

the essence of software

Daniel Jackson, MIT CSAIL · SDCCon 2024 · July 4, 2024

the challenge: software is

usable, but overcomplicated & burdensome

scalable, but insecure & unsafe

intelligent, but unpredictable & unreliable

the solution: go back to basics

functionality: what should software do?

modularity: how is it structured?

mental models: how do we think about it?

what does
success look like?
3 stories

story #1:
iPod (2001)

what was novel about the iPod?



Apple iPod
(2001)

a new industrial design?



Apple iPod
(Jony Ive, 2001)



Braun Pocket Radio T3
(Dieter Rams, 1958)

a technology breakthrough?



iPod 5GB drive
(Toshiba, 2001)

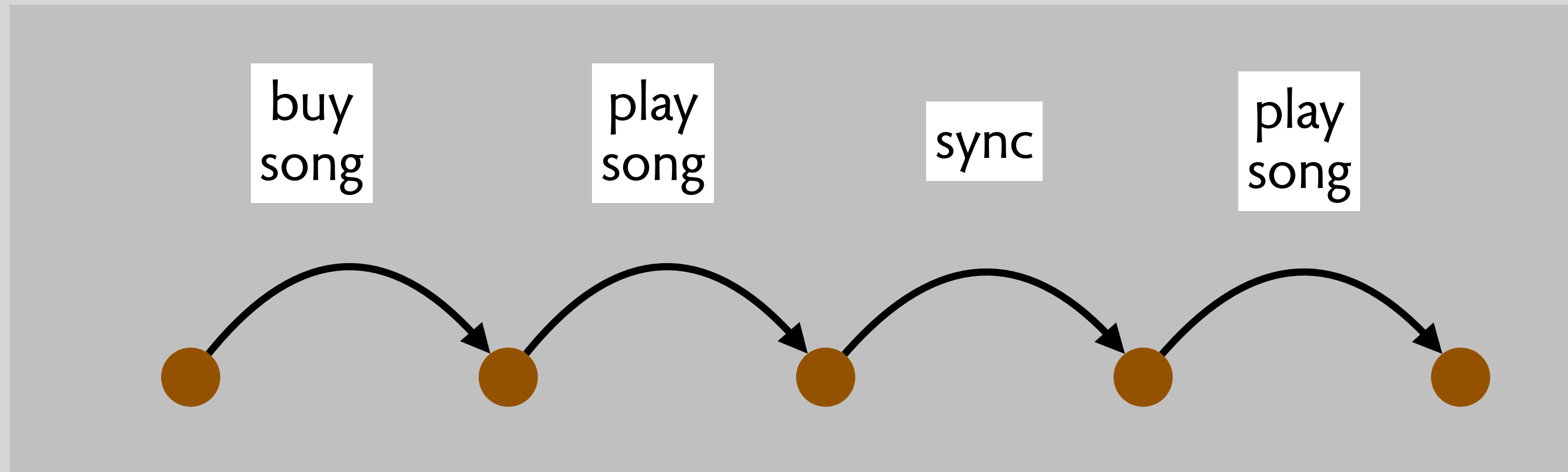
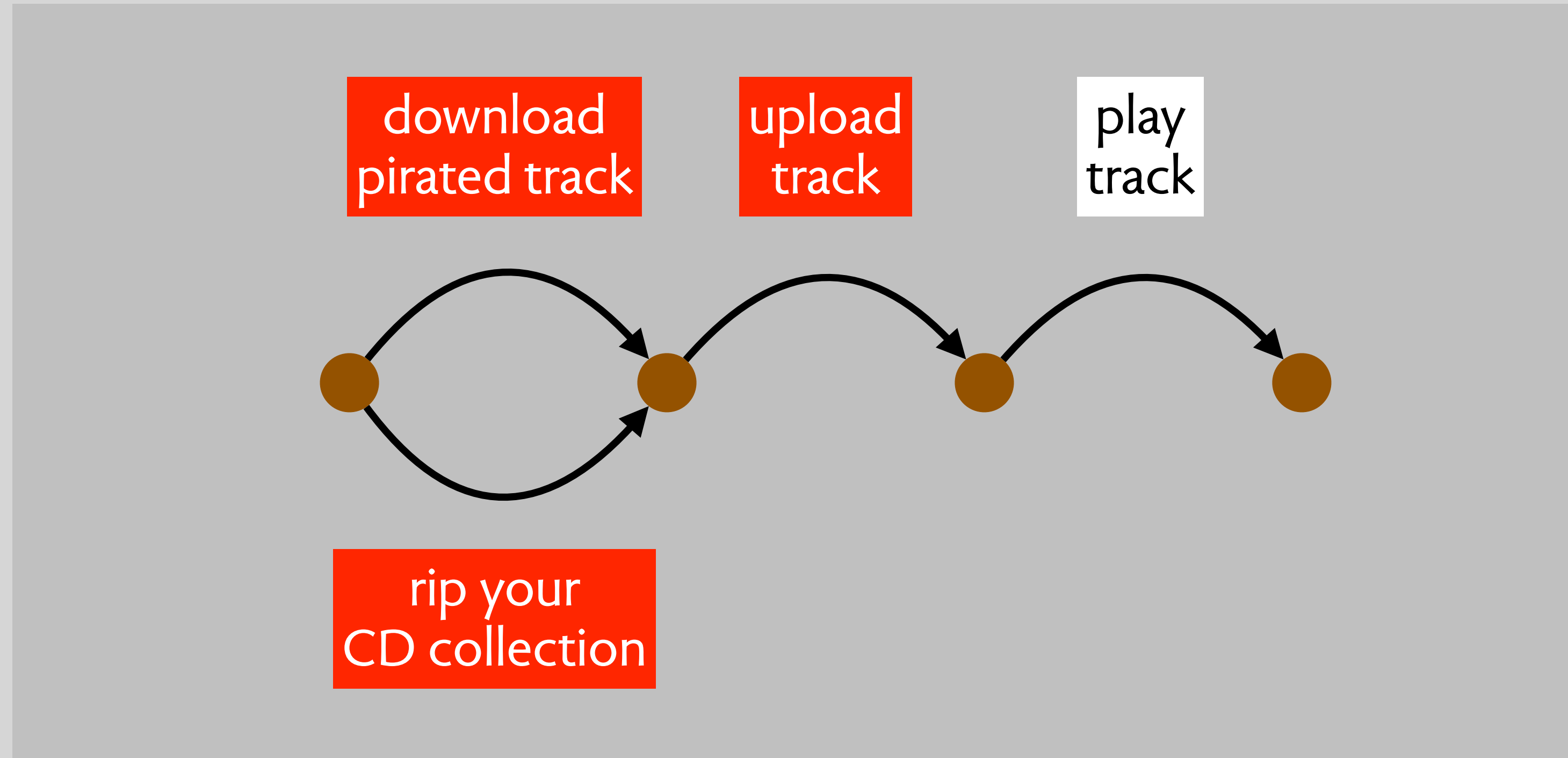


FireWire serial bus
(Apple, 1995)

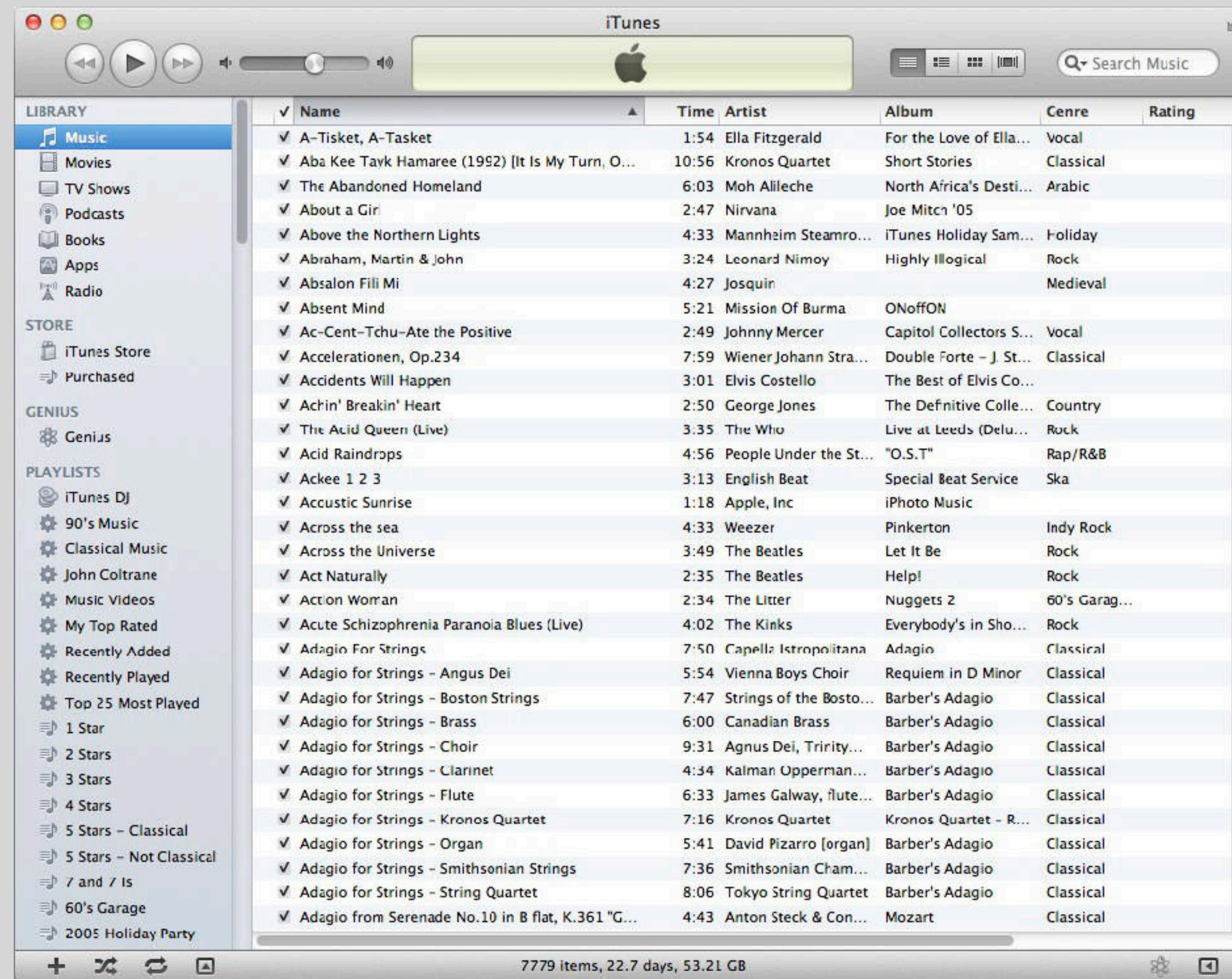


Personal Jukebox 5GB drive
(DEC, 1999)

the ipod scenario



supporting cast: iTunes



iTunes Media Player (2001); iTunes Music Store (2003)

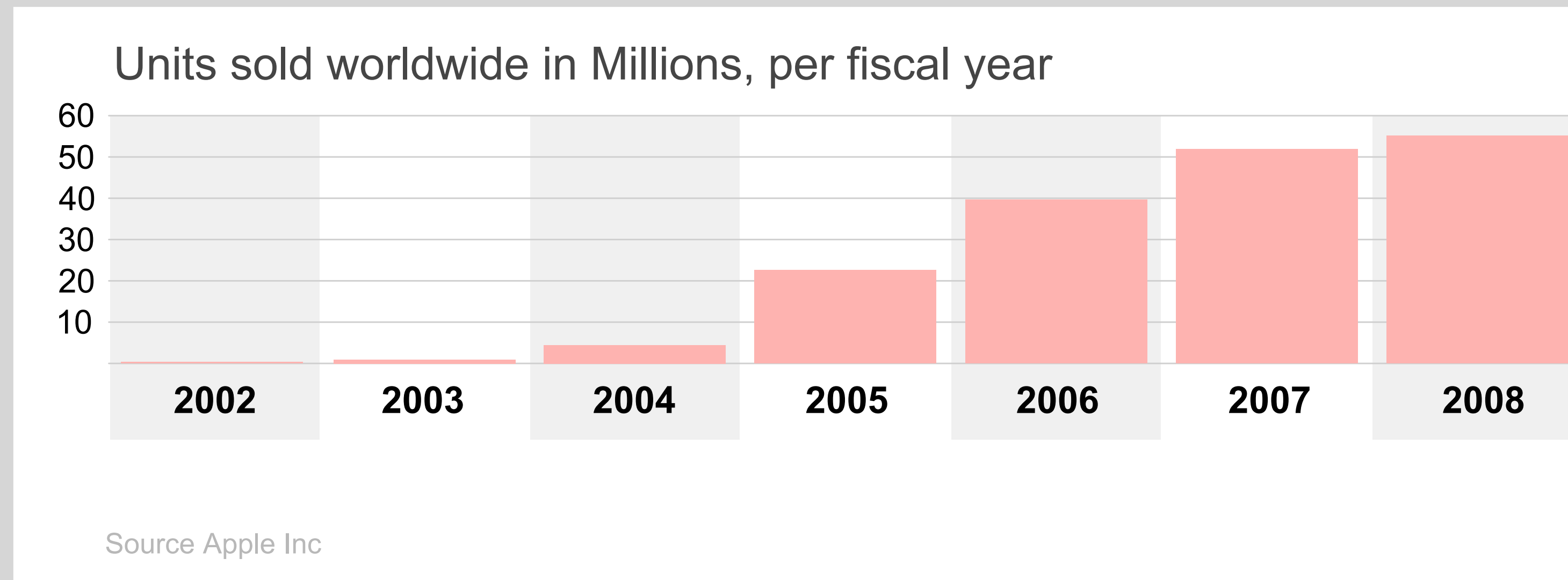
explosion in sales came after iTunes took off

iPod
appears

iTunes
store

100m
songs sold

iPod
dominates



how did Sony fail?

all ingredients of success (1999)

Network Walkman: a digital audio player

Bitmusic: a store for downloading songs

what went wrong?

proprietary compression scheme (ATRAC)?

store limited to release in Japan?

DRM controls made trouble for users?


no simple usage scenario?




1 Connecting your Network Walkman to the computer

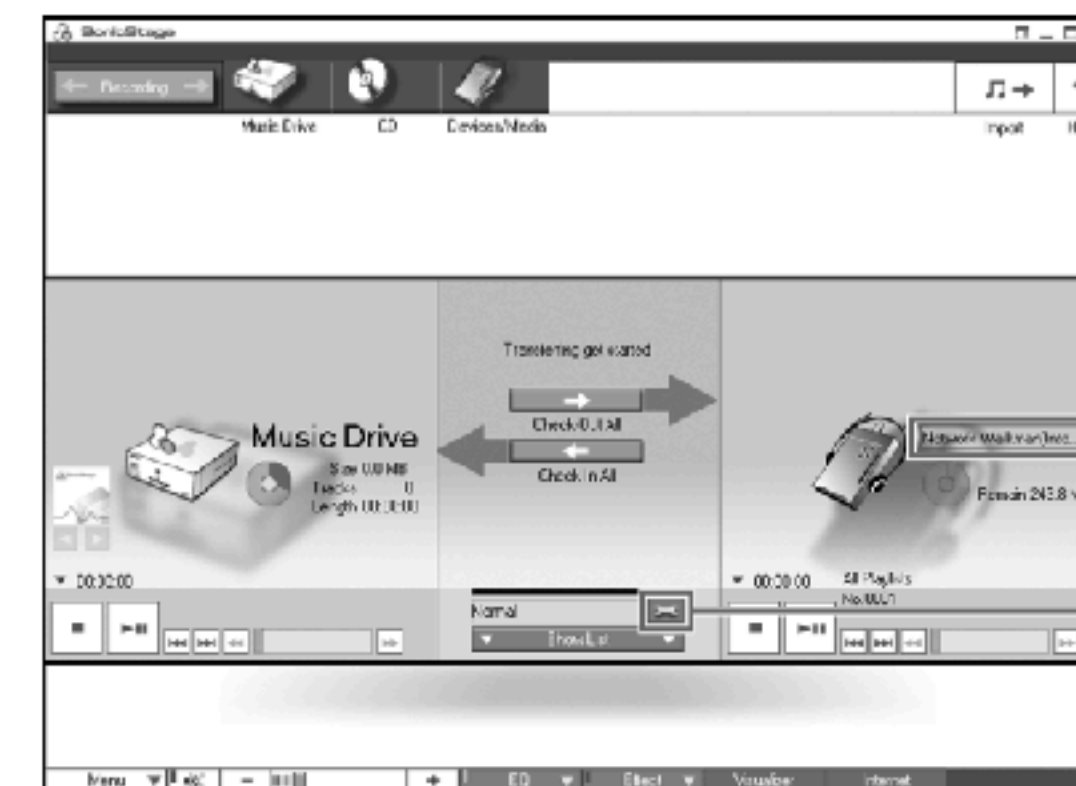
For details, refer to the instruction manual of your Network Walkman.

