chapter 19

groupware

Groupware

- What is groupware
- Types of groupware
  - computer-mediated communication
  - meeting and decisions support systems
  - shared applications and artefacts
- Models of groupware
- Implementation issues

What is groupware?

- Software *specifically* designed
  - to support group working
  - with cooperative requirements in mind
- NOT just tools for communication
- Groupware can be classified by
  - *when* and *where* the participants are working
  - the *function* it performs for cooperative work
- Specific and difficult problems with groupware implementation

The Time/Space Matrix

Classify groupware by:

when the participants are working, at the same *time* or not

where the participants are working, at the same *place* or not

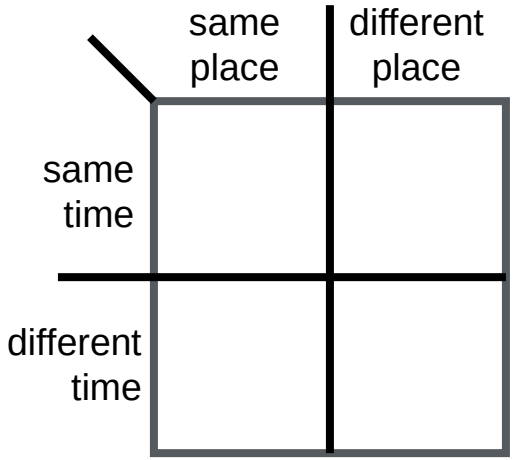
Common names for axes:

time:

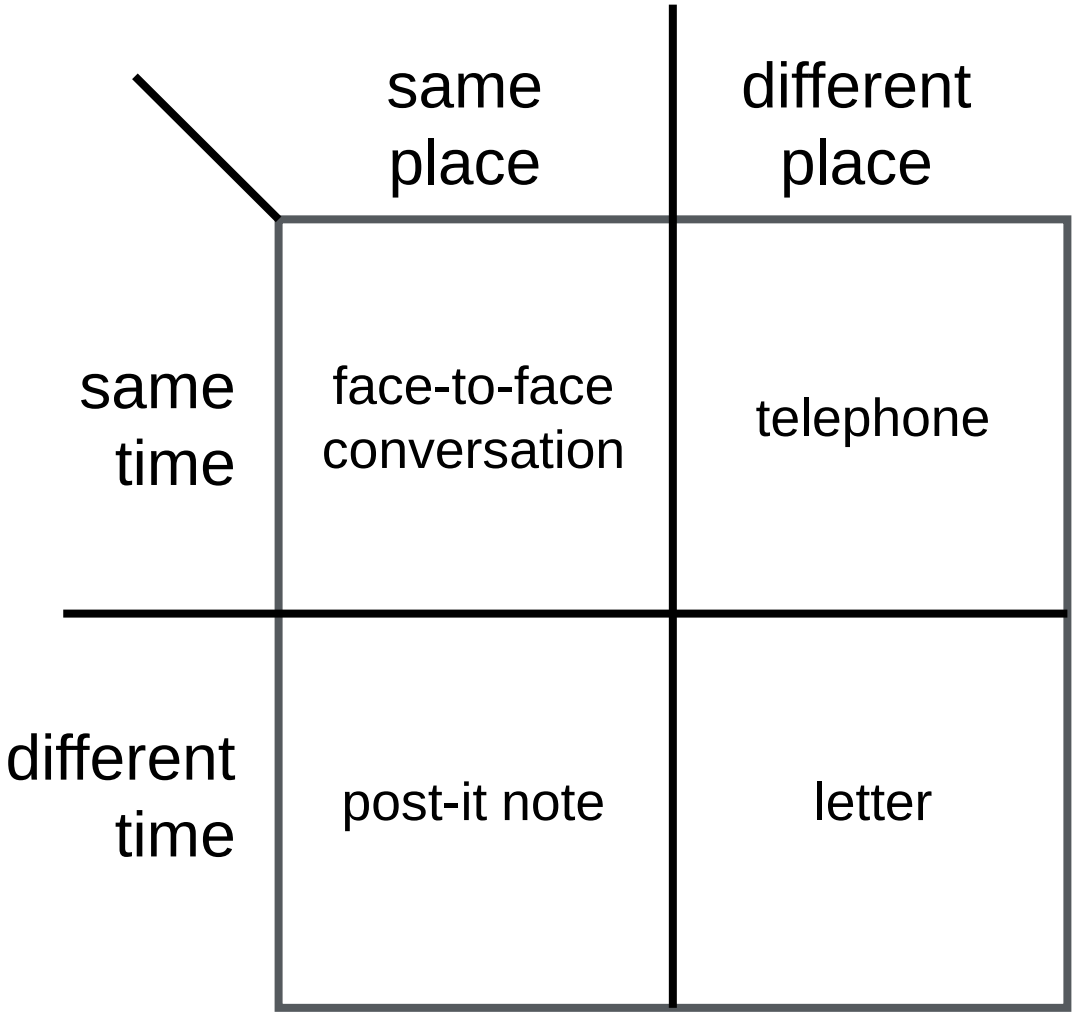
synchronous/asynchronous

place:

co-located/remote



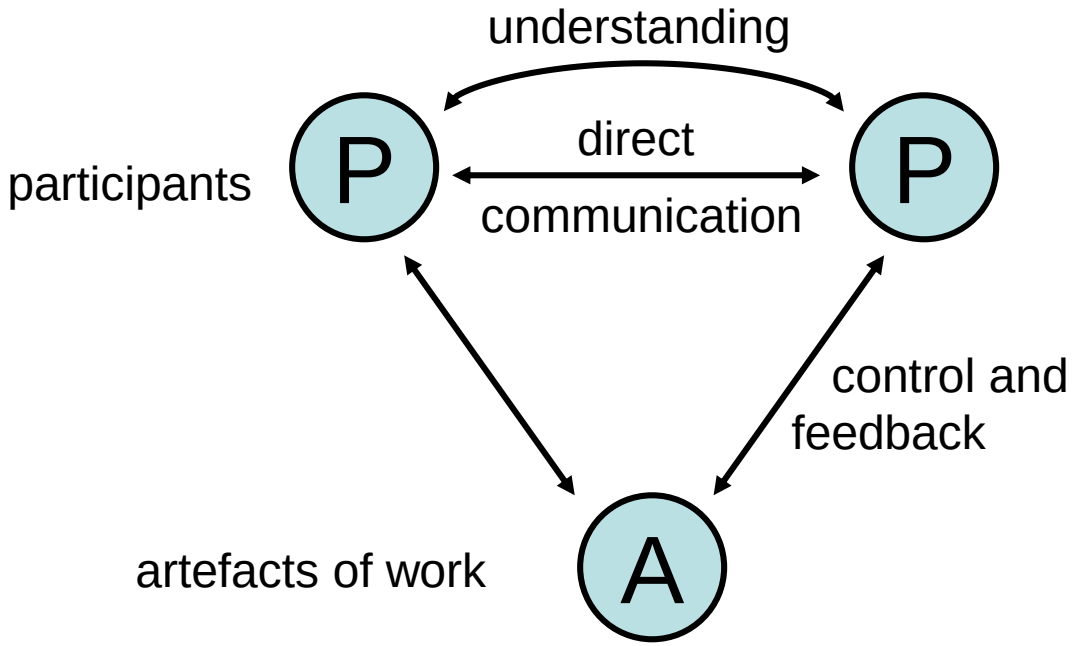
Time/Space Matrix (ctd)



