Lecture: Multi-Screen Design

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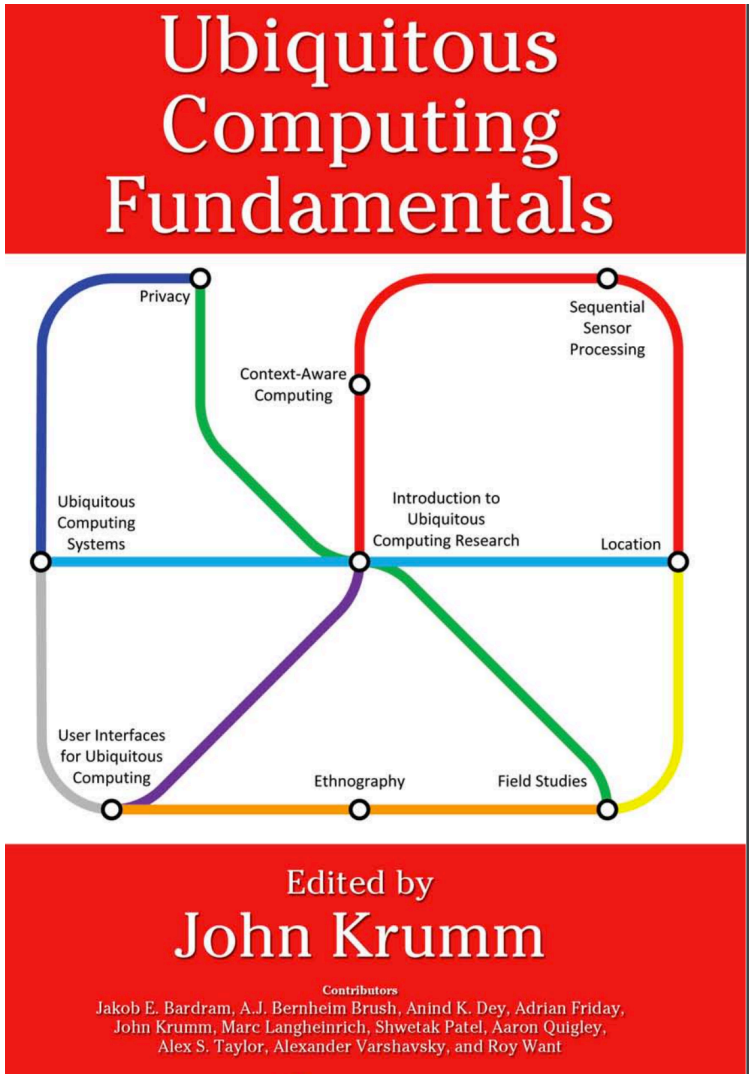
BACKGROUND MATERIAL



Krumm, John, ed. Ubiquitous computing fundamentals. CRC Press, 2016.

Background material

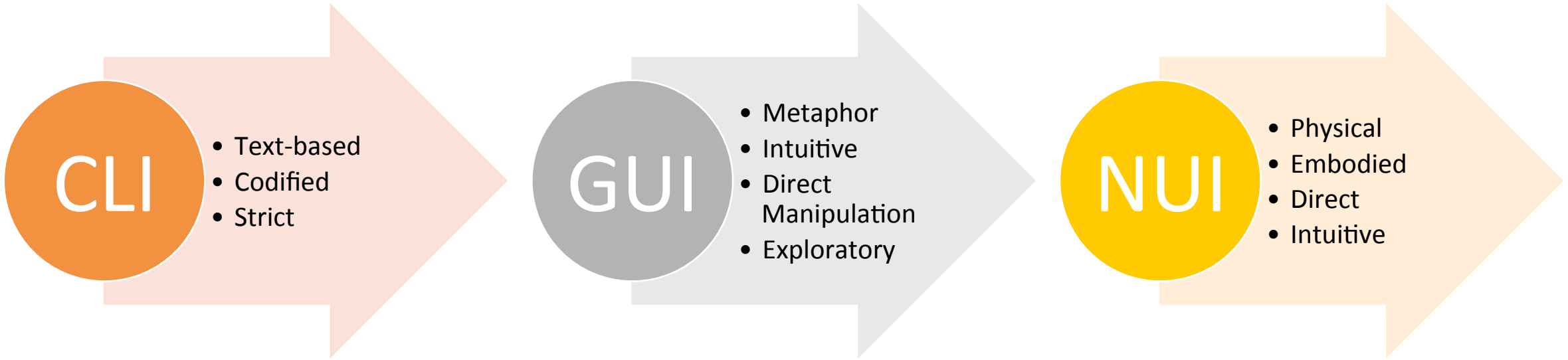
Nagel, Wolfram. *Multiscreen UX Design: Developing for a Multitude of Devices*. Morgan Kaufmann, 2015.

Ubiquitous Computing

PART 1 | MULTI-SCREEN DESIGN

HISTORY

50-70s: text-based **Command Line Interfaces** (CLI)
80-90s: emergence of **Graphical User Interfaces** (GUI)
2000s: start of natural and **Natural User Interfaces** (NUI)




Xerox Parc 1991

UBIQUITOUS COMPUTING

The Computer for the 21st Century

Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence

by Mark Weiser

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti. Candy wrappers are covered in writing. The constant background presence of these products of "literacy technology" does not require active attention, but the information to be transmitted is ready for use at a glance. It is difficult to imagine modern life otherwise.

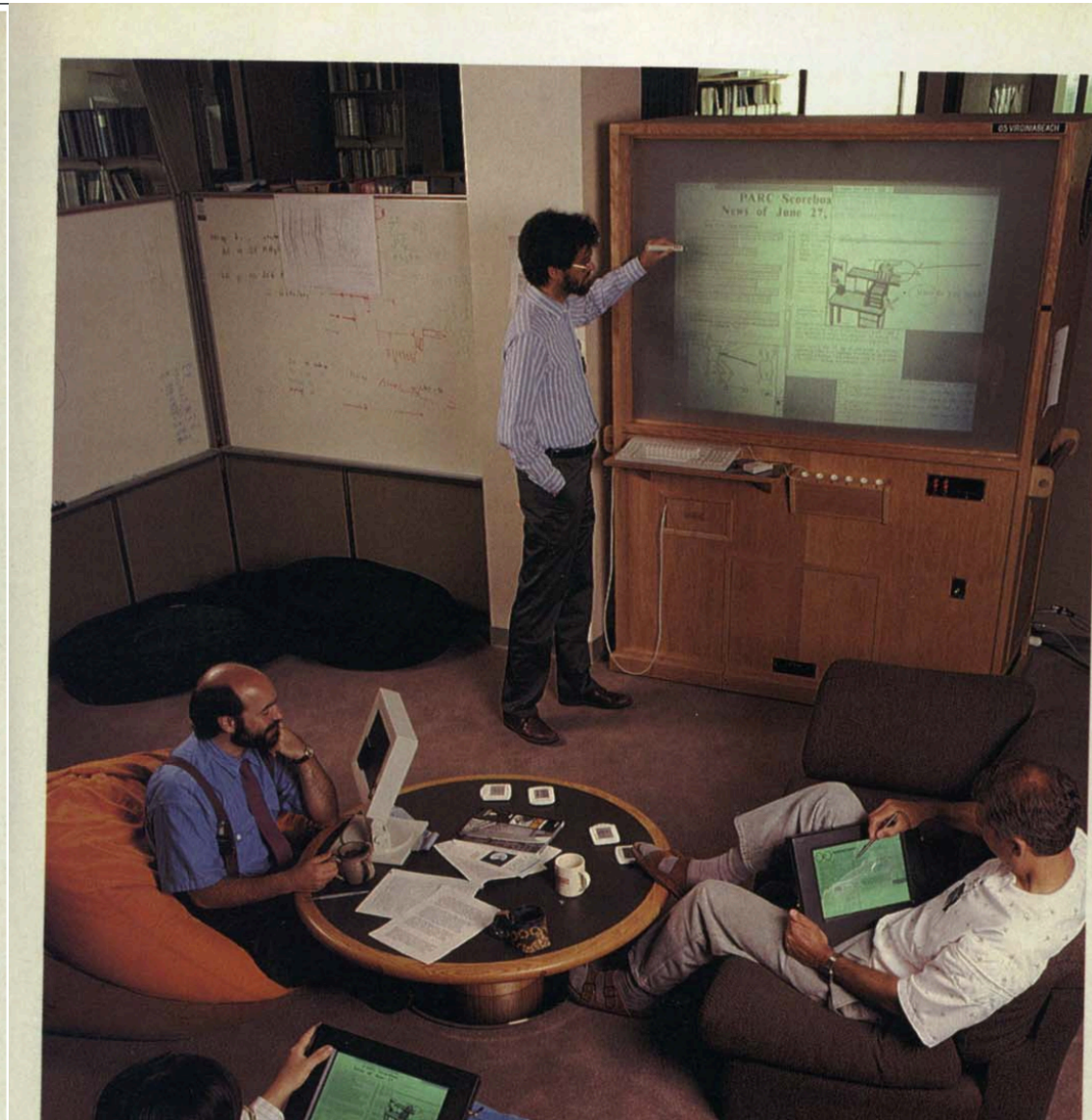
Silicon-based information technology, in contrast, is far from having become part of the environment. More than 50 is approachable only through complex jargon that has nothing to do with the tasks for which people use computers. The state of the art is perhaps analogous to the period when scribes had to know as much about making ink or baking clay as they did about writing.

The arcane aura that surrounds personal computers is not just a "user interface" problem. My colleagues and I at the Xerox Palo Alto Research Center think that the idea of a "personal" computer itself is misplaced and that the vision of laptop machines, dynabooks and "knowledge navigators" is only a transitional step toward achieving the real potential of information technology. Such machines cannot truly make computing an integral, invisible part of people's lives. We are therefore trying to conceive a new way of thinking about computers, one that takes into account the human world and allows the computers themselves to vanish into the background.

The idea of integrating computers seamlessly into the world at large runs counter to a number of present-day trends. "Ubiquitous computing" in this context does not mean just computers that can be carried to the beach, jungle or airport. Even the most powerful notebook computer, with access to a worldwide information network, still focuses attention on a single box. By analogy with writing, carrying a superlaptop is like owning just one very important book. Customizing this book, even writing millions of other books, does not begin to capture the real power of literacy.

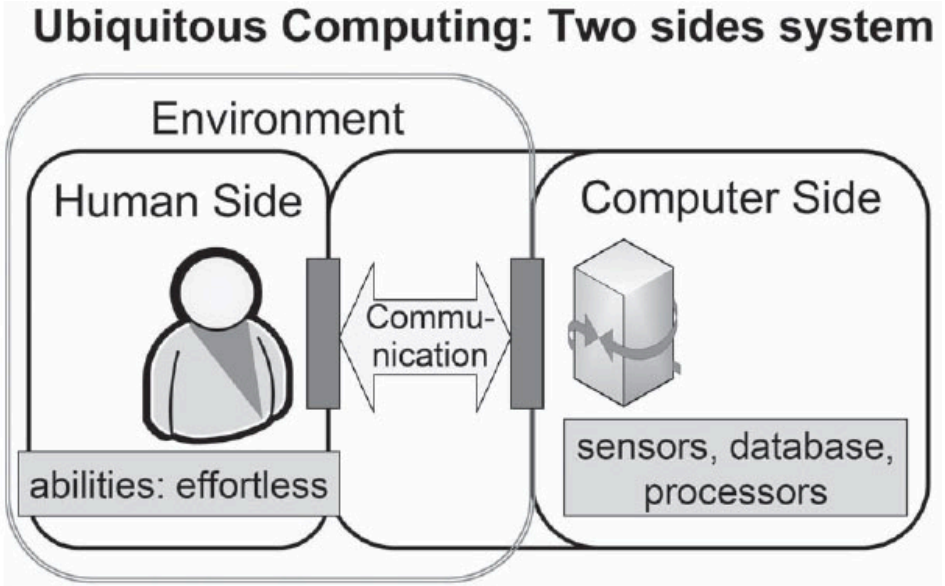
Furthermore, although ubiquitous computers may use sound and video in addition to text and graphics, that does not make them "multimedia computers." Today's multimedia machine makes the computer screen into a demanding focus of attention rather than allowing it to fade into the background.

Perhaps most diametrically opposed to our vision is the notion of virtual re-



UBIQUITOUS COMPUTING

Computers **blend** into the **environment** and become **invisible** (or transparent).



Sensors can **recognize** human action in the environment and suggest new interactions.

Devices of different sizes and **shapes**: pads, tabs and boards

UBIQUITOUS COMPUTING

Established the idea that devices could have **different** form **factors** and work in unity.

Computing **devices** could be as "**ubiquitous**" as **paper documents**.

Shared by **people** and used as part of our day to day work in offices.

Combine **stationary**, **mobile** and **desktop** devices.

UBIQUITOUS COMPUTING

Based on idea that computing is "**situated**" or contextual.

