Streaming Real-time Video Images
For Mixed Reality Applications

14.07.2004

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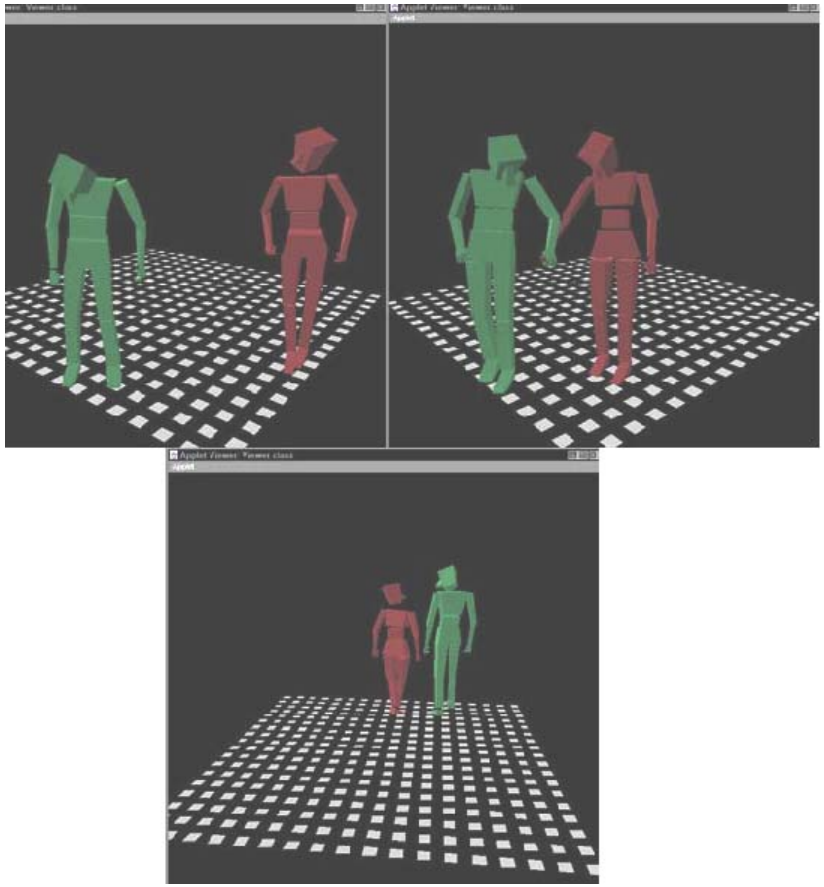
The Dilemma

… imagine yourself, interacting with other users in the virtual environment over the Internet,

…accessing objects in the scene

… you are so immersed, it's like real…

… suddenly the Internet browser hanged…



Source: NYU Media Research Lab

What is Mixed-Reality?

Source: International Conference on Virtual Storytelling 2003, Springer.

Virtual World + You = Mixed-Reality

Why do we need to stream?

- Quality
- Multiple Clients
- Waiting
- Network Resources
- Interactive Experience

