Pervasive and ad-hoc services

Pervasive/ubiquitous collaborative systems (2/3)

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Content

I. CSCW principles: Collaboration in space & time

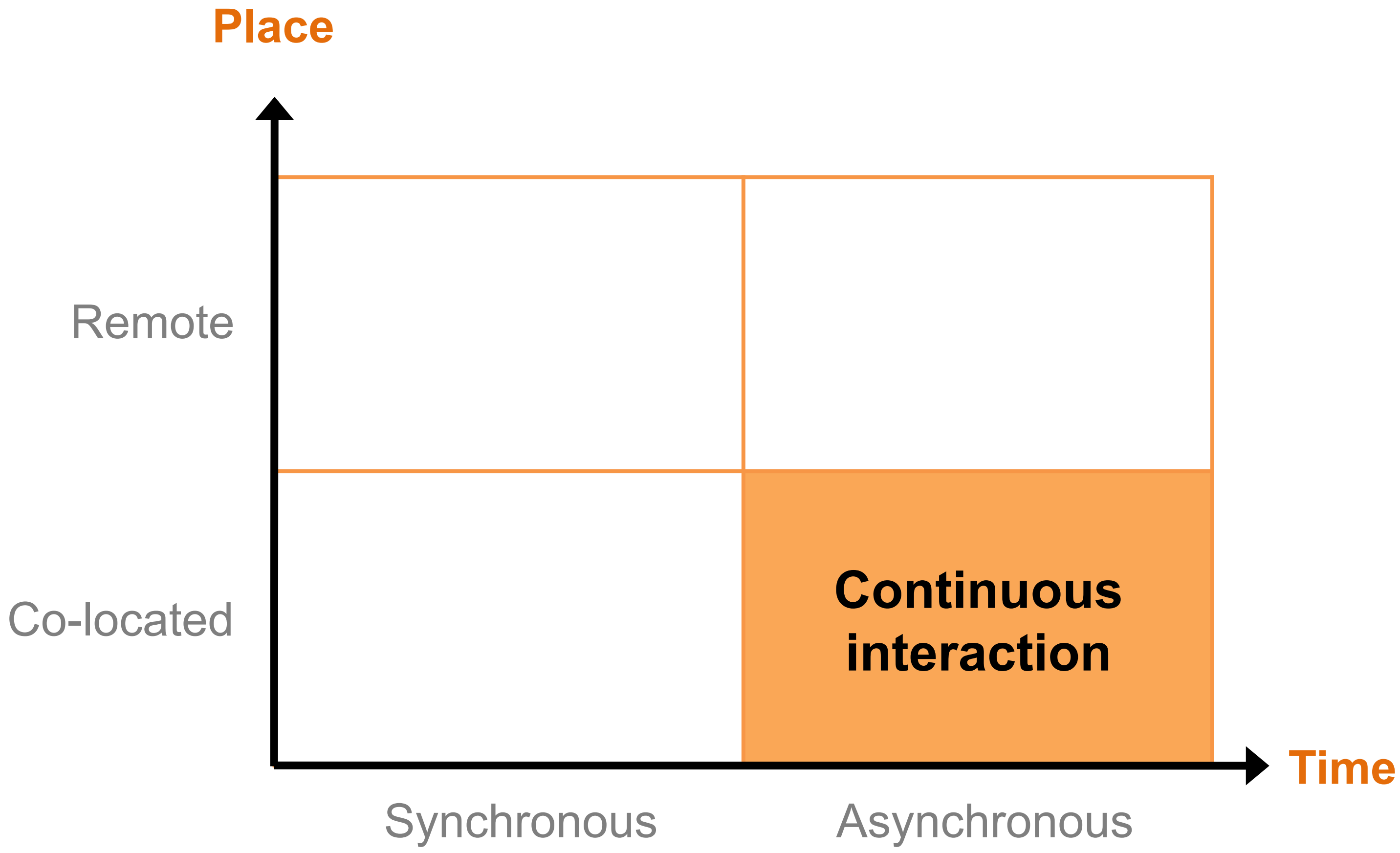
II. Building groupware

III. Collaboration and pervasive interactive surfaces

IV. Multimodal and Multi-user interaction

V. Collaboration in mobility & tangible interaction

Space/Time matrix



Place

Remote

Co-located

Continuous interaction

Time

Synchronous

Asynchronous

Control rooms

Work shifts

- Continuous task
- Information passing
- Traces of actions

Power plant control room

Public displays

- ▷ Interaction history
- ▷ Social learning
- ▷ Social experience of gaming
- ▷ Honeypot effect

Chained Displays [Koppel 2012]

Extended Space/Time matrix

Place

	Same	Different but predictable times	Different and unpredictable
Different and unpredictable	Interactive multicast seminar	BBS	Workflow
Different but predictable	Videoconferencing	email	Collaborative writing
Same place	Shared interactive surface	Work shifts	Team rooms

Time

[Grudin 1994]

Content

I. CSCW principles: Collaboration in space & time

II. Building groupware

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Outline

Building groupware applications

1. Group task analysis
2. Design
3. Implementation
4. Evaluation

Outline

Building groupware applications

1. Group task analysis
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1. Group task analysis

Understand how

- Goups work
- Groups would adopt groupware

Understand the organisation of work

Social context of activity

- Social protocols

Task analysis

Traditional HCI methods fail

- ▷ Focuses on individual tasks
- ▷ Individual knowledge of the total complex task

CSCW work stresses the importance

- ▷ Situational aspects
- ▷ Group phenomena
- ▷ Organizational structures and procedures

⇨ **Ethnographic methods**

[Van der Veer 1997] [Van der Veer 1999]

Approaches

Ethnology, sociology, psychology of groups

- ▷ Complex structures
- ▷ Unpredictable
- ▷ Evolution of usages

Participatory design

- ▷ Involve users in the development process

Ethnography

Studying a community of practices

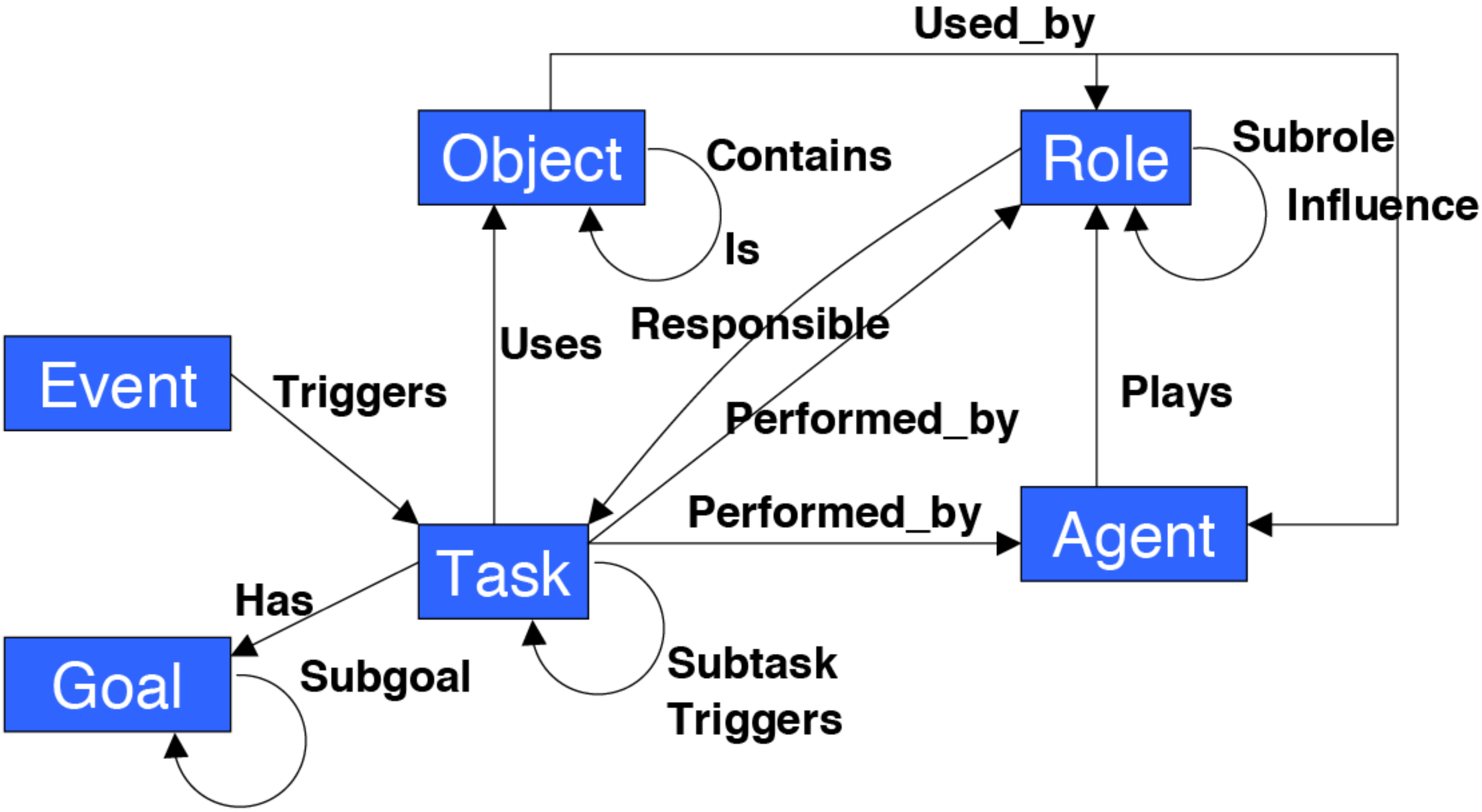
- Observing the world "*through the eyes of the aboriginal*"

Focus

- Activities
- Environment
- People
- Objects

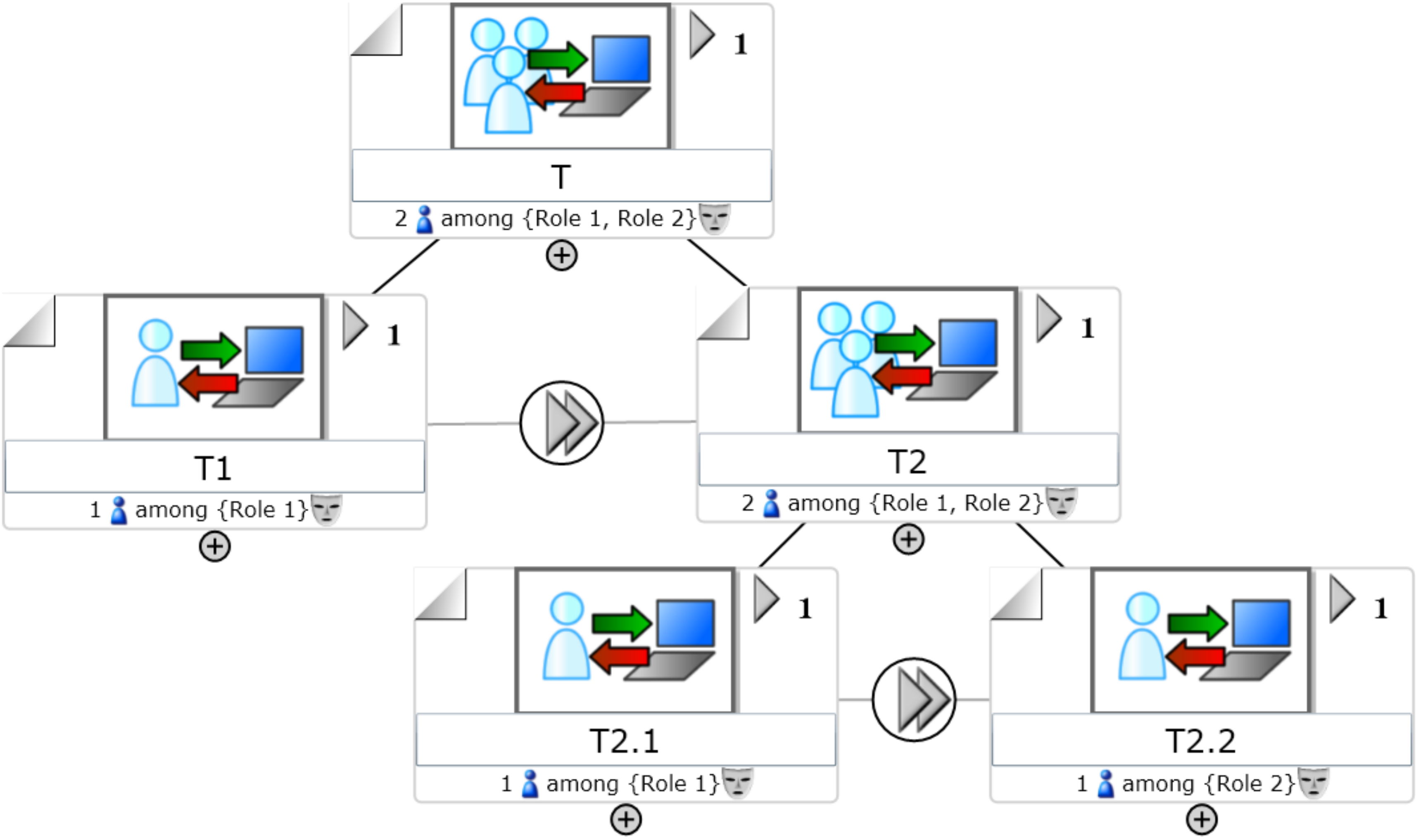
[Van der Veer 1997]

Basic concepts of group activities



[Van Welie 2001]

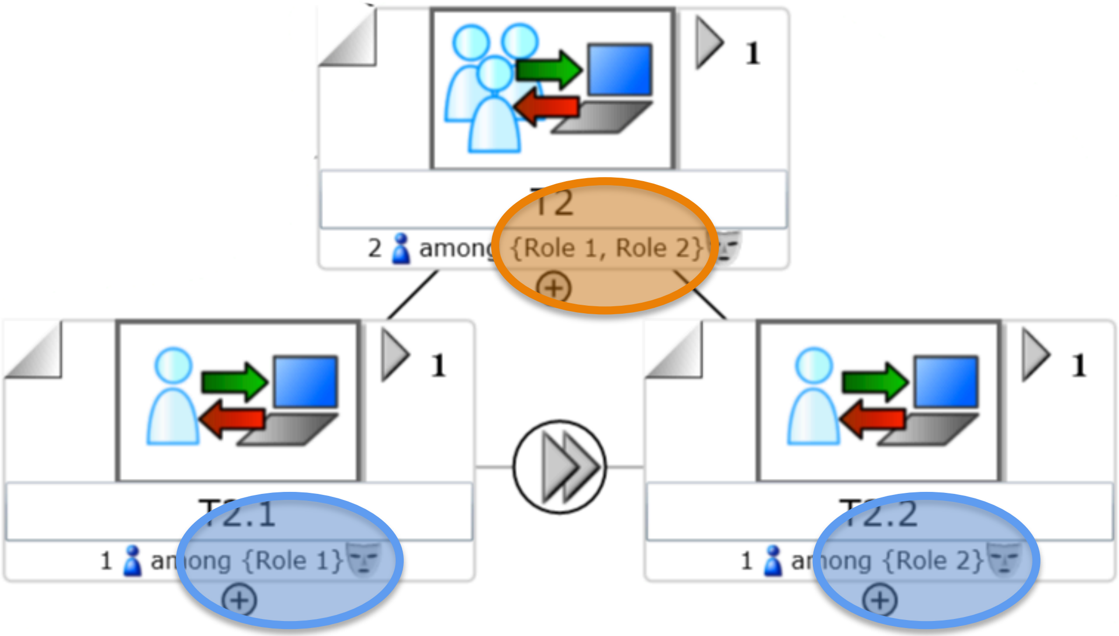
Task modeling



Task modeling

Cooperative task

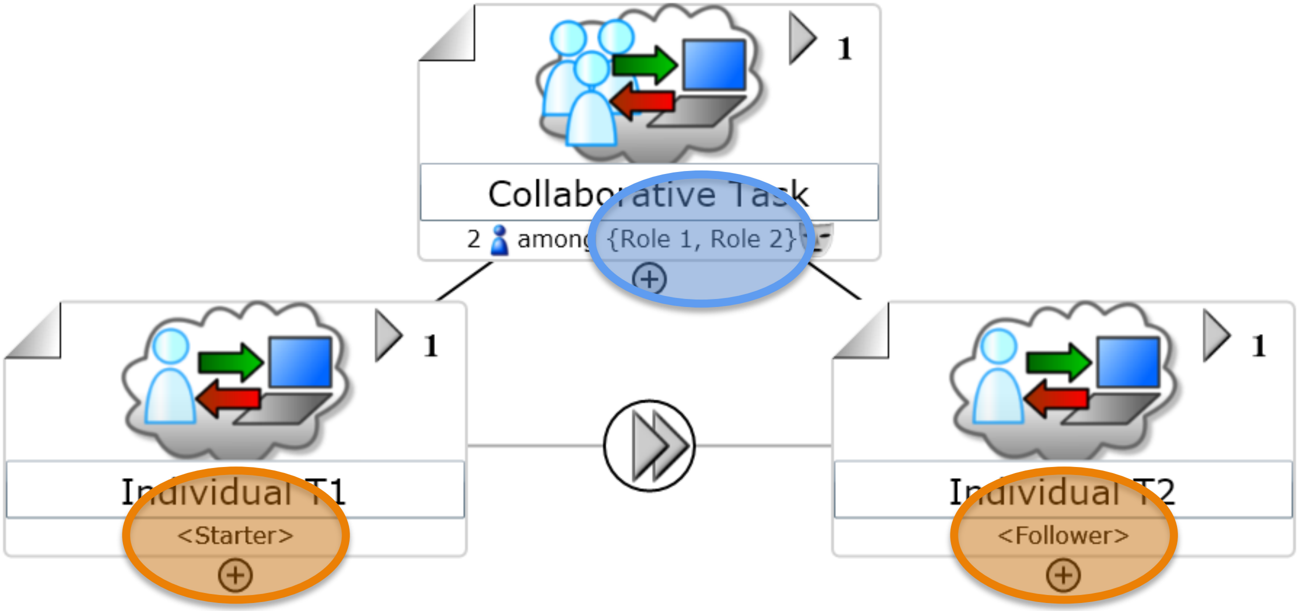
"Cooperative work is accomplished by the division of labour among participants, as an activity where each person is responsible for a portion of the problem solving"



Task modeling

Collaborative task

"Collaboration involves the mutual engagement of participants in a coordinated effort to solve the problem together"



