Collaboration Support for Mobile Users in Ubiquitous Environments

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Agenda

- Motivation
- Definitions
- Collaboration Characteristics
- UbiCollab
- Human Grid
- UbiBuddy
- Conclusion

Motivation

- Business requires collaboration among geographically distributed people.
- Some advantages: distribution of work, reliability on just one person is reduced, different time zones availability.
- Collaboration among people not limited to meeting rooms.
- Existing technologies create a virtual place.
- Information relates to locations in the virtual world
- These limitations are addressed by UbiCollab.

Definitions

- Computer Supported Cooperative Work
  - way people work in groups with the enabling technologies of computer networking, and associated hardware, software, services and techniques.
- *Awareness*
- *Articulation work*
- *Appropriation*
- Context of a system's use: Same time/Same place; Same time/ Different place; Different time/same place; Different time/ different place.

Definitions

- Ambient Intelligence (AmI): *a digital environment that proactively, but sensibly, supports people in their daily lives.*
- *E.g., a trained* nurse will help when needed but will restrain to intervene except when necessary.
- Context Aware
- Personalized
- Adaptive
- Anticipatory

Collaboration Characteristics Common to CSCW and AmI

- **Collaboration and Shared Context**
- **Embodied Interactions and Artifacts as Resources**
- **Mobility of People and Resources**
- **Physical Distribution of People**
- **Flexibility and the Need for Tailoring**

Collaboration and Shared Context

Three types of information exchange among collaborating parties:

- Intentional communication:
  - verbal and non-verbal (e.g. gesture) communication.
- Feedthrough:
  - E.g. cutting a file creates snip of scissors sound.
- Consequential communication:
  - information transfer that emerges as a consequence of a person's activity within an environment.

- The above leads to 'Awareness'
  - "an *understanding of the activities of others, which provides a context for your own activity*"

- Awareness information = AmI context

Embodied Interactions and Artifacts as Resources

- Natural collaboration, similar to any type of natural interaction is **embodied in 3D** physical spaces.
- Characteristics of 3D space:
  - relational orientation and reciprocity- (e.g. "down", "up", "left")
  - proximity and action - actions are limited to our physical proximity
  - partitioning - distance and physical obstacles used to partition the physical room
  - presence and awareness - physical space contains information about people and signs of their activities
- The spaces and the artifacts contained within are essential resources for both CSCW and AmI
- Space = Physical Surroundings
- Place = social constructs to which people associate a meaning, norms ***of*** behavior, and the like.
  - E.g. Home, Office etc

Mobility of People and Resources

- Mobility of people and resources is a common concern for AmI and CSCW.
- People move frequently in order to meet other people or access resources that are not available locally.
- Being able to move freely while using technology is a prerequisite for making technology disappear.

Physical Distribution of People

- Physical distribution is a reality of today's businesses
- The type of rich interaction that is possible in face-to-face scenarios is reduced considerably when using technology as a mediator.

Flexibility and the Need for Tailoring

- Flexibility = property of a system that makes it modifiable to satisfy new or changing needs of its users.
- How much 'Flexibility' is required?
  One concern = privacy
- Personalization of preferences for Individual users
- Challenge:
  - Often impossible to identify a set of predefined configurations that users or groups can select from. Why?
- End user tailoring and programming
  - CSCW and AmI are complementary,
  - CSCW: focus on group issues
  - AmI: Flexibility with respect to the technical environment and personalization.

Existing Technology in Support of Ubiquitous Collaboration

- Promoting awareness = key in collaboration
- E.g.
  - Workspace Awareness – TeamRoom
  - P2P connection / Physical Resource sharing – Speakeasy
- Challenges:
  - Heterogeneity & Dynamism of the environment
  - Robustness of interaction techniques
- Mobile applications have different challenges compared to desktop versions
- Increasing need for frameworks / platforms to create flexible tools like UbiCollab

UbiCollab

- *UbiCollab* = platform for the development of ubiquitous applications.
- Open Source project
- Started by Norwegian University of Science and Technology, Department of Computer and Information Science, and Telenor Research & Innovation.