When using a device supporting “MG Memory Stick”, insert the “MagicGate Memory Stick” media into the device before connecting to the computer.

2 Transferring audio files to your Network Walkman – Check-out

1 Click  to display the Recording Assistant Window.

2 Click and select  (Music Drive) for [1 Sources] and  (Device/Media) for [2 Targets], and then click 3  (Jump to Record Window).
The Record/Transfer window is displayed.



Device/media
Drop-down list

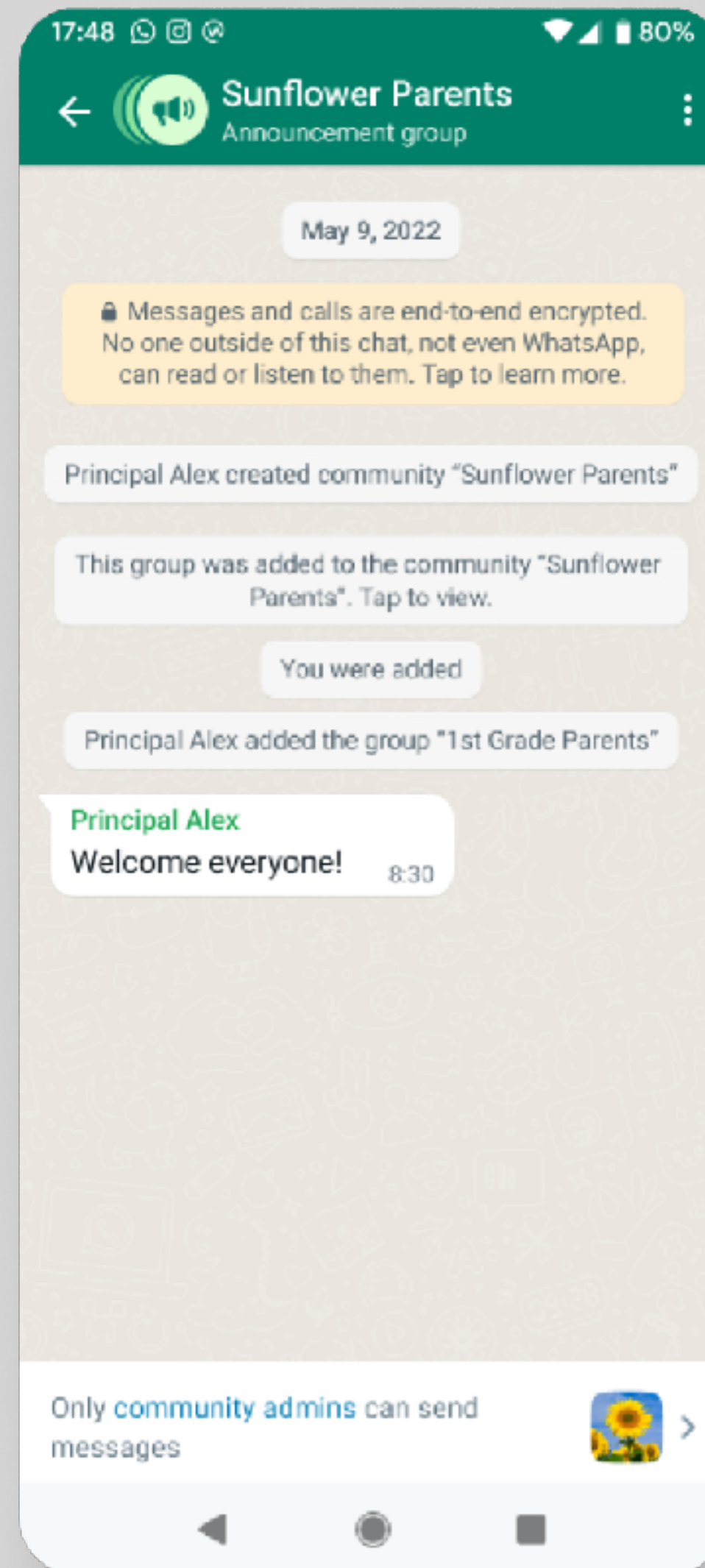
Transfer mode button

3 Select the device/media from the drop-down list at the right of the window.
When using the Network Walkman supporting two or more medium types, select the target medium.
When you check out to the built-in flash memory, select “Network Walkman (Internal),” and when you check out to the “Memory Stick”, select “Network Walkman (Memory...)”

story #2

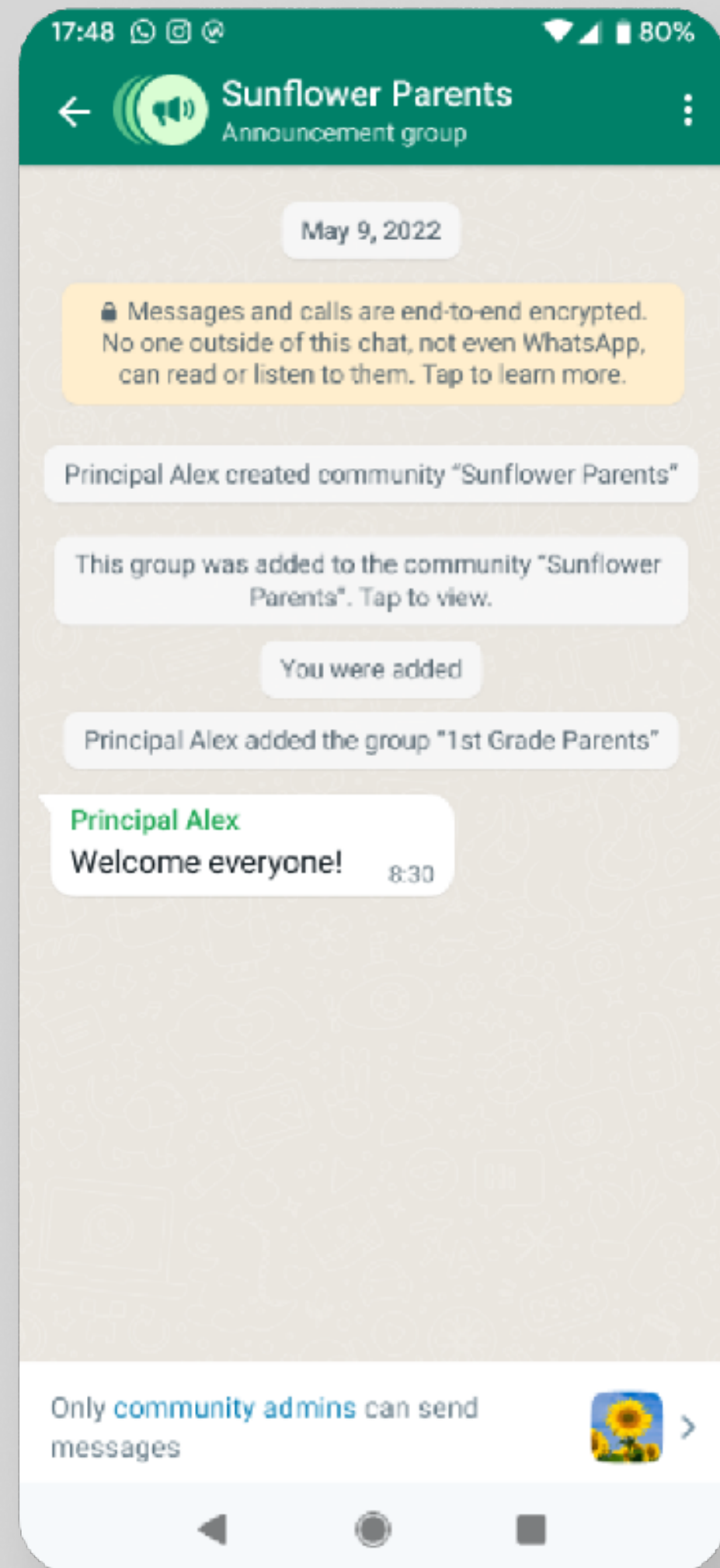
WhatsApp (2009)

what was novel about WhatsApp?



WhatsApp (2009)

was it free texting?

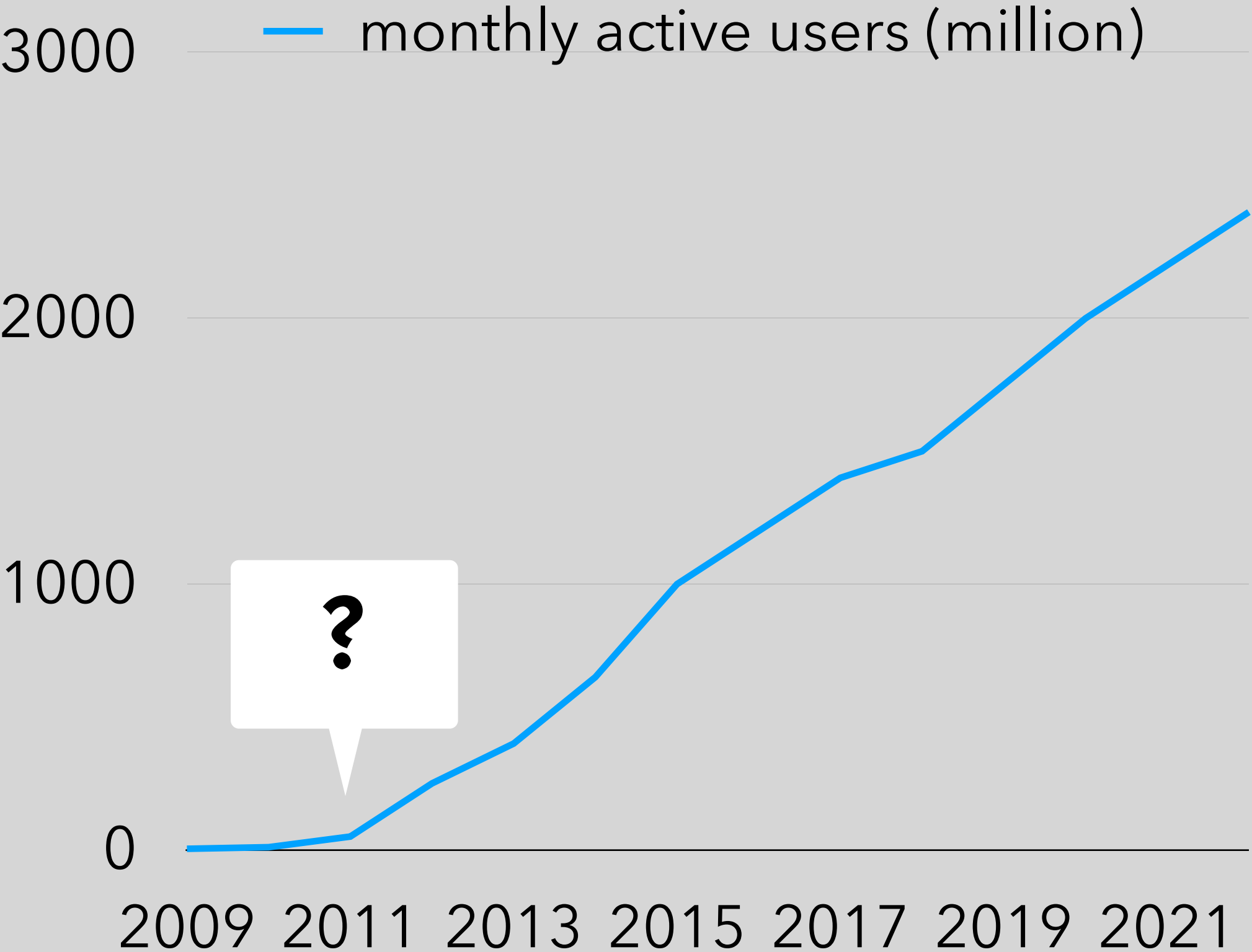
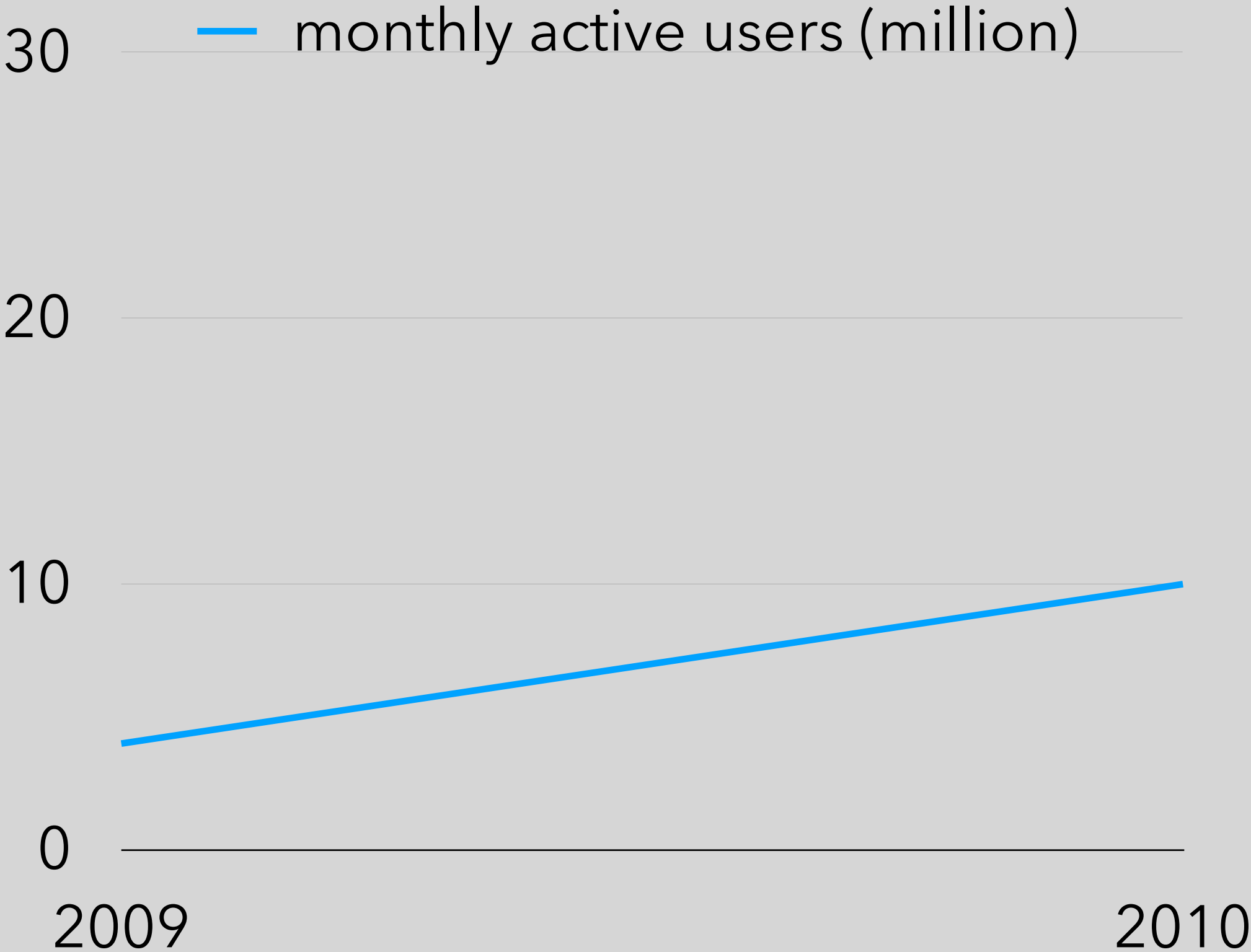
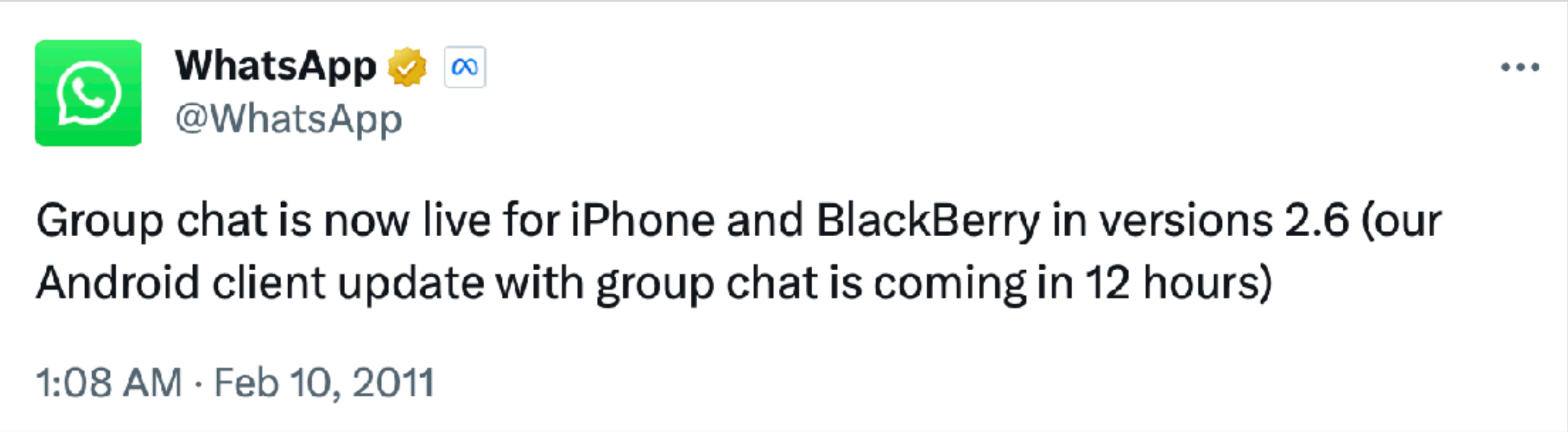


