# Mobile and Context-aware Interactive Systems

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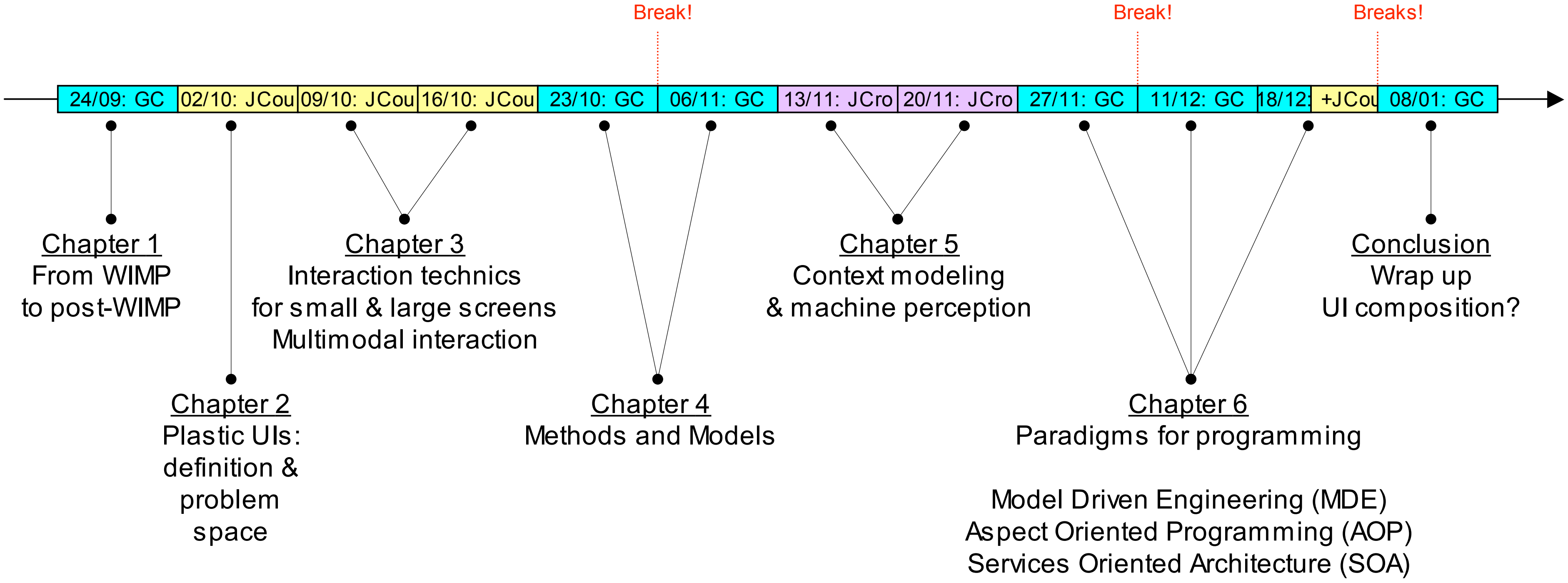
ENSIMAG

Laboratoire d'Informatique de Grenoble (LIG)

# Outline and schedule



Break! Break! Breaks!

24/09: GC | 02/10: JCou | 09/10: JCou | 16/10: JCou | 23/10: GC | 06/11: GC | 13/11: JCro | 20/11: JCro | 27/11: GC | 11/12: GC | 18/12: | +JCou | 08/01: GC

<u>Chapter 1</u>
From WIMP
to post-WIMP

<u>Chapter 2</u>
Plastic UIs:
definition &
problem
space

<u>Chapter 3</u>
Interaction technics
for small & large screens
Multimodal interaction

<u>Chapter 4</u>
Methods and Models

<u>Chapter 5</u>
Context modeling
& machine perception

<u>Chapter 6</u>
Paradigms for programming

Model Driven Engineering (MDE)
Aspect Oriented Programming (AOP)
Services Oriented Architecture (SOA)

<u>Conclusion</u>
Wrap up
UI composition?

GC: Gaëlle Calvary
JCou: Joëlle Coutaz
JCro: James Crowley

# Outline of Chapter  2

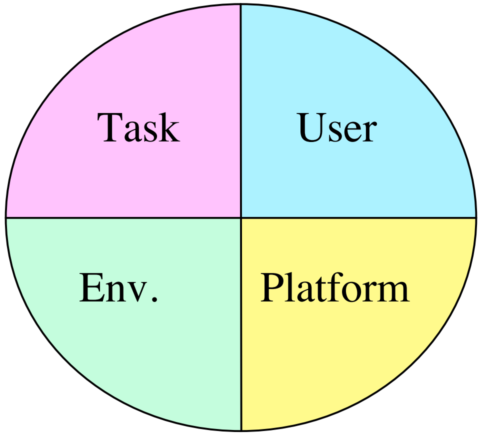
1. Introduction

2. Definitions (simplified)
   - User Interface (UI) plasticity
   - Context of interaction
   - Usability
   - Adaptation

3. The problem space of UI plasticity

# introduction

- In conventional HCI: the problem space is bounded
  - The target user (e.g., an office clerk)
  - accomplishes a well-defined set of tasks (e.g., writing a report)
  - using a fixed class of devices (e.g., a workstation)
  - in a predefined set of environments (e.g., in the office)



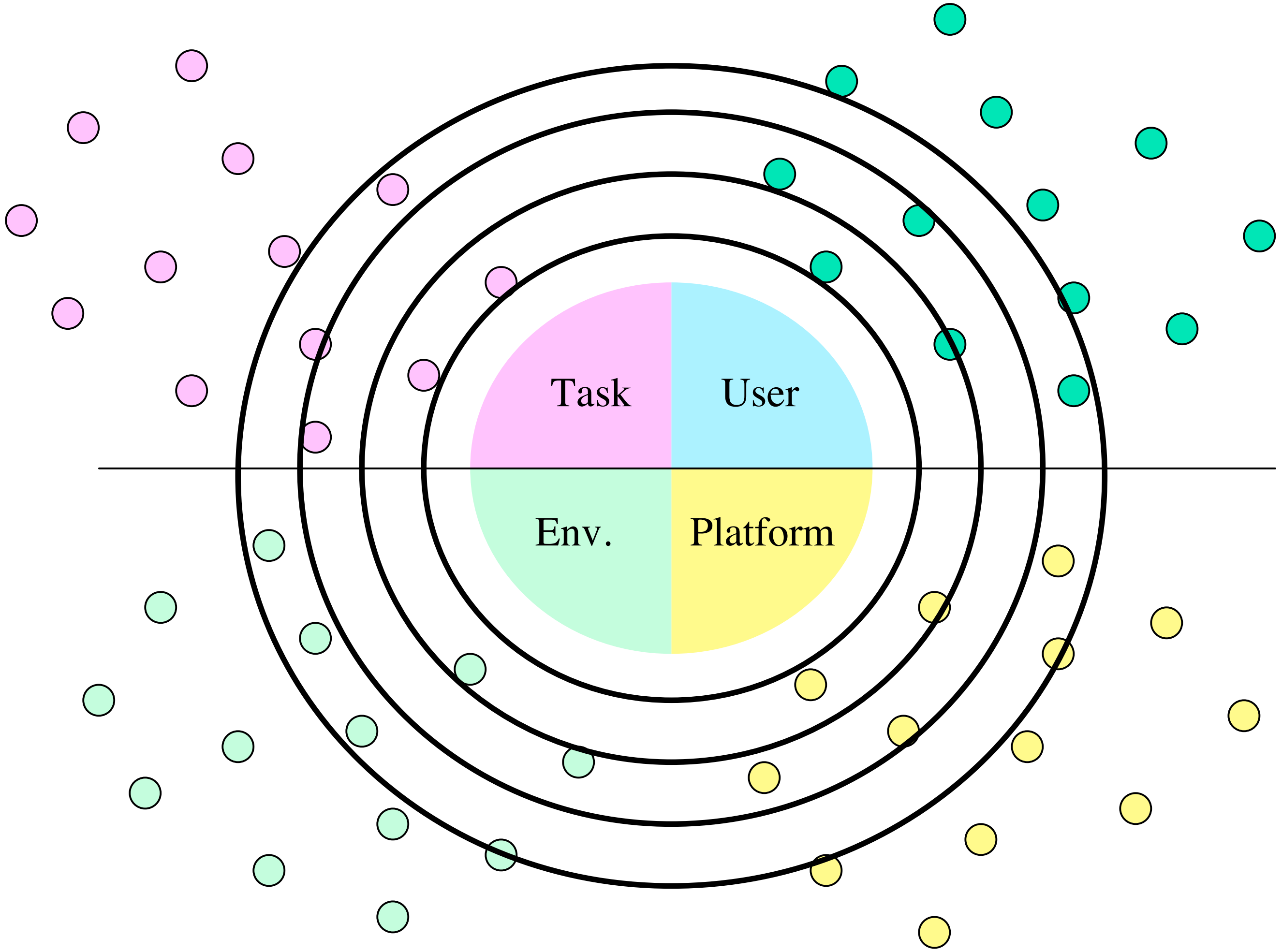
Task

User

Env.

