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 underlaying 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
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

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

LAUNCH OPENARENA

DISCOVERED PEERS, TAP TO CONNECT
Launch app after connection is established

Ann
27440e96-9973-3dbc-ad64-dc3f81f2e739
Network state: CONNECTED
IDLE
fe80::26:eff:fea3:c630%aware_data0

Connected to
fe80::1c:20ff:fe50:40c%aware_data0
You fragged UnnamedPlayer
1st place with 1
UnnamedPlayer
Tinkering: what have we learned?

It works!

Flexible prototypes
- Each network technology 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
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
Are big cats awesome? 😸

- Yeah: 1
- Hell yeah: 0
- I don't know: 0

Share results with the audience
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't?

**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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