WhatsApp (2009)



first free-texting app
TextFree/Pinger (2006)

whatsapp's big moment



what was happening in 2011

Start-Ups Are in a Rush to Bring the Chat Room to the Smartphone

Share full article



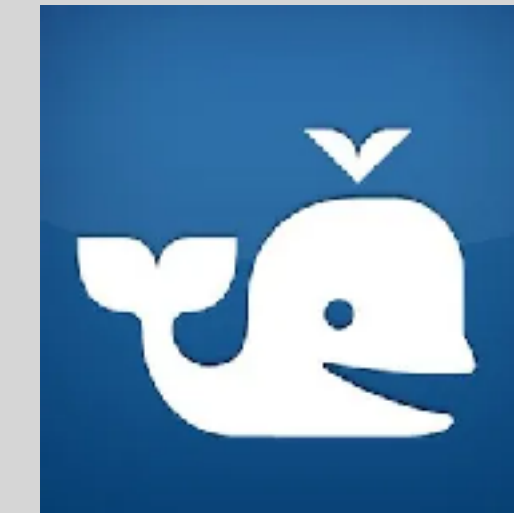
Caleb Elston, left, and David Kasper, co-founders of the social messaging site Yobongo, in the company's offices in San Francisco. Jim Wilson/The New York Times

By Jenna Wortham

March 10, 2011



GroupMe

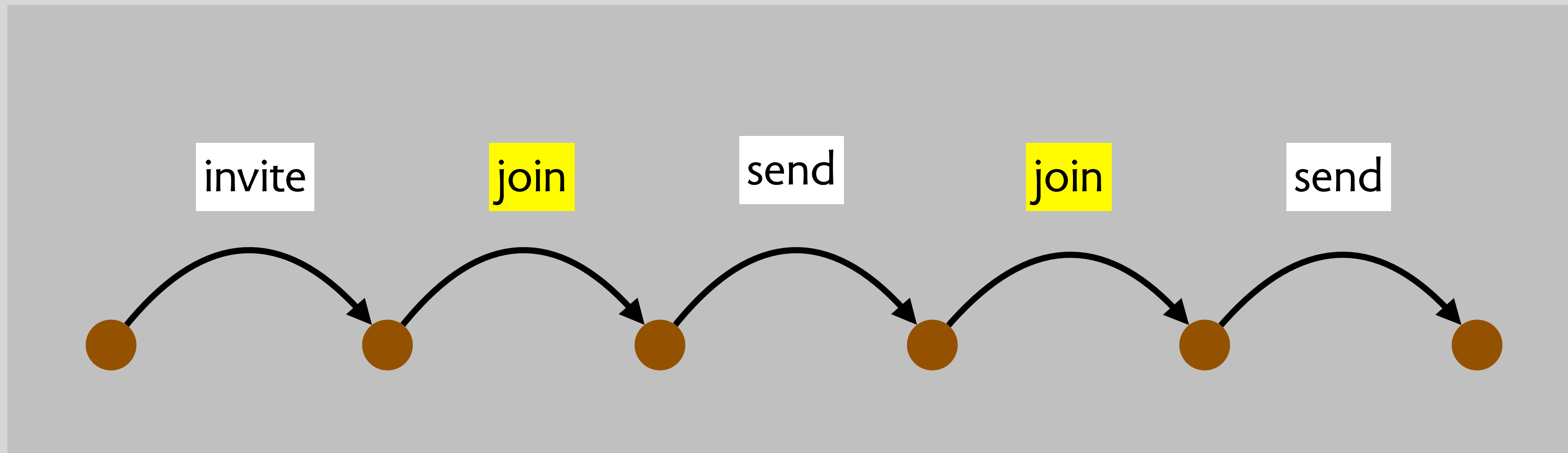
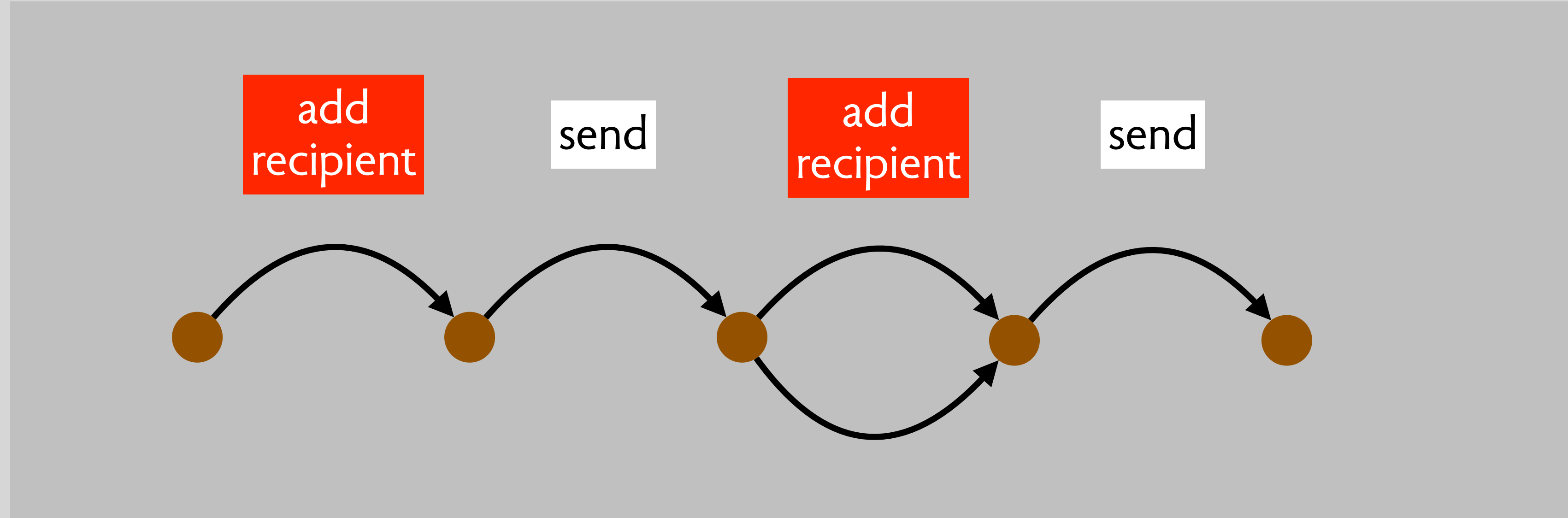


Beluga



Yobongo

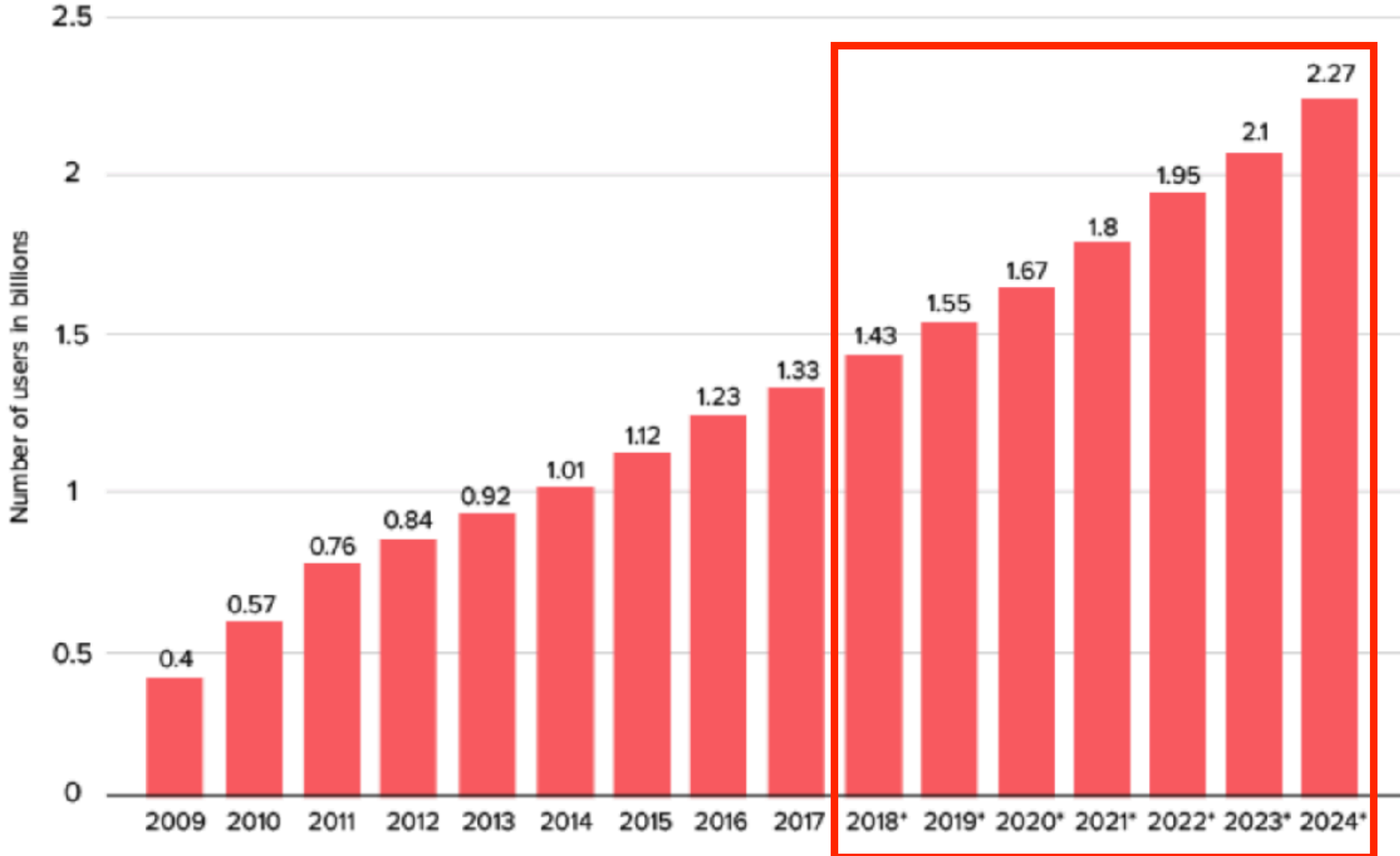
the group scenario



story #3

Zoom (2013)

Number of estimated Skype users registered worldwide from 2009 to 2024 (in billions)

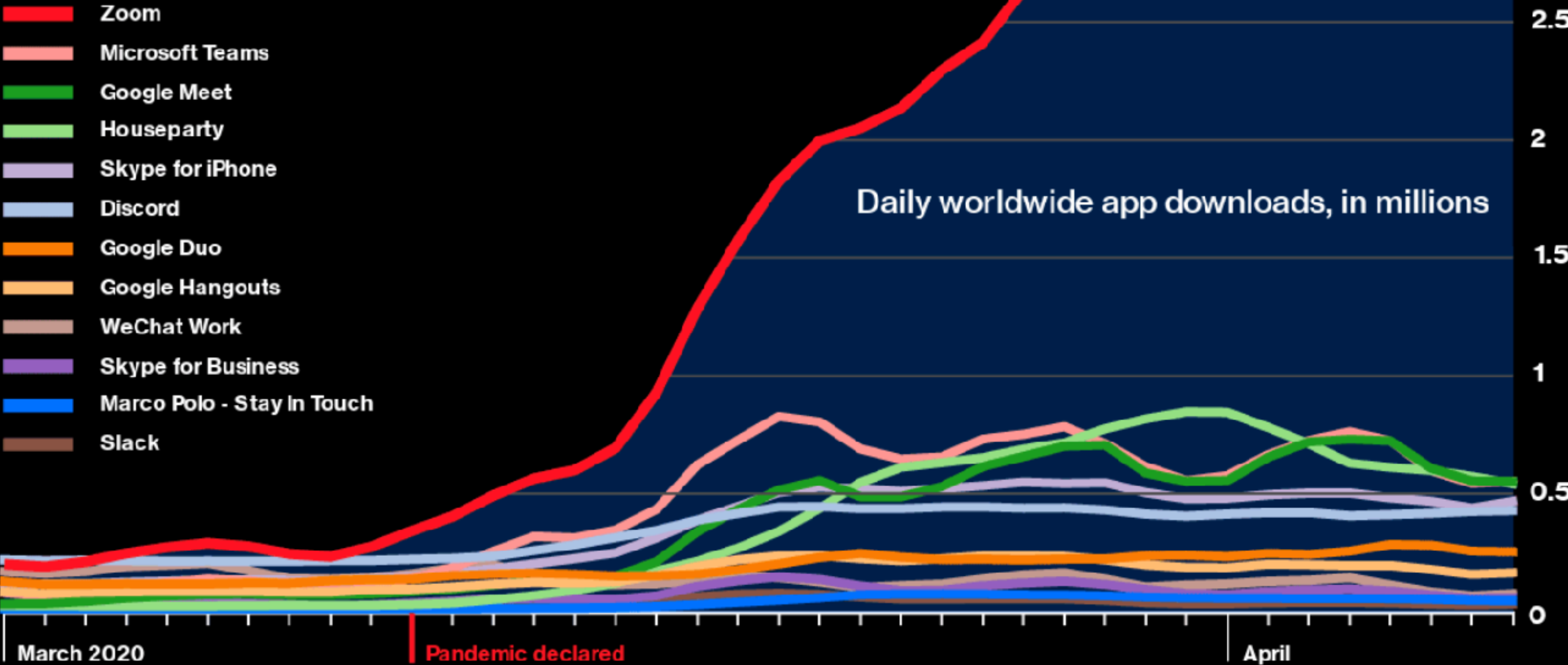


from Statistica: 2018-2024 estimated

Covid-19 / Zoom-a-Zoom-Zoom

BBOViz
Covid-19

There's only one winner in the work-from-home meeting app wars



Source: Apptopia

BEN SCHOTT

what was novel about Zoom?