Outline

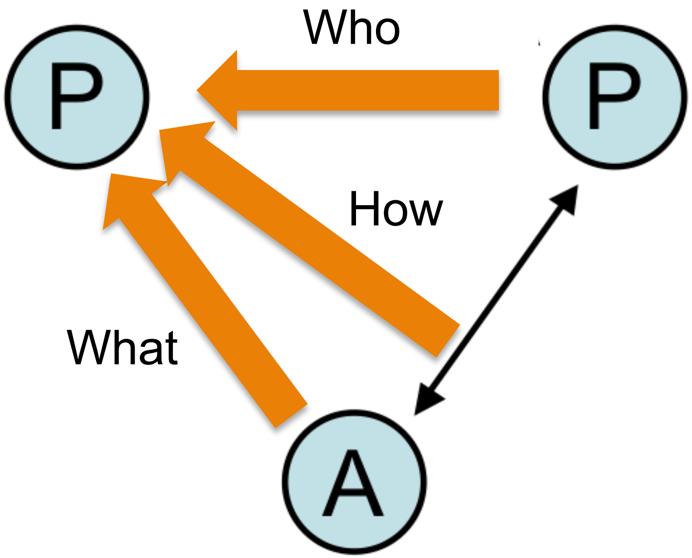
Building groupware applications

1. Group task analysis
2. Design
   - ▷ Groupware principles
   - ▷ Multi-user widgets
   - ▷ Metaphors
   - ▷ Mechanisms
3. Implementation
4. Evaluation

Principles

Activity awareness: to know continuously

- ▷ Who is present
- ▷ What is done
- ▷ What actions are performed
- ▷ etc



➪ Peripheral activities

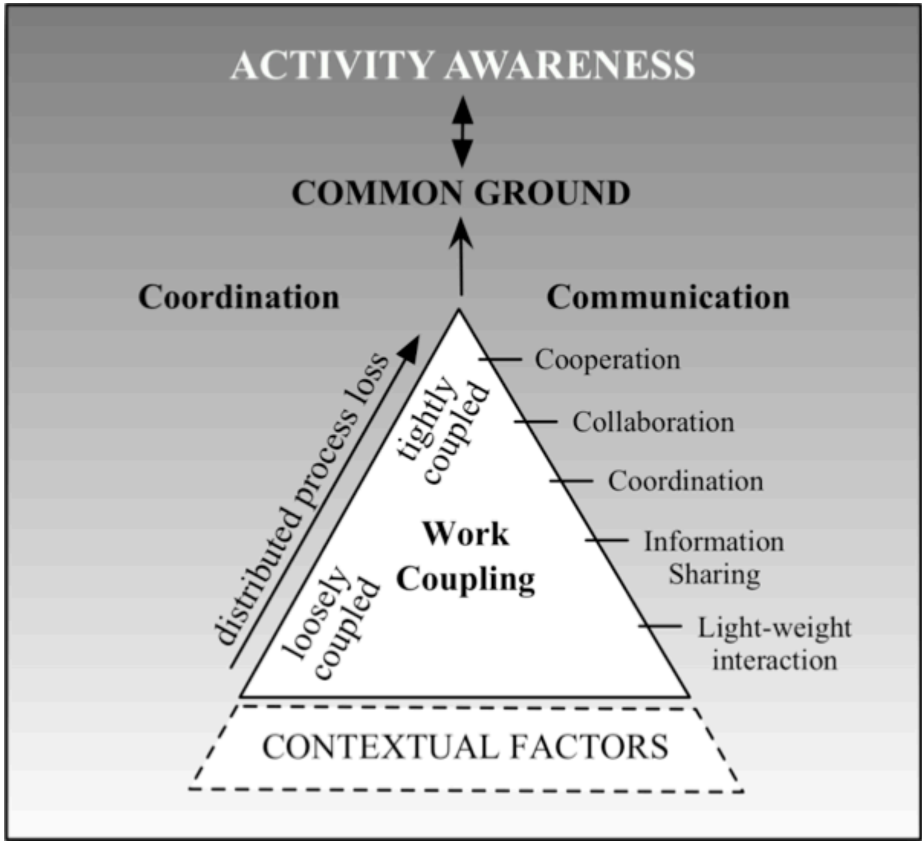
➪ Core challenge for CSCW systems

[Neale 2004]

Principles

Activity awareness

- ▷ Social awareness
- ▷ Presence awareness
- ▷ Action awareness
- ▷ Workspace awareness
- ▷ Situation awareness



[Neale 2004]

Principles

Coupling

"tightly coupled work involves two or more people whose work is directly dependent on each other, and their work typically involves a number of interactions to complete the task. Immediate interaction helps them to communicate clearly or to negotiate some resolution ...

At the other extreme, loosely coupled work is work in which people need to be aware of others' activity and decisions, but without the need for immediate clarification or negotiation."

[Pinelle 2003][Olson 1996]

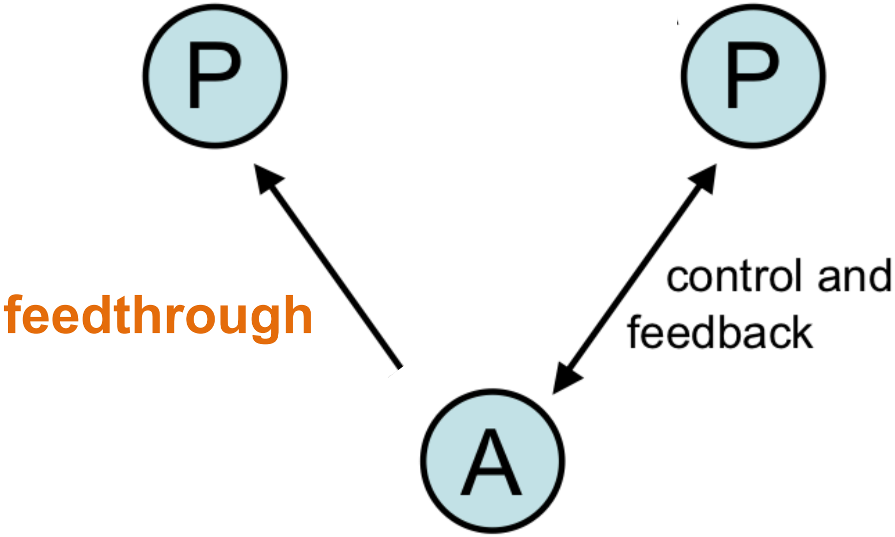
Principles

Feedback

- ▷ You see the effect of an action

Feedthrough

- ▷ Others can see the effect too
- ➩ Action awareness

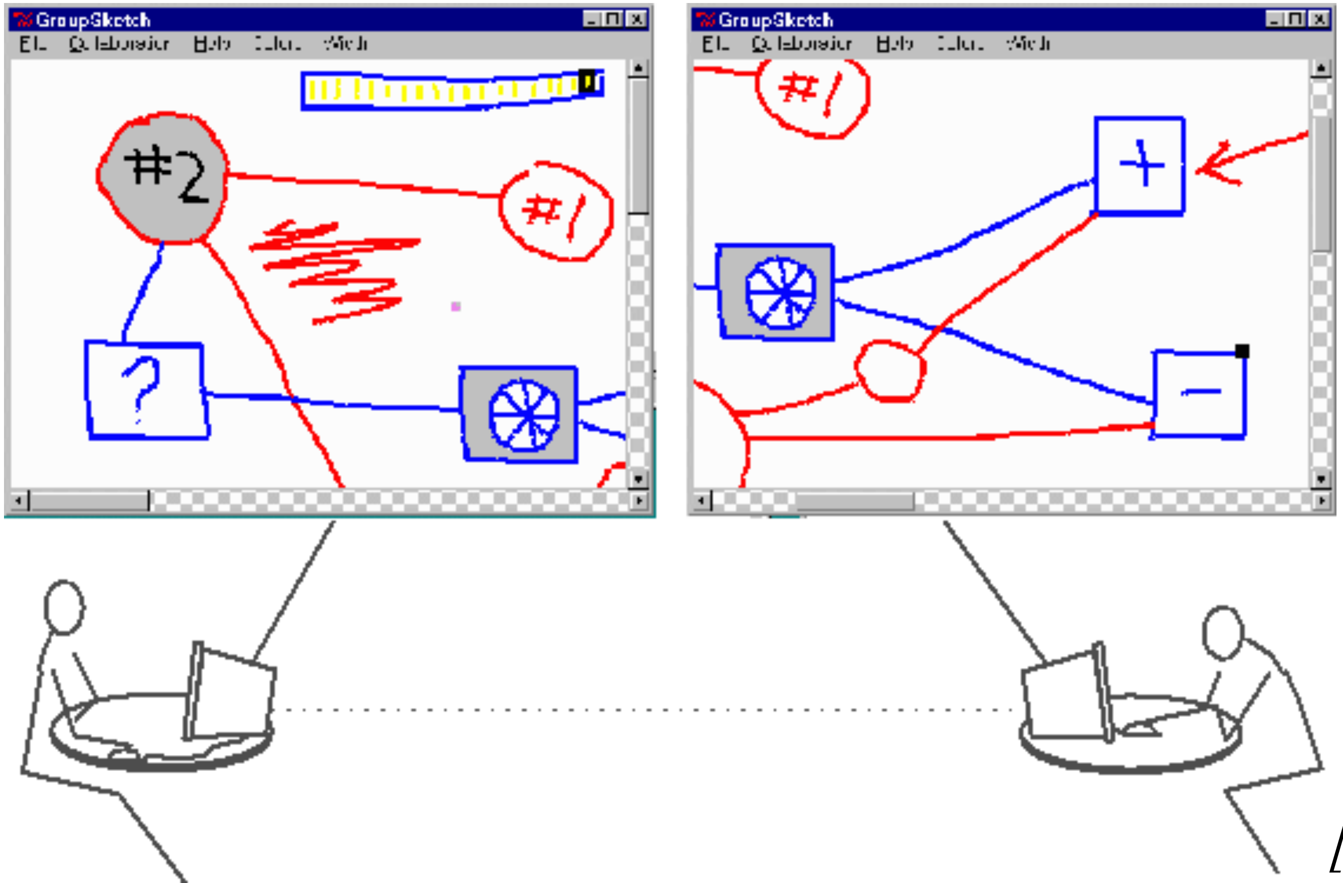


[Dix 1999]

Principles

WYSIWIS: *What-You-See-Is-What-I-See*

- ▷ Mutual understanding
- ▷ Relaxed or strict (c.f. coupling)

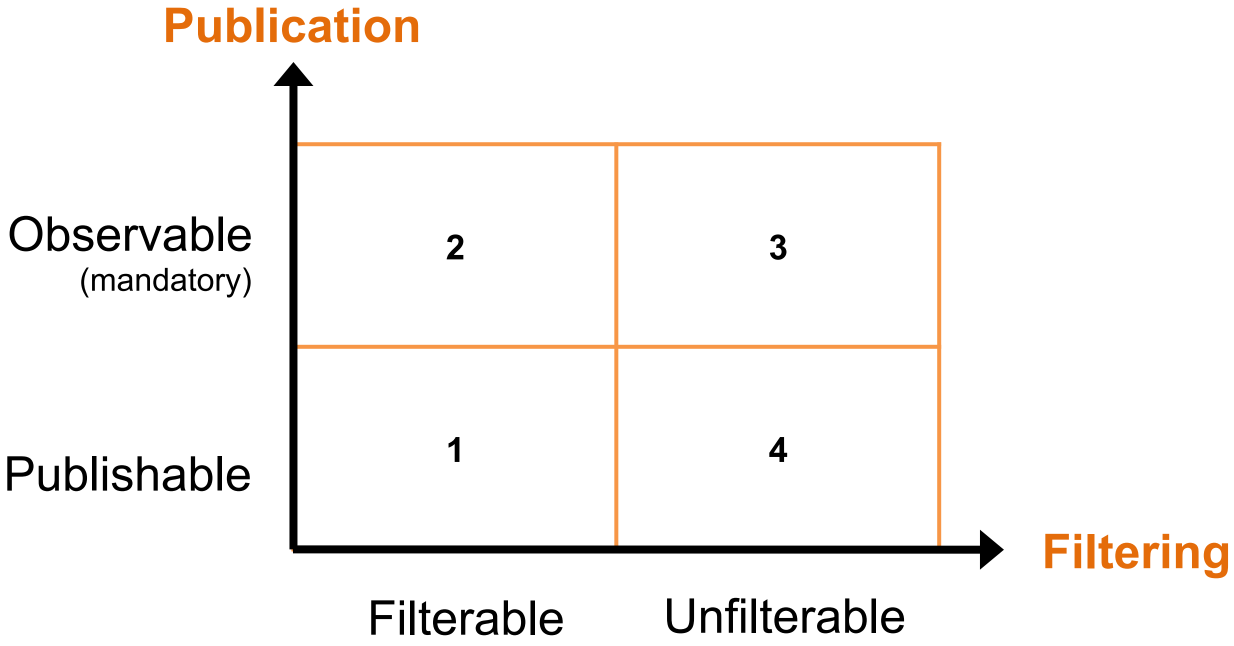


[Stefik 1987]

Principles

Privacy

- Observability and filtering



Publication

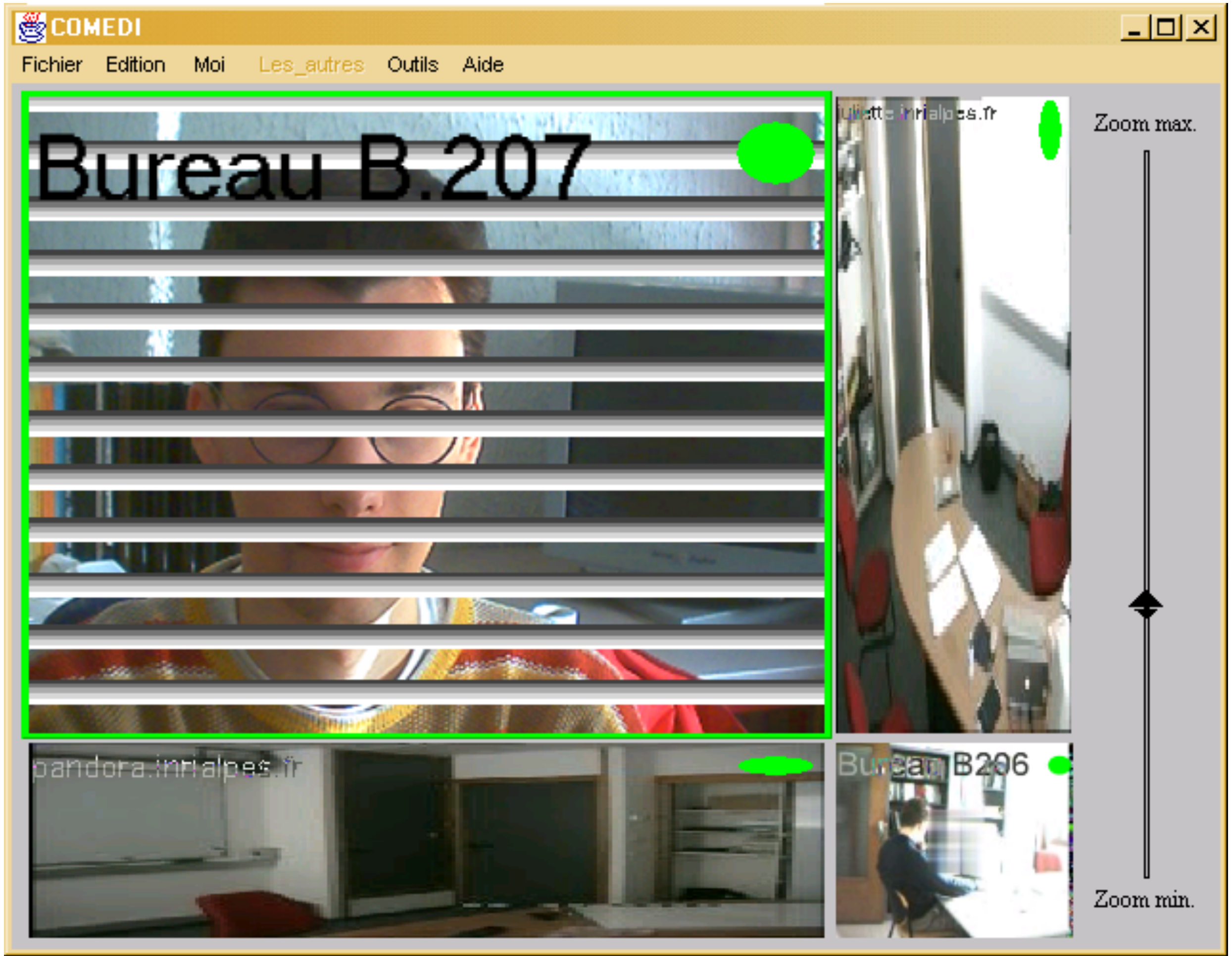
	Filterable	Unfilterable
Observable (mandatory)	2	3
Publishable	1	4

Filtering

Principles

Privacy

- Observability and filtering



Principles

Privacy

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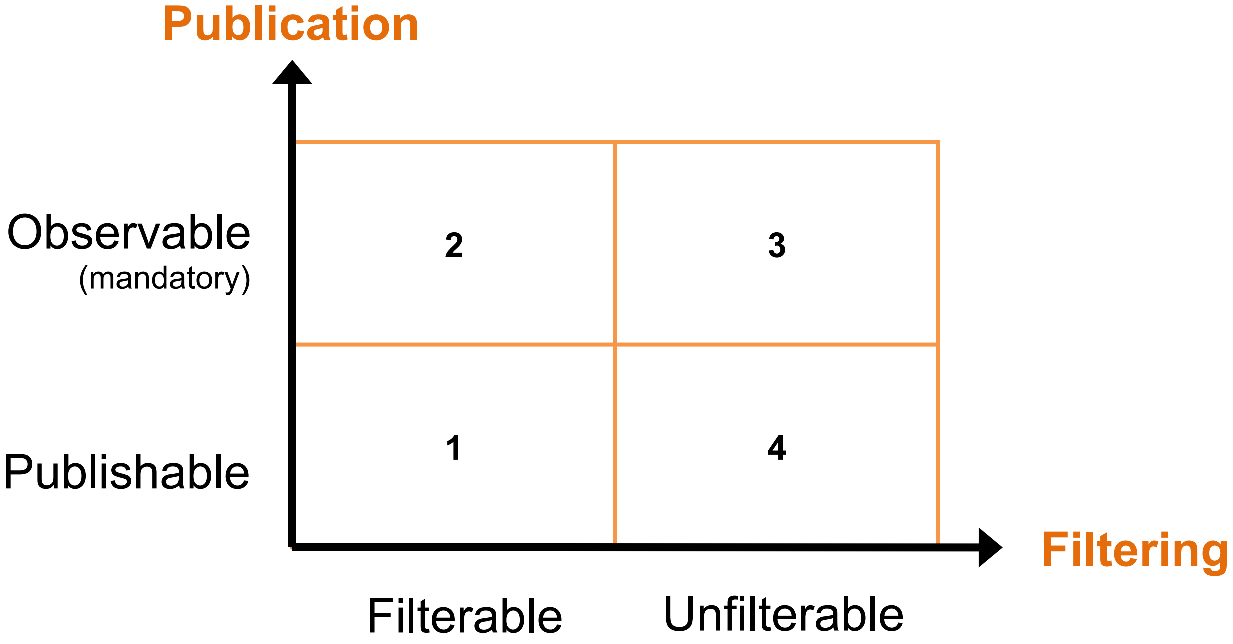


