Advanced User Interfaces
aka Ubiquitous Computing

Session 1
Introduction

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outline

- what is ubiquitous computing?
  - Weiser 1991
  - Abowd & Mynatt 2000
  - Davies 2002
  - Want et al 2002

- the rest of the course

  - course mechanics

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what is
ubiquitous(?) computing

[Weiser 91]:   the most profound technologies
                    are those that disappear

- virtual reality vs. real virtuality
- scale: tabs, pads, and boards
  - tabs: keep track of things (self-awareness)
  - pads: task support (grabbed/used anywhere)
  - boards: collaboration
- dynamic change & adaptation
- privacy (improve current situation)

charting
ubiquitous computing

[Abowd&Mynatt 00]

- human-computer interactions
  - natural interfaces
  - context-aware applications
  - automated capture & access
- everyday computing (user activities)
- evaluating Ubicomp systems

natural interfaces

- keyboard, mouse, display
  to handwriting, speech, gesture
  - structure in new data types
    - ink: inferring group structure...
    - speech: pause, tone, speaker id...
    - tangible interfaces: co-location, shake...

- dealing with errors
  - error reduction: improve accuracy (?)
  - error & ambiguity detection
  - error recovery:
    proactive correction and disambiguation

more in Session 6

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context awareness

historically & frequently:
   location, location, location...

- [Want 93,95] active badges, PARCTab
  - phone call forwarding
  - "live" maps of people inside a building

- countless tourist guides

5 aspects of context

- who
  user, other people next to the user
- what
  user activity: sitting, driving, meeting...
- where
  location vs. type of location
- when
  habits, duration vs. expected duration
- why
  intention, goals

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context
sensing & interpreting

- all sensing has limitations
  - GPS outdoors
  - location by proxy: laptop, cell phone...
  - cross info: calendar
- fusion of sources
 [Hightower] Location stack

more in Session 10

automated capture & access

- why?
  entertainment, sentimental/intellectual value,
  decision rationale, why is the bridge cracked?

- capture responsibility: individual -> environment
  - meetings, classes
    - synch multimedia (slides, video, sound...)
  - sports events, civil engineering
    - fusion/synch multiple cameras

- challenges
  - finding what you want: semantic search
  - privacy (more in Session 7)

everyday computing

- systems designed for local, short duration interactions
  e.g., open file, spell-check...

- human tasks/activities
  - last hours... months... years
  - concurrent, frequently interrupted
    time is semantic (e.g., last meeting) not linear
  - associative organization of info/tasks
    not hierarchical, e.g., file systems
  - span many locations
    different devices available

scaling computing in space and time

radiotelephony

internet

LAN

wireless

- mobile computing
- wearable computing
- smart spaces

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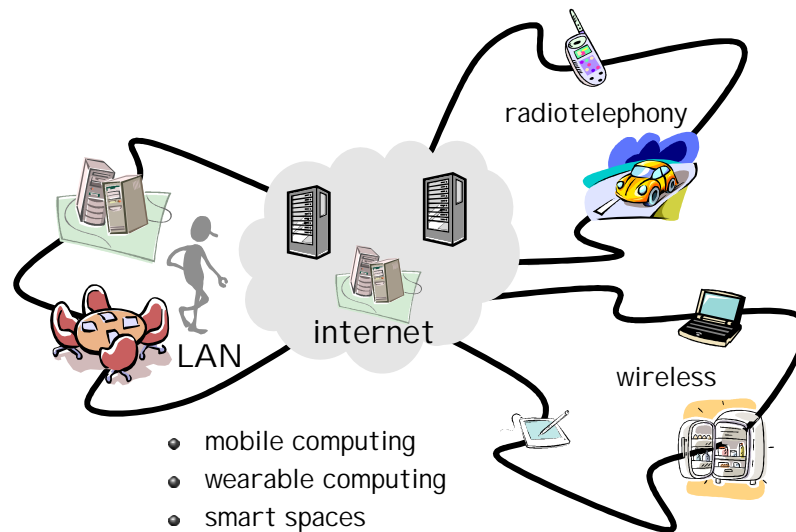
evaluating Ubicomp systems

