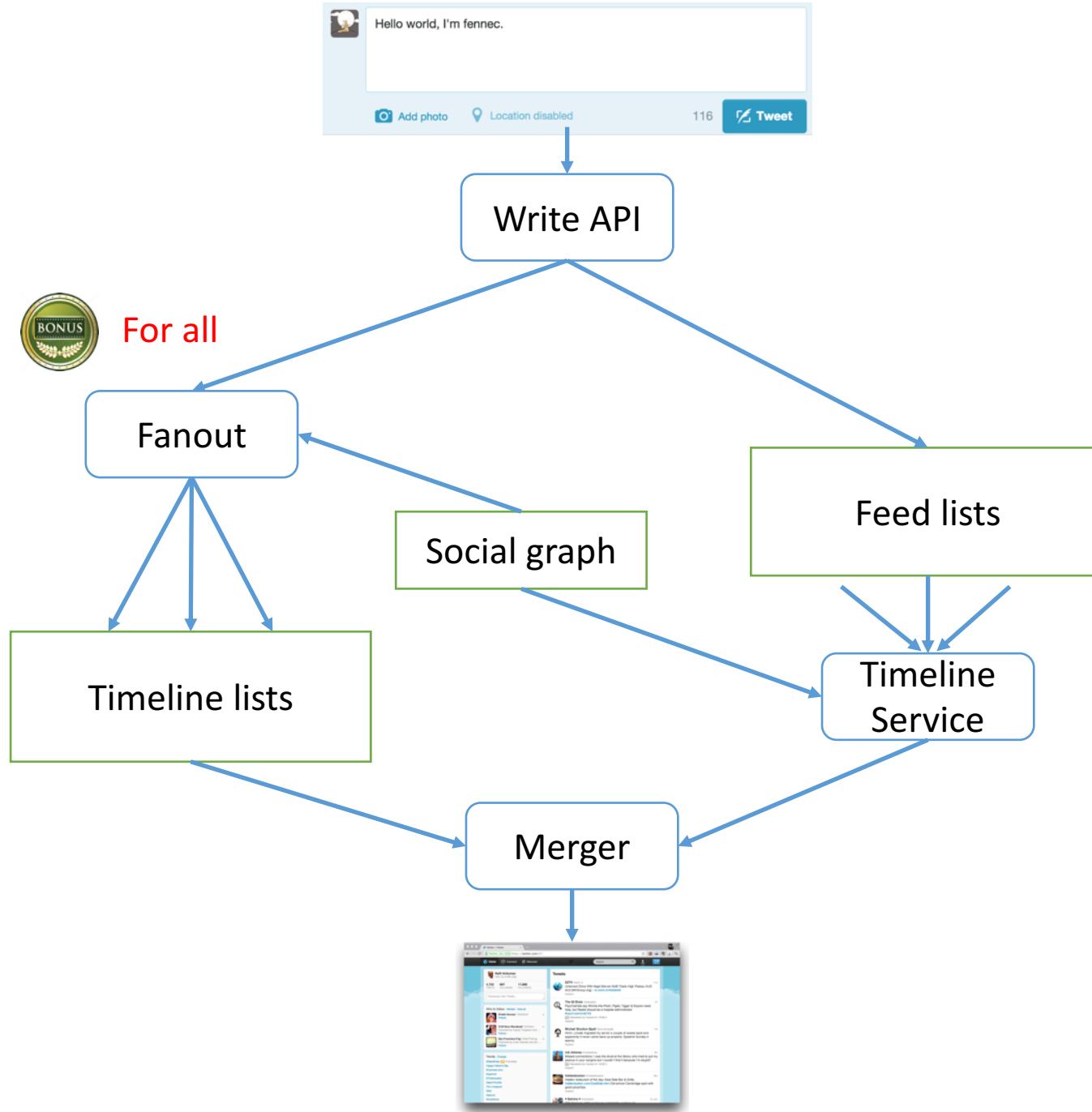
[Read More](#)

Novice/Expert, <http://url.cn/Do4CHm>

## Facebook style



# Instagram style



# Interviewer: How to speed up?

## Speed up with memory

### Assumption

- 1billion users
- Average feed size: 50 tweets
- Average timeline size: 1000 tweets
- Tweet size: 200B
- Average followers = 30

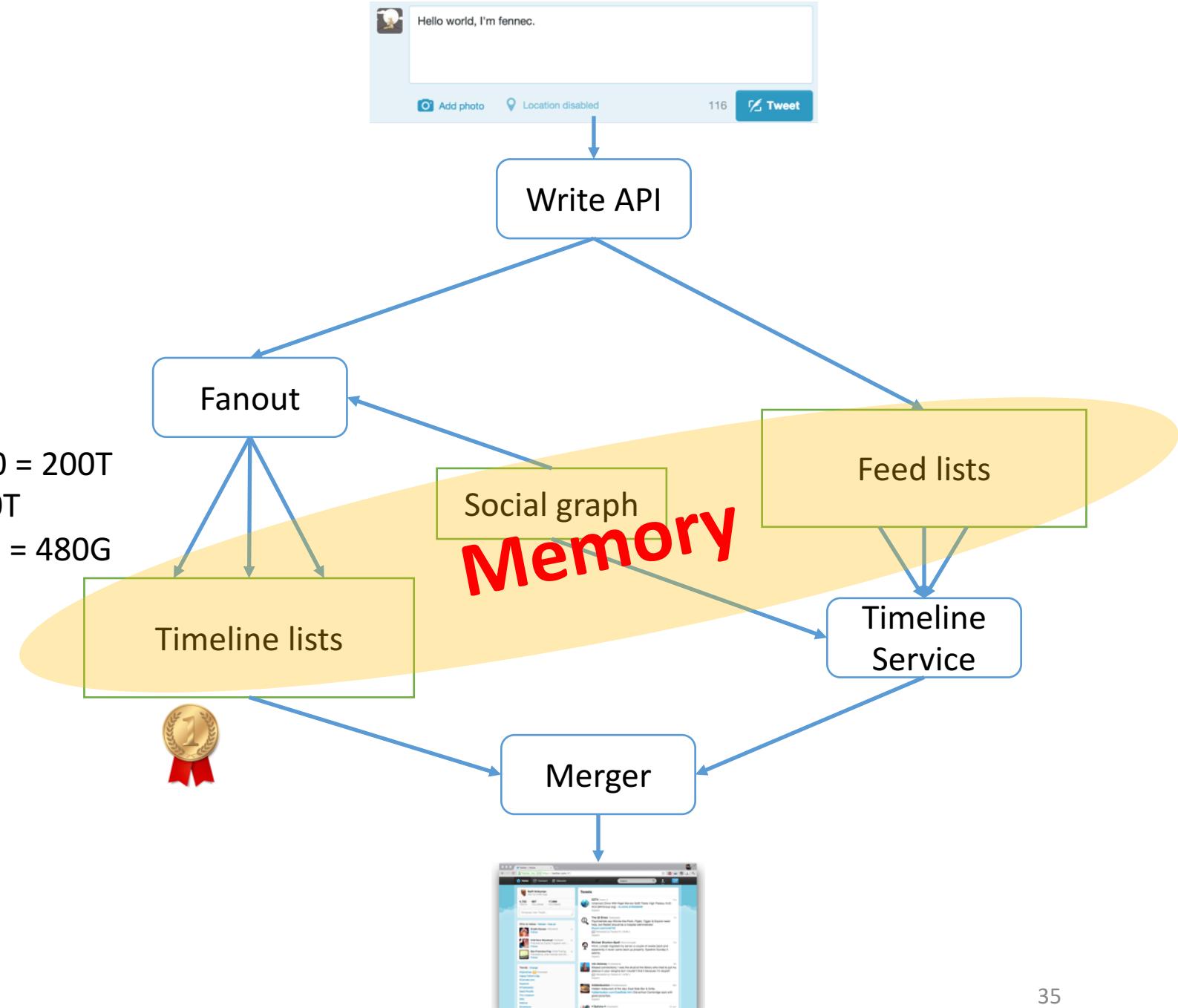
### Memory needed

- Size of timeline lists =  $1\text{billion} * 10^3 * 200 = 200\text{T}$
- Size of feed lists =  $1\text{billion} * 50 * 200 = 10\text{T}$
- Size of social graph =  $1\text{billion} * 30 * 2 * 8 = 480\text{G}$



