

SYSTEM DESIGN - CASE STUDY

FB Messenger

Requirements

- (1) 1:1 messages only - ✓ (V0)
- (2) V0 → message to friends OK
→ fof - ✓ (V1)
- (3) Chat / Email → Chat Realtime
 - (3.1) Notifications (Push notifications, in-app notifications) ✓ (V1)
- (4) Images/video/file attachment
 - (V0) we don't X
 - Emojis; GIFs → (V0) X
- (5) Read receipt/delivered receipt
 - (V0) X → (V1) ✓
- (6) History of chat → ✓ (V0)
- (7) Size of message → < 1000 characters
- (8) SSO
- (9) Encryption → (V0) X → (V1) ✓
 - Multi-device
- (10) Active status → (V0) X
- (11) Search messages → (V0) X / (V1) ✓
- (12) Blocking users → (V0) X / (V1) ✓
- (13) update/delete message → (V0) X / (V1)
- (14) Unicode → plaintext → (V0) X

① Requirements

② Estimation & Scale

↳ shard
↳ read vs.
write
↳ QPS (QPS)

③ Design goal

④ API design
↳ final design

(15) find message \rightarrow $\text{User} \times \text{User}$

Estimation of scale

2B - Total registered users

DAU \rightarrow 250 million

2B
↓
800M

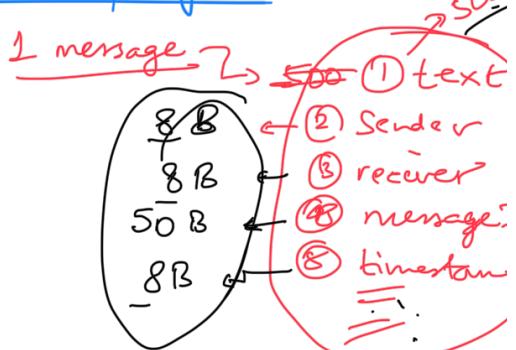
↓
250 million

40B msg

1 - 2 Billion

5 Billion msgs / day

integer \rightarrow 8 bytes
long long.



5B * 700 bytes

$= 3500 \text{ GB}$

$= 3.5 \text{ TB / day}$

$3.5 \text{ TB} * 365 * 10 = 12775 \text{ TB} = \underline{\underline{12}}$

① Sharding
Both read & write heavy

① Sharding
② write-heavy vs read-heavy

Design goal

① C vs A (Consistency)

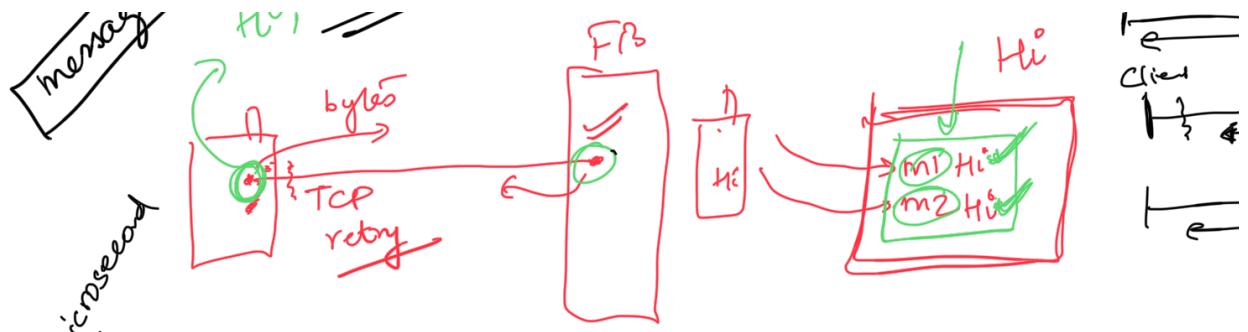
② Latency \rightarrow Realtime
low

Design

.Id

in messageId: X^2

① sendMessage(senderId, receiverId, messageId, timestamp, text)