A human grid = collection of users and the resources in their vicinity

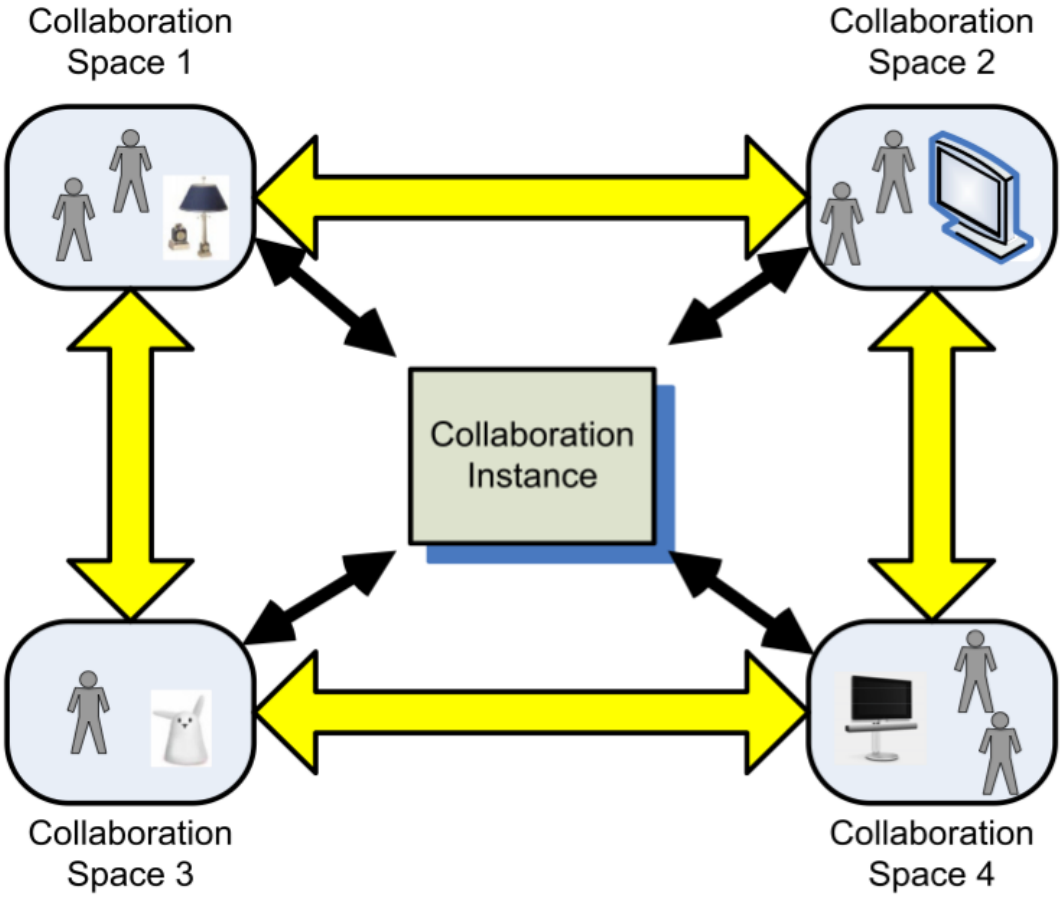


Fig. 1 The Human Grid

Human Grid Architecture:

- *Collaboration instance* = shared context for collaboration.
- Information in a CI can be grouped and represented according to the needs and the habits of the users.
- Support different views of collaboration.
- Participants of a CI will physically inhabit *collaboration spaces*
- Collaboration spaces = physical spaces (such as offices, streets, homes) where CI participants reside in the course of their collaboration with other participants.

Human Grid Architecture:

- CS contains physical and digital *resources, available to its inhabitants.*
  E.g. : projectors, whiteboards, printers, and file servers.

- Resources are owned by individual CI participants, a participant can allow other participants in the human grid to use and control his/her resources.

- Resources in a human grid are deployed for collaboration using *applications.* Applications implement the collaboration logic necessary for each CI

- Ambient information using sensors is *published* to a CI by applications.
  E.g.: presence application publishes state of a light switch.

- Published information can be used to *actualize* actions.
  E.g.: the light is off might trigger an action such as locking the door.

