System Design: Chat application - Session 3

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Agenda

- Speaker Introduction
- Why is designing a chat application interesting
- Design

Speaker Intro

Pooja Gada

Current: Engineering Leader @ 1Password

Previously: Slack, Digit, Qventus

Education: Carnegie Mellon University

Motto: *Lift as we climb*

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Who is this meetup for

- Preparing for interviews
  - Software Engineering
  - Engineering Management
  - Technical Product/Project Manager

- Build on System Design Skill set
  - Early in career
  - Expand knowledge on types of challenges
  - Learn how to build scalable systems

System Design Interview Blueprint

- **Phase 1 - Understand & Define Scope**
  - Functional / Non-Functional Requirements
- **Phase 2 - Plan & Get Buy-in**
  - Focus of time
- **Phase 3 - Deep Dive**
  - Algorithms
  - System Design / Data Flow
  - Why / What / How - with hint of trade-offs
- **Phase 4 - Summarize**

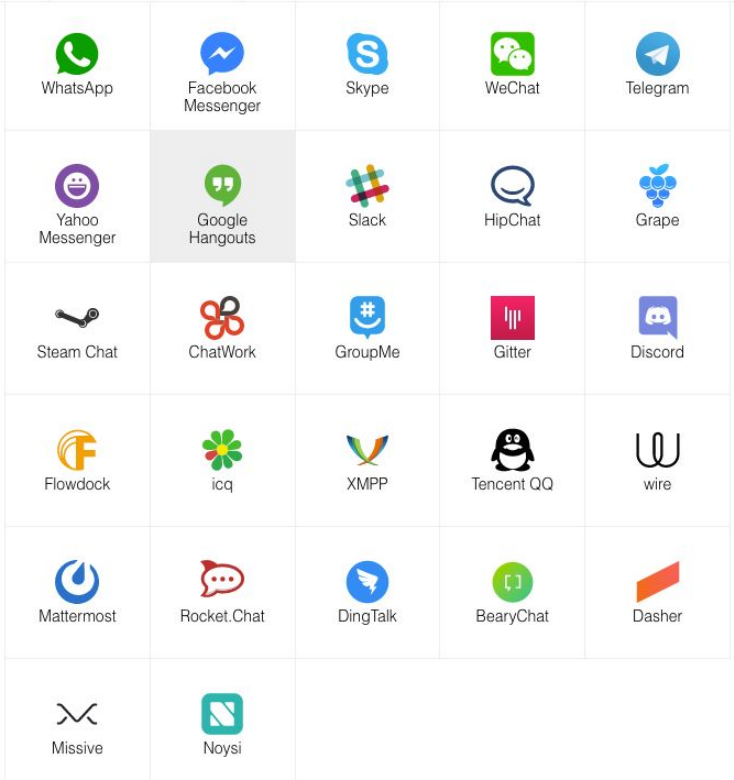
Caveats...

- Most System Design Interviews require a bit of prep
  - You have 1 hour to impress the interviewer
  - Instagram / Youtube / Meetup - wasn't build in an hour - you kinda have to....
- There is no one-perfect-solution
  - There are many ways of designing a system - Leverage your background!
- You will hear names of products - they are just for references

I want you go back to first principles...

Why did we choose this topic?

So many apps...


WhatsApp
Facebook Messenger
Skype
WeChat
Telegram
Yahoo Messenger
Google Hangouts
Slack
HipChat
Grape
Steam Chat
ChatWork
GroupMe
Gitter
Discord
Flowdock
icq
XMPP
Tencent QQ
wire
Mattermost
Rocket.Chat
DingTalk
BearyChat
Dasher
Missive
Noysi

But why...

- Everyone uses/interacts with a chat app every day
    - Most of us use more than one
- Many interesting nuances around chat app
    - Nature of interactions
    - Edge cases
    - Distinct features
    - Scale/Availability
- Most requested topic from previous sessions...

Let’s Build Something!

Design a chat application

Stop before you jump into problem solving...

- Make sure you really understand what the interviewer wants you to solve...
- What is the interviewer interested to learn from you...
- Let's look up our blueprint...

