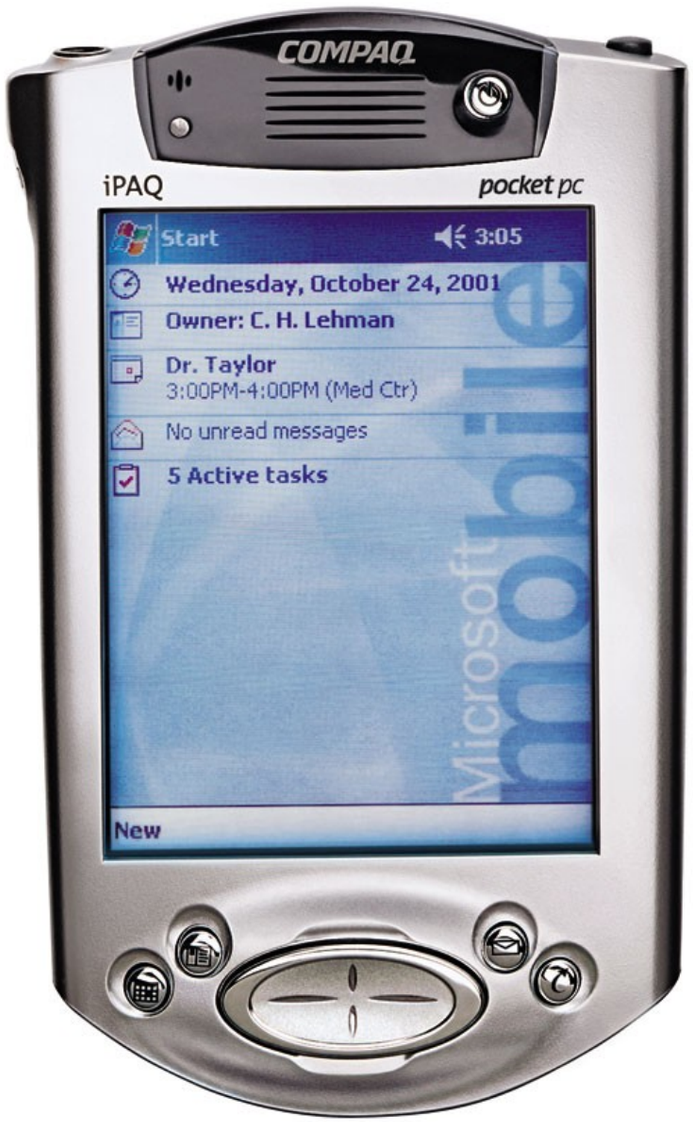
Ubicomp, Context Awareness, & CSCW

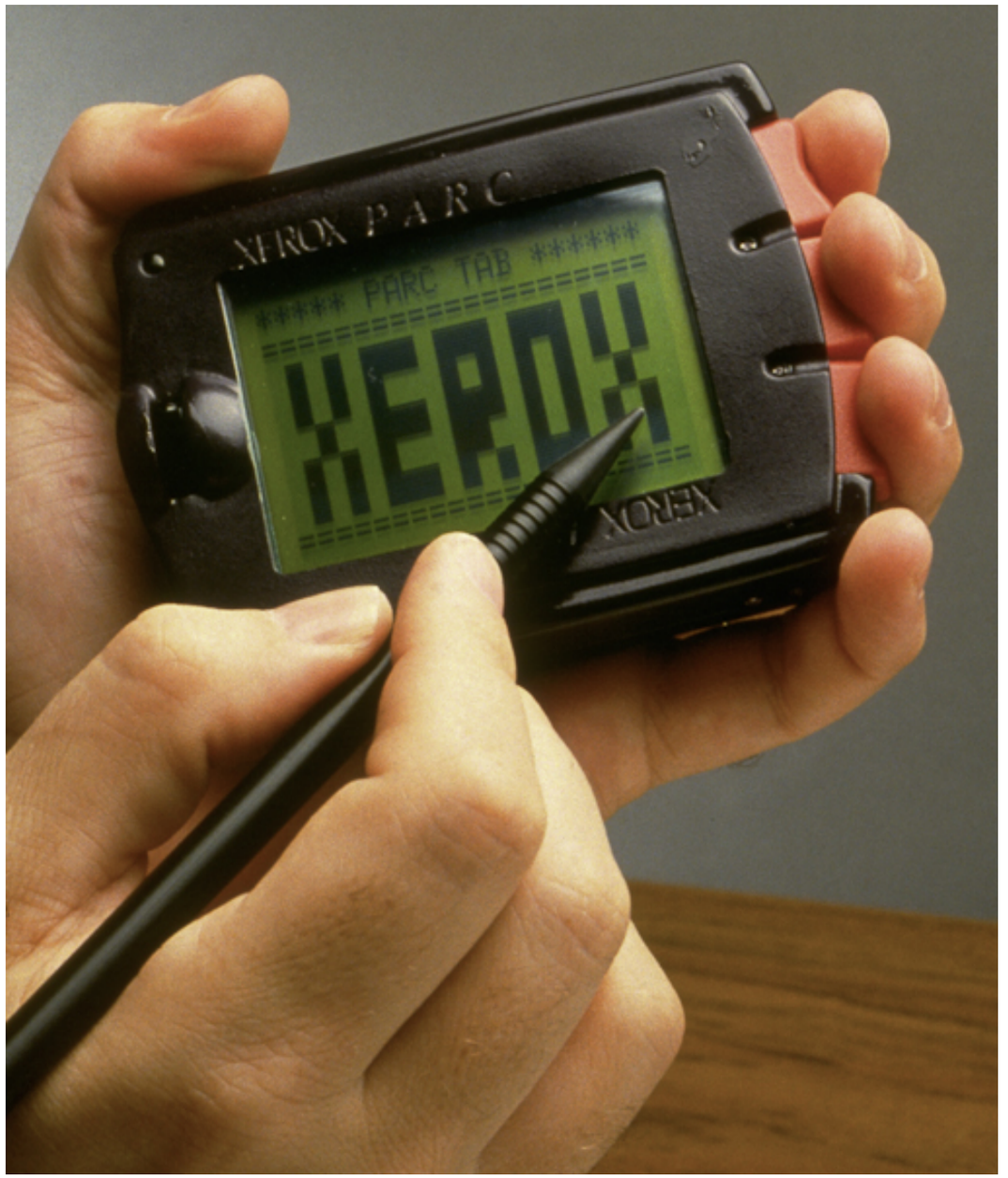
Gus Henry



What is Ubicomp?