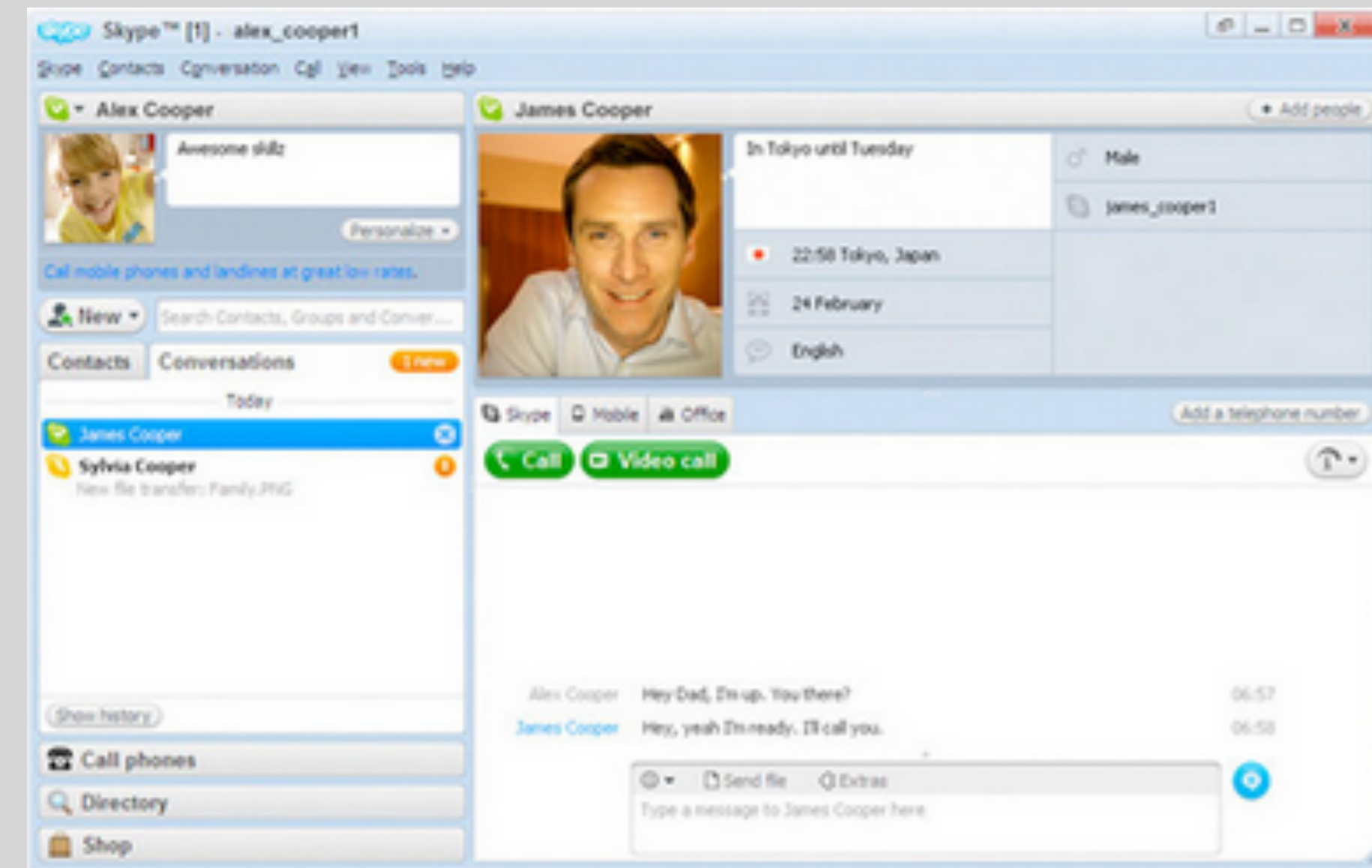
shares meeting id!

March 31, 2020

were video calls new?



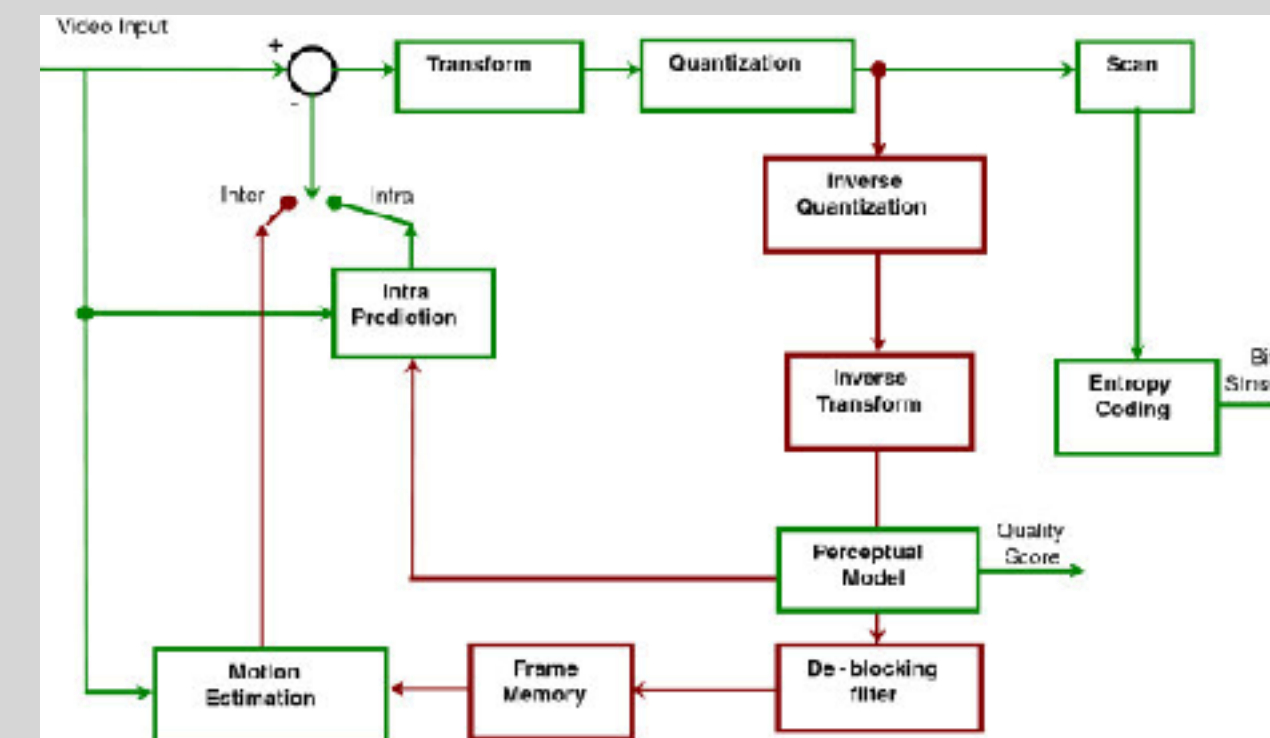
Picturephone (1964)



Skype (2009)

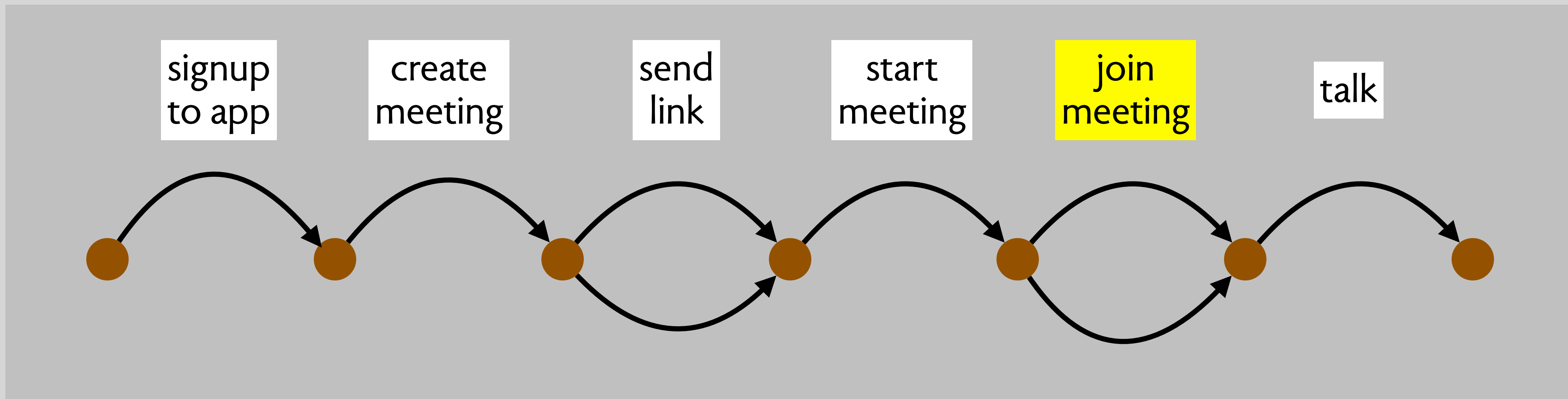
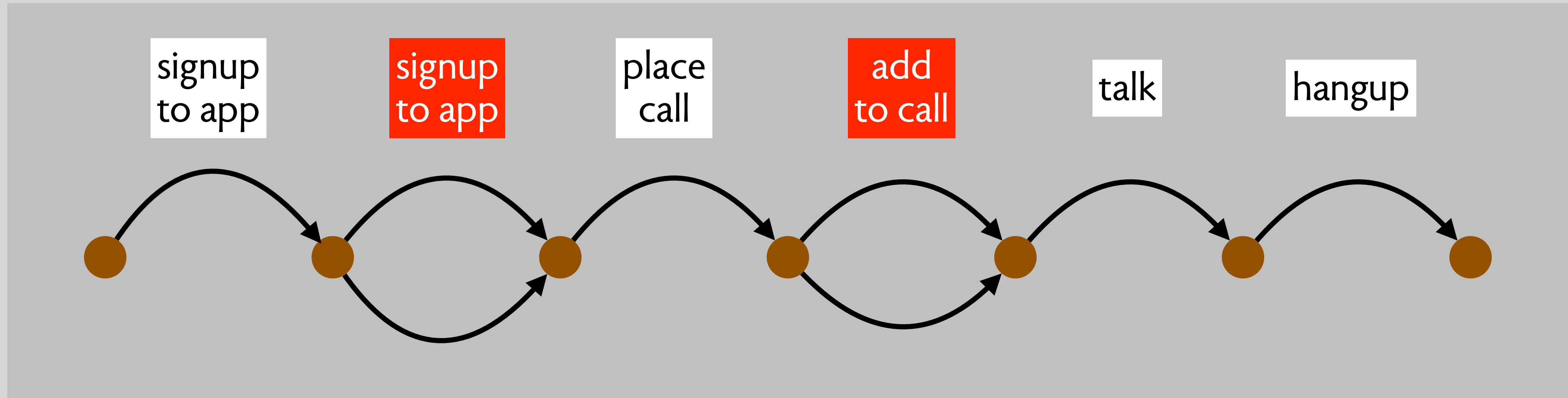


QuickCam (1994)
first commercial webcam



H.264 Video Codec (2003)

the meeting scenario



tracing zoom's meeting concept



Skype
initially P2P (2003)
Microsoft (2013)



FaceTime
Apple (2010)



Google Hangouts
in Google+ (2011)
own product (2013)
Duo replaces (2016)



Zoom
Eric Yuan (2013)

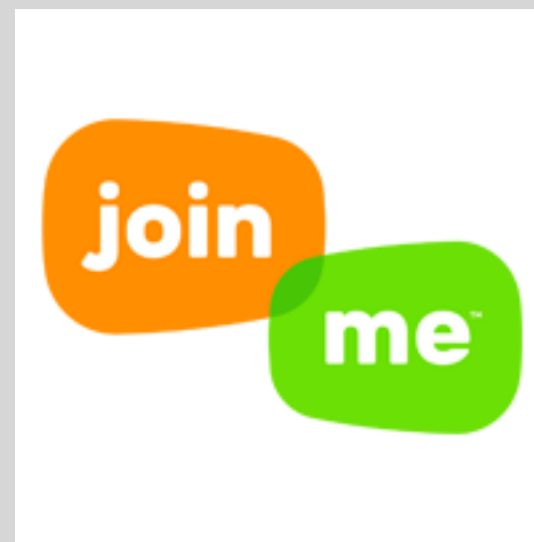


Google Meet
launched (2017)
absorbs Duo (2022)



Microsoft Teams
launched (2017)

meeting concept
added to Skype
April 2020



Join.me
LogMeIn (2010)

meeting scenario

meeting scenario
added to Teams
June 2022?

lessons so far

a product is defined by a scenario

a compelling story of how to use it
a social protocol and a service API at once
hints at why the user's purpose is fulfilled
an archetypal usage, not the only one