UbiBuddy

g. 2 UbiBuddy integrates with physical artifacts and devices surrounding its user

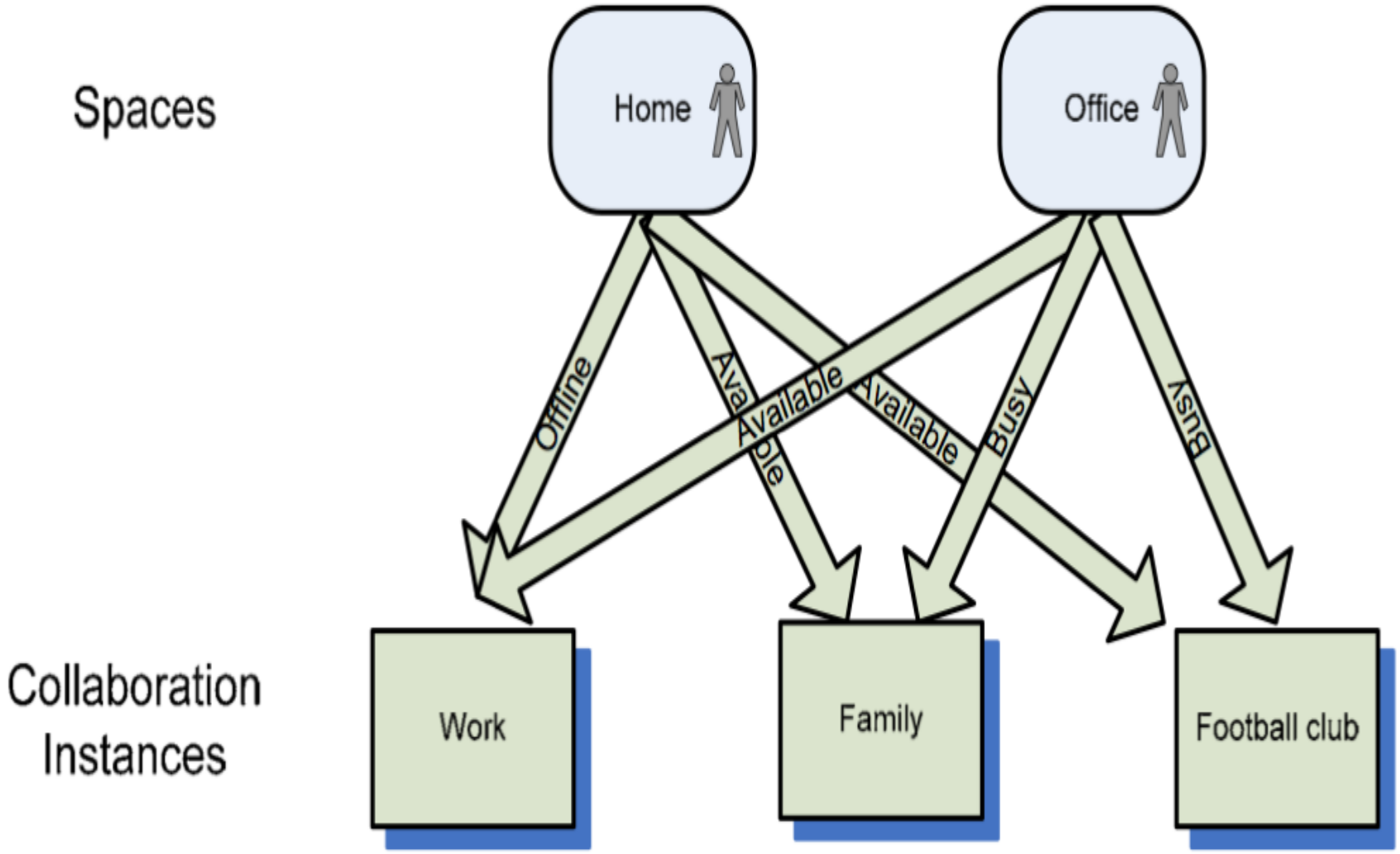


Figure 4: Collaboration Instances in UbiBuddy can provide contextual availability depending on where the user is.

UbiBuddy

- Shortcomings of available buddy list applications:
  - • *Limited support for collaboration context* - individuals are either available to all their buddies or to none of them.
  - • *Limited support for mobility* - Users can define collaboration spaces using meaningful information. "home" or in the "office" instead of as being a "dot on the map".
- Peripheral notices - changes in a user's online status can be actualized by turning on/off a lamp in the living room •

UbiBuddy

- *Lack of connection to the physical context :*
  - limited array of output channels for displaying presence and availability information
  - limited set of input sources for collecting information about users' context (often limited to keyboard and mouse activities).
- UbiBuddy uses physical resources in users' surroundings as both sensors and displays of presence information.