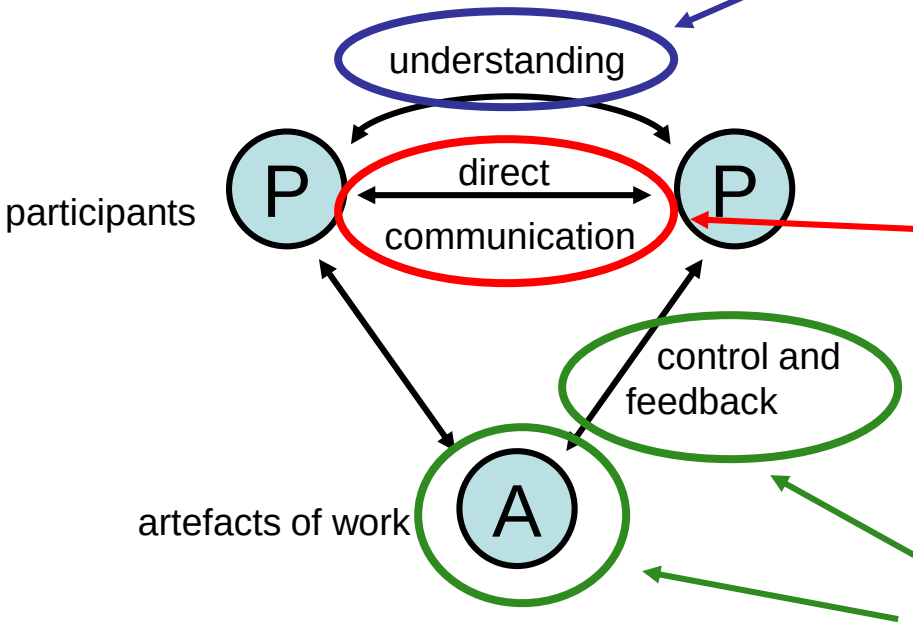
Classification by Function

Cooperative work involves:

- **Participants** who are working
- **Artefacts** upon which they work



What interactions does a tool support?



meeting and decision support systems

- common understanding

computer-mediated communication

- direct communication between participants

shared applications and artefacts

- control and feedback with shared work objects

computer-mediated communication

email and bulletin boards
structured message systems
text messaging
video, virtual environments

Email and bulletin boards

asynchronous/remote

familiar and most successful groupware

Recipients of email:

direct in To: field

copies in Cc: field

delivery identical – difference is social purpose

Email vs. bulletin boards

fan out

- one-to-one – email, direct communication
- one-to-many – email, distribution lists
  BBs, broadcast distribution

control

- sender – email, private distribution list
- administrator – email, shared distribution list
- recipient – BBs, subscription to topics

Structured message systems

asynchronous/remote

`super' email
- cross between email and a database

sender
- fills in special fields

recipient
- filters and sorts incoming mail based on field contents

… but
- work by the sender
- benefit for the recipient

Structured message systems (ctd)

Type: Seminar announcement
To: all
From: Alan Dix
Subject: departmental seminar
Time: 2:15 Wednesday
Place: D014
Speaker: W.T. Pooh
Title: The Honey Pot
Text: Recent research on socially constructed meaning has focused on the image of the Honey Pot and its dialectic interpretation within an encultured hermeneutic. This talk …

N.B. global structuring by designer
vs. local structuring by participants

txt is gr8

- instant messaging
  - 1996 – ICQ small Israeli company
  - now millions
  - more like conversation

Hi, u there
yeh, had a good night last night?
uhu 
want to meet later

- SMS
  - y is it we al lv shrt msgs
  - originally a feature of internal management protocol
  - short messages (160 chars) and text with numbers
  - no-one predicted mass adoption!!
  - now phones with cameras for MMS

SMS in action

- serious uses too … the 'SPAM' system
- two hostels for ex-psychiatric patients
- staff send SMS to central number
- messages appear in both offices
- avoids using phone
- 'mission critical' … but used for jokes too!

Video conferences and communication

synchronous/remote

Technology:

- ISDN + video compression
- internet, web cams

major uses:

- video conferences
- pervasive video for social contact
- integration with other applications

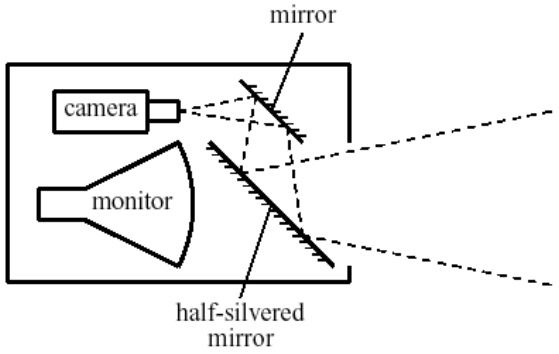
often cheaper than face-to-face meetings
(telecommunications costs vs. air flights)

Video issues …

not a substitute for face-to-face meetings

- small field of view
- lack of reciprocity
- poor eye contact

One solution for lack of eye contact … the video-tunnel



web-video

- video-conferencing – expensive technology
- but internet (almost) free!
- web-cams
  - used for face-to-face chat
  - for video-conferencing
  - for permanent web-cams
- low bandwidth
  - pictures 'block out' … not terrible
  - audio more problematic
  - may use text chat

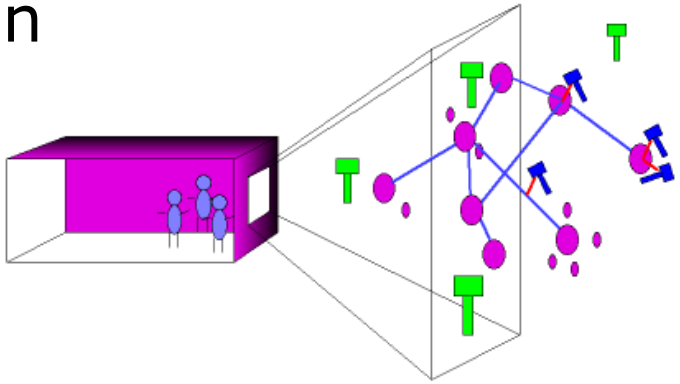
collaborative virtual environments (CVEs)

- meet others in a virtual world
  - participants represented – embodiment
  - artefacts too …
    - computer (e.g. spreadsheet) and 'real' (virtually) objects
  - text?
    - consistent orientation or easy to read

- MUDs (Multi-user domains)
  - 2D/3D places to meet on the web
  - users represented as avatars