Platform

- In ambient computing: the problem space is unbounded



# Introduction: how to address this problem?

- Approach1: to develop the systems on a case per case basis (ad-hoc manner)
  - Development cost and maintenance: very high!
  - Consistency problem between the various versions
- Approach2: to improve the methods and tools in order to support
  - Portability
  - Reusability
  - Modifiability (please, make the distinction between adaptability and adaptativity)
  - Scalability in terms of
    - Computing resources
    - Services
    - Interaction techniques (multimodality, UI for small and large devices)

=> Plastic UI

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1. Introduction

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3. The problem space of UI plasticity

# plasticity

- Materials: capability to change their own shape while preserving usage, they do not break (within some limits, of course)
- Physiology: capabilities of tissues to rebuild themselves to recover from injuries (e.g., the brain)
- Animals, plants: they adapt to the environment to survive
- By analogy in HCI …

# Plasticity of an interactive system

- Capacity of the system to adapt to the context of use while preserving their own utility and usability

- Context of use …

- Adaptation …

- Utility and Usability …

# Context of use (simplified version)

- Context: it’s complex! Generally speaking, it is an information space
  - that is shared between actors, dynamic, structured, and
  - that serves interpretation (by the actors)
- There is “no context without context” -> context of use
- Context of use: an information space
  - that is shared (between the software components of the interactive system and between the system and the users), dynamic, and structured into 3 sub-spaces:
    - The users
    - The platform (from an elementary platform such as a mobile phone to a cluster of elementary devices)
    - The physical environment (location, light-sound-heat and social conditions)
  - that supports the adaptation process to perserve the system utility and usability

# Plasticity of an interactive system

- Capacity of the system to adapt to the context of use while preserving their own utility and usability

- Context of use …

- Adaptation …

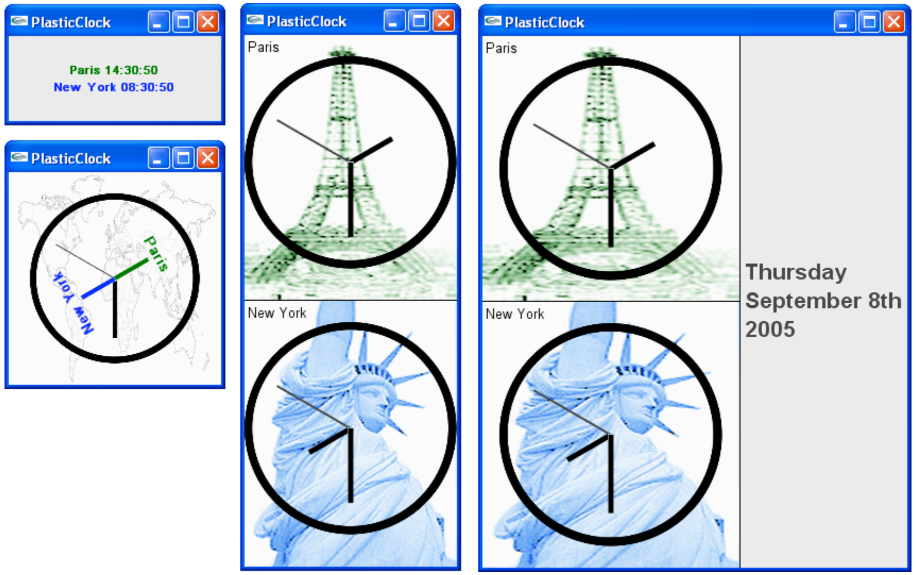
- Utility and Usability …

# Two means for UI adaptation

- Remolding (reshaping)
- Redistribution

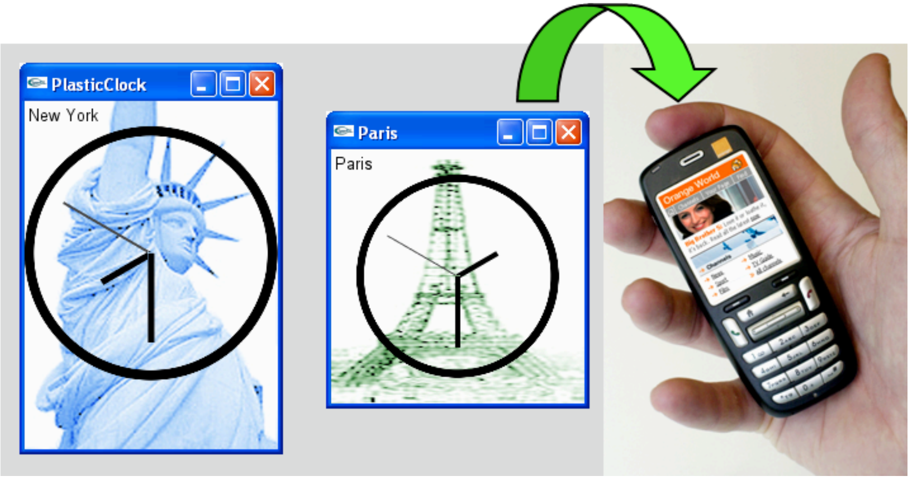
# UI remolding (reshaping)

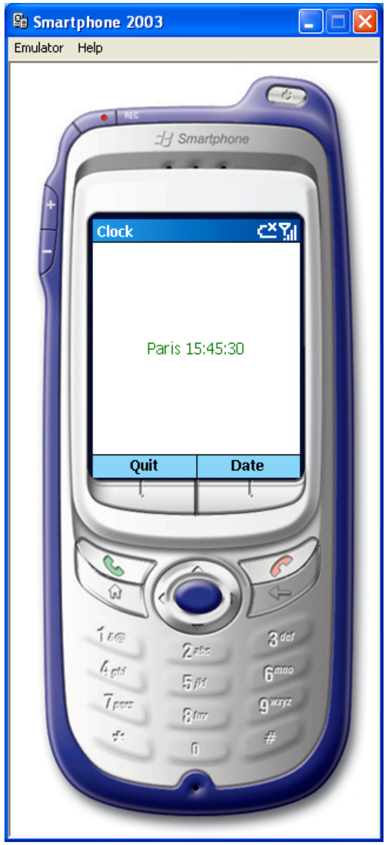
- Example: Plastic Clock



Paris 14:30:50
New York 08:30:50

Thursday September 8th 2005

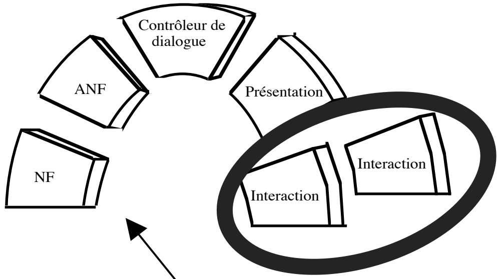




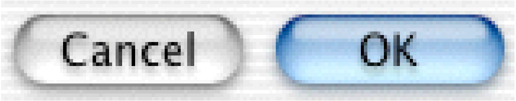
Paris 15:45:30

# UI remolding (reshaping)

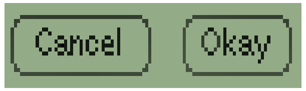
- Physical Presentation level (PP)



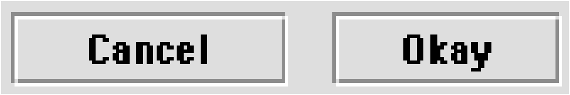
NSButton :



Button :



JButton :

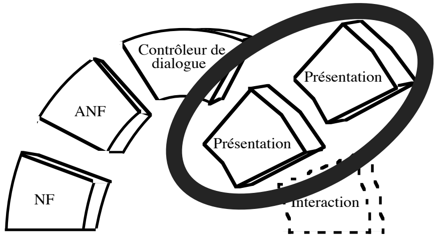


The classes of widgets are maintained but their behaviour (possibly, their spatial and temporal layout) has changed

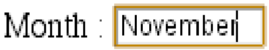
*NB: Arch model (see readings)*

# UI remolding (reshaping): may cover multiple levels of abstraction

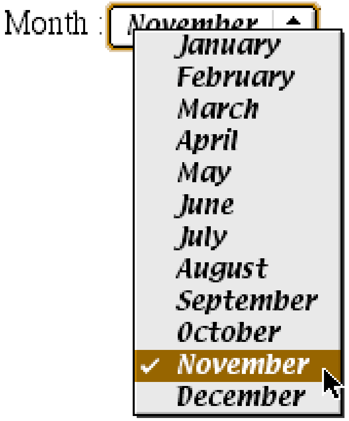
- Logical presentation level (LP)



Label + T extField :


Month : November

Label + ComboBox :

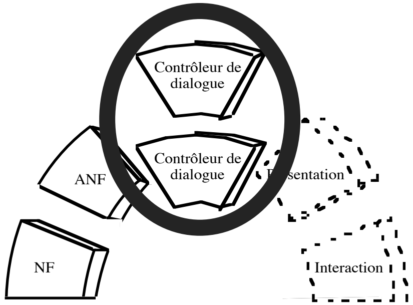

Month : November

Substitution of widgets

LP Modification -> PP Modification

# UI remolding (reshaping)

- Dialogue Control level (DC)

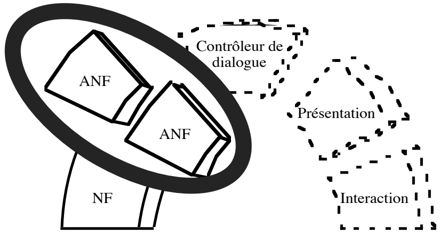


Tasks are maintained but their ordering has changed

DC Modification -> LP modification -> PP modification

# UI remolding (reshaping)

- Functional Core Adaptator level (FCA)



**Livre** (sur station de travail)
- titre
- auteurs
- résumé
- mot clefs
…

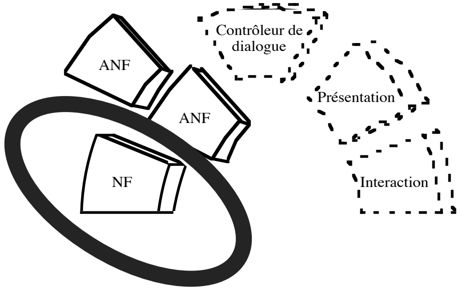
**Livre** (sur PalmPilot)
- titre
- auteur principal
- mot clefs

Tasks and domain-dependent concepts may be added/suppressed

FCA Modification -> DC modification -> LP modification > PP modification

# UI remolding (reshaping)

- Functional Core level (FC)



The nature of the services of the functional core has changed (cf. very last course on UI composition)