- Ubiquitous computing
- Pervasive Computing
- Coined by Mark Weiser
- Envisioned 3 size classes

UBICOMP 2017
Sept. 11-15, Maui, Hawaii



Tabs

- Focus on wireless communications
- Terminal rather than workstation
- Gesture-based input
- Hundreds per person

Pads

- Meant to have portable workstation power
- Processing done remotely in practice
- Also wireless
- Included additional ports and sensors

Boards

- Xerox LiveBoard
- Collaborative work environment
- Manipulation of on-screen elements directly or through tab/pad
- 1-2 per office
- Sold commercially

Common Traits

- Computing anytime and anywhere
- Devices know statuses of each other
- Experience is mobile and custom to the user
- “Unified ecosystem”

Modern Examples

IoT

Remaining Issues

- Interoperability
- Processing Limitations
- Cost
- Security

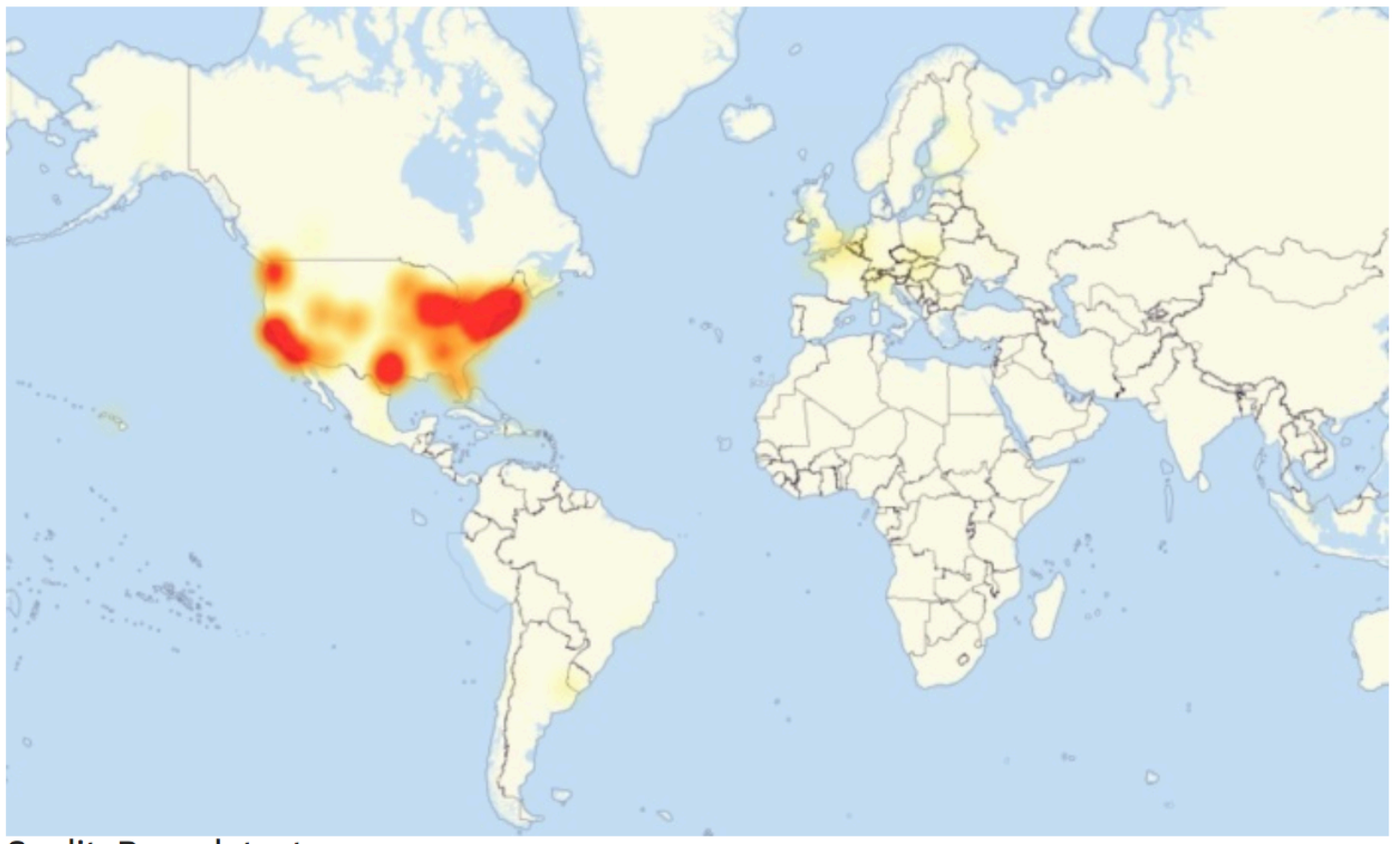
NEWS

An IoT botnet is partly behind Friday's massive DDOS attack

DVRs and other devices compromised with the Mirai malware are being the attack.

By Michael Kan

U.S. Correspondent, IDG News Service | OCT 21, 2016 4:21 PM PT



Credit: Downdetector

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Chinese firm admits its hacked DVRs, cameras were behind Friday's massive DDOS...


