

Mobile design with device-to-device networks

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Hi, I'm Felipe!

Work

- ▶ Terranet AB (2014-present)
R&D: mesh networks, direct connectivity, automotive sensors
- ▶ Igalia (2007-2014)
Nokia GNU/Linux devices, GNOME desktop, Android...

Study

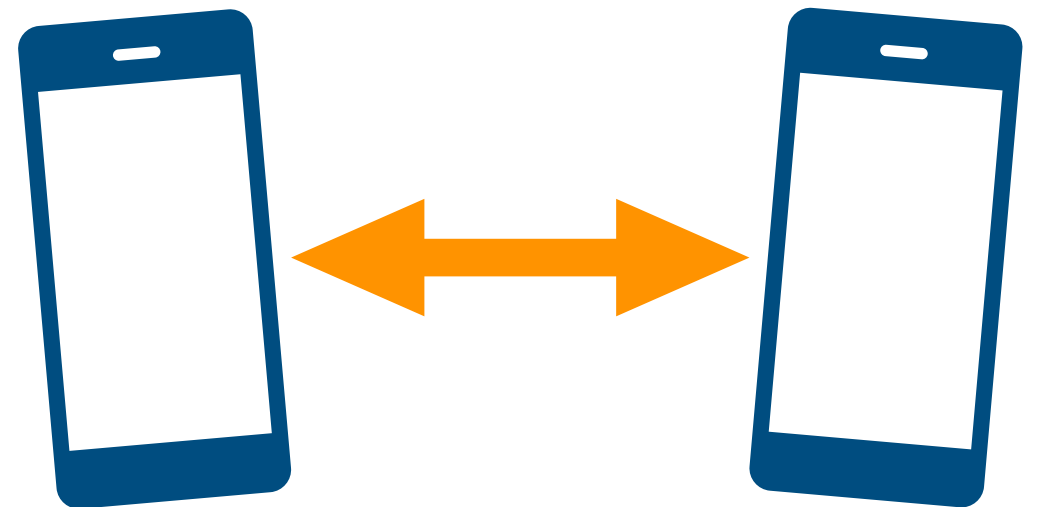
- ▶ SW Engineering (Uni. of Coruña )
- ▶ Human-Computer Interaction (Uni. of York )
- ▶ Interaction Design (Uni. of Malmö )

Direct connectivity

Ad-hoc networks between two or more devices, without any other infrastructure nor Internet access

Technologies

- ▶ Bluetooth, Hotspot, WiFi Direct
- ▶ WiFi Aware, 5G device-to-device



Why now?

- ▶ The technology is becoming fast/convenient/flexible enough to support new interactions

“So what is this for?”

Exploring a new technology and finding out what's possible

- ▶ Engineering p.o.v.: research technology, tinker
- ▶ Design p.o.v.: solve real use cases,
- ▶ Build and test prototypes
- ▶ Critique, reflect

Learn

- ▶ Evolve the underlying technology
- ▶ Define design guidelines
- ▶ ...

WiFi Aware

Based on Neighbour Aware Networking standard

- ▶ Hardware: Qualcomm/Intel/Marvell/Broadcom
- ▶ Qualcomm/Android: open source but behind closed doors
- ▶ Intel: supported by iwlwifi driver on PCs (*“experimental”*)

Node discovery

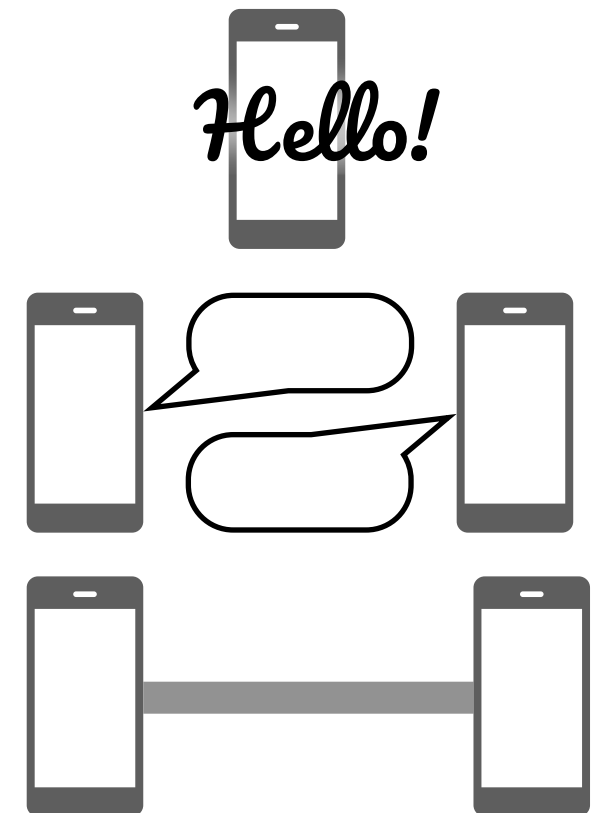
- ▶ Service ID + small payload

Exchange messages without a connection

- ▶ 255 bytes, ~5msg/sec

1-to-1 connections between nodes

- ▶ Limited number (two in Pixel2)



Approaching from the engineering p.o.v.