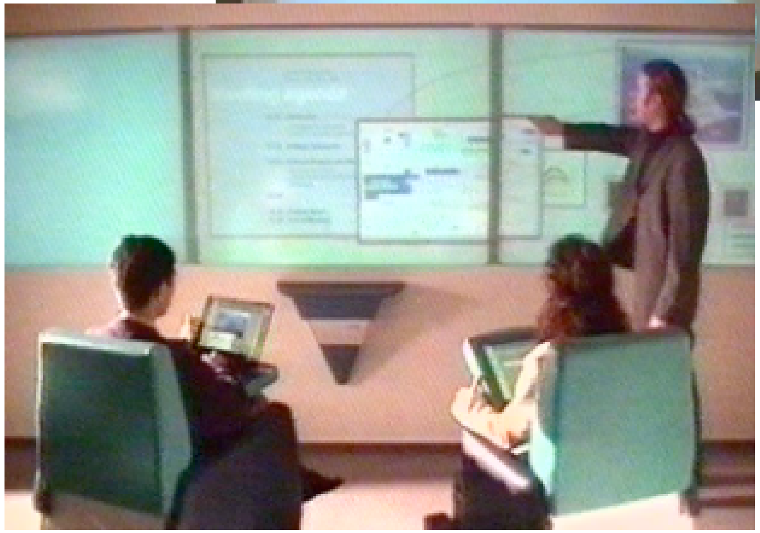
FC modification ->FCA Modification -> DC modification -> LP modification > PP modification

# UI Redistribution

- The UI uses interaction resources that are distributed over multiple elementary platform (distributed UI)
- UI redistribution may be static or dynamic
- Dynamic redistribution => on-the-fly migration of the UI
    - Migration may be total: the UI releases (frees) all of the interaction resources currently used and migrates entirely to other interaction resources
    - Migration may be partial: only portions of the UI migrate -> what is the granularity for UI migration?
        - Workspace level
        - Pixel level

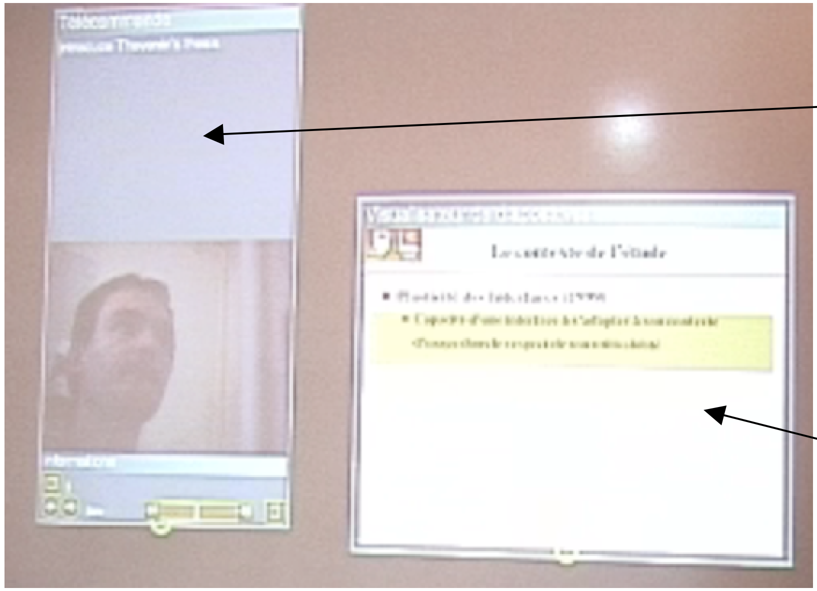
# UI Redistribution

- Rekimoto’s “pick and drop”
  - Distribution is static
  - Distribution at the workspace level
  - No remolding
- i-LAND
  - Distribution is dynamic
  - Distribution at the pixel level
  - No remolding