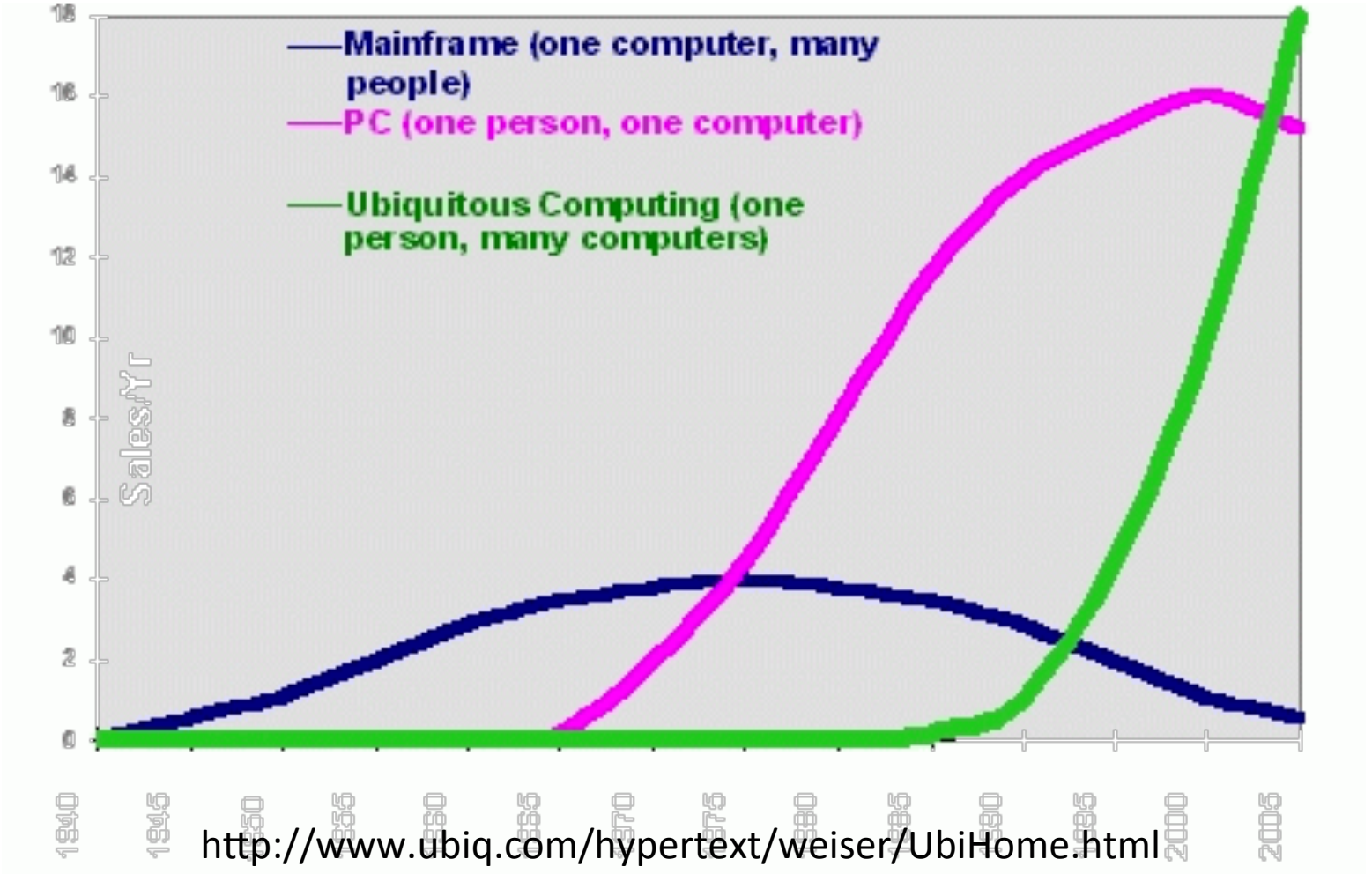
You interact with a certain type of computer for specific **reasons**.

Activity-centric computing (users' task or activity).

Context-aware computing (environment).

Proxemic computing (space).

UBIQUITOUS COMPUTING



http://www.ubiq.com/hypertext/weiser/UbiHome.html

MULTIPLE DEVICES/SCREENS

People increasingly **access information** or content through **different types** of devices.

Different **form** factors.

Different **input** methods.

Choose devices with most appropriate **affordances**

TYPES OF DEVICES

Stationary devices: desktop, smart-TV, interactive surfaces, large displays, consoles,..

Mobile devices: smartphones, music players, tablets, e-readers,…

Wearable devices: smartwatch, google Glass,…

1. STATIONARY DEVICES

Fixed to one **location** or space.

Bulky, **heavy** and **large.**

Computationally **strong**.

A lot of **display** real **estate**.

Designed for **focused** work and **collaboration.**

2. MOBILE DEVICES

Support **mobile** and **nomadic** use.

Often **touch input** devices.

Smaller and **easier** to carry.

One **hand** use.

Designed for **individual**.

App-based.

3. WEARABLE DEVICES

Support **mobile** and **nomadic** use.

Body-worn devices connected to other mobile devices.

Designed for **general use** but often also used for **medical** or **fitness** purposes.

Various **form factors.**

Multi-Device Usage?

PART 2| MULTI-SCREEN DESIGN

REAL-WORLD USE

Study by Facebook:

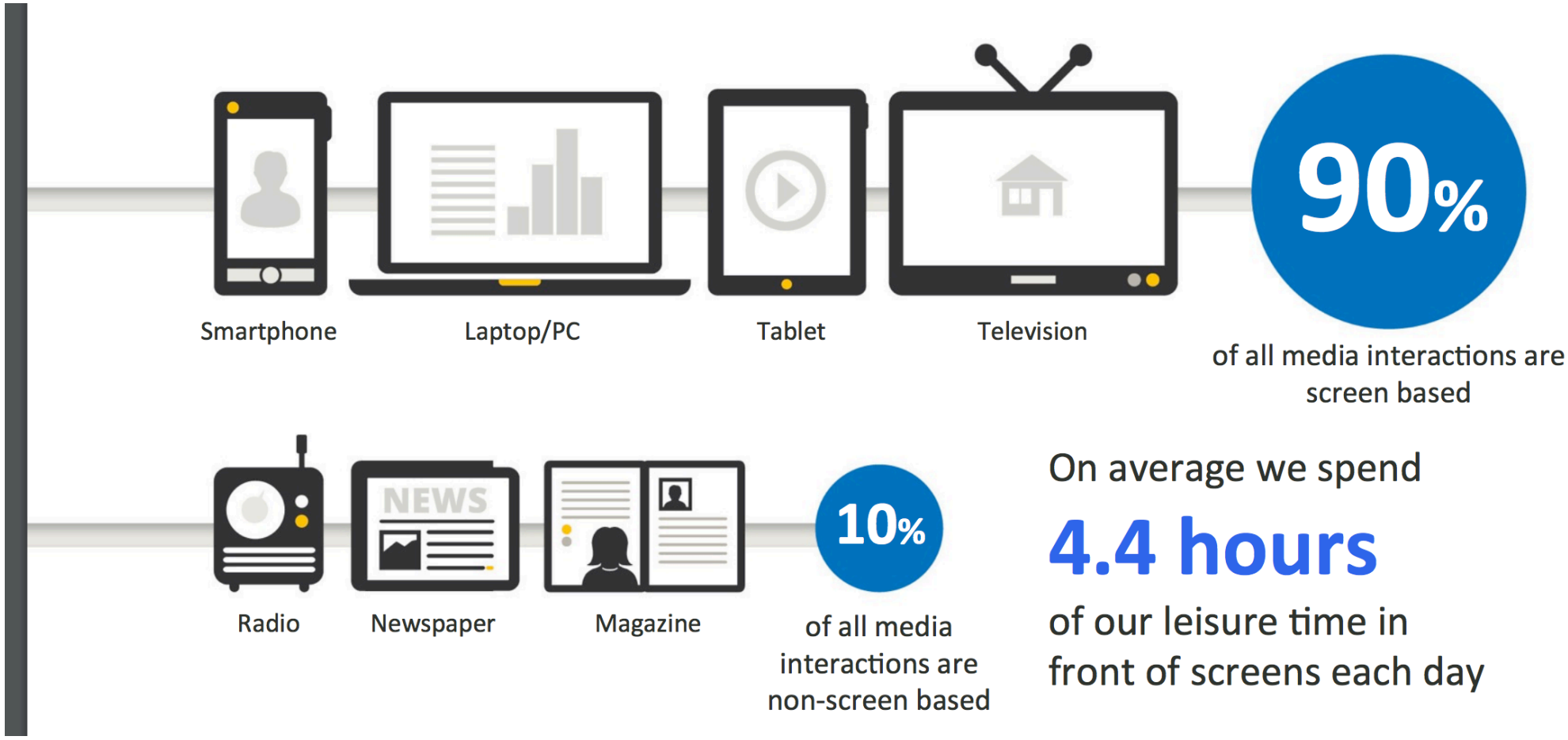
60% of people use at least **two devices**.
40% of people start an **activity** on device and **switch** to another to finish/complete it.
76% use **smartphone** for **communication**
43% **share tablets** with others
80% use **laptop/desktop** as **main** work machine

MULTIPLE DEVICES/SCREENS

Study by Google:

1. People **use multiple** screens
2. **Sequential** vs **simultaneous** screening
3. **Choice** of **device** driven by context of use
4. **TV** has become a **peripheral** device
5. **Search** is the most common used cross-device application.
6. We **split attention** across devices
7. **Smartphones** have **highest use**
8. Multiple screens creates perception of **efficiency**