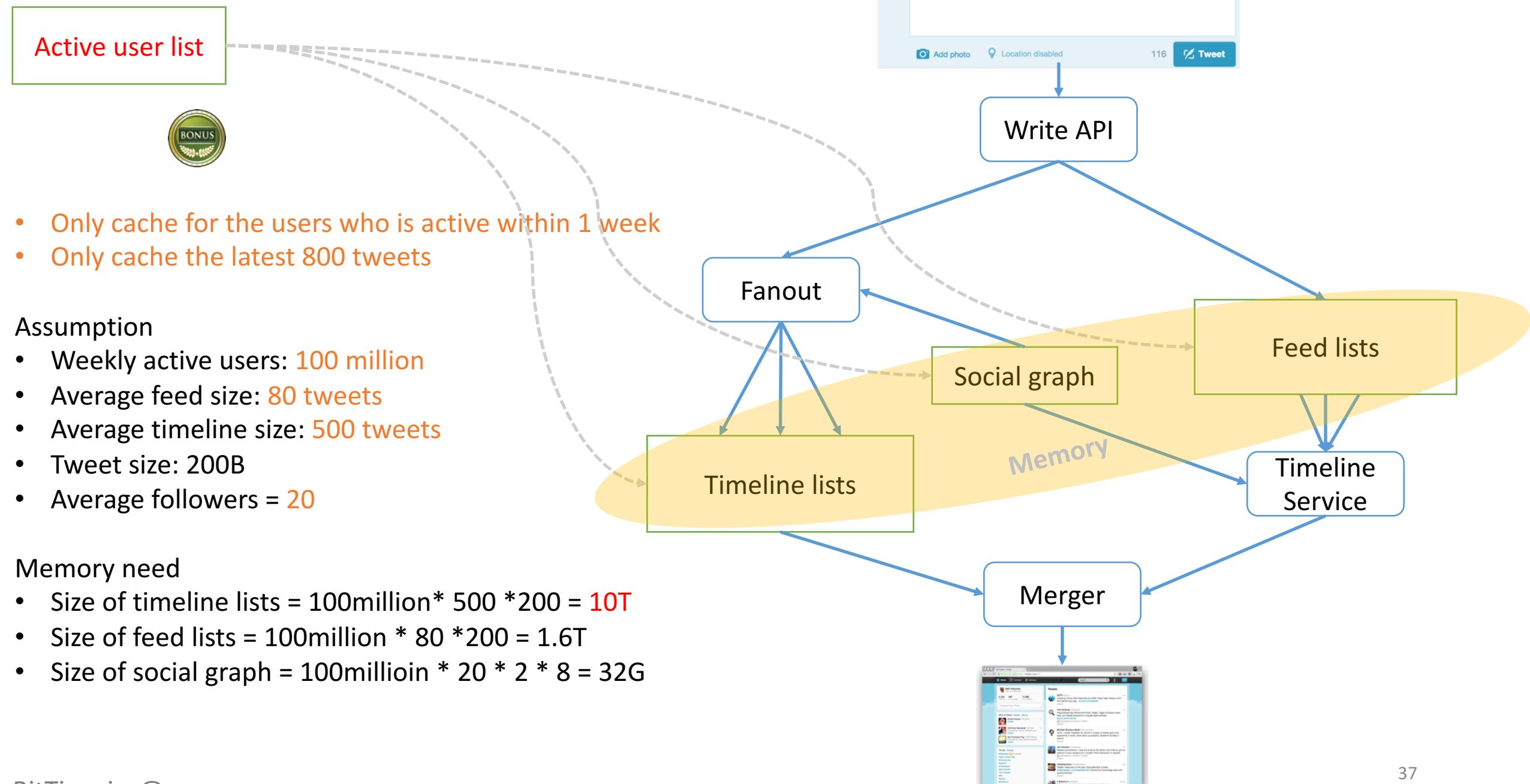
Read More

Novice/Expert/Master, <http://url.cn/bZZASX>  
Novice, <http://url.cn/1ob37A>



**Interviewer: How to save space?**

Save space with active user list



# Save space by separating tweet content



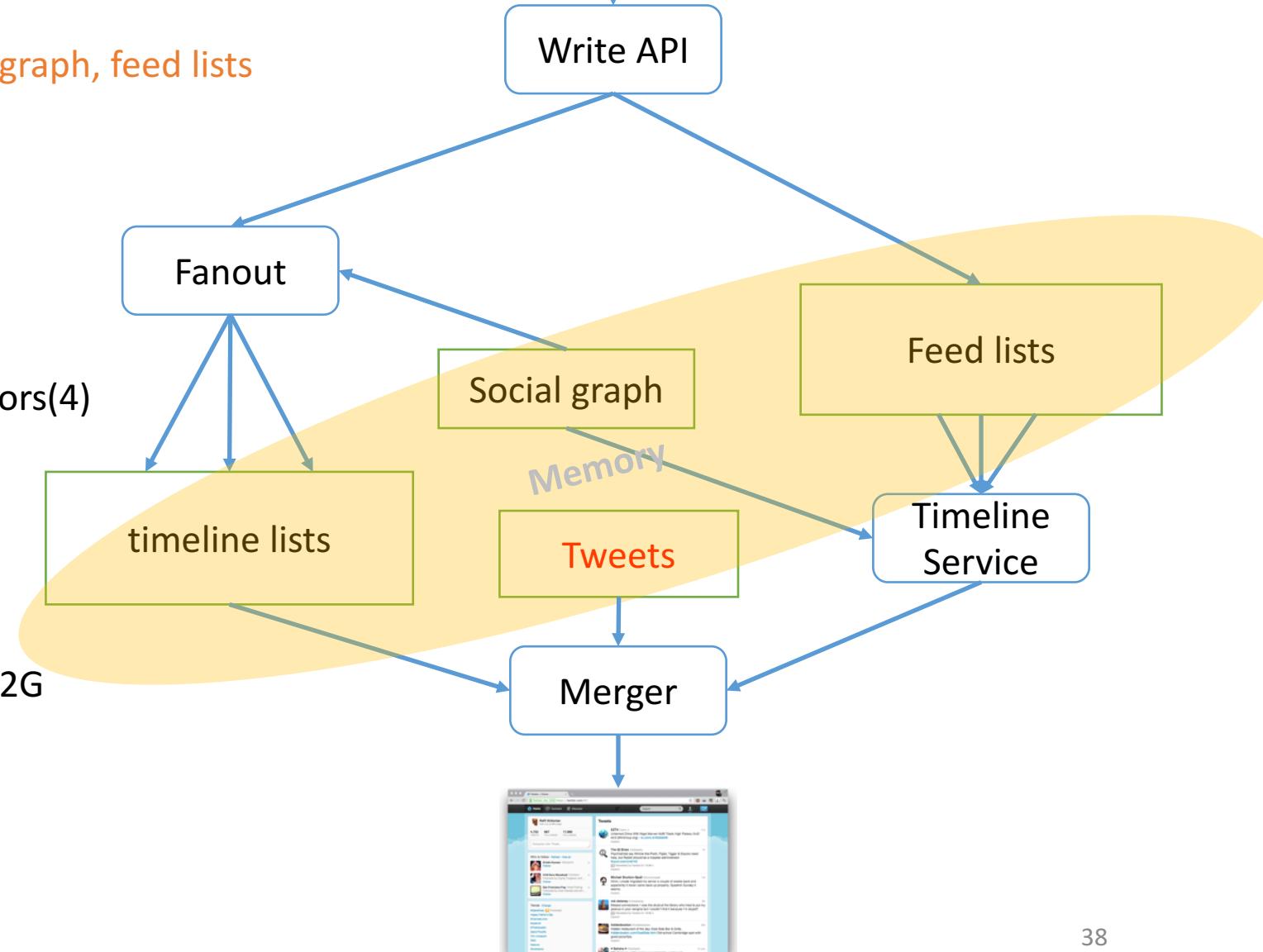
- Only TweetIDs are stored in timeline lists, social graph, feed lists
- Tweet contents are appended in merger

## Assumption

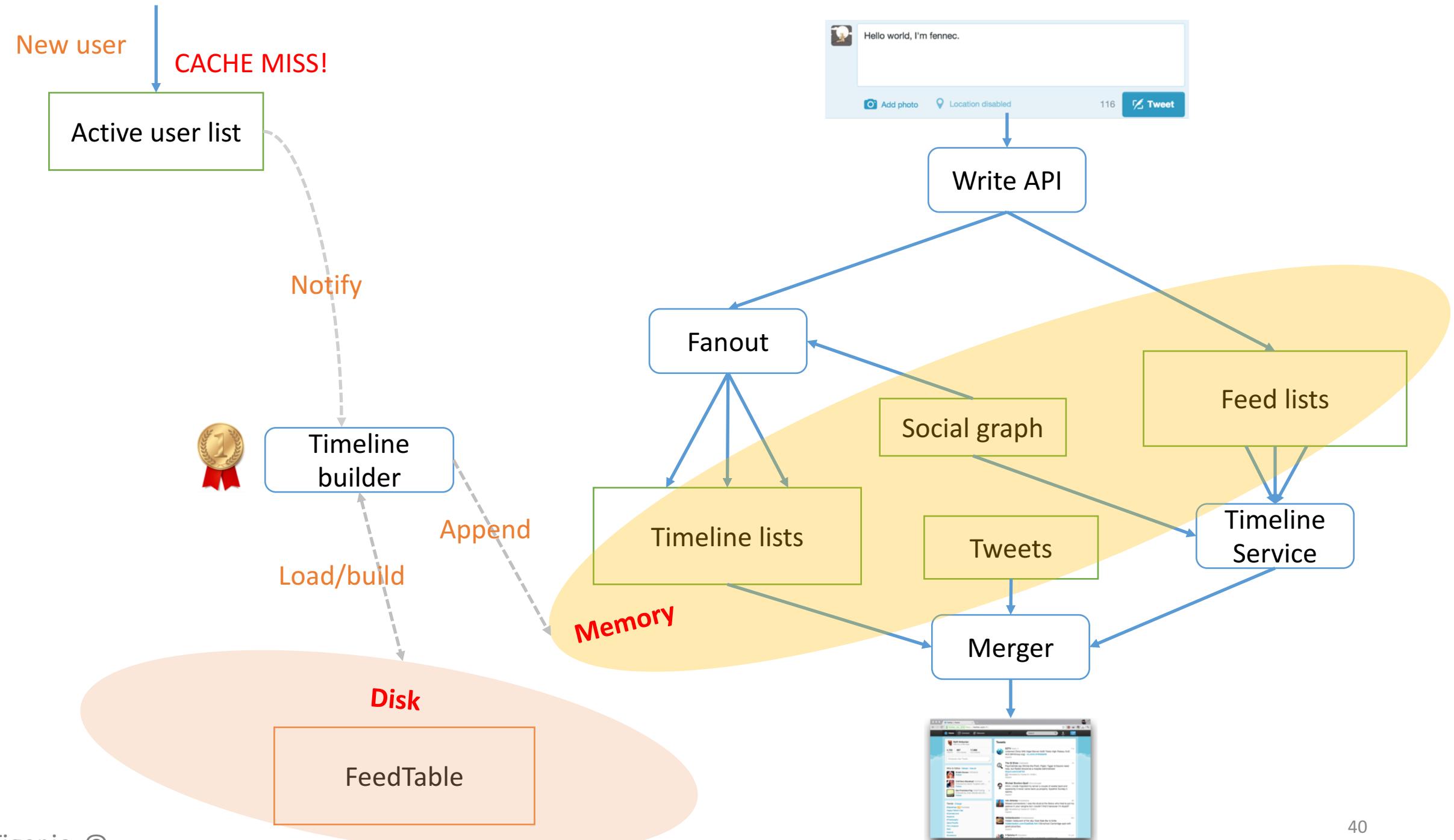
- Weekly active users: 100 million
- Average feed size: 80 tweets
- Average timeline size: 500 tweets
- Tweet size:  $20B = \text{userID}(8) + \text{tweetID}(8) + \text{indicators}(4)$
- Average followers = 20