# UI Redistribution

- CamNote, a slide viewer



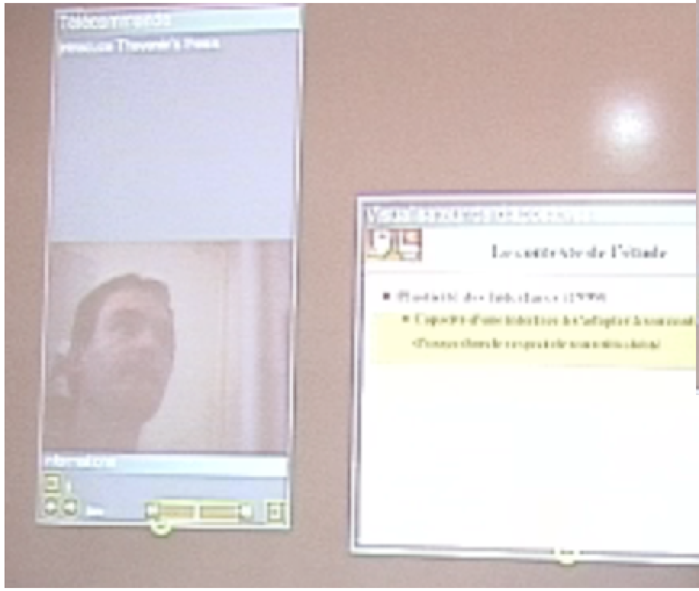
workspace for the control panel

workspace for the slides

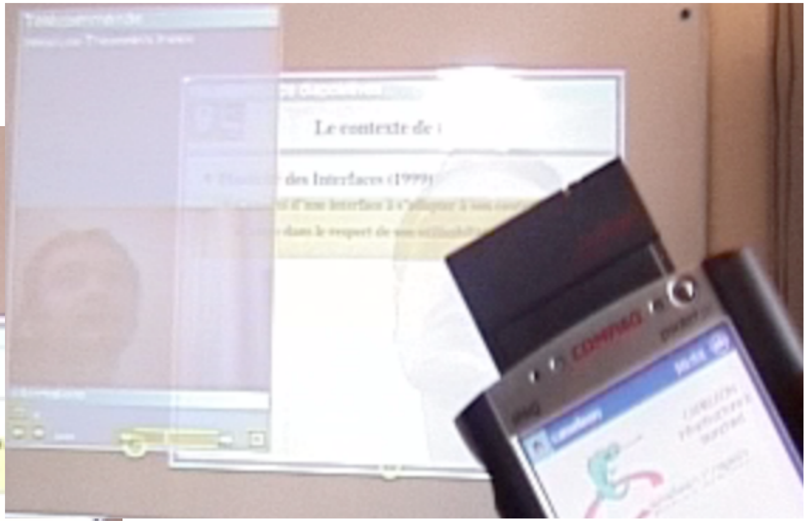
**1. PC only: centralized UI**

# UI Redistribution

- CamNote



1. PC only: centralized UI

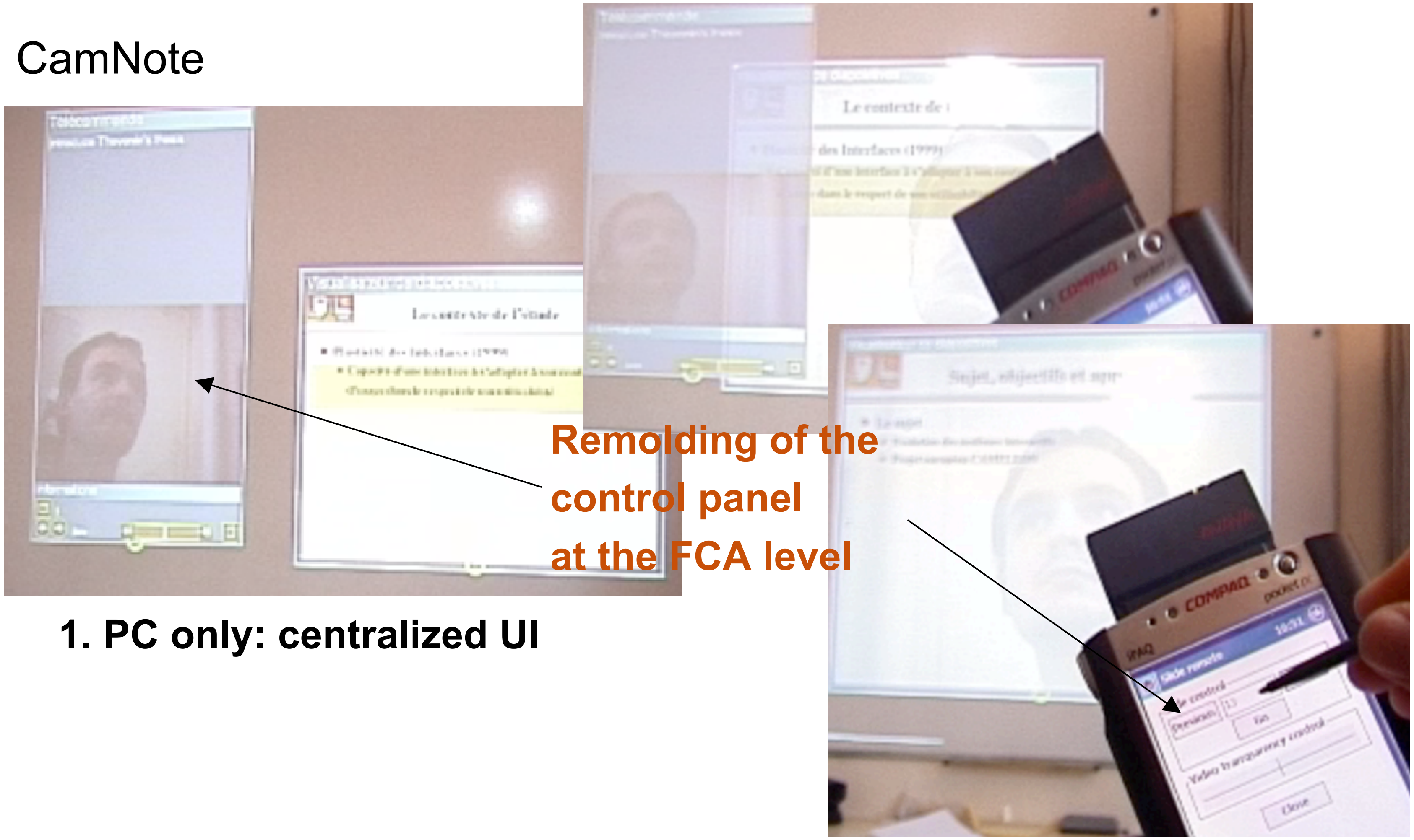


2. Arrival of the PDA: UI partial migration

# UI Redistribution

- CamNote

2. Arrival of the PDA: UI partial migration



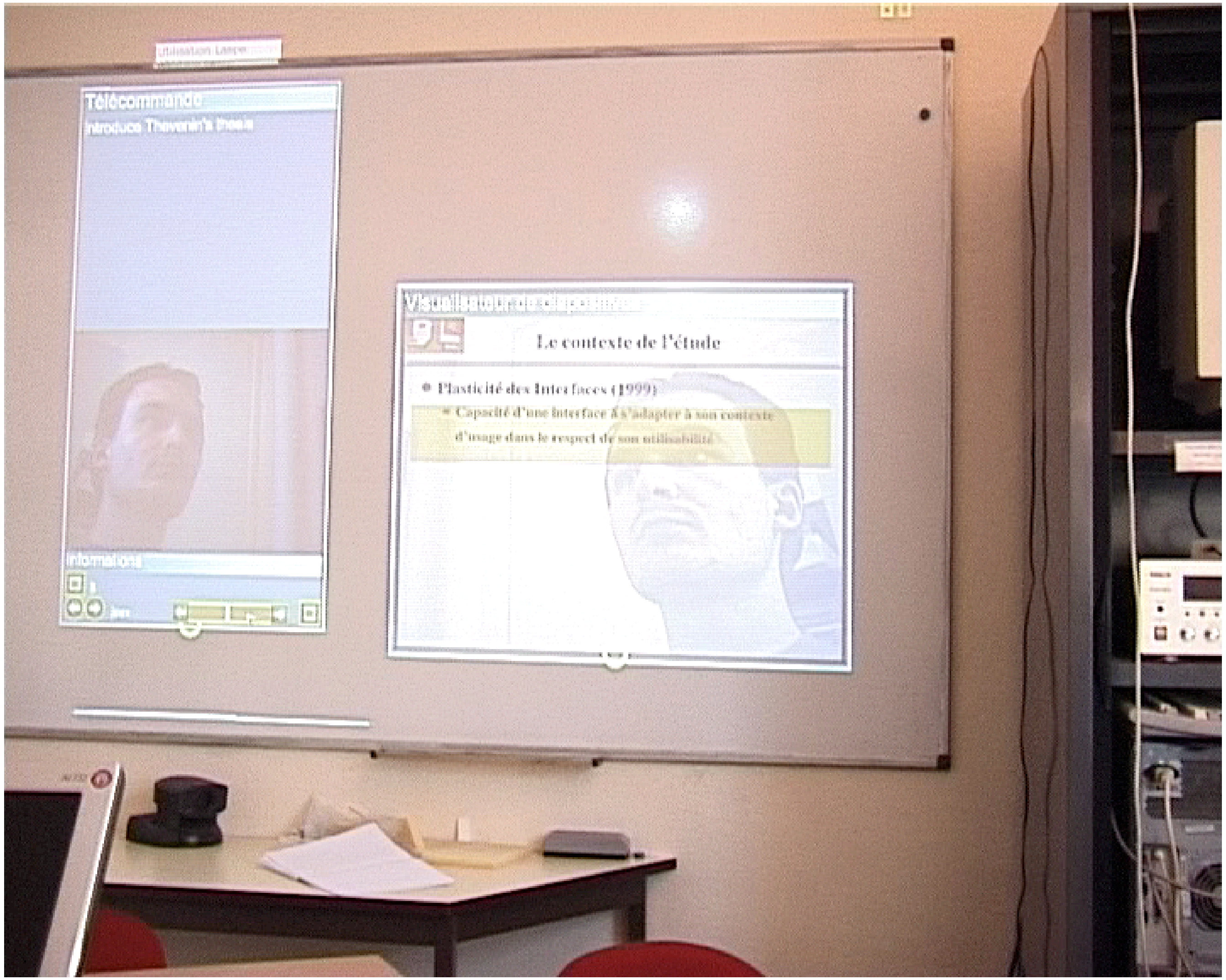
Remolding of the control panel at the FCA level

1. PC only: centralized UI

3. Distributed UI (PC and PDA) + remolding

# UI Redistribution

- CamNote


Télécommande
Introduce Thevenin's thesis
Informations
Visualisateur de diapositives
Le contexte de l'étude
Plasticité des Interfaces (1999)
Capacité d'une interface à s'adapter à son contexte d'usage dans le respect de son utilisabilité

# Plasticity of an interactive system

- Capacity of the system to adapt to the context of use while preserving their own utility and usability

- Context of use …
- Adaptation …
- Utility and Usability …

# Utility of an interactive system

- Capacity of the system to provide the target users with the appropriate functions/services (not less, not more)

- Appropriate = in conformity with users'need (not with designers' and developers' needs!)

- How to elicit the appropriate services?
  - Talking to users is not a luxury, it is mandatory!
  - Questionnaires, focus group, persona, evaluation, rapid prototyping (low-fidelity), observation of users in their daily activities, etc.
  - In short: user-centered design

# Usability of an interactive system: many faces!

- To make it simple: Capacity of the system to allow the target users to access and manipulate the services provided by the interactive system in conformity with their cognitive, motor and perceptual capabilities
  - Cognitive is the hard part ! Knowledge, pleasure, emotion, mood come into play!

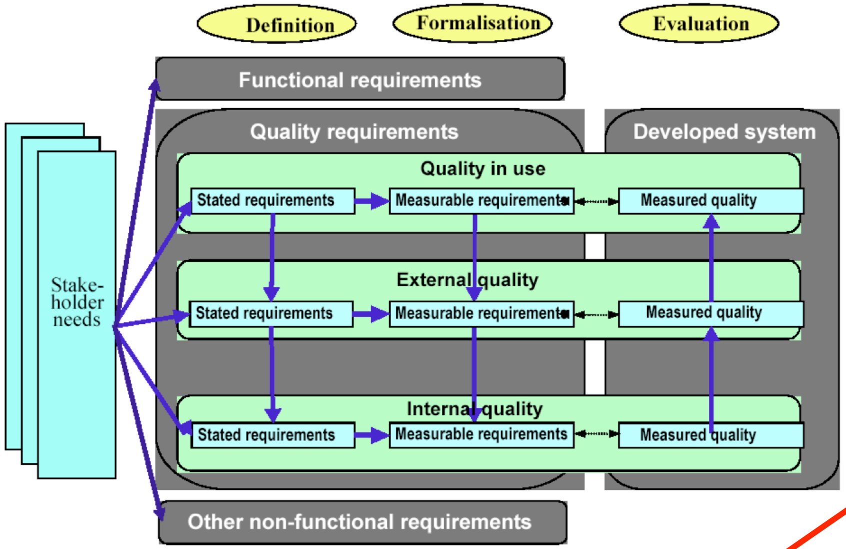
- How to develop a usable system?
  - Use theory-based knowledge (e.g., Fitts law, etc. = another course)
  - Apply ergonomics rules (another course)
  - Design, evaluate with the end-user and iterate

# Utility and Usability are not intrinsic to a product!
It depends on the context of use

- Utility and usability depend on the “values” that the user associates to the system
- The “values” depend on the context of use
- Example: possible values for a heating control system that may depend on the context of use
  - Money saving
  - Sustainability
  - Comfort

# Usability within the Software Engineering community

- Properties are translated into metrics: ISO9126-1 quality model. That’s good because this is done in HCI as well, but …



Definition

Formalisation

Evaluation

Functional requirements

Quality requirements

Developed system

Quality in use

Stated requirements

Measurable requirements

Measured quality

External quality

Stated requirements

Measurable requirements

Measured quality

Internal quality

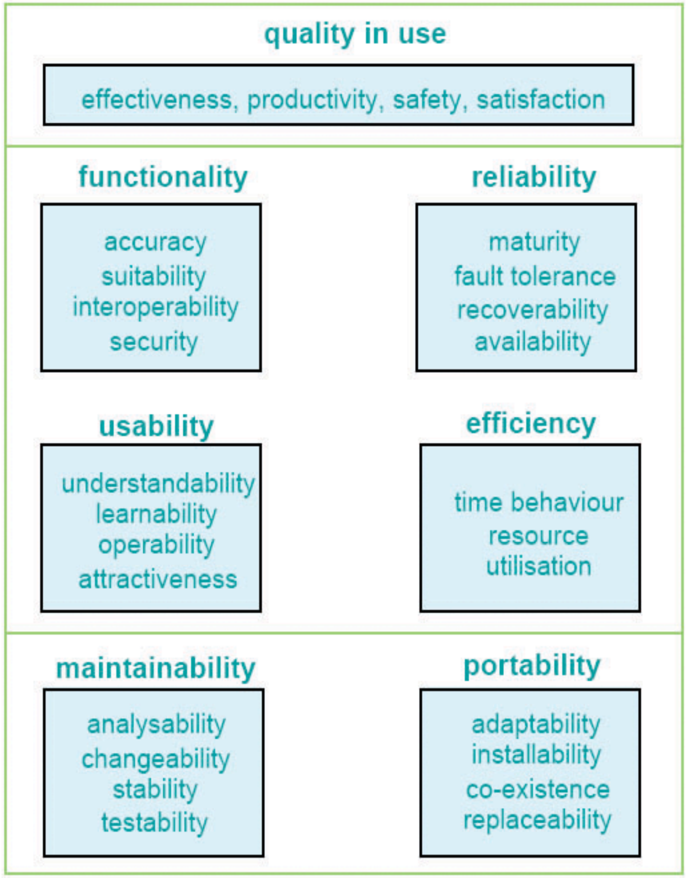
Stated requirements

Measurable requirements

Measured quality

Stake-holder needs

Other non-functional requirements



quality in use

effectiveness, productivity, safety, satisfaction

functionality

accuracy
suitability
interoperability
security

reliability

maturity
fault tolerance
recoverability
availability

usability

understandability
learnability
operability
attractiveness

efficiency

time behaviour
resource
utilisation

maintainability

analysability
changeability
stability
testability

portability

adaptability
installability
co-existence
replaceability

**Utilisability is considered as a quality that is independent from the rest**
**Thus, temptation is high to assimilate usability as cosmetic criteria!**