Friday's DDoS attack came from 100,000 infected devices


Competing hackers dampen the power of Mirai botnets

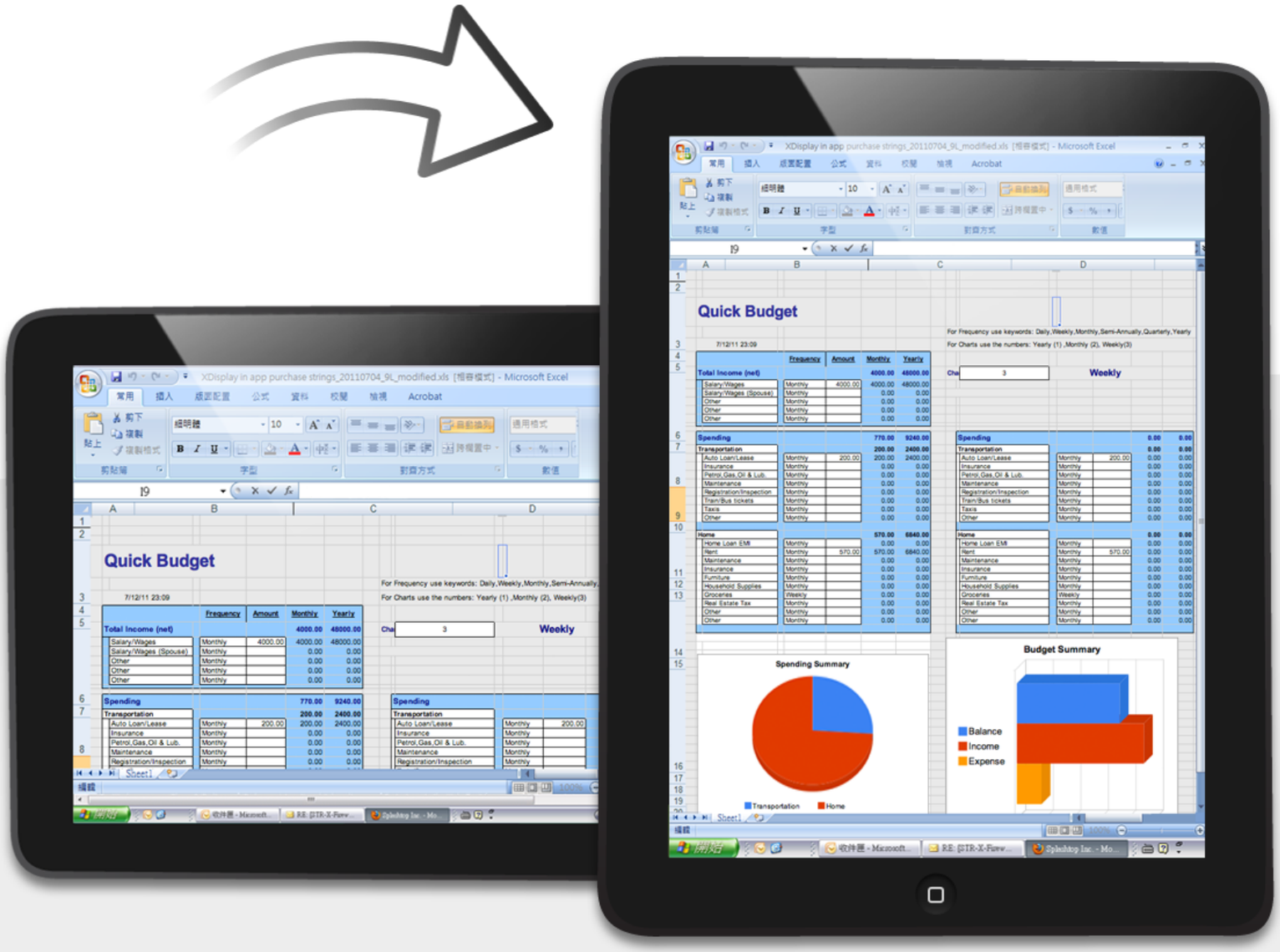

VIDEO
Why You Lost Your Windows 10 Product Key

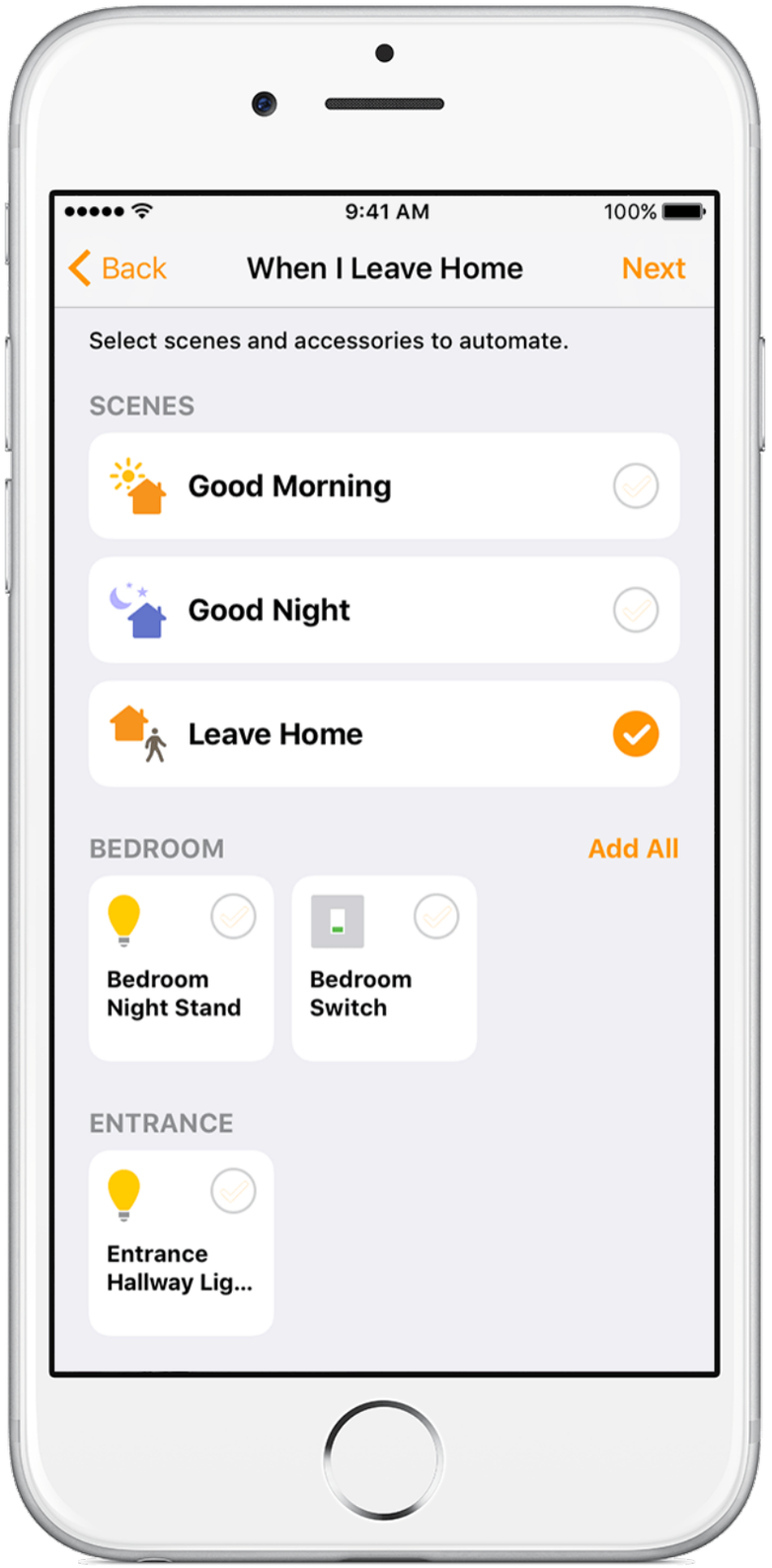
Remaining Issues

- Interoperability
- Processing Limitations
- Cost
- Security

What is Context Awareness?