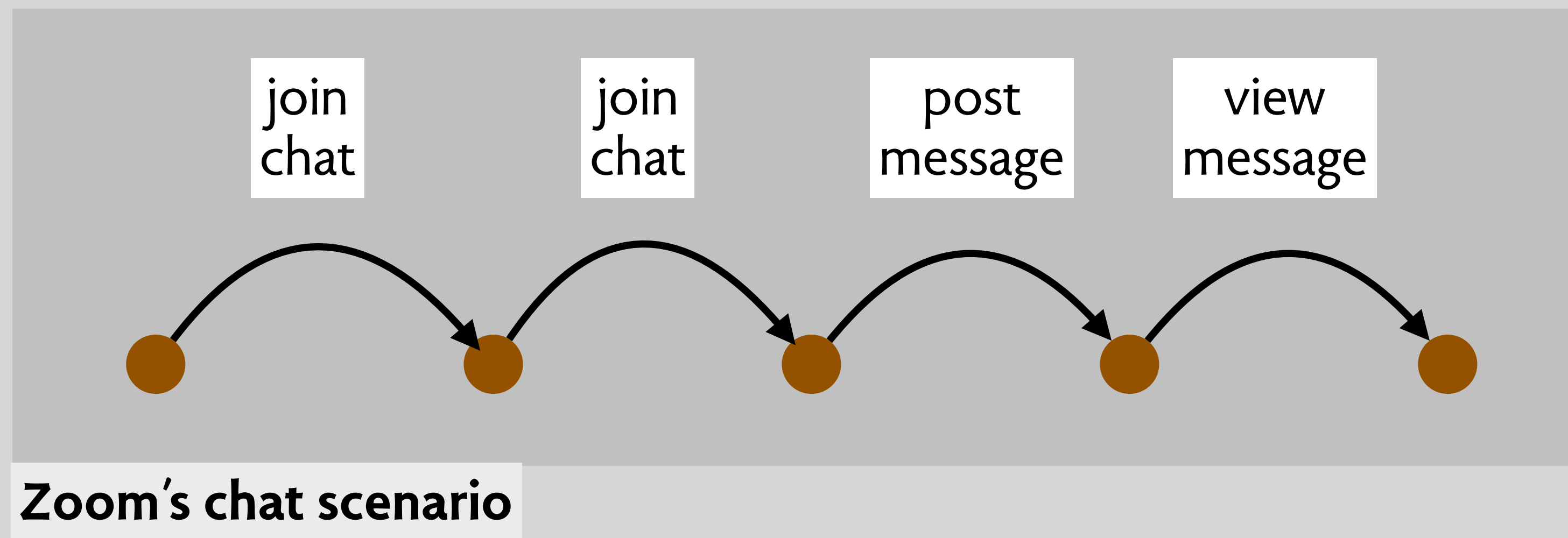
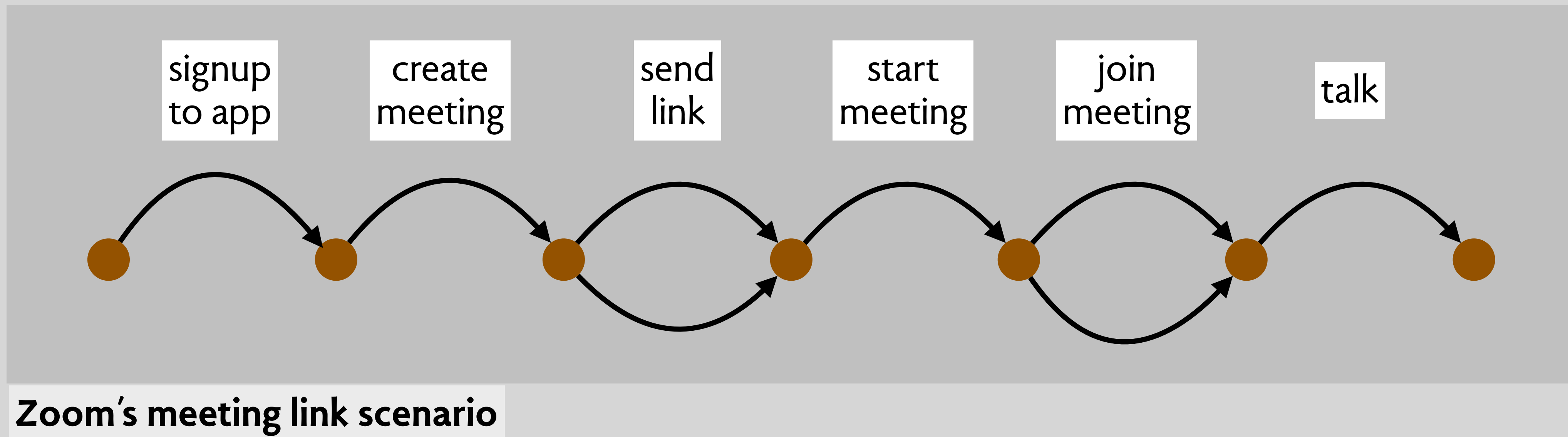
innovations (almost) never enable new things

they just make them easier to do
an old scenario with pain points is replaced by new one

scenarios for
design, not
specification!

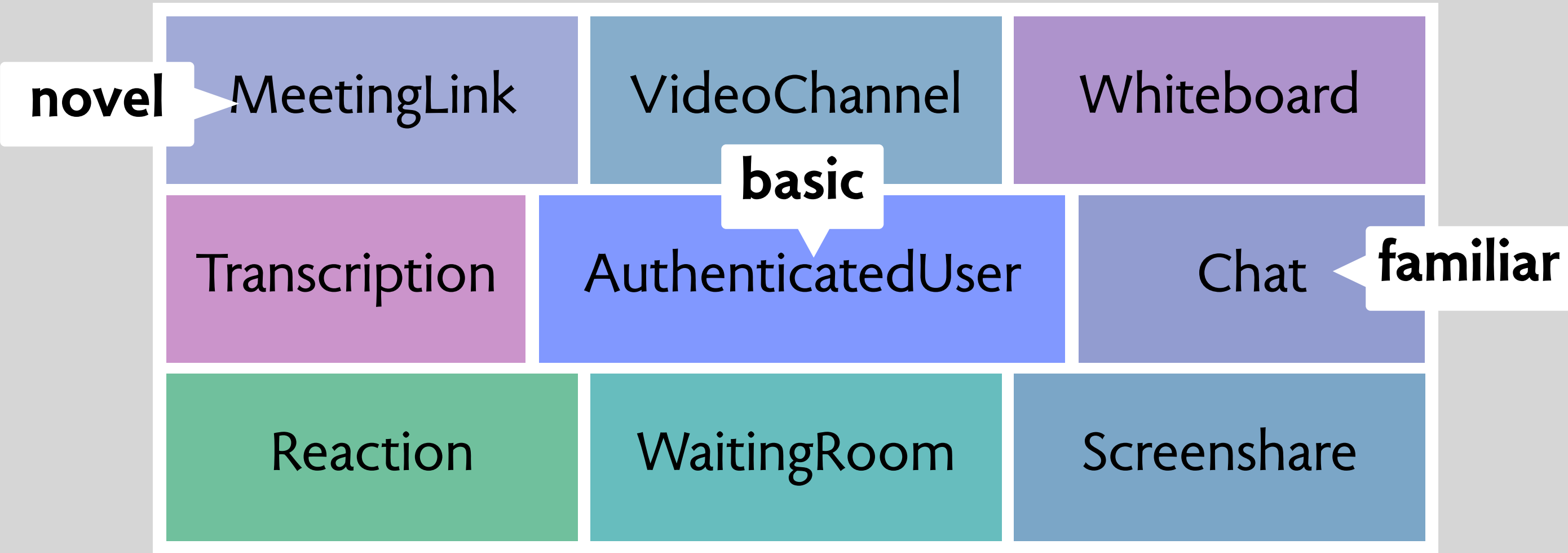
*from scenarios
to concepts*

zoom isn't just the meeting scenario

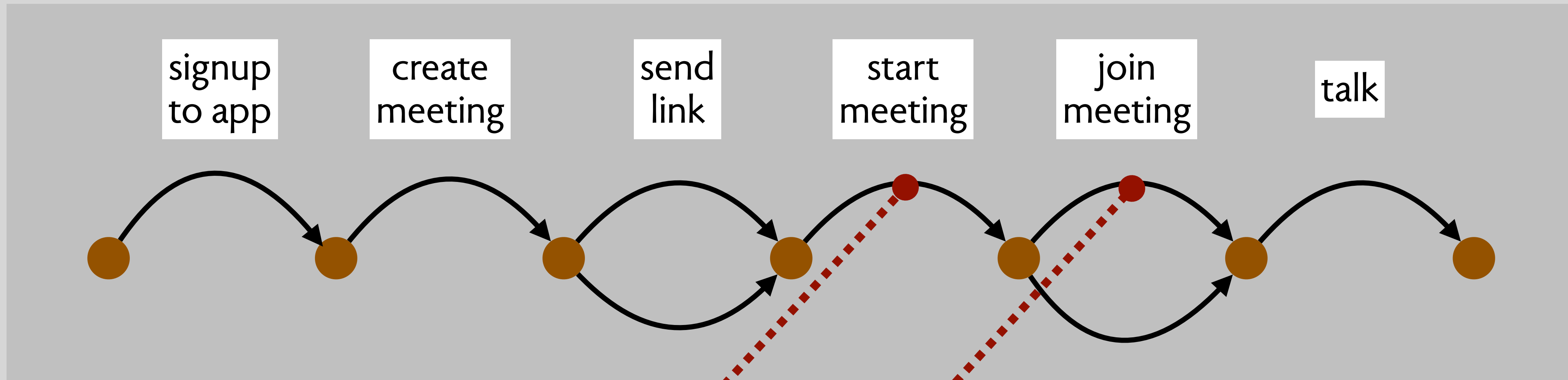


software = concepts

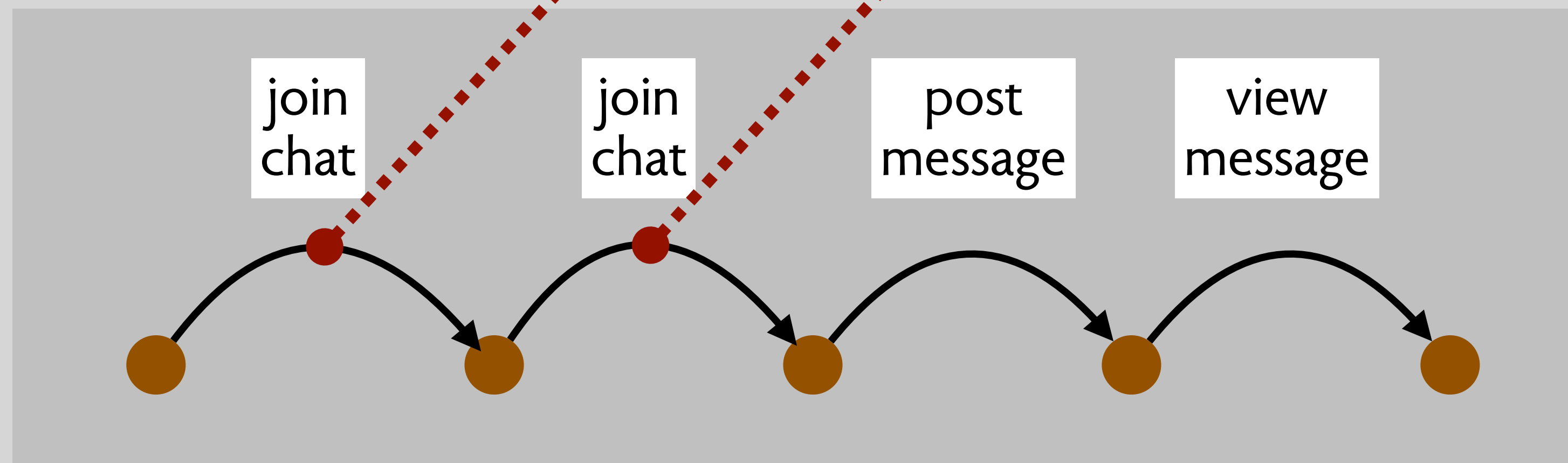
Zoom



how are concepts composed? by interleaving & synchronization



Zoom's meeting link scenario



Zoom's chat scenario

essential concept compositions

Zoom = MeetingLink + VideoConference

Calendly = SelfSchedule + Notify

iPod = Song + Store + Sync

designing a concept

concept Chat

purpose share short messages in group

principle after two users join, if one posts a message, the other can read it

state

msgs: set Msg

content: Msg -> one String

posted: Msg -> one Date

joined: User -> one Date

actions

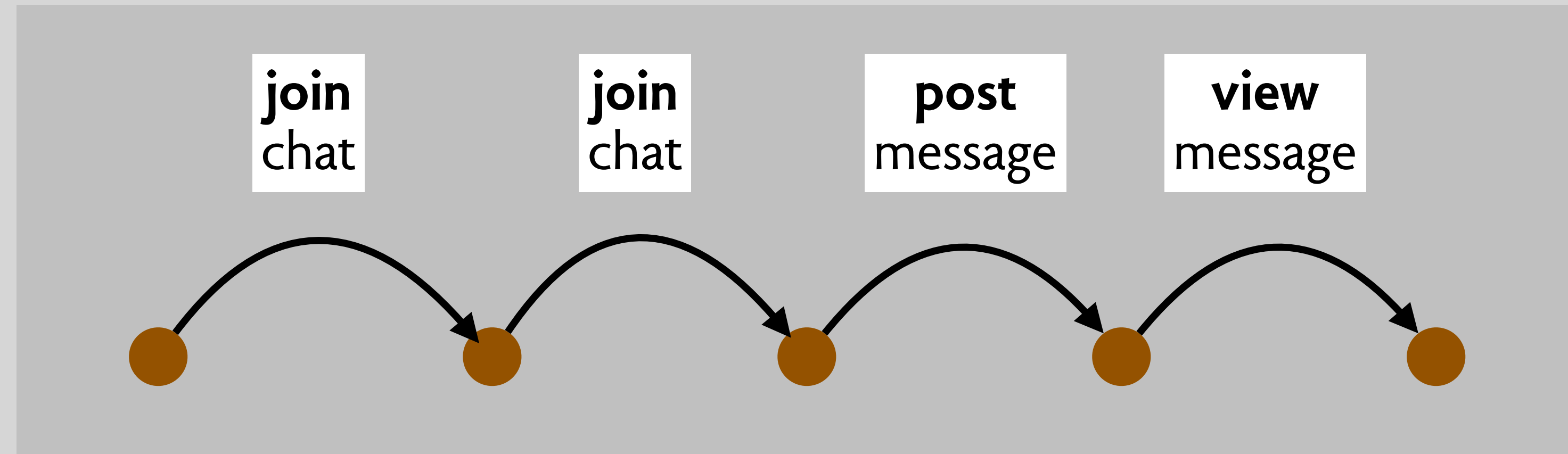
join (u: User)

post (u: User, s: String, out m: Msg)

view (u: User, out msgs: set Msg)

// returns all messages posted after

// u's joining date



actually a serious design flaw

how many “differentiator” concepts?



Gmail: email + search



Zoom: meeting



Photoshop: pixel array,
layer, mask, channel, ...



Arc: tabs as bookmarks



WhatsApp: group



Quark: flow, kerning,
bezier curves, ...

no new concepts
combinational creativity

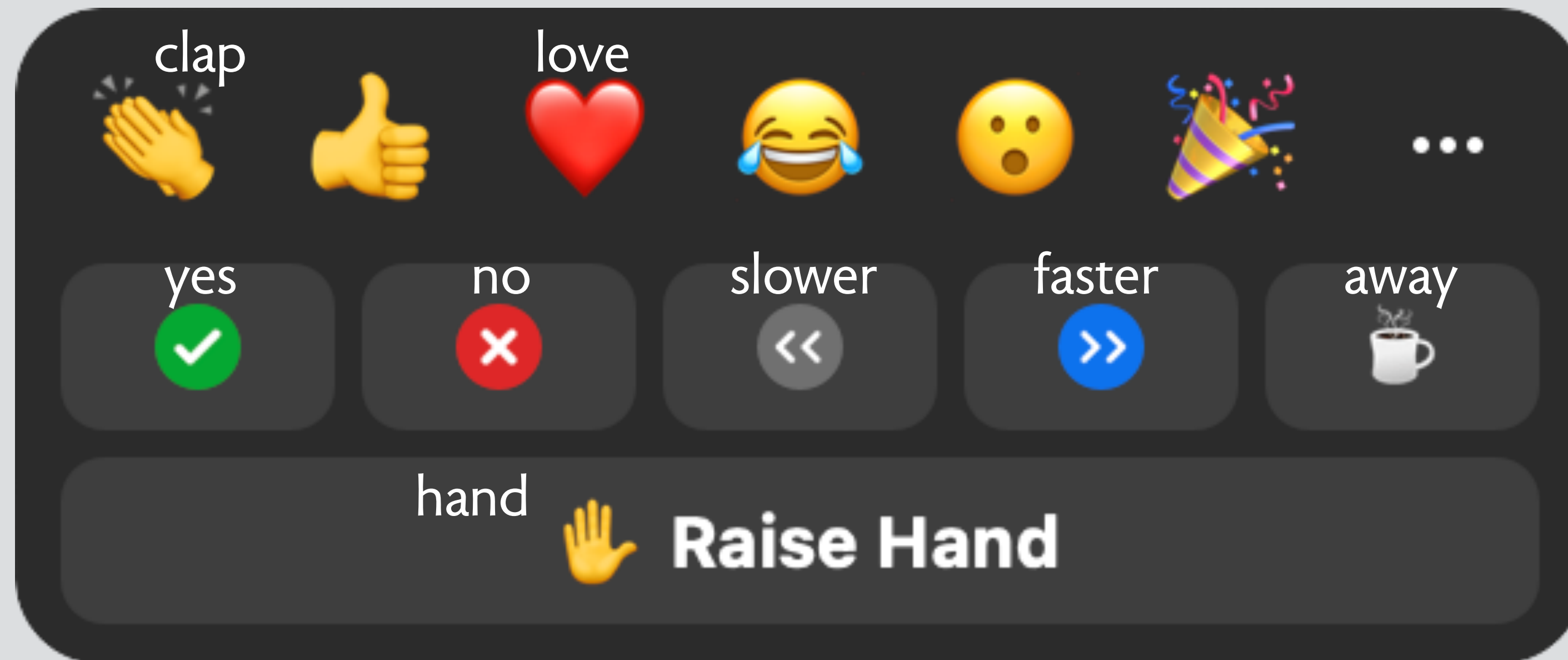
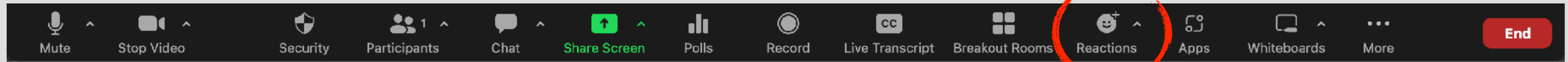
one new concept
a better way to work