A tool to test WiFi Aware

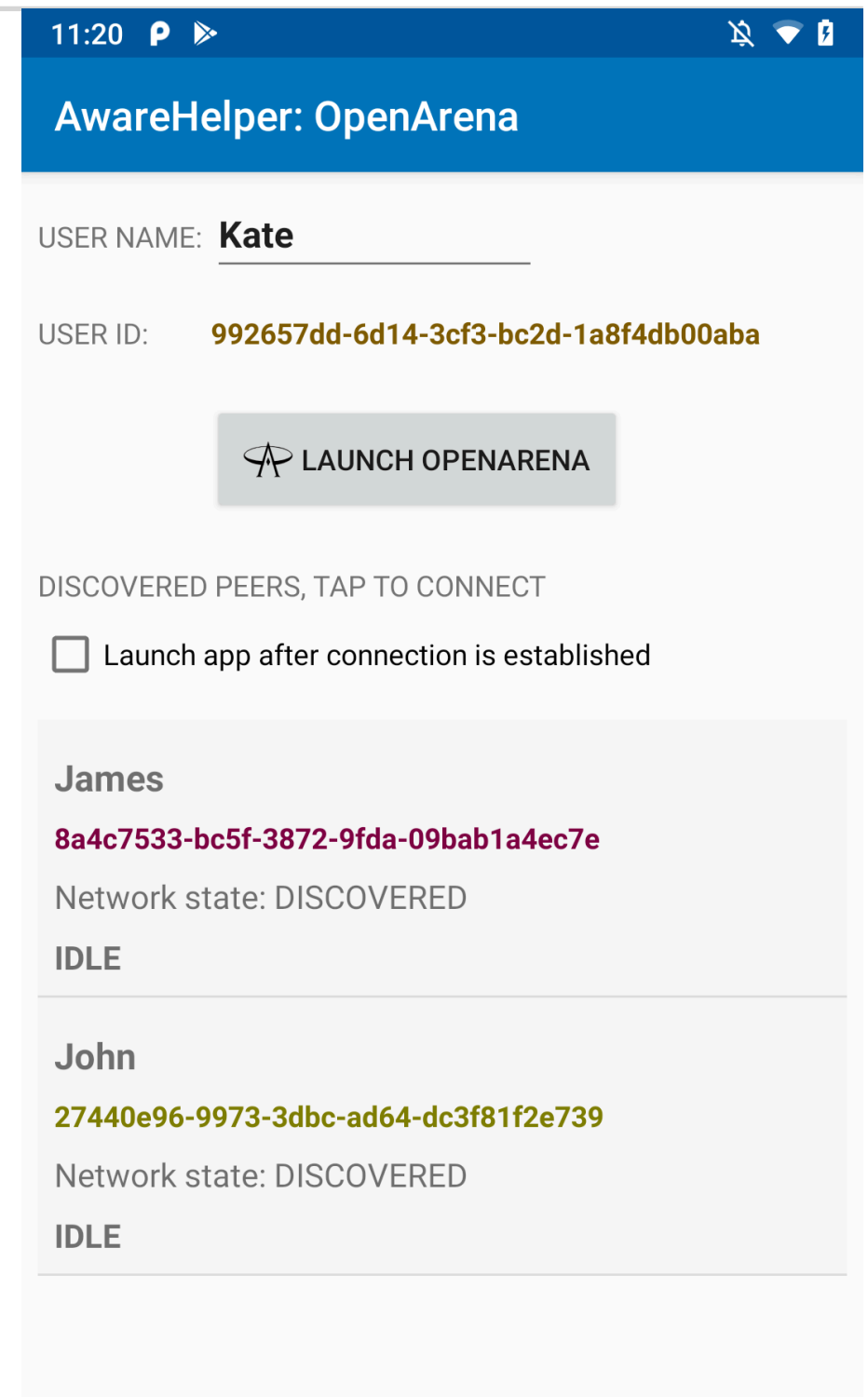
- ▶ Announce
- ▶ Discover peers
- ▶ Connect