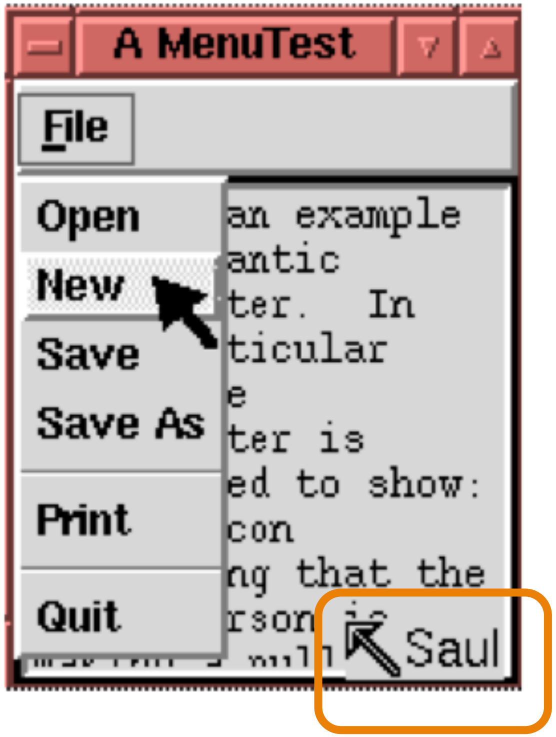
	Filterable	Unfilterable
Observable (mandatory)	2	3
Publishable	1	4

- ▷ Reciprocity
- ▷ Identification

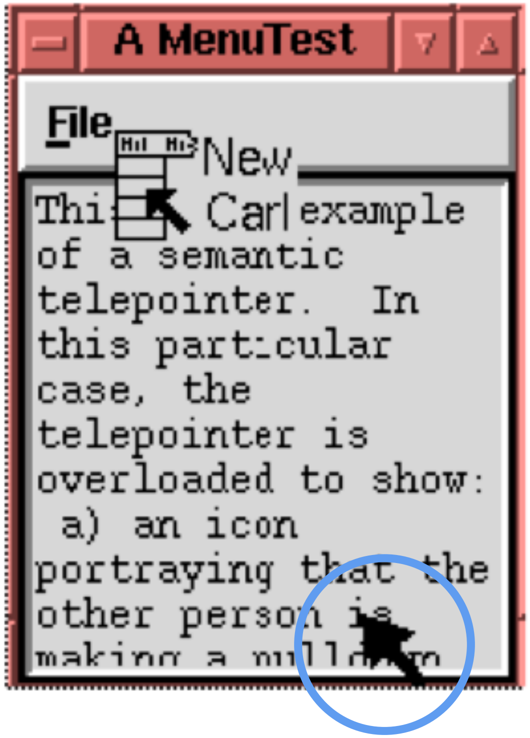
Multi-user widgets

Multi-pointers

Carl's view



Saul's view



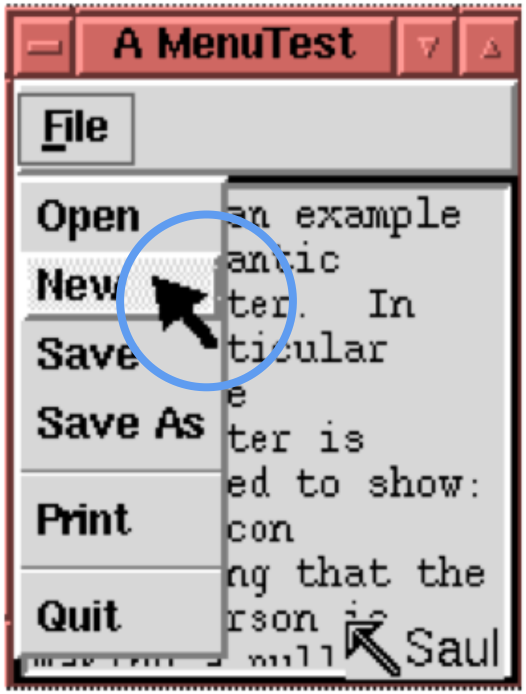
Thi example
of a semantic
telepointer. In
this particular
case, the
telepointer is
overloaded to show:
a) an icon
portraying that the
other person is
making a pull-d m

[Greenberg 1996]

Multi-user widgets

Multi-pointers

Carl's view



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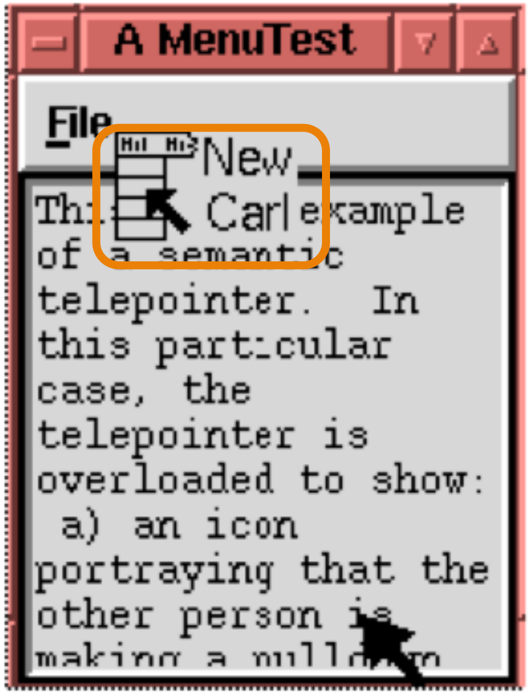
Saul's view



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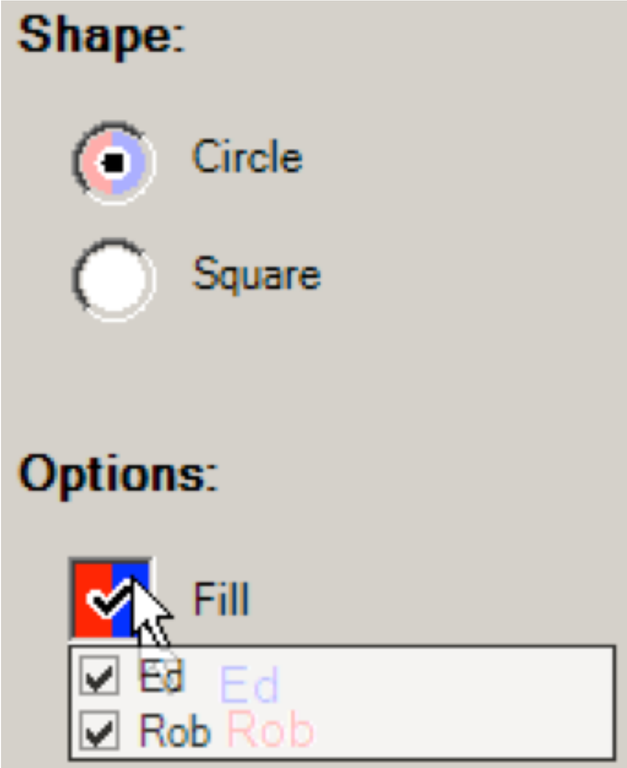
[Greenberg 1996]

Multi-user widgets

User-differentiated widgets

- ▷ Single instance
- ▷ Different behaviours
- ▷ Parallel state machines



Shape:

● Circle

○ Square

Options:

☑ Fill

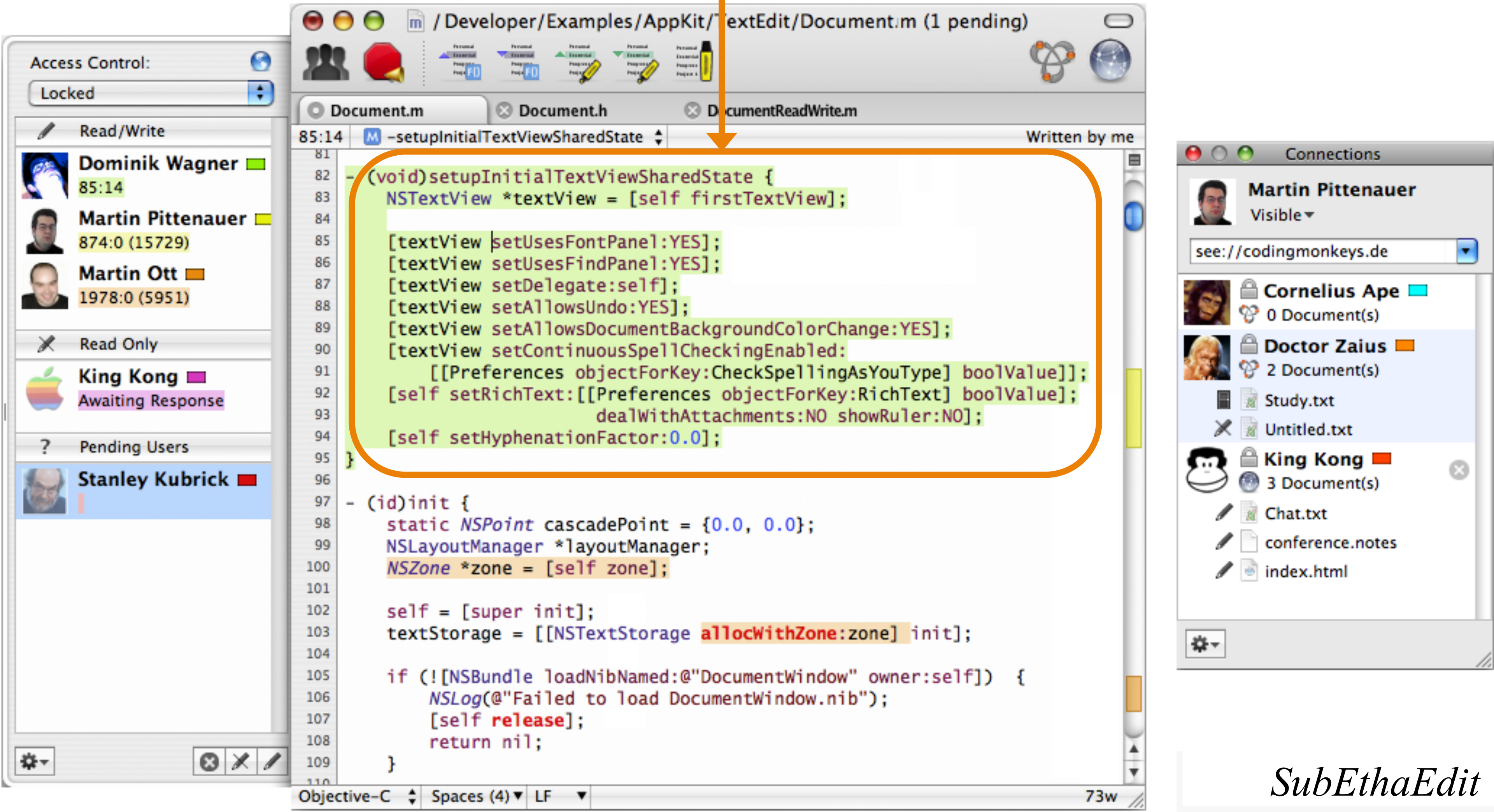
☑ Ed Ed

☑ Rob Rob

SDG Toolkit [Tse 2004]

Multi-user widgets

Shared workspace



/Developer/Examples/AppKit/TextEdit/Document.m (1 pending)

```
- (void)setupInitialTextViewSharedState {
    NSTextView *textView = [self firstTextView];

    [textView setUsesFontPanel:YES];
    [textView setUsesFindPanel:YES];
    [textView setDelegate:self];
    [textView setAllowsUndo:YES];
    [textView setAllowsDocumentBackgroundColorChange:YES];
    [textView setContinuousSpellCheckingEnabled:
        [[Preferences objectForKey:CheckSpellingAsYouType] boolValue]];
    [self setRichText:[[Preferences objectForKey:RichText] boolValue]
                        dealWithAttachments:NO showRuler:NO];
    [self setHyphenationFactor:0.0];
}

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    NSLayoutManager *layoutManager;
    NSZone *zone = [self zone];

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    if (![NSBundle loadNibNamed:@"DocumentWindow" owner:self])  {
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        return nil;
    }
```

Access Control: Locked

Read/Write
- Dominik Wagner 🟩 85:14
- Martin Pittenauer 🟨 874:0 (15729)
- Martin Ott 🟧 1978:0 (5951)

Read Only
- King Kong 🟪 Awaiting Response

? Pending Users
- Stanley Kubrick 🟥

Connections

Martin Pittenauer
Visible

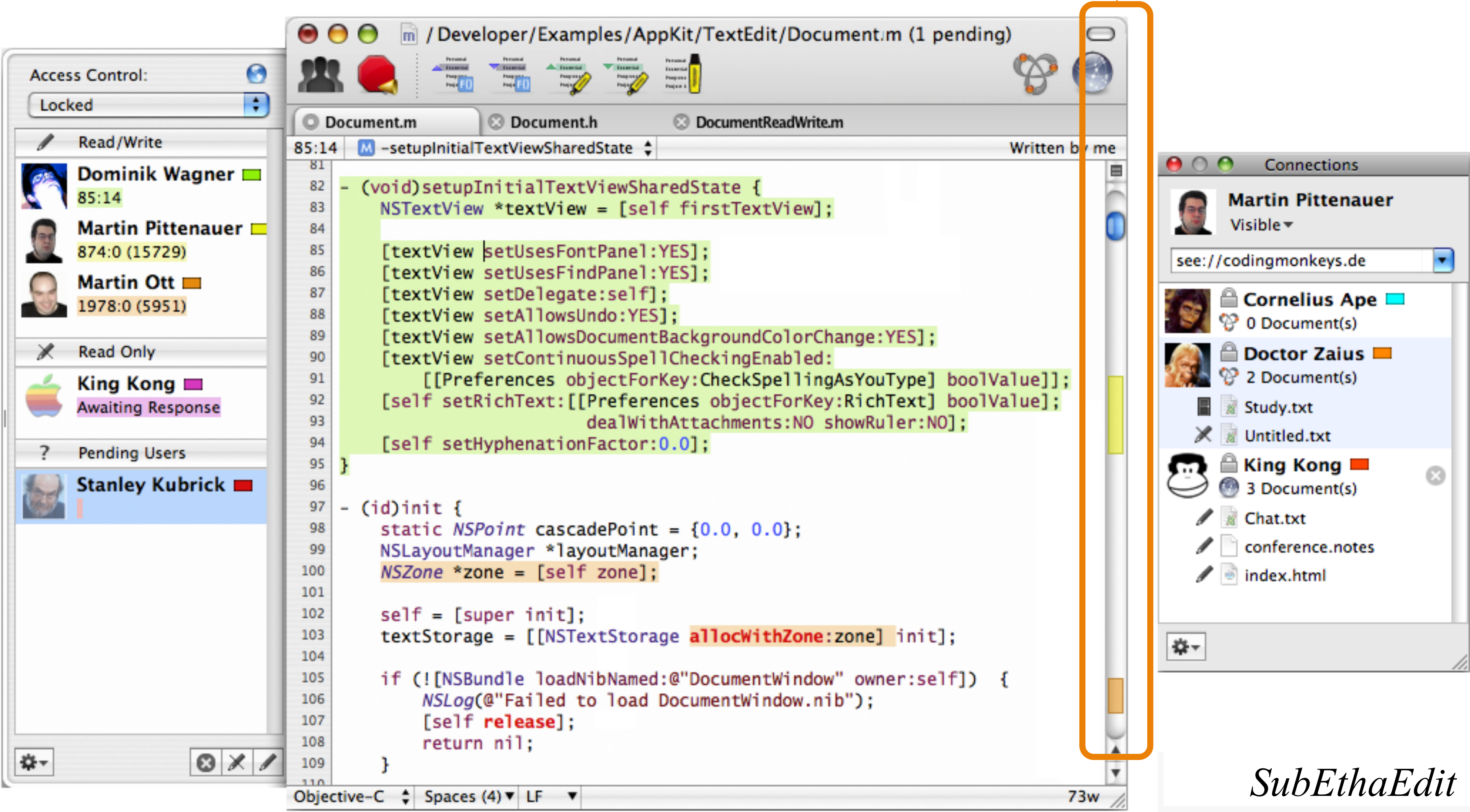
see://codingmonkeys.de

- Cornelius Ape 🟦 0 Document(s)
- Doctor Zaius 🟧 2 Document(s)
  - Study.txt
  - Untitled.txt
- King Kong 🟥 3 Document(s)
  - Chat.txt
  - conference.notes
  - index.html

SubEthaEdit

Multi-user widgets

Multi-user scrollbar



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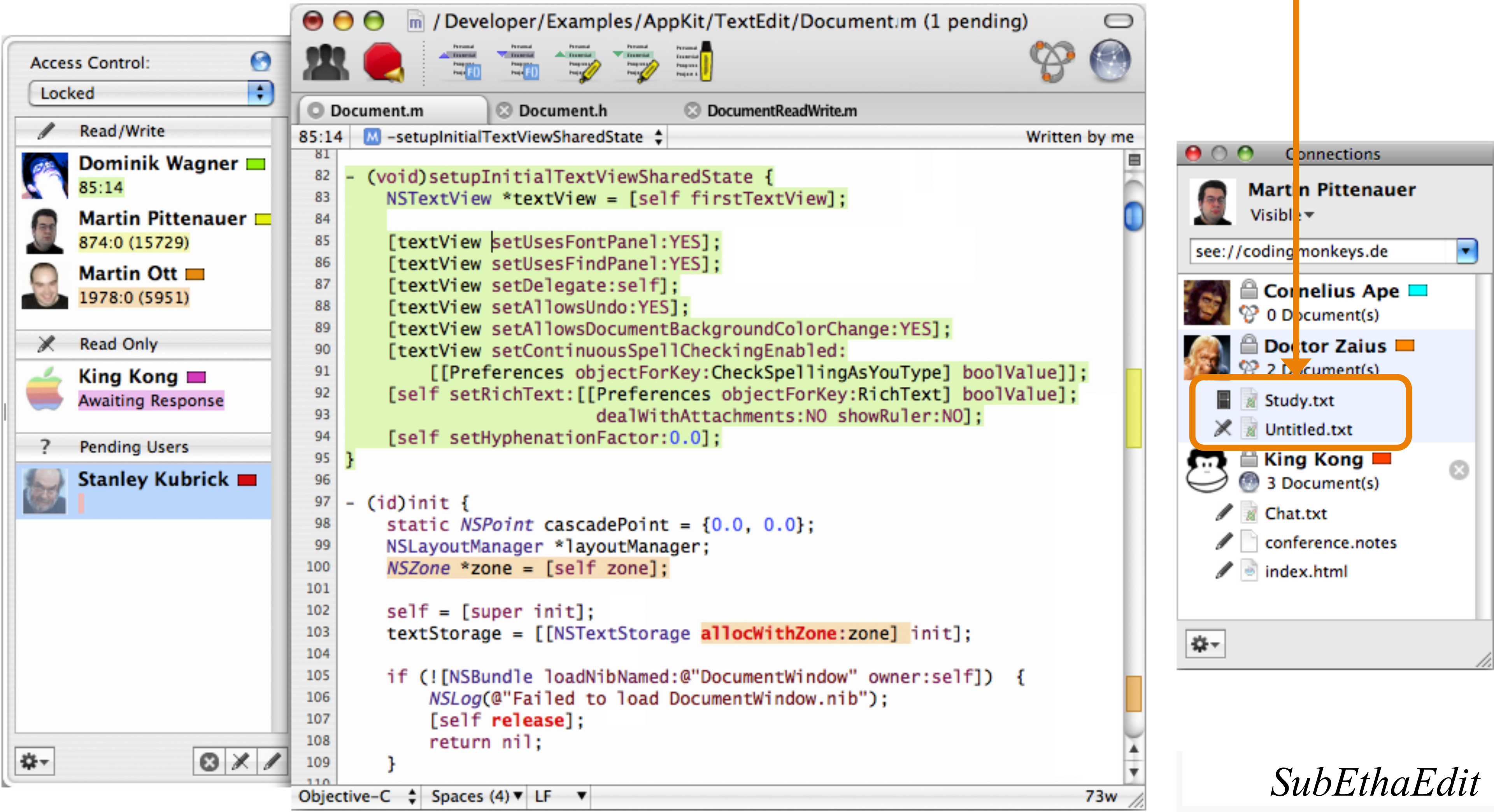
SubEthaEdit