REAL-WORLD USE

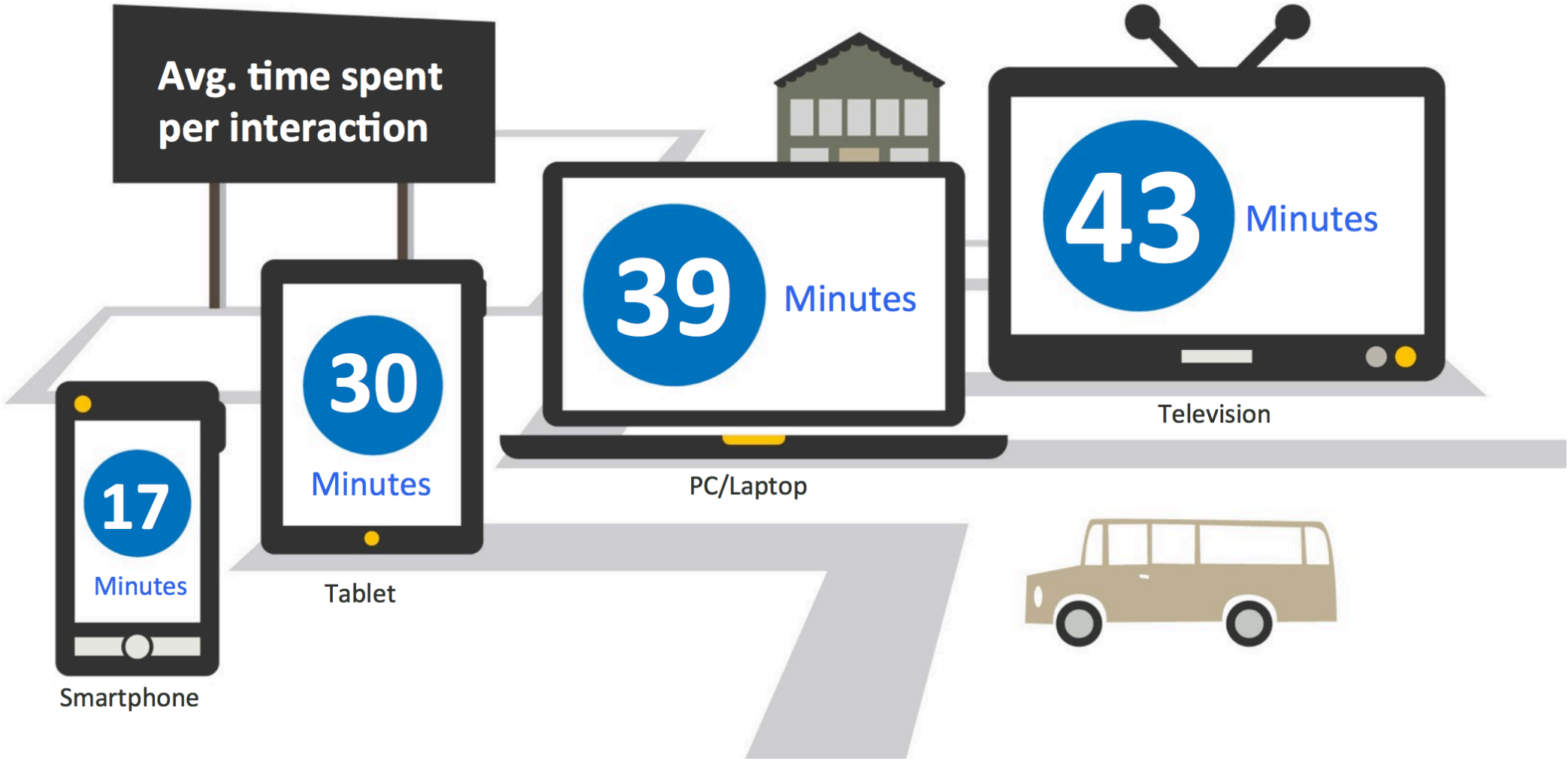


On average we spend

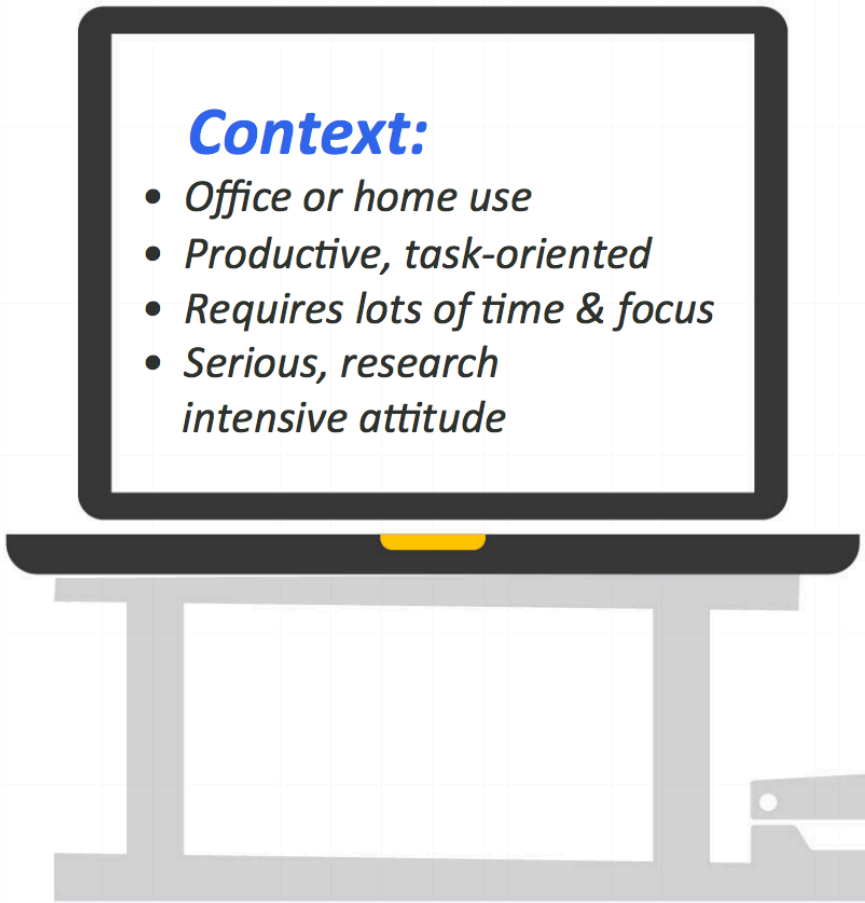
4.4 hours

of our leisure time in front of screens each day

REAL-WORLD USE



REAL-WORLD USE

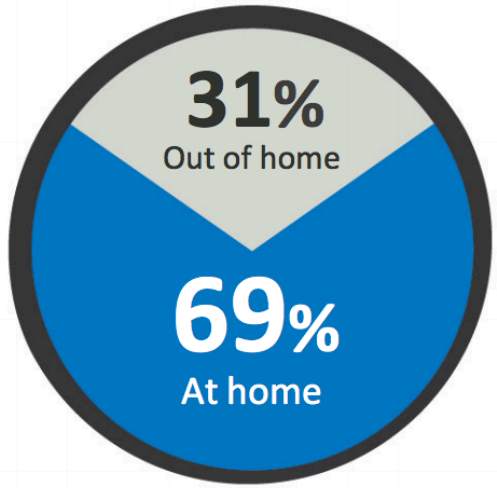


Context:

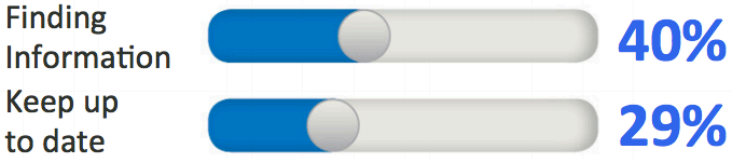
- *Office or home use*
- *Productive, task-oriented*
- *Requires lots of time & focus*
- *Serious, research intensive attitude*

24%

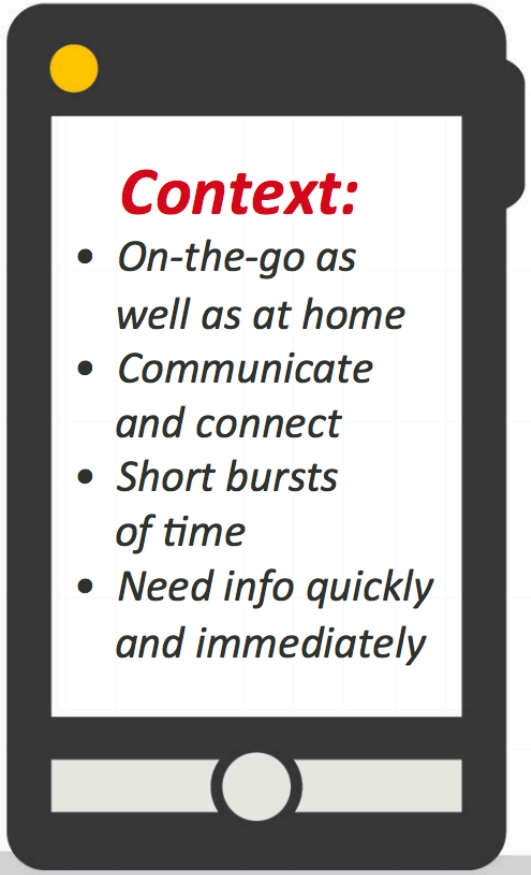
of our daily media interactions occur on a PC



PC use is motivated by:



REAL-WORLD USE

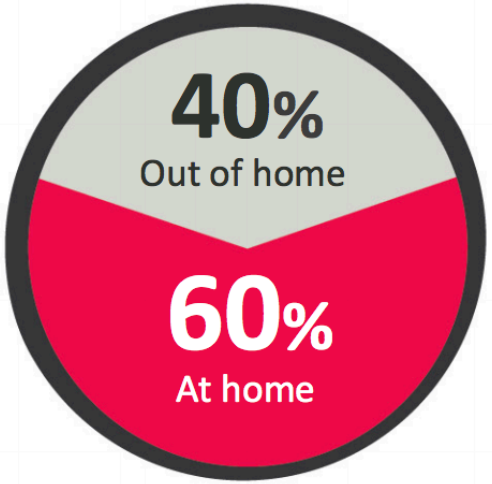


Context:

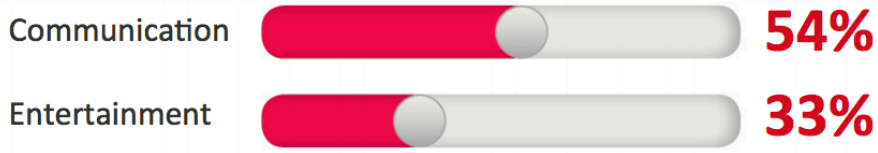
- *On-the-go as well as at home*
- *Communicate and connect*
- *Short bursts of time*
- *Need info quickly and immediately*

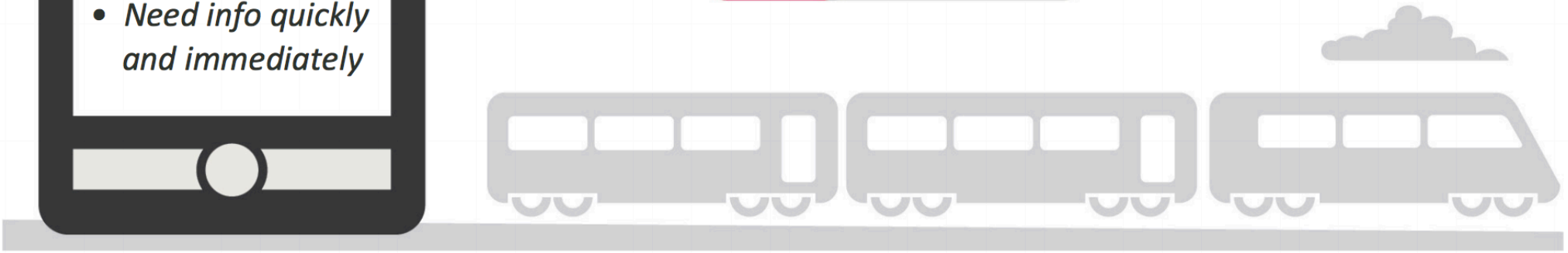
38%

of our daily media interactions occur on a smartphone

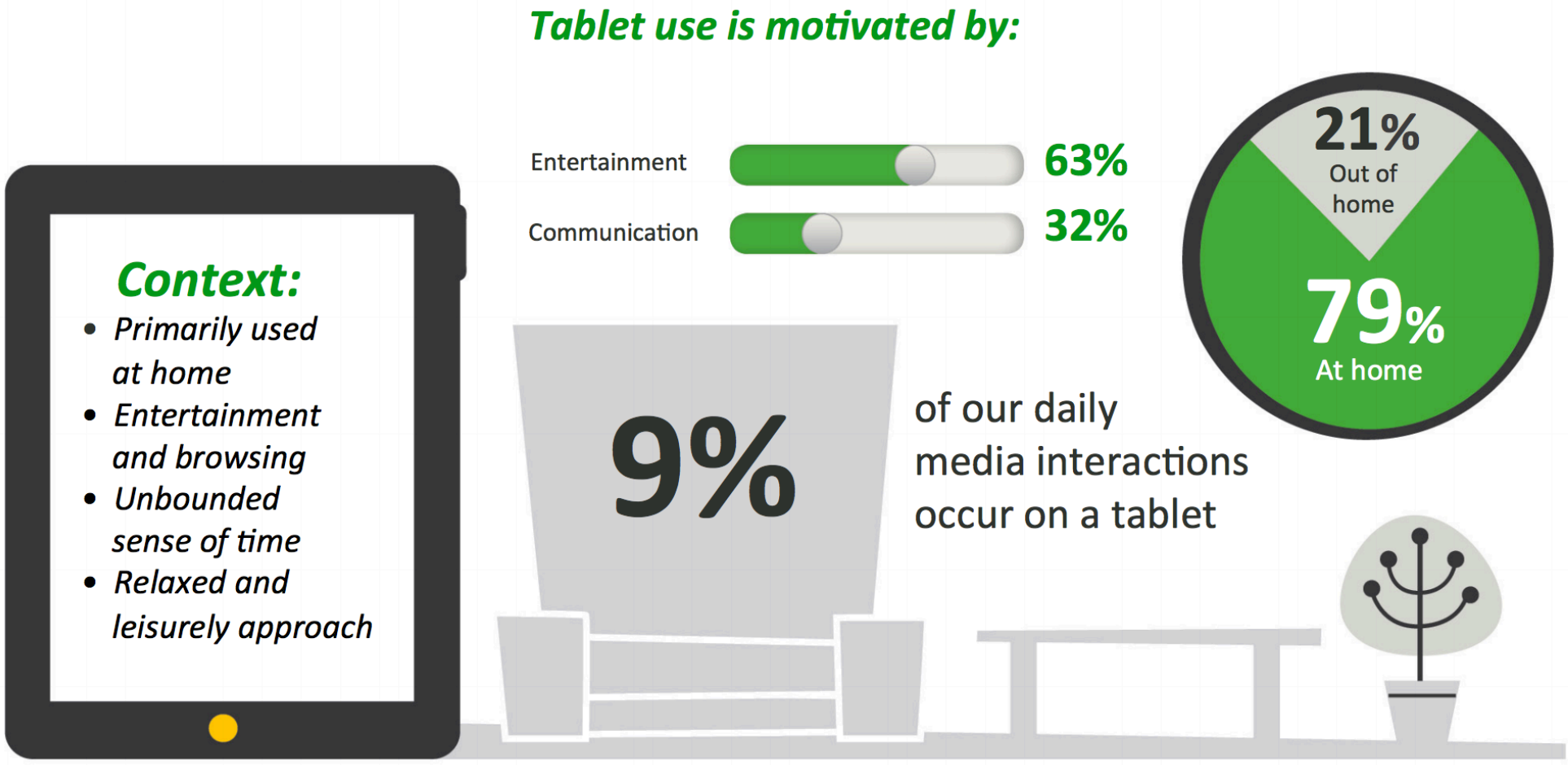


Smartphone use is motivated by:



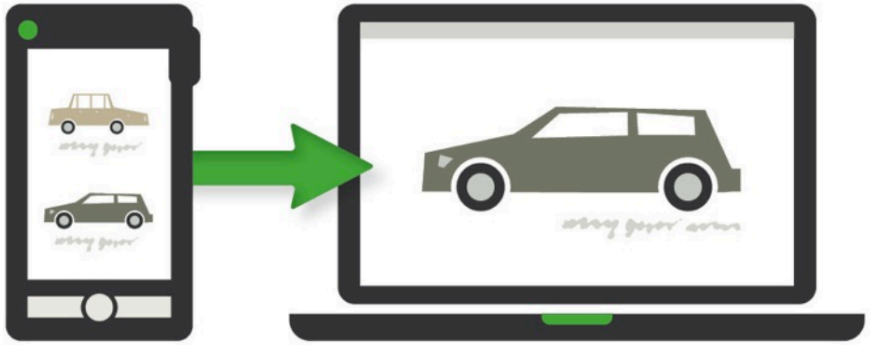


REAL-WORLD USE

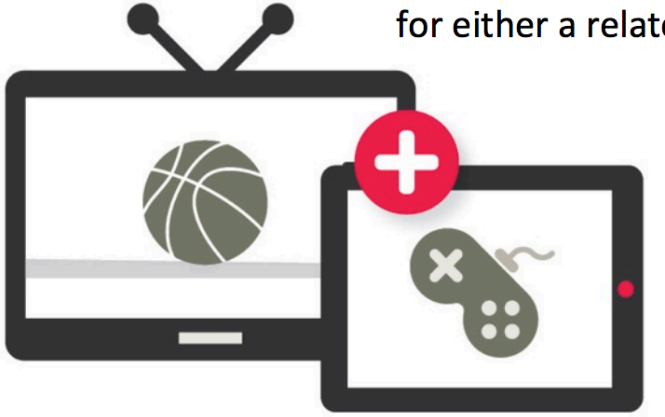


REAL-WORLD USE

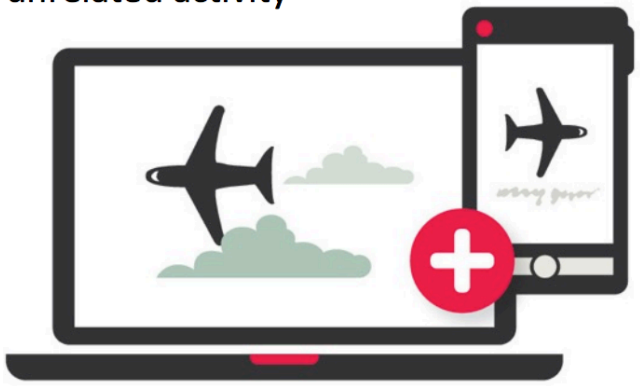
Sequential Usage
Moving from one device to another at different times to accomplish a task



Simultaneous Usage
Using more than one device at the same time for either a related or an unrelated activity



Multi-tasking - Unrelated activity



Complementary Usage - Related activity

REAL-WORLD USE

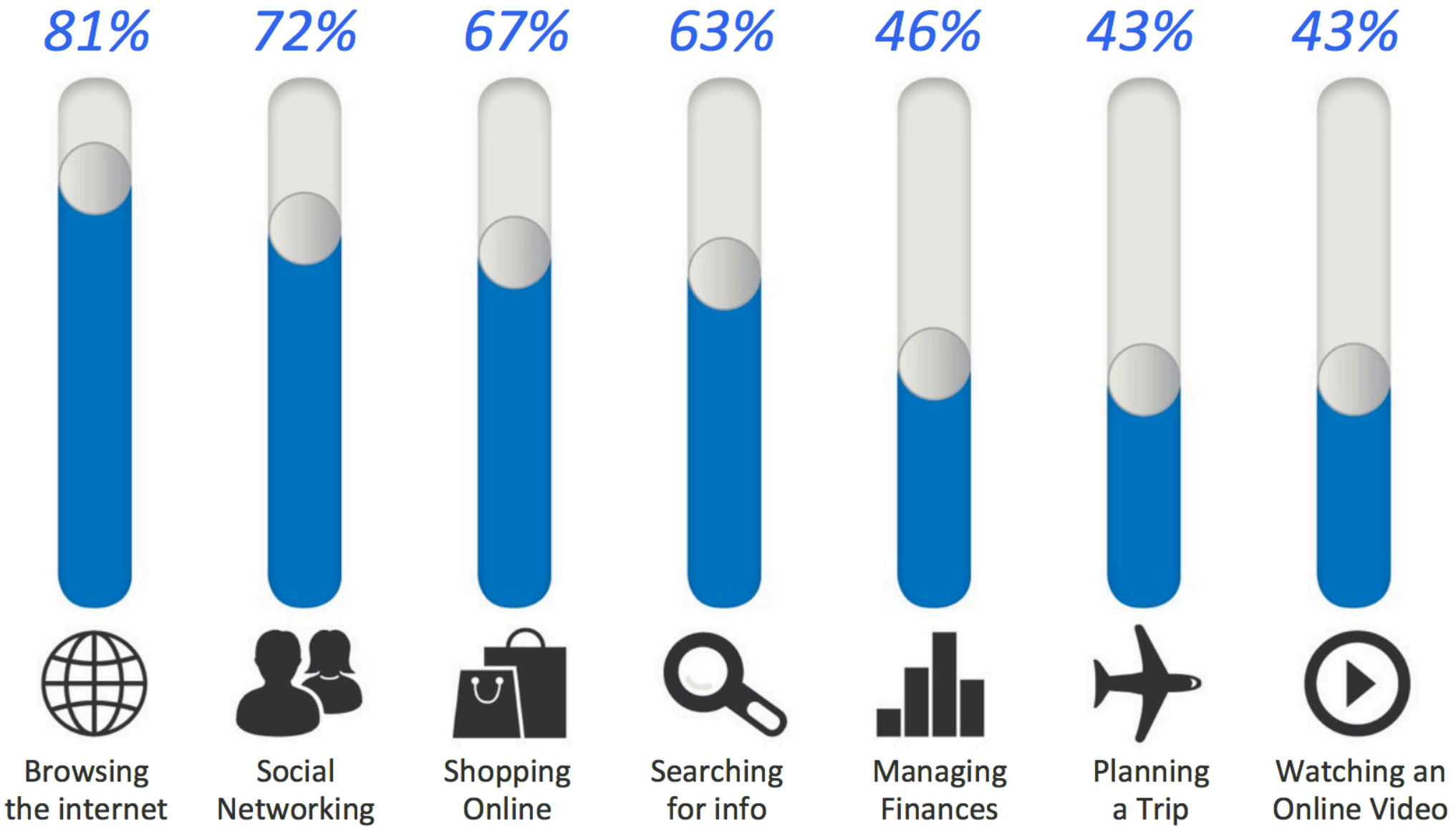
Sequential screening is common & mostly completed within a day

90%

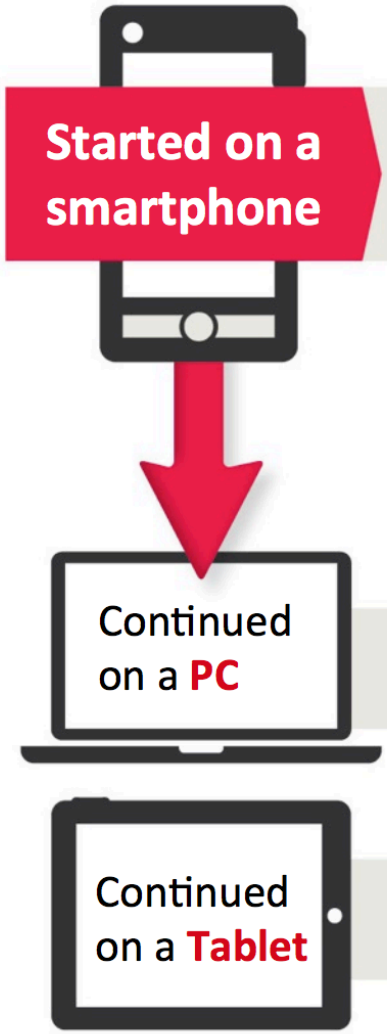
Use multiple screens **sequentially** to accomplish a task over time