Test network topologies

Test other applications

- ▶ Copy remote IP
- ▶ Launch app
- ▶ Paste IP

Tinker




10:45



AwareHelper: OpenArena

USER NAME: **Ann**

USER ID: 27440e96-9973-3dbc-ad64-dc3f81f2e739

 LAUNCH OPENARENA

DISCOVERED PEERS, TAP TO CONNECT

☐ Launch app after connection is established

Beth

8a4c7533-bc5f-3872-9fda-09bab1a4ec7e

Network state: CONNECTED

IDLE

fe80::26:eff:fea3:c630%aware_data0

Connected to
fe80::26:eff:fea3:c630%aware_data0


10:45



AwareHelper: OpenArena

USER NAME: **Beth**

USER ID: 8a4c7533-bc5f-3872-9fda-09bab1a4ec7e

 LAUNCH OPENARENA

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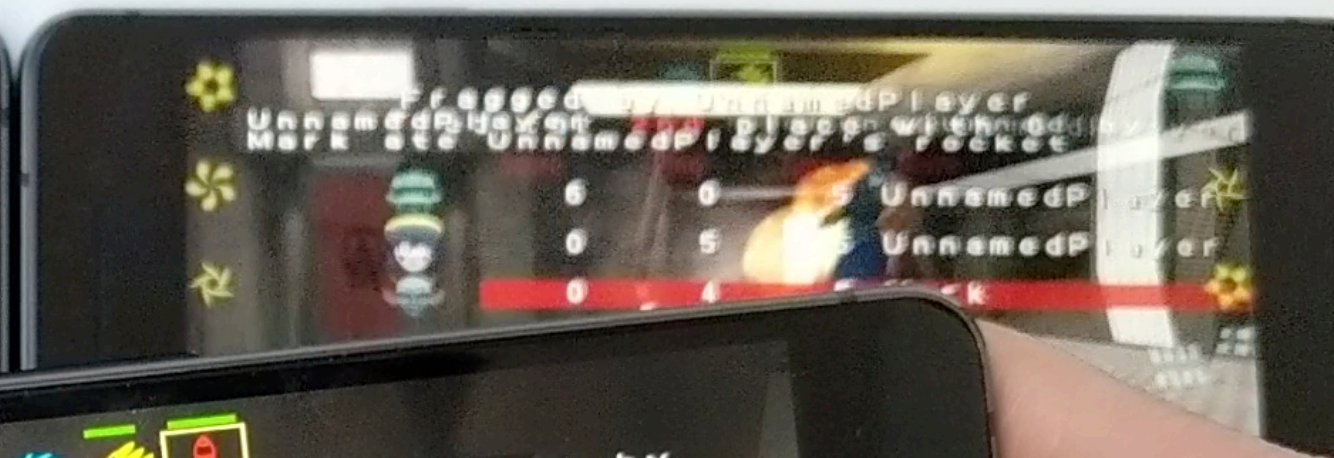
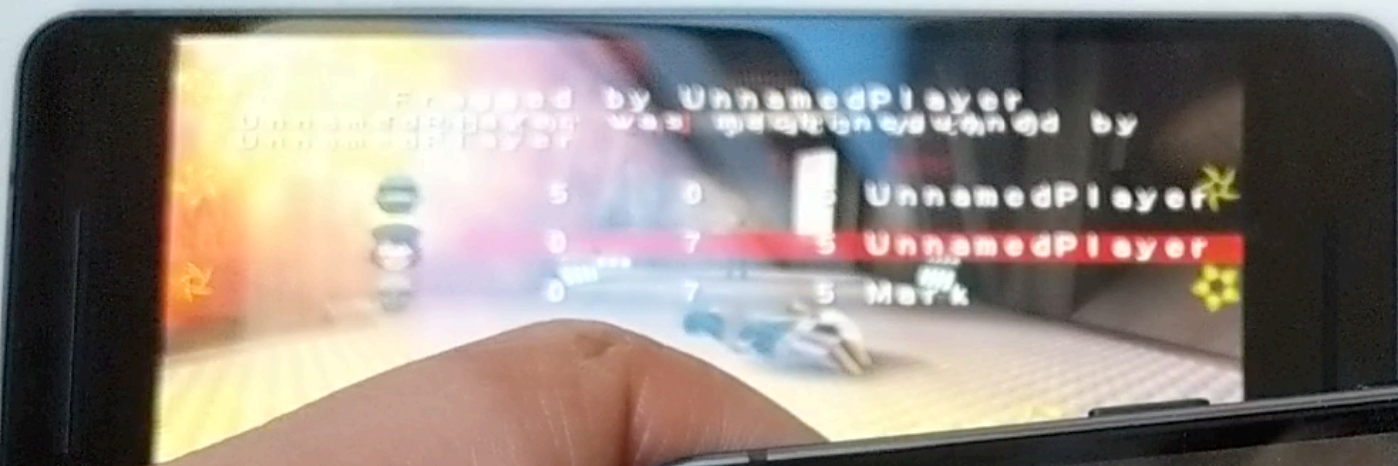
Network state: CONNECTED

IDLE

fe80::1c:20ff:fe50:40c%aware_data0

Connected to fe80::1c:
20ff:fe50:40c%aware_data0





Tinkering: what have we learned?

It works!

Flexible prototypes

- ▶ Each network technologies has its trade-offs
- ▶ Some prototypes have used 5 different technologies

Quite a bit of work to do

- ▶ Better APIs
- ▶ Better support from protocols/tools/libraries/apps

Possible privacy concerns

- ▶ Service announcements are public and can be faked

Approaching from the design p.o.v.

Research: find real use cases

Design a solution

Create a prototype

Test the prototype

Evaluate, critique, reflect

- ▶ What worked? What didn't?
- ▶ Which assumptions were mistaken?
- ▶ What was surprising?
- ▶ Any new opportunities?
- ▶ Patterns and guidelines?

Interaction Design Master project (2015)

University of Malmö + Terranet AB

Research questions:

- ▶ How could meetings and presentations become more collaborative?
- ▶ How could mesh networks improve collaboration in a work context?
- ▶ What other possibilities open up when we are able to connect devices with one another?

