

# Privacy in Mobile and Ubiquitous Computing

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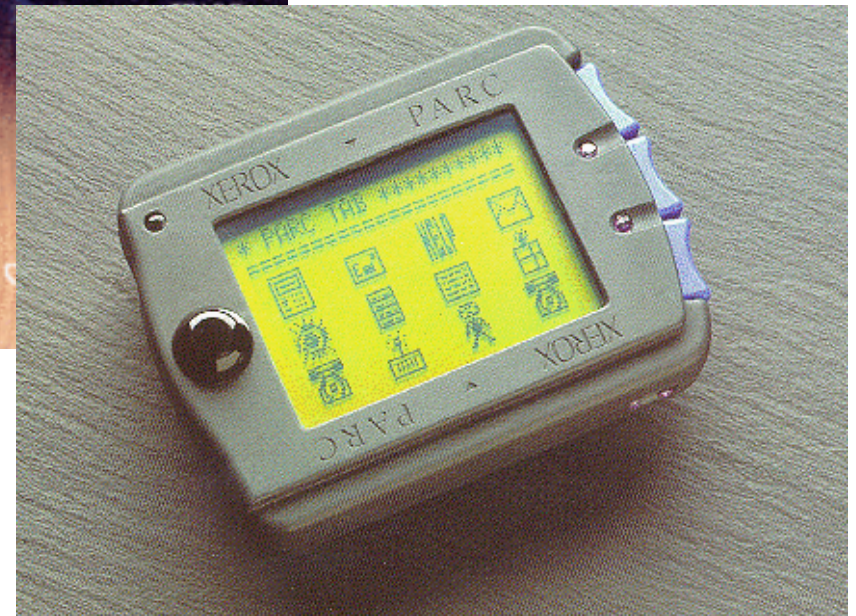
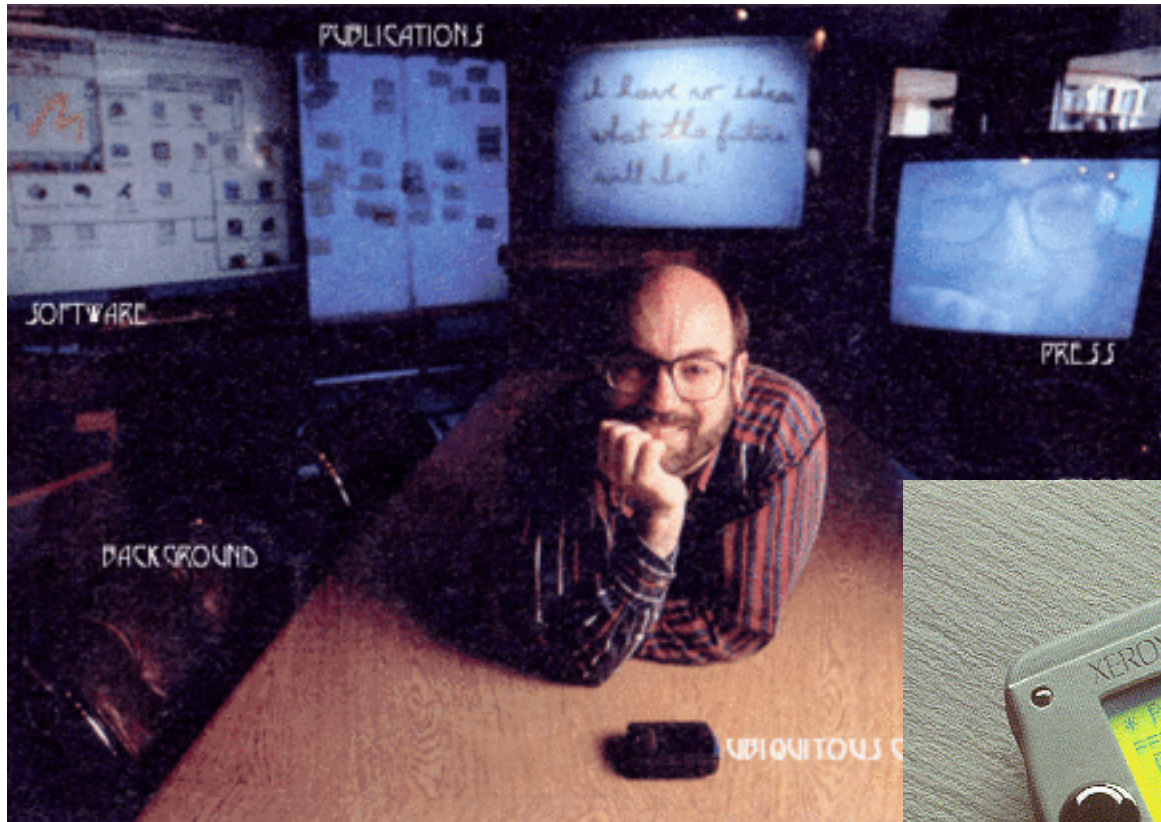
# The two-line summary

Today, the average person interacts with numerous “computational devices” in her daily life

- This brings lots of benefits and opportunities
- It also introduces a host of privacy issues

First, some background...

