Smart Spaces to Go

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Human-Information Interaction that transcends the desktop
People work and live on the move

- Rescue Workers
- Doctors
- Soldiers
- Police Officers
- Factory Workers
- Sailors
How do people on the go interact with information today?

Growing population of portable, embedded, wearable computing devices, each specialized for particular tasks, but

• User interacts with each device independently

• Applications control, format, and present specific information

• User must track, convert, and transfer information across devices
Two Things Have Changed

1. Networking-capable PDAs, Sensors, and Devices
   IrDA and Blue Tooth Wireless LANs and Fire Wire and USB Plug-and-Play Buses

2. Location-aware Devices
   GPS, Cell Phones, Active Badges
Three Hard Problems

- Coordinating interactions across devices and modalities
- Enabling software to manage information mobility
- Adapting information delivery using knowledge of people, places, and devices
New Idea: Poly-Device, Poly-Modal Interface

Develop a distributed coordination bus that:

- enables coordinated user interactions, individually or collaboratively, across multiple physical devices and multiple modalities
- dynamically composes interfaces optimized for tasks, modalities, and devices

Multi-modal interaction and tracking exists in ITO research prototypes

Multi-party, distributed event buses developed by ITO

Multi-media, cross-device drag-and-drop developed by ITO
New Idea: Active Information

Develop systems of mobile, replicable objects that communicate as groups to:

• track location, state, and trajectory of information users, replicas, and linked objects
• plan information movement and replication
• implement consistency, access, and sharing policies among objects and replicas

Managing Information Mobility

Processing-capable network infrastructures under development in ITO programs

Commercial push toward distributed objects and mobile code

New multicast, transcoding, and beaconing protocols emerging from ITO research

Processing-capable network infrastructures under development in ITO programs
New Idea: Inter-Space

Couple sensor data with resource and scene description languages to model physical and logical space, as perceived by people, so that software can:

• exploit location, proximity, visibility of resources to determine delivery devices
• adapt presentation to characteristics of available devices and services

Small, capable sensors commercially available
Location-based networking services emerging from ITO research
Vision-based computational geometry research funded by DARPA
**Mobility Over Four Working Hours**

**Product Design Engineer**

- **Gus**
  - 100%
  - 80%
  - 60%
  - 40%
  - 20%
  - 0%

- **Harry**
  - 100%
  - 80%
  - 60%
  - 40%
  - 20%
  - 0%

Source: Bellotti and Bly study of distributed collaboration in a product design team, *Proceedings CSCW 96*.

- 10-13% of work completed at desktop
- 76-82% of work spread between 11 other locations
- 8-11% of time spent moving between locations
**Worker Productivity vs. Information Technology Investment in the Service Sector**

- Service sector IT investment rises 8% yearly
- Service sector productivity remains flat


**How Do Software Engineers Transfer Information Among Computers?**

- Computers on desktop: 54% >= 3; 39% = 2; 7.7% = 1
- Transfer data between desktop computers: 70% very often and 25% often
- Transfer data between nearby computers: 28% very often; 23% often; 36% sometimes

Source: Jun Rekimoto, study of software engineers *Proceedings of the ACM Symposium on User Interface Software Technology (UIST)*, 1997
Human-Information Interaction that transcends the desktop

Well-Worn HCI Model

Windows, Icons, Menus, Pointing
User Manages Personal Information
User Initiates All Interactions
Application Software Formats Data

New Smart Spaces HII Paradigm

Multi-device, Multi-modality Interaction
Critical Information Follows User
Information Anticipates User Needs
Information Adjusts to Task/Environment

WIMP HCI

Smart Spaces HII
Smart Spaces to Go

When Can We Start?

WIMP HCI

Smart Spaces HII

Going Our Way?