The Promise and Reality of Collaborative Computing

- Introduction to Collaborative Computing
- Characterization of Collaboration Tools
- Where Are We Today?
- Security as a Collaboration Enabler
- Collaboration Standards
- Challenges Implementing Collaboration Technologies
- Video Conferencing Systems
- Setting up for a Videoconference

MM Conferencing Applications

- Applications
  - Distance Learning
  - Video Conferencing
  - Tele Medicine
  - Surveillance
  - Broadcast TV
- Enabling Technologies
  - Conferencing
  - Broadcasting
  - Video on Demand
Conferencing—Room to Room

Dedicated Systems
- Polycom, Sony, Tandberg
- A console package
- PTZ cameras
- Omni microphones
- TV monitor

Conferencing—Desktop

Add-ons to PCs
- H.323 standard
- Known as e-meetings

Conferencing—Multipoint

Three or more remote points
- Multipoint Control Unit (MCU)
- Continuous Presence
Multimedia - Authoring

Graphics  Audio  Video  Text

Authoring

Multimedia Distribution

CD-ROM
- ISO 9660,
- Mac HFS,
- PhotoCD,
- etc...

DVD
- MMDatabase
- File system

Network
- Interactive game
- Video-on-demand

Broadcast—Pre-Recorded

Server

Network
Rules

- Rule #1
  - Remote collaboration is not (and it does not claim to be) like face to face collaboration and it will probably never be like that
    - May be one day when virtual reality will not be only a game anymore
- Rule #2
  - The computer does not have to be seen as a substitute to human interaction
    - It is only an instrument!
    - Distance/Computer based training will never substitute teachers completely!
      - I hope it for the best of humanity

Real-Time vs. Delayed Communication

Real-time communication (synchronous):

- participants meet in real time
- participants see each other's typed messages as they are typed
- examples: Talk and Chat

Delayed communication (asynchronous):

- Participants type, post, and read messages at their convenience
- Participants share an electronic mailbox related to the group's purpose
- Examples: email and Newsgroups
The Groupware Paradigm & Technologies

<table>
<thead>
<tr>
<th>Same Time/</th>
<th>Different Times/</th>
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<tbody>
<tr>
<td>Synchronous</td>
<td>Asynchronous</td>
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<tr>
<td>Face to face interactions</td>
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<tr>
<td>Public computer screens</td>
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<td>Decision rooms</td>
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<td>Brainstorming tools</td>
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<td>Continuous task</td>
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<td>Team rooms</td>
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<td>Group displays</td>
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<td>Shift work groupware</td>
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<td>Project management</td>
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Remote interactions

- Video conferencing
- Walls & hallways
- Desktop conferencing
- Shared views

Communication & Coordination

- Email
- Bulletin boards
- Asynchronous conferencing
- Schedulers
- Version control...

Teleconferencing

- Just like the telephone, except you can see who you are talking to.
- You can talk to one or many other people at the same time, just as with the telephone.
- It is NOT video broadcasting.

Alternative names:
- Audio conferencing, telephone conferencing, phone conferencing, Internet Telephony.

Two Types of Video Conferencing

<table>
<thead>
<tr>
<th>Traditional</th>
<th>Internet</th>
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</thead>
<tbody>
<tr>
<td>Use in special room; rare</td>
<td>Use anywhere; ubiquitous</td>
</tr>
<tr>
<td>Uses ISDN telephone lines</td>
<td>Uses Internet</td>
</tr>
<tr>
<td>High installation cost</td>
<td>Low installation cost</td>
</tr>
<tr>
<td>High usage cost</td>
<td>No usage cost</td>
</tr>
<tr>
<td>Usage at plateau</td>
<td>Usage growing rapidly</td>
</tr>
<tr>
<td>Professional operator</td>
<td>Do-it-yourself</td>
</tr>
<tr>
<td>Centralized control</td>
<td>Decentralized control</td>
</tr>
<tr>
<td>H.320 standard</td>
<td>H.323 standard</td>
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</tbody>
</table>
Videoconference Standards

Encoder → Focused Upon Interoperability → Decoder

Organized by Network Type

Decoding Standardized

Collaboration Standards

Video Conferencing Standards

H.261 Video
G.711 Audio
G.722 Video
G.728 Audio
T.120 Data

ISDN H.320

H.263 Video
G.711 Audio
G.723 Video
G.722 Audio
G.728 Audio
T.120 Data

LAN / IP H.323
The H.323 standard is a summary recommendation that describes point-to-point and multipoint interoperability of audio and/or visual terminal equipment connected via a IP based non-guaranteed quality of service network.

- **Key Functional Components**
  - **Terminal:**
    - Endpoint Equipment or "Terminal Application"
  - **MCU**
    - Provides Multipoint Conference Connectivity
  - **Gateway**
    - Provides Interoperability
  - **Gatekeeper**
    - Manages "QoS"

**Terminal**

- H.323 terminals are client endpoints that must support:
  - H.225 call control signaling.
  - H.245 control channel signaling.
  - RTP/RTCP protocols for media packets.
  - Audio codecs.