# To sum up …

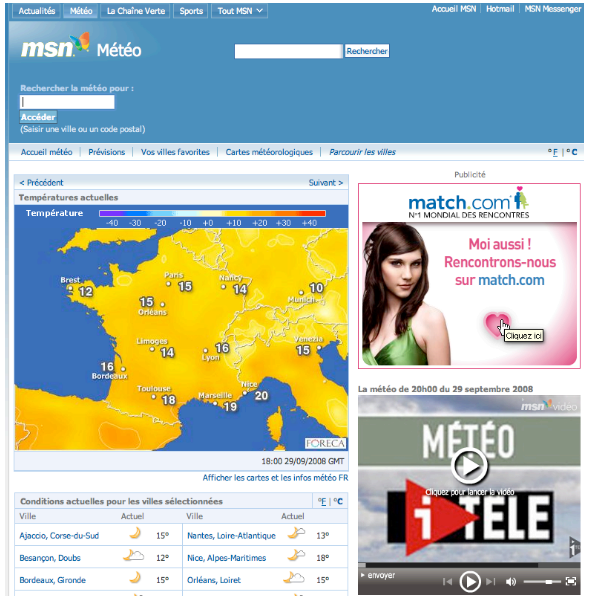
- UI Plasticity = UI adaptation to the context of use while preserving utility and usability

- Adaptation of all or portions of the UI in two complementary ways that can be compbined: remolding (reshaping) and redistribution (migration)

- Examples
  - Plastic clock: remolding only, up to the FCA level
  - Pick and Drop: no remolding, static UI distribution at the workspace level
  - I-LAND: no remolding, dynamic UI redistribution at the pixel level
  - CamNote: remolding up to the FCA level, dynamic UI redistribution at the workspace level

# Exercice

- Caracterize the UI plasticity of the following interactive system (meteo)



Rechercher la météo pour :

(Saisir une ville ou un code postal)

Températures actuelles

18:00 29/09/2008 GMT

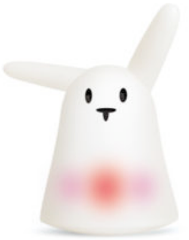
Afficher les cartes et les infos météo FR

La météo de 20h00 du 29 septembre 2008

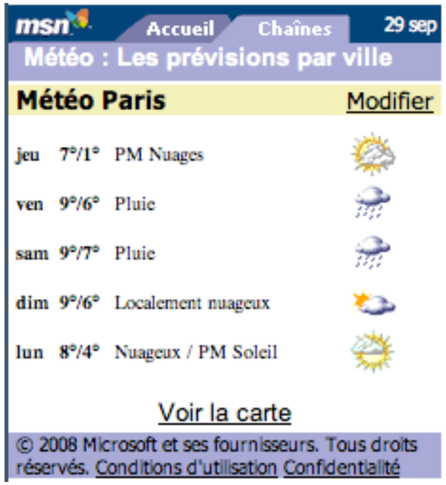
Conditions actuelles pour les villes sélectionnées °F | °C

| Ville | Actuel | Ville | Actuel |
|---|---|---|---|
| Ajaccio, Corse-du-Sud | 15° | Nantes, Loire-Atlantique | 13° |
| Besançon, Doubs | 12° | Nice, Alpes-Maritimes | 18° |
| Bordeaux, Gironde | 15° | Orléans, Loiret | 15° |

PC



Nabaztag



29 sep

Météo : Les prévisions par ville

Météo Paris Modifier

| | | |
|---|---|---|
| jeu | 7°/1° | PM Nuages |
| ven | 9°/6° | Pluie |
| sam | 9°/7° | Pluie |
| dim | 9°/6° | Localement nuageux |
| lun | 8°/4° | Nuageux / PM Soleil |

Voir la carte

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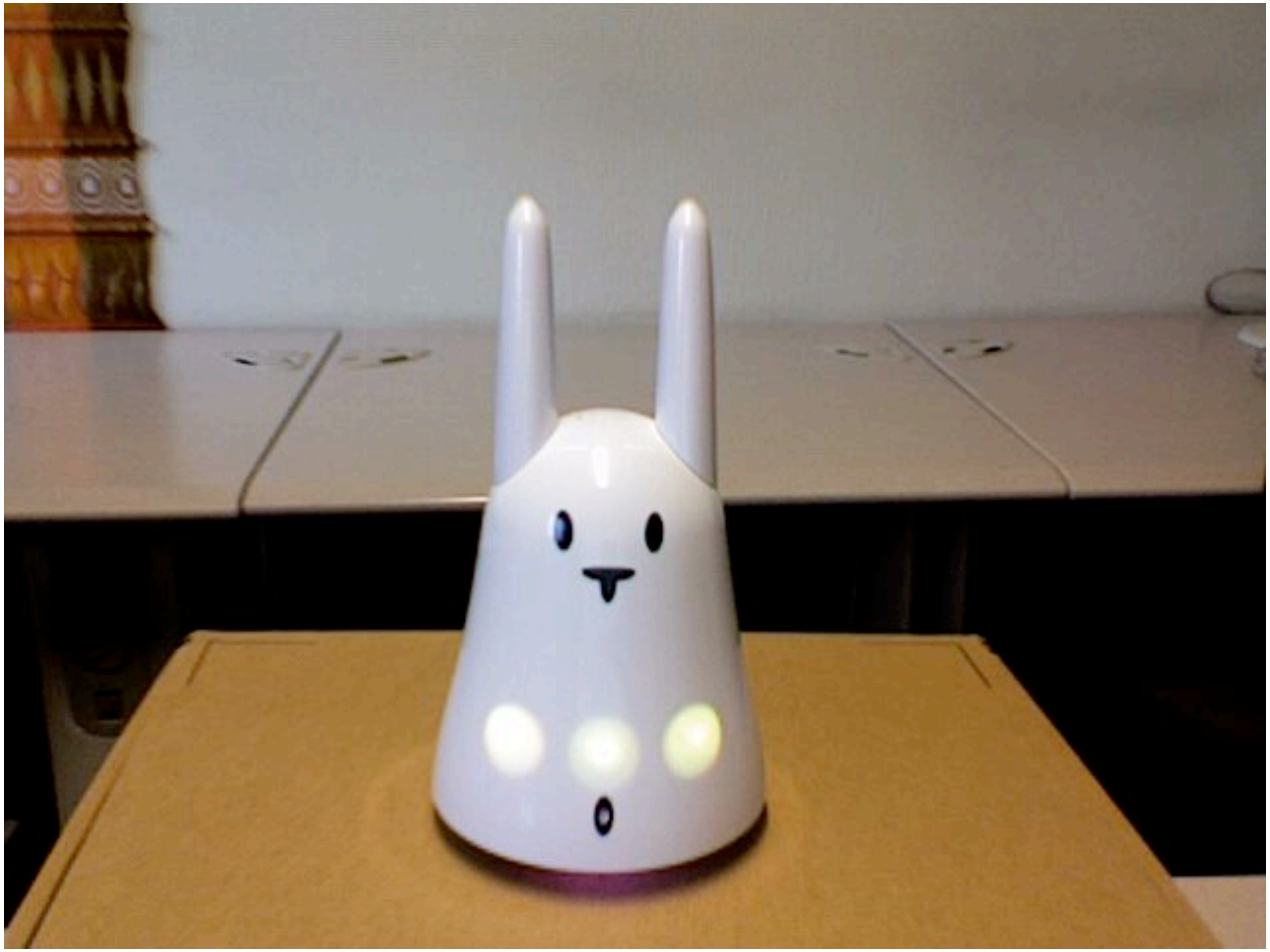
PDA

# Exercice



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1. Introduction

2. Definitions (simplified)
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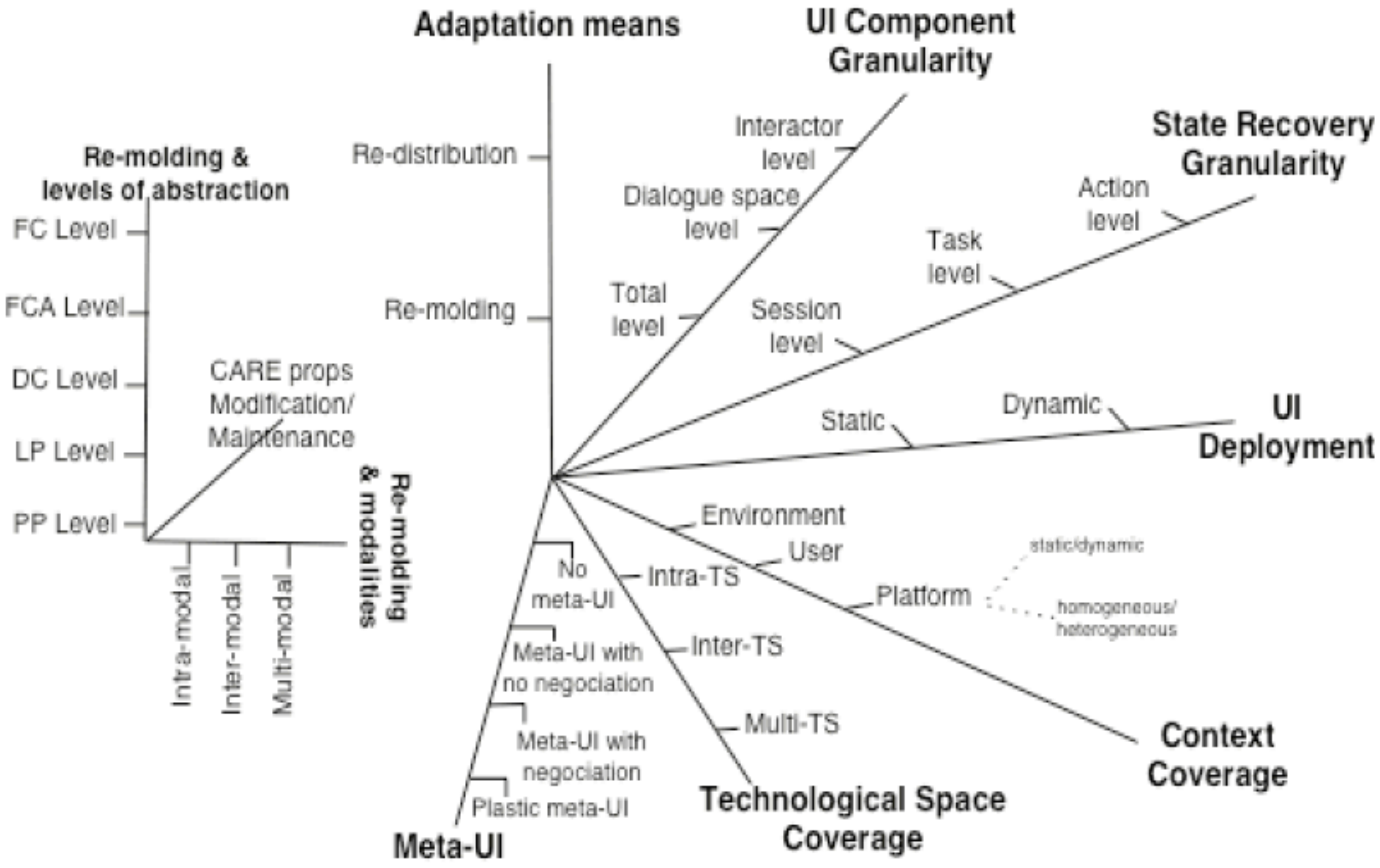
    - Adaptation

