Multimedia Collaboration and Application Sharing

Omer Boyaci

June 5, 2008
Outline

- Introduction
- Taxonomy of sharing systems
- Collaboration-aware systems
- Collaboration-transparent systems
- Collaboratories
Introduction

- Application sharing
  - Real-time concurrent event
  - Two or more participants
  - Working on the same document/drawing/..
Introduction

CoWord and CoPowerPoint
Converting off-the-shelf single-user applications for multi-user real-time collaboration

CoWord and CoPowerPoint are real-time collaborative applications that support multiple users to collaborate in the same MS Word and PowerPoint documents at the same time over the Internet.
Introduction
Introduction
Introduction
Introduction

Challenges and features

- **Applicability**
  - Generic (support all applications)
  - Specific (per application or per domain)

- **Scalability**
  - Unicast
  - Multicast

- **Clients**
  - Thin-client
  - Fat-client

- **Concurrency and consistency**
  - Sequential work
  - Concurrent work
Application sharing models

- Collaboration-aware
  - Netbeans / Google Docs

- Collaboration-transparent
  - Generic
    - VNC / MAST
  - App/Domaín specific
    - CoWord / CTE
Application sharing models

- Collaboration-aware
  - New
  - Existing
  - Frame buffer
- Collaboration-transparent
  - Generic
  - App/Domain specific
- Generic
- App/Domain specific
- New
- Existing
- Frame buffer
- OS
- Homogeneous
- Heterogeneous
Collaboration-aware models

- **New**
  - Google Docs
  - Draw-Together
  - Collaborative distance learning

- **Existing**
  - Microsoft Office
  - Netbeans IDE
  - N-ABLE
  - Collaborative CAD
Collaboration-aware models (New)

- **Draw-together**

![Draw-Together application](image)
Collaboration-aware models (New)

- **Draw-together**
  - Fine granularity locking
  - Concurrent work
Collaboration-aware models (New)

- Collaborative distance learning
  - Different bandwidth clients

Figure 1: Semantic Video Scenario
Collaboration-aware models (Exist)

Figure 2: N-ABLE™ snapshot with collaboration enabled, showing peer awareness, group chat, and screenboard common mental model for problem and solution
Collaboration-aware models (Exist)

- "3D streaming"
  - VRML, X3D, STEP

- Thin server + strong client
- Strong server + thin client
- Peer-to-peer
## Collaboration-transparent models

<table>
<thead>
<tr>
<th>Collaboration aware</th>
<th>New</th>
<th>Existing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration transparent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generic (VNC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frame Buffer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>App/Domain specific</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homogeneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneous</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Frame Buffer based models

- VNC
- RDP
- THINC
- Distributed Workspace
- TTT: Tele-teaching Tool
- SharedAppVNC
- MAST: Multicast App Sharing Tool
Frame Buffer based models

- Low level commands (pixel updates)
- Very-thin client
- Can be inefficient
- Compression is a must
- Generic (Collaboration-transparent)
- Mostly sequential access to K&M
Frame Buffer based models

- **SharedAppVNC**
  - Modified VNC protocol, multiple cursors

Figure 3: Shared Display Wall deployed in the NSTX control room of Princeton Plasma Physics Lab. Tens of data plots from multiple scientists are shown on the shared display. A camera shot of the plasma and also a log are also shown on the left.
# Frame Buffer based models

<table>
<thead>
<tr>
<th>System</th>
<th>Pull / Push</th>
<th>Technique</th>
<th>Multicast</th>
<th>App Sharing</th>
<th>Movies</th>
</tr>
</thead>
<tbody>
<tr>
<td>VNC</td>
<td>Pull</td>
<td>Mirror Driver</td>
<td>Region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTT: TeleTeachingTool(VNC)</td>
<td>Pull + Push</td>
<td>Mirror Driver</td>
<td>Region</td>
<td>Region</td>
<td></td>
</tr>
<tr>
<td>SharedAppVNC</td>
<td>Pull</td>
<td>Polling</td>
<td>Region</td>
<td>Region</td>
<td></td>
</tr>
<tr>
<td>MAST</td>
<td>Push</td>
<td>Polling</td>
<td>Region</td>
<td></td>
<td>High B/W</td>
</tr>
<tr>
<td>RDP</td>
<td>Push</td>
<td>Mirror Driver</td>
<td>High B/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THINC</td>
<td>Push</td>
<td>Mirror Driver</td>
<td>High B/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distributed Workspace</td>
<td>Push</td>
<td>Mirror Driver</td>
<td>High B/W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interesting Work

- A generic application sharing architecture based on message-oriented middleware platform.
On the performance of wide-area thin-client computing
- Optimize latency versus bandwidth
- Minimize synchronization b/w client/server
- Use simpler display encoding primitives
- Compress display updates
- Push display updates eagerly
- Optimize transport protocol
OS level models

- **MPX (Multi-pointer X)**

- MultiPoint for education (MS Research)