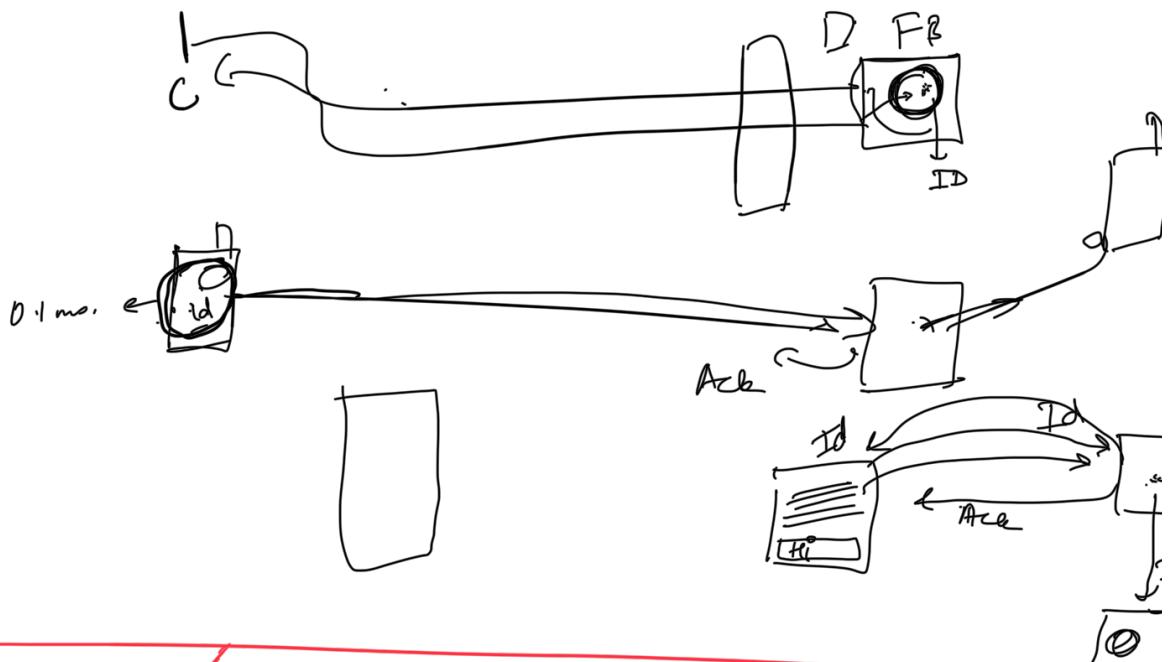
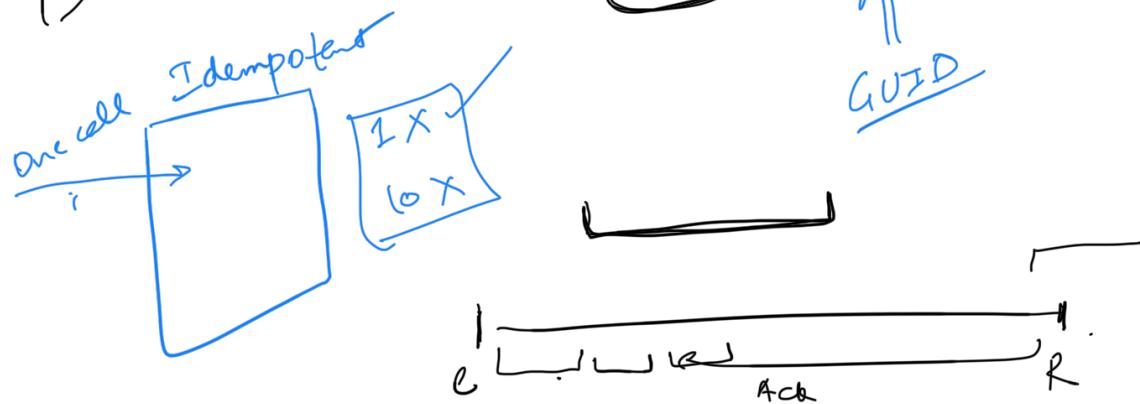


messageId → guarantee of uniqueness
 $\text{senderId} + \text{receiverId} + \text{TS}$