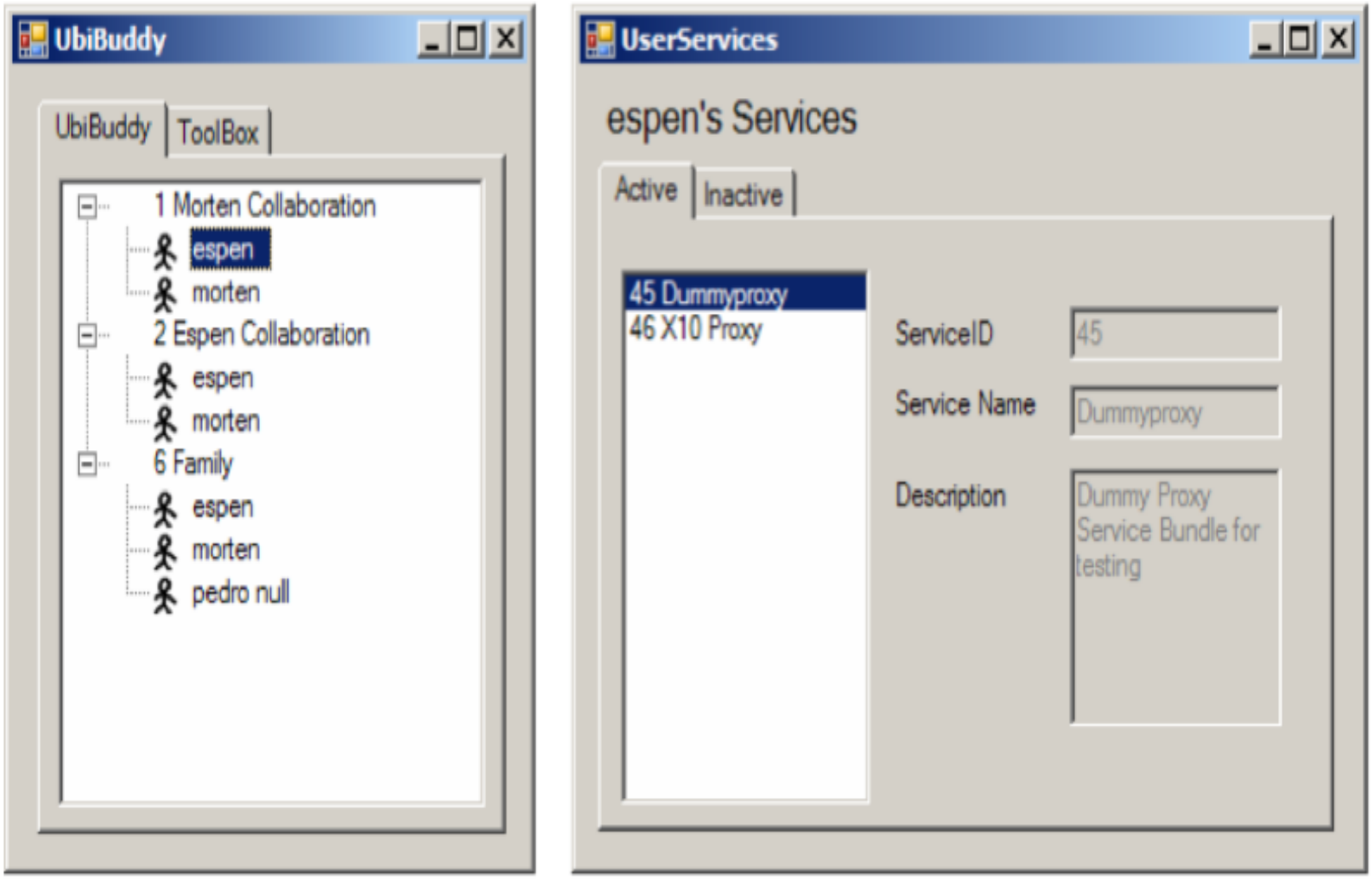


Fig. 3 UbiBuddy main window and context details window

UbiBuddy Summary

- UbiBuddy is implemented on top of UbiCollab.
- UbiBuddy demonstrates the human grid concept by defining buddy groups as CIs, while physical resources are used as sources and displays of presence information .
- Collaboration spaces are used to locate users and resources, and to publish and actualize presence information in the correct way.
- The logic to handle changes to the availability of buddies (e.g. going offline for colleagues when at home) is done by UbiBuddy itself, which is implemented in form of an application.