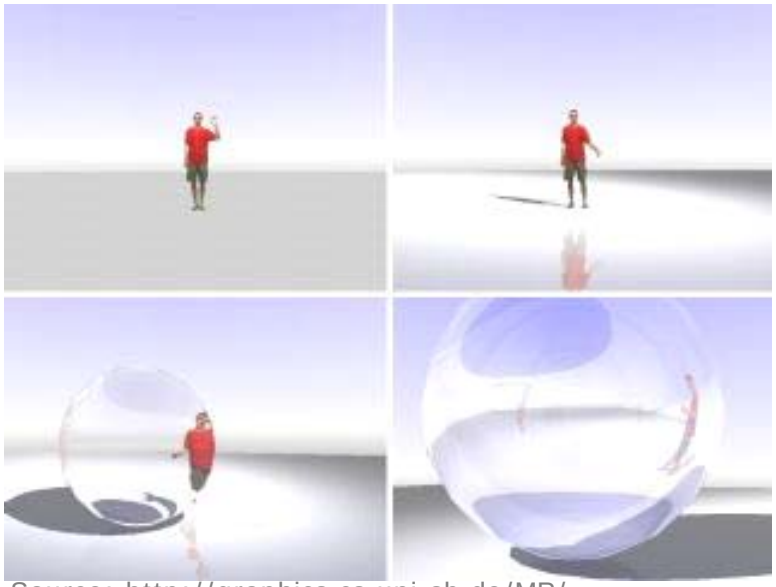
Research Applications

Real-time, real world video vs 3D environment:

- Video textures for real-time ray tracing
- Segmented real-time images for 3D contents

Application I

Video Textures for Real-time Ray Tracing



Source: http://graphics.cs.uni-sb.de/MR/

Shadows

Lightings

Reflections

Refractions

FRUSTRATION:

...Rendering in real-time!

...And we want to capture as much data as we can.

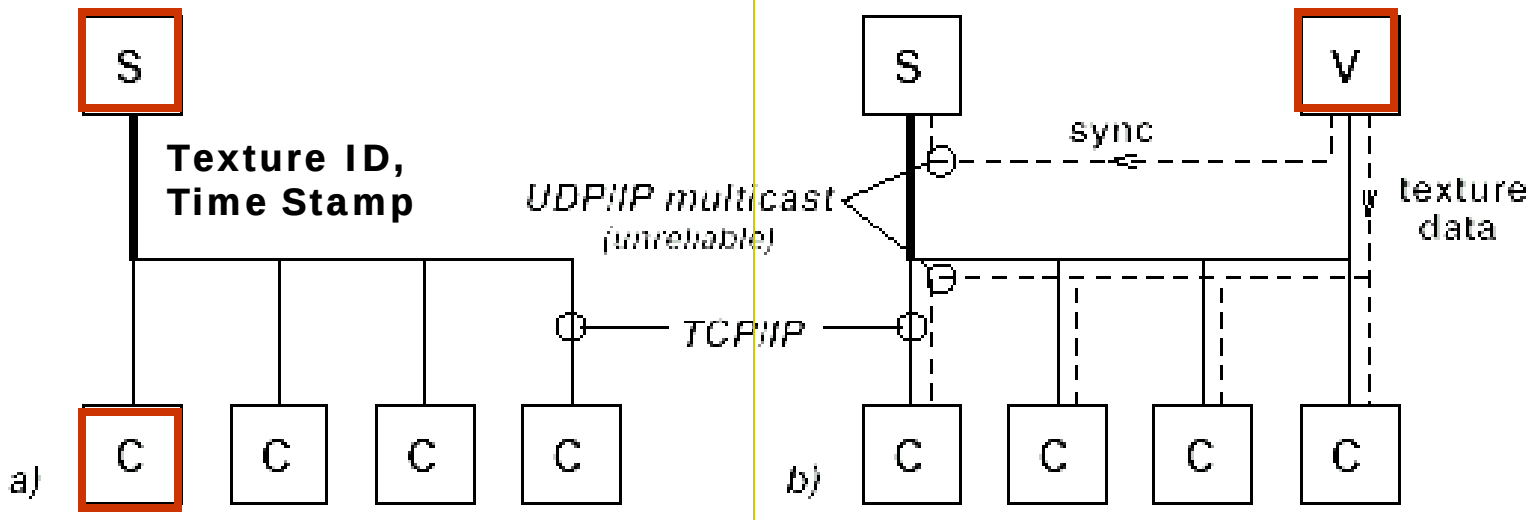
Possible Approaches

Approaches	Advantages	Disadvantages
1. Explicit network connection to each clients	Ease of deployment by using TCP-IP	Scalability Issues. As the client increases, more bandwidth is required.
2. Video on demand	Not all clients are accessing same parts, thus will reduce bandwidth.	Increase latency is intolerable in real-time.
3. Video frame grabber in each client	Resolution and frame rate can be adjusted dynamically.	Impractical and difficult to implement.
4. IP Multicast	distribution of contents to multiple hosts in parallel (flexible leave, rejoin)	Scalable streaming of contents across the Internet.