~~senderId # receiverId # TS # MAC~~

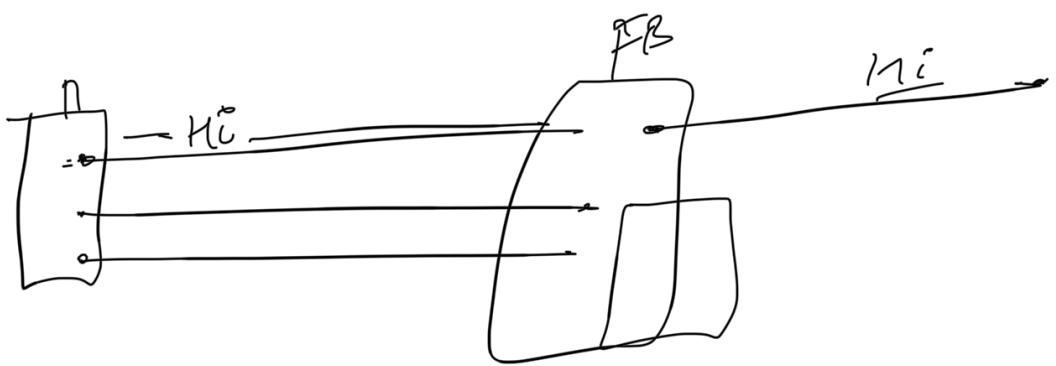
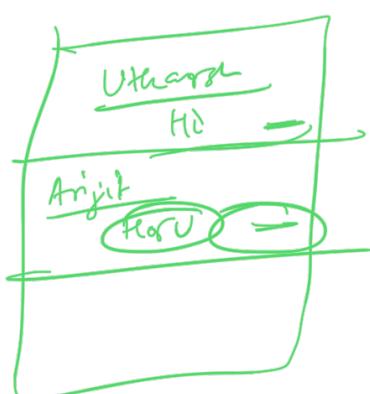
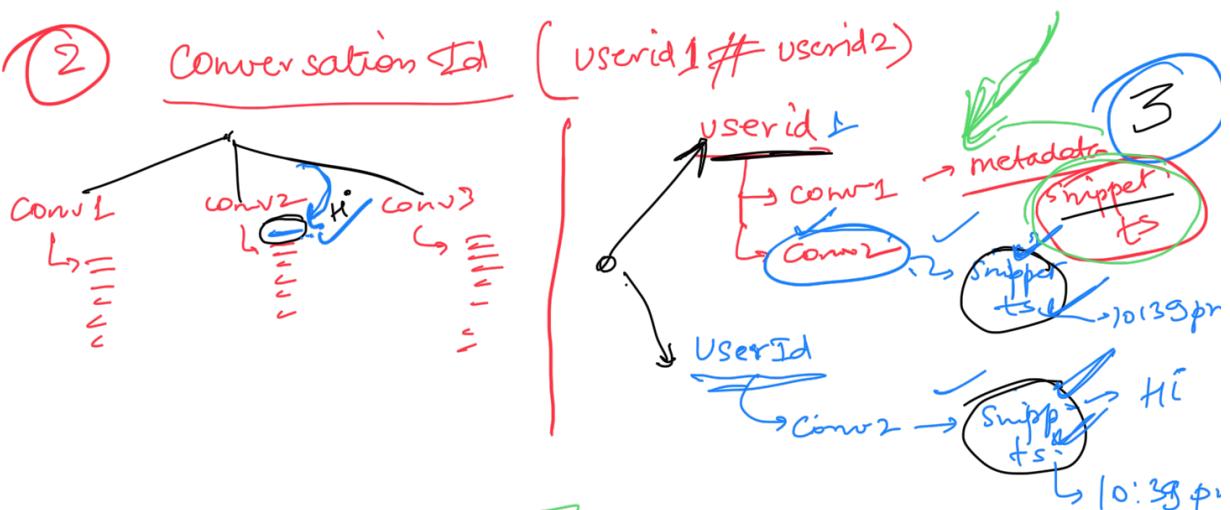
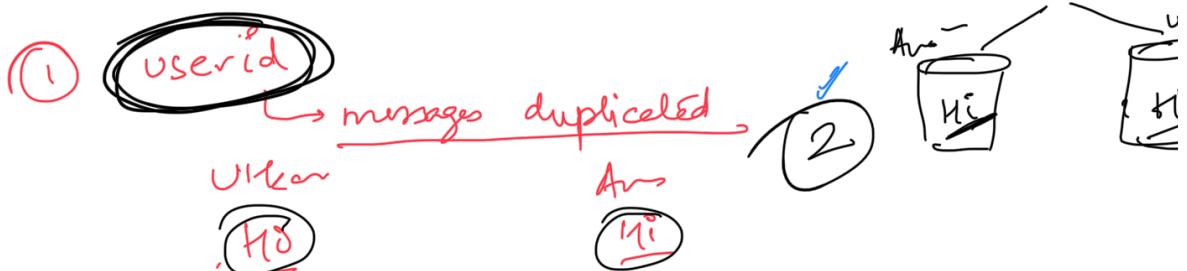
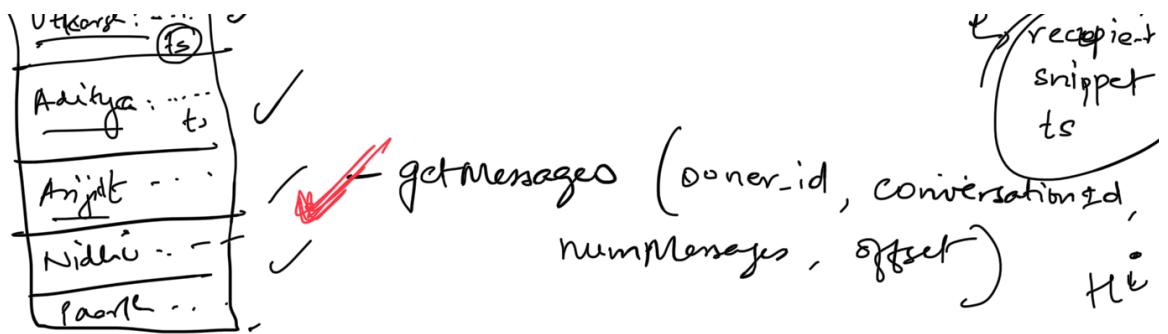
~~# random()~~