internet foyer

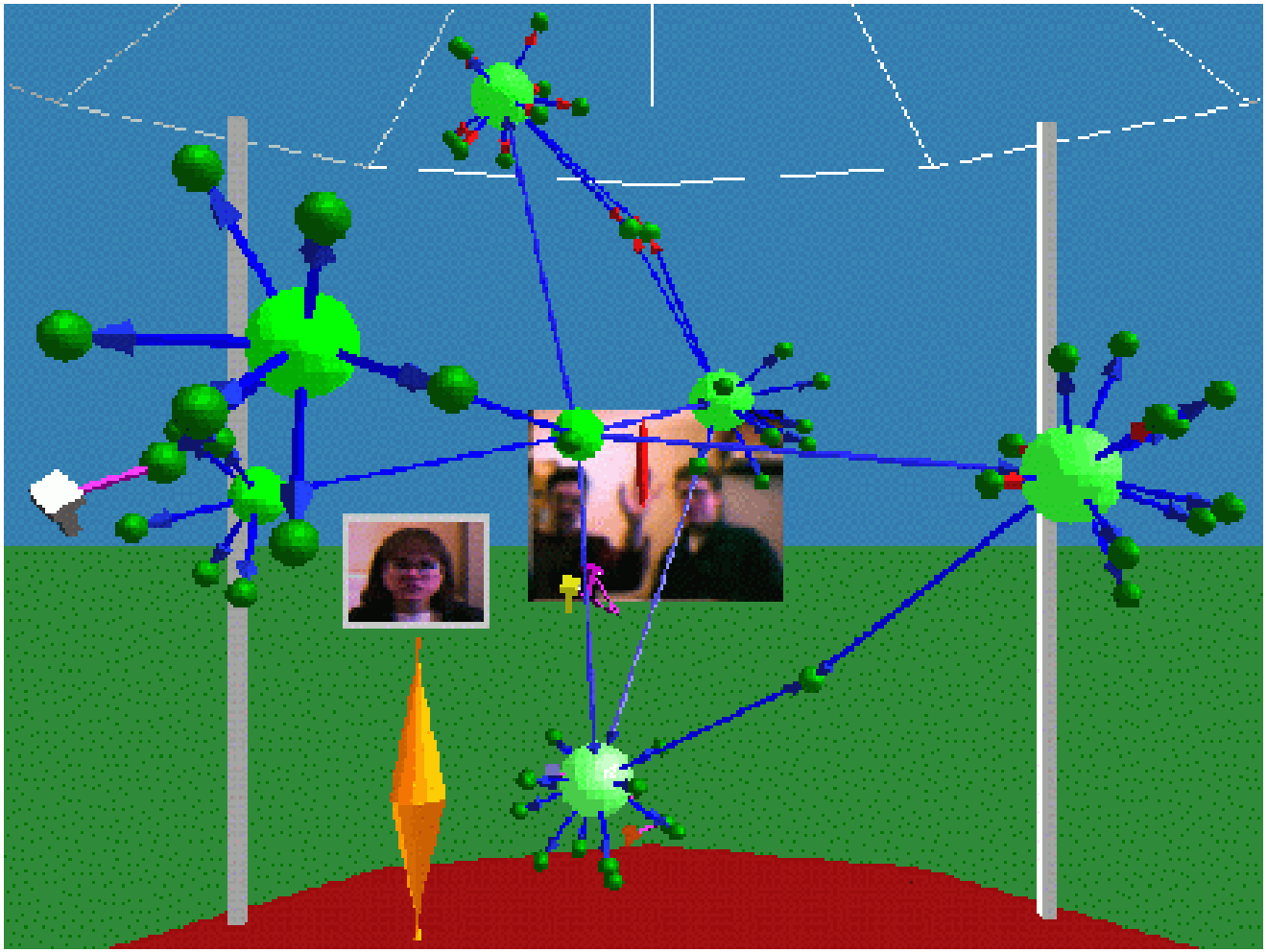
- real foyer
  - large screen, camera
  - see virtual world on screen



- virtual world
  - representation of web
  - see real foyer on virtual screen

'outside' looking in

'inside' looking out



meeting and decision support systems

argumentation tools

meeting rooms

shared work surfaces

Meeting and decision support

In design, management and research, we want to:

- generate ideas
- develop ideas
- record ideas

primary emphasis

- common understanding

Three types of system

- argumentation tools
  - *asynchronous co-located*
  - recording the arguments for design decisions
- meeting rooms
  - *synchronous co-located*
  - electronic support for face-to-face meetings
- shared drawing surfaces
  - *synchronous remote*
  - shared drawing board at a distance

argumentation tools

asynchronous co-located

hypertext like tools to record design rationale

Two purposes:

- remining the designers of the reasons for decisons
- communicating rationale between design teams

Mode of collaboration:

- very long term
- sometimes synchronous use also

gIBIS

graphical version of IBIS
– issue based information system

various node types including:

- issues e.g. ‘number of mouse buttons’
- positions e.g. ‘only one button’
- arguments e.g. ‘easy for novice’

linked by relationships such as:

- argument supports position
  e.g., ‘easy for novice’ *supports* ‘only one button’

Meeting rooms

synchronous co-located

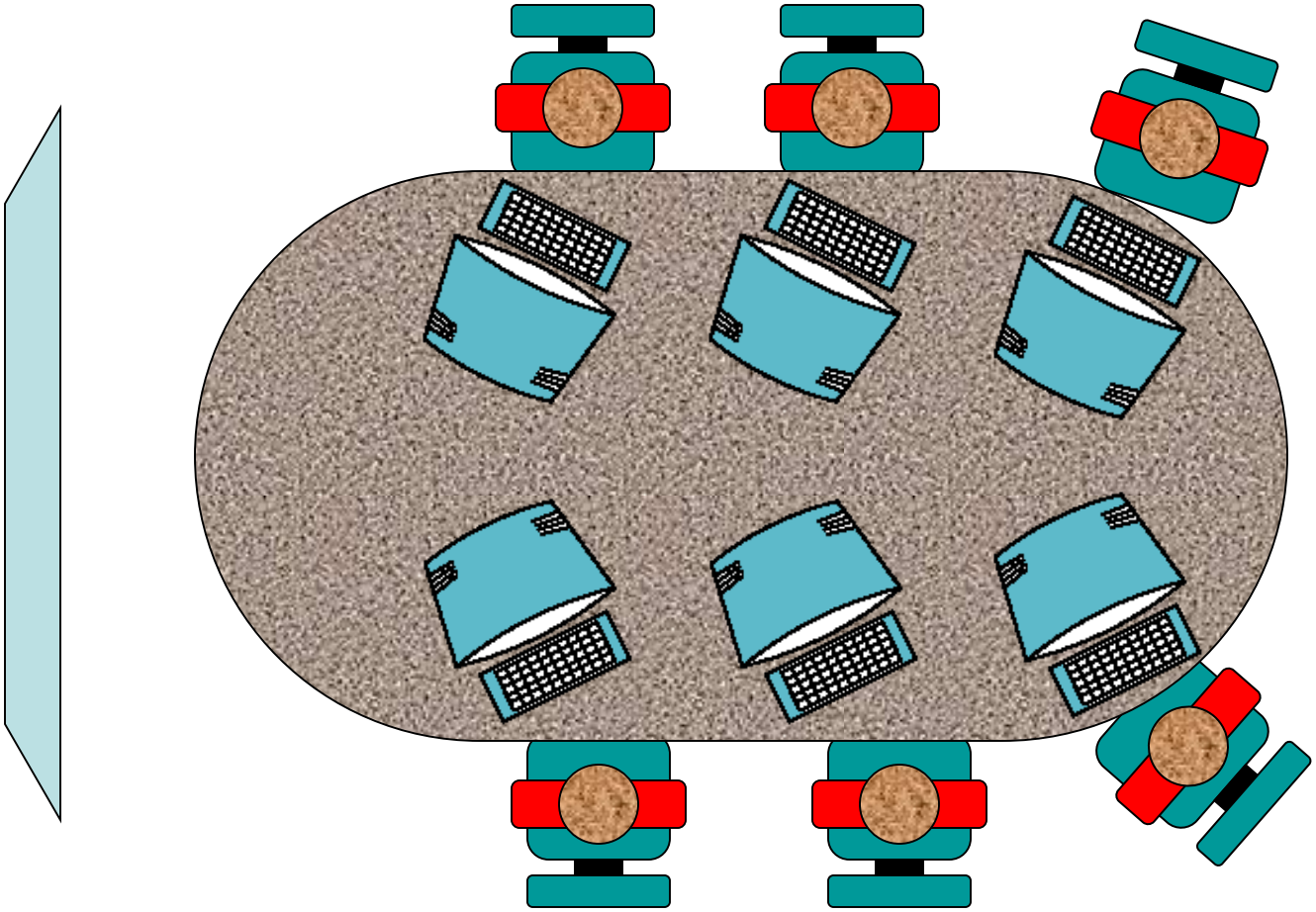
electronic support for face-to-face meetings
- individual terminals (often recessed)
- large shared screen (electronic whiteboard)
- special software
- U or C shaped seating around screen