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Phase 1 - Understand & Define scope

What is the feature subset of the application? Does it allow 1x1 / group interactions?

Yes 1x1 and group interactions

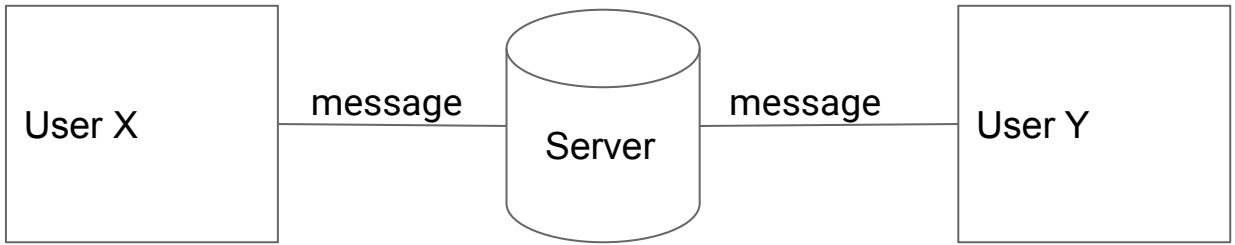
Scale of the system?

1 million users

Any other features? Last seen?

We can ignore for now. But may be in future if time permits.

First principles



- User X <> User Y are able to send messages to each other
- Server is relaying the messages, when messages are available

- But HTTP is client-initiated - how does user Y get new messages?
    - Let’s learn some techniques…