98% move between devices that same day

REAL-WORLD USE

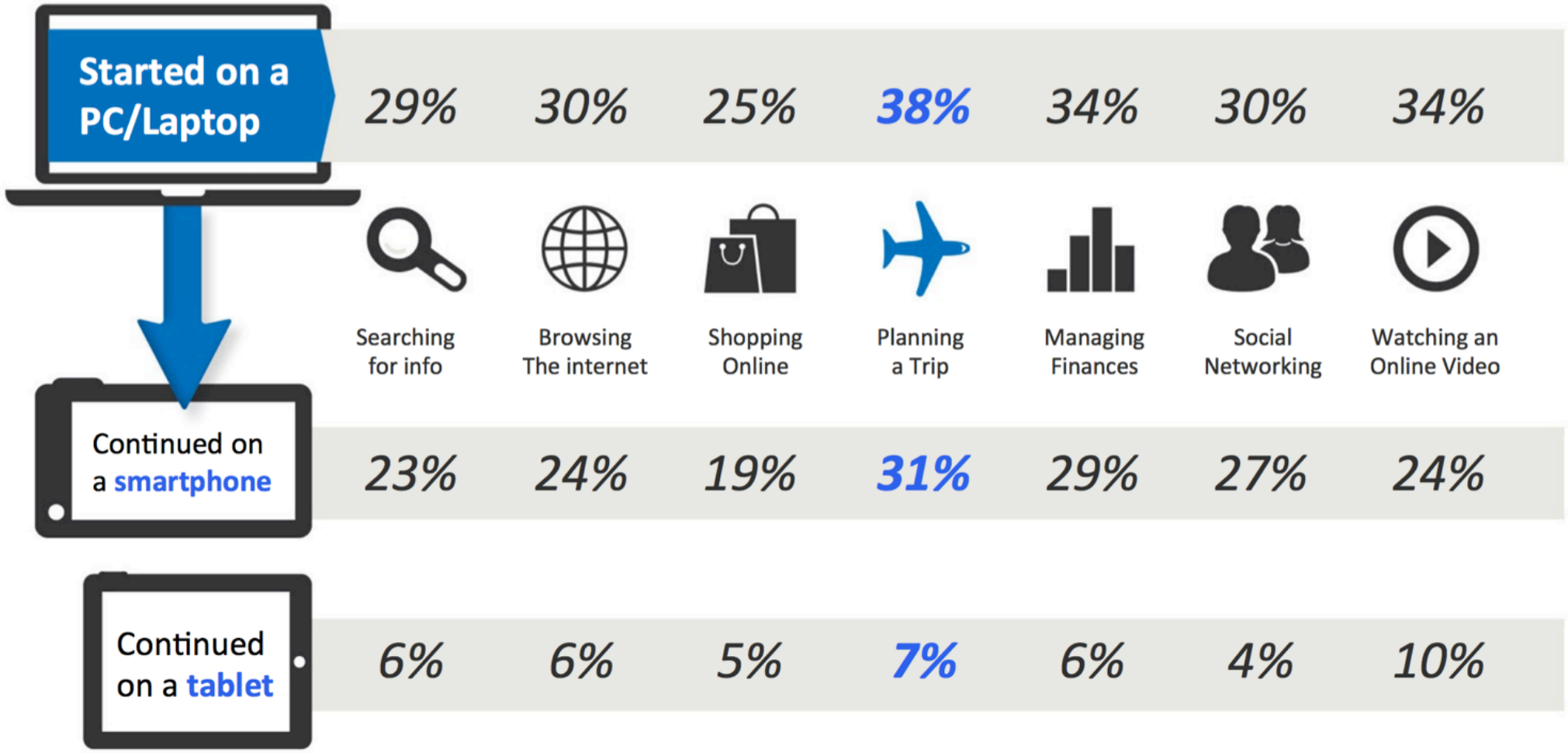


REAL-WORLD USE

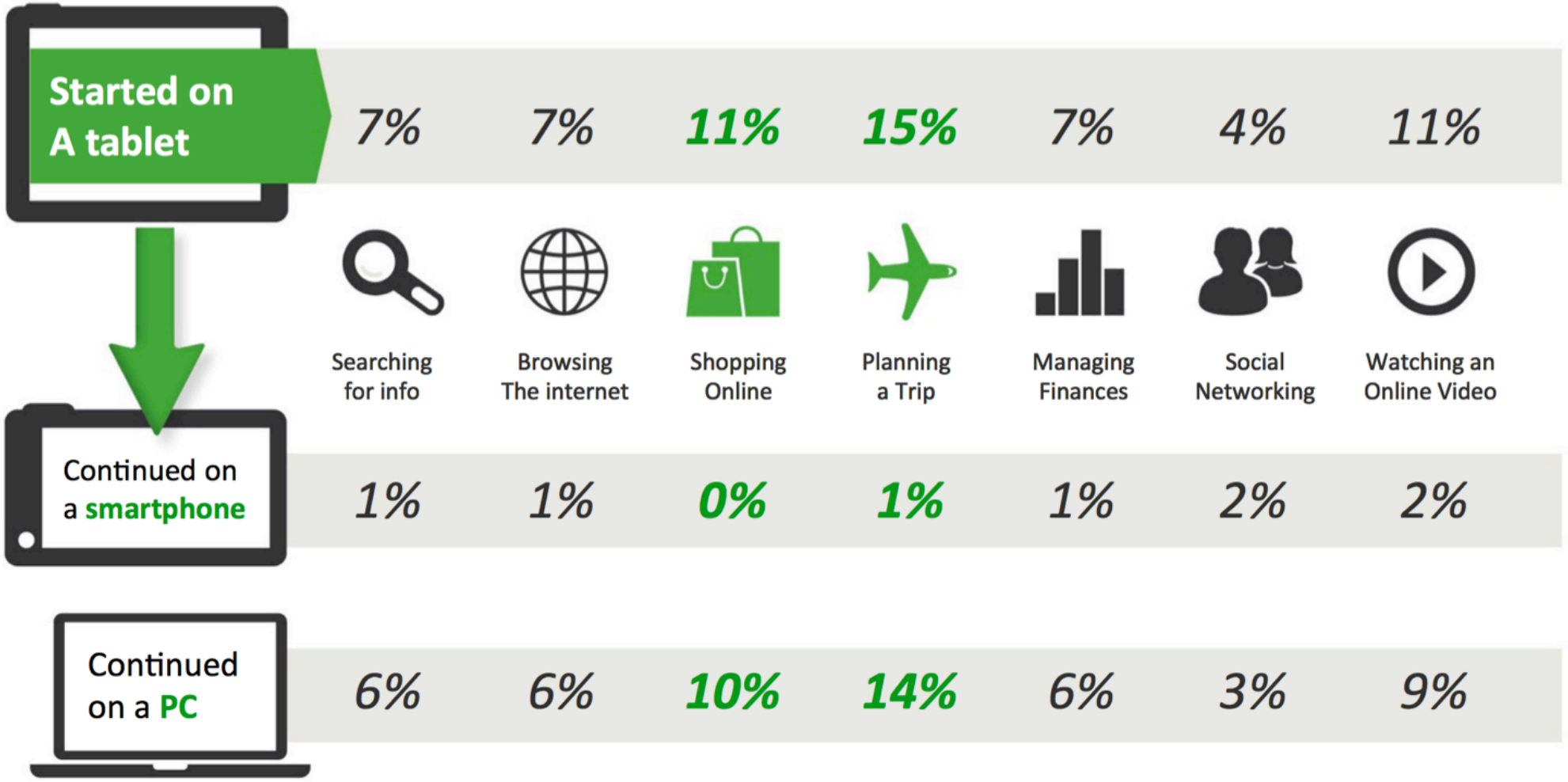


	Searching for info	Browsing The internet	Shopping Online	Planning a Trip	Managing Finances	Social Networking	Watching an Online Video
Started on a smartphone	65%	63%	65%	47%	59%	66%	56%
Continued on a PC	60%	58%	61%	45%	56%	58%	48%
Continued on a Tablet	4%	5%	4%	3%	3%	8%	8%

REAL-WORLD USE



REAL-WORLD USE



REAL-WORLD USE

People do **use multiple** device in combination.

Studies show that people own **between 2 and 12 devices**.

How to **create meaningful** multi-device **connections**?

Is there a real **value** in **simultaneous** interaction?

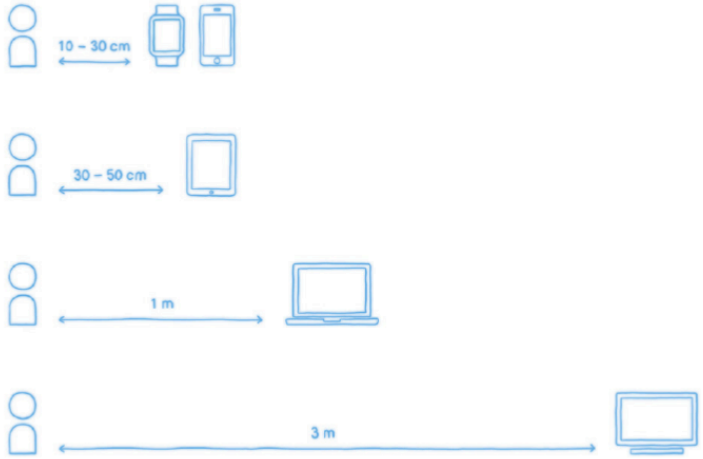
Combine Devices

PART 3 | MULTI-SCREEN DESIGN

MULTI-SCREEN ECO SYSTEMS

Different devices have **different form factors** and strengths.

People use **combinations of devices** depending on activity and context.



Most devices **do not work** well together.

Moving from **interaction** with **single** device to interaction with entire device **ecology**.

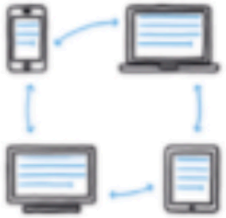
Mobile First

Simultaneity

Social TV

Device Shifting

Complementarity



Synchronisation

Screen Sharing

Coherence

Fluidity

Smart Content

Mashability

Communication

Gamification

Storyfication

Emotionality

Microjoyment

Hybrid Media

PATTERNS

https://medium.com/@wolframnagel

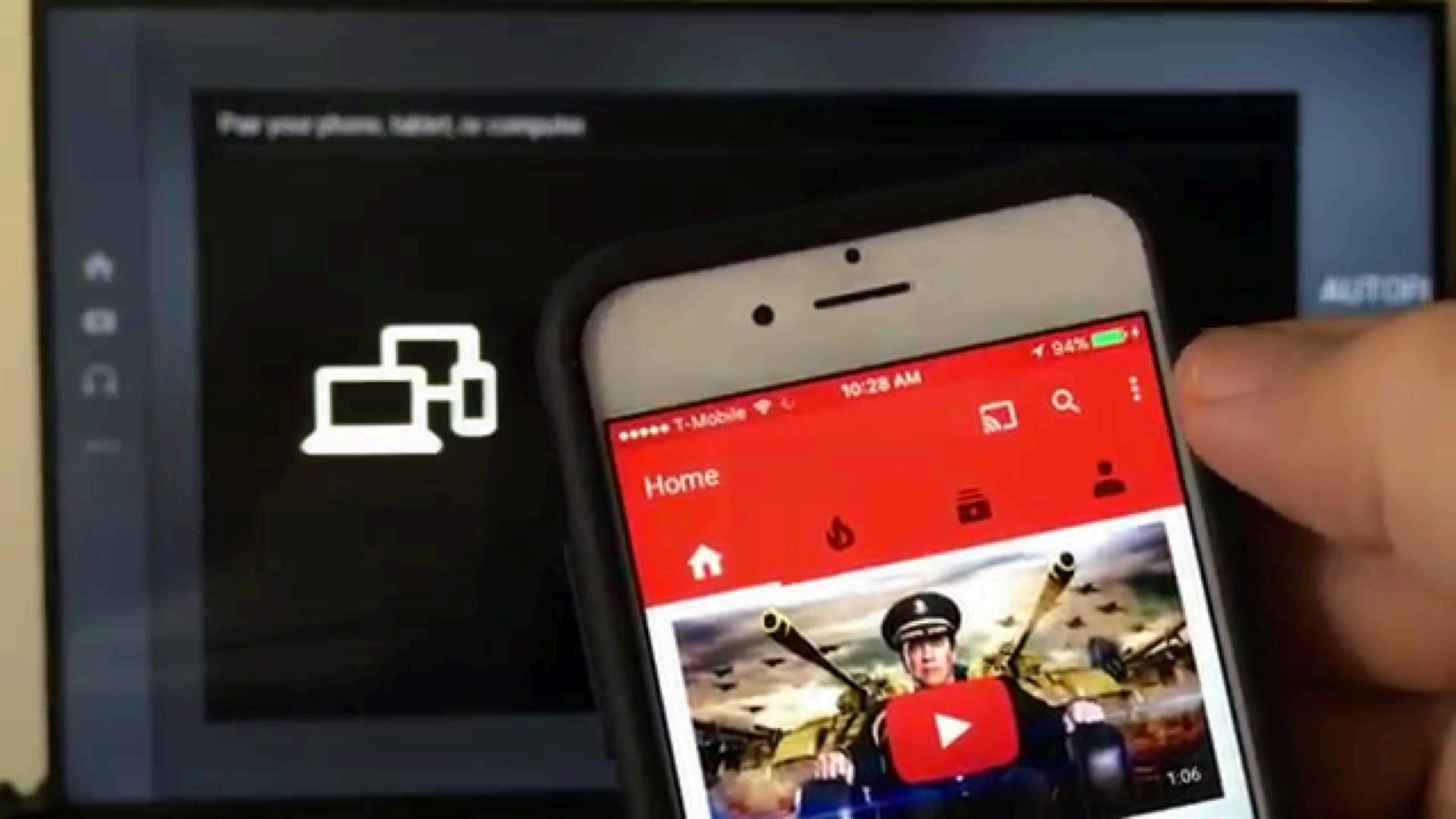
MOBILE FIRST

Focus on mobile device first.

Central device used by people,
at the center of the eco-system.

Small screen, so **harder** to distill the core
meaningful information/visualization.

Often **starting point** of interaction
with other devices.


Pair your phone, tablet, or computer
T-Mobile
10:28 AM
94%
Home
1:06

SIMULTANEITY

Different devices are used at the same time

Which devices are chosen and how are they combined?

Dynamic vs **static**: people might start an activity across devices but add or remove device as they go.

Distribute UI across the devices in use?

SOCIAL TV

Remote users can watch TV "together"

Smart TV's allow people to define **user profiles**, friend list and social interactions.

Watch TV **together** "**remotely**".

Add **additional** devices for **interactive** or **informative** purposes


Mallorca-Real Madrid
Söndag 23.20
Wall Street: Money Never
Söndag 22.10
svt1
Go'kväll
10:00 – 10:45
svt2
SVT Forum
09:00 – 12:00
Våra bästa år
10:20 – 11:10
10:00 – 11:35
Desperate
housewives
10:20 – 11:15
En plats i solen
10:35 – 11:05
KANAL
STARTTID
Filtrera
ALLT
TV-SERIER
FILM
SPORT

DEVICE SHIFTING

Move content/view from one device to another.

Redirect content or view from one device to another to leverage the form factor or interactions of the particular device.

Hard to do with **non-compliant** devices.

Think about downscaling or upscaling the view or content depending on **device capabilities**.


Tues 9/15
6.0mi
summary splits
Name this run
6:45
Duration
54:36
Start Time
7:05am
Calories
346
Fats
232
Carbs
114
54:36
6.0 miles
9:06 /mile

COMPLEMENTARITY

Devices influence each other and work together.

"The whole is better than its parts."

Combining devices should **reduce complexity** and **increase usability** and interactions.

Devices should be able to **recognize** each others **capabilities** and provide **ways** to complement.

Very hard to get right.


MEDIA

CHALLENGES

1. Creating device connections/configurations
2. Designing for scale and interoperability
3. Cross-device interaction challenges
4. Privacy and authentication
5. Building cross-device toolkits and frameworks
6. New technologies

1. CROSS-DEVICE CONNECTIONS

How do people know what **devices** can be **used together**?

In different **context**, people might want to use different **configurations** of devices.

How to opt-in and out of cross-device configurations.

Moving from **simultaneous** use to **sequential** use.

2. INTEROPERABILITY

Devices are **designed** and **build** from an isolated **single device perspective**.

Own **interface**, user **experience**, file systems, networking protocols,..

Internet and **web** technology to enable cross-device content and share data.

How to **design** for **future technologies**?

3. INTERACTION CHALLENGES

Mouse, touch, swipe and keyboard are **single device input methods**.

Can these basic techniques be used **across** multiple **heterogeneous** devices?

How to **interact** with devices at a **distance**?

Studies extensively in HCI.

4. PRIVACY

Protect **people's privacy** when **combining personal** devices with **public** or share devices.

Cross-device authentication to enable people to grant devices access to their personal information.

Handled through the **cloud** or **locally**?

Combine devices **owned** by **different people**?

5. BUILDING CROSS-DEVICE APPS

Most developer environments are focused on **designing technology** for a **single device** or **platform**.

New tools are needed to enable cross-device support for developers and engineers.