Insights and implications for design

Presentations are usually one-way and linear

- ▶ One person talking almost all of the time

But when people share their own content → collaborative

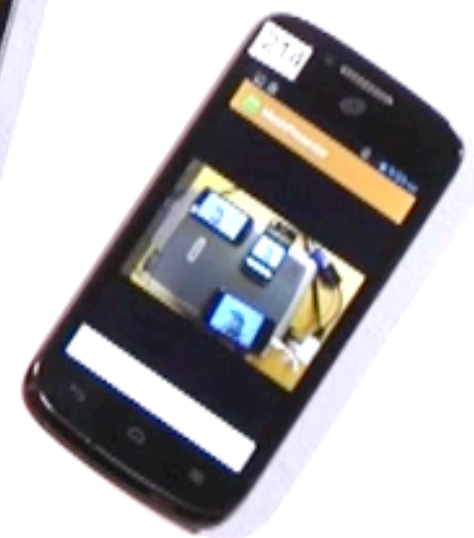
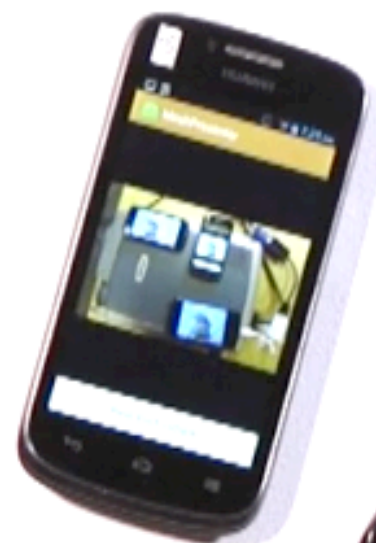
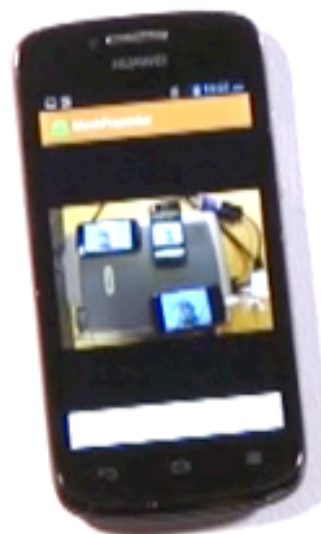
- ▶ The presenter becomes a moderator?

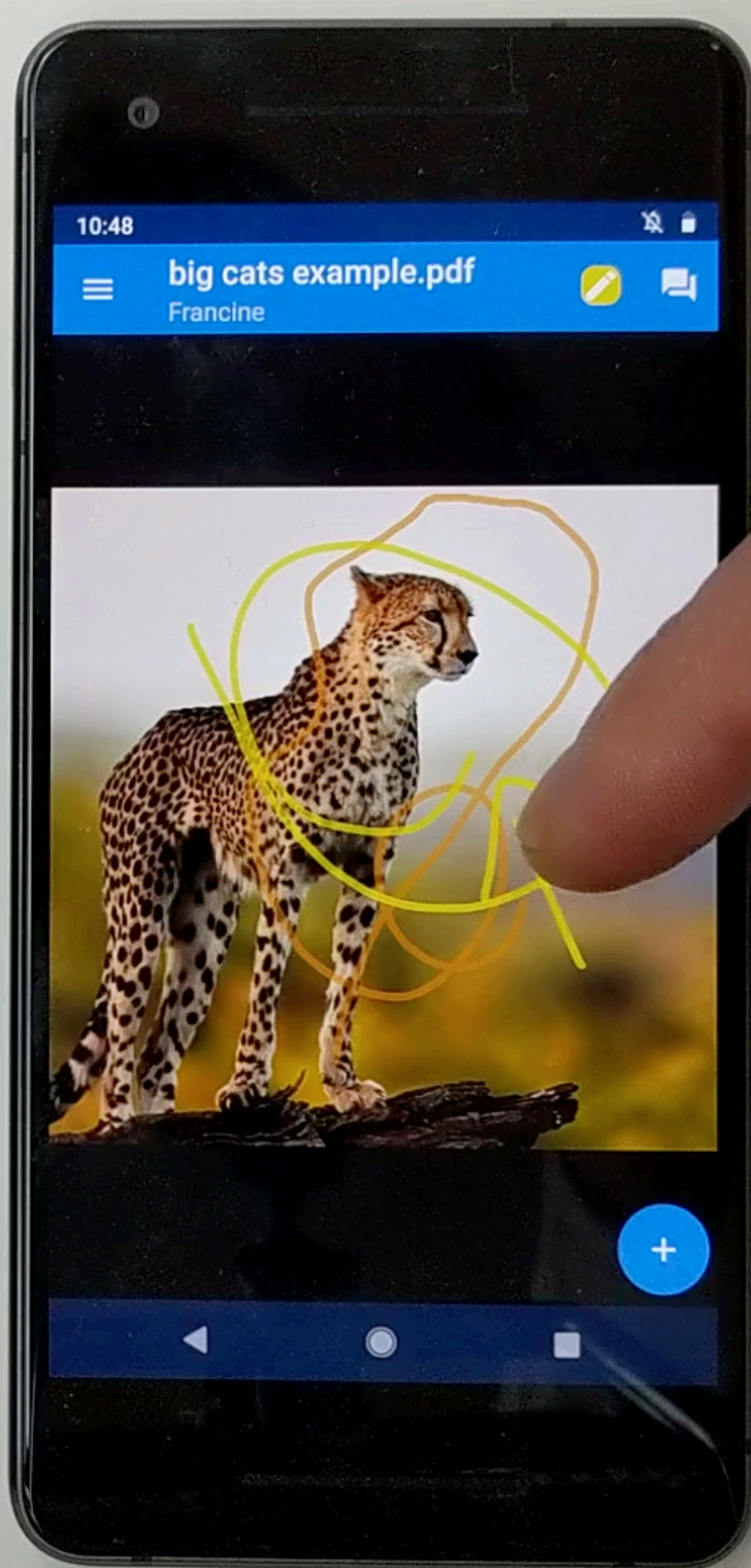
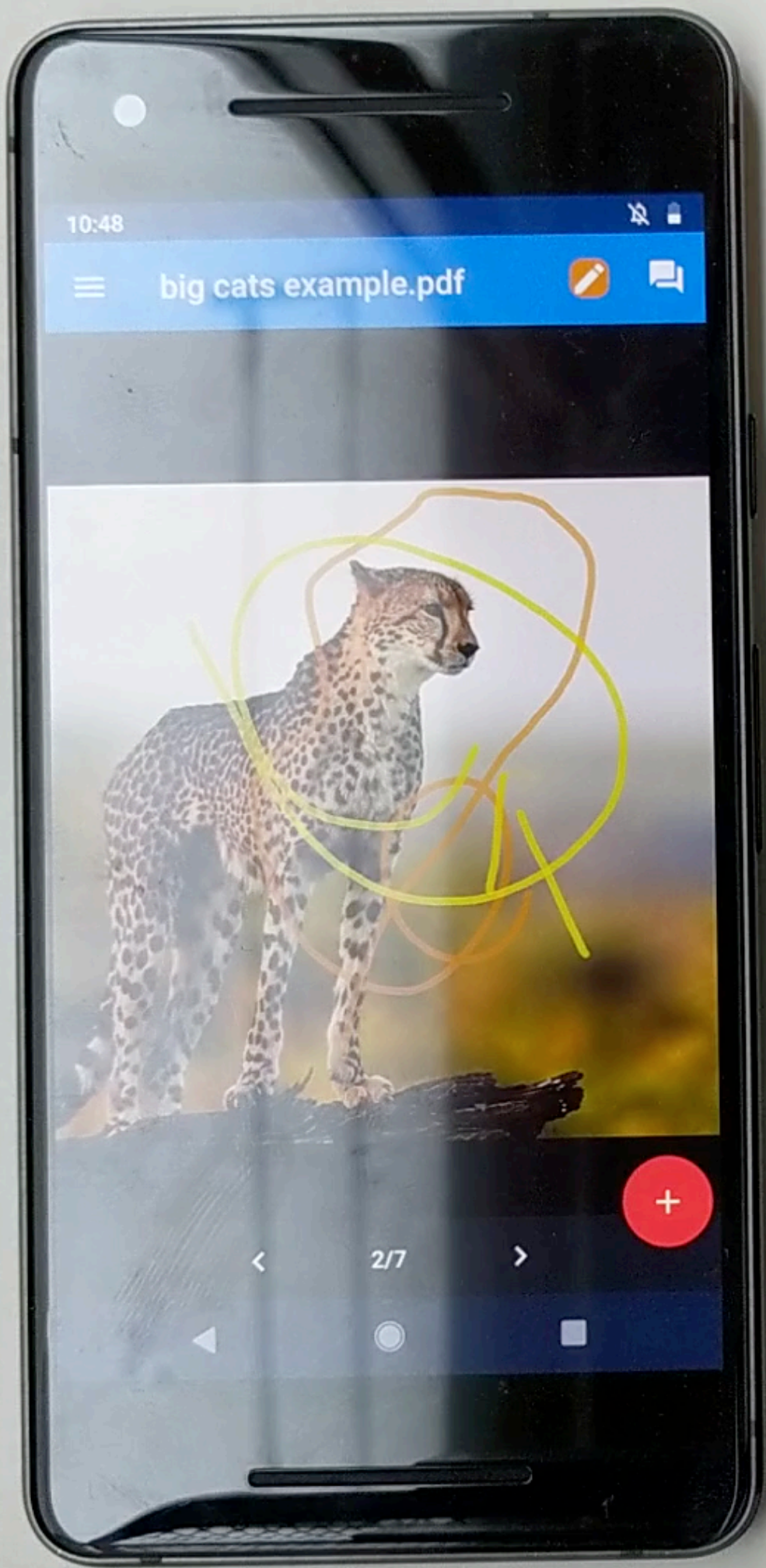
Social choreography, physical actions