many new concepts
a new paradigm

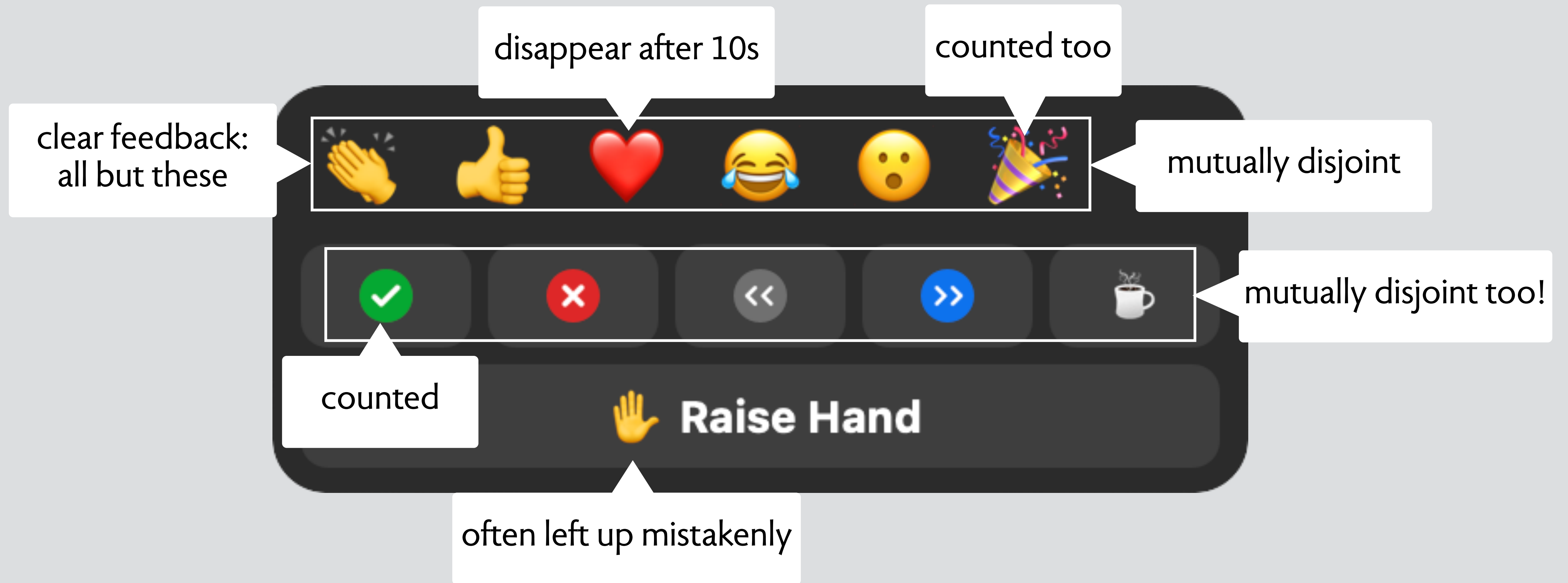
how can you
use these ideas?

designing
with concepts

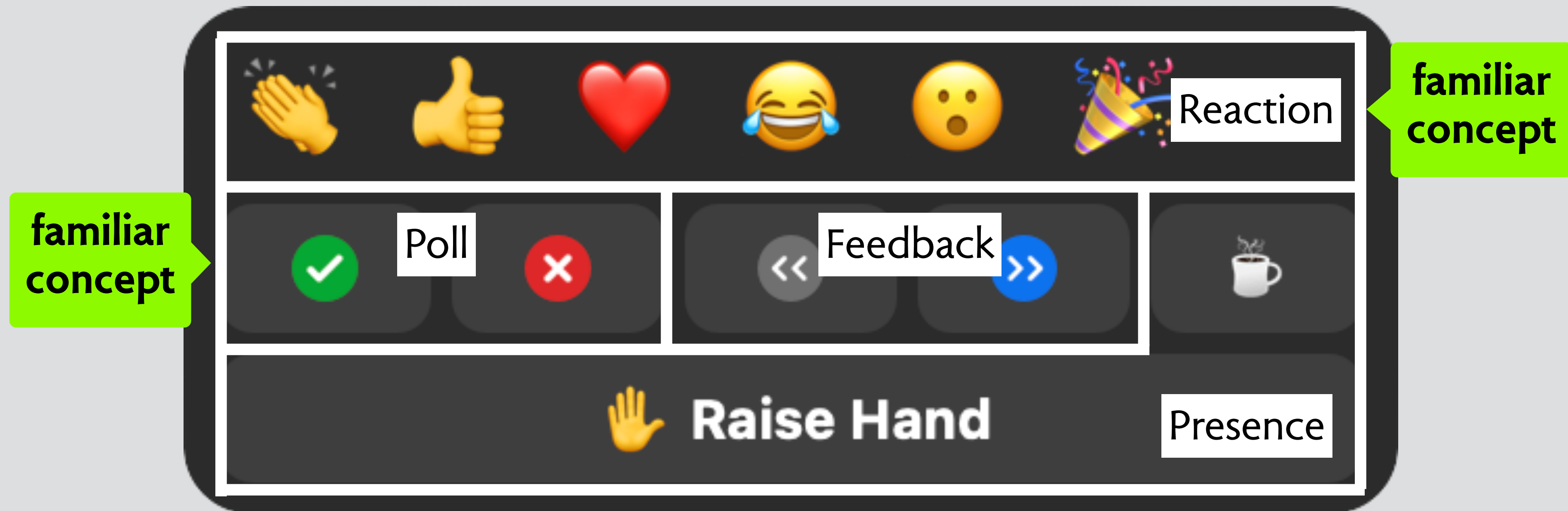
Zoom's reactions

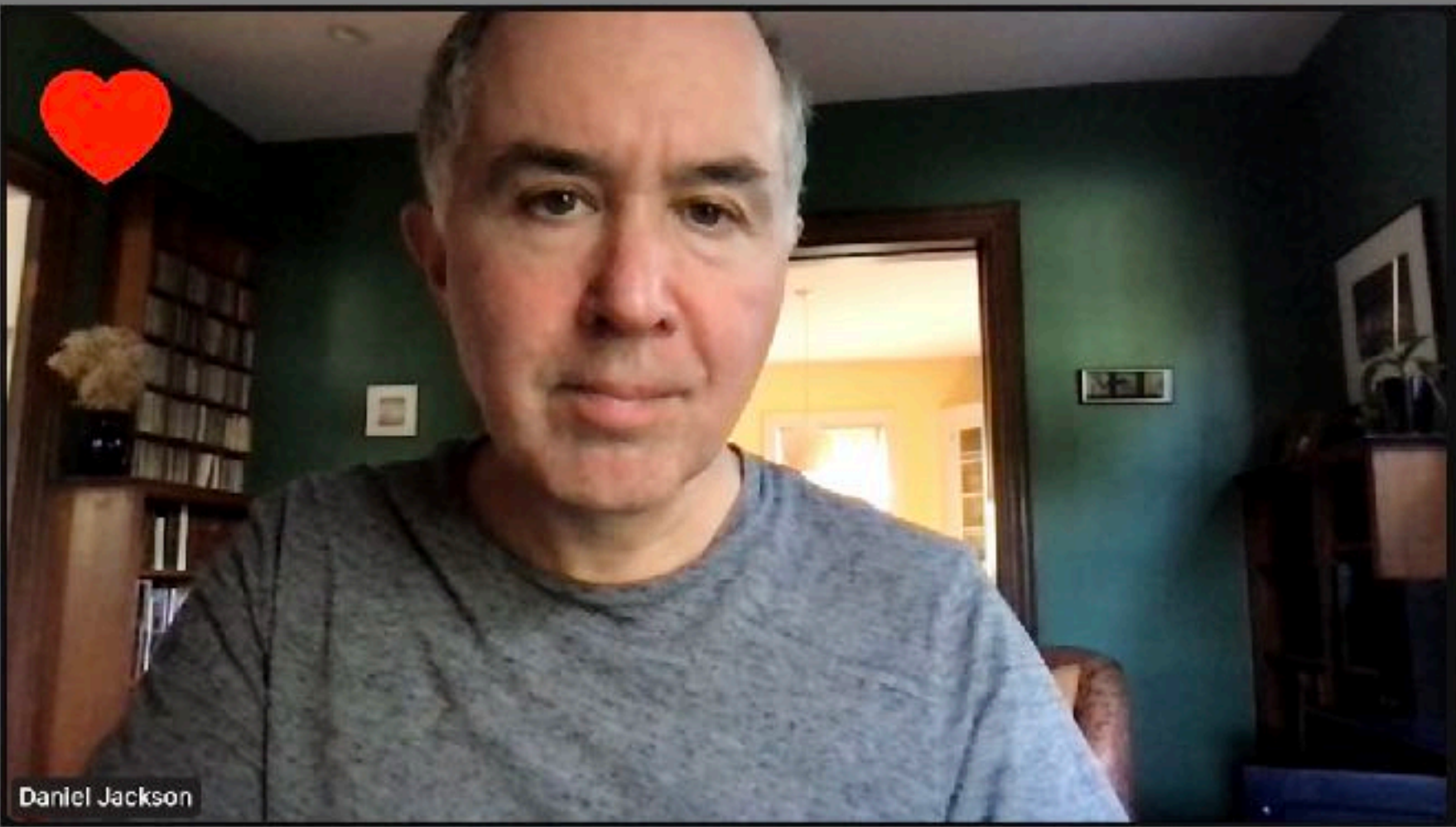


anomalous behaviors



splitting into coherent concepts





Presence

Chat

Reaction

Feedback

Request to speak

Watching/listening

Speaking

I'm away



Audience



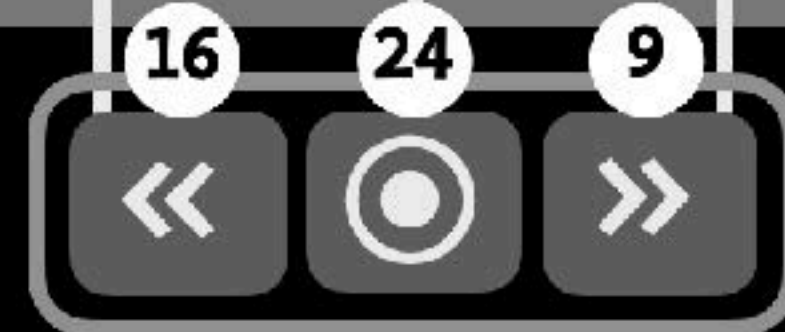
Other emoji

Recent emoji

Slow down

Just right

Speed up



programming with concepts

with Abutalib Namazov

how good are LLMs at generating code?

single functions

46%

of code is autogenerated
when Copilot enabled
(June 2023)

92%

accuracy of coding
GPT-4 + AgentCoder on MBPP
(Jan 2024)

whole apps

If you ask GPT-4 to write whole apps for you, it usually can't get there. But if you architect the app in your head, you can ask it to build it out one function at a time pretty effectively.

HackerNews, May 2024

The skills of the developer will be to figure out, "How small do I have to go until I can leverage AI to synthesize that code for me?"

Thomas Dohmke, GitHub CEO, June 2023

it's time to
rethink how software
is **structured**

most apps are made from familiar functions

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▲ Jackson structured programming (wikipedia.org)

Post

Session

106 points by haakonhr 63 days ago | hide | past | favorite | 69 comments

Upvote

Favorite

▲ danielnicholas 63 days ago [-]

user: danielnicholas
you might find helpful an annotated version [0] of Hoare's explanation of JSP that I edited for a Michael Jackson festschrift

created: 63 days ago
, I'd point to these ideas as worth knowing:

karma: 11
ing problem that involves traversing structures can be solved very systematically. HTDP addresses this class, but bases code structure only on input structure; JSP synthesized it.

Comment

- The archetypal problems that, however you code, can't be pushed under the rug—most notably structure clashes—and just recognizing them

Karma

- Coroutines (or code transformation) let you structure code more cleanly when you need to read or write more than one structure. It's why real iterators (with yield), which offer a limited form of this, are (in my view) better than Java-style iterators with a next method.

- The idea of viewing a system as a collection of asynchronous processes (Ch. 11 in the JSP book, which later became JSD) with a long-running process for each real-world entity. This was a notable contrast to OOP, and led to a strategy (seeing a resurgence with event storming for DDD) that began with events rather than objects.

[0] <https://groups.csail.mit.edu/sdg/pubs/2009/hoare-jsp-3-29-09...>

▲ ob-nix 63 days ago [-]

... this brings back memories! In the late eighties I, as a teenager, found a Jackson Struct. Pr. book at the town library. I remember I was amazed at the text and wondered why I hadn't heard about the method before.

If I remember correctly did the book clearly point out backtracking as a standard method, while mentioning that most languages lacked that, so it had to be implemented manually.

... with some creative variation

▲ Jackson structured programming (wikipedia.org)

106 points by haakonhr 63 days ago | hide | past | favorite | 69 comments

▲ danielnicholas 63 days ago [-]

If you want an intro to JSP, you can find it in 2009.

For those who don't know JSP, I

- There's a class of programming languages that are statically typed but bases code structure only on types.

- There are some archetypal problems that solving them helps.

- Coroutines (or code transformers) and iterators (with yield), which offer a way to write code that is more like a sequence of operations.

- The idea of viewing a system as a sequence of events for each real-world entity. This is a way of thinking about events rather than objects.