<table>
<thead>
<tr>
<th>Collaboration aware</th>
<th>Single PC Multiple I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td></td>
</tr>
<tr>
<td>Existing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collaboration transparent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic (VNC)</td>
<td></td>
</tr>
<tr>
<td>Frame Buffer</td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>App/Domain specific</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Homogeneous</td>
<td></td>
</tr>
<tr>
<td>Heterogeneous</td>
<td></td>
</tr>
</tbody>
</table>
OS level models

- X-Multiplexors
  - CCFX(98), XMX(93)
  - Heterogeneous X-Servers
    - Byte-orders
    - Pixel format and depth
  - Late connection problem

Collaboration aware
- New
- Existing

Collaboration transparent

Generic (VNC)

Frame Buffer

OS

App/Domain specific
- Homogeneous
- Heterogeneous
Collaboration-transparent models

<table>
<thead>
<tr>
<th>Collaboration aware</th>
<th>New</th>
<th>Existing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration transparent</td>
<td>Generic (VNC)</td>
<td>Frame Buffer</td>
</tr>
<tr>
<td></td>
<td>OS</td>
<td></td>
</tr>
<tr>
<td>App/Domain specific</td>
<td>Homogeneous</td>
<td>Heterogeneous</td>
</tr>
</tbody>
</table>
Collaboration-transparent (Homogeneous)

- **CoWord**
  - Concurrent work
  - High engineering cost
  - Independent view
  - All participants require MS Word
  - Efficient
  - Based on Word's API
Collaboration-transparent (Homo)

- **CoWord**

Figure 1: The user’s view and the adapted API’s view of a Word document.
Collaboration-transparent (Homogeneous)

- **CoWord**

**Problems**
- Does not support all MS Word features
- Depends on MS Word API
- Does not support MS Word 2007

Figure 2: Three layers in the transparent adaptation approach.
Collaboration-transparent (Heterogeneous)


![Diagram]

Figure 1: The essential ideas of our approach
Collaboration-transparent (Heterogeneous)

- Fazhi He, Soonhung Han, A method and tool for human-human interaction and instant collaboration in CSCW-based CAD

Fig. 15. Group communication for transparent 3D CAD.
Collaboration-transparent (Heterogeneous)

- Fazhi He, Soonhung Han, A method and tool for human-human interaction and instant collaboration in CSCW-based CAD

-Fine granularity locking for concurrent work
Comparison of application sharing models

<table>
<thead>
<tr>
<th>Metric</th>
<th>Collaboration-aware</th>
<th>Collaboration-transparent (Generic)</th>
<th>Collaboration-transparent (Specific)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrent work</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Good</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Application support</td>
<td>Single/some</td>
<td>All</td>
<td>Single/some</td>
</tr>
<tr>
<td>Application modification</td>
<td>Source code</td>
<td>No</td>
<td>External plug-in</td>
</tr>
<tr>
<td>Engineering cost per app</td>
<td>Moderate</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Thin-client</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Collaboratories

- BSC (Biological sciences collaboratory)
- The Access Grid
Collaboratories (BSC)
# Collaboratories (Active Grid)

## Projects

To add your Access Grid Project to the list, click [here](#).

<table>
<thead>
<tr>
<th>Media Tools</th>
<th>Shared Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Presence (VP)</td>
<td>Shared Desktop</td>
</tr>
<tr>
<td>SUMOVER Project (vic and rat)</td>
<td>TigerboardAG</td>
</tr>
<tr>
<td></td>
<td>VPCScreen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Network / Bridging Tools</th>
<th>Recording Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>VB Multicast Bridge</td>
<td>AGVCR</td>
</tr>
<tr>
<td>Portal Access Grid</td>
<td></td>
</tr>
<tr>
<td>AG Connector</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
<th>Requests</th>
</tr>
</thead>
<tbody>
<tr>
<td>VX</td>
<td>Improve Bridge Listing</td>
</tr>
<tr>
<td>AccessGrid 3 All in one Installer for Windows</td>
<td></td>
</tr>
<tr>
<td>AG Toolkit Management</td>
<td></td>
</tr>
</tbody>
</table>
Papers

- VNC
- RDP
- THINC
- Distributed Workspace
- TTT
- SharedAppVNC
- MAST
- MPX
- Wide-area Thin client
- MOM

- Distance Learning
- CoWord
- Familiar editors
- ACPBrush
- CAD tool
- CAD R&D
- Draw-together
- BSC
- N-ABLE
- Access Grid
Backup Slides
Application sharing models

- Distributed
  - Example: CoWord
  - Each participant must install an application
- Centralized
  - Example: Frame Buffer based models
Application sharing models

- **Same View**
  - Example: All Frame Buffer models
  - May require floor control mechanism
- **Independent View**
  - Example: CoWord
  - May allow concurrent work
Frame Buffer based models

- **TTT: Tele-teaching Tool**
  - VNC based system
  - Supports multicasting (Refresh in every 2 sec)
  - Participants are viewer only
  - Basic encoding (Hextile)

---

**Figure 2: TeleTeachingTool environment overview**
Collaboration-transparent (Hetero)


Figure 4. Data organization views showing file system, project structure, and organism phylogeny.
Collaboratories (Active Grid)
Collaboratories (Active Grid)