- ▶ Tapping phones to start

When people can interrupt, we get more social interaction

- ▶ In tests, the presentation became more shared and open





10:57



presentation_iotap_sma...

Francine



Collaborative presentations

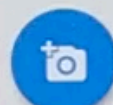
Context

- Presentations tend to become monologues
- Access to the projector is an issue
- Emergent configurations of connected components

Design considerations

- Choreography to start the meeting
- Current slide appears in all phones
- Fluid interaction between presenter and audience
- Audience can easily display their images
- Encourages sharing and collaboration

Take photo



Share Image



Share PDF



10:57



presentation_iotap_sma...



Collaborative presentations

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3/13



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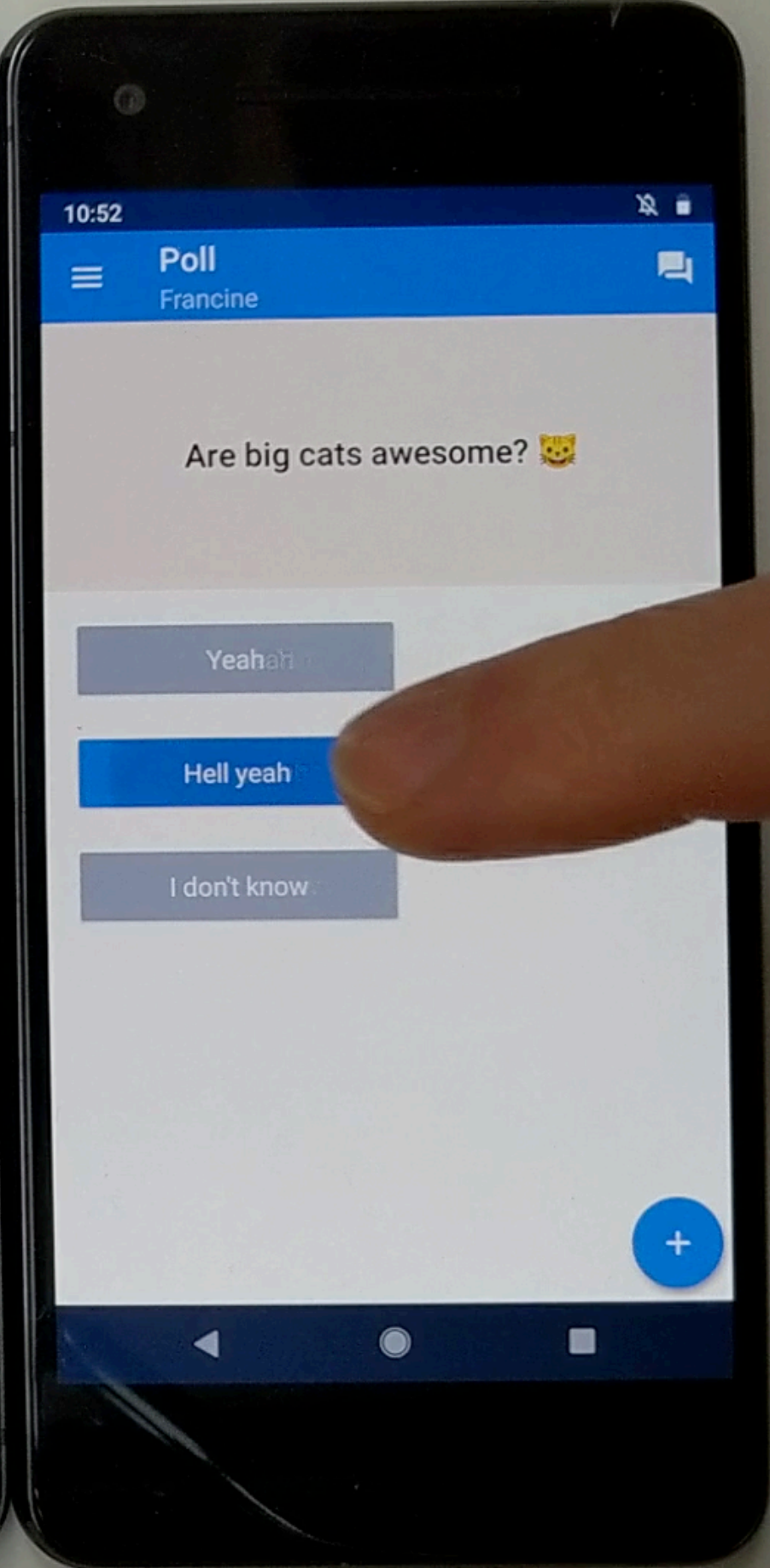
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Design: what have we learned?

Very flexible tool to quickly sketch other use cases:

- ▶ Drawing, annotating PDF, share camera...
- ▶ A demanding testbed (5 diff techs)

The prototype is very good for demos&communication

- ▶ (as long as we are there to set it up!)

Hard to get people onboard on their own

- ▶ Need at least two devices
- ▶ Different mental model: hard for people to understand