## Memory needed

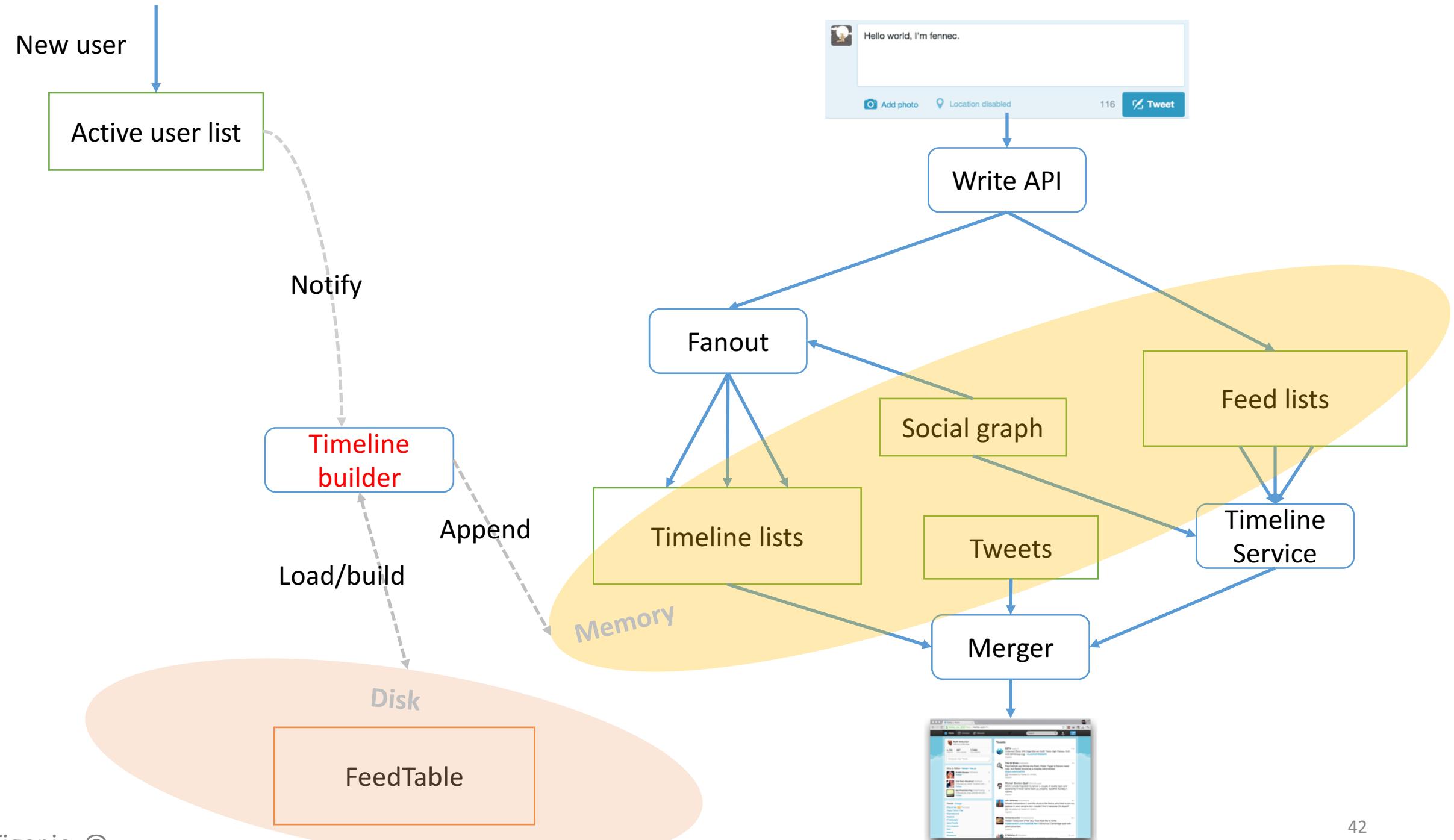
- Size of timeline lists =  $100\text{million} * 500 * 20 = 1T$
- Size of feed lists =  $100\text{million} * 80 * 20 = 160G$
- Size of social graph =  $100\text{million} * 20 * 2 * 8 = 32G$



Interviewer: How to deal with  
cache miss?



**Interviewer: What is the interface  
of timeline builder?**



# Interface



- Get( userIDList )
- Get( userIDList, k)
- Get( userIDList, k, endTime )
- Get( userIDList, k, endTime, beginTime)



Interviewer: What is the data of timeline builder?

TweetListTable



TweetID	UserID	Time	Content	State
274	22	2015-08-14 19:35:13	I Love YOU	Verify
273	54	2015-08-14 19:34:00	Eat my food	Active
272	17	2015-08-14 19:33:33	f***	Ban
271	22	2015-08-14 19:32:31	I Miss YOU	Delete
270	19	2015-08-14 19:32:05	Whooooo	Active

## TweetListTable



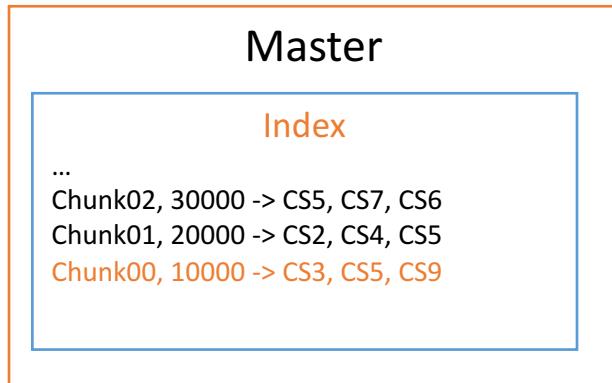
TweetID	UserID
274	22
273	54
272	17
271	22
270	19

Quiz: have you reviewed  
PPT after classes?

Interviewer: How to save the  
TweetListTable on disk?

# Save TweetListTable

- Each chunk is a 64MB of time capsule/chunk
  - Reversed TweetID to speedup lookup



CA datacenter

ChunkServer3

index

...

**Chunk00**

Chunk19

Chunk08

Chunk07

...

ChunkServer5

index

...

Chunk13

Chunk46

Chunk89

**Chunk00**

Chunk09

...

WA datacenter

ChunkServer9

index

...

Chunk34

Chunk44

**Chunk00**

Chunk22

Chunk09

...

TweetID      UserID

...	
274	2
273	54
272	17
271	22
270	19
...	
...	
...	

Interviewer: How to lookup on a  
chunk of time capsule?

Get( {2, 12, 22} ) 

Time complexity: O(n)

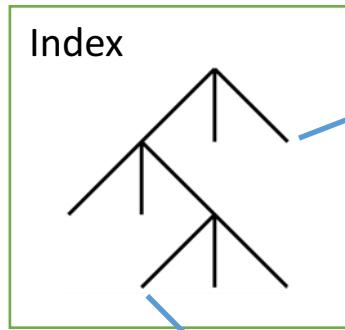
time capsule	
...	
274	2
273	54
272	17
271	22
270	19
269	22
268	33
267	22
266	19
265	5
264	2
263	7
...	

# Interviewer: How to speed up?

Speed up: Get( {2, 12, 22} )



time capsule



(22)

(2)

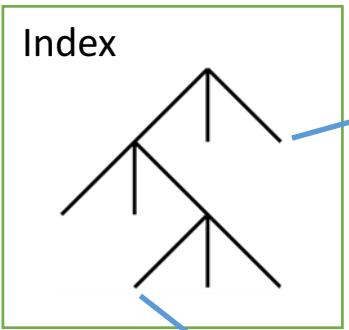
Time complexity:  $O( q * \log(n) + k )$

time capsule	
...	
273	54
...	
268	33
...	
271	22
269	22
267	22
...	
270	19
266	19
...	
272	17
...	
263	7
...	
265	5
...	
274	2
264	2
...	

# Interviewer: How to save space?

Save space: Get( {2, 12, 22} )

time capsule



(22, 3)

(2, 2)

...	
273	
...	
268	
...	
271	
269	
267	
...	
270	
266	
...	
272	
...	
263	
...	
265	
...	
274	
264	
...	

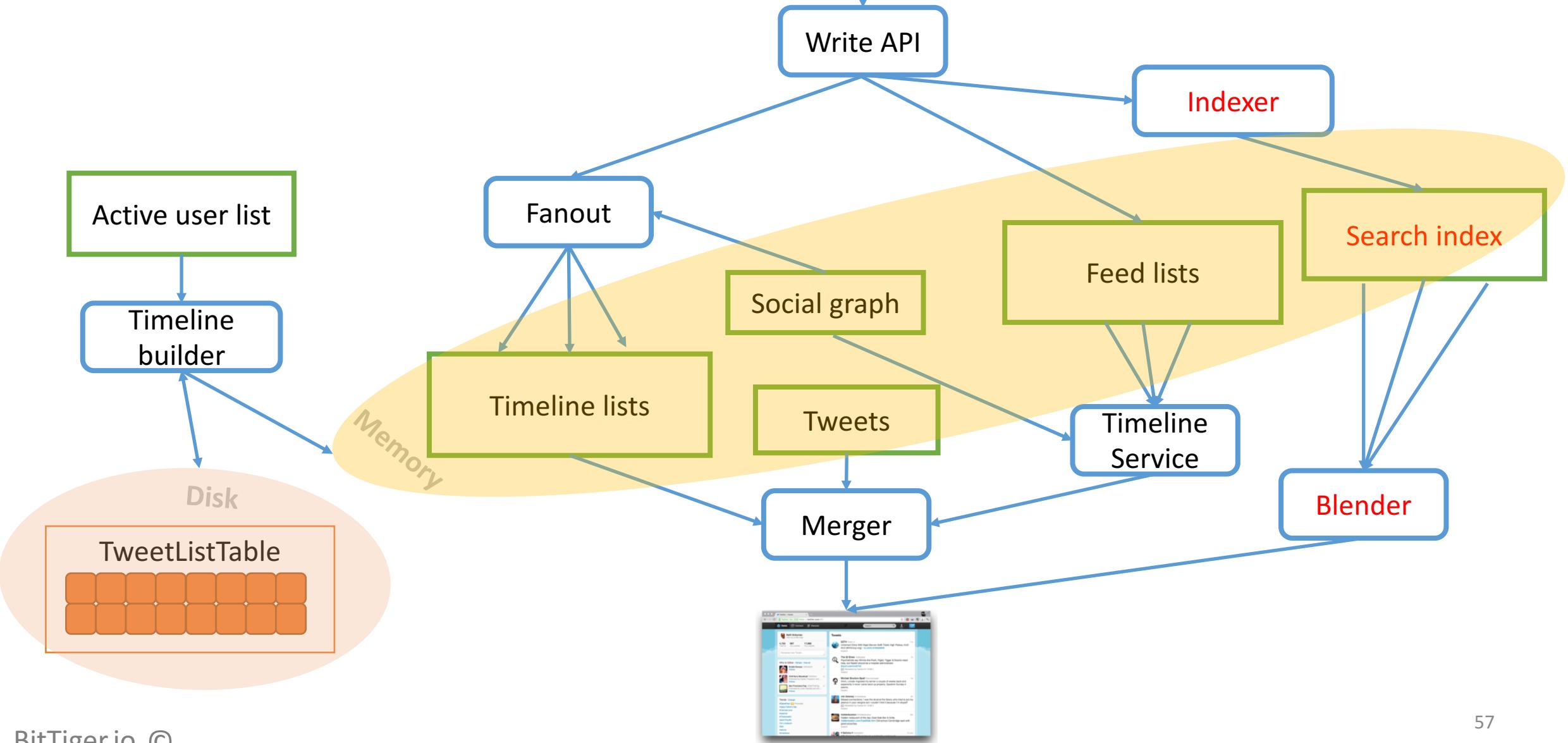


Compress

...	
273	54
...	
268	33
...	
271	22
269	22
267	22
...	
270	19
266	19
...	
272	17
...	
263	7
...	
265	5
...	
274	2
264	2
...	