# Weiser and Ubiquitous Computing



"Ubiquitous computing names the third wave in computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives." -- Mark Weiser

# Apple Knowledge Navigator (1987)

[http://www.youtube.com/watch?  
v=QRH8eimU\\_20](http://www.youtube.com/watch?v=QRH8eimU_20)

# Four Distinguishing Properties of Ubicomp

- Ubiquity
  - The power of computing is accessible everywhere
- Invisibility
  - It recedes to the background and doesn't get in the way
- Sensing
  - Contextual awareness to know how to behave
- Persistence
  - Data can be saved and revisited by the user, or used as inputs to improve behavior of the system

# Ubicomp vs Mobile Computing

- Ubicomp (originally defined) has a sense of:
  - Implicit/natural interaction
  - Fading into the background
  - Focus on infrastructure
- Mobile computing
  - Familiar to us: explicit interaction with our phones
  - More device-centric

What computing devices do you encounter in your daily life?



# Siri (2011)

<http://www.apple.com/iphone/features/siri.html>

# Think about those properties from before again

- Ubiquity
  - It's hard to get away
- Invisibility
  - You don't know it's there
- Sensing
  - It can know a lot of things
- Persistence
  - It doesn't forget

# Kinds of Data

What are the kinds of data that your computing devices know about you?

What other things could they know?

# Kinds of Data

- Audio
- Photo/video
- Motion
- Location
- Communication logs

# Risks



What are some of the risks?

- Lots of (potentially sensitive) new data sources
- You're taking your device many more places
  - Connecting to unknown networks
  - Shoulder surfing
  - Losing the device
- Installing lots of apps
- More opportunities for social sharing
- Device size constraints












# Two ways to think about privacy in Ubicomp

- Ubicomp involves lots of potentially sensitive data
- Using Ubicomp data as an input for managing privacy and sharing preferences

# Sharing online is already complex

-  **Friends**
-  Contacts

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-  another special list
-  classified list
-  college classmates
-  cool colleagues
-  current coworkers
-  exes
-  featured friends
-  general professional
-  high school
-  relatives
-  special friend list

# Sharing mistakes can be costly

The Joy of Tech™

by Nitrozac & Snaggy





With Ubicomp, there's more to share than ever before:

- More types of data
- More individual data points

What features of  
**social relationships**  
predict a person's  
**willingness to share?**

# Study Design

- **39 Participants** Each Provided **70 Friends**
  - Specifically elicited from categories:
    - Family, coworkers, people you're close to, people you do hobbies with
    - Rest randomly sampled from Facebook friends list

# Study Design

Each Participant Rated 70 Friends

## Observables

Sex of Friend

Age of Friend

Frequency of  
communication

Frequency of collocation

Years Known

## Non-Observables

Closeness

Categorized social grouping:

- Family
- Social
- Work

Signed in as jason. Not you? [Sign out](#)

# John Smith

Gender  Male  FemaleAge  If you are unsure, estimate or guessYears you have known him/her  If less than one year enter 0

Give information about who this person is and how you know him or her. Indicate groups this person belongs in, and don't forget that you can add new groups.

Remember, people may be in more than one group.

• [Test Friend \(done\)](#)• [joe blow](#)

• John Smith

[See All People](#)

## Closeness

 How close do you feel to this person?

Very Distant     Distant     Neither Distant nor Close     Close     Very Close

## Frequency Seen

 About how often do you see this person face-to-face?

Less than yearly     Yearly     Monthly     Weekly     Daily

## Frequency Of Communication

 By any means, including phone, email, text message, facebook, etc

Less than yearly     Yearly     Monthly     Weekly     Daily

## Groups

[Add A New Group](#)

Soccer Team (2) Hobby  
John Wood , William Greeneuille

Chess Club (1) Hobby  
Henrie Greene

Jefferson HS (1) School  
Iames Browewich

# 21 Scenario ratings per Friend

Current personal location (7 scenarios)

“How willing are you to share your location in the situation that you’re within 1 mile of this person”

Personal location history (5 scenarios)

Calendar and location plans (7 scenarios)

Communication activity (1 scenario)

Social graph information (1 scenario)

# Study Design

39 Participants

70 Friends

X 21 Scenarios

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57330 Data points

# Results

- **Closeness** is more predictive of sharing than **Social Groups**
- Frequency of **communication** is more indicative of sharing than frequency of **collocation**



# Scenarios people were most willing to share

The next calendar event that we have in common

All calendar events that we have in common

I am with a person

**In Common**

My location when

person

Details of who my  
relationships are

**Information**

ly

My personal travel plans that mean we will be in the same place

My location when I am closer to this person than we normally are

# Summary

- Ubicomp-observable data can be a useful signal for indicating sharing preferences
- Mechanisms for sharing should depend on context of sharer and receiver
- Ubicomp is more than mobile phones

AND

- Everywhere there is computing there is the potential for privacy concerns