[0] <https://groups.csail.mit.edu/robotics-1/www/ftp/pub/6.034/lectures/10/JSD/JSD.pdf>

▲ ob-nix 63 days ago [-]

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“combinatorial creativity” [Boden]

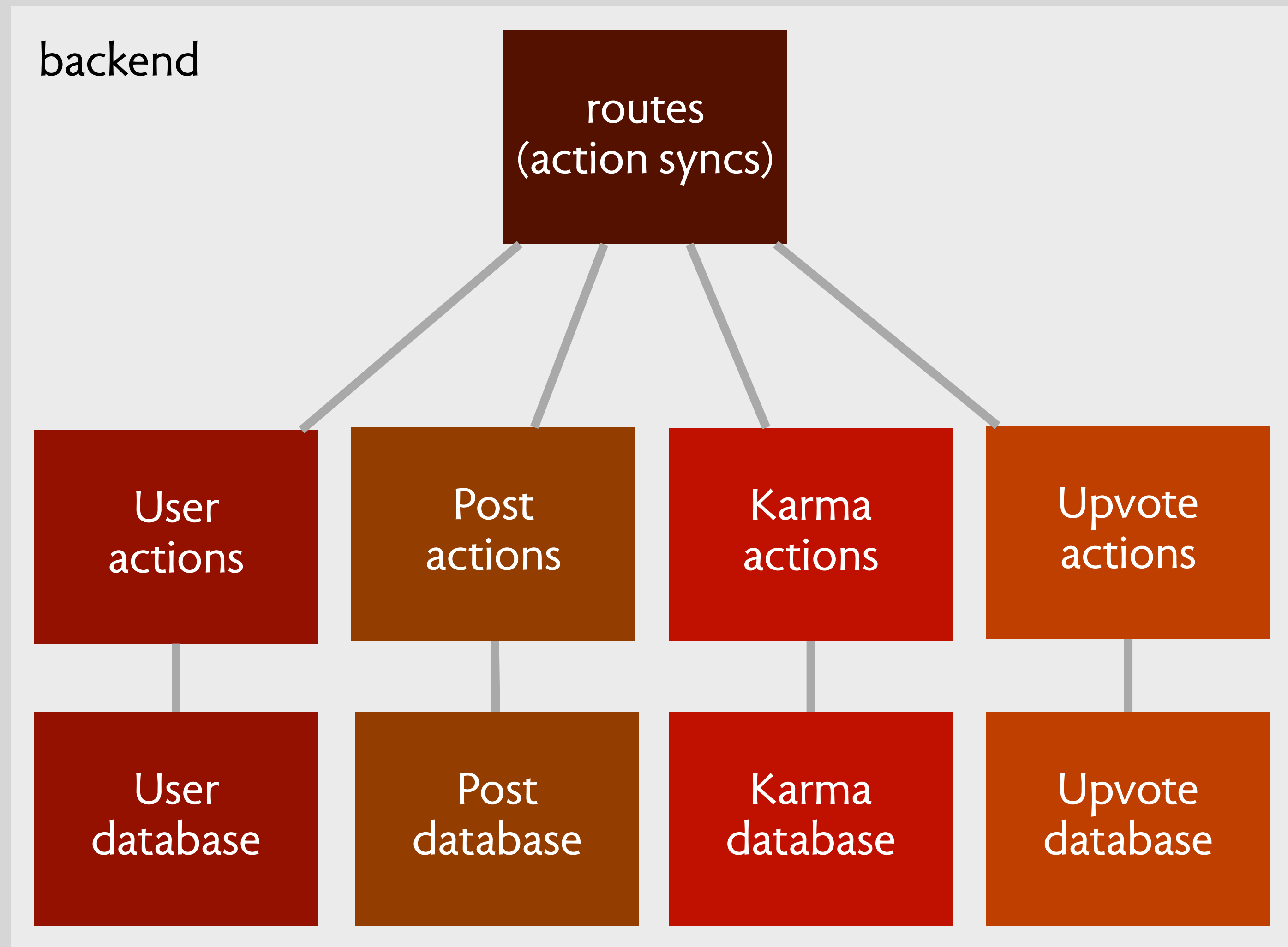
familiar elements combined in new ways

for HackerNews

a post has a title and either just a link, or just a question
no comments on a post after 2 weeks, no edits after 2 hours
need karma of 501 to downvote a comment, 30 to flag it

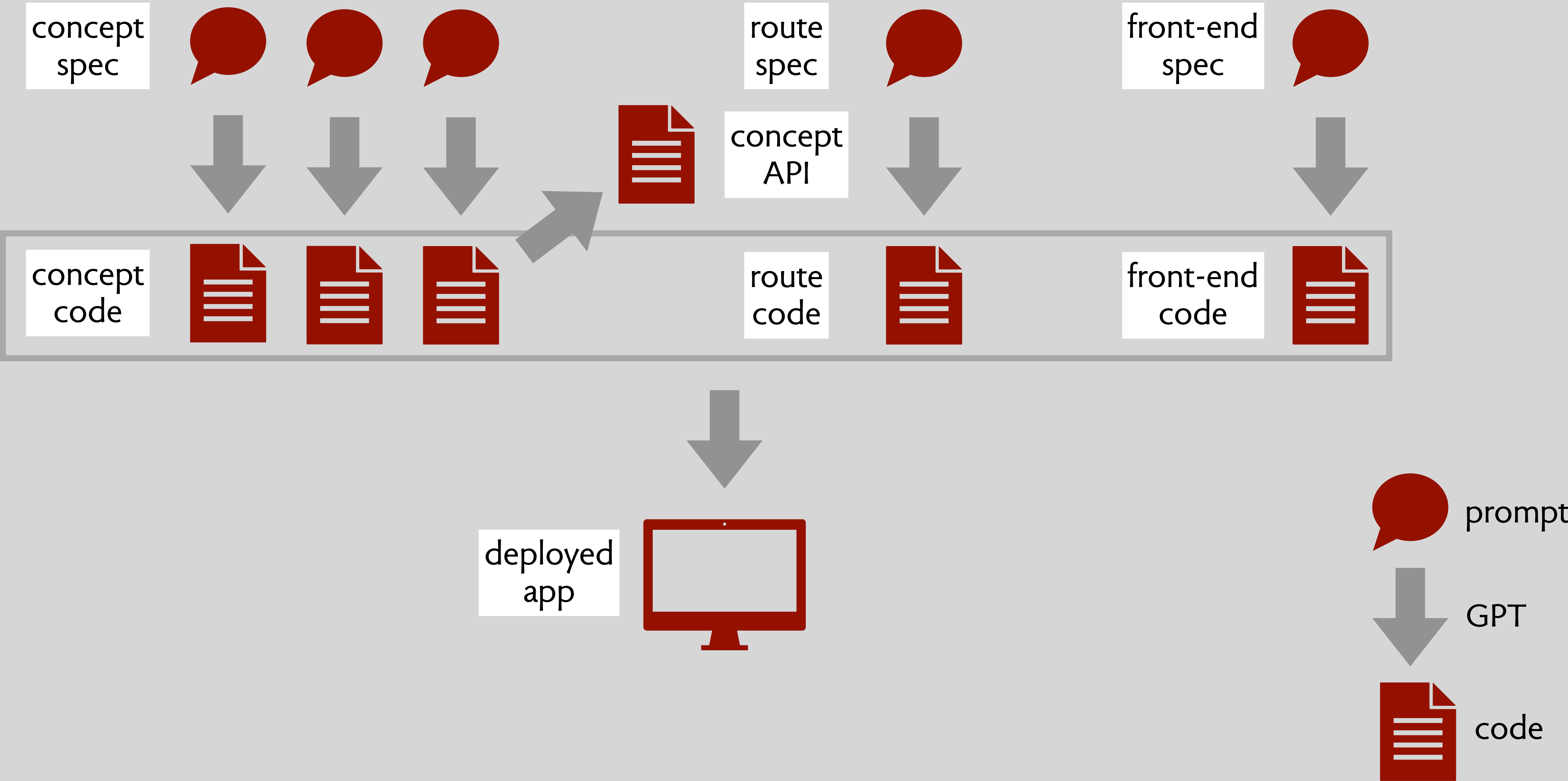
...

a new way to structure a web app



no dependencies between concepts!

now we can generate code!



Kodless: a prototype app generator

Abutalib Namazov

creating a concept



Create a new concept

Bulk create

Concept name

Karma

Description

Each karma should have user (generic) and points (number). Actions should be: increase(user, x), decrease(user, x), get(user), isAllowed(user, threshold) (throws error if user doesn't have at least threshold)

Create

**brief &
application
independent**

first kodless generates the concept code

Source code:

```
1 import { ObjectId } from "mongodb";
2 import DocCollection, { BaseDoc } from "../framework/doc";
3 import { NotAllowedError } from "../framework/errors";
4
5 interface KarmaDoc extends BaseDoc {
6   user: ObjectId;
7   points: number;
8 }
9
10 export default class KarmaConcept {
11   public readonly karmas: DocCollection<KarmaDoc>;
12
13   constructor(collectionName: string) {
14     this.karmas = new DocCollection<KarmaDoc>(collectionName);
15   }
16
17   async increase(user: ObjectId, x: number) {
18     const karma = await this.karmas.readOne({ user });
19     if (karma) {
20       await this.karmas.collection.updateOne({ user }, { $inc: { points: x } });
21     } else {
22       await this.karmas.createOne({ user, points: x });
23     }
24   }
25 }
```

database
schema
etc

typical
coding
details

then it generates an API spec from the code


Generated spec:

```
KarmaDoc = {  
  user: ObjectId;  
  points: number;  
}
```

```
KarmaConcept = {  
  constructor: (collectionName: string) => KarmaConcept; // instantiates a new KarmaConcept with the  
  given collection name  
  async increase: (user: ObjectId, x: number) => void; // increases the karma points for a user; cre  
  ates a new karma record if not exists  
  async decrease: (user: ObjectId, x: number) => void; // decreases the karma points for a user; thr  
  ows NotAllowedError if resulting in negative karma  
  async get: (user: ObjectId) => number; // returns the karma p user; returns 0 if the us  
  er has no karma record  
  async isAllowed: (user: ObjectId, threshold: number) => void; // throws NotAllowedError if user's  
  karma points do not meet the threshold  
}
```

**spec is more
detailed
than prompt**

creating a route

 Create a new route

Bulk create

Route description

POST /register – register and login. New users start with 1 karma.

Create

**no explicit mention
of concepts or their
actions**

kodless generates the route code

Delete

```
1 @Router.post("/register")
2   async createUser(session: WebSessionDoc, username: string, password: string) {
3     WebSession.assertLoggedOut(session);
4     const { msg, user } = await User.create(username, password);
5     await Karma.increase(user._id, 1);
6     WebSession.start(session, user._id);
7     return { msg };
8   }
```

**Kodless
uses concept APIs
to select actions**

hacked news: home page

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hacked news: thread

Software = concepts (essenceofsoftware.com)

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* [kodless](#) 9 days ago | [next \[-\]](#)

dnj, you should check out my platform Kodless -- it helps you generate software with concepts without writing any code.

[reply](#)

dnj 9 days ago | [next \[-\]](#) [unvote](#)

That's great to see! Have you seen GPT-powered concept tutor? <https://essenceofsoftware.com/studies/larger/tutor/>

[reply](#)

hacked news: user profile

user: kodless

created: 2024-03-25T19:14:36.316Z

karma: 3

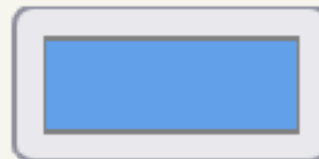
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successes & challenges

coverage of all major functionality

flagging, hiding, karma, etc

nested comments, complicated ranking rules

many application-specific details (eg, about karma)

minimal prompting required

< 1,000 words in total in prompts

no code editing needed

some prompt revisions to tweak behavior

frontend code not yet fully automated

but have designed HTMx like DSL

generation not as hard as backend

need actions to query concept state

eg, Post.getByIds to simplify route code

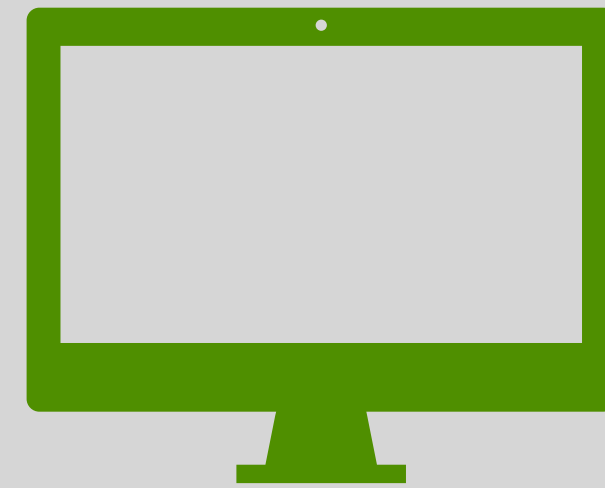
implementation details in a few route specs

eg, prompt for GET /session says “return currently logged in user with karma in same object”

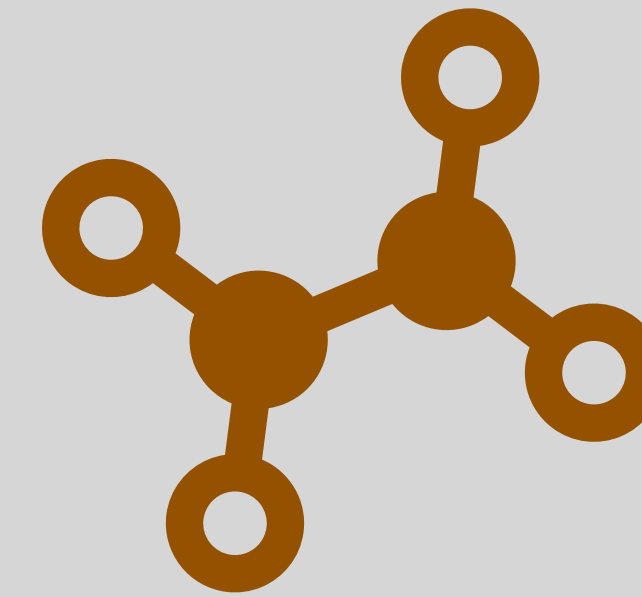
what we're working on



concept catalog
collection of
precoded concepts



front end generation
with reactive DSL
generate CSS too

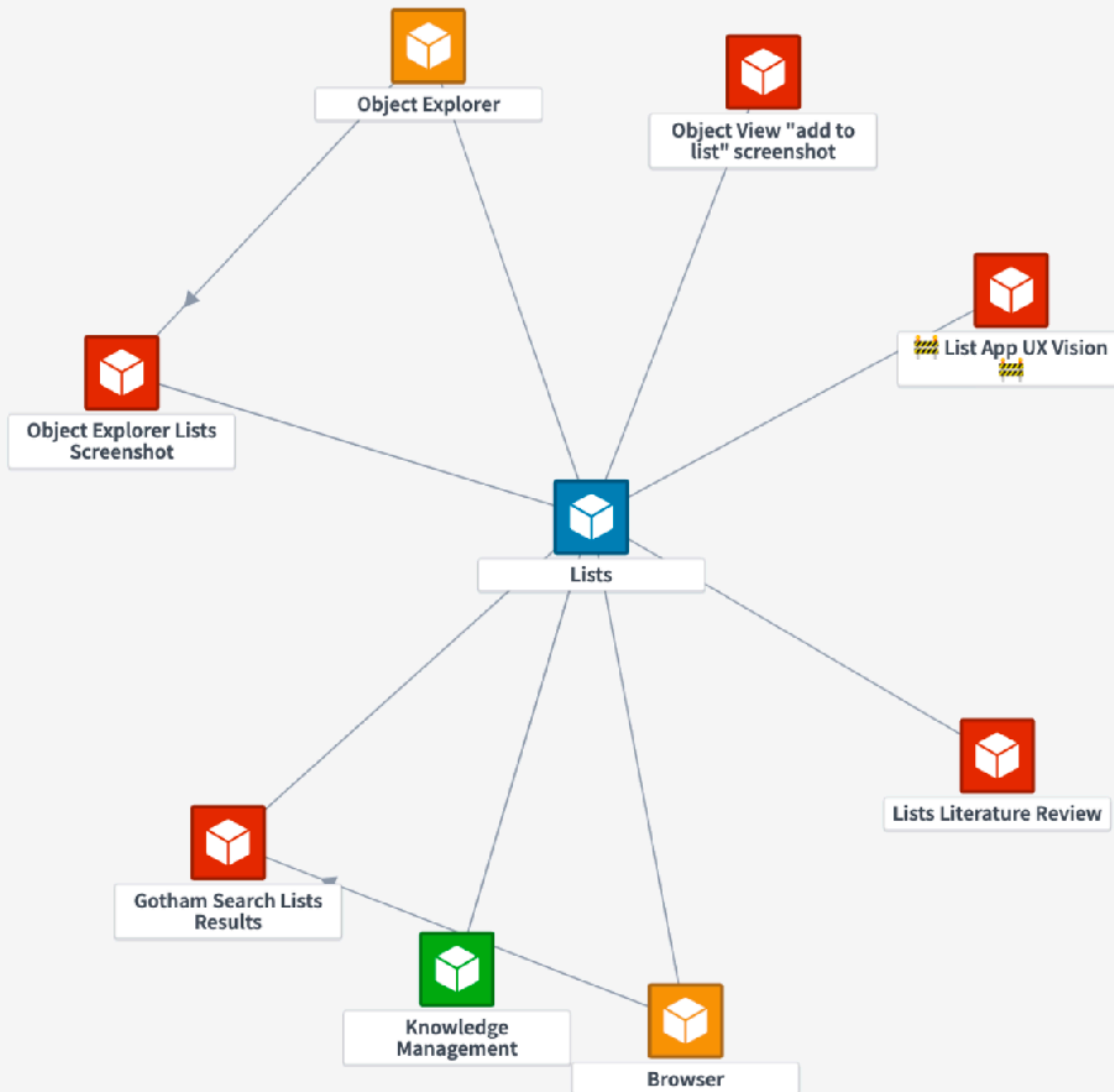


intent graph
integrating prompts
as artifacts

align products
in suite

concepts at Palantir (2023)