Various modes:
- brainstorming, private use, WYSIWIS

WYSIWIS – 'what you see is what I see'
- all screens show same image
- any participant can write/draw to screen

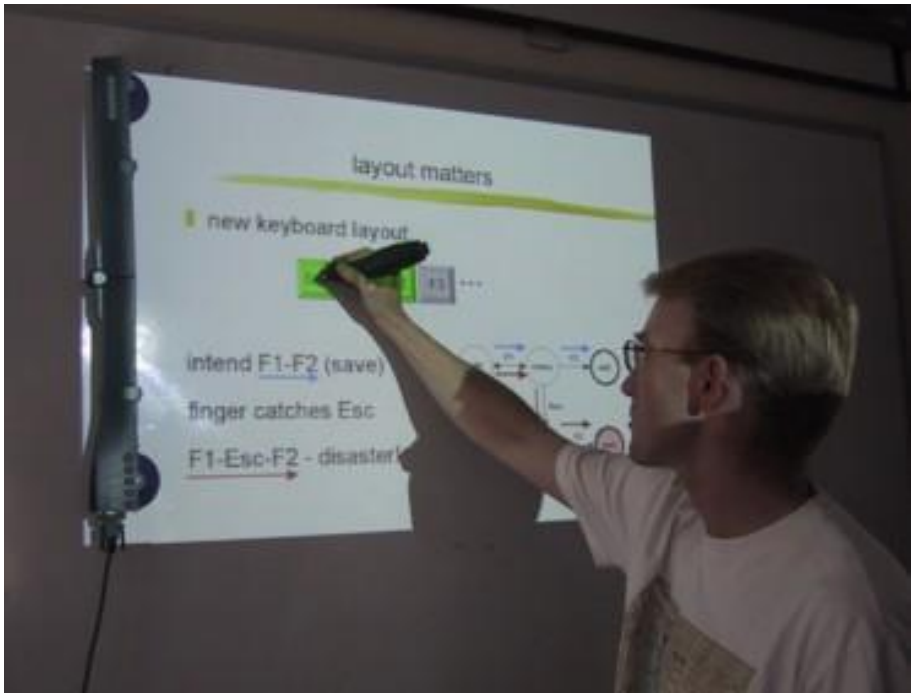
Typical meeting room

shared screen



meeting capture

- use ordinary whiteboard
- detector and special pens
- LCD projection on whiteboard
- low-cost alternative to dedicated meeting room



Issues for cooperation

Argumentation tools

- concurrency control
  - two people access the same node
  - one solution is node locking
- notification mechanisms
  - knowing about others' changes

Meeting rooms

- floor holders one or many?
  - floor control policies
- who can write and when?
  - solution: locking + social protocol
- group pointer
  - for deictic reference (this and that)

Shared work surfaces

synchronous remote

At simplest, meeting rooms at a distance, but …

- additional audio/video for social protocols and discussion
- network delays can be major problem

Additional special effects:

- participants write onto large video screen
- problems with parallax
  - shadow of other participant's hands appears on screen
- electronic image integrated with video and paper images

Example: TeamWorkStation

- remote teaching of Japanese calligraphy
- student's strokes on paper overlaid with video of instructor's strokes

shared applications and artefacts

shared PCs and windows
shared editors, co-authoring tools
shared diaries
communication through the artefact

Shared Applications and Artefacts

Compare purpose of cooperation:

- meeting rooms and decison support systems
  - develop shared understanding
- shared applications and artefacts
  - work on the same objects

technology similar but primary purpose different

many different modalities (time/space matrix)

- shared windows – synchronous remote/co-located
- shared editors – synchronous remote/co-located
- co-authoring systems – largely asynchronous
- shared diaries – largely asynchronous remote
- shared information – any, but largely asynchronous

synchronous remote needs additional audio/video channel

Similar … but different

- Shared PCs and shared window systems
  - Multiplex keyboard and screen
  - Individual applications *not collaboration aware*
  - Floor control problems:
    - user A types: `interleave the'
    - user B types: `keystrokes'
    - result: `inkeytersltreaokeve tshe'
- Shared editors
  - An editor which is *collaboration aware*
  - One document – several users
  - Similar to shared screen in meeting room …
    … with similar floor control problems!
  - Additional problem – multiple views

Shared editors - multiple views

Options:

- same view or different view
- single or separate insertion points

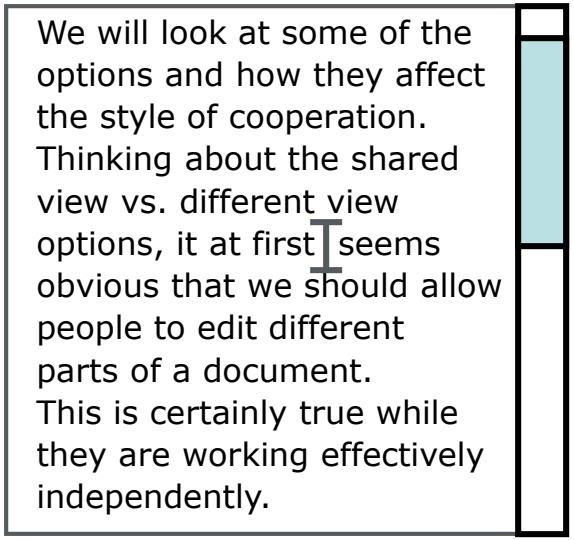
Single view

⇒ scroll wars

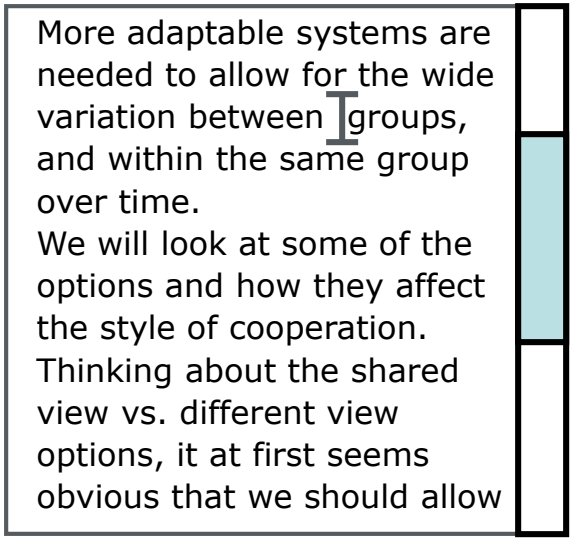
Multiple views

⇒ loss of context with *indexicals*

loss of WYSIWIS …



your screen



your colleague's screen

'I don't like the line at the top'

'but I just wrote that!'

Co-authoring systems

Emphasis is on long term document production, not editing

Two levels of representation
- the document itself
- annotation and discussion

Often some form of hypertext structure used

Similar problems of concurrency control to argumentation systems

Sometimes include rôles:
- author, commentator, reader, …
- but who decides the rôles?
- and how flexible are they?

Shared diaries

Idea:

- make diaries and calendars more easily shared
- allow automatic meeting scheduling etc.

Issues for cooperation:

- *privacy* – who can see my diary entries?
- *control* – who can write in my diary?