3. The problem space of UI plasticity

# The problem space of UI plasticity (see readings)

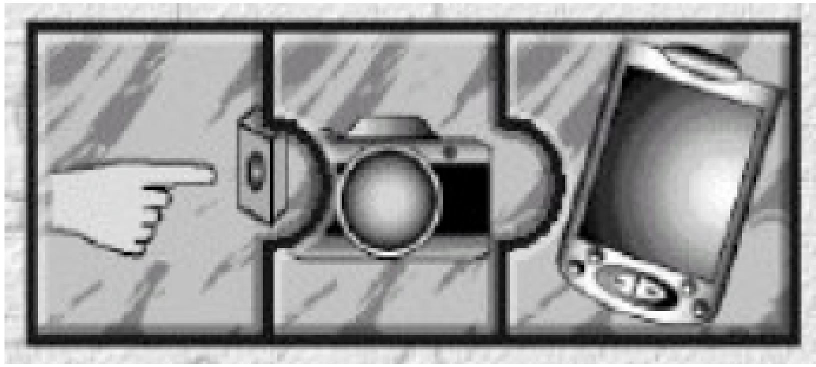


# Meta-UI

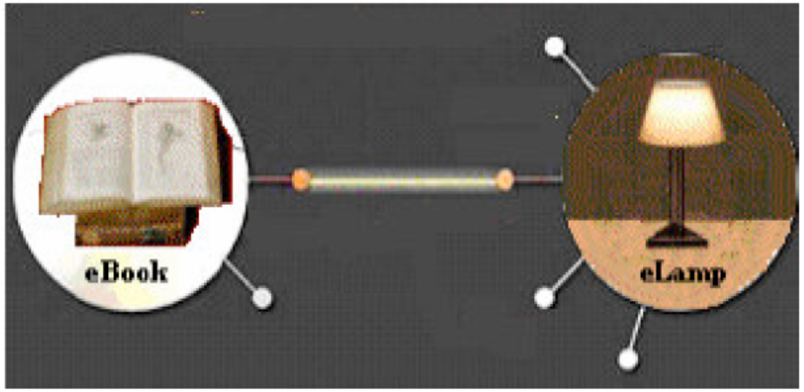
- A meta-UI is an interactive system that covers the services and their UI that are necessary and sufficient to allow the user to configure, control and evaluate the state of the interactive system (up to the ambient space)
  - *Meta*: it is on top of/in addition to the domain-dependent services that are available in the ambient space
  - *UI*: it permits the user to configure, control, and evaluate the state of that space
- A meta-UI is the « to-morrow desktop' for ambient spaces
  - It has to be invented!
- Meta-UI is about *end-user programming*

# Examples of meta-UI

- Assembling services



Jigsaw [Rodden 04]

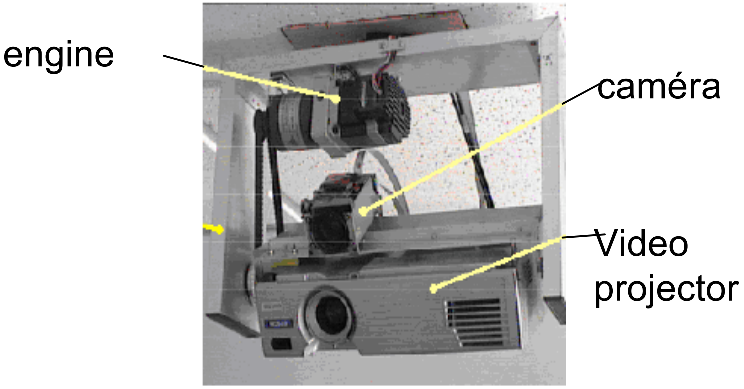


E-gadget [Marcopoulos 04]

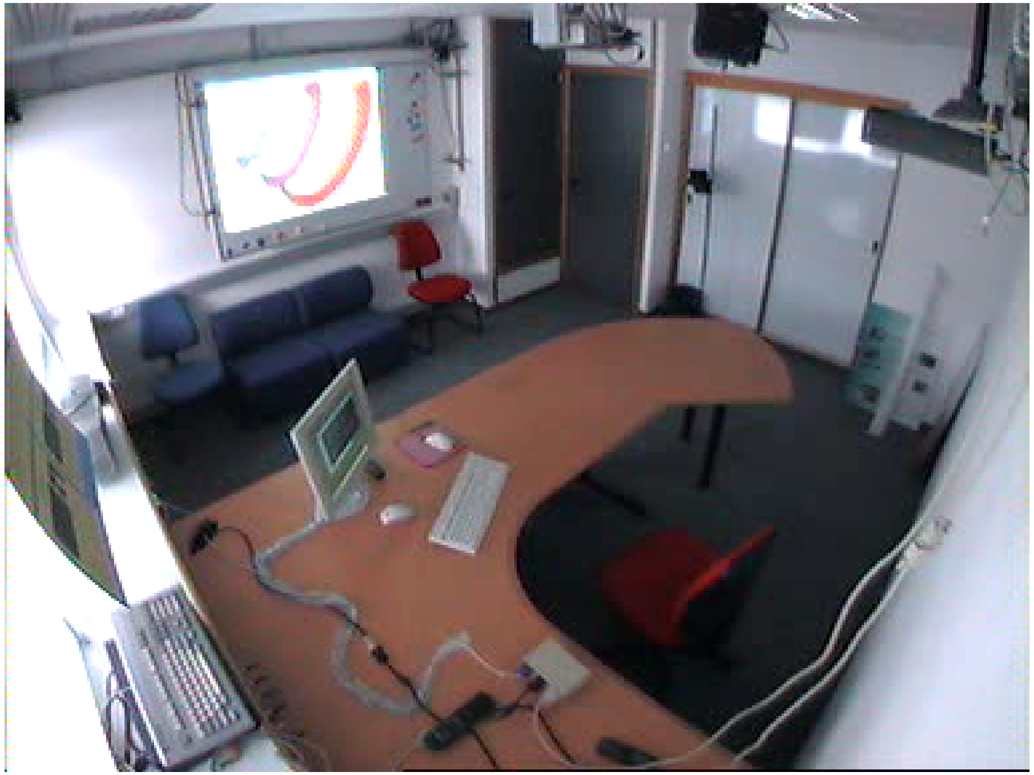
See also, Rekimoto's data tiles (chap 1)

# Examples of meta-UI

- Controling UI distribution (smart room, PRIMA): using gesture

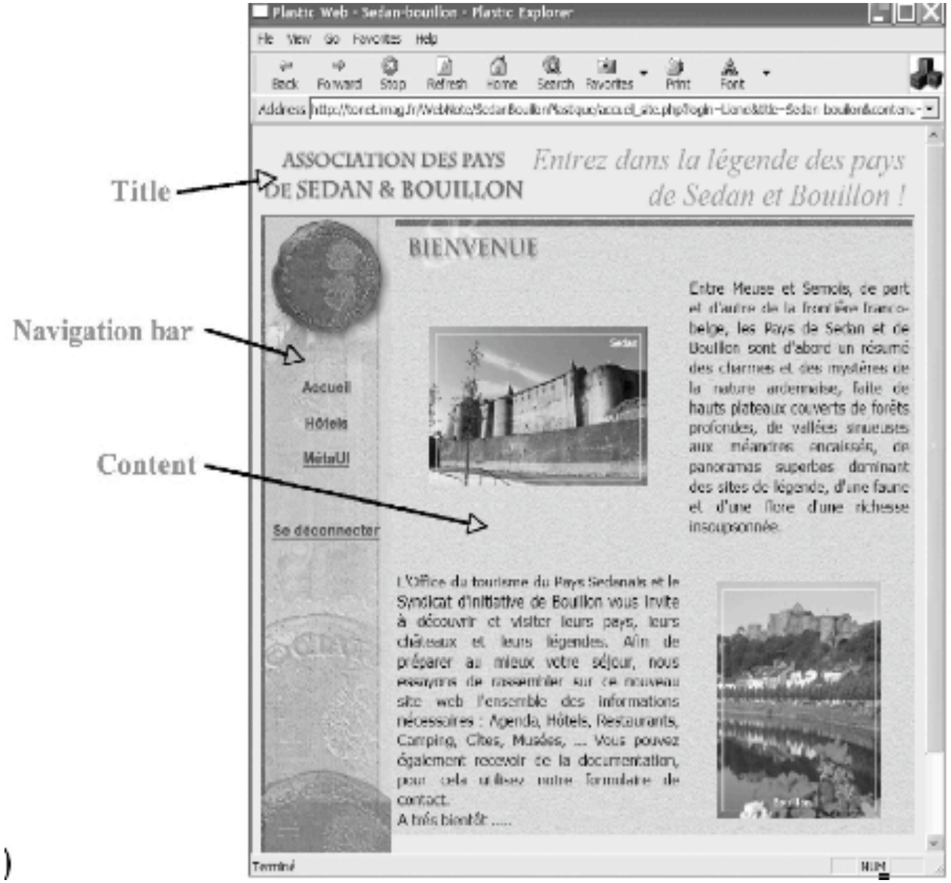


[Borkowski 06]