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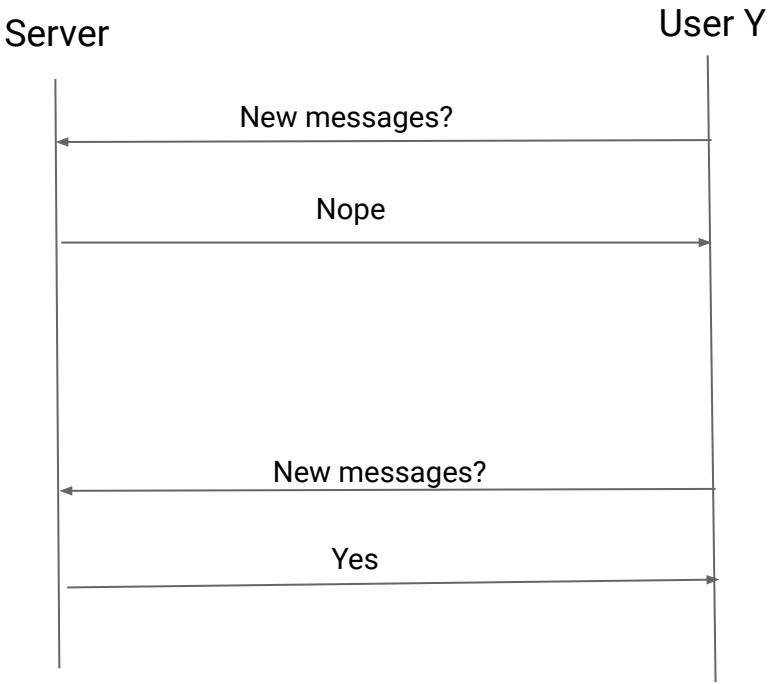
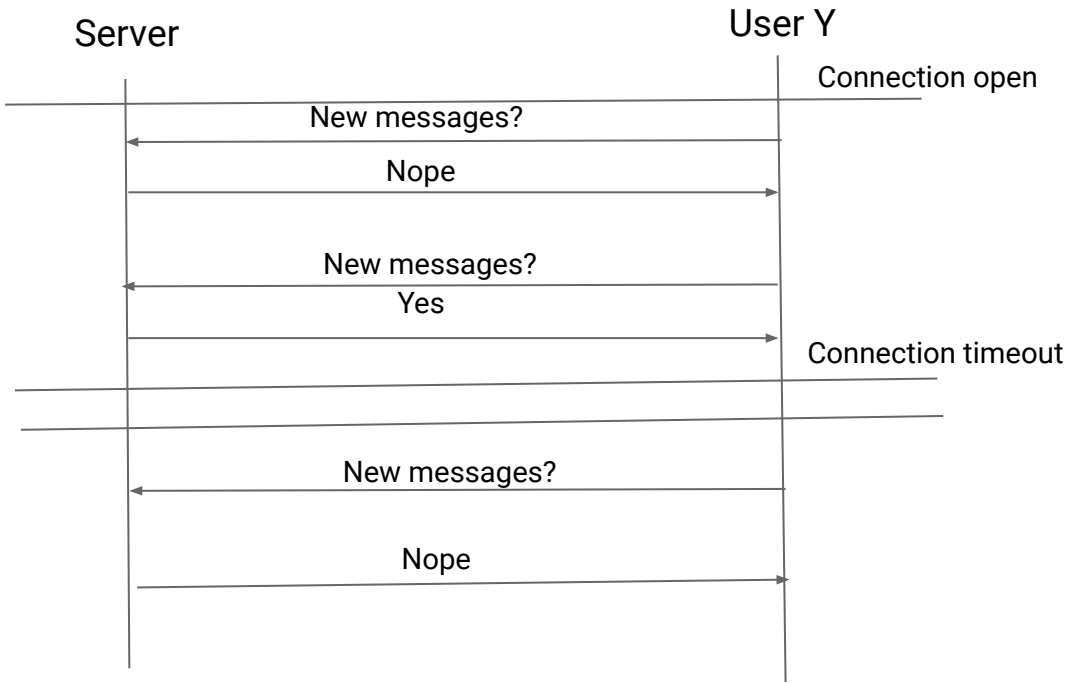
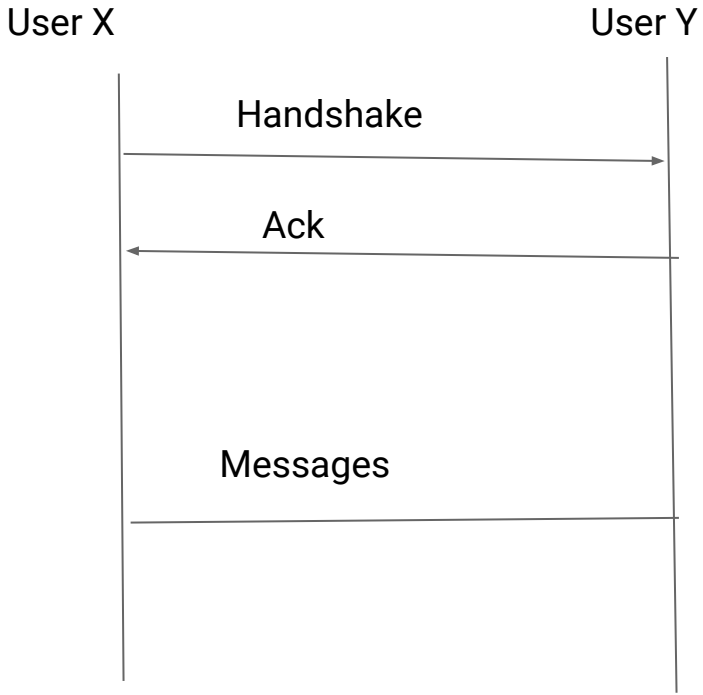
Polling



Long Polling



Websocket



Data Model

How do we store all this data?

User Models

Table: user

field	field_type
id	integer
first_name	varchar
last_name	varchar

Table: user_profile

field	field_type
id	integer
user_id	<FK user>
email	varchar
phone	varchar
address	varchar

Group Model

Table: group

field	field_type
id	integer
name	varchar
type	enum

- Type determines if its 1x1 or group/channel
- For 1x1 - name will be empty or something a system can set

Group Membership Model

Table: group_membership

field	field_type
id	integer
user_id	<FK user>
group_id	<FK user>

Message Model

Table: message

field	filed_type
id	integer
group_id	<FK group>
sender_id	<FK user>
message_txt	text
ts	datetime