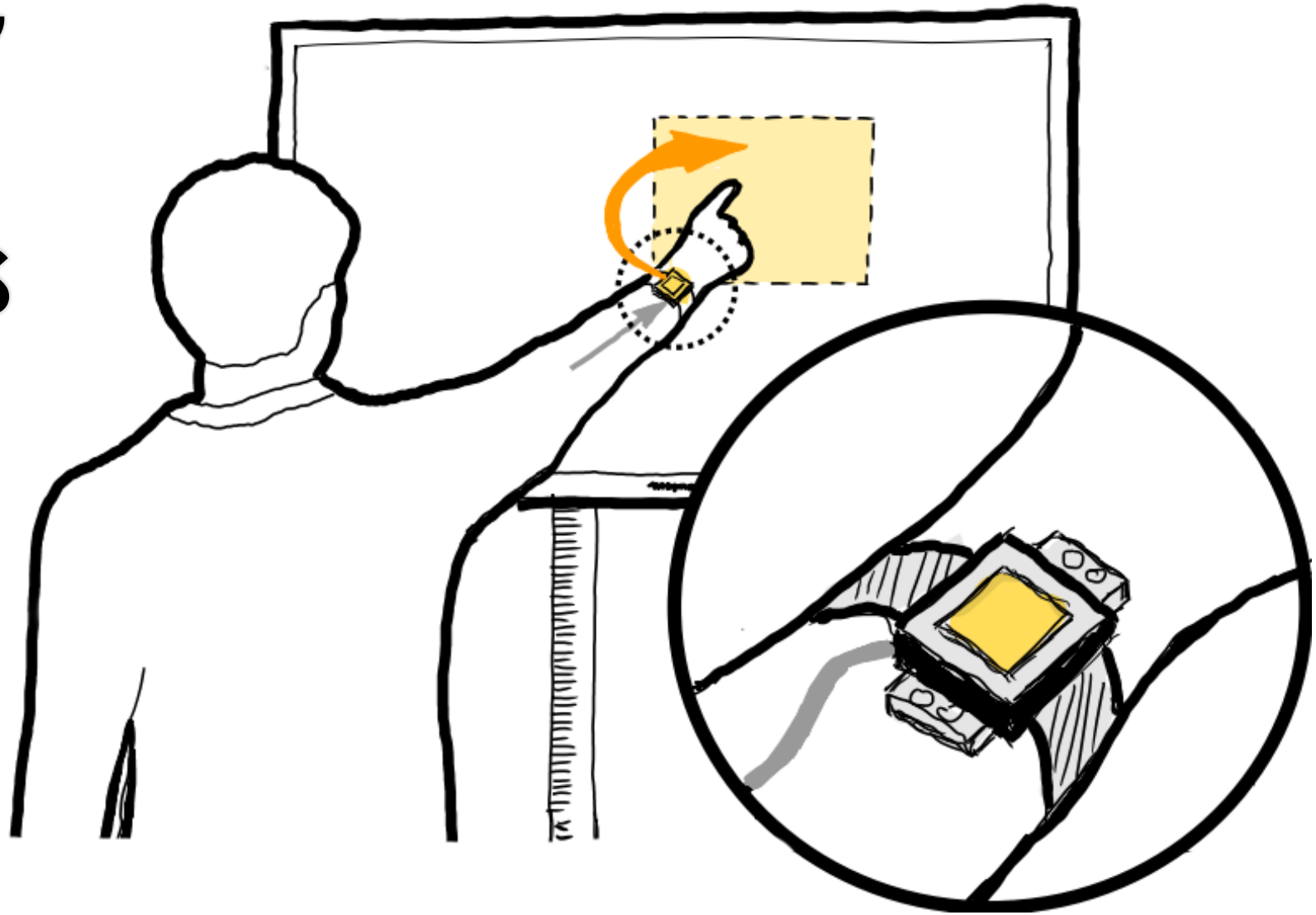
Responsive UX helps but fails to support complex tasks **across** devices.

OSX Continuity and Windows 10

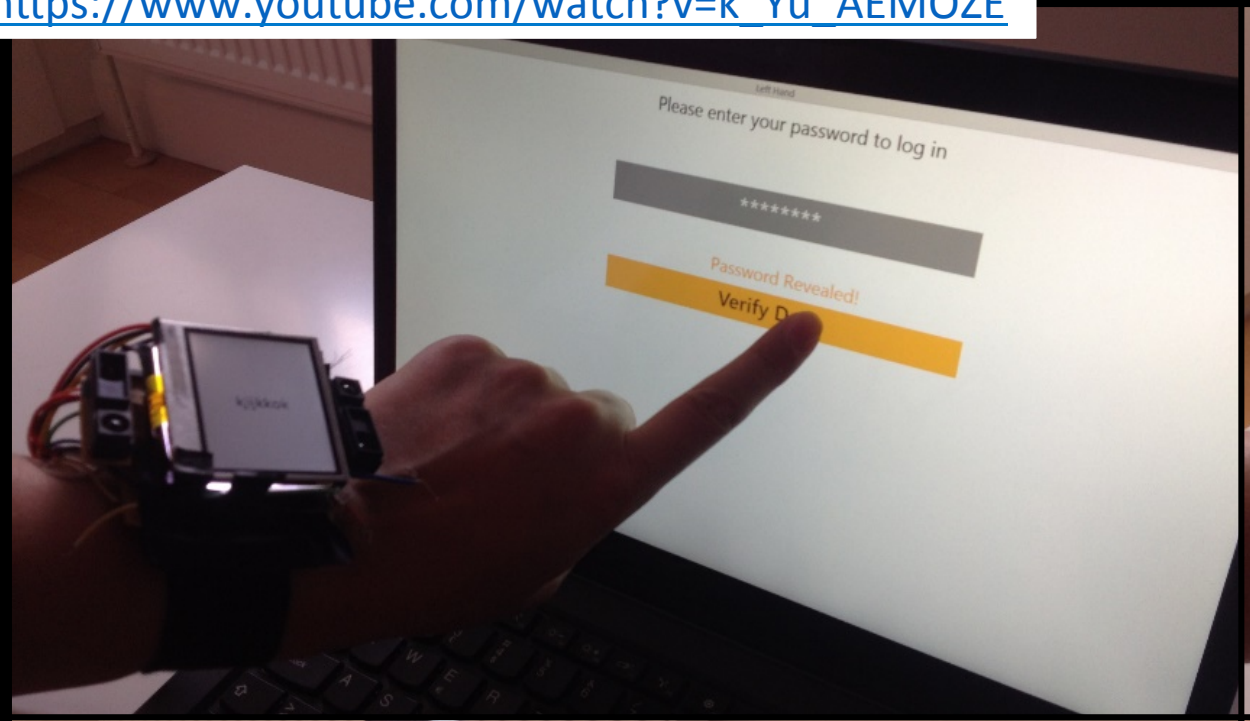
6. NEW TECHNOLOGIES

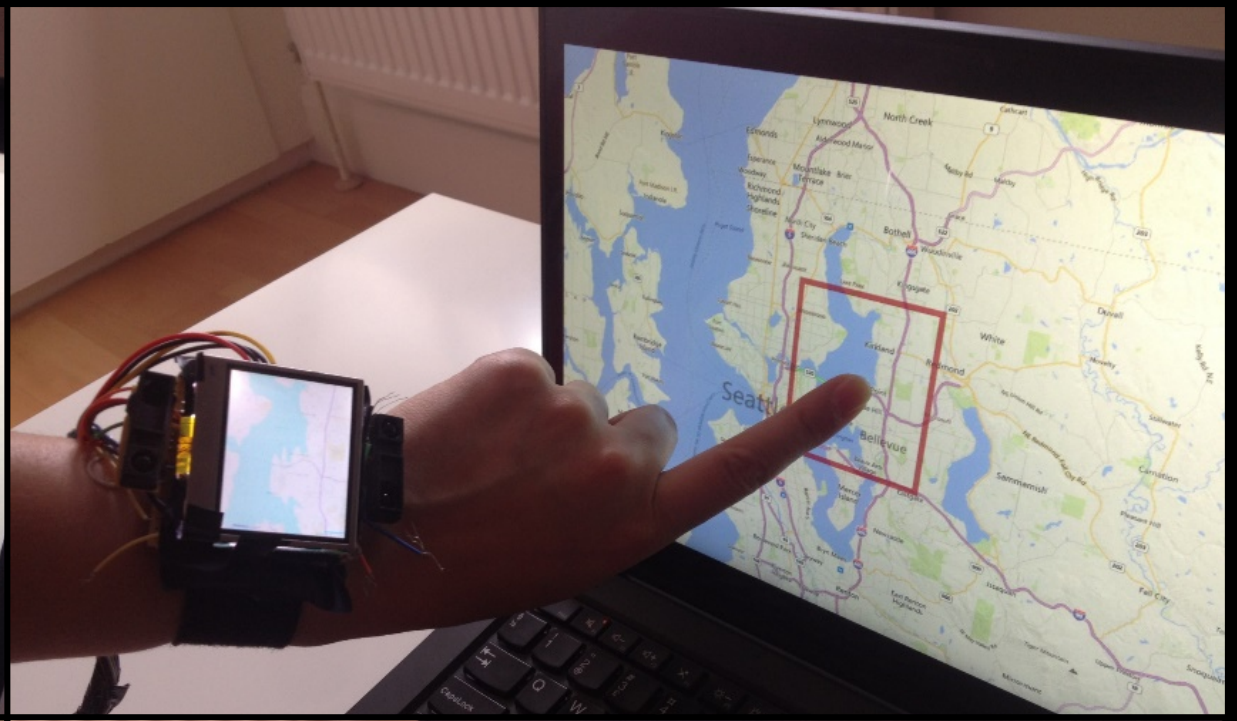
Researchers are **exploring** a whole range of new **techniques** and **technologies** to enable **cross-device information systems.**