GUID

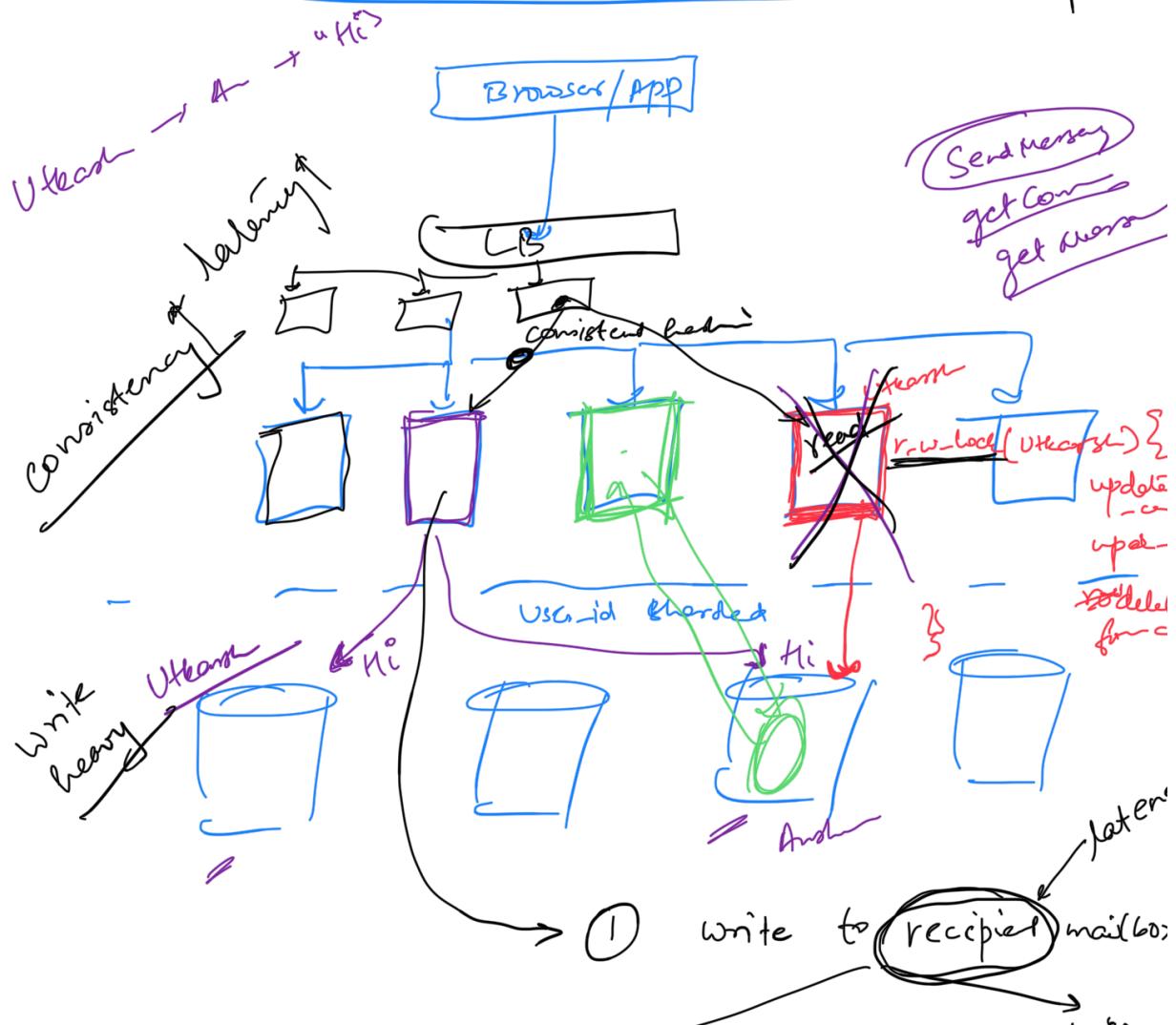