# Interviewer: How to support search?

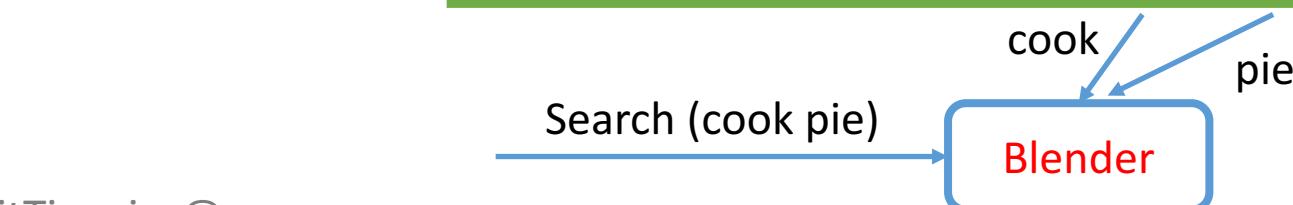
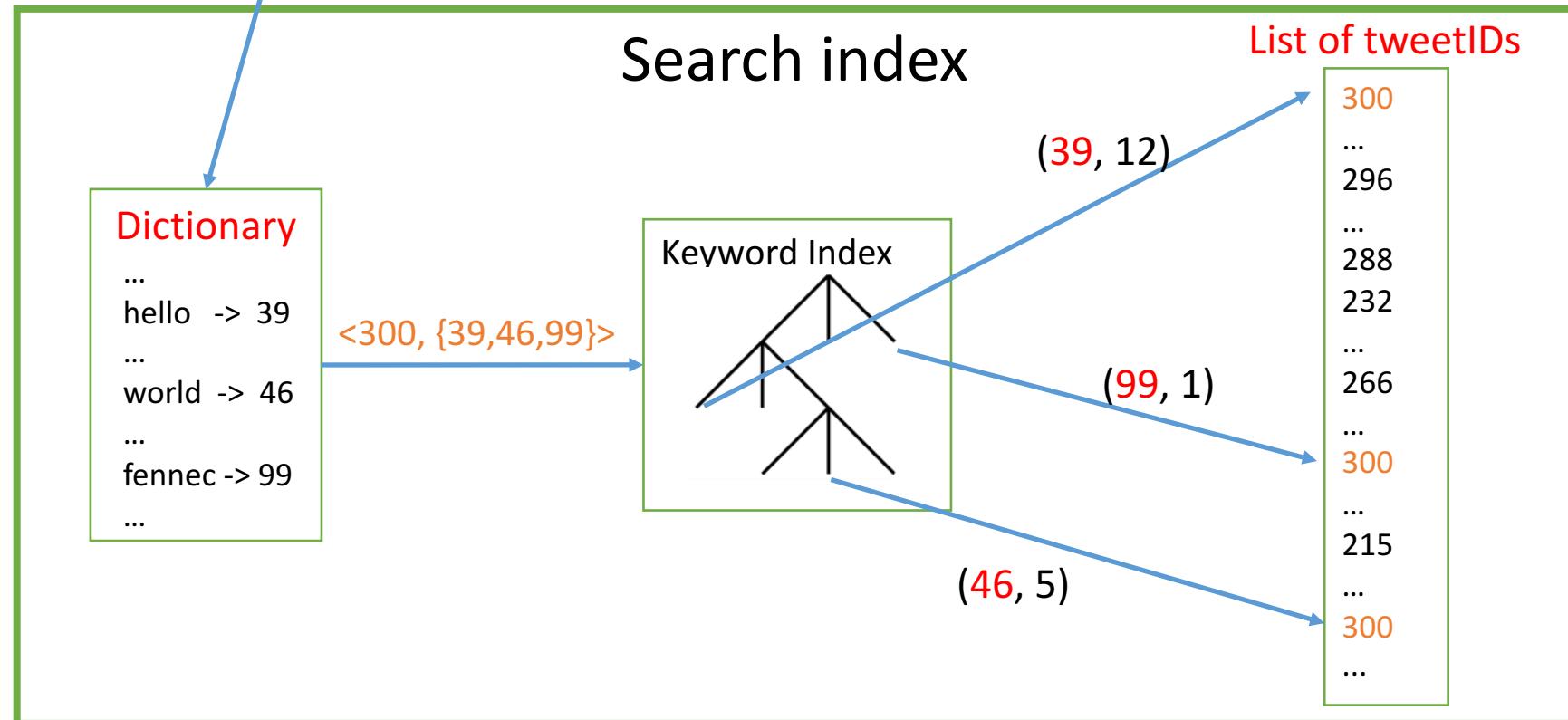
# Support search



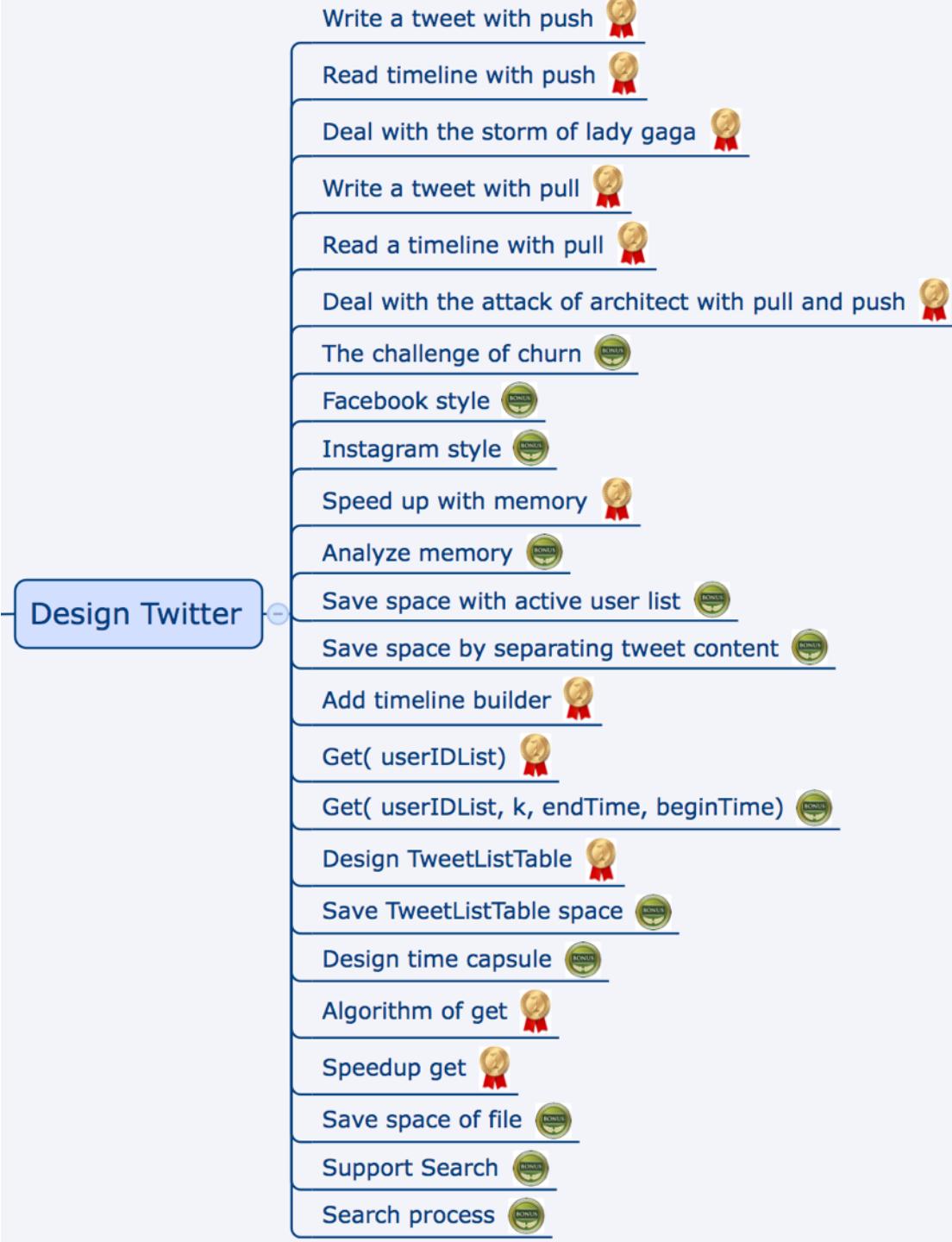
# Search process



(tweetID=300, keyword = {hello, world, fennec})