Multi-user widgets

Activity status



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King Kong 🟪
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Stanley Kubrick 🟥

/ Developer/Examples/AppKit/TextEdit/Document.m (1 pending)

Document.m | Document.h | DocumentReadWrite.m

85:14 -setupInitialTextViewSharedState — Written by me

```objc
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Objective-C | Spaces (4) | LF | 73w

Connections

Martin Pittenauer
Visible

see://codingmonkeys.de

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King Kong
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Chat.txt
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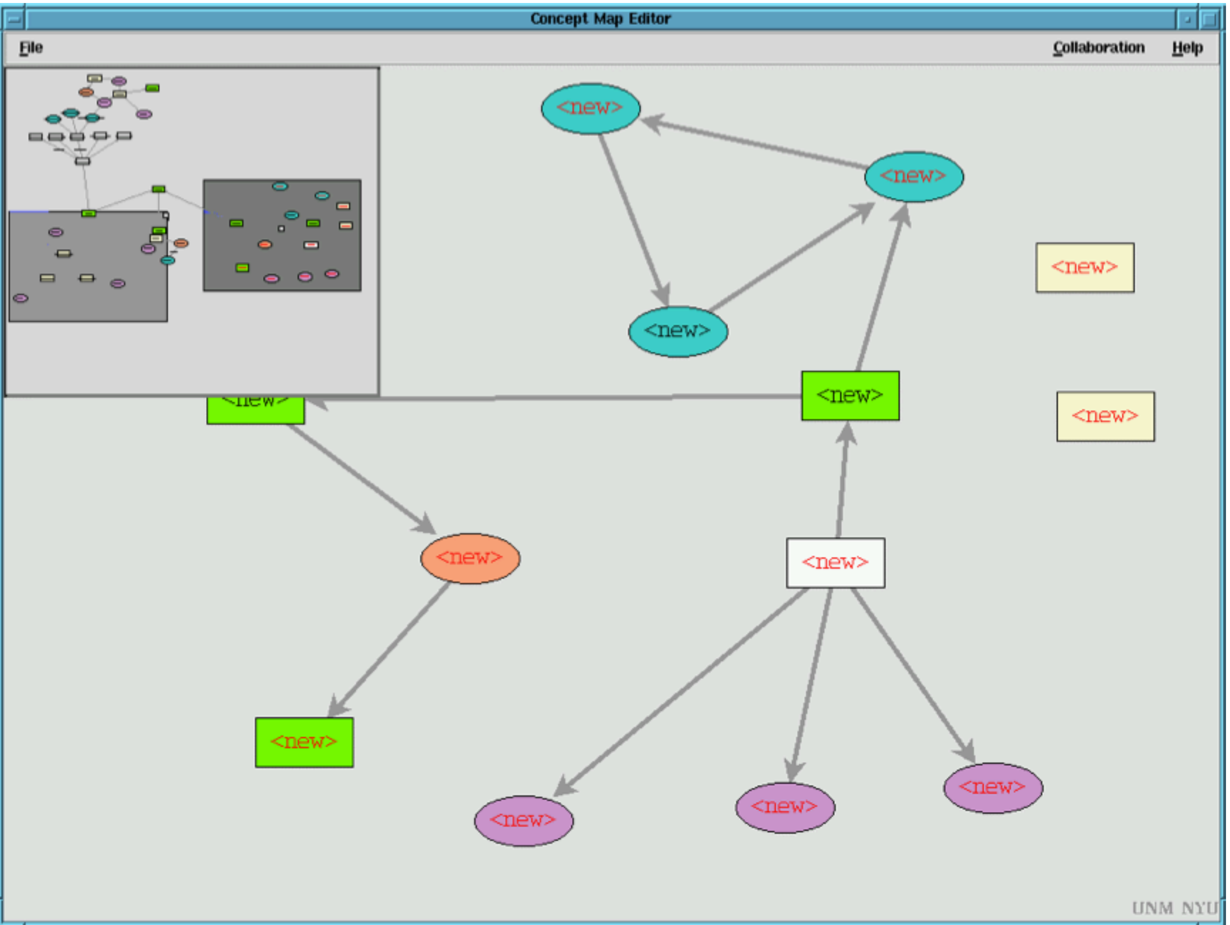
index.html

SubEthaEdit

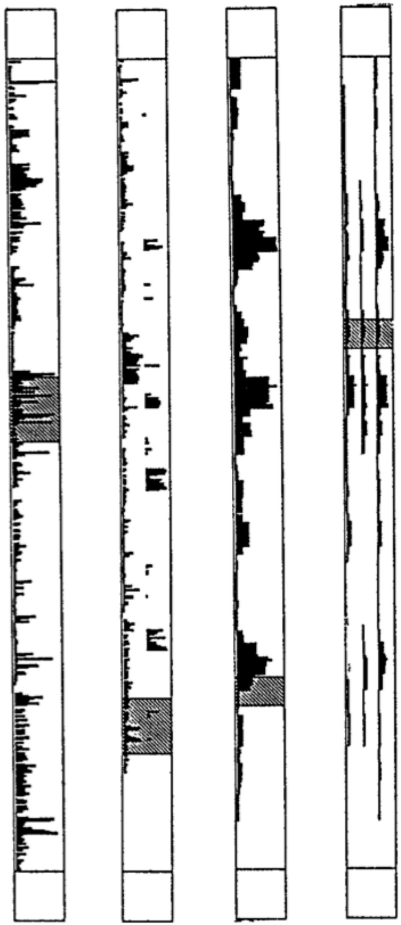
Multi-user widgets

Awareness widgets

[Gutwin 1999]



[Hill 1992]

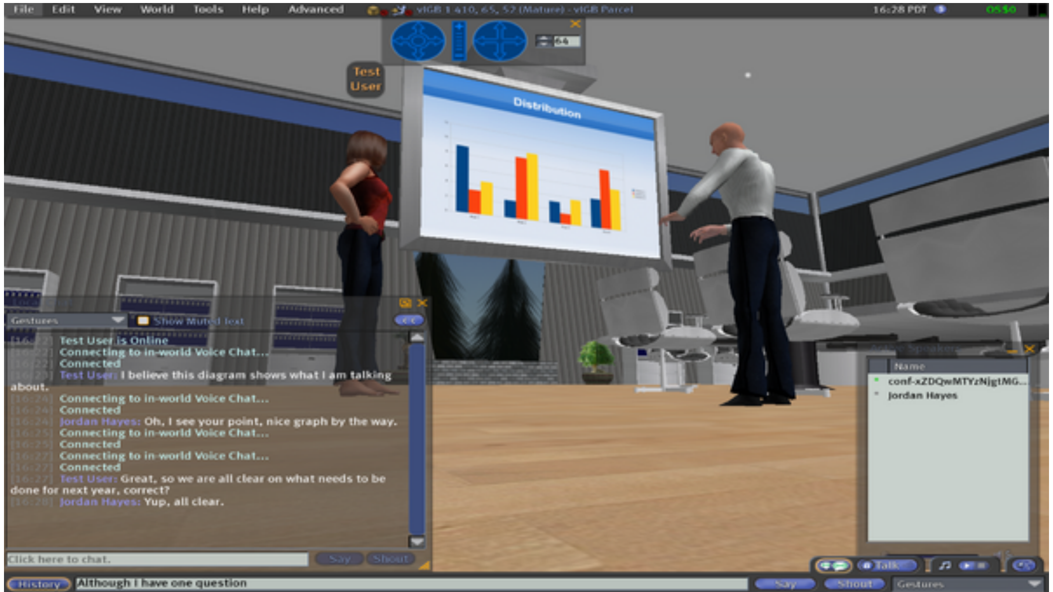


Metaphors

Space

- Spatial organisation to facilitate and structure interaction
  - Arrangements of objects around us
  - Structure of physical space

  - e.g. Desktop metaphor = office, shared workspace
  - e.g. Collaborative Virtual reality, Communication tools



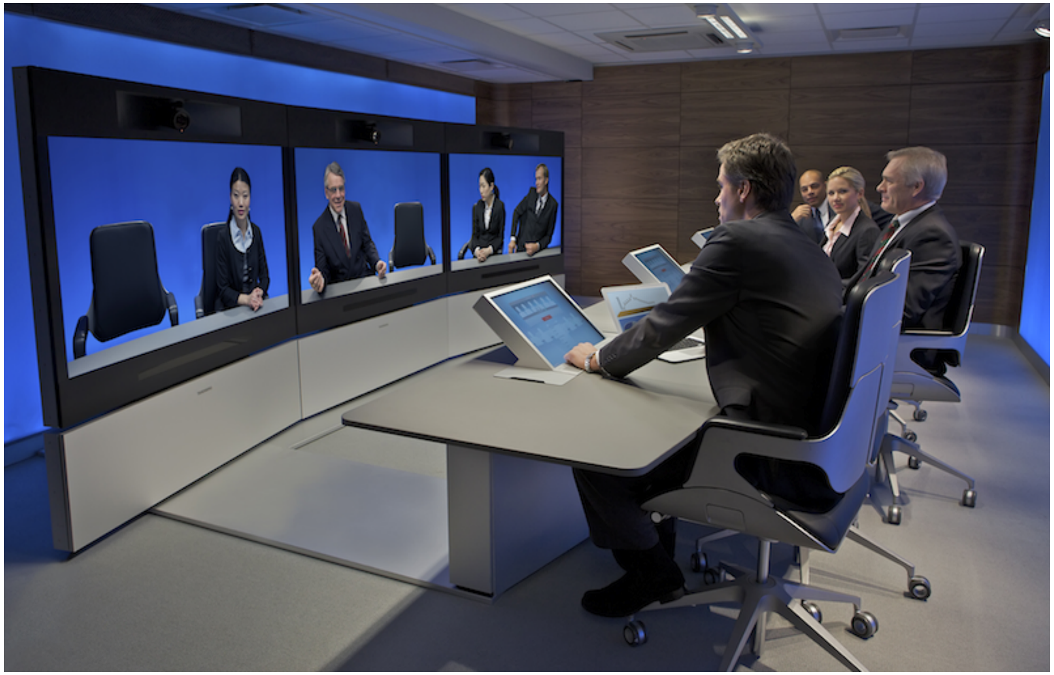
[16:22] Test User is Online
[16:22] Connecting to in-world Voice Chat...
[16:22] Connected
[16:23] Test User: I believe this diagram shows what I am talking about.
[16:24] Connecting to in-world Voice Chat...
[16:24] Connected
[16:24] Jordan Hayes: Oh, I see your point, nice graph by the way.
[16:25] Connecting to in-world Voice Chat...
[16:25] Connected
[16:27] Connecting to in-world Voice Chat...
[16:27] Connected
[16:27] Test User: Great, so we are all clear on what needs to be done for next year, correct?
[16:28] Jordan Hayes: Yup, all clear.

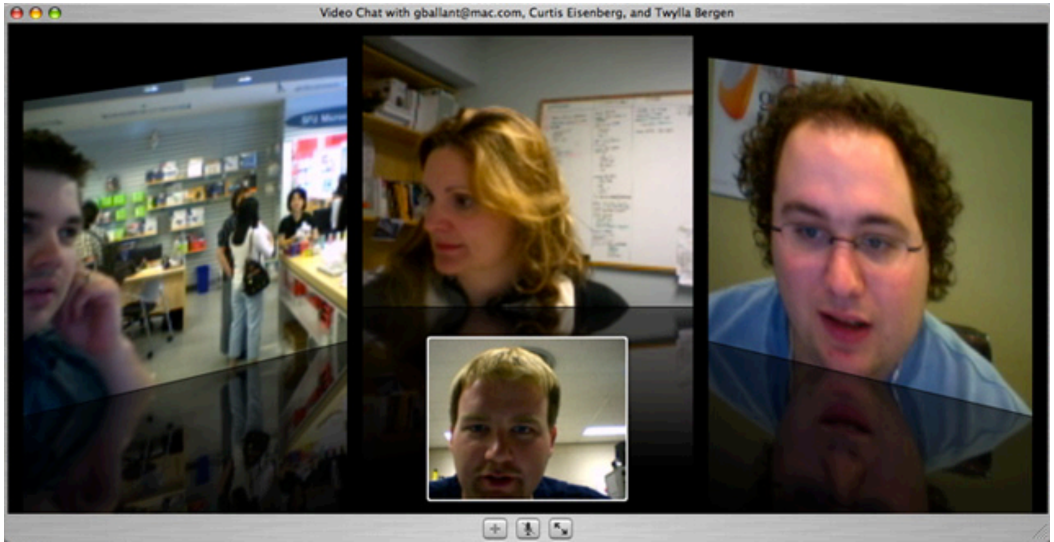
Although I have one question

[Harrison 1996]

Metaphors

Space




Video Chat with gballant@mac.com, Curtis Eisenberg, and Twylla Bergen

Metaphors

Space

- Features of space
  - Relational orientation and reciprocity
  - Proximity and action
  - Partitioning
  - Presence and awareness

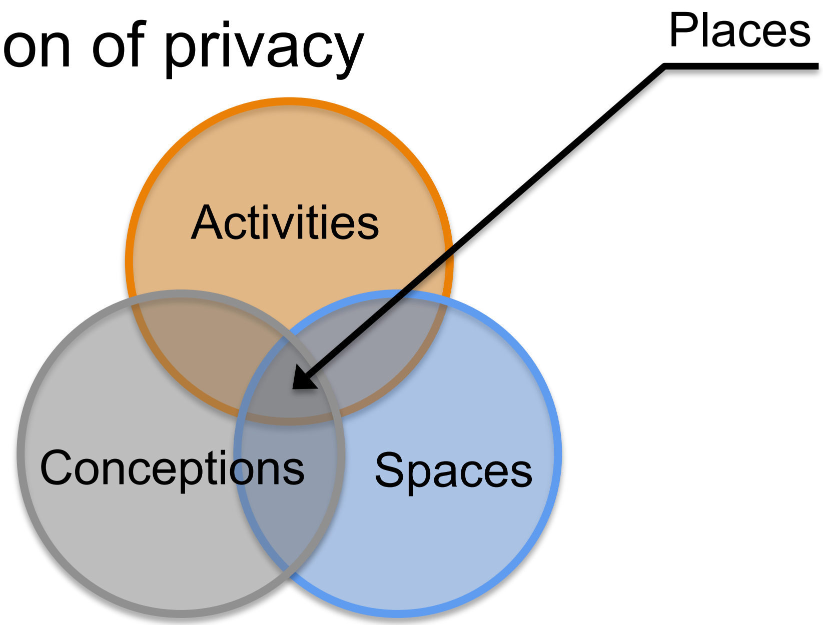
[Harrison 1996]

Metaphors

Place = valued space