- Context-Aware Computing
- Computers can react and respond based on their environments
- Context-Aware Pervasive Systems





Types of Context

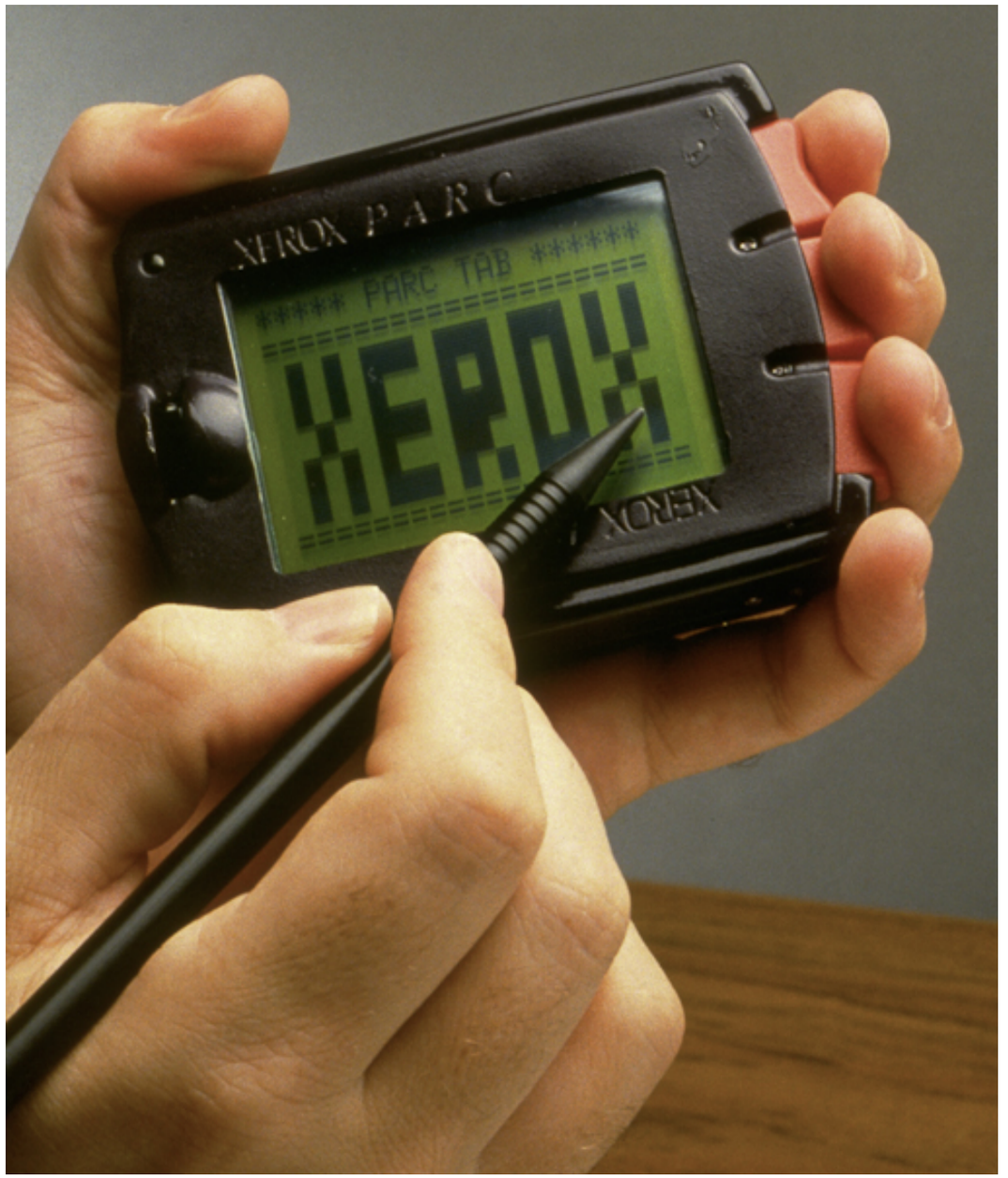
- Location/Speed
- Weather
- Biometrics
- Social Interactions
- User Tasks
- Sounds
- Infrastructure
- Current Events

Remaining Issues

- Accuracy
- Performance
- Privacy and Security

What is CSCW?

- Computer-Supported Cooperative Work
- Using technology to support people in their work
- First coined by Irene Greif and Paul Cashman



Ubiquitous computing
@ Xerox PARC, 1988 - 1995

Devices according to model size approach:

PARCtab

Inch-sized

PARCpad

Foot-sized

Liveboard

Yard-sized

Augmented Surfaces: A Spatially Continuous Workspace for Hybrid Computing Environments

Jun Rekimoto

Sony Computer Science Laboratory

Benefits of CSCW

- Increase Productivity in the Workplace
- Allow simultaneous manipulation of the same elements
- Work could be done together or remotely

Challenges to CSCW

- Difficult to design and implement
- Common state must be maintained
- Network bandwidth/latency a limiting factor

Toolkits

iStuff: A Physical User Interface Toolkit for Ubiquitous Computing Environments

- 2003

- Explores potential infrastructure and architecture of a Ubiquitous Computing environment