# Examples of meta-UI

- Controling UI distribution: Web site (IIHM)


Plastic Web - Sedan-bouillon - Plastic Explorer
File View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites Print Font
Address http://tonet.imag.fr/WebNoto/SedanBouillon/Plastique/accueil_site.php?login=Lionel&title=Sedan bouillon&conten…
Title
Navigation bar
Content
Accueil
Hôtels
MétaUI
Se déconnecter
Sedan
Terminé
NUM
)

ASSOCIATION DES PAYS DE SEDAN & BOUILLON

*Entrez dans la légende des pays de Sedan et Bouillon !*

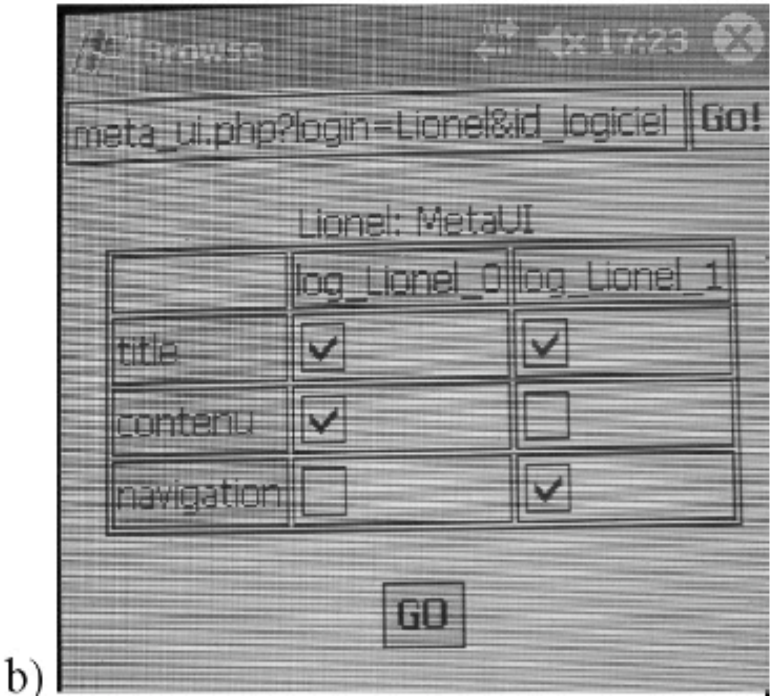
BIENVENUE

Entre Meuse et Semois, de part et d'autre de la frontière franco-belge, les Pays de Sedan et de Bouillon sont d'abord un résumé des charmes et des mystères de la nature ardennaise, faite de hauts plateaux couverts de forêts profondes, de vallées sinueuses aux méandres encaissés, de panoramas superbes dominant des sites de légende, d'une faune et d'une flore d'une richesse insoupçonnée.

L'Office du tourisme du Pays Sedanais et le Syndicat d'initiative de Bouillon vous invite à découvrir et visiter leurs pays, leurs châteaux et leurs légendes. Afin de préparer au mieux votre séjour, nous essayons de rassembler sur ce nouveau site web l'ensemble des informations nécessaires : Agenda, Hôtels, Restaurants, Camping, Gîtes, Musées, ... Vous pouvez également recevoir de la documentation, pour cela utilisez notre formulaire de contact.
A très bientôt .....

1- Centralized UI

Meta-UI



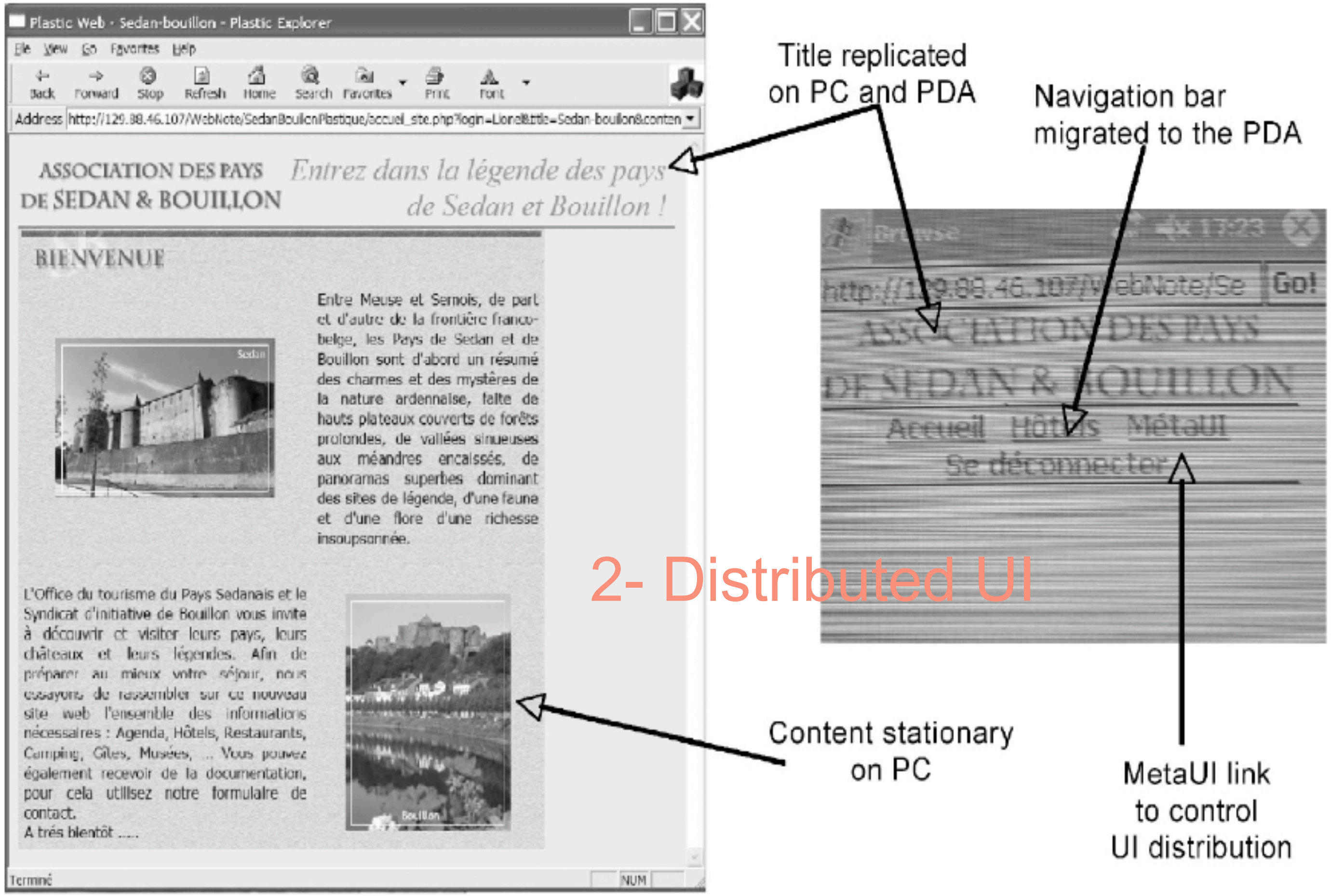
meta_ui.php?login=Lionel&id_logiciel

Lionel: MetaUI

| | log_Lionel_0 | log_Lionel_1 |
|---|---|---|
| title | ☑ | ☑ |
| contenu | ☑ | □ |
| navigation | □ | ☑ |

# Examples of meta-UI

- Controling UI distribution: Web site (IIHM)


Plastic Web - Sedan-bouillon - Plastic Explorer
File View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites Print Font
Address
Browse
17:23
Go!
Terminé
NUM

http://129.88.46.107/WebNote/SedanBouillonPlastique/accueil_site.php?login=Lionel&title=Sedan-bouillon&conten

ASSOCIATION DES PAYS DE SEDAN & BOUILLON

*Entrez dans la légende des pays de Sedan et Bouillon !*

BIENVENUE

Entre Meuse et Semois, de part et d'autre de la frontière franco-belge, les Pays de Sedan et de Bouillon sont d'abord un résumé des charmes et des mystères de la nature ardennaise, faite de hauts plateaux couverts de forêts profondes, de vallées sinueuses aux méandres encaissés, de panoramas superbes dominant des sites de légende, d'une faune et d'une flore d'une richesse insoupsonnée.