- Contextualized space
  - Knowledge
  - Practicies
  - e.g. House (space) vs. Home (place)

- Social construction of privacy
  - e.g. bedroom



[Harrison 1996]

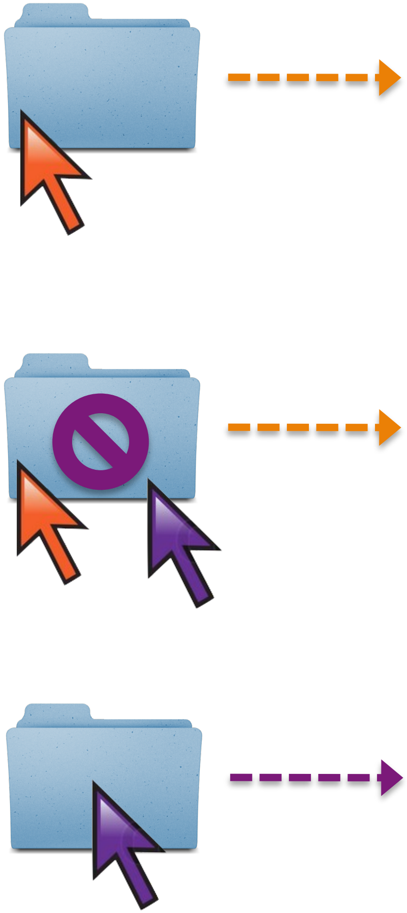
Metaphors

Place = valued space

Mechanisms

Floor control

- ▷ Managing interaction
- ▷ Who can write and when
- ➪ Locking access
- ➪ Social protocol



Dimensions

- ▷ Degree of interaction
- ▷ User characteristics
- ▷ Granularity
- ▷ Duration
- ▷ Ex. *fair dragging*

[Boyd 1993]

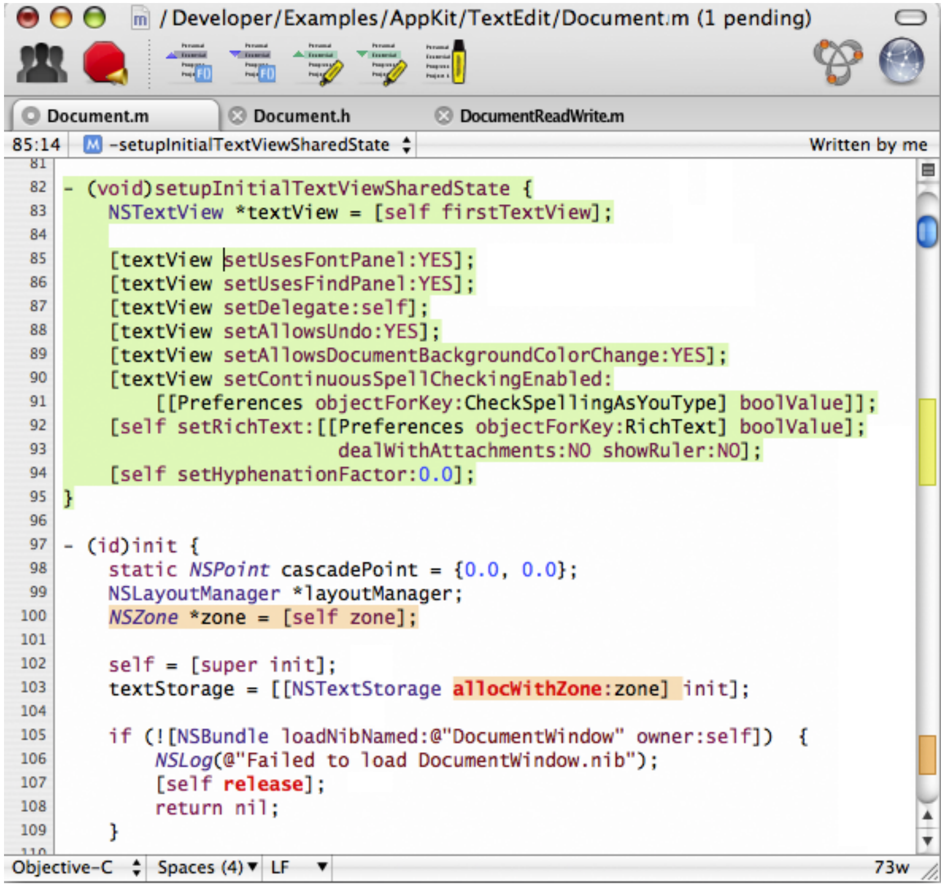
Mechanisms

Concurrent actions

- Ex. Deleting while inserting
- Simultaneous access
- Opposite actions
  - Destructive

Concurrency control

- Node locking
- Notification
- Awareness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Document.m
Document.h
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85:14
-setupInitialTextViewSharedState
Written by me
Objective-C
Spaces (4)
LF
73w

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```
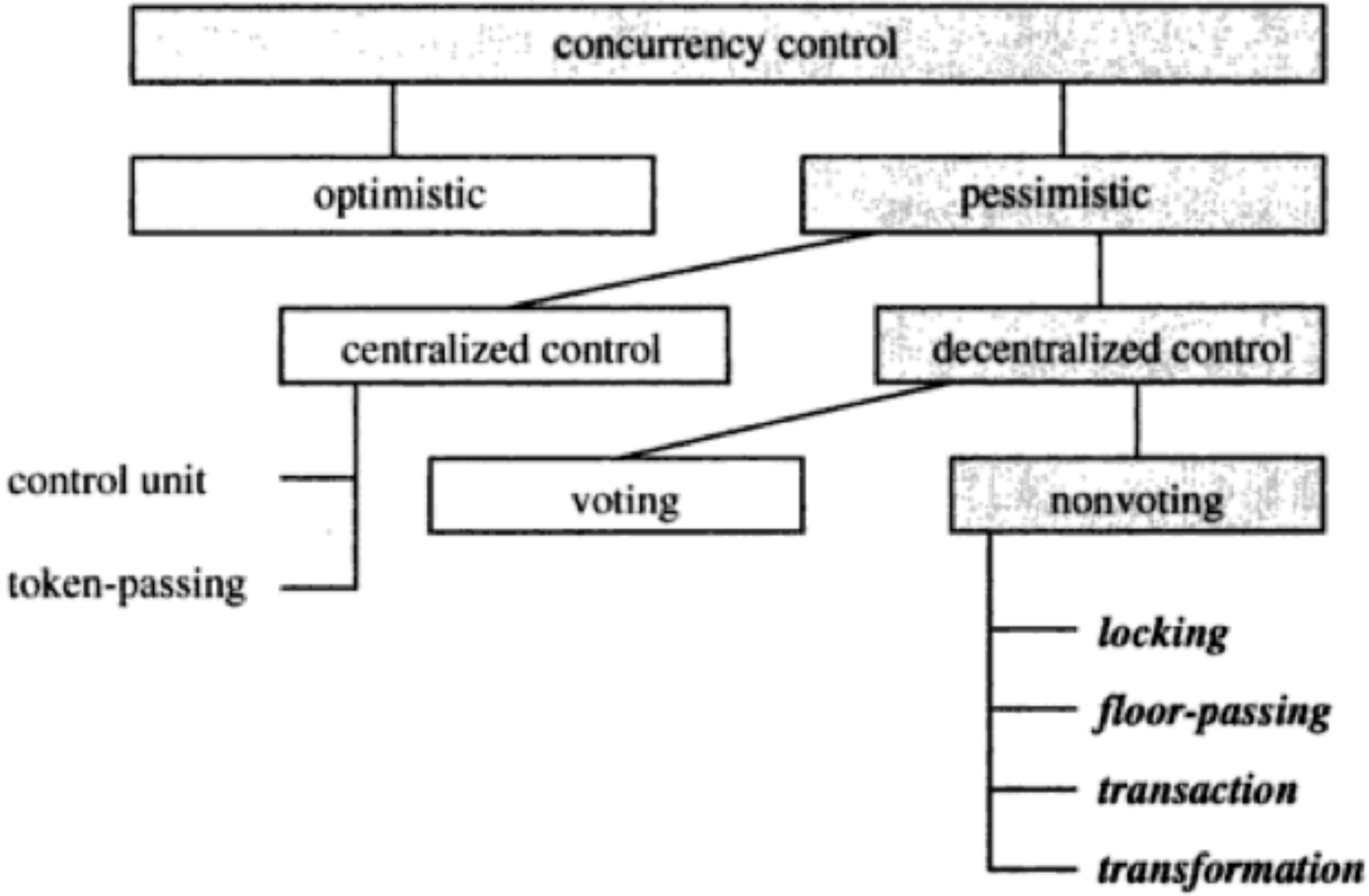

[Ellis 1989]

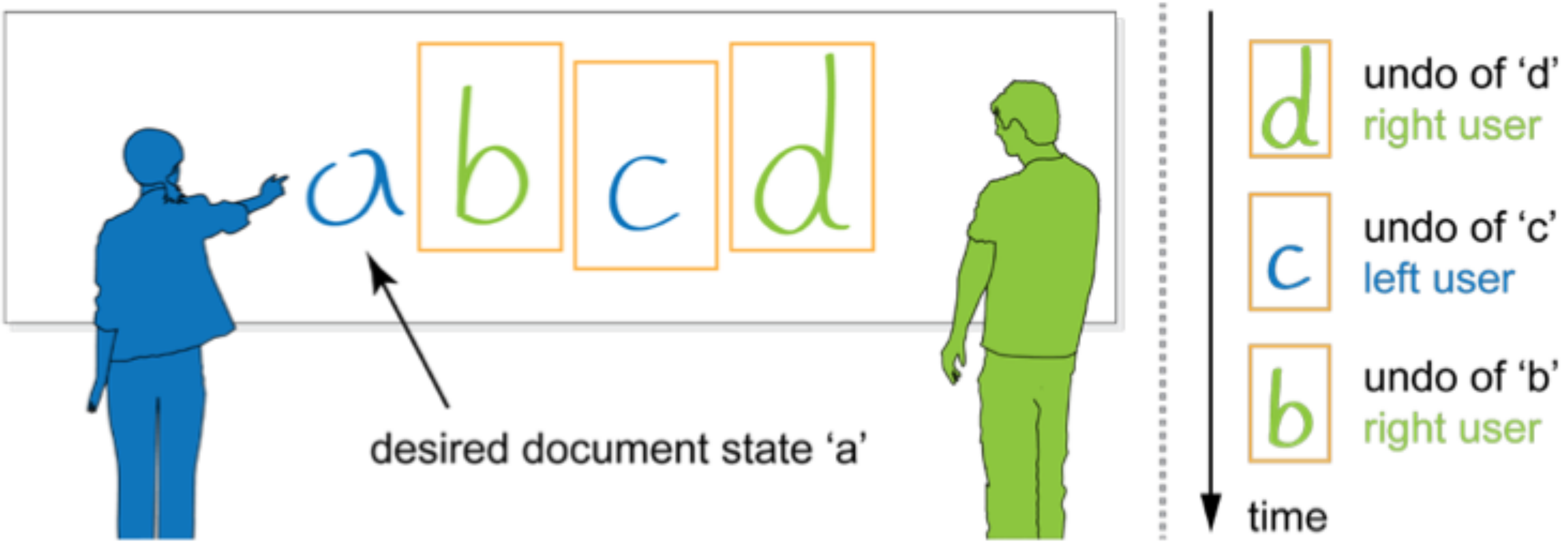
Mechanisms


concurrency control
optimistic
pessimistic
centralized control
decentralized control
control unit
token-passing
voting
nonvoting
locking
floor-passing
transaction
transformation

Mechanisms

Undo/Redo

- ▷ Essential function to correct errors
- ▷ Complex
    - ▷ Technical
    - ▷ User inferface



[Seifried 2012]

Mechanisms

Undo/Redo

- ▷ Essential function to correct errors
- ▷ Complex
  - ▷ Technical
  - ▷ User inferface

Models

- ▷ Linear : sequential undo (e.g. stack)
- ▷ Non-linear : arbitrary
  - ▷ Synchronous multi-user interaction

Methods

- ▷ Global, personal, selective, regional

[Seifried 2012]

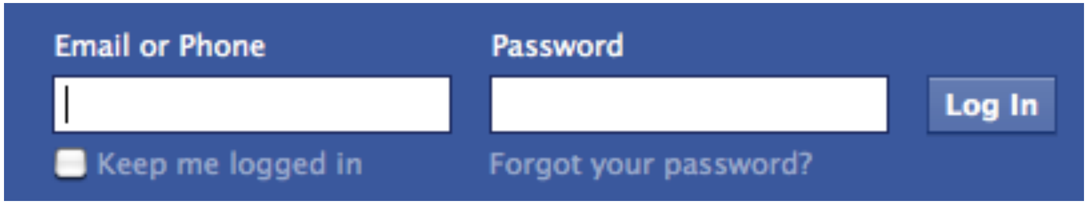
Mechanisms

Session management

- Manage membership
- Maintain connectivity
- Orchestrate sessions
- Provides session state information

Actions

- Joining
- Inviting
- Excluding
- etc



Outline

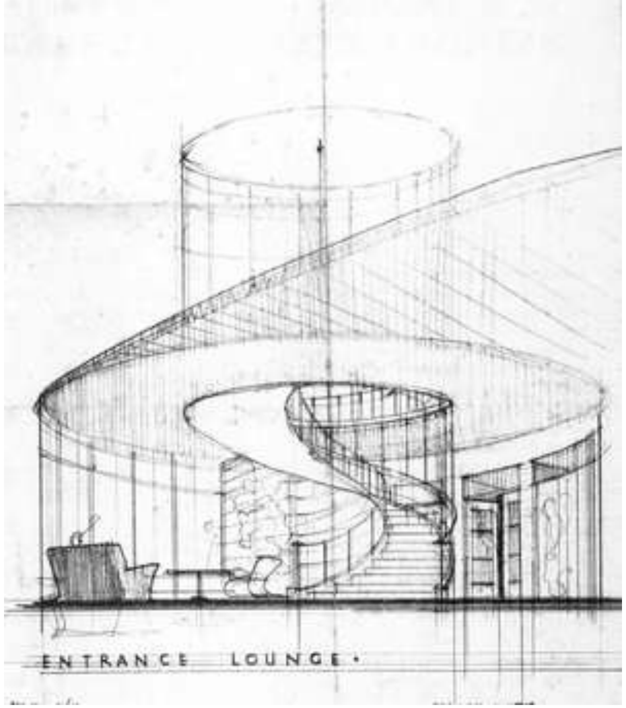
Building groupware applications

1. Group task analysis
2. Design
3. Implementation
    - ▷ Software architecture
        - ▷ Distribution of software components
        - ▷ Functional architecture