# Part1 Summary (12+12)

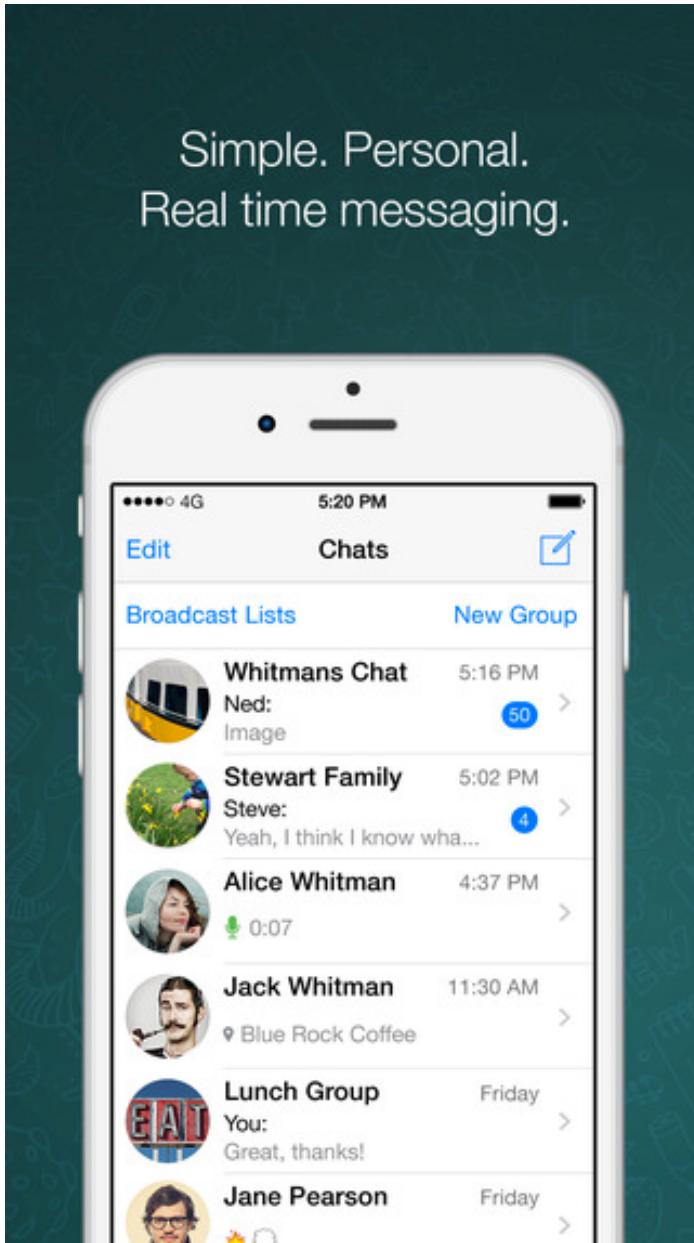




# Part 2, Chat

[Read More](#)

Expert, <http://url.cn/cNRIYQ>



# Interviewer: Design data structure

**UserTable**

uid, parameters  
uid, parameters

...

**FriendTable**

uidFrom, uidTo, state  
uidFrom, uidTo, state

...

**ChannelTable**

cid, uid, state  
cid, uid, state

...

**MessageTable**

mid, time, uid, cid, content  
mid, time, uid, cid, content

...

# Interviewer: How to choose the storage?

[Read More](#)

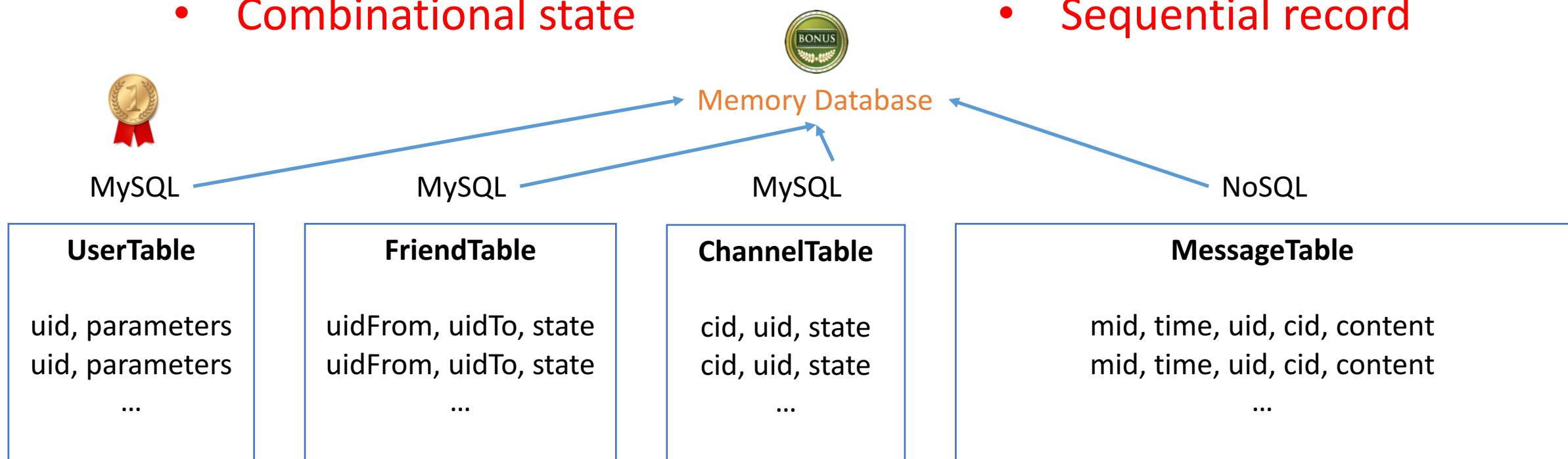
Expert/Master, <http://url.cn/Xv8Vm0>

## SQL

- Relationship
- Edit
- Correct
- Transaction
- Combinational state

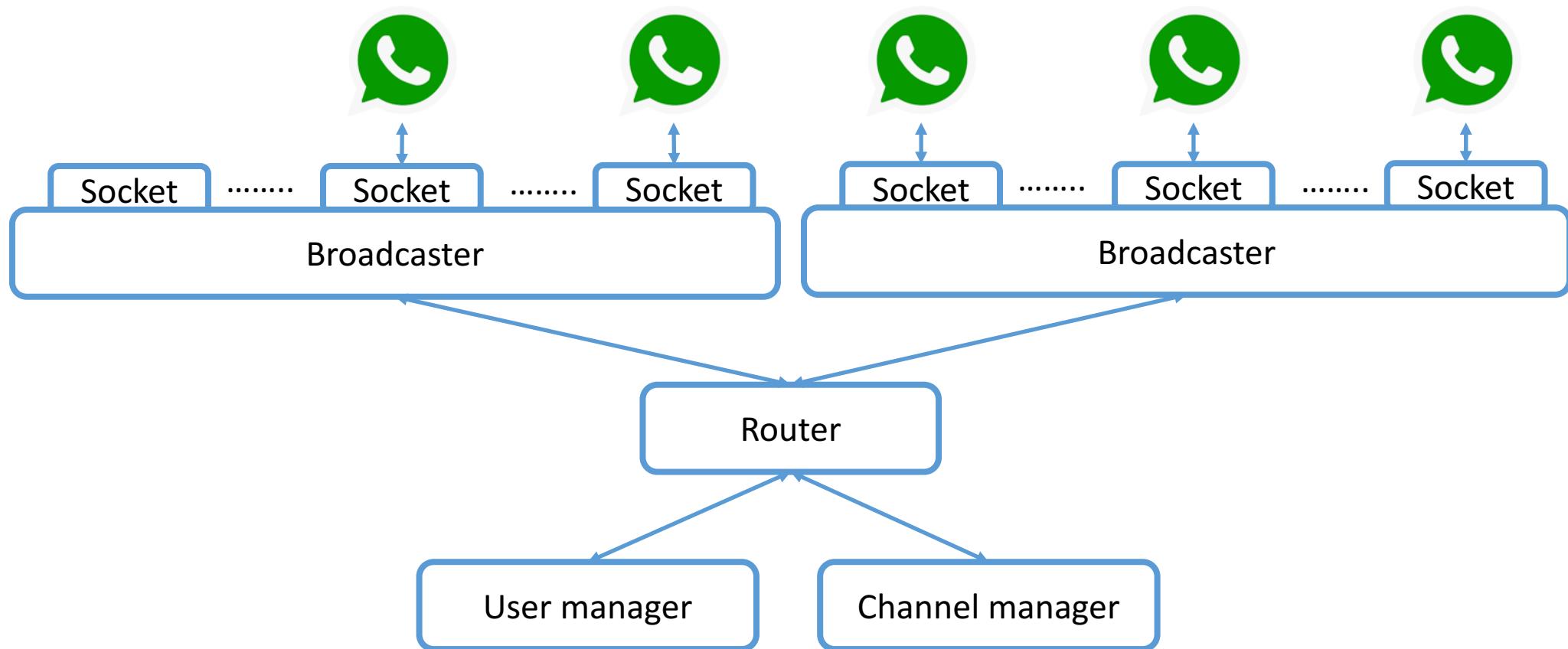
## NoSQL

- K/v pair
- Append
- Tolerant
- Performance
- Sequential record



**Interviewer: What is the architecture?**

# Chat architecture



Read More

Expert, <http://url.cn/Ny0w5S>  
Master, <http://url.cn/GyeOb7>

**Interviewer: How to support  
chat group with 1 million users?**

# Necessaries

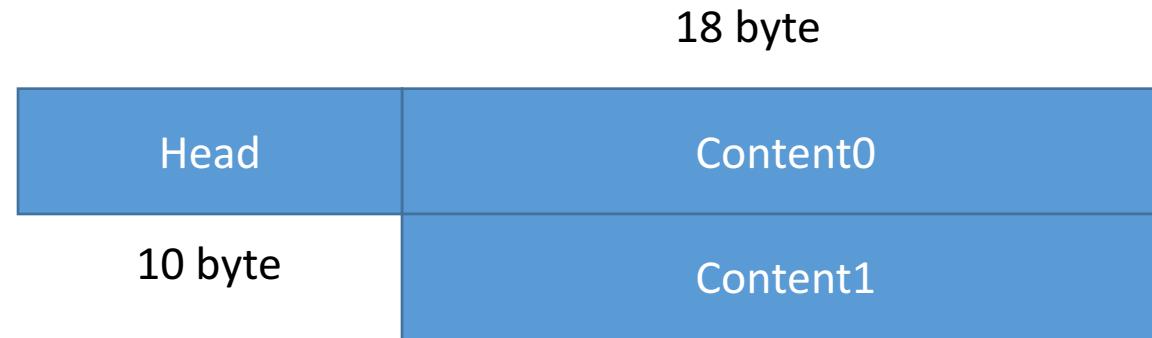


Head	Content	Tail
10 byte	18 byte	2 byte

- Assumption
  - 1 message/user/10min
  - Message = 30 Byte
- Message per second=  $10^6/600 = 1,667$
- Traffic for one=  $1,667 * 30 = 50\text{KB/s}$
- Traffic for all =  $50 * 10^6 = \text{50GB/s}$