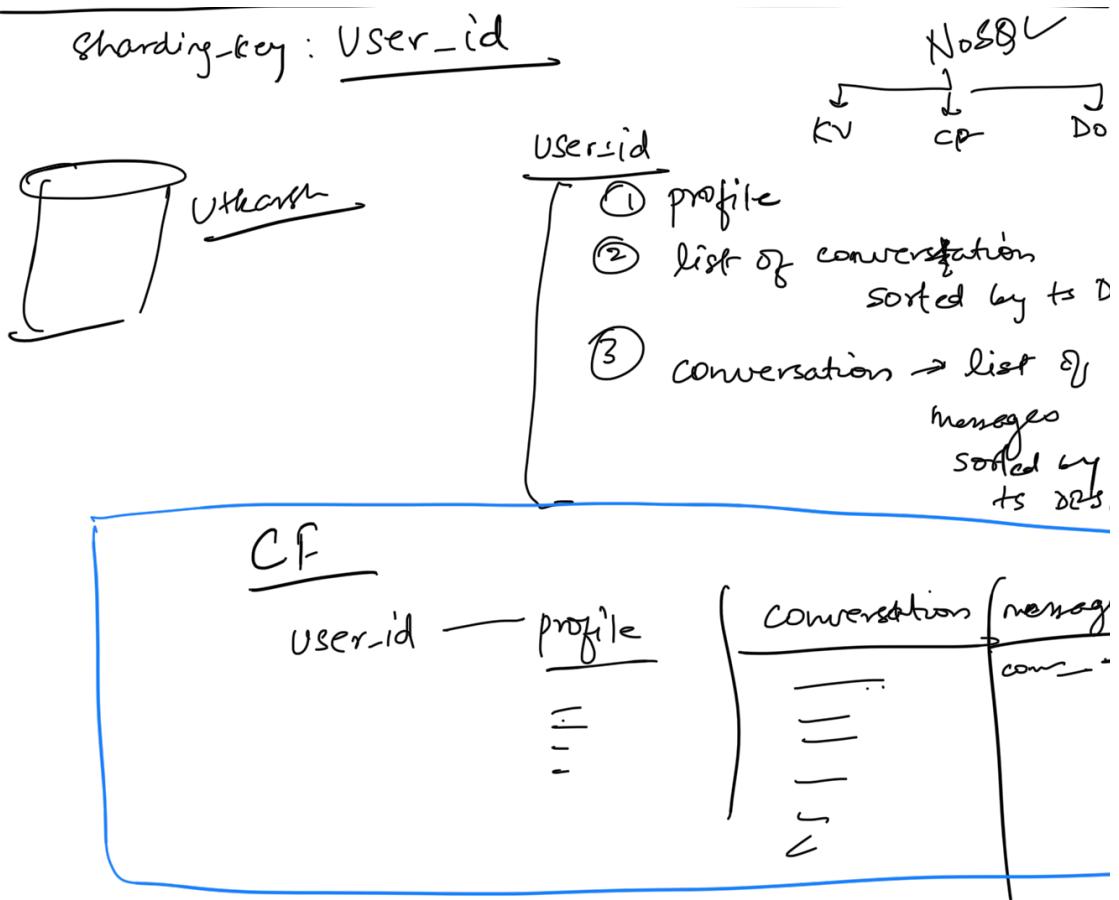