    - ▷ Networking
4. Evaluation

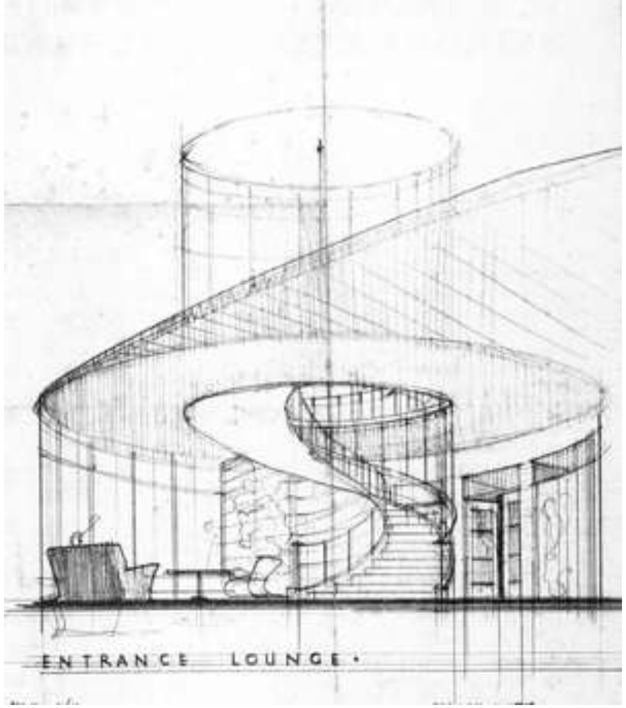
Software architectures for groupware

Software architecture

- ▷ Functional organisation
- ▷ Logical organisation
- ▷ Modular set of components



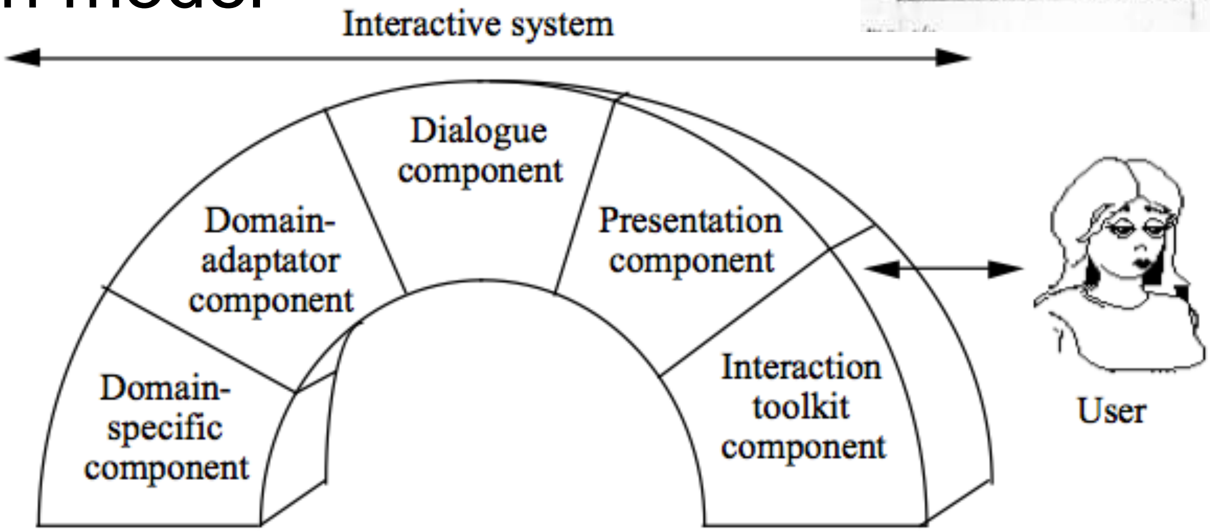
Software architectures for groupware



Software architecture

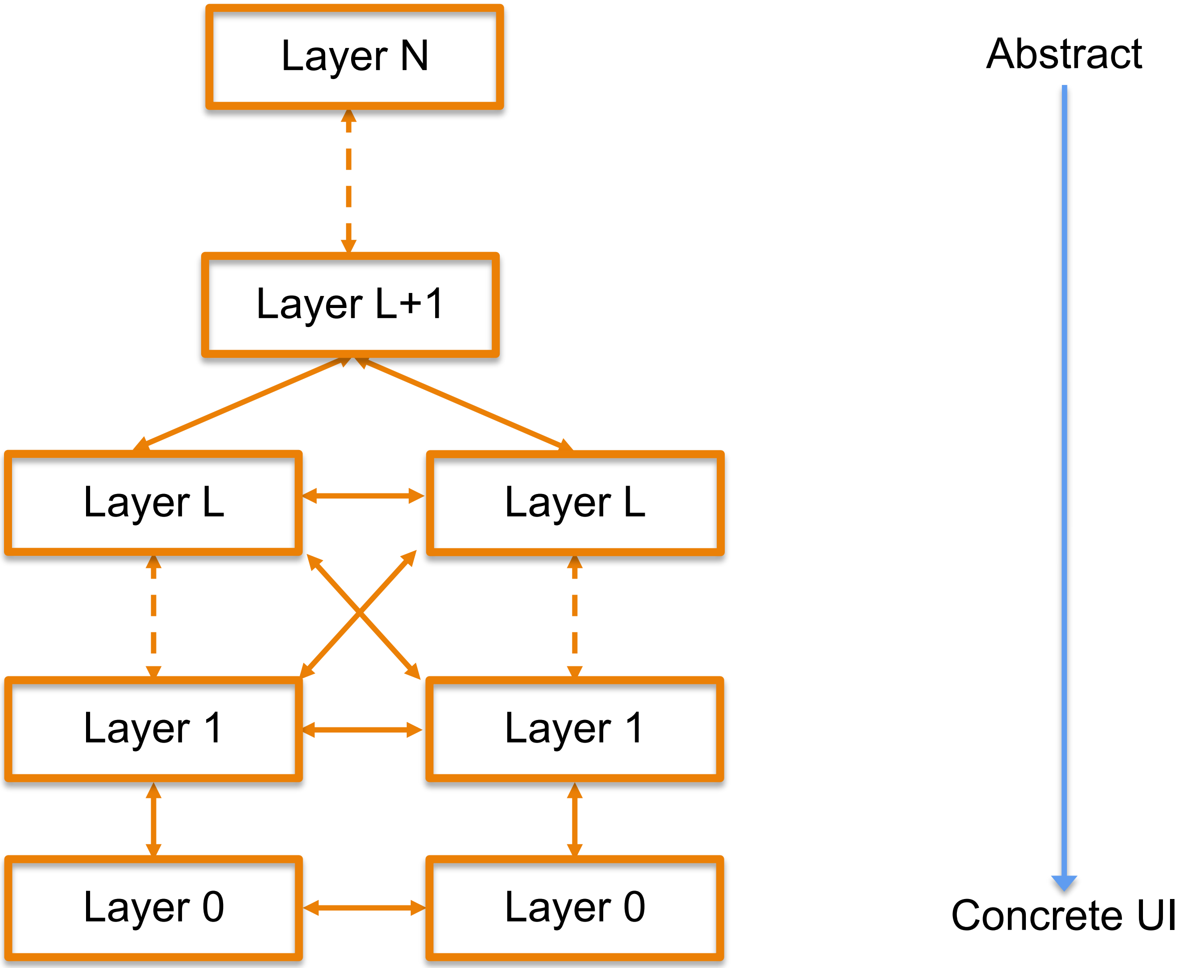
- ▷ Functional organisation
- ▷ Logical organisation
- ▷ Modular set of components

HCI : Arch model


Interactive system
Dialogue component
Domain-adaptator component
Presentation component
Domain-specific component
Interaction toolkit component
User

Functional architectures

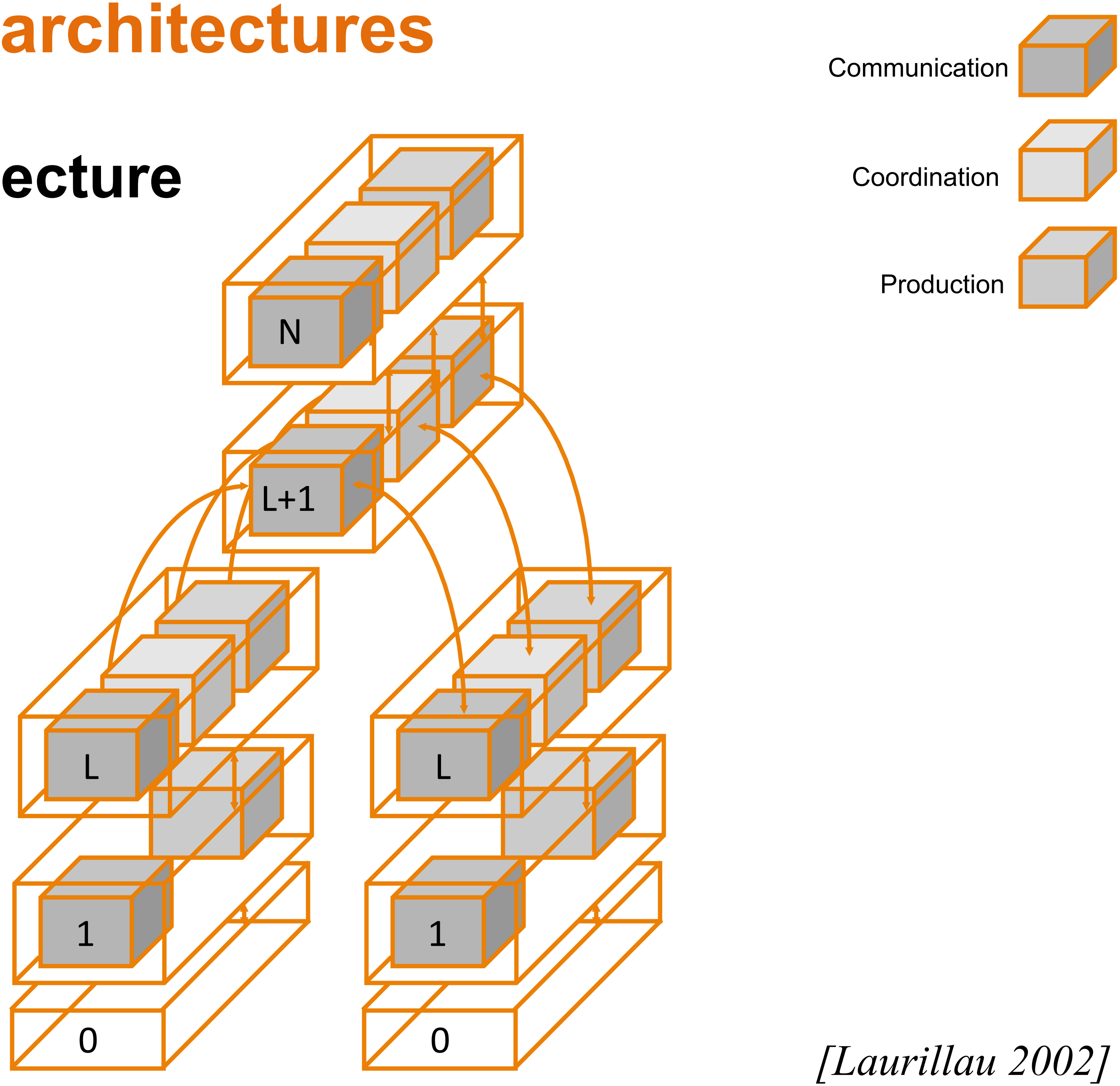
Zipper model



[Dewan 1999]

Functional architectures

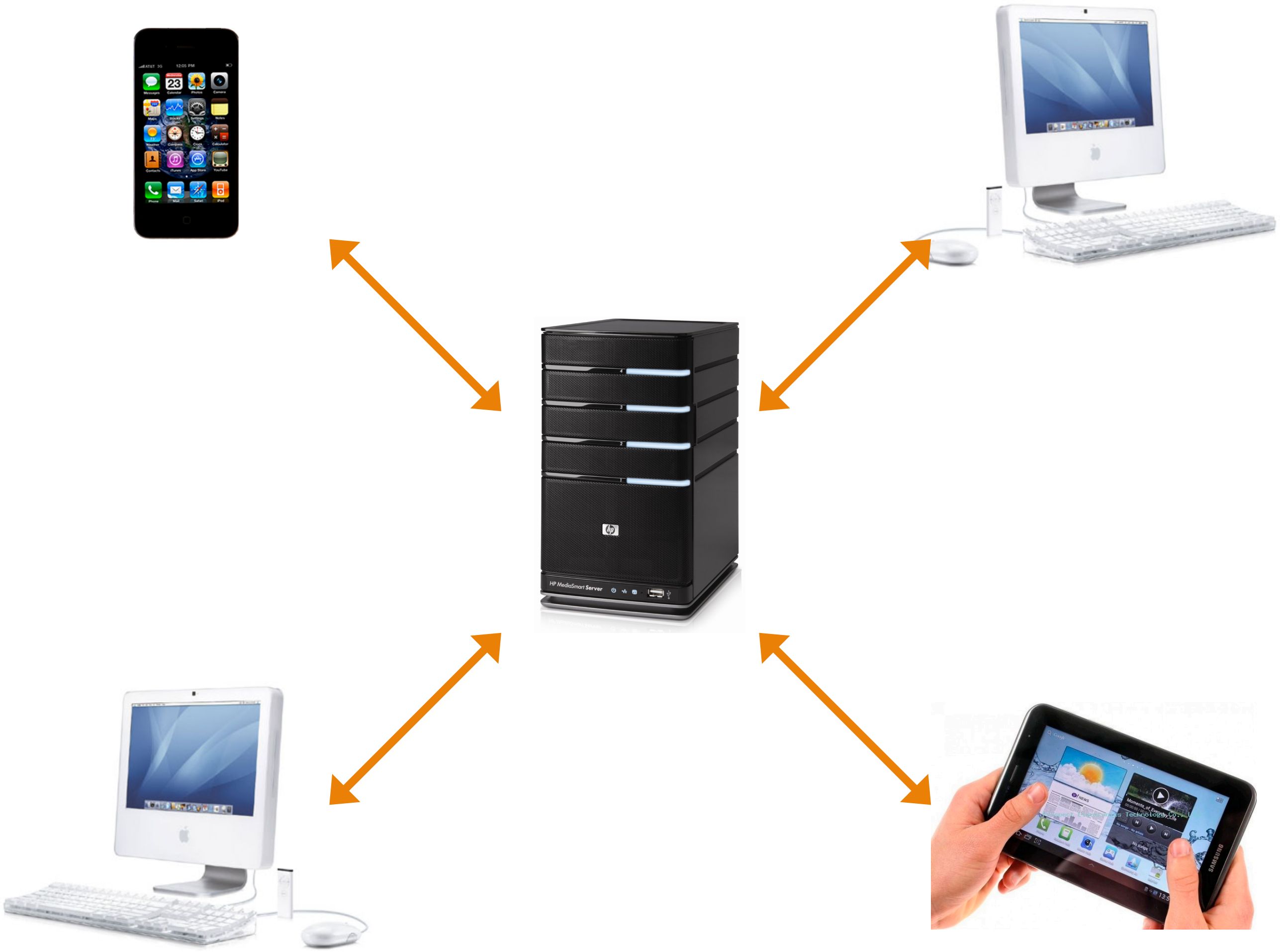
Clover architecture model



[Laurillau 2002]

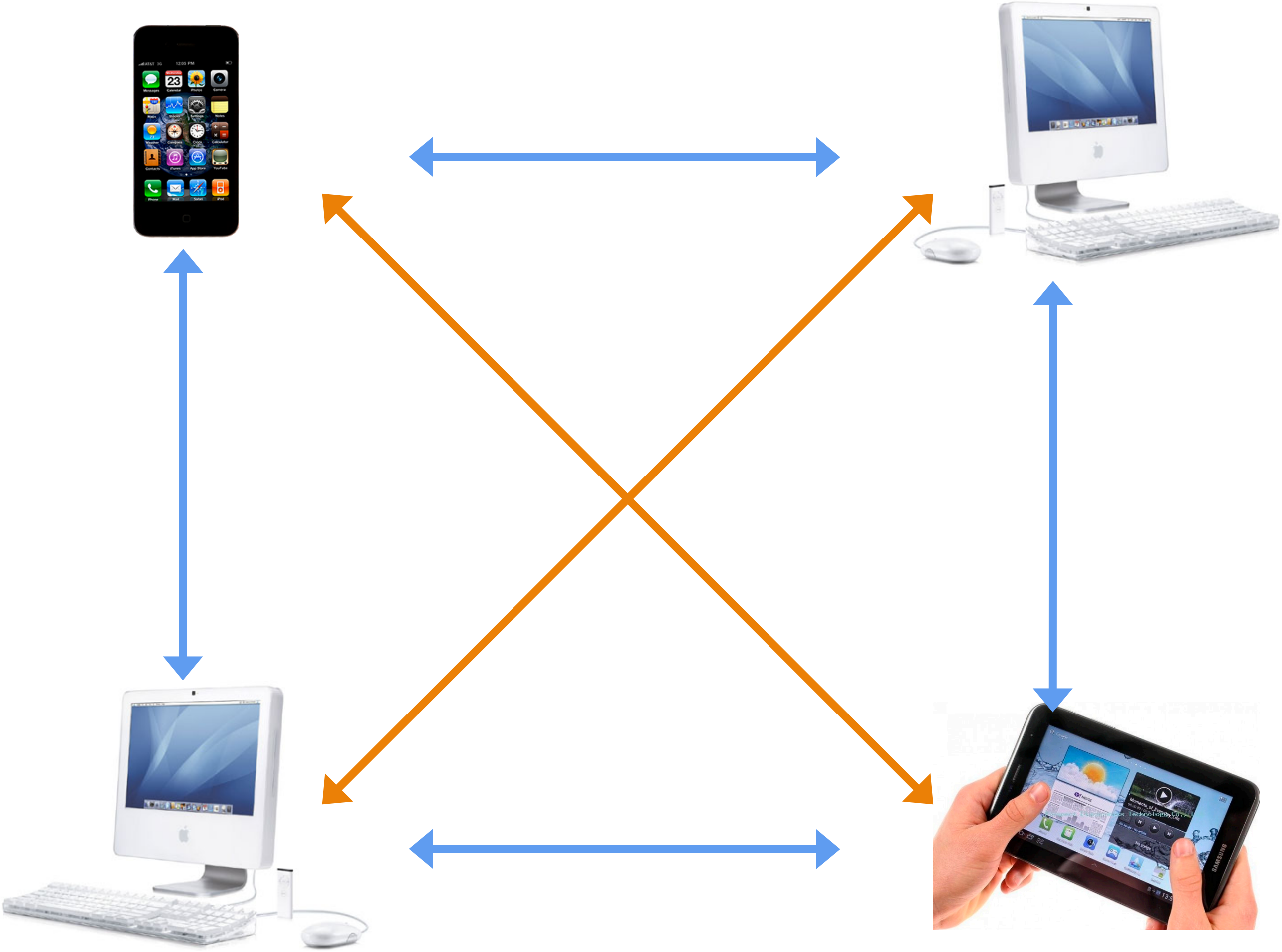
Distributed architectures

Centralized architecture



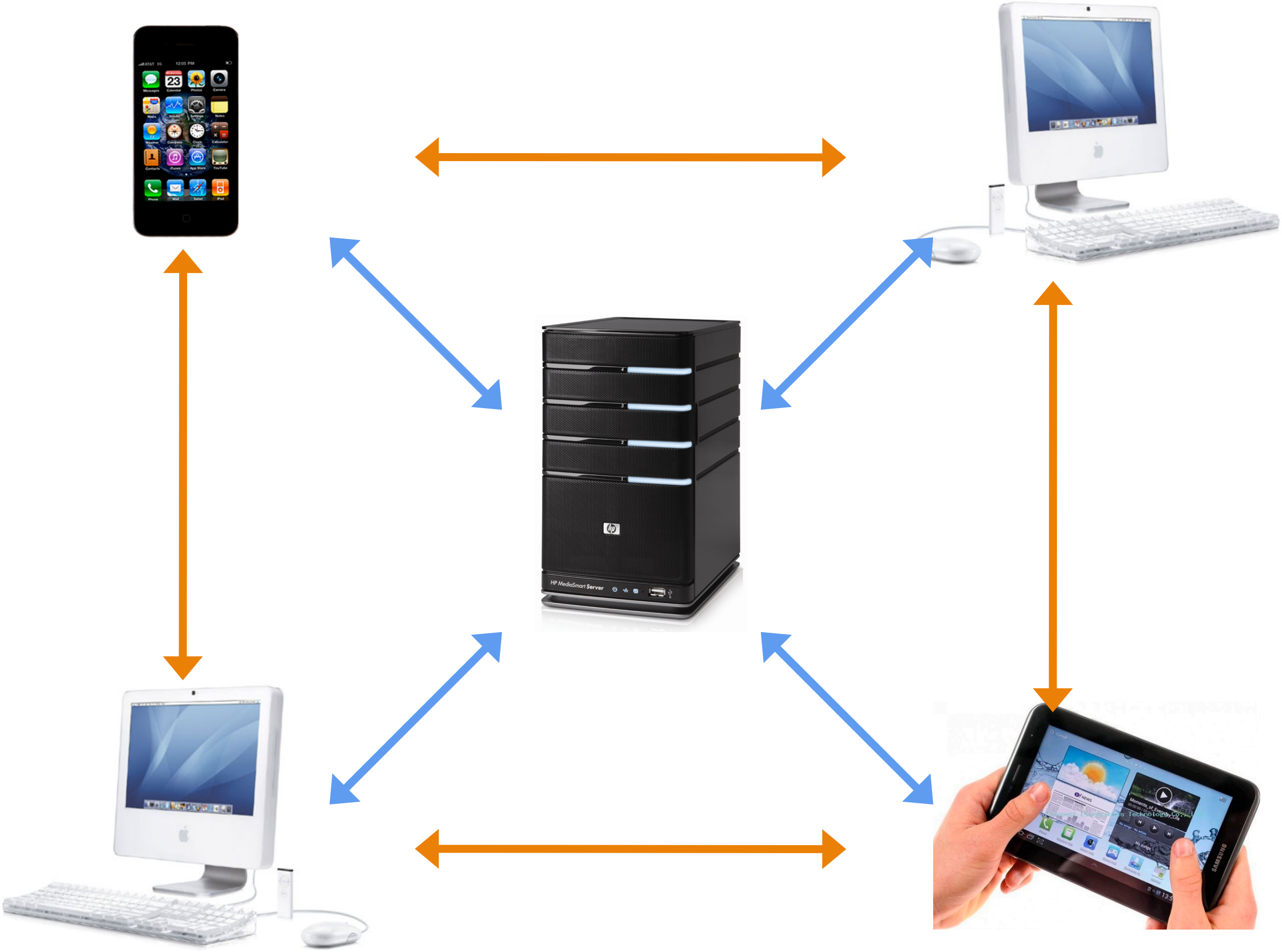
Distributed architectures

Distributed architecture



Distributed architectures

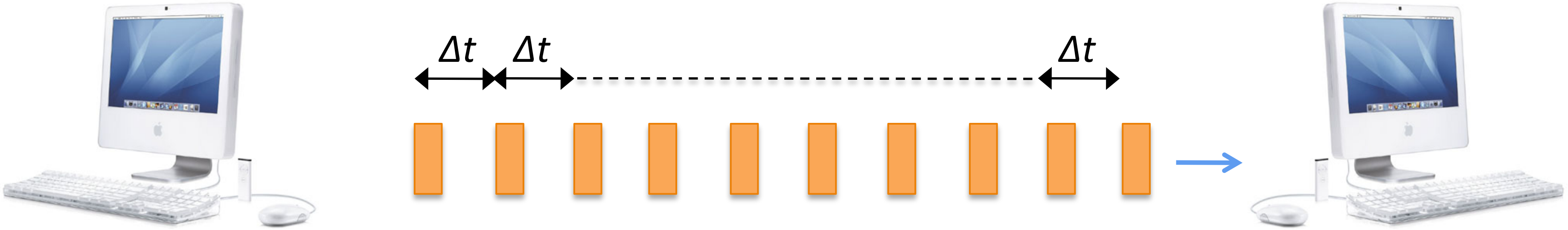
Hybrid architecture



Networking issues

Latency

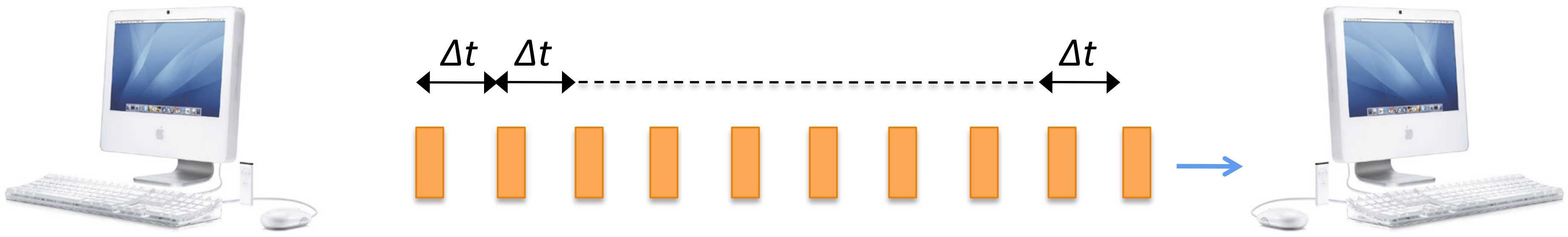
- Time to travel across the network



Networking issues

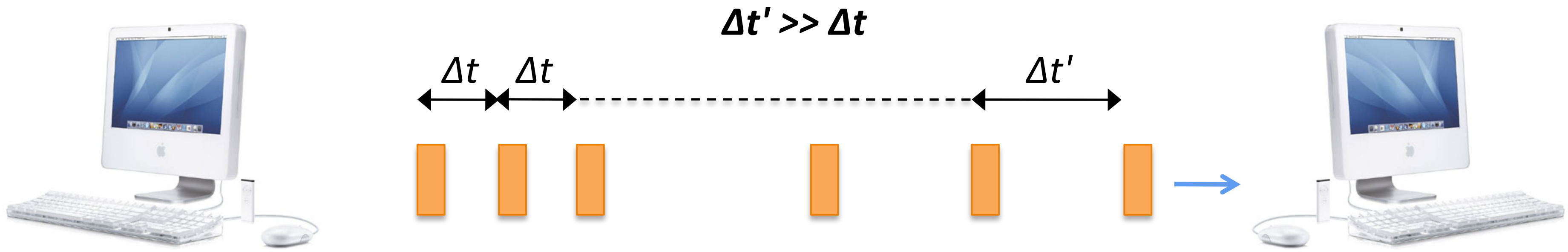
Latency

- Time to travel across the network



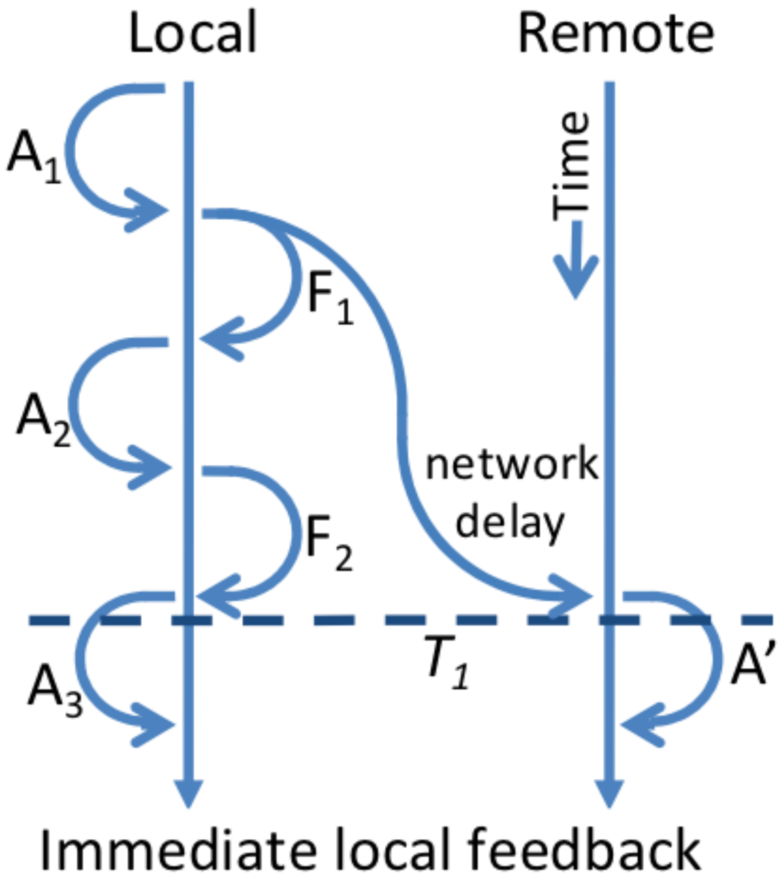
Lag

- Increased latency



Networking issues

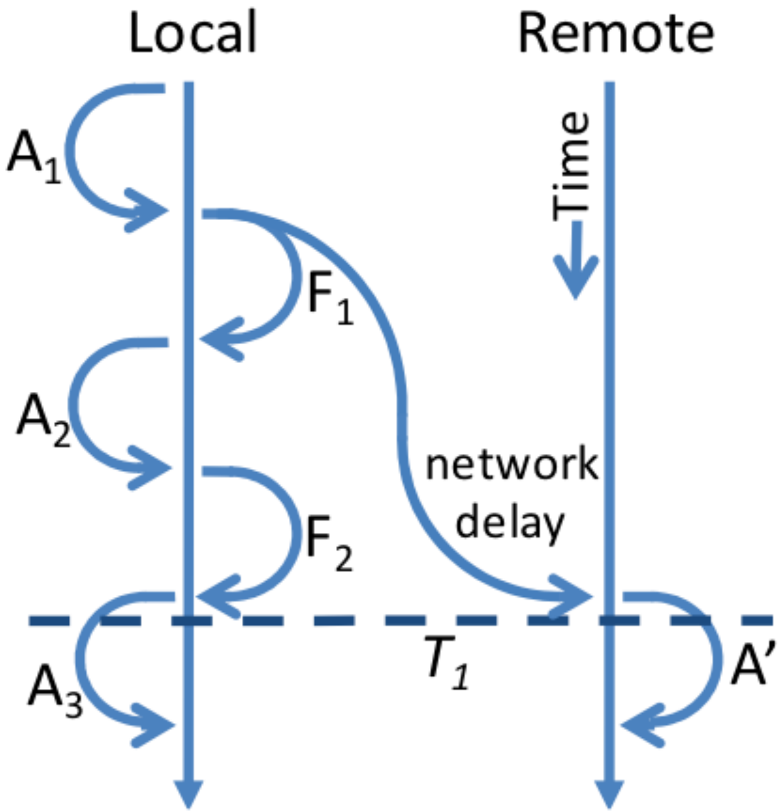
Effects of lag on remote interaction



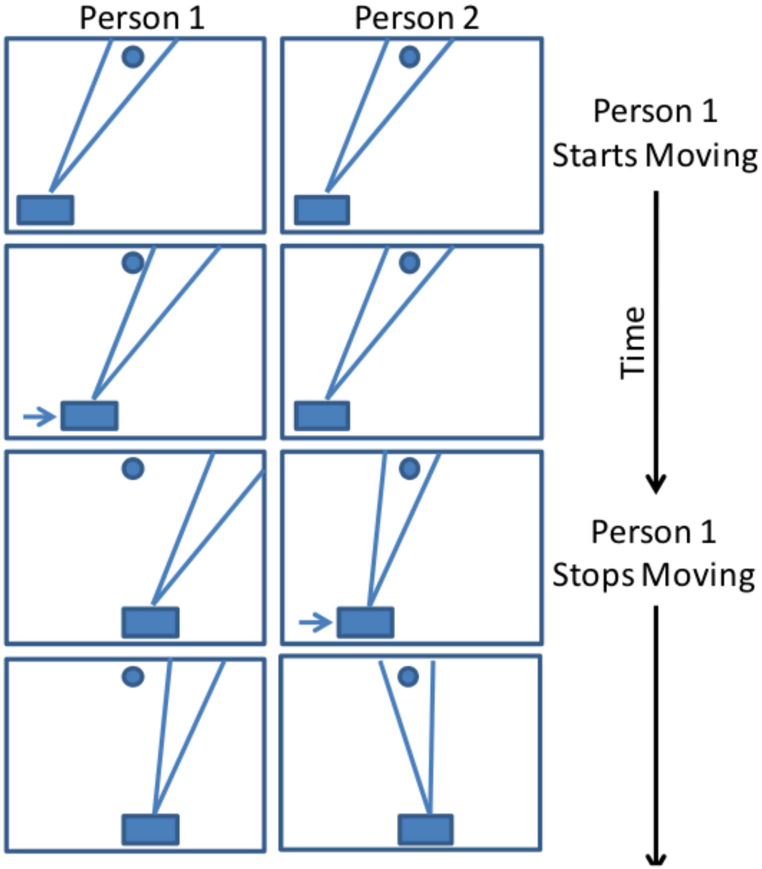
[Stuckel 2008]

Networking issues

Effects of lag on remote interaction



Immediate local feedback

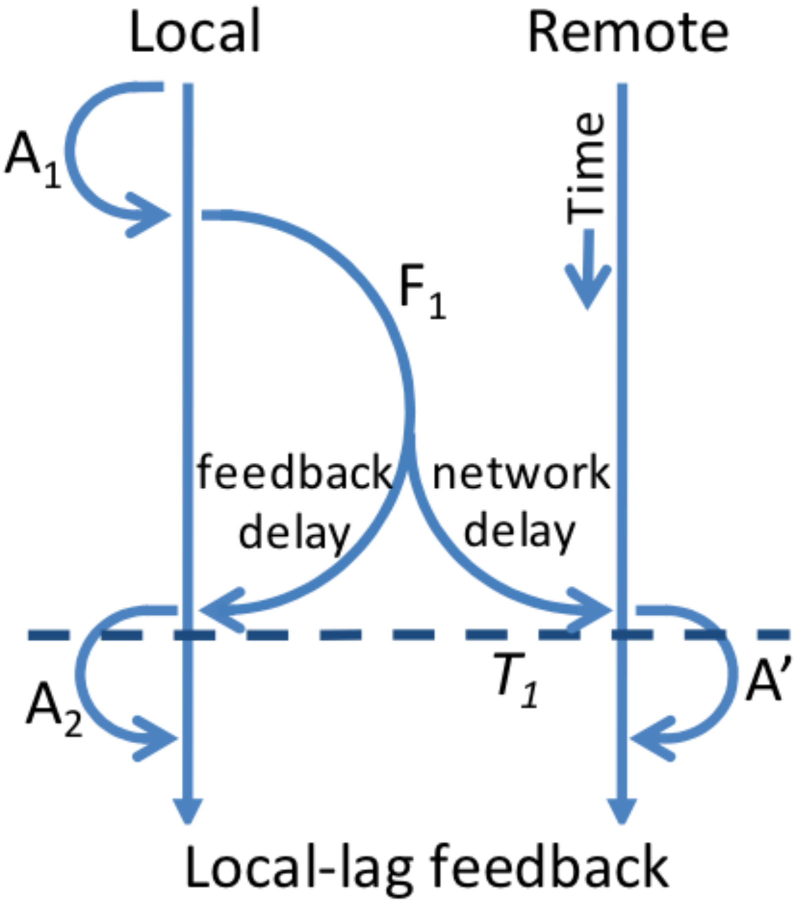


Immediate local feedback

[Stuckel 2008]

Networking issues

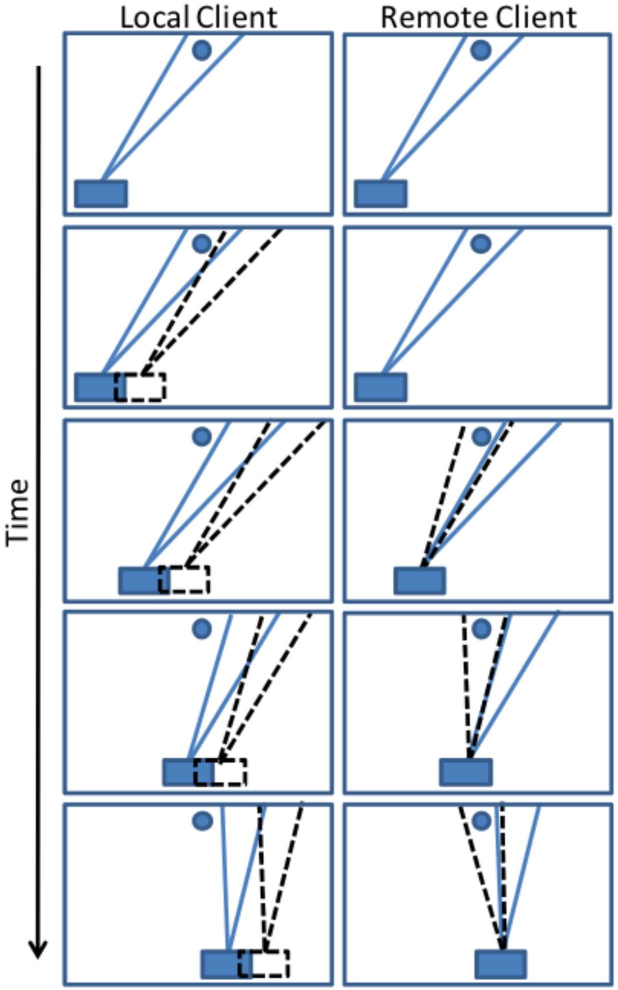
Solution #1: local lag



[Stuckel 2008]

Networking issues

Solution #2: ghost



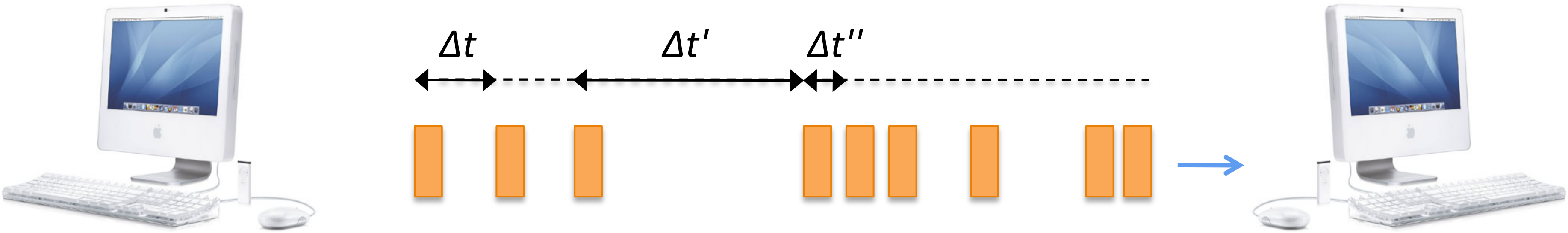
[Stuckel 2008]

Networking issues

Jitter

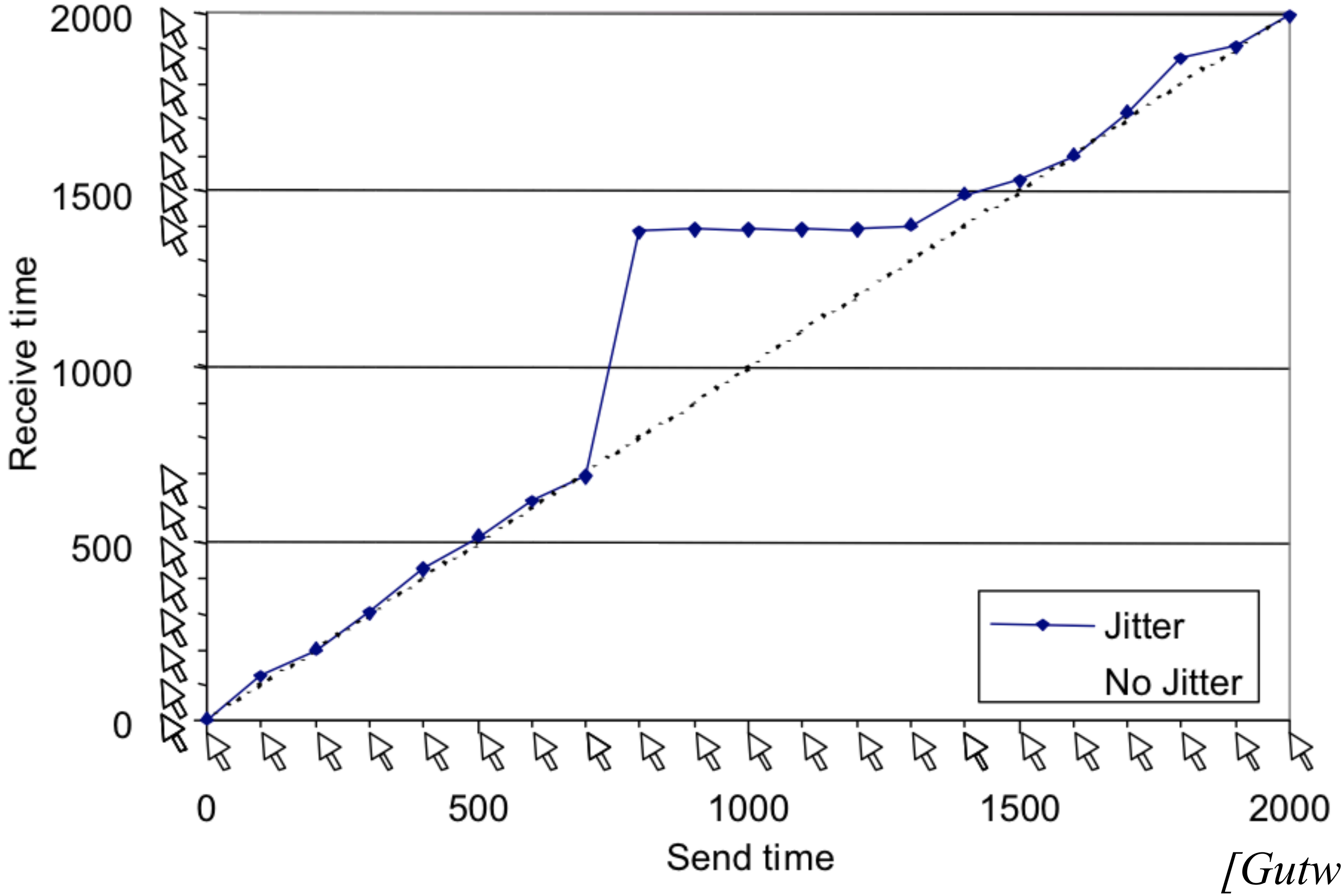
- Irregular and unwanted variation

$\Delta t'' \ll \Delta t \ll \Delta t'$



Networking issues

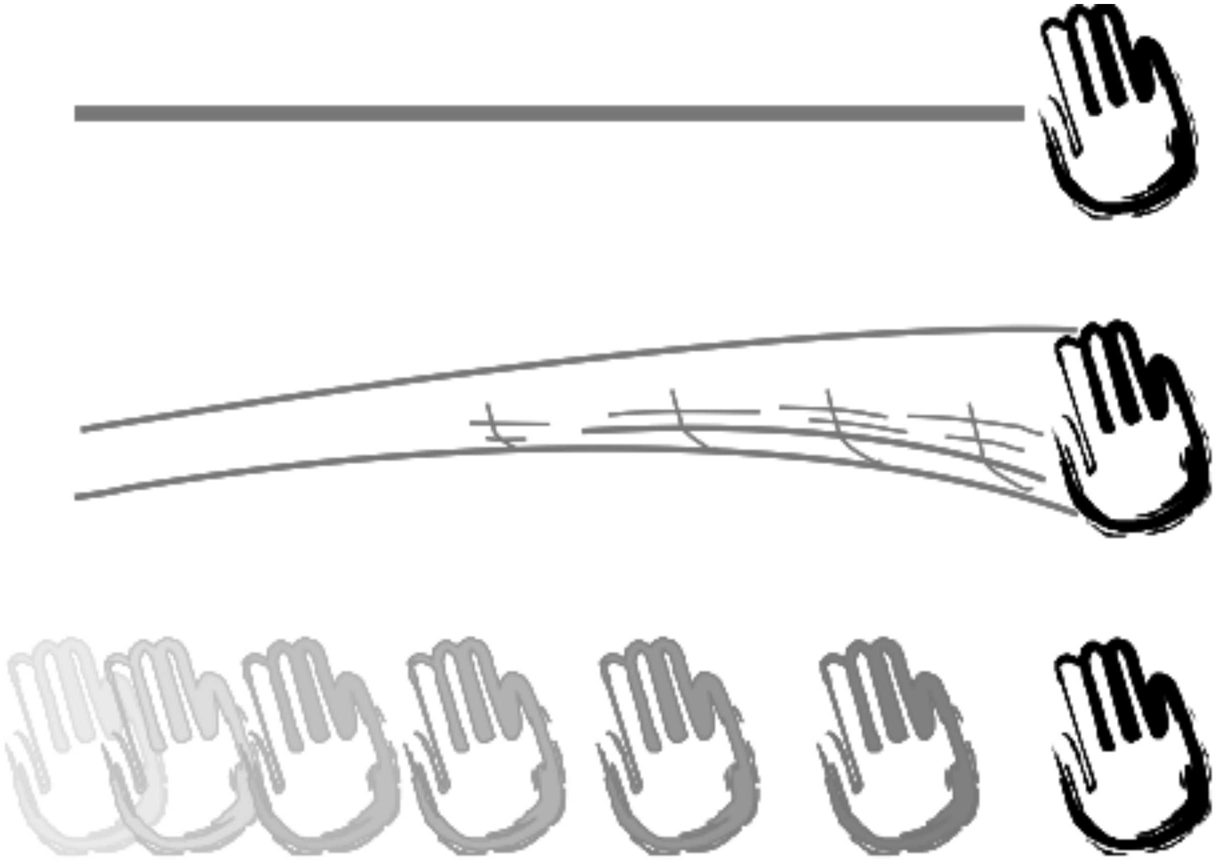
Effects of jitter on remote interaction (e.g. telepointer)