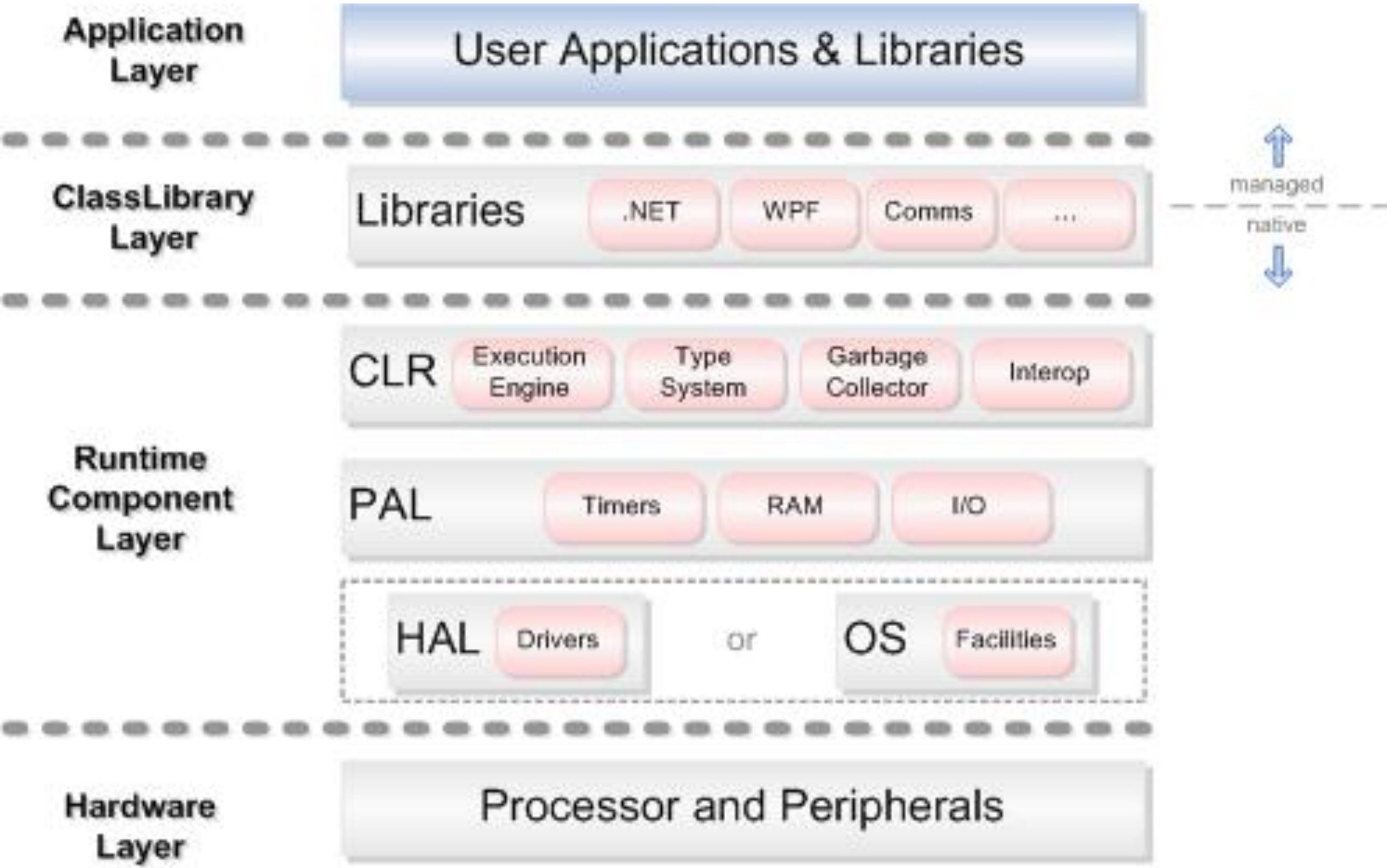
- Physical Toolkit

iStuff: A Physical User Interface Toolkit for Ubiquitous Computing Environments

- Existing devices had only 1 set of input and 1 focus for a single device
- Typically screen-based
- Effective Ubiquitous Computing required the shattering of this model
- Co-located in the “iRoom”

iStuff: A Physical User Interface Toolkit for Ubiquitous Computing Environments

- Agent Framework
  - Central server processes all events between all devices in iRoom
  - Allows existing devices to participate in iRoom without requiring writing of custom environment-specific software and operating systems


Application Layer
User Applications & Libraries
ClassLibrary Layer
Libraries
.NET
WPF
Comms
...
managed
native
CLR
Execution Engine
Type System
Garbage Collector
Interop
Runtime Component Layer
PAL
Timers
RAM
I/O
HAL
Drivers
or
OS
Facilities
Hardware Layer
Processor and Peripherals

Why doesn't this pattern work for Ubicomp/CSCW frameworks?

- Each device is different
- Application designer has no knowledge of device-specific implementation
- Common state must be maintained across all devices

Solutions

- Single-manufacturer environment

Ubiquitous computing
@ Xerox PARC, 1988 - 1995

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Liveboard

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Solutions

- Single-manufacturer environment
- Highly Contained Environment

Solutions

- Single-manufacturer environment
- Highly contained environment
- Device independent environment

Application

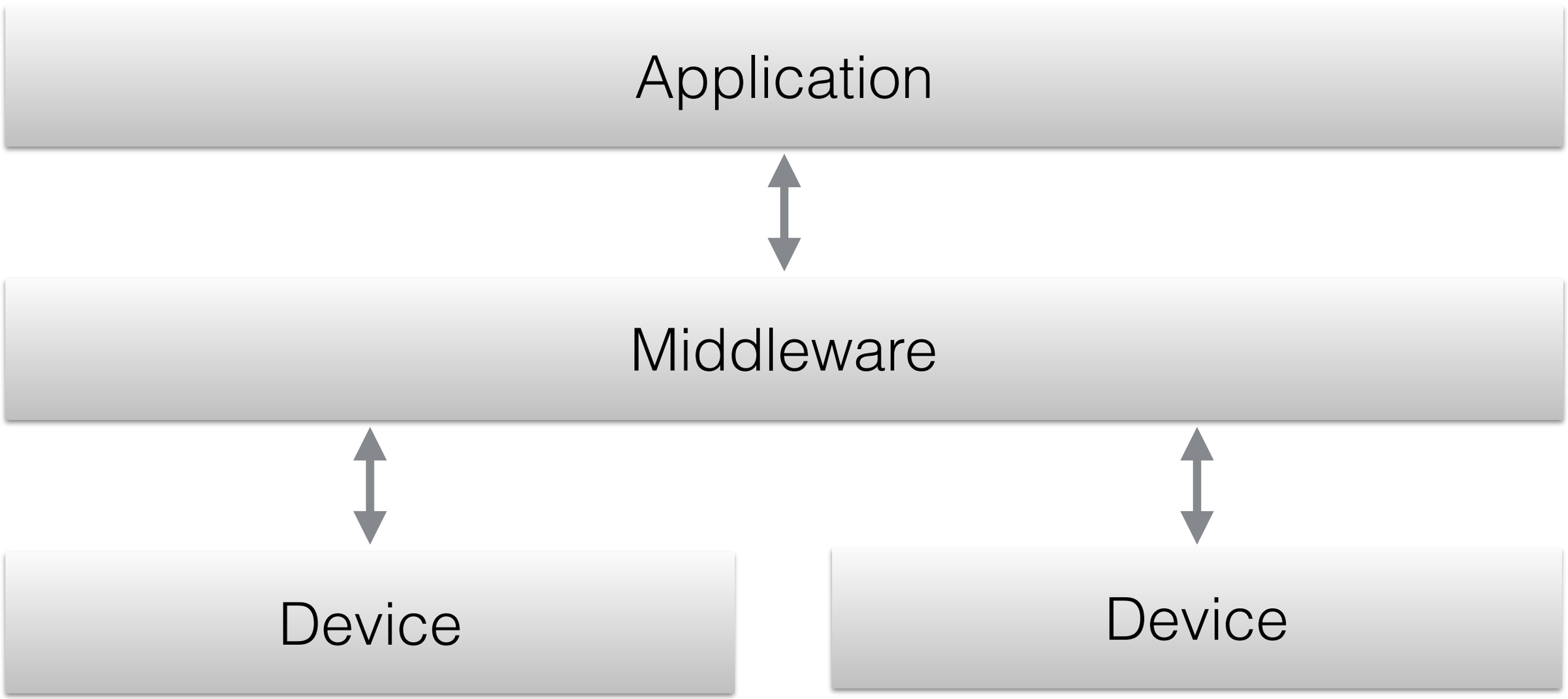
- Define Components (Song Tempo)
- Define State Limitations (60bpm - 160bpm)