Similar to file sharing issues, but need to be lightweight

Many systems have failed because they ignored these issues

Communication through the artefact

When you change a shared application:

- you can see the effect – *feedback*
- your colleagues can too – *feedthrough*

feedthrough enables …

communication through the artefact

Shared data

Feedthrough – not just with 'real' groupware …

Shared data is pervasive:

- shared files and databases
- casework files (often non-electronic)
- passing electronic copies of documents
- passing copies of spreadsheets

Often need direct communication as well, but indirect communication *through the artefact* central

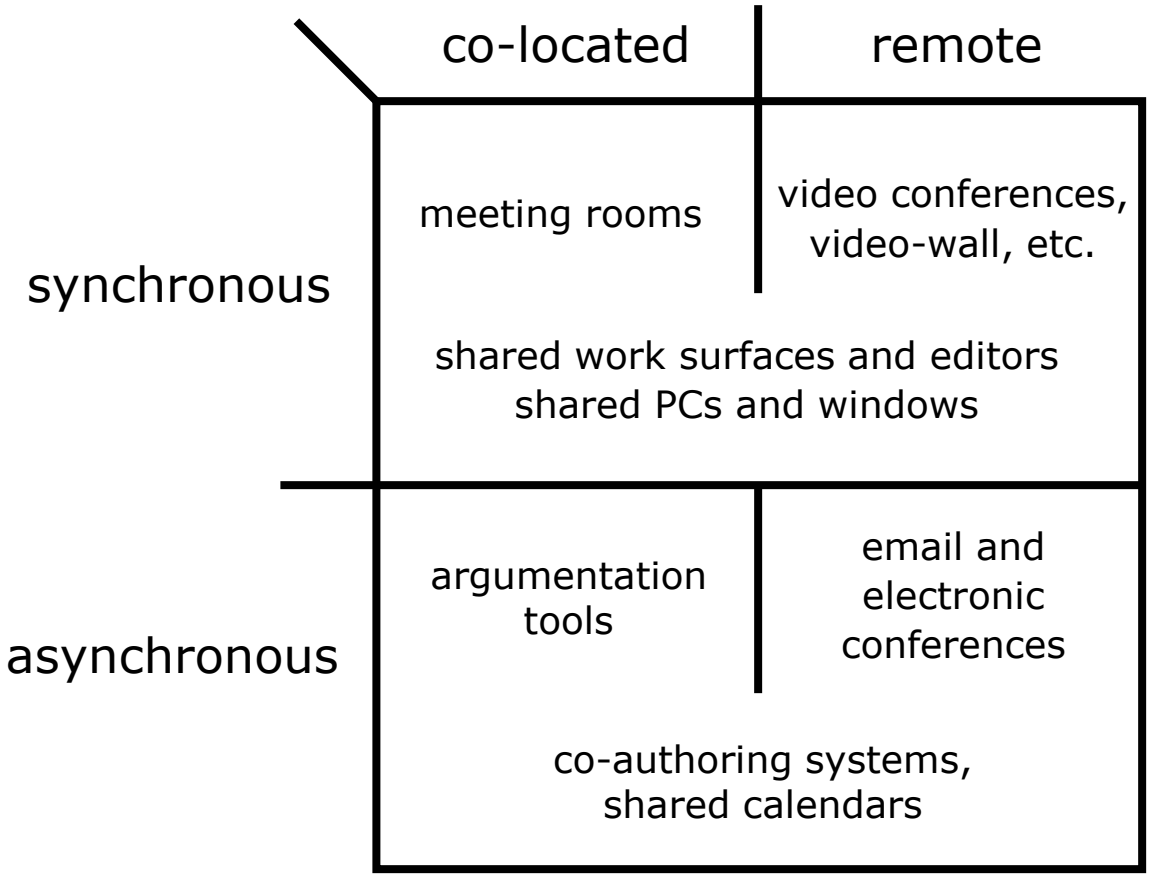
Few examples of explicit design for cooperation.

- *Liveware* is an exception,
  a database with 'merging' of copies

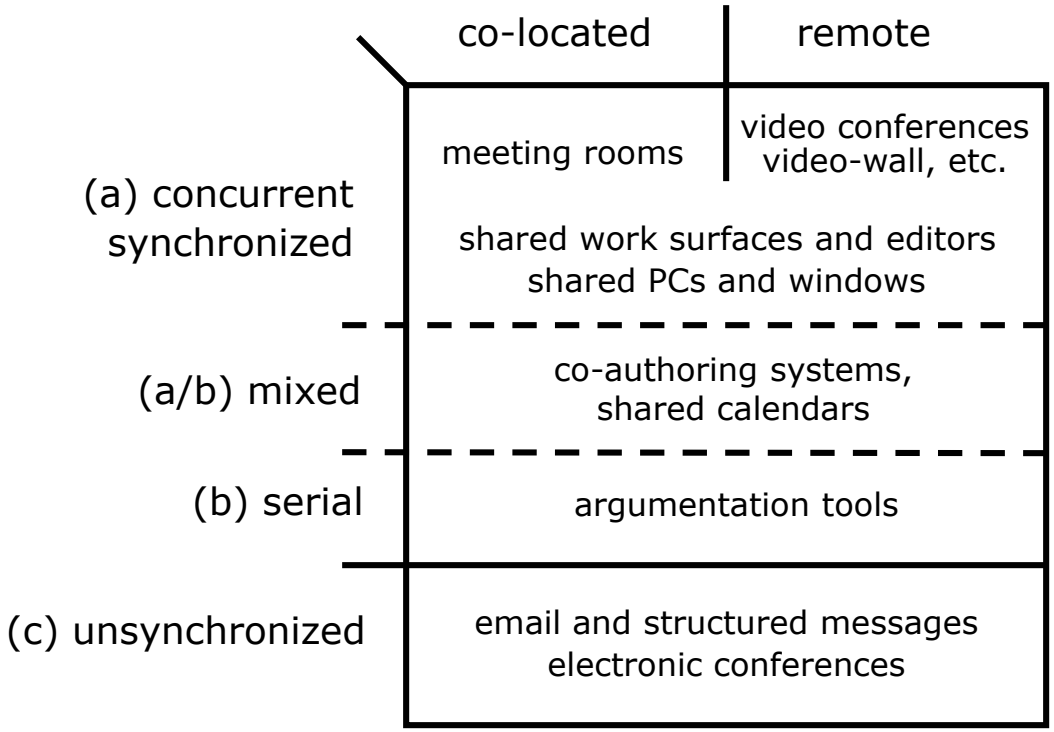
frameworks for groupware

time/space matrix revisited!
shared information
communication and work
awareness

Time/space matrix revisited



Refined time/space matrix



Mobile workers and home workers have infrequent communication
- they require unsynchronised groupware

Need fluid movement between synchronised/unsynchronised operation

Shared information

Granularity of sharing

- chunk size
  - small – edit same word or sentance
  - large – section or whole document
- update frequency
  - frequent – every character
  - infrequent – upon explicit ‘send’

level of sharing

output:

- shared object
- shared view
- shared presentation

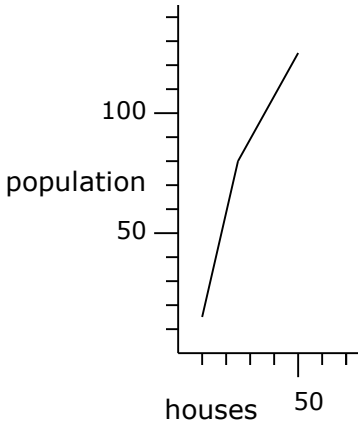
input:

- single insertion point
  - shared virtual keyboard
- multiple insertion points
  - other participants visible
  - group pointer
  - no visibility