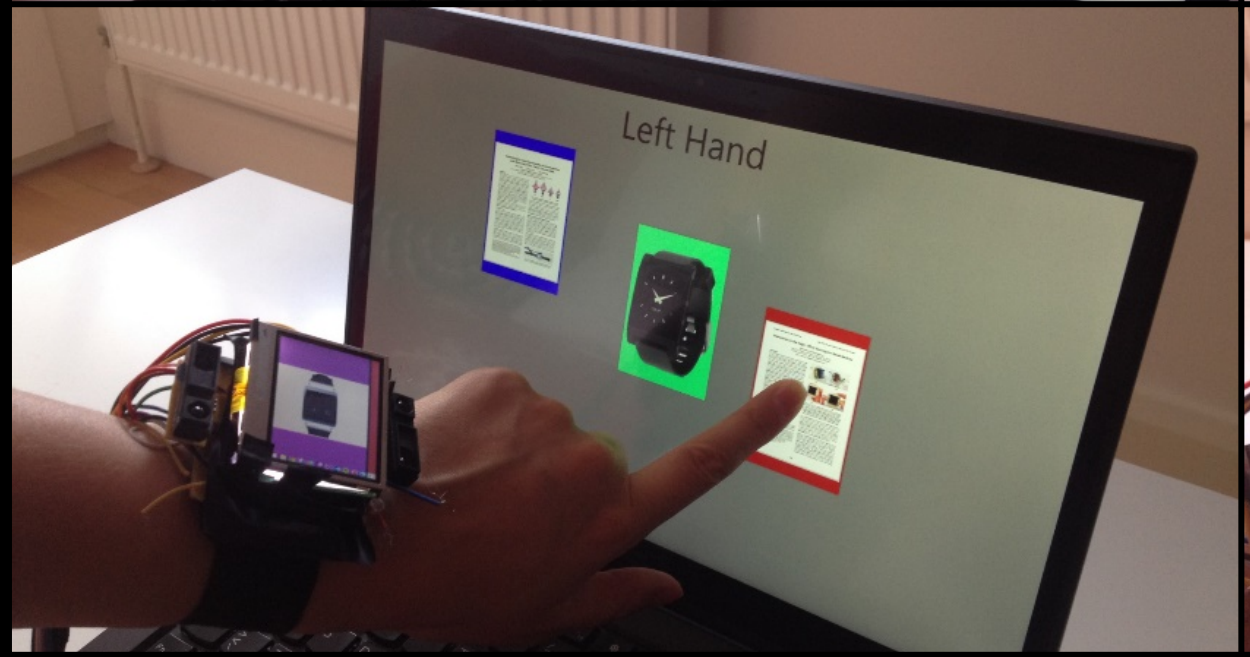
Mediating role of Wearables

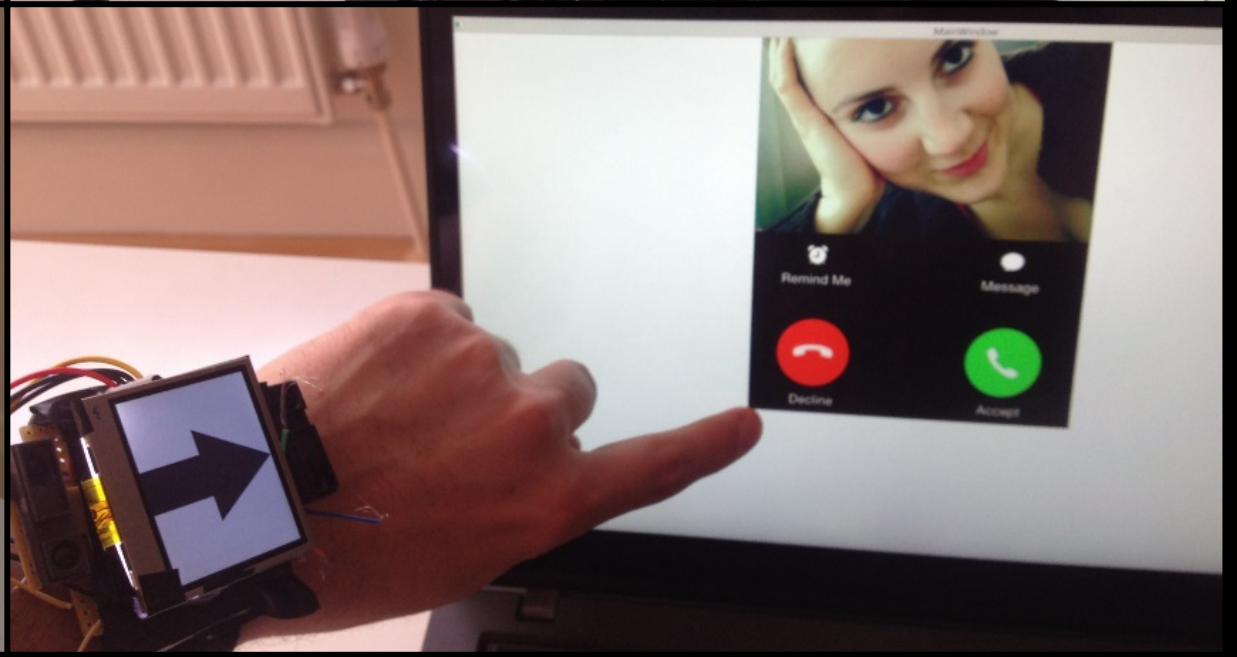


https://www.youtube.com/watch?v=k_Yu_AEMOZE





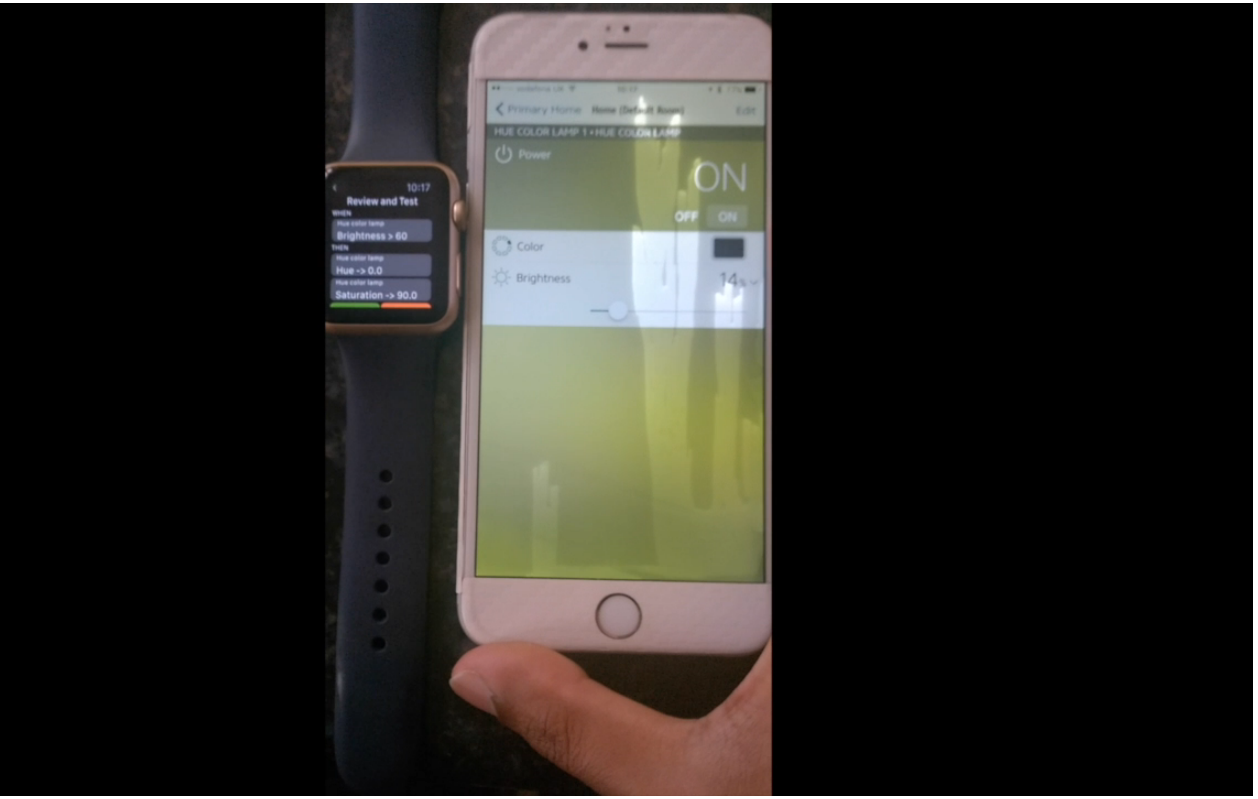


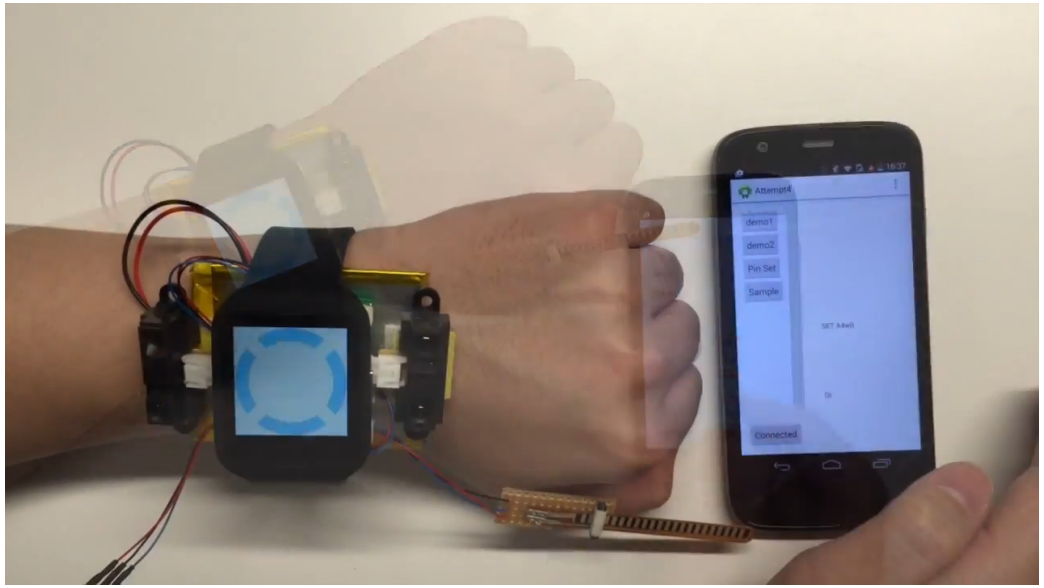


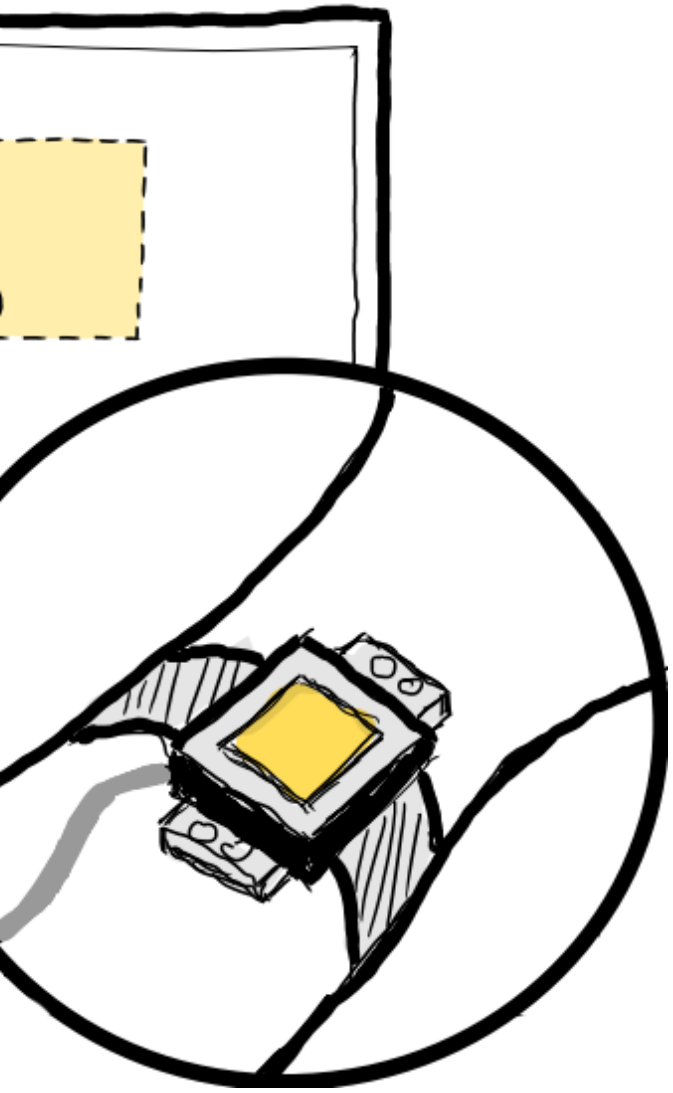





SMARTWATCHES TO CONTROL IOT







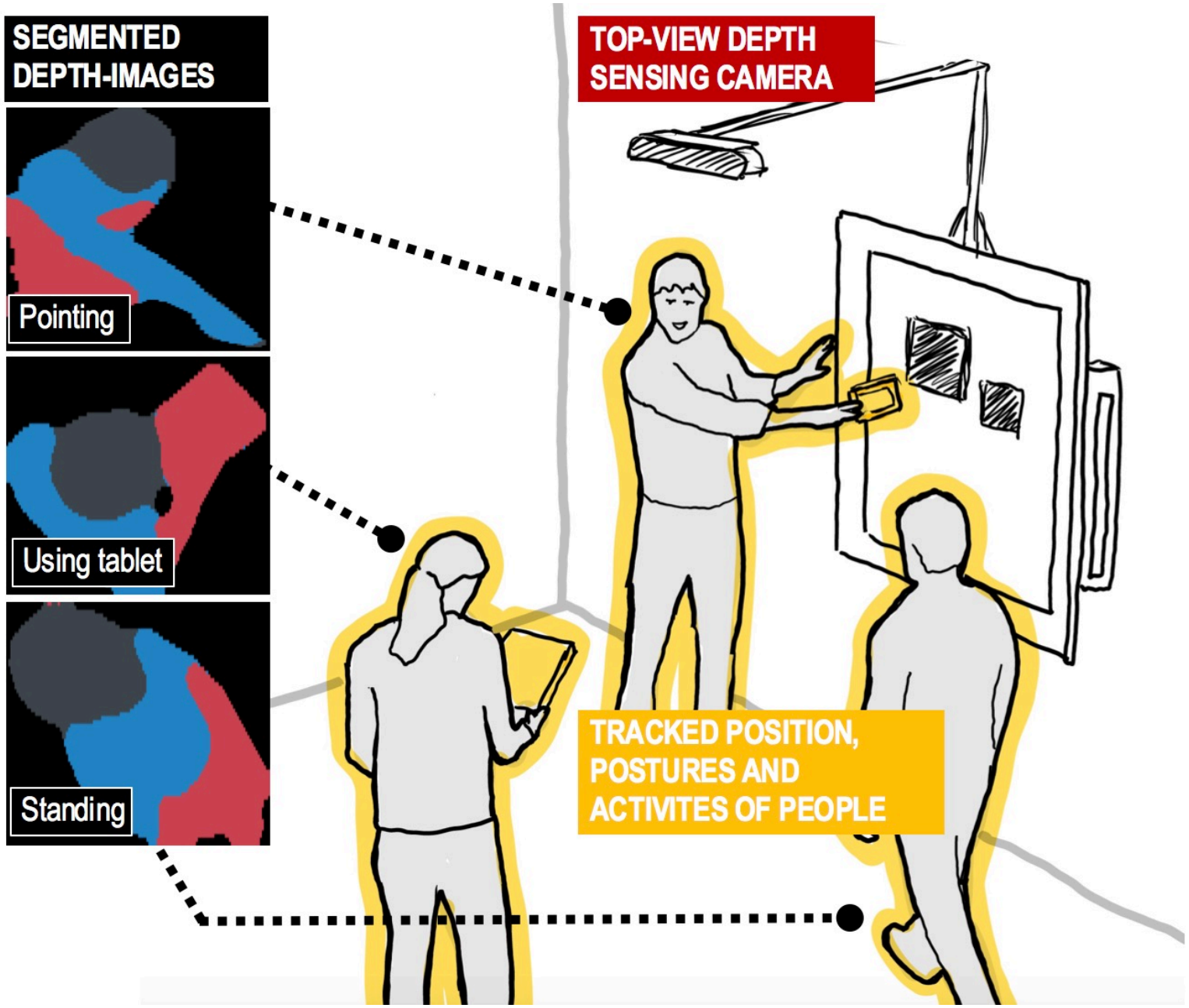
Explore and study **physical instrumental interaction**