The UbiCollab Platform

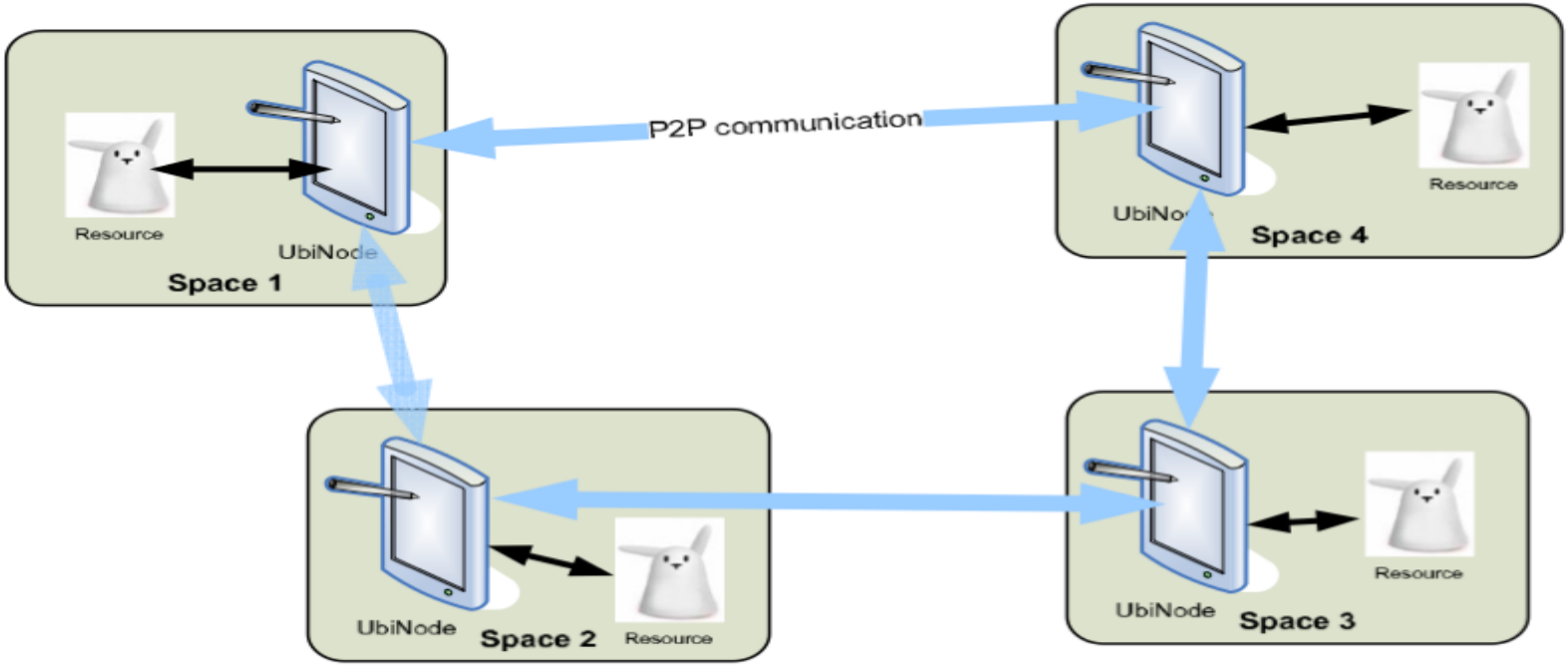


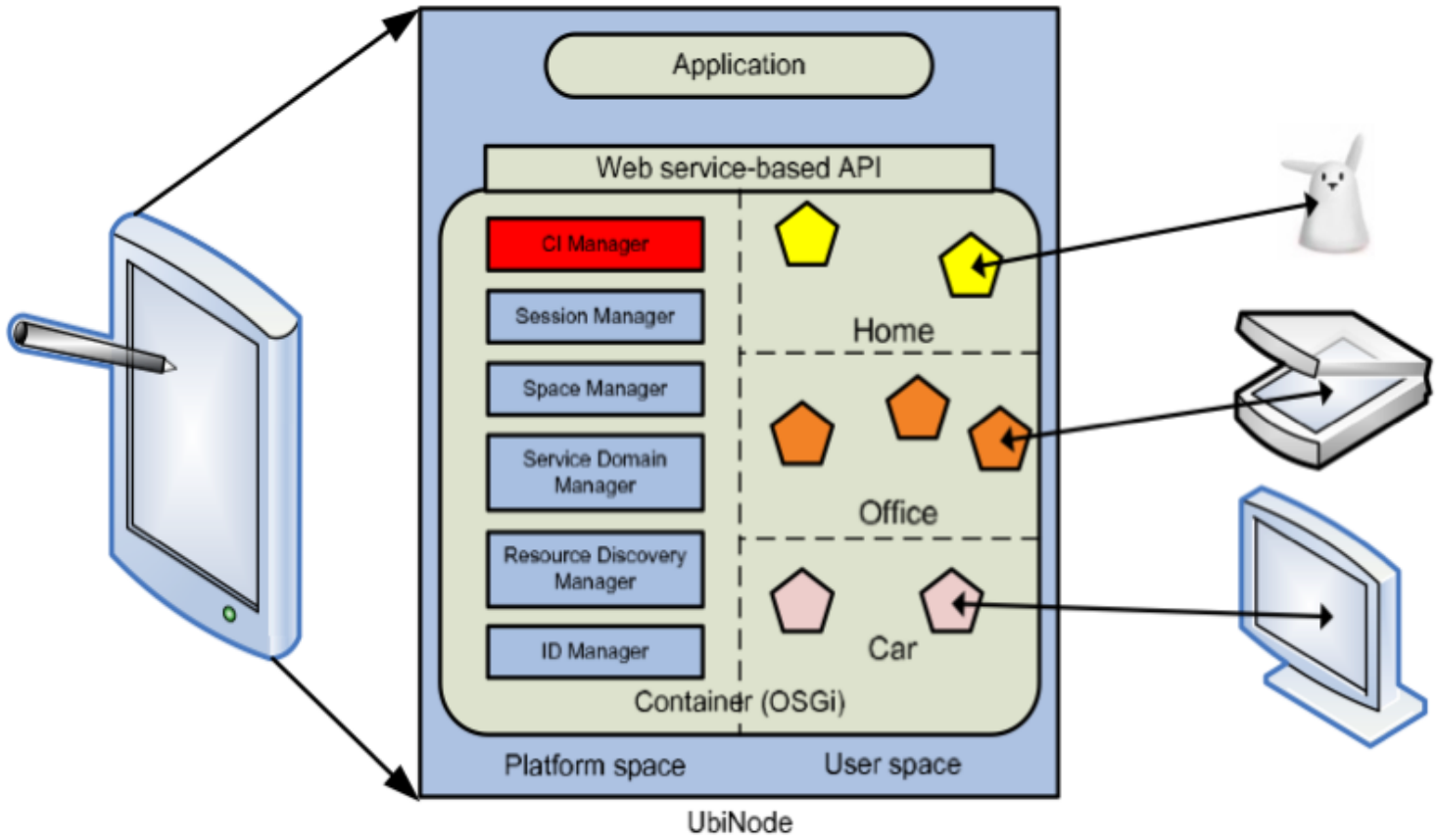
Fig. 5 A sample UbiNetwork with four UbiNodes

- UbiCollab platform is deployed on each UbiNode

UbiCollab

- Multiple human grids form a *UbiNetwork*
- Each peer = *UbiNode* and belongs to one UbiCollab user.
- The UbiNode = identifier for the user.
- Each UbiNode communicates directly with the resources in the physical space where its owner resides.
- Proxy Services run on the user's UbiNode and implement a uniform way of communicating with the various resources.

UbiNode Architecture



. 6 The architecture of a UbiNode

UbiCollab Architecture:

- CI manager: creation and maintenance of Collaboration Instances.
- SessionManager: runtime environment for the applications.
- CS manager: Collaboration Spaces.
- Service Domain (SD) manager: managing the user's Proxy Services.
- Resource Discovery(RD) manager: finding external resources.
- Identity manager: create multiple virtual identities

External Links

- UbiCollab:
  - http://www.ubicollab.org/
- UbiCollab Architecture:
  - http://www.ubicollab.org/system/files/UbiCollab_architecture_whitepaper.pdf
- Paper:
  - http://cs.gmu.edu/~jpsousa/classes/895/readings/0173.pdf

Conclusion

- This paper
  - Points out challenges for collaboration when users are mobile.
  - Points out shortcomings of current groupware software
  - Provides an abstract phenomenon called ‘human grid’ to support collaboration among users.
  - Developed a sample application ‘UbiBuddy’ using UbiCollab platform.

- Thank you.

- Sunitha Thummala