**Interviewer: How to save the traffic?**

# Batch message



- Message per second=  $10 * 6 / 600 = 1,667$



- Traffic for one =  $1,667 * 18 = 30 \text{ KB/s}$

- Traffic for all=  $30 * 10^6 = 30\text{GB/s}$

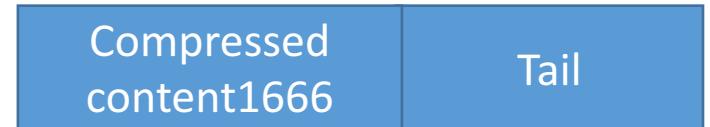
# Compress content



- Message per second=  $10 * 6 / 60 = 1,667$



- Traffic for one =  $1,667 * 9 = 15$  KB/s



- Traffic for all =  $15 * 10^6 = 15\text{GB}/s$

[Read More](#)

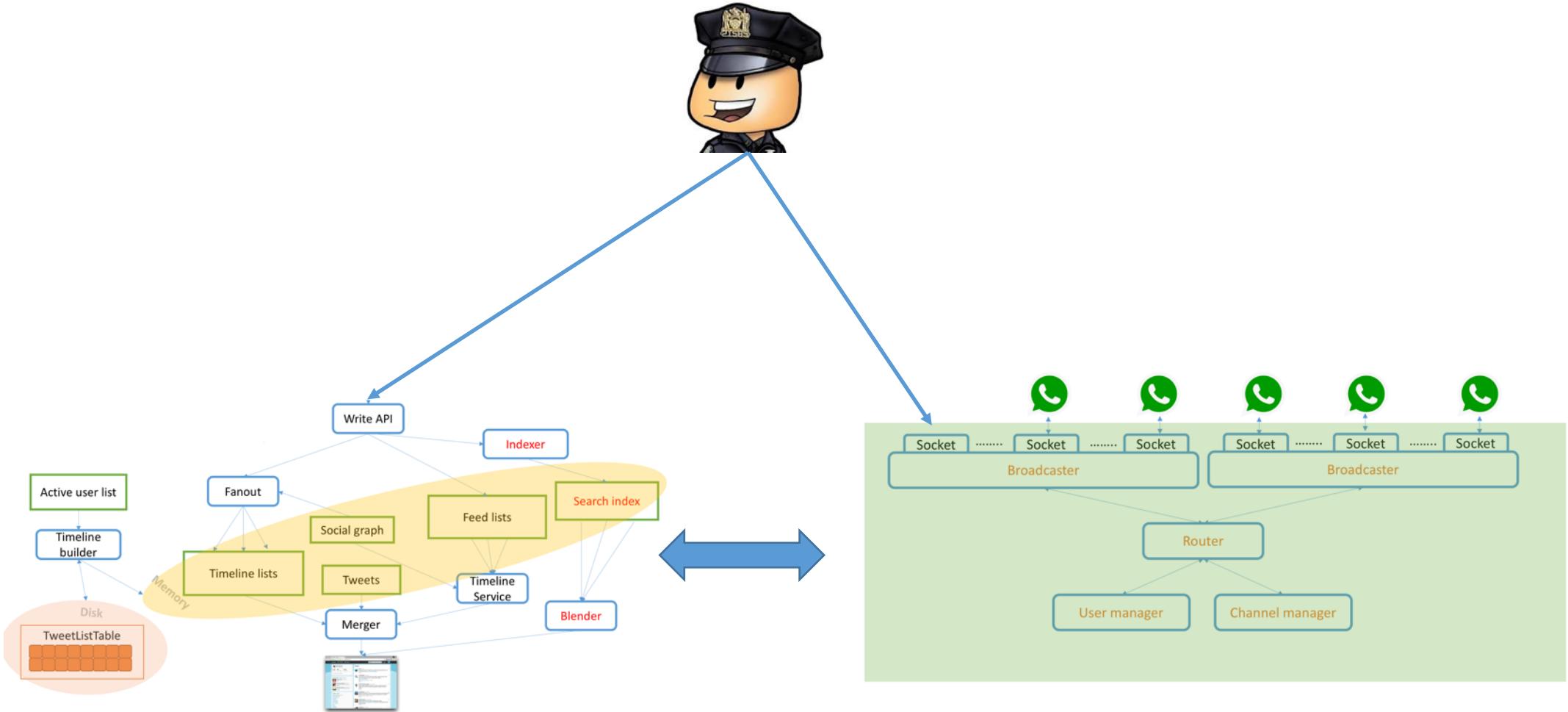
Expert, <http://url.cn/em8PuX>

Interviewer: How to save the message when a user is offline?

Interviewer: How to support  
chat history?

**Interviewer: How to support  
search on chat history?**

# Combination of architectures



**Interviewer: How to support  
timeline notification in Twitter?**

# #apple

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13 new results



**Top 10 Movies** @itmovierank · 1m

Australia 97. Nick & Norah's Infinite Playlist - Peter Sollett [tinyurl.com/poonmnk](http://tinyurl.com/poonmnk)  
#Movies #iTunes #iPhone #Apple



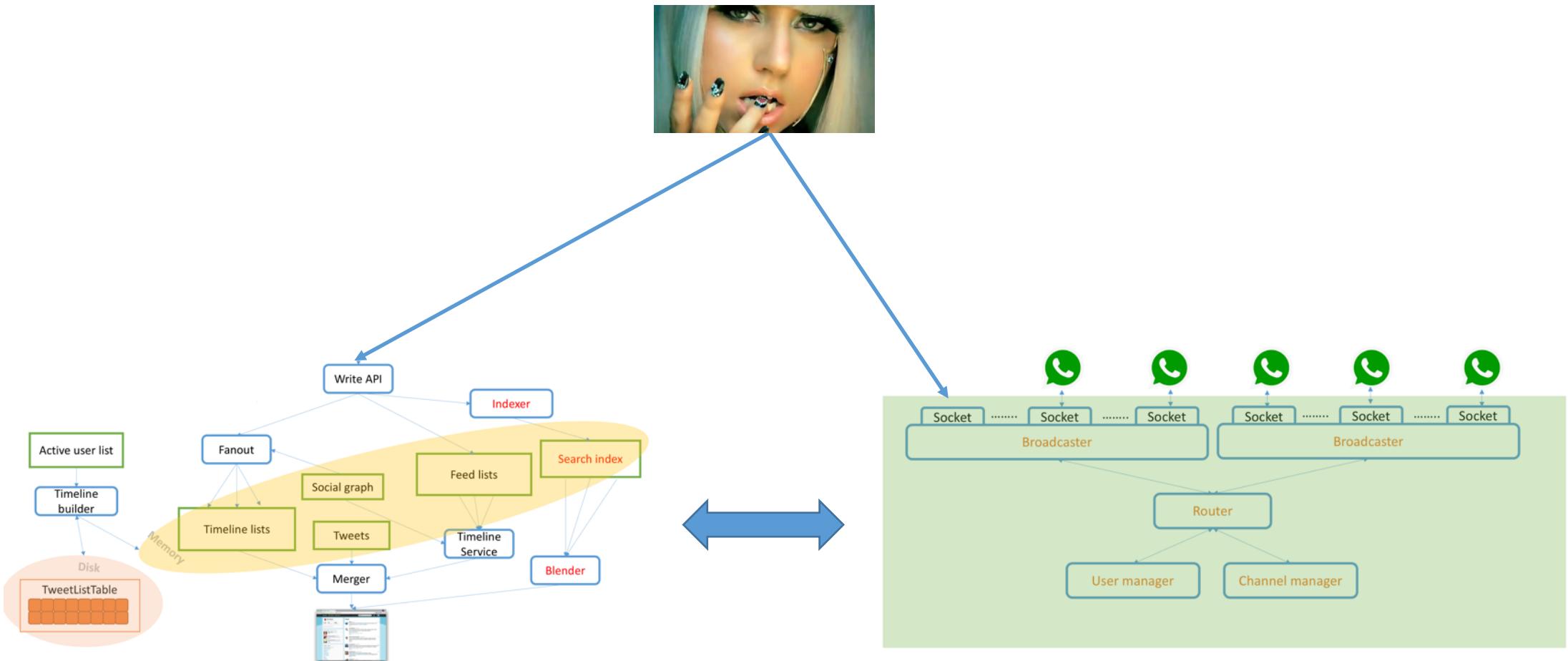
**WordPress #4h2o** @wordpress4h2o · 1m

#Mac or #PC? A Brief History of #Apple & #Microsoft's Ad War [dld.bz/d6A6r](http://dld.bz/d6A6r)



[View summary](#)