Wilczynski et al, arxiv.org/abs/2304.14975



challenges they were facing

issues not attributable to modules or even products
inconsistent UX across products for similar functions
“conceptual entropy”: growing complexity

what they did

integrated concepts into company knowledge base
leaders bootstrapped by writing initial concepts
exploiting existing documents
now 200 concepts recorded, 280 regular users

concepts go beyond engineering

concepts used in marketing; IP lawyers interested too

concepts empower PMs

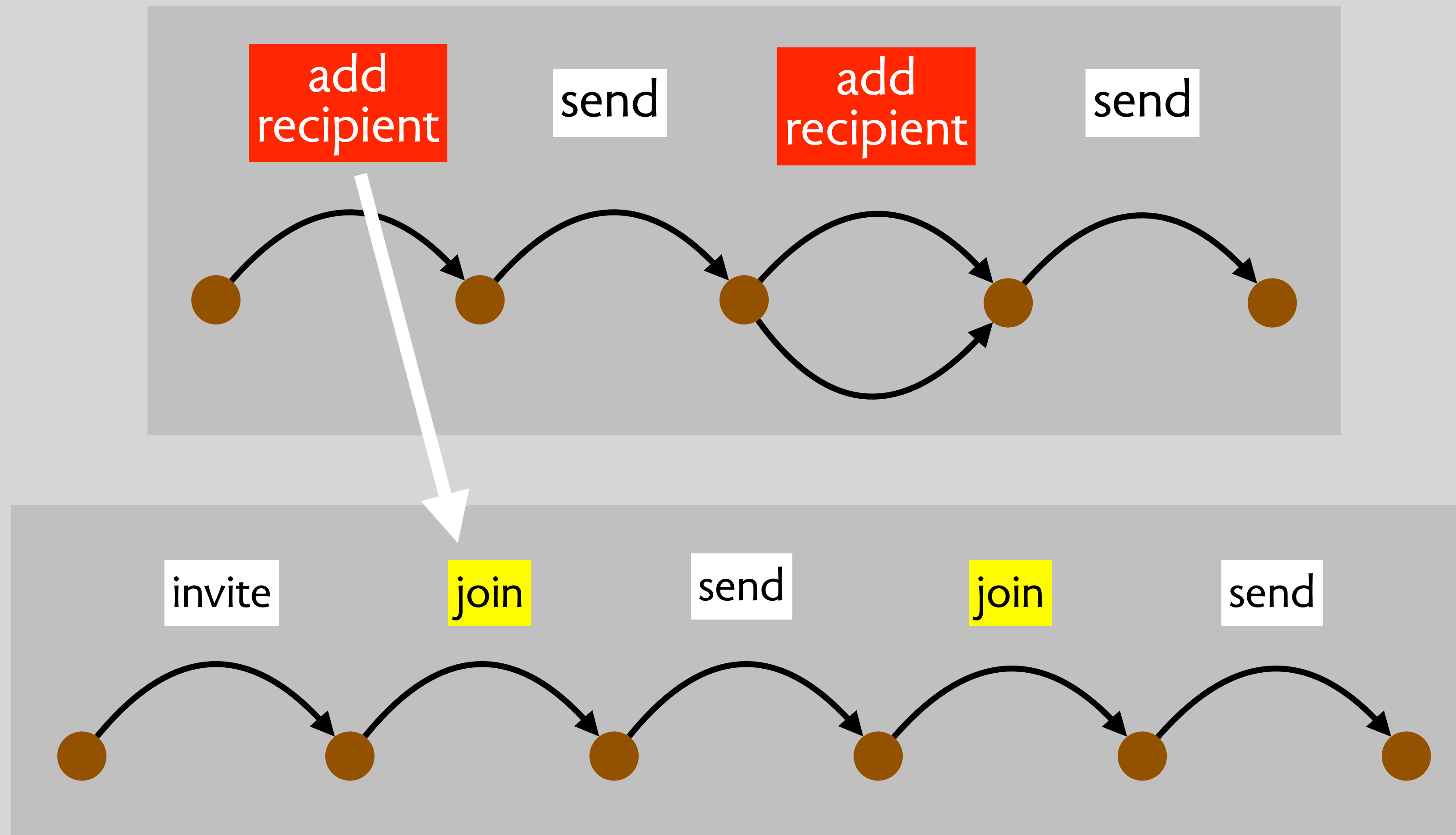
new career path: PMs given ownership of concepts

anticipated impacts

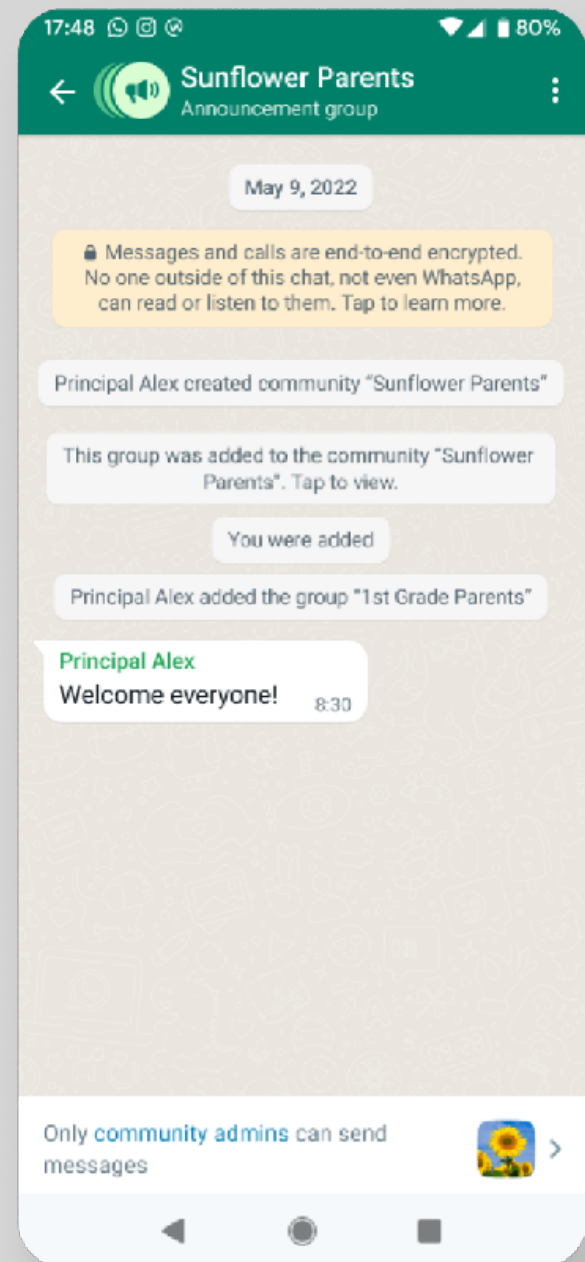
cataloging key assets & avoiding rework
aligning concepts across products, reuse
aligning marketing/design/engineering

takeaways

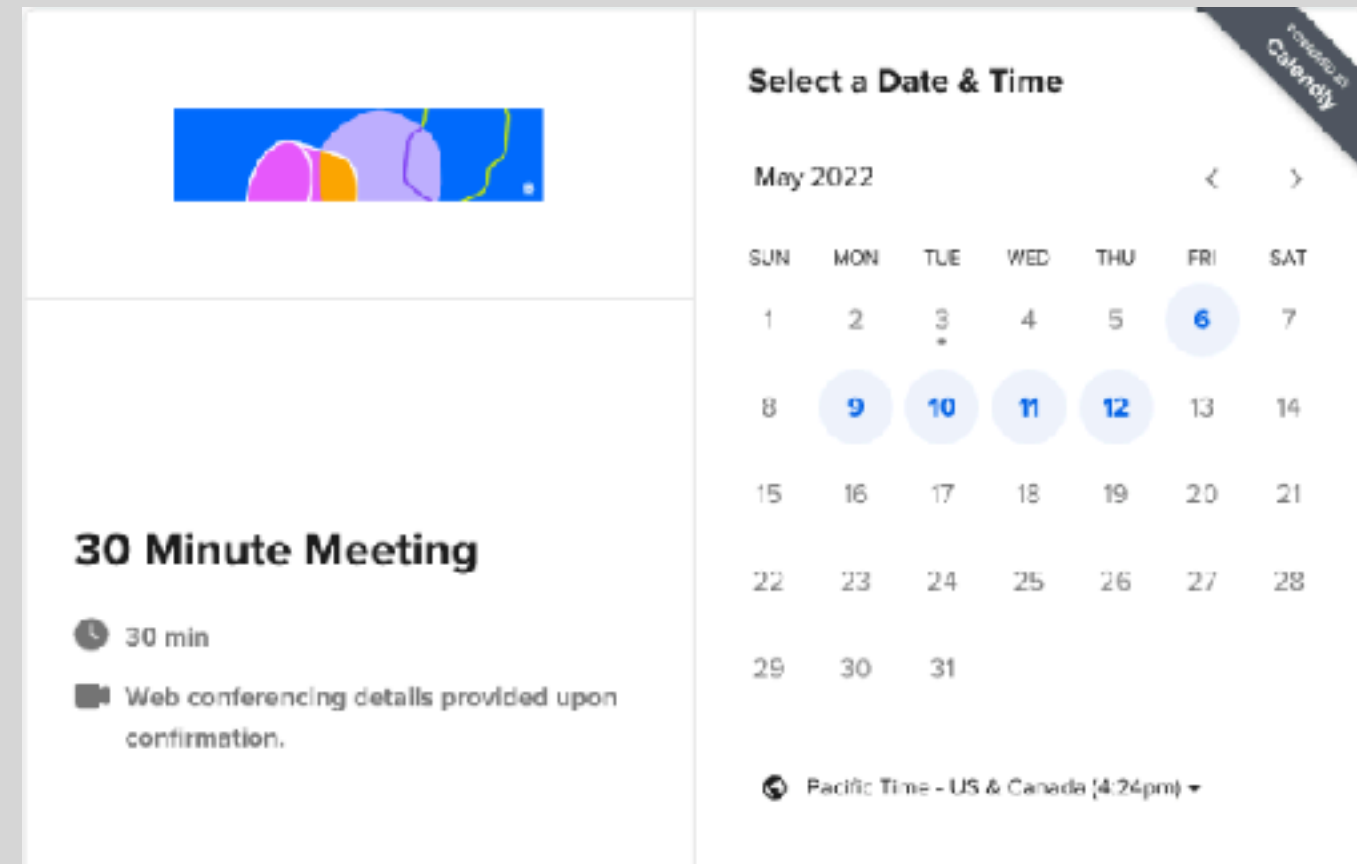
innovations simplify scenarios



design starts with function & concepts help structure it



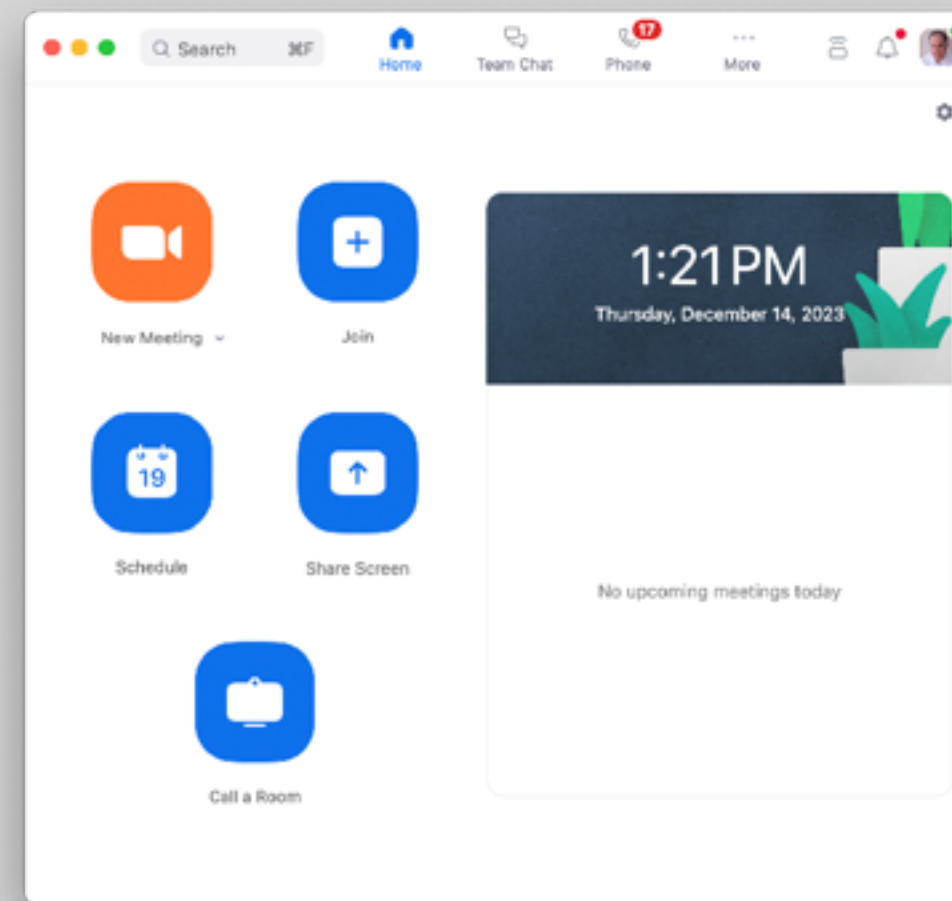
Group



SelfSchedule



Song



MeetingLink

World Wide Web

The WorldWideWeb (W3) is a wide-area [hypermedia](#) information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an [executive summary](#) of the project, [Mailing lists](#), [Policy](#), [November's W3 news](#), [Frequently Asked Questions](#).

[What's out there?](#)

Pointers to the world's online information, [subjects](#), [W3 servers](#), etc.

[Help](#)

on the browser you are using

[Software Products](#)

A list of W3 project components and their current state. (e.g. [Line Mode](#), [X11 Viola](#), [NeXTStep](#), [Servers](#), [Tools](#), [Mail robot](#), [Library](#))

[Technical](#)

Details of protocols, formats, program internals etc

[Bibliography](#)

Paper documentation on W3 and references.

[People](#)

A list of some people involved in the project.

[History](#)

A summary of the history of the project.

[How can I help?](#)

If you would like to support the web..

[Getting code](#)

Getting the code by [anonymous FTP](#), etc.

URL

modularity is key

factor out familiar parts

goodbye agile

**concepts
are fully
independent**

**concepts are
standard,
routes custom**

**specs
matter after all!
code is not king**

CHEERS
湛庐

—卓越工程师系列

Why Concepts Matter for Great Design



为什么有些软件设计得
如此成功，
而有些却很失败

软件设计的要素 Essence of Software

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