Application

Application

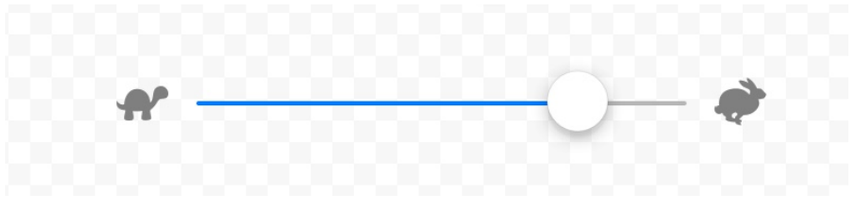
Middleware

- setTempo(int bpm)
- Handle sending of Tempo update events



Device

Device

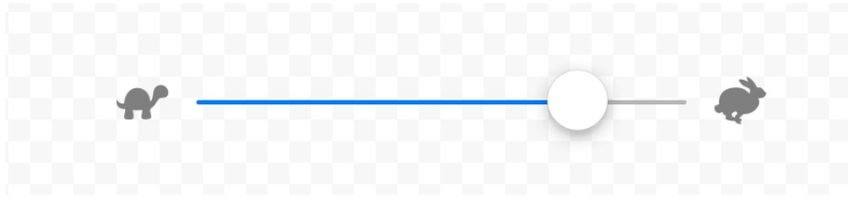


Device

- User sets bar to 20%
- Device code maps 20% to 80bpm
- Device calls setTempo(80) in Middleware

Device

- User sets dial to 2
- Device code maps 2 to 73bpm