# Combination of architectures



**Interviewer: How to update  
online status of friends?**

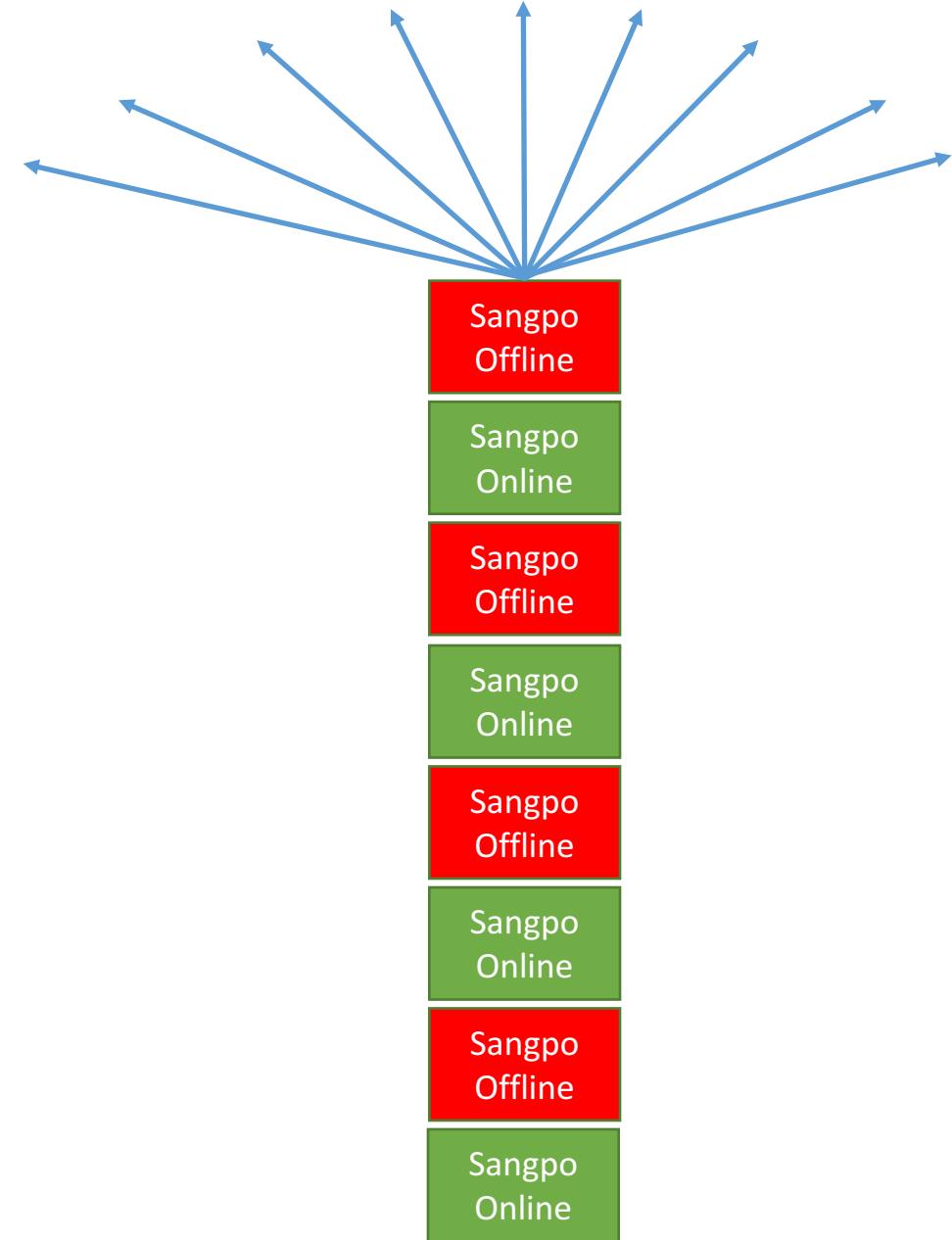
	Deepanker Verma	WEB	●
	Utsav Singh	WEB	●
	Chetan Khanna Sachinist	1h	⌚
	Anshuman Shukla	46m	⌚
	Mishra Avanish	MOBILE	●
	Rinku Mathur	WEB	●
	Varun Mishra	WEB	●
	Aamir Khan	MOBILE	●
<input type="text"/> Search <span>✖</span> <span>⟳</span> <span>▼</span>			

# Interviewer: the vacillation of status?

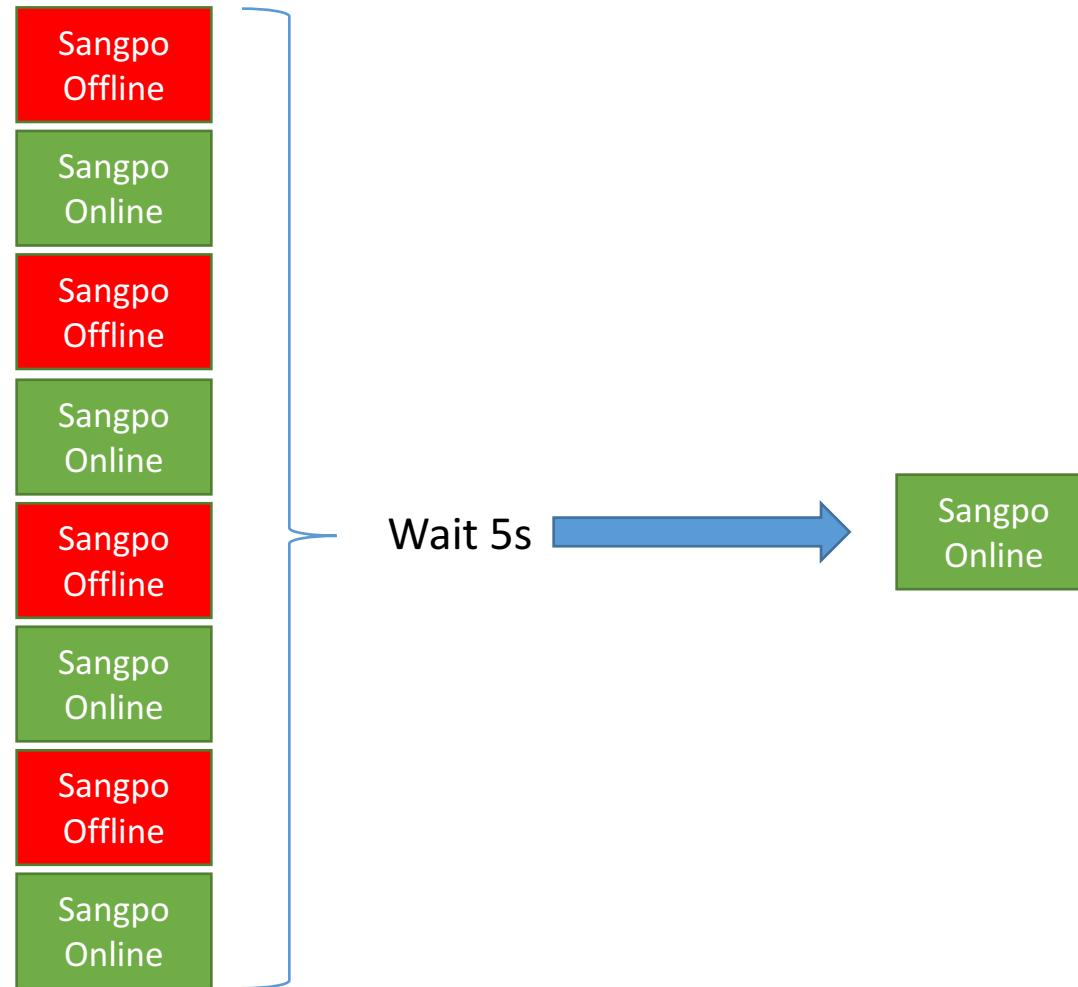
# Online



# Offline



# Delayed change of status

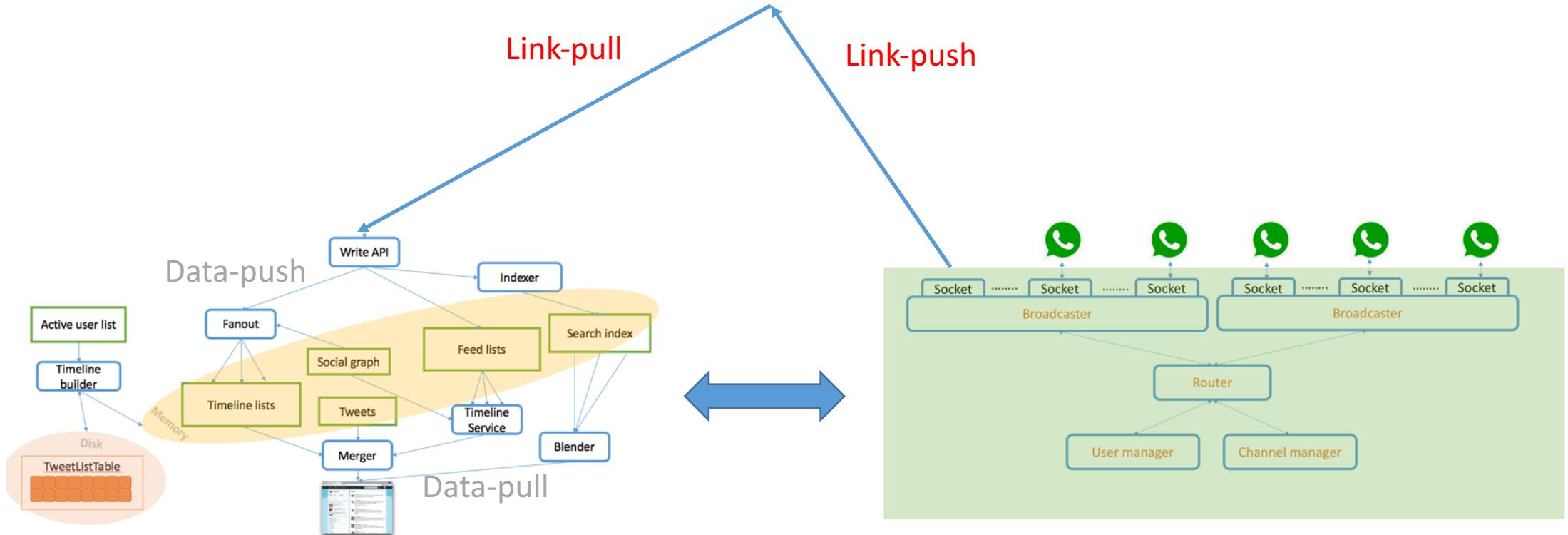


# Two kinds of push/pull



Read More

Novice/Expert/Master, <http://url.cn/PdXMO6>  
Expert, <http://url.cn/YLC49j>



Data-pull: build a user's timeline by pulling data from his followings

Data-push: build a user's timeline by pushing data from his followings

Link-pull: a user pulls the notification from the user every k seconds

Link-push: the server pushes the notification to the user with WebSocket as soon as it appears