Let’s put it to action

What’s a database without data

1x1 Messaging: User X <> User Y

Table: user

id	first_name	last_name
1	User X	X
2	User Y	Y

Table: group

id	name	type
12	n/a	DM

Table: group_membership

id	user_id	group_id
123	1	12
123	2	12

Table: message

id	group_id	sender_id	message_txt	ts
1234	12	1	hello	2023-5-4 09:00
1235	12	2	Hi there	2023-5-4 09:01
1235	12	1	Have a question..	2023-5-4 09:03

Scope Change

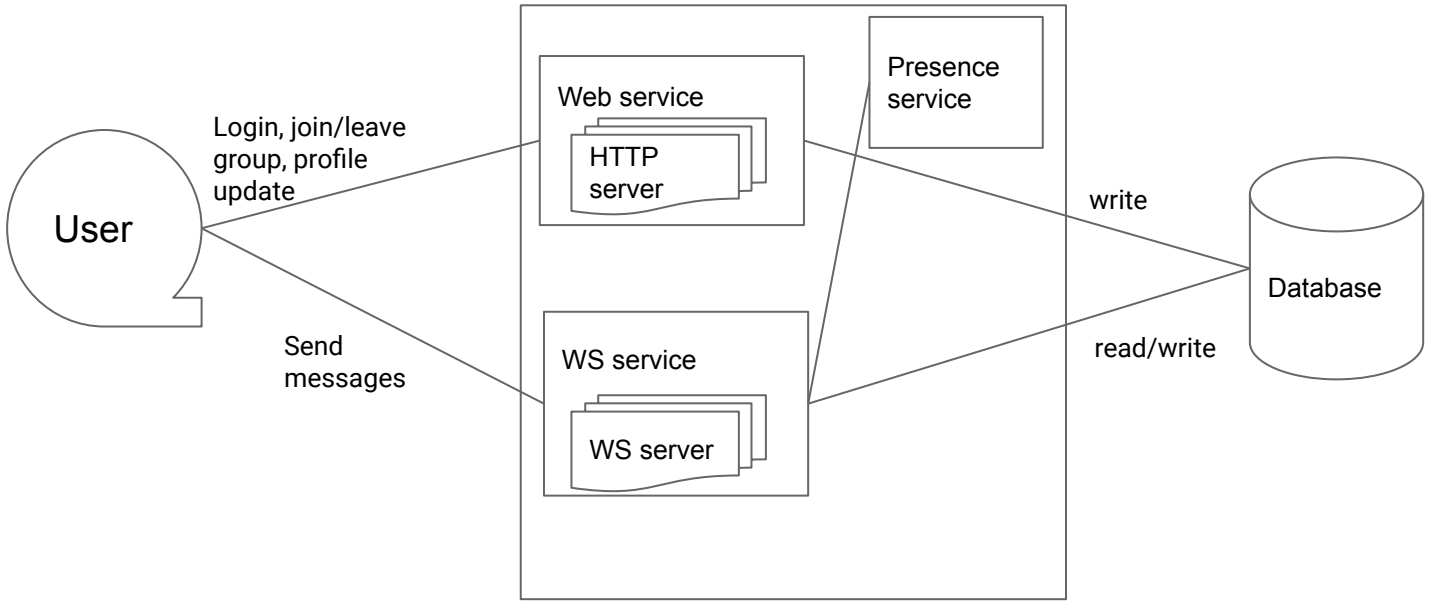
- How will you adapt your data model to track
  - If a message was seen by a user
- Allow only specific users to update group membership
- Allow images in messages
- Allow videos in messages
- And so on….
- Interviewer may further probe in any of the above directions…

Data model – last seen

field	field_type	
id		
message_id	<FK message>	
user_id	<FK user>	
last_seen_ts	datetime	

Select * from last_seen where message_id=1;

High Level System Design



Other potential questions/follow-up

- How would you introduce push notifications
- How will multiple devices be supported
- What type of database would be used
    - MySQL?
    - No-SQL?

References

- System Design Interview Volume 1 & 2
  - Alex Xu & Sahn Lam
- Educative.io
- Tryexponent

What would you like to see in the next session?

Upcoming sessions:

- News Feed System
- Nearby
- Payment system

What else would you like to learn?