[Gutwin 2004]

Networking issues

Solution: telepointer traces

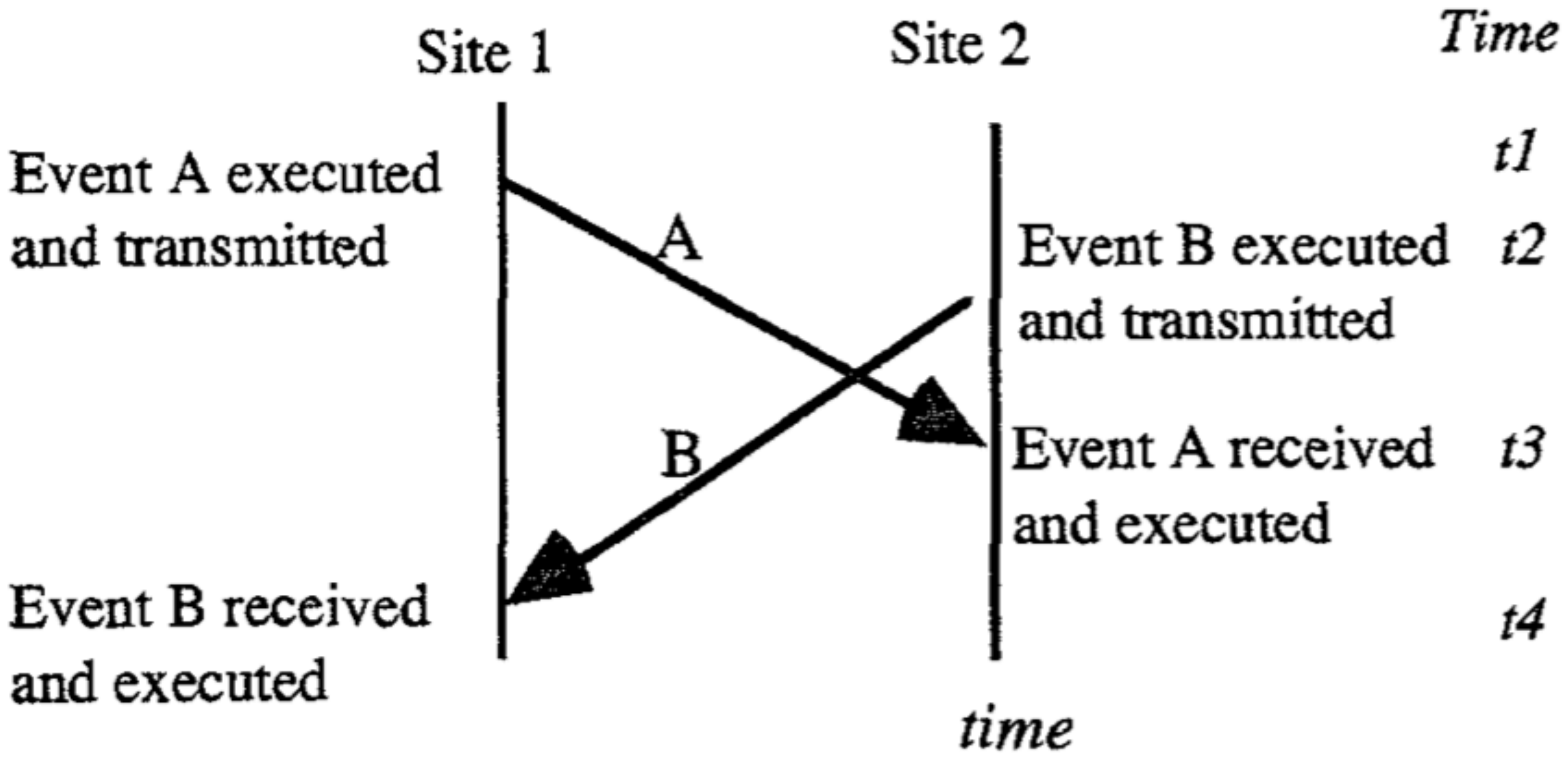


[Gutwin 2004]

Networking issues

Loss of synchronicity

- Inconsistencies


Site 1
Site 2
Time
t1
Event A executed and transmitted
A
Event B executed and transmitted
t2
Event A received and executed
t3
B
Event B received and executed
t4
time

[Greenberg 1996]

Networking issues

Loss of synchronicity

- Caching mechanisms
    - Local copy of data
    - Broadcast data to maintain up-to-date
- Operational transformation
    - Reordering
        - Causally dependent operations
    - Convergence
    - Numerous complex algorithms

[Ellis 1989]

Outline

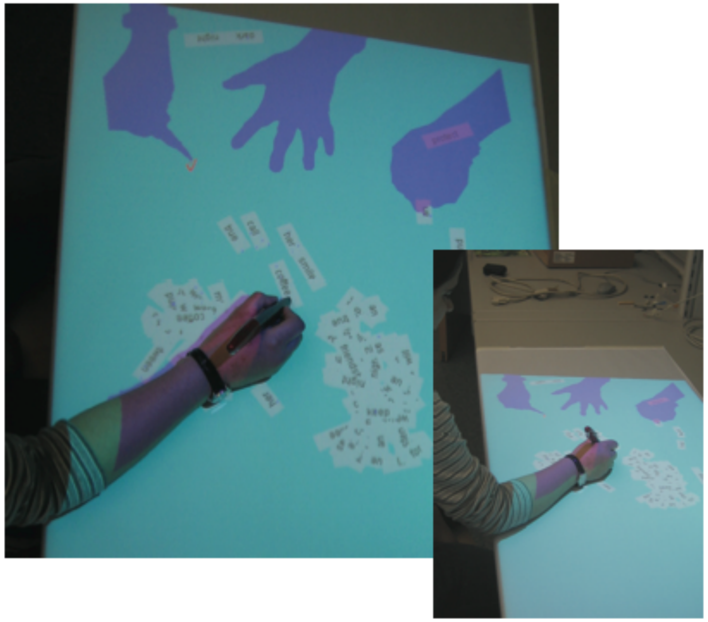
Building groupware applications

1. Group task analysis
2. Design
3. Implementation
4. Evaluation
   - ▷ Mechanics of collaboration

Mechanics of collaboration

Support intentional communicatior

- Verbal conversations
  - Textual dialogs
  - Audio channels
- Gestures
  - Video channels
  - Avatars
  - Telepointers, shadows

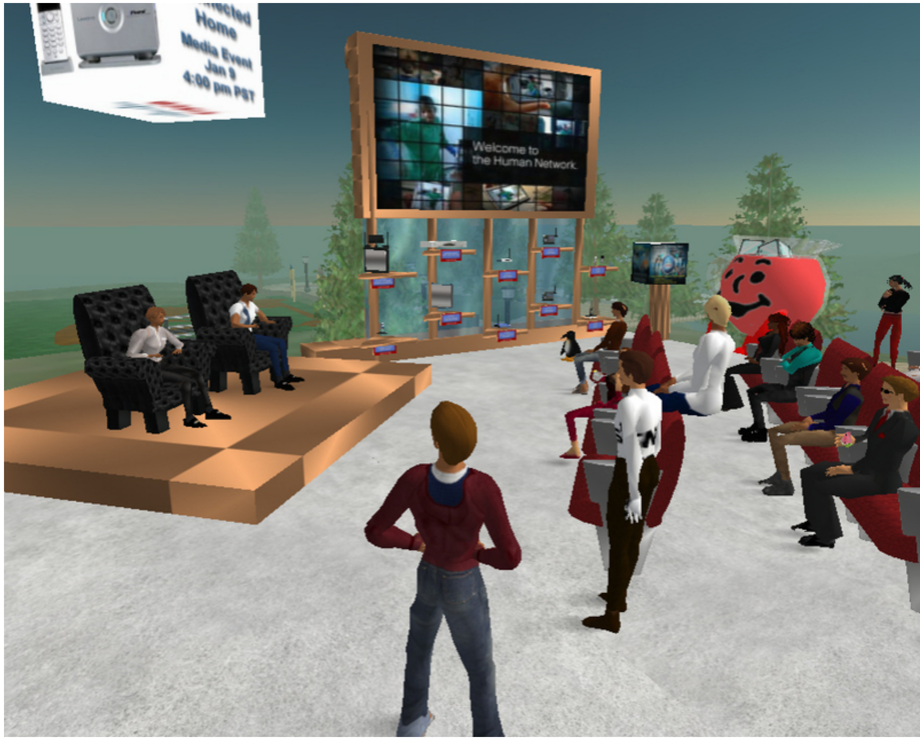


[Gutwin 2002]

Mechanics of collaboration

Support consequential communication

- Bodily actions: position, posture, movements, etc
  - Video
  - Audio channels
  - Eye gaze
  - Avatars (embodiement)
  - Telepointers
  - Spatial proximity



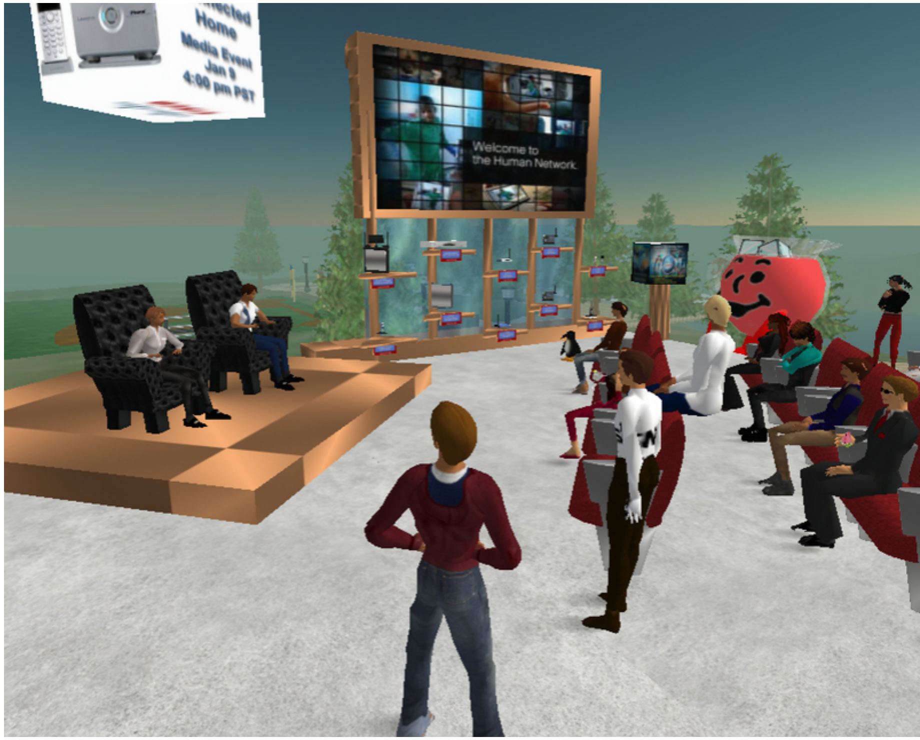
...ected Home Media Event Jan 9 4:00 pm PST
Welcome to the Human Network

[Gutwin 2002]

Mechanics of collaboration

Support consequential communication

- Bodily actions: position, posture, movements, etc
  - Video
  - Audio channels
  - Eye gaze
  - Avatars (embodiement)
  - Telepointers
  - Spatial proximity

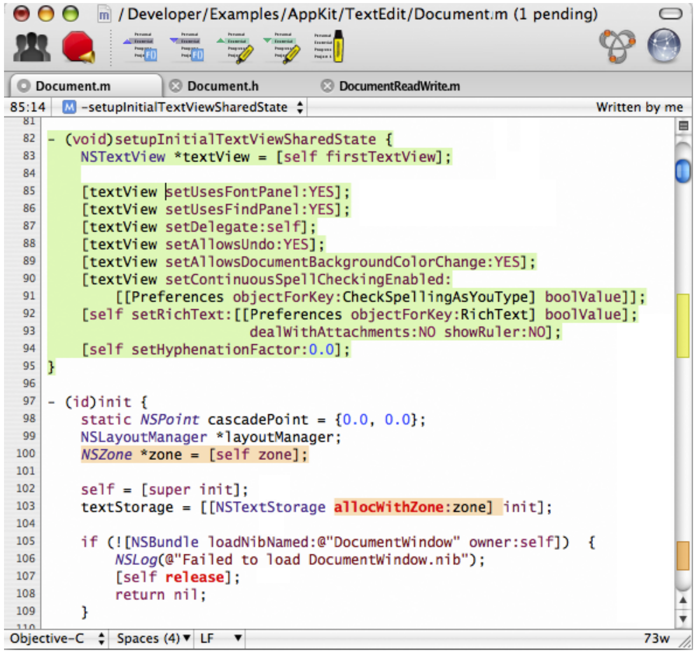

Connected Home Media Event Jan 9 4:00 pm PST
Welcome to the Human Network

[Gutwin 2002]

Mechanics of collaboration

Support consequential communication

- ▷ Feedthrough
- ▷ Artifacts as they are manipulated by others
  - ▷ WYSIWIS
  - ▷ Activity indicators (ex. colors)


/ Developer/Examples/AppKit/TextEdit/Document.m (1 pending)
Document.m
Document.h
DocumentReadWrite.m
85:14
-setupInitialTextViewSharedState
Written by me
Objective-C
Spaces (4)
LF
73w