# Interviewer: How to choose between pull and push?

## Link-push



- Fast
- Waste for users seldom check
- Need more connections

## Link-pull

- Delayed
- Waste for users with less news
- Need more bandwidth



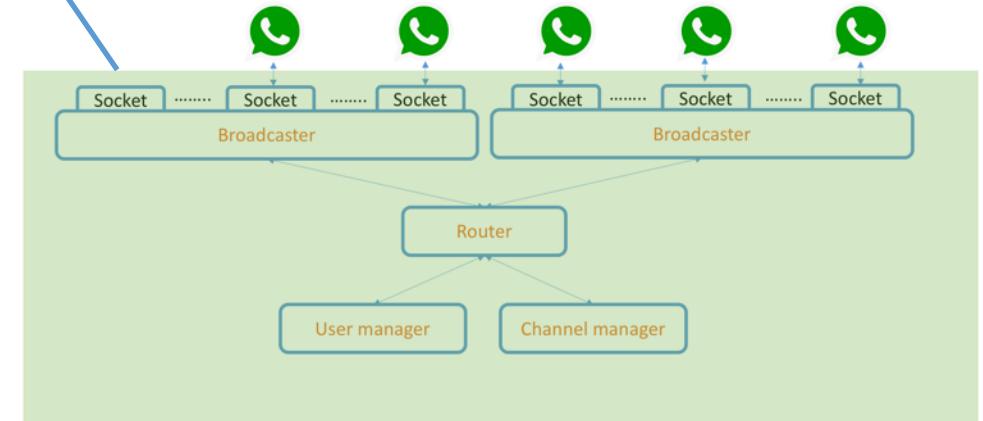
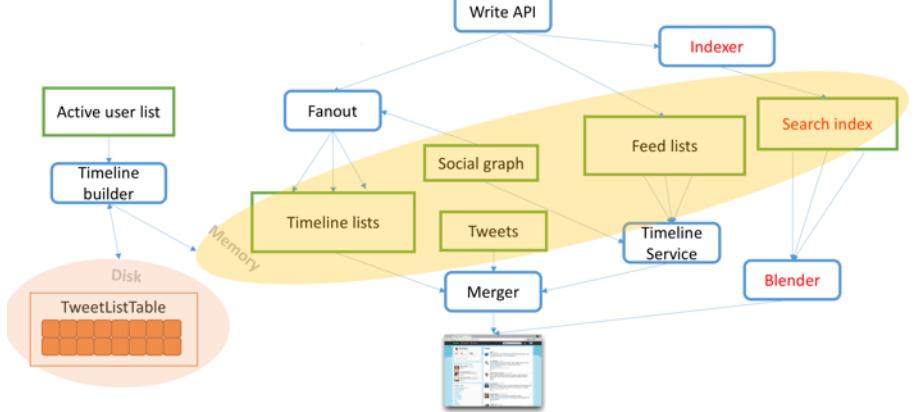
Interviewer: How to combine  
pull and push?

# Combine link push/pull

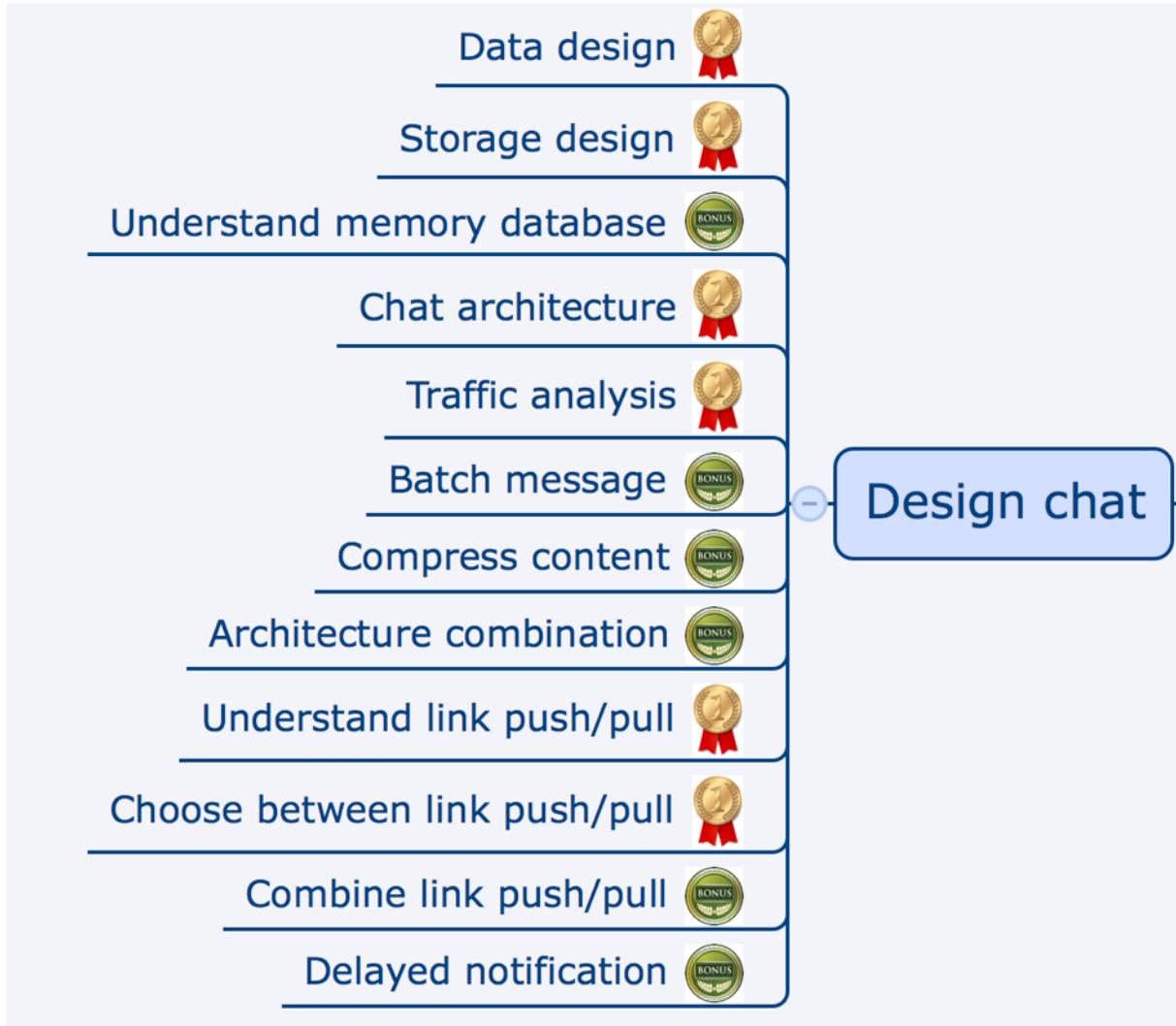


1. Push number of notifications

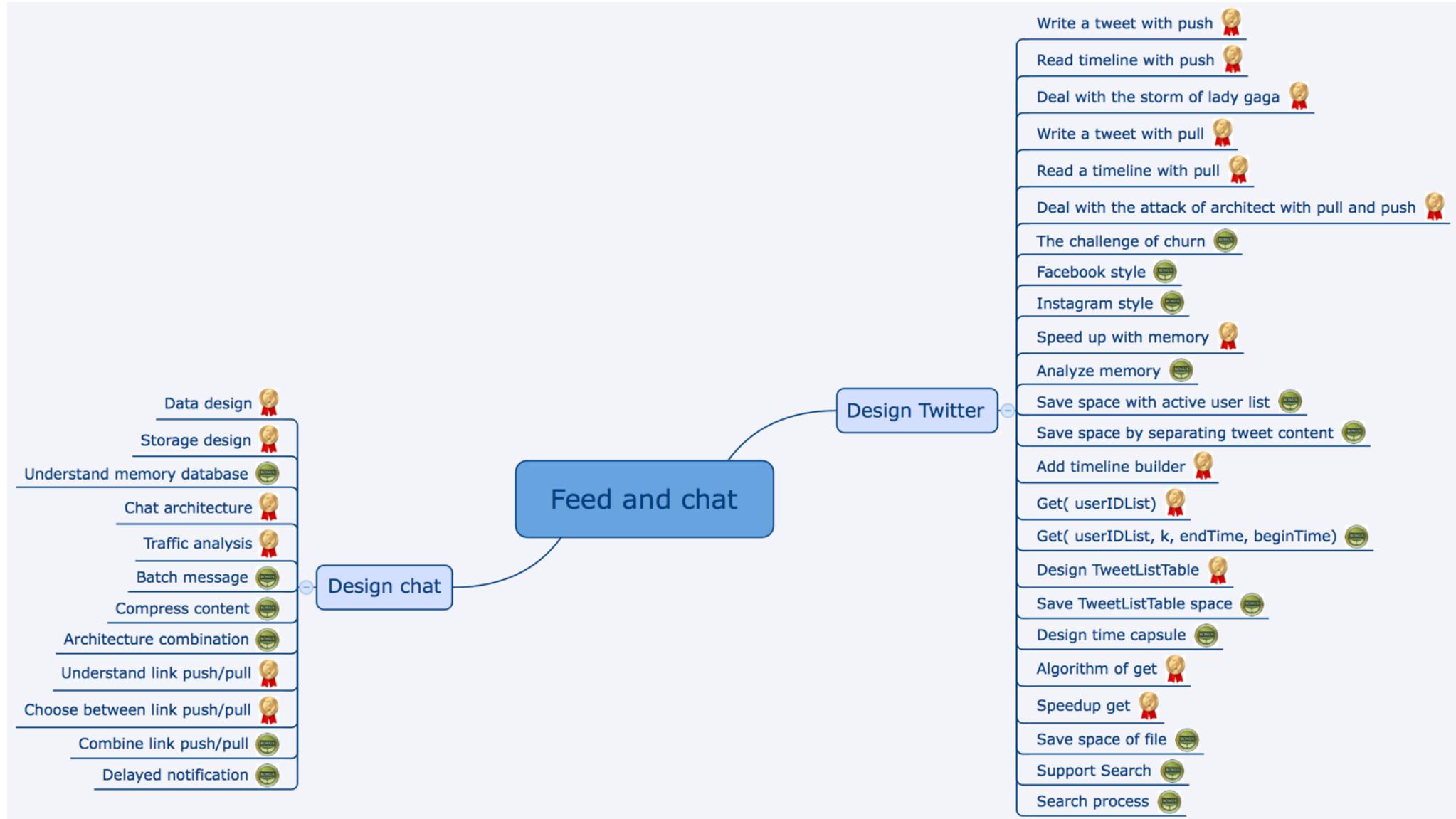
2. Pull details of notifications



# Part2 Summary (6+6)



# Summary of Class



# Keyword

- Feed
- Pull
- Push
- Search
- Chat
- SQL
- NoSQL
- Memory database
- Broadcast
- Batch
- Compression
- Delay



# Change

Kunga Lodro

Change is upon us  
Confusion on its tail  
Seeing this is what we practice for

Fertile ground for new beginnings  
A luminous vast array of possibilities  
Yet still we cling to the past

So drink from the bittersweet cup  
And share in this feast among friends  
There is no outlet but the present