Streaming Methods (1)

(1) Rendering Server

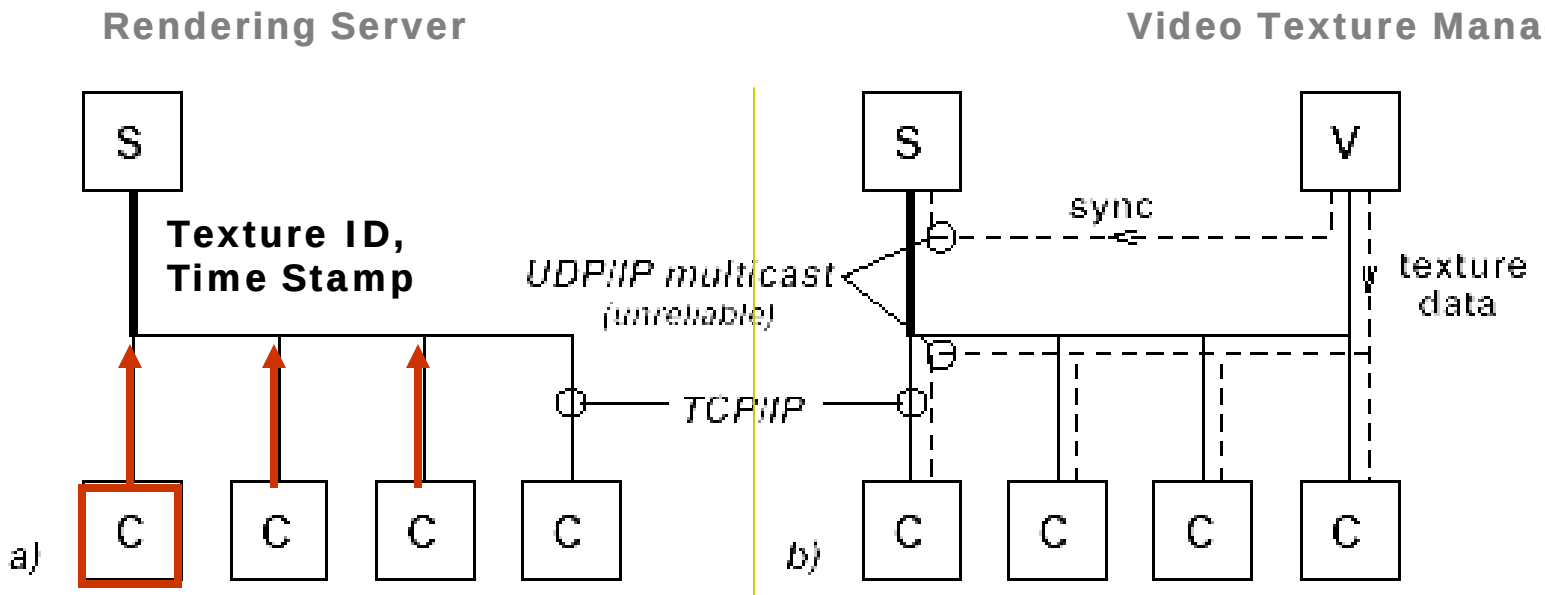
(3) Video Texture Manager



(2) Clients

Source: http://graphics.cs.uni-sb.de/MR/

Streaming Methods (2)