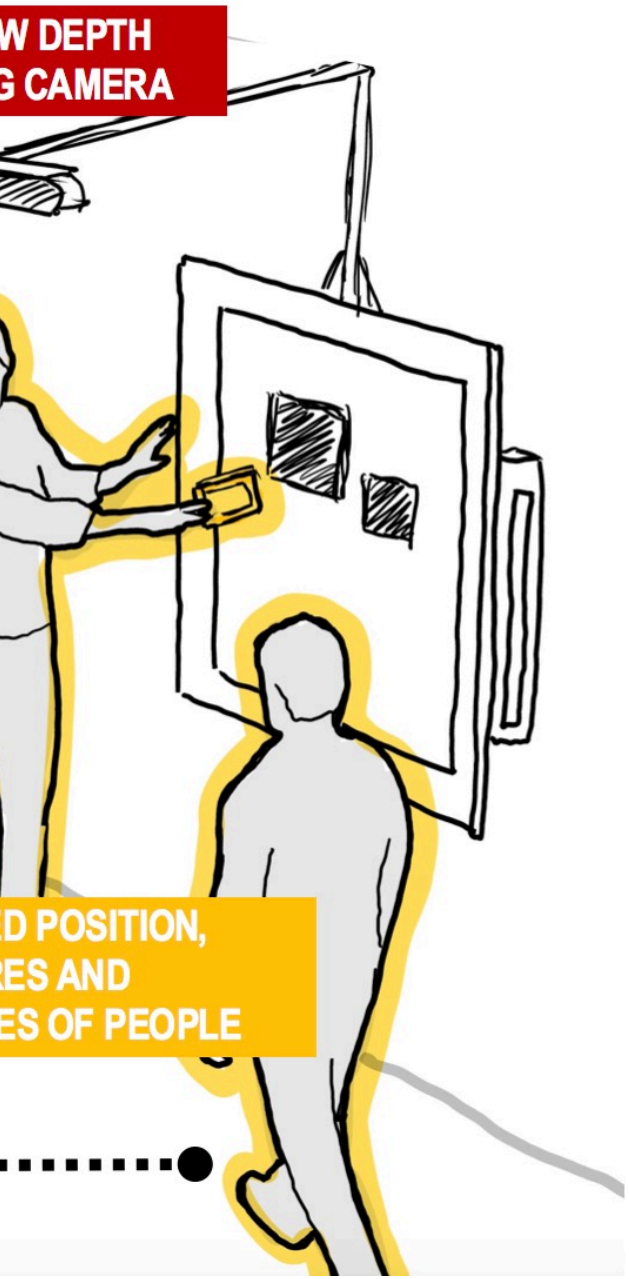
New **techniques** and **methods** for user/device pairing/recognition

Interaction techniques for watch-centric cross-device interactions

Other **wearable** devices/IOT

TRACKING PEOPLE AND DEVICES IN SPACE





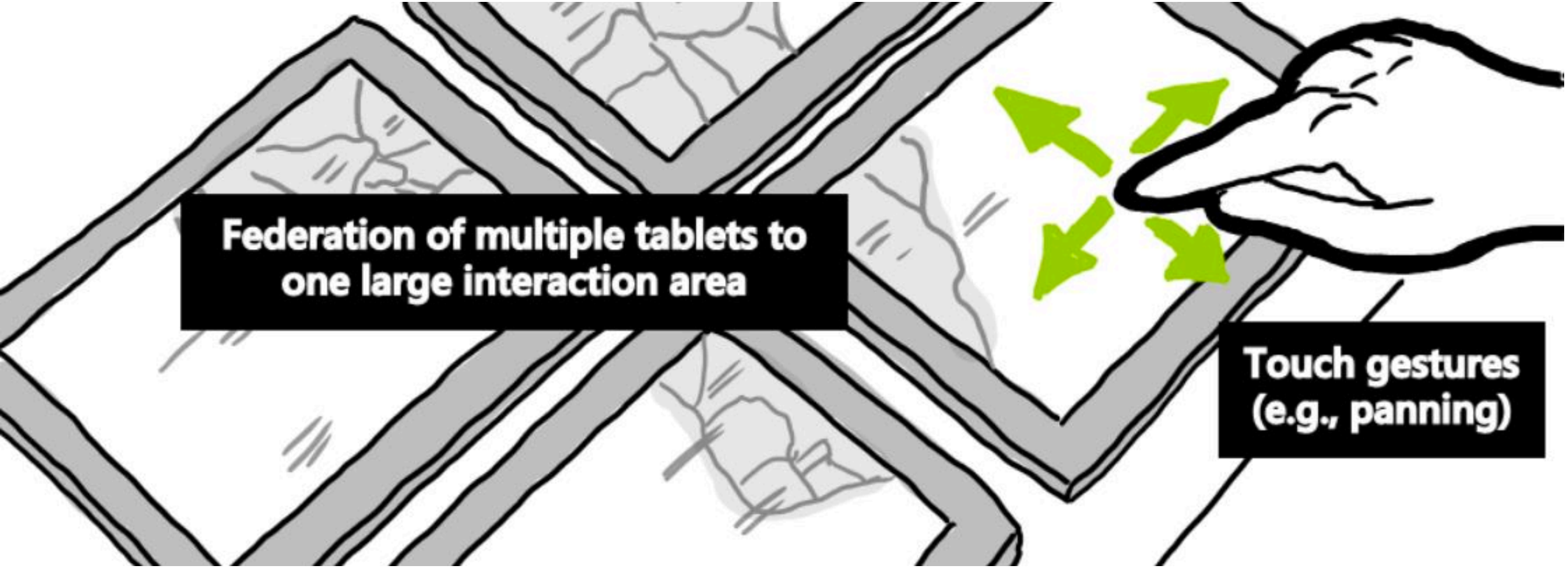
Better machine learning and supporting **toolkits**

Opt-in/out methods and techniques

Auto-configuration and **activity-centric** configuration work

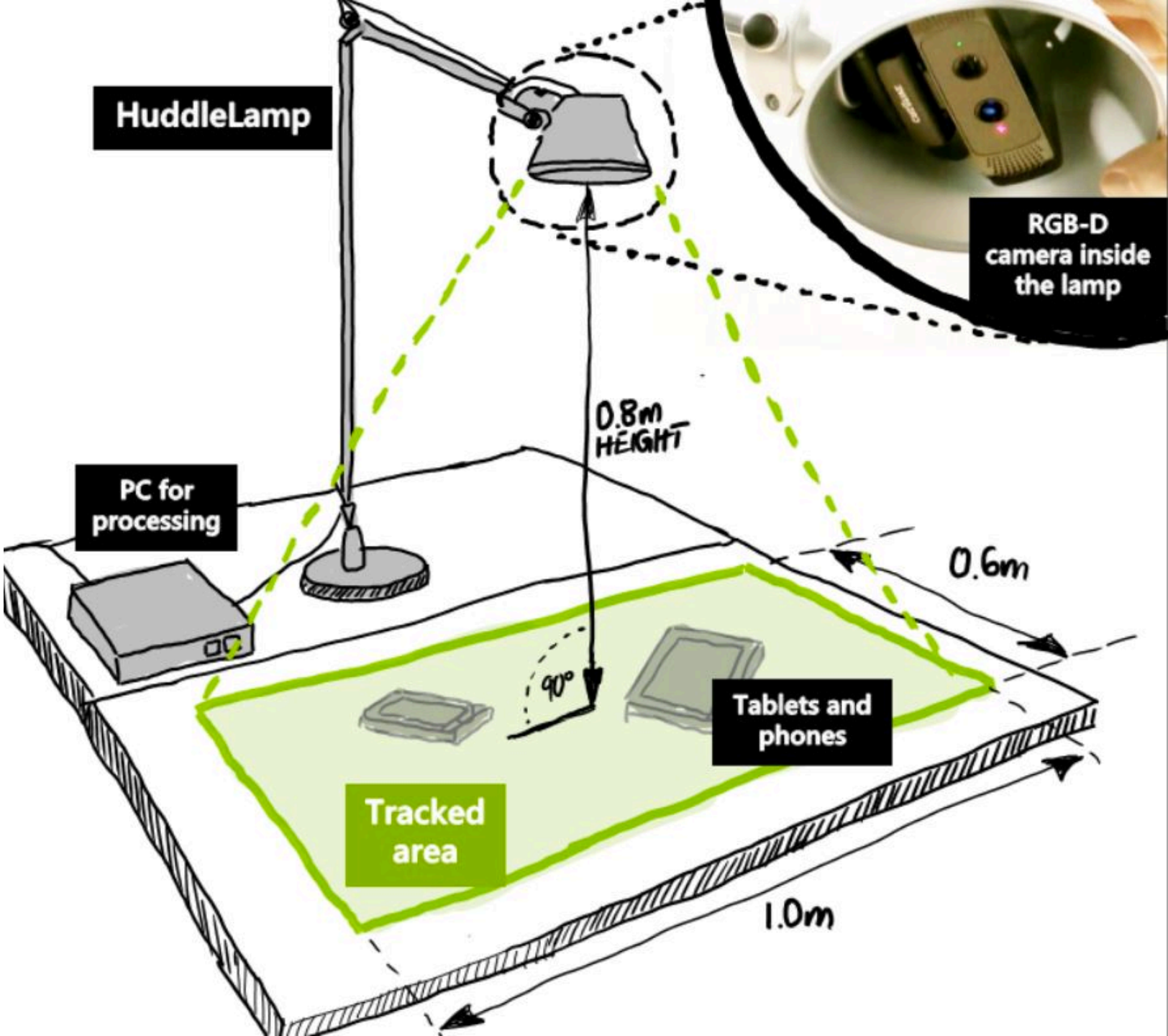
Gradual Tracking Methods

Recombinant Computing




LIBYA
EGYPT
SAUDI ARABIA
ALGERIA
SOUTH SUDAN
ETHIOPIA
DEMOCRATIC REPUBLIC OF THE CONGO
ANGOLA
BRAZIL


SAMSUNG


HuddleLamp
RGB-D camera inside the lamp
0.8m HEIGHT
PC for processing
0.6m
90°
Tablets and phones
Tracked area
1.0m

Understanding device properties & how form factor impacts collaboration

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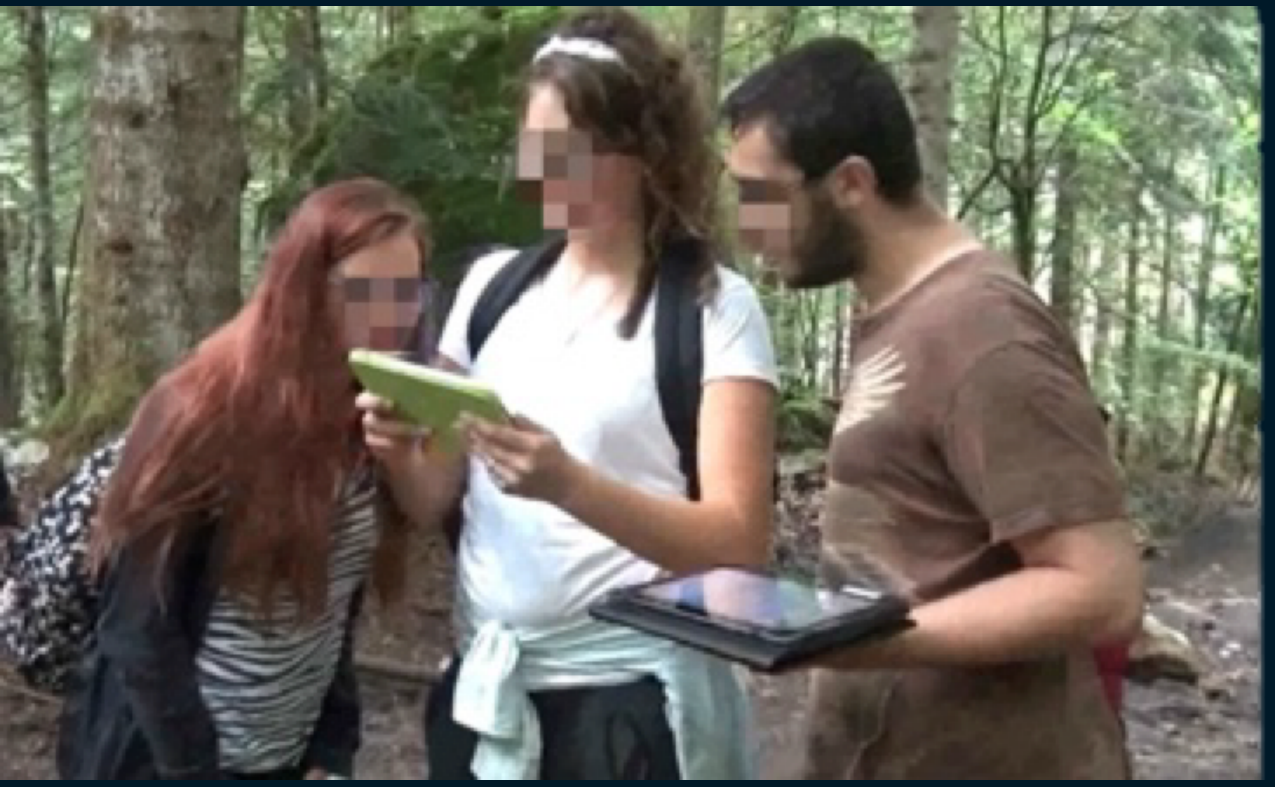

SUMMARY

"Multi-Screen Design"

Part 1: Ubiquitous Computing
Part 2: Multi-Device Usage
Part 3: Combining Devices