- Device calls setTempo(73) in Middleware



Device

- Device receives Tempo=100bpm state change event
- Maps 100bpm to 40%
- Sets bar to 40%

Device

- Device receives Tempo=100bpm state change event
- Maps 100bpm to 3 (3.2)
- Sets bar to 3

iStuff Architecture

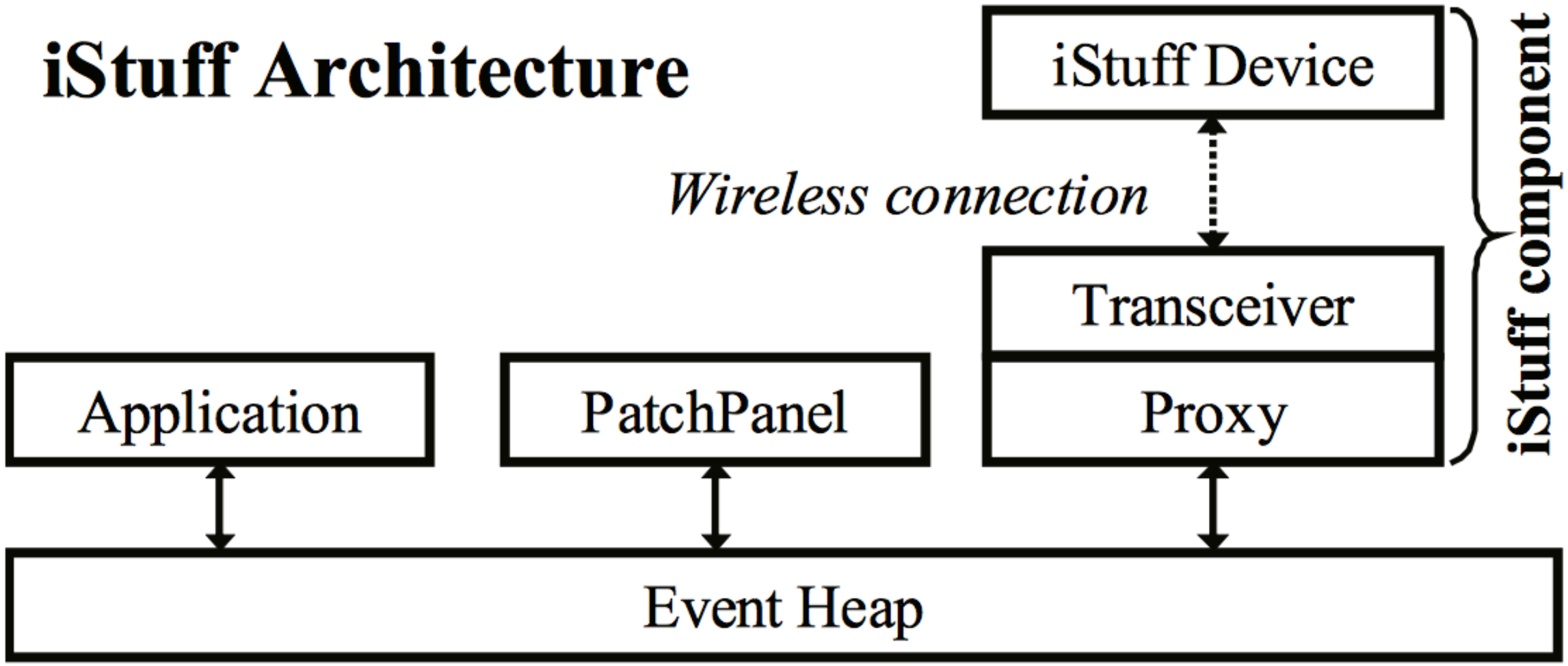
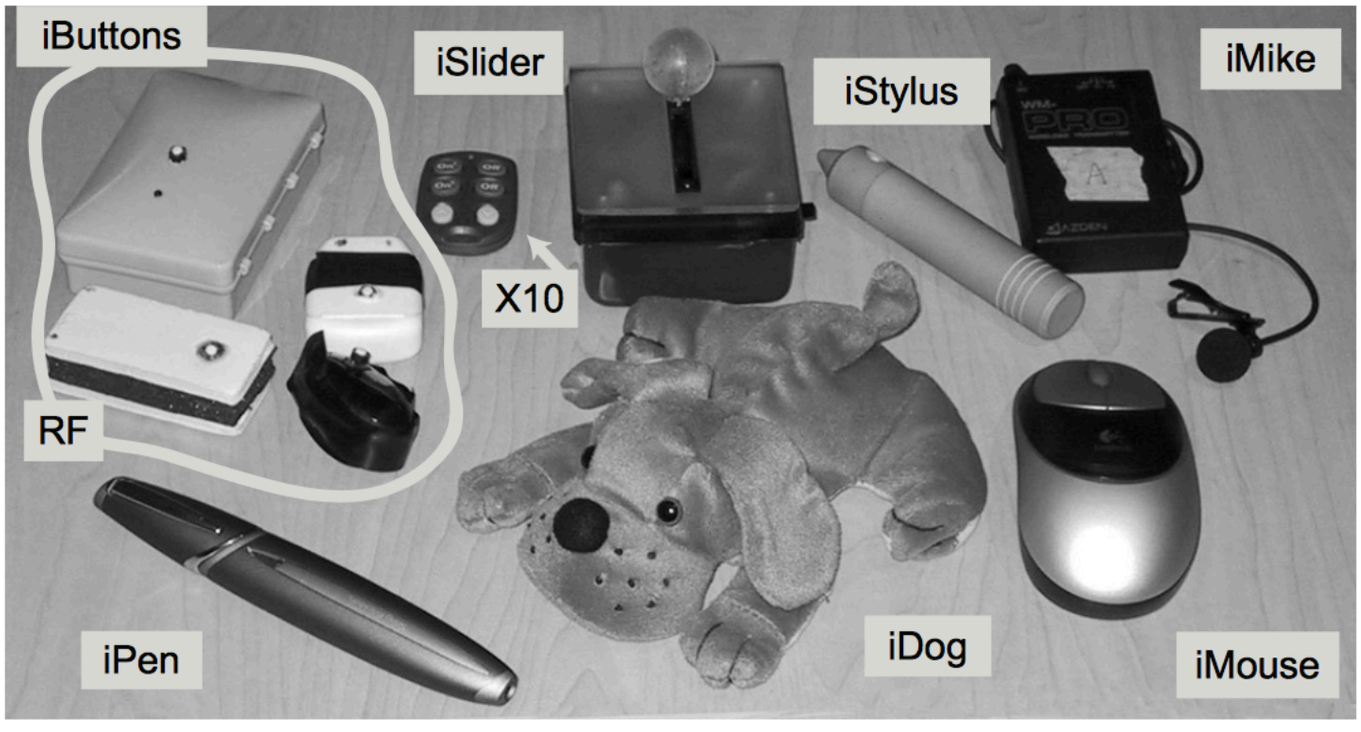
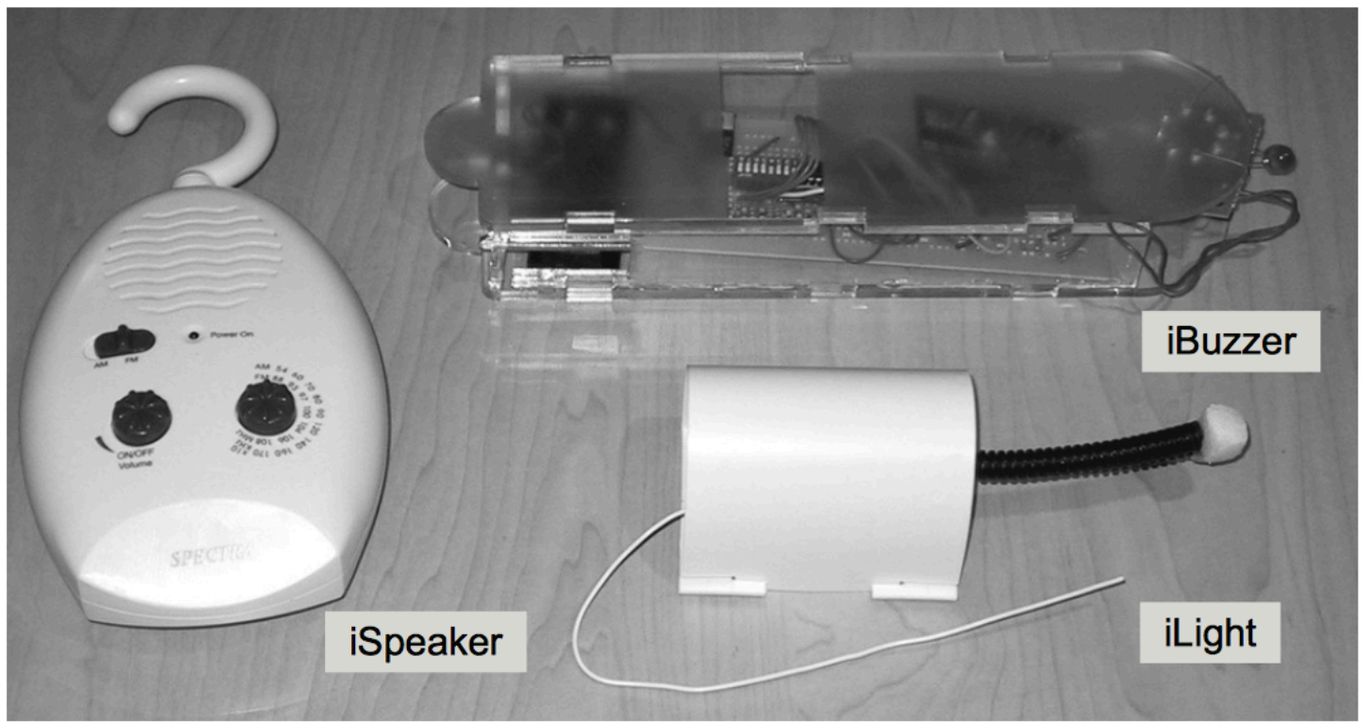