- find a user need
  - something users already do (do it better)
    - ethnographic studies, e.g., Flatland, Classroom 2000
    - identify variables of concern (what's to improve)
  - something users would like to do
    - compelling story/case study, e.g., Audio Aura
    - user studies

- innovation
  - something people didn't know they wanted
  - vision, e.g., cars, internet, cell phones
    - long term user studies "in the wild"

more in Session 5

take 5

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challenges in deploying Ubicomp
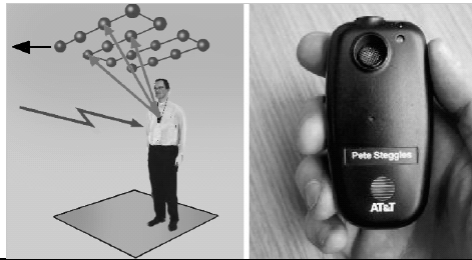# beyond prototypes

[Davies 02]

- tech progress since [Weiser 91]
  - GPS
  - smart cards, RFID
  - web, cell telephony
    - devices become commodity to access user's virtual identity

- "integration" (not interfaces & discovery)
  is lacking for widespread adoption of Ubicomp

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technical challenges

- user models   more in Session 10
  - task, intent, preferences
    - driving to work -> find parking -> preferred spots

- social issues
  - tradeoff between functionality & privacy
    - cameras to find parking also find people
    - anonymization versus crime

- economic issues
  - ubiquity -> cost breakdown? ad-hoc billing?
 - unsolicited, everywhere -> user acceptance of costs?

prototypes beyond the lab

- XeroxParc
  - tabs (phone & PDA) pads (laptop & wireless) smart boards
  - email on pads was killer app in lab, but real users went to WS

- Active badge (Olivetti/AT&T)
  - first indoor location-aware system (active badge & RF beacons)
  - initially for routing phone calls
    later for teleporting user's WS over X Windows
  - room awareness
    -> fine grain location and
     orientation – ultrasound
  - privacy concerns
    "Orwellian workspace"

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more
prototypes beyond the lab

- Touring Machines (Lancaster et al)
  - deployed in museums & small towns
  - location-aware info,
    navigation, and blogs
  - disambiguation of
    location and intention
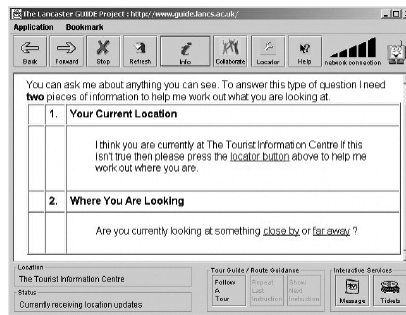
more
prototypes beyond the lab

- Cooltown (HP)
  - integrate Web and Ubicomp: people places & things on the Web
  - people still brought documents rather than URLs to meetings

- Media Cup (Karlsruhe)
  - connecting the real and virtual – tabs/bar codes/RFID
    - location – where's my cup?
    - inference – meeting: gathering of cups
    - assistance – coffee is getting cold
    - safety – coffee is too hot

challenges

- component interaction
  - current interfaces are brittle
    -> deal with diversity, dynamism, QoS

- context awareness
  - infrastructure for contextual triggers
  - how to interpret triggers? – user's task and intent

- distributed multi-organization system management
  - trustworthiness issues, economics

- natural user interfaces
  - adaptive to resources, disambiguation, attention management

- privacy concerns & legislation
  - capture, storage, and dissemination of user's electronic trail

[Want et al 02]

- "invisibility" comes from high quality
  - networking: no delays or blind spots
  - processing: no delays
  - displays: focus on contents
  - storage: perceived as limitless
  - availability: everywhere, no need to carry hardware

- how about invisible software?

  - big issue: integration
    software is still designed assuming ownership
    of hardware and data resources
  - research challenge: self-describing interchangeable data

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