```
- (void)setupInitialTextViewSharedState {
    NSTextView *textView = [self firstTextView];

    [textView setUsesFontPanel:YES];
    [textView setUsesFindPanel:YES];
    [textView setDelegate:self];
    [textView setAllowsUndo:YES];
    [textView setAllowsDocumentBackgroundColorChange:YES];
    [textView setContinuousSpellCheckingEnabled:
        [[Preferences objectForKey:CheckSpellingAsYouType] boolValue]];
    [self setRichText:[[Preferences objectForKey:RichText] boolValue];
                        dealWithAttachments:NO showRuler:NO];
    [self setHyphenationFactor:0.0];
}

- (id)init {
    static NSPoint cascadePoint = {0.0, 0.0};
    NSLayoutManager *layoutManager;
    NSZone *zone = [self zone];

    self = [super init];
    textStorage = [[NSTextStorage allocWithZone:zone] init];

    if (![NSBundle loadNibNamed:@"DocumentWindow" owner:self])  {
        NSLog(@"Failed to load DocumentWindow.nib");
        [self release];
        return nil;
    }
```

[Gutwin 2002]

Mechanics of collaboration

Management of coupling

- Degree to which people are working together
- Strict WYSIWIS vs. Relaxed WYSIWIS
  - Views
  - Real-time, near real-time, asynchronous
  - Private conversations

Coordination of actions

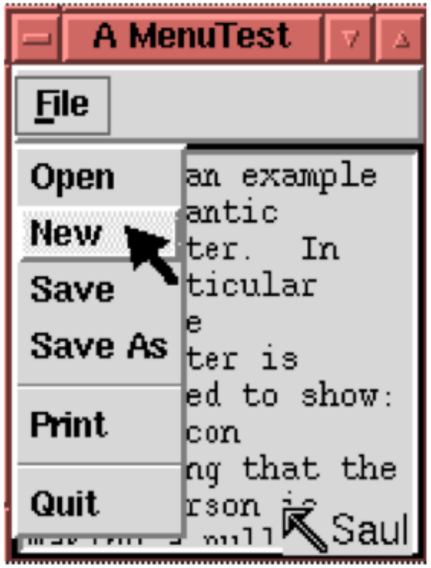
- Explicit communication
- Workspace awareness
- Social protocols

[Gutwin 2002]

Mechanics of collaboration

Simplification of communication

- Deictic references
  - "*this*" and "*that*"
  - Video channels
  - Remote pointers
  - Embodiement



an example
antic
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con
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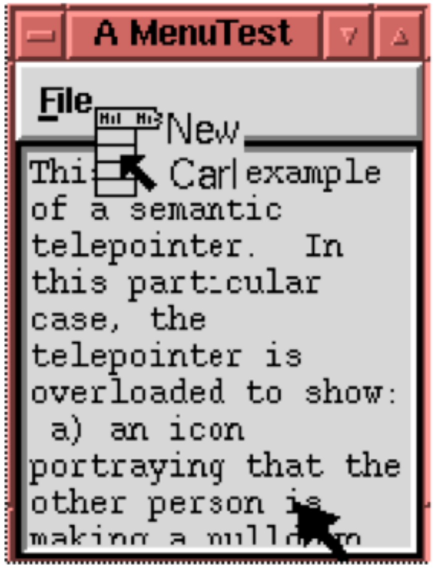


Thi example
of a semantic
telepointer. In
this part:cular
case, the
telepointer is
overloaded to show:
a) an icon
portraying that the
other person is
making a pull

[Gutwin 2002]

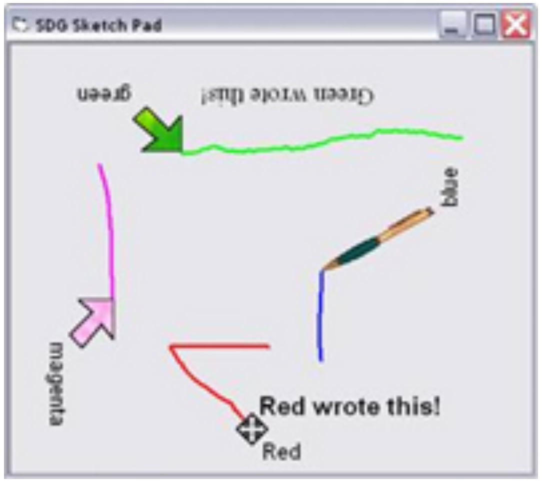
Mechanics of collaboration

Assistance

- Assist people in understanding the context
- Opportunistic and informal
  - Annotations

Protection

- Concurrency control
- Undo/Redo
- Floor control



[Gutwin 2002]

Conclusion

Building groupware applications

Success or failure ?

[Grudin 1988]