Figure 1: iStuff architecture diagram.





Pros

- Simple Middleware API for changing and maintaining state
- Allows use of any device
- No need for designation or maintenance of standard

Cons

- Potential inconsistency of device states
- No control over devices could lead to clarity issues for end user
- Requires central authority (agent) to facilitate communication

A Context-Aware Framework for Collaborative Activities in Pervasive Communities

- Application of both context-awareness and ubiquitous computing to a collaborative workspace
- Contextual Information acts as a resource for collaborative work
- Provides one potential way of implementation of this type of environment

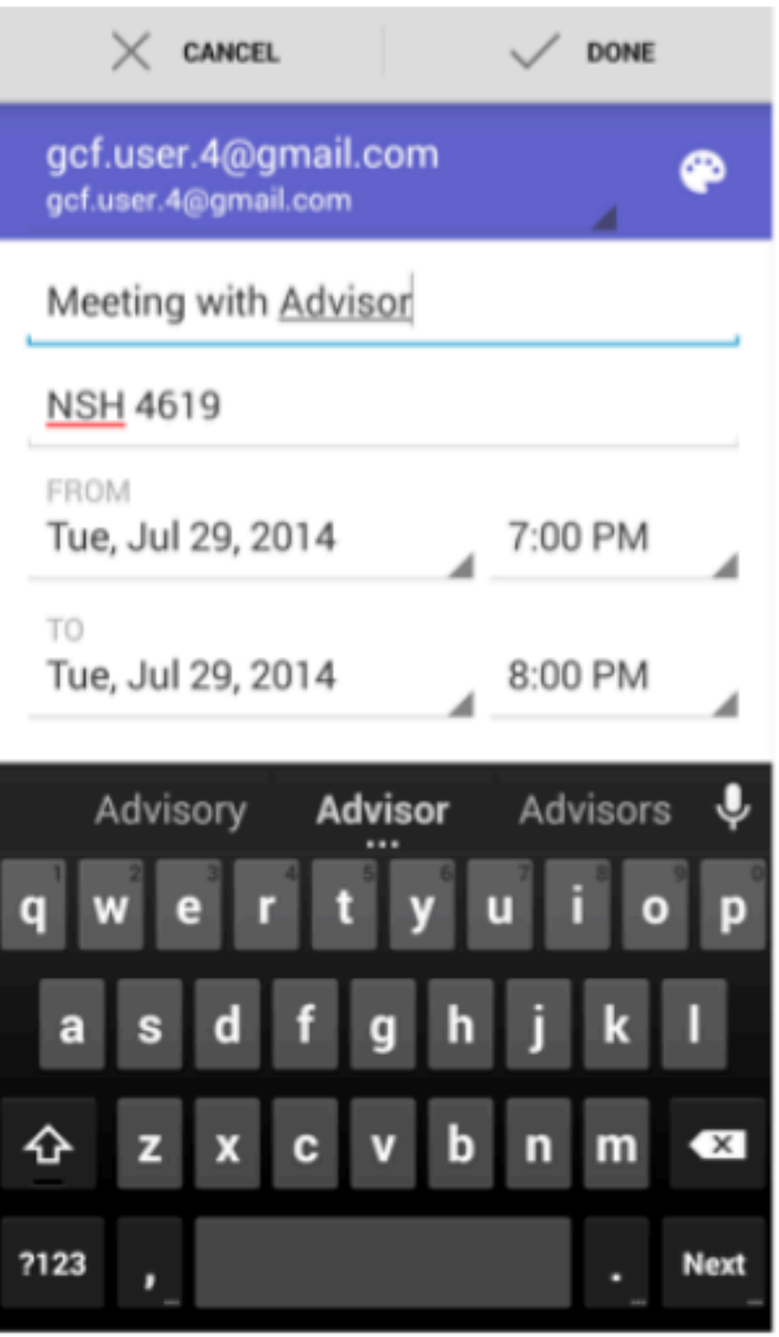
Newest Research

The Group Context Framework: An Extensible Toolkit for Opportunistic Grouping and Collaboration

- Anind Dey
- Potential Framework for opportunistic information/ context sharing
  - Defines different types of sharing - same task, different task, in-situ; as well as device's own capabilities
  - Dynamic maintenance of "Groups"
  - Collection of additional (anonymous) data from others, utilization of open resources from others

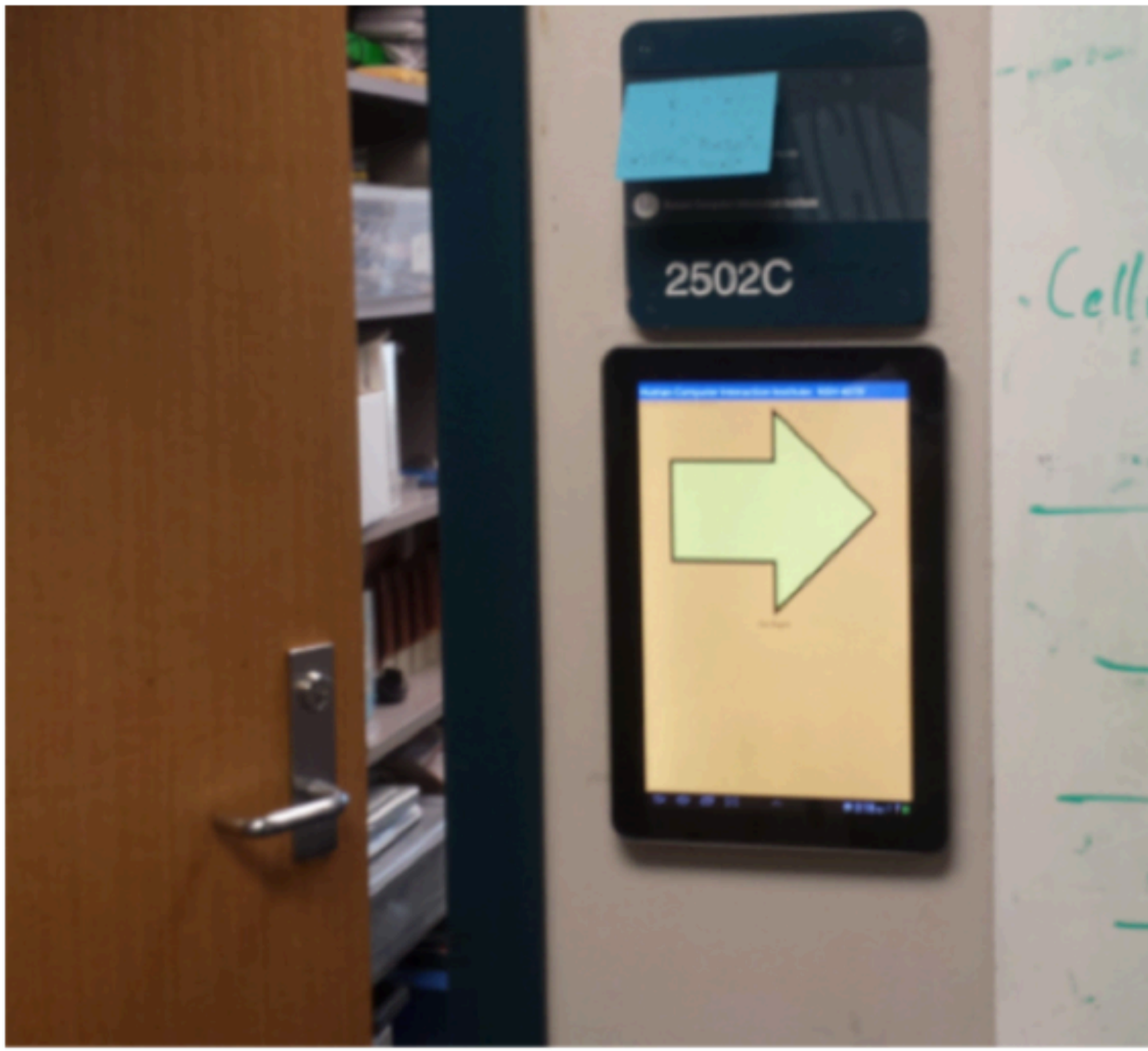
The Group Context Framework: An Extensible Toolkit for Opportunistic Grouping and Collaboration

- Potential Privacy Concerns
- How to parse nonstandard information
- Manufacturers prefer pushing their own environments



Request:
Room #

Room #



ConnectUs: A New Toolkit for Teaching about the Internet of Things

UBICOMP LAB HCII Carnegie Mellon

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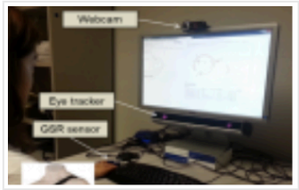

Cyber-learning with a Sensor Support

May 15, 2015

This project aims to better support student learning by adapting computer-based tutoring to individual learning phases and real-time capabilities. In this manner, computer-based tutors may be more effective in supporting robust learning. The specific research goal is to explore a method for …

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Mobile Computing

Multisensory Augmentation

May 15, 2015

In this project, we design multisensory cues or alternative interaction schemes that help to reduce end-users' mental workload while engaged in physical and virtual information spaces. Specifically, we employ theories related to executive control of our working memory (e.g., cognitive load …

Human-Vehicle Interaction

February 26, 2014

In this project, we improve drivers' HCI experience by understanding human cognition and attention in the cars. For this, we use sensors and machine learning techniques by developing objective and near real-time methods to recognize driver and driving states and in-situ …

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