Levels of shared output

presentation

houses	population
7	15
23	79
51	123



view

select houses, population from VILLAGE_STATS
where population < 200
sort by houses ascending

object

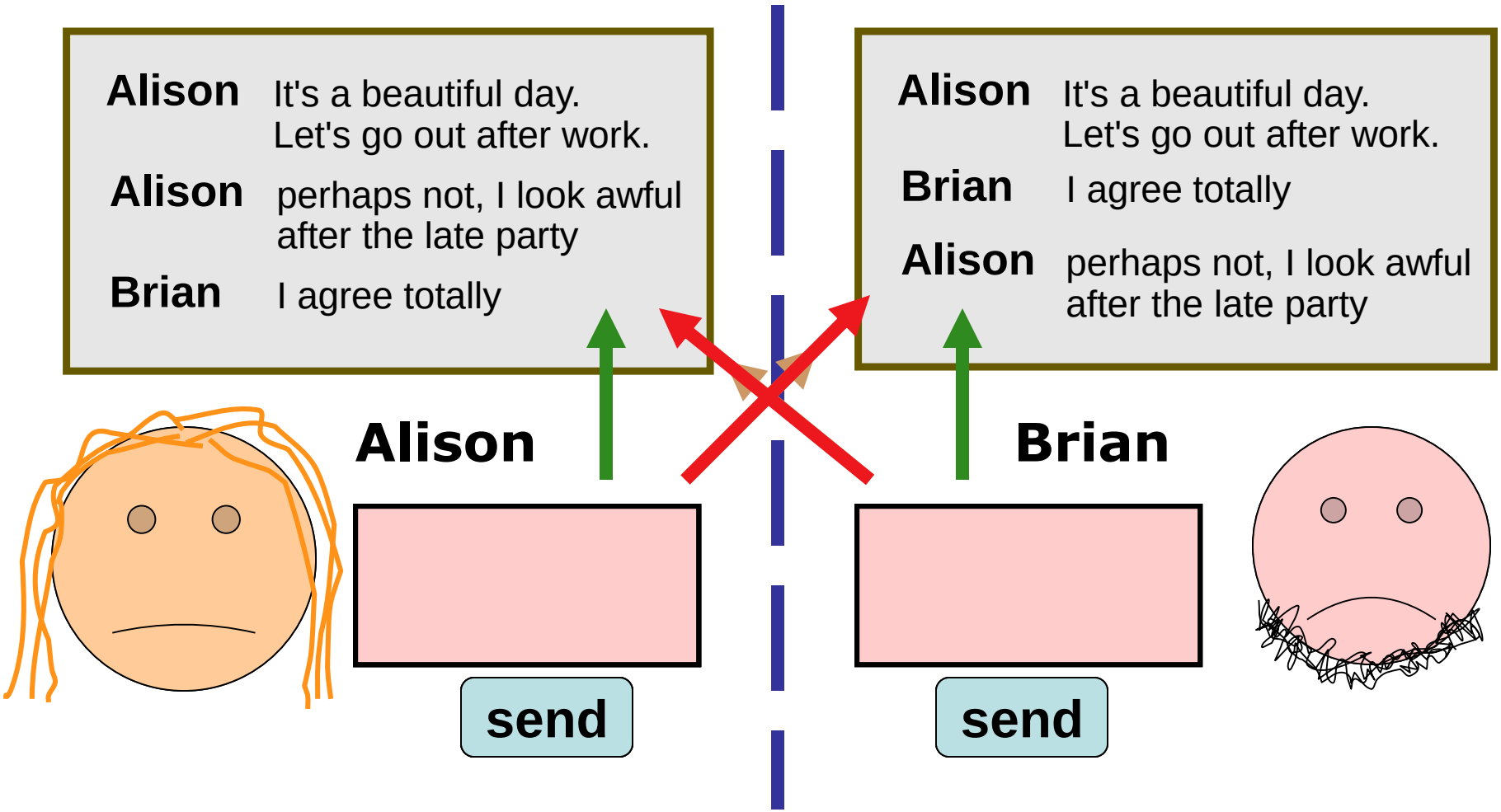
VILLAGE_STATS

village	houses	population
Burton	23	79
Marleigh	339	671
Westfield	7	15
Thornby	51	123

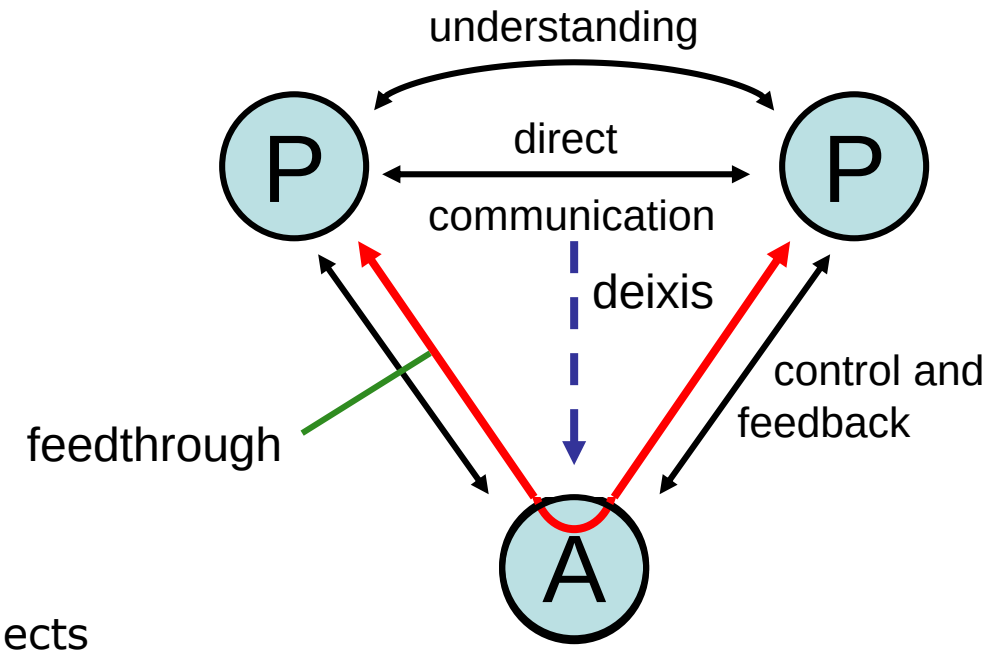
types of object to share

- type of shared data … influences style of sharing
- linear transcript (e.g. text chat)
  - monotonic – only add - makes things easier
  - … but sequenced – danger of race conditions
- shared add-only hypertext
  - montonic & unsequenced
    - several people can add children to same node
- whiteboard
  - montonic & unsequenced … apart from eraser!!
  - user defined structure
- complex object – shared hypertext or file system
  - !!!!!!!

ordering problems (race conditions)



Integrating communication and work



Added:

- *deixis* – reference to work objects
- *feedthorough* – for communication through the artefact

Classified groupware by function it supported

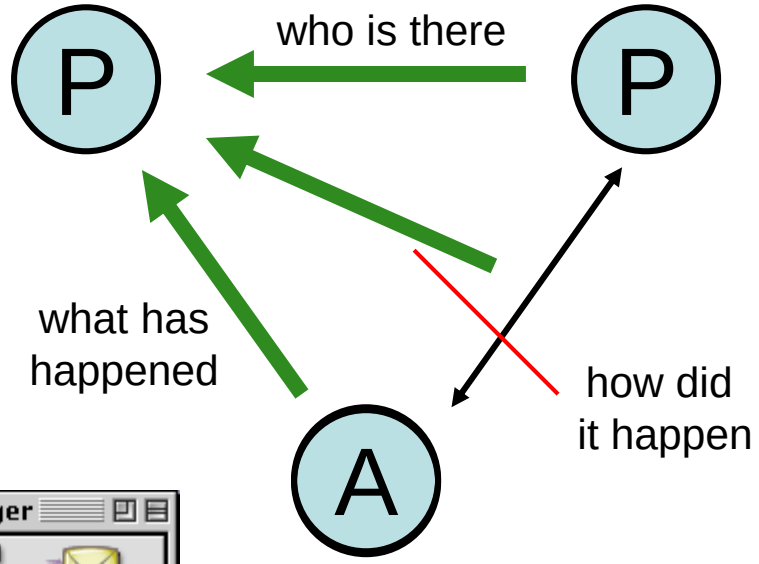
Good groupware – open to all aspects of cooperation