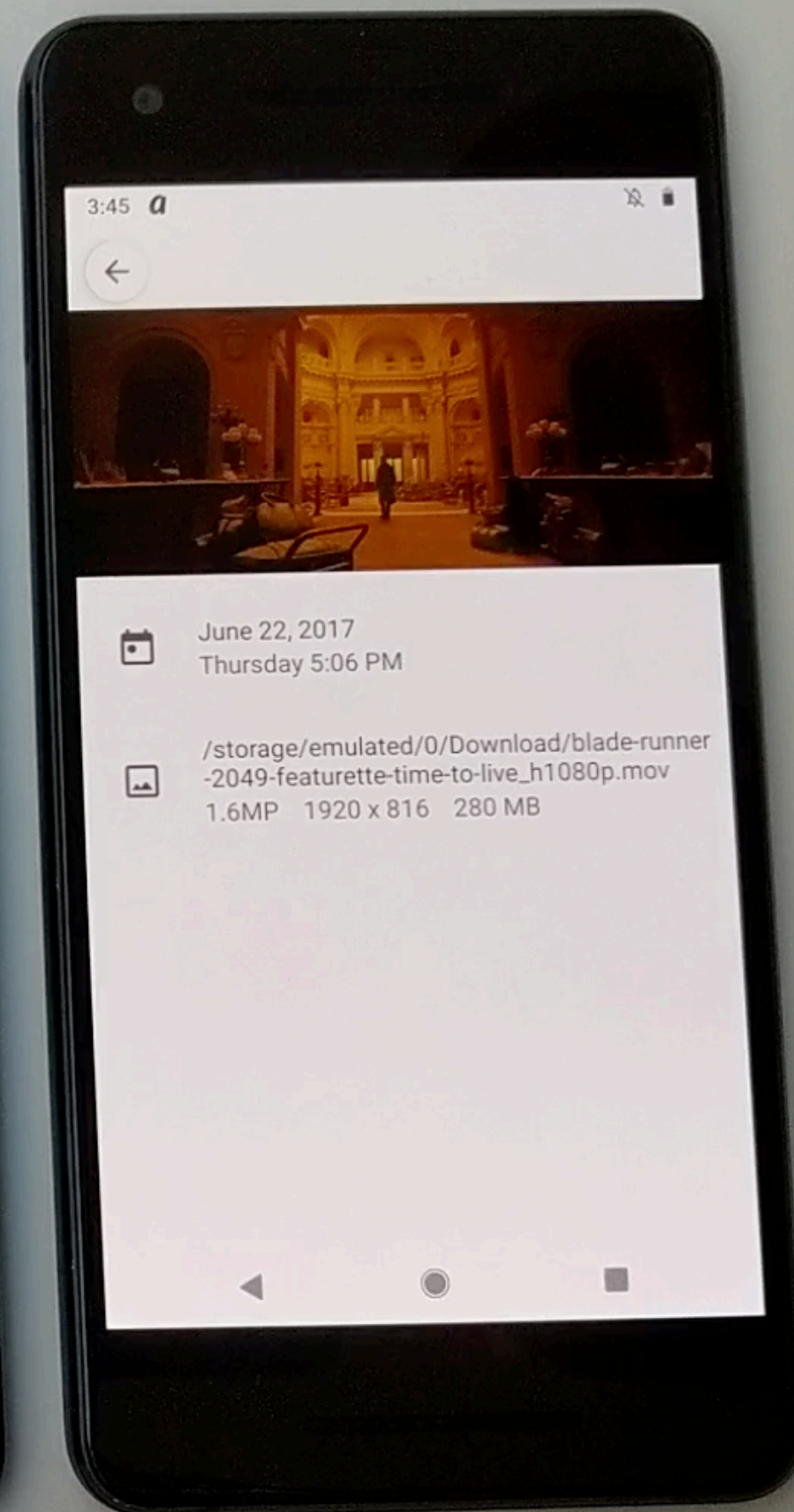
Next project: AwareBeam

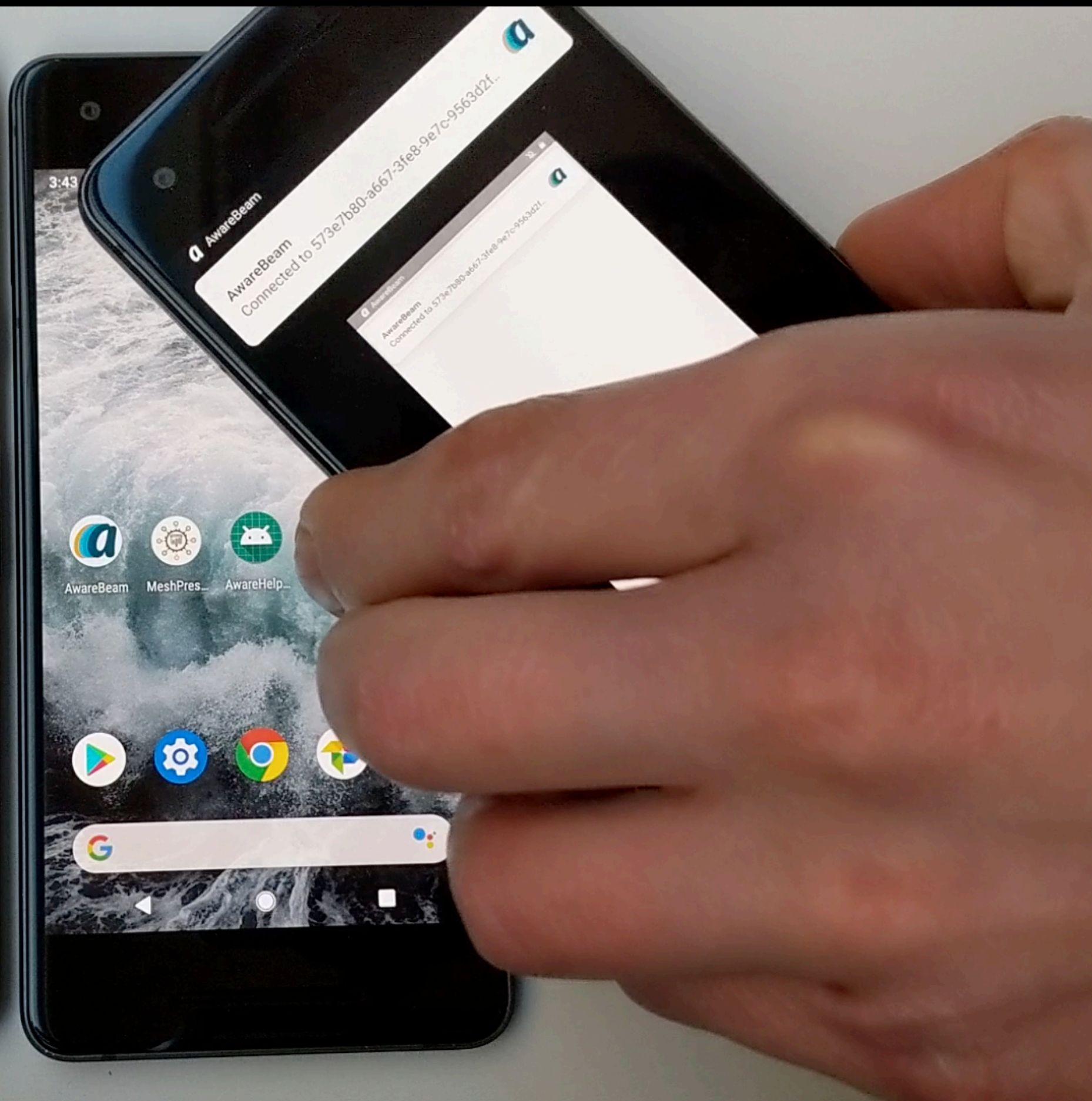
A small focused tool, not a large one

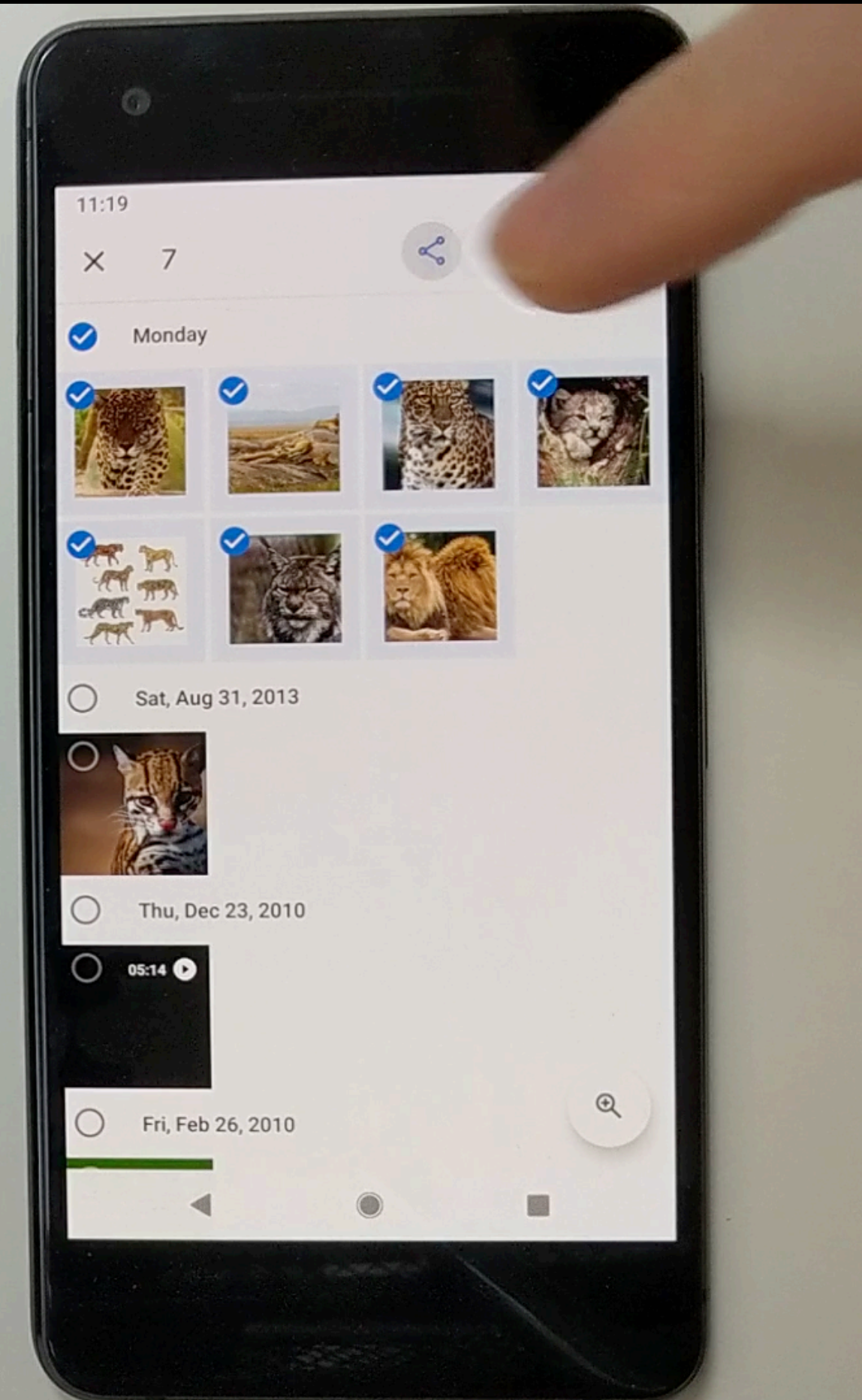
- ▶ Make common tasks more convenient
- ▶ Use tapping to trigger the work

Small fluid interaction

- ▶ Select media to share
- ▶ Tap phones (NFC)
- ▶ Connection is automatically established
- ▶ Files are sent
- ▶ Done!







Next areas to explore

Improved privacy

- ▶ Service announcements are public and can be faked
- ▶ How can we make it so your friends can recognise you, but everyone else can not?

Video streaming

- ▶ Share cameras in real time
- ▶ Some protocols don't support WiFi Aware (e.g. WebRTC)

Automotive

- ▶ Detect pedestrians/cars (*“see around corners”*)

Implications for design

“Nearby social” tools

- ▶ Tools that are aware of the people around us and support us when we are collaborating with them, in a way that can be much more context-aware and private than an Internet-based solution

Look for scenarios where this tech makes sense

- ▶ E.g. small tools, complementing existing apps...

The right mental model

- ▶ Search for a simple mental model of how the tech works
- ▶ Explore embodied interactions to communicate how the network will work: tap to connect, photo...

Exploring a new design space

Combine different approaches

From the design point of view

- ▶ Find real use cases
- ▶ Reflect and analyse how existing practices might evolve

From the technology point of view

- ▶ Tinker, experiment, understand limitations...
- ▶ Build flexible prototypes (mockup unexpected scenarios)

Work on how to communicate

- ▶ Usefulness (*“why should I use this?”*)
- ▶ Mental model (*“what do I need to understand to use this?”*)

Thank you

Get in touch!

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