L'Office du tourisme du Pays Sedanais et le Syndicat d'initiative de Bouillon vous invite à découvrir et visiter leurs pays, leurs châteaux et leurs légendes. Afin de préparer au mieux votre séjour, nous essayons de rassembler sur ce nouveau site web l'ensemble des informations nécessaires : Agenda, Hôtels, Restaurants, Camping, Gîtes, Musées, ... Vous pouvez également recevoir de la documentation, pour cela utilisez notre formulaire de contact.
A trés blentôt .....

http://129.88.46.107/WebNote/Se

ASSOCIATION DES PAYS DE SEDAN & BOUILLON

Accueil Hôtels MétaUI
Se déconnecter

Title replicated on PC and PDA

Navigation bar migrated to the PDA

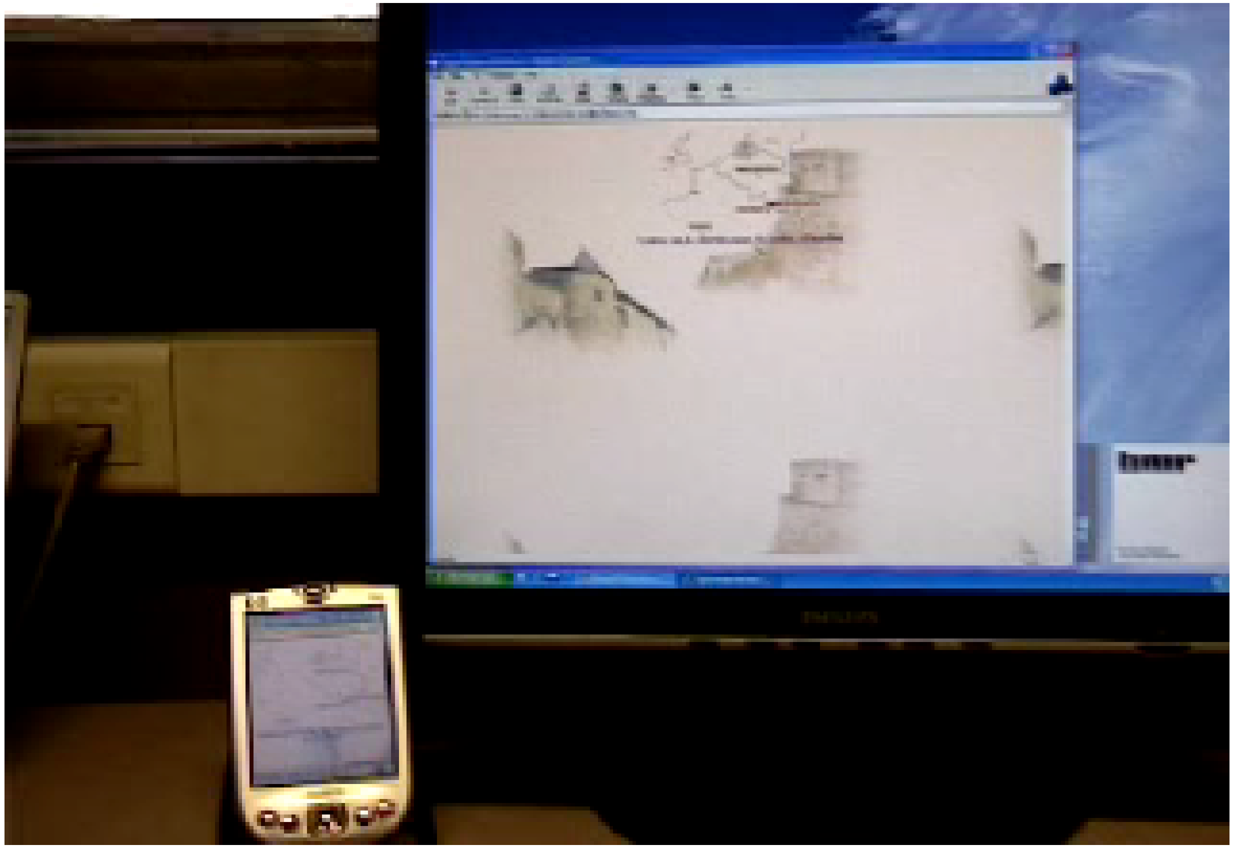
2- Distributed UI

Content stationary on PC

MetaUI link to control UI distribution

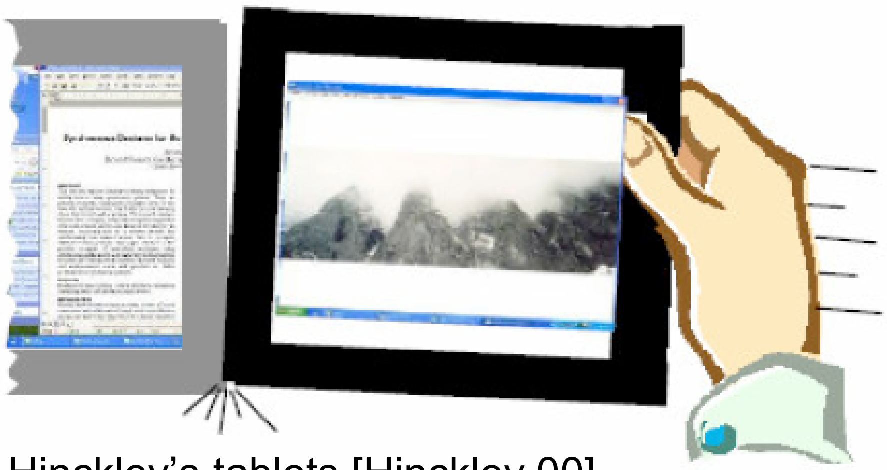
# Examples of meta-UI

- Controling UI distribution: Web site (IIHM)

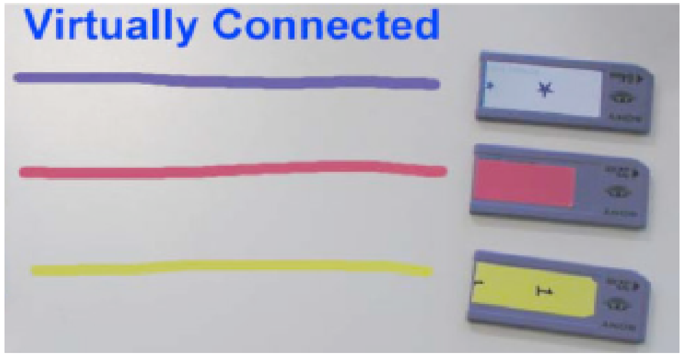


# Examples of meta-UI

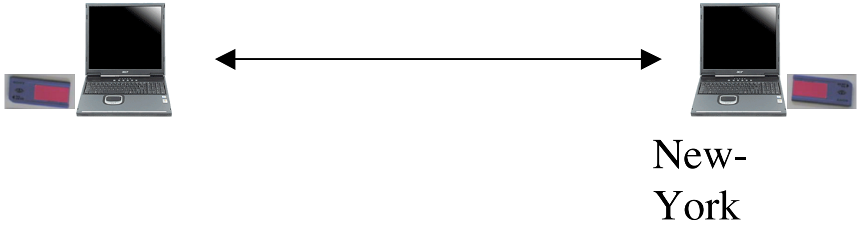
- Configuring the platform



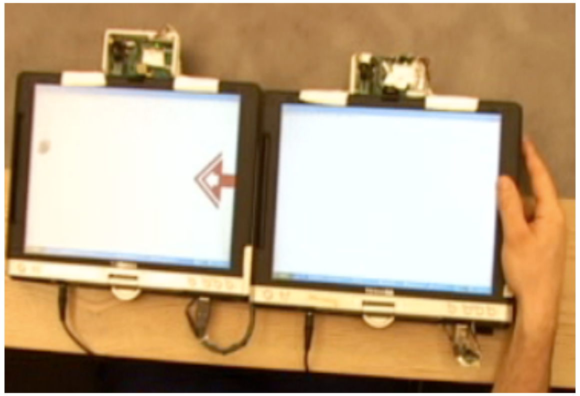
Hinckley's tablets [Hinckley 00]



tranSticks [Rekimoto 05]



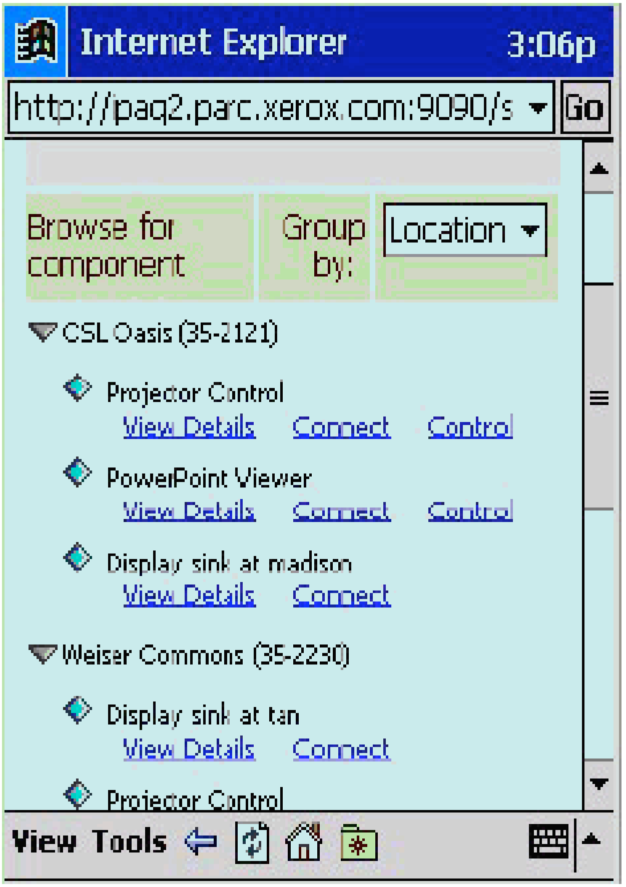
- Configuring the platform: the result depends on the gesture (synchronized gesture): The set of gestures is a programming language



Hinckley’s tablets [Hinckley 00]

# Examples of meta-UI

- Discovering and using interaction resources (configuring the ambient space)



http://ipaq2.parc.xerox.com:9090/s

Browse for component

Group by: Location

CSL Oasis (35-2121)

Projector Control
View Details Connect Control

PowerPoint Viewer
View Details Connect Control

Display sink at madison
View Details Connect

Weiser Commons (35-2230)

Display sink at tan
View Details Connect

Projector Control

Speakeasy [Newman 02 ]

# Exercice

- Apply the problem space of UI plasticity to your ambient university