- e.g., annotations in co-authoring systems
  - embedding direct communication

bar codes – form of deixis, aids diffuse large scale cooperation

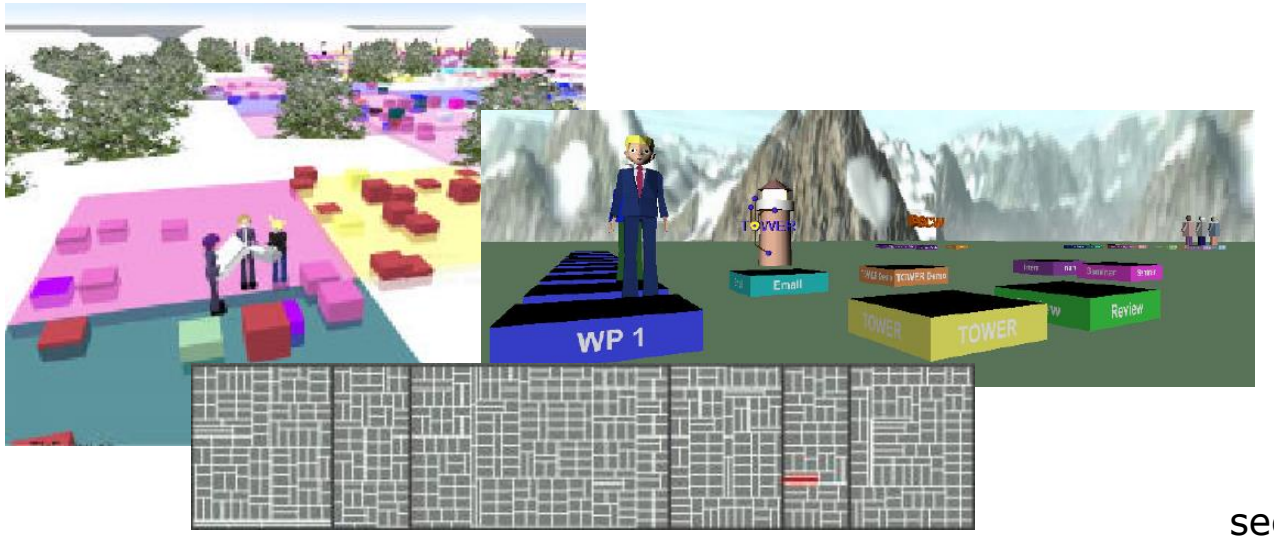
awareness

- what is happening?
- who is there
  e.g. IM buddy list
- what has happened
  … and why?



TOWER – workspace awareness

- virtual 'space'
  - work objects (files etc.) shown as buildings
  - avatars where other people are working
  - built over flexible event infrastructure

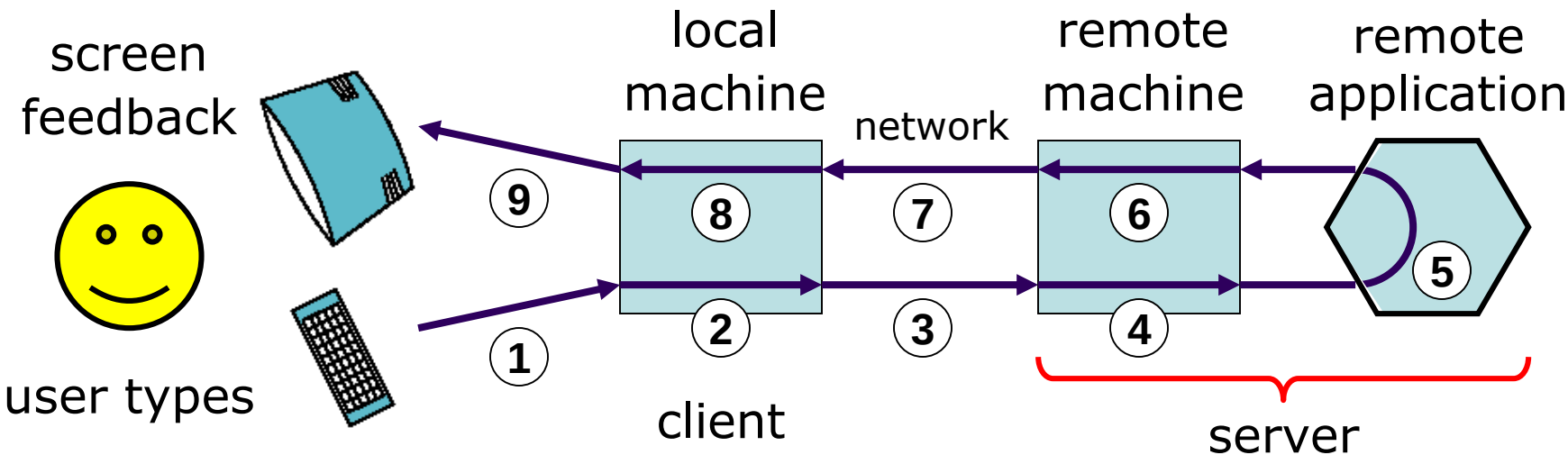


see http://tower.gmd.de/

implementing groupware

feedback and network delays
architectures for groupware
feedthrough and network traffic
toolkits, robustness and scaling