   - Video codecs support is optional

**H.323 Terminal**

- H.263 Video
- G.711, G.722, G.723, G.728 Audio
- T.120 Data
- H.245 Control
- H.225 Frame
- LAN I/O
- Camera
- Monitor
- Microphone
- Audio
- Data Exchange
Multipoint Control Unit - MCU

Required With 3 or More Terminals In Conference

Internals:
- Multipoint Controller
- Multipoint Processor

Implementation:
- Hardware Based
- Software

Gateway Requirements

- H.320
  - H.261 Video
  - H.221 Frame
  - G.7xx Audio

- H.323
  - H.263 Video
  - H.225 Frame
  - G.7xx Audio

Gateway Solution

- H.320
  - H.261 Video
  - H.221 Frame
  - G.7xx Audio

Gateway Provides Translation and Transcoding

- H.323
  - H.263 Video
  - H.225 Frame
  - G.7xx Audio

ISDN-PSTN

IP
Gatekeeper
Software products that reside on a server
- Control Access
- Call Routing
- Address Translation
- Bandwidth Management

Remote collaboration: what hardware do we need?
Basic configuration
- Standard PC
- Sound card + Speakers
- Microphone
Optional devices
- Webcam/camera
- Scanner
- Tablet (es. Wacom, Mimio, etc)
- ... ...
NETWORK CONNECTION

H.323 Implementation

Multipoint Control Unit
Gateway
Ethernet

H.323 Terminals

H.320 Terminal
State of the Practice

- Mostly asynchronous collaboration
- Coordination and information sharing

- Market segment strong (5-10 years)
- Stable technology base
- Scalable to enterprise
- Some interoperability standards
- Most tools have some security support

State of the Art

- Synchronous collaboration
- Virtual meetings and interactive production

- Current product offerings are largely young (3-5 years)
- Requires stability and scalability to support large conferences
- Requires sufficient network bandwidth, reliability, and quality of service
- Interoperability across tools, but can be spotty
- Issues with security and firewall support

Problems of Today

Current System

- Requires dedicated ISDN lines to the desktop and Boardrooms, which mean additional infrastructure.
- Expensive MCU (Hub) is needed for mixing and re-transmitting.
- Expensive WAN link is proprietary and dedicated to video conferencing only.
- Expensive WAN bandwidth increases proportionally with each new user.

Research Areas of Future System

- Use your existing LAN infrastructure. Zero additional infrastructure cost.
- Do not require an expensive MCU. It uses a server.
- IP-based and merges with your existing corporate WAN link or uses the Internet.
- WAN bandwidth needs remain constant, irrespective of the number of users.
Virtual Private Networks (VPNs) provide secure communications channel between two entities
- A private, encrypted tunnel

Extranets are a segment of an organization’s network that is shared with partners
- Authenticated access enables presentation of tailored views of shared data
- Often coupled with VPN technology

Collaboration and Security

- Security is often weakly addressed by collaboration tools
- Approach: Integration of security services with applications
  - Authentication to verify identity and protect from spoofing
  - Access control within collaboration tool
  - Data encryption to ensure privacy
- Approach: Use of external security mechanisms to secure the networks and/or provide authenticated access
  - Firewall support to enable safe collaboration with partners (includes tailored firewall policies, and firewall proxies)
- De-militarized zone (DMZ) approaches
- Extranets
- Virtual Private Networks (VPNs)
Motivation for Using VPNs and Extranets

- Authentication and encryption techniques ensure user authentication, data privacy, and integrity
- Cost-effective way to eliminate expensive dedicated leased lines between sites and long distance calls for remote and mobile users
- Users can gain direct access to the company’s resources from anywhere due to the almost universal availability of the Internet
- Facilitates the compartmentalization of information exchanges among selected user groups or organizations
- Replicated content and accompanying administration overhead no longer necessary

Challenges Implementing Collaboration

Infrastructure (easiest): Networks, systems, support

Culture (hardest): Learning a new “economics of trust”

Security (harder): Risk management vs. risk avoidance

Infrastructure Challenges

Networks
- Bandwidth and bandwidth management
- Quality of service and bandwidth reservation
- Network protocols (e.g., IP Multicast, ATM)

Systems
- Integration and interoperability
  - With other systems and applications
  - With partner’s collaboration environments
- Maintainability, upgradability

Support
- Managing large scale roll-outs
- Robust administration tools
- Troubleshooting

Performance, scalability, reliability, cost
Security Challenges

Risk management vs. risk avoidance

Security is often weakly addressed by collaboration tools
- Authentication to verify identity
- Access control within collaboration tools
- Data encryption to ensure privacy
- Firewall support for safe collaboration with partners

Some solutions available (e.g., VPNs, PKI, Extranets)

Policies
- There are no policies for supporting virtual organizations
- Flexible concept of operations to enable secure collaboration
- Willingness to challenge and evolve policies to support collaboration goals

Cultural Challenges (1 of 2)

- Learning a new “economics of trust”
- Modifying reward structure to incentivize team contributions
- Organizational readiness to change - timing is everything
  - Support from the top, clear benefits to participants
  - Dealing with resistance
  - Sharing ownership of the effort with partners
- Dealing with user’s fears
  - The person who does the work does not receive the benefit
  - Failure to support exception handling
  - Existing power structure is modified
  - Work crosses organizational lines
  - Implicit behavior is made explicit

Cultural Challenges (2 of 2)

- Understanding how to evolve the technology and the business process to realize improvement
  - Concept of operations, planned roll-out process, clear goals, managing expectations, letting users evolve concept of operations and new collaborative process, training and user support
  - Understanding social scalability
    - How do you establish virtual communities?
    - What is the best way to run a virtual meeting, a virtual team?
  - Few publications to guide; learning on the job
Setting up for a Videoconference

**Clothing**
- Solid color shirts
- "Busy" outfits blur when on camera
- Simpler patterns aid the video compression

**Lighting**
- Soft white light
- Light from in front
- Standard overhead lights don’t cut it
- Think of TV studio lighting
- Camera can not focus in low light

**Backdrop**
- No Hard Lines or complicated patterns
- Can use a dry erase board
- Solid color is ideal
  - Avoid red backgrounds
- Give audience one thing to focus on

**Audio Setup**
- Separate Microphones and Speakers
- Test levels ahead of time
  - Polycom’s “Generate Tone”
  - Polycom’s “Audio Meter”
- May need to add echo canceling hardware