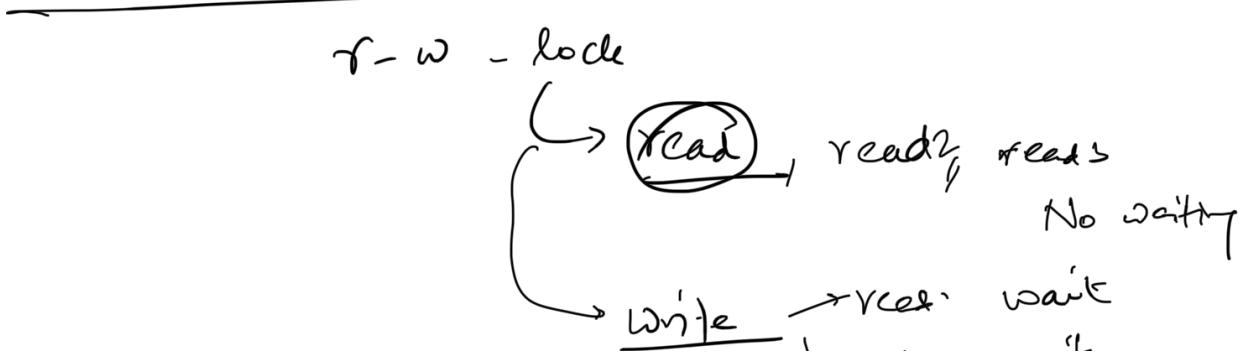
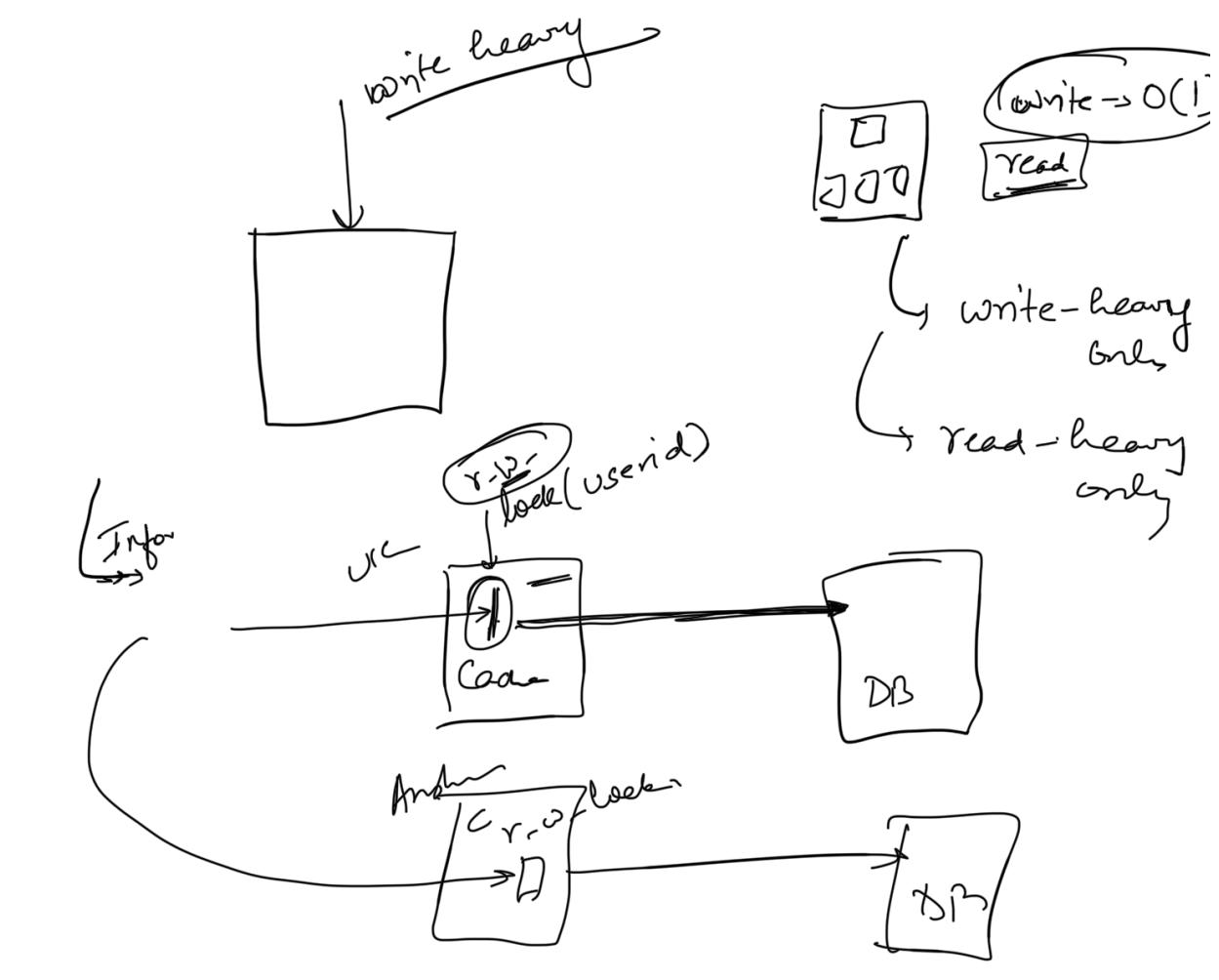
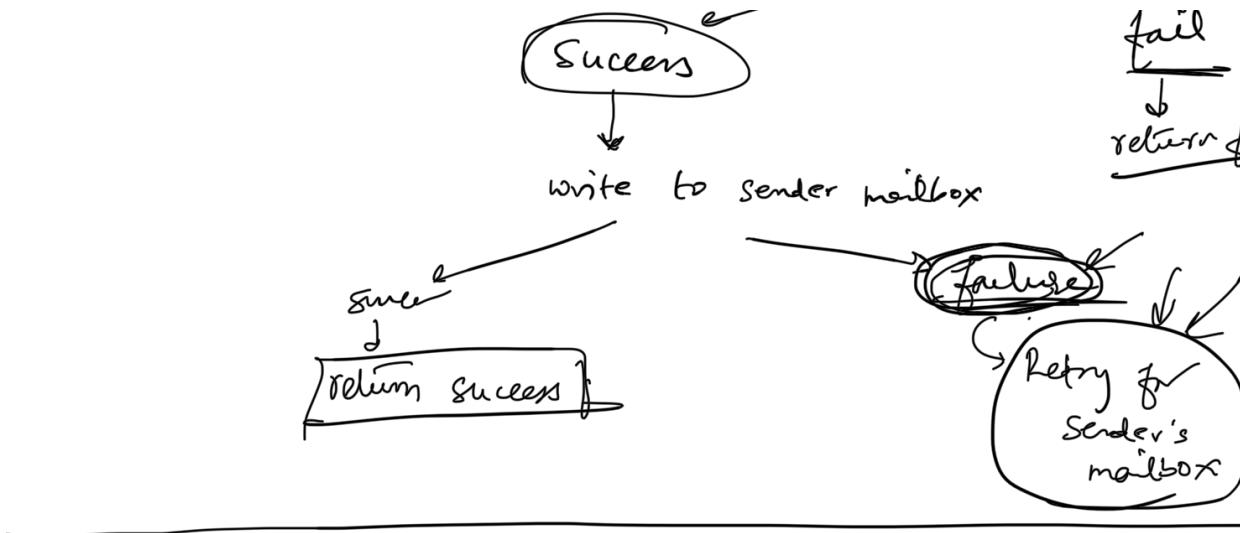
✓ - `sendMessage (sid, rid, context, msgid, clientTs)`

✗ `getConversation (ownerId, numConversations, offset, response → list<conv>)`



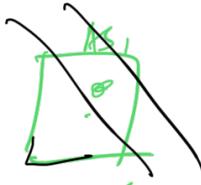
Sharding-key : User_id





→ write out

regular case ↗



Notification ✓

Optimise for mobile ✓