Feedback and network delays



At least 2 network messages + four context switches

With protocols 4 or more network messages

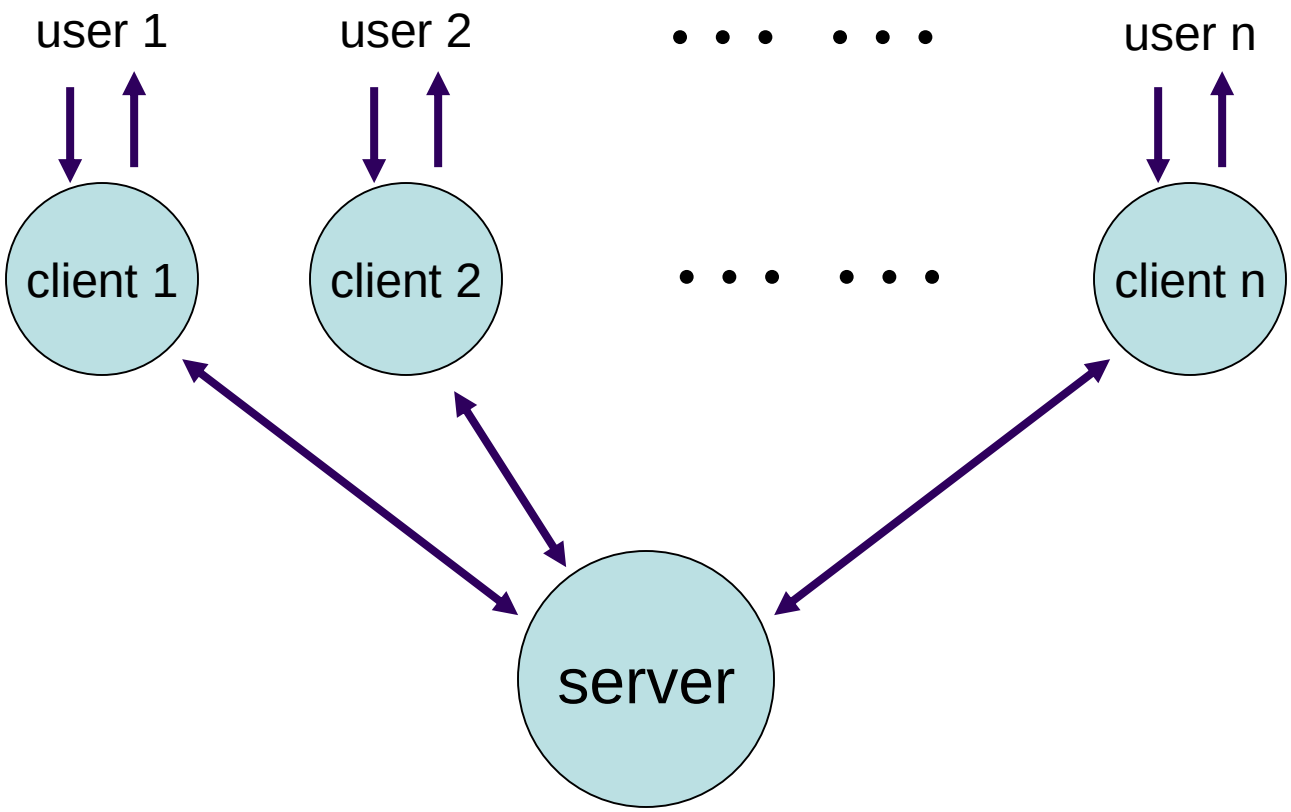
Types of architecture

centralised – single copy of application and data
- client-server – simplest case
  - N.B. opposite of X windows client/server
- master-slave special case of client-server
  - N.B. server merged with one client

replicated – copy on each workstation
- also called peer-peer
- + local feedback
- race conditions

Often 'half way' architectures:
- local copy of application + central database
- local cache of data for feedback
- some hidden locking

Client-server architecture



Shared window architecture

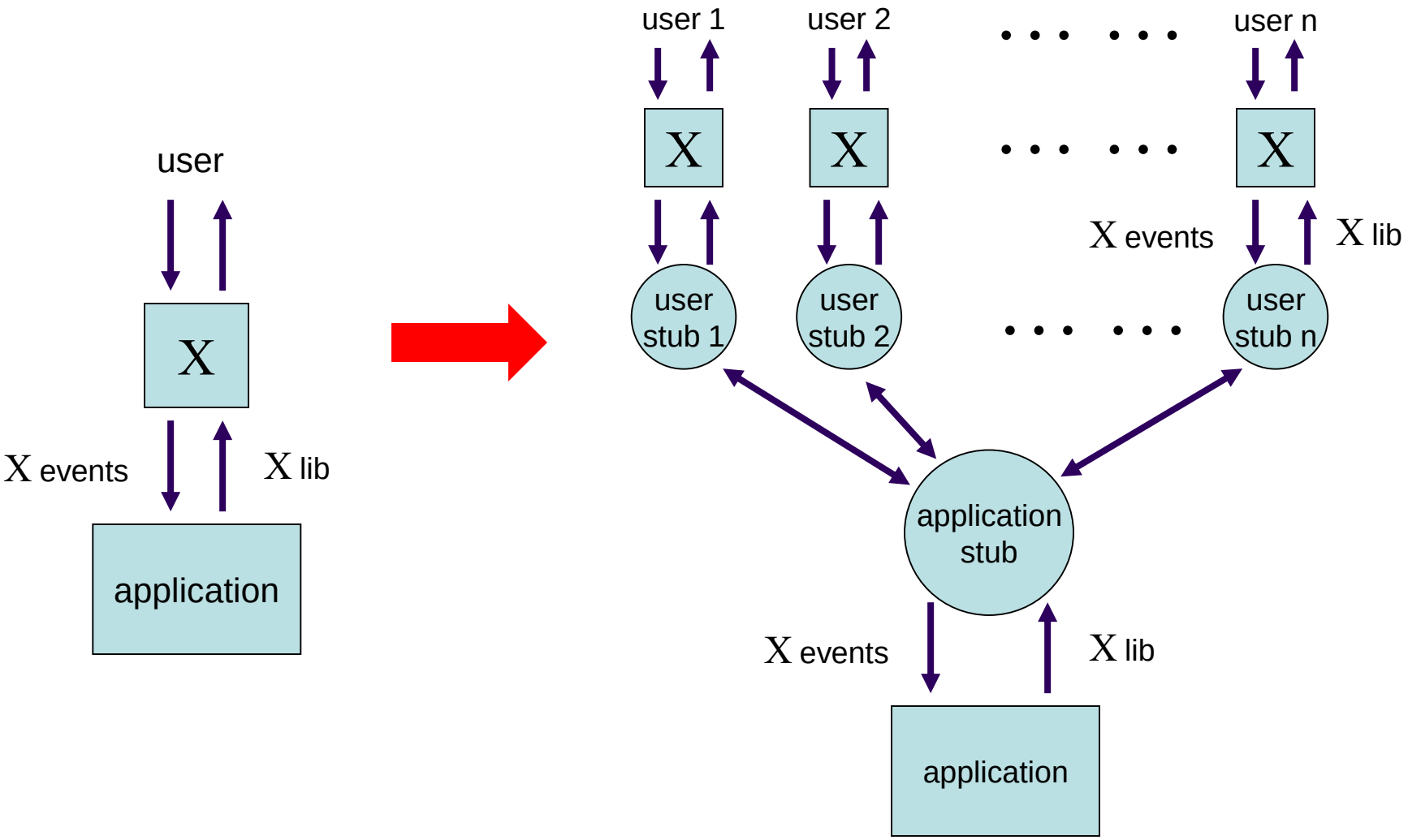
- Non-collaboration aware applications
  $\Rightarrow$ *client/server* approach
  corresponding feedback problems

- no 'functionality' – in the groupware
  but must handle *floor control*

example: shared X

- single copy of real application
- *user stub* for each user acts as an X application (X client)
- one *application stub* acts like X server for real application
- *user stub* passes events to single *application stub*
- stubs merge X events coming in
  and replicate X lib calls going out (strictly protocol)

Shared X


user
X
X events
X lib
application
user 1
user 2
user n
X
X
X
X events
X lib
user stub 1
user stub 2
user stub n
application stub
X events
X lib
application

Feedthrough & traffic

- Need to inform all other clients of changes
- Few networks support broadcast messages, so …
  n participants ⇒ n–1 network messages!
- Solution: increase granularity
  - reduce frequency of feedback
  - but …
    poor feedthrough ⇒ loss of shared context
- Trade-off: timeliness vs. network traffic

Graphical toolkits

Designed for single user interaction

Problems for groupware include

- pre-emptive widgets
  (e.g., pop-up menus)
- over-packaged text
  (single cursor, poor view control)

notification-based toolkits with *callbacks* help (chap. 8)

Robustness and scaleability

crash in single-user interface – one sad user

crash in groupware – disaster !

but …

- groupware complex: networks, graphics etc.
- scaling up to large numbers of users?
- testing and debugging – hard!

… some tips …

- network or server fails – standard solutions
- client fails – three `R's for server:
  - **robust** – server should survive client crash
  - **reconfigure** – detect and respond to failure
  - **resynchronise** – catch up when client restarts
- errors in programming
  - defensive programming
  - simple algorithms
  - formal methods
- unforeseen sequences of events
  - *deadlock* – never use blocking I/O
  - never assume particular orders
  - network packet ≠ logical message

scaling and testing

- scaling up
  - robustness ⇒ simple algorithms
    … but don't scale well – need to evolve
  - good software architecture helps
  - document fixed-size assumptions
  - know operating system limits (e.g. open files)

- testing for robustness
  - take off the kid gloves … mistreat it
  - reboot, pull out network cable, random input
  - create a rogue client, simulate high loads
  - and when you think it is perfect
    … give it to some computing students to test