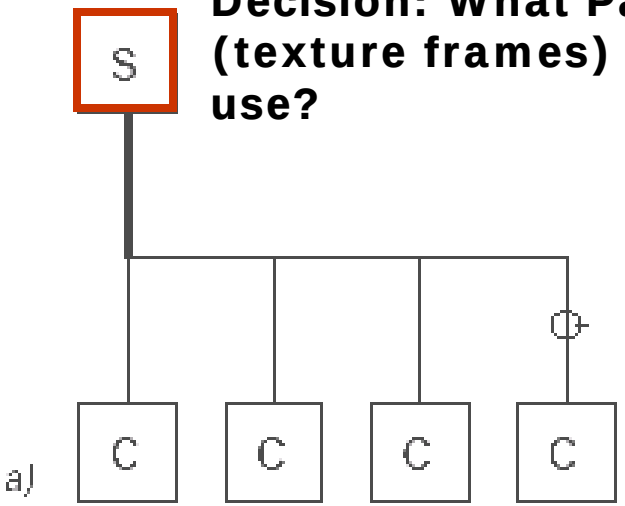


(2) Clients

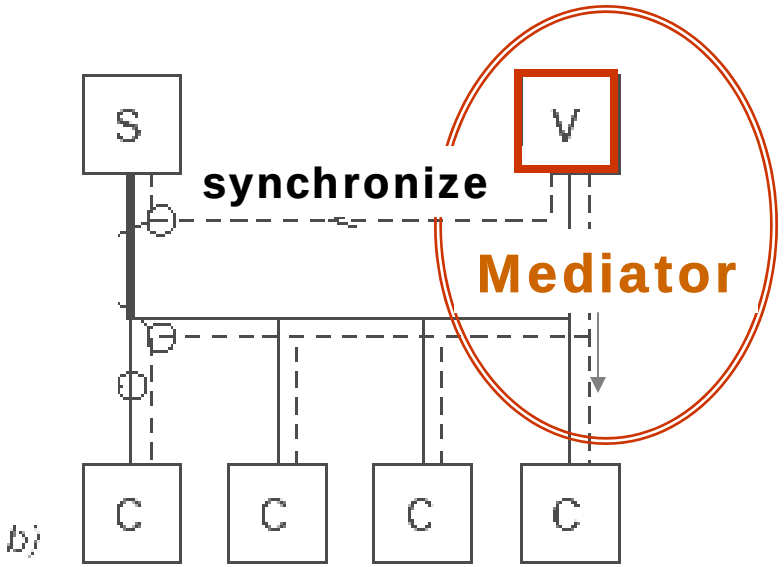
Streaming Methods (3)

(1) Rendering Server

Decision: What Part (texture frames) to use?



(3) Video Texture Manager

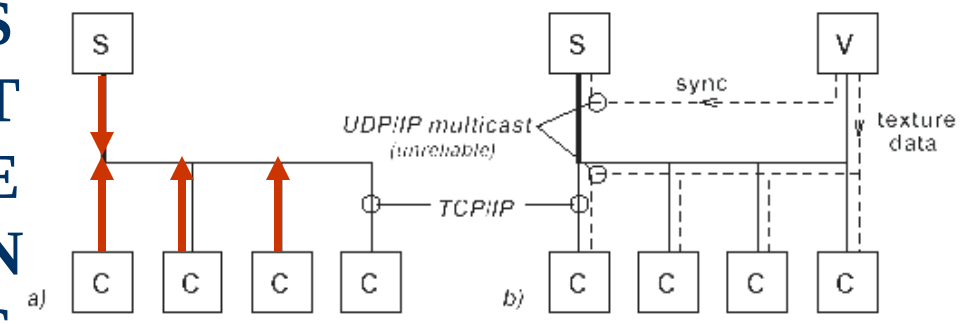


HOW ABOUT THE LOSS???

Challenges of using IP Multicast

LOSS?

L I S T E N S



One solution:

Increase buffer size and synchronization.

(but still unreliable)

Another solution:

Cover lost parts by reusing previous texture.

• Since UDP is unreliable, there is no guarantee that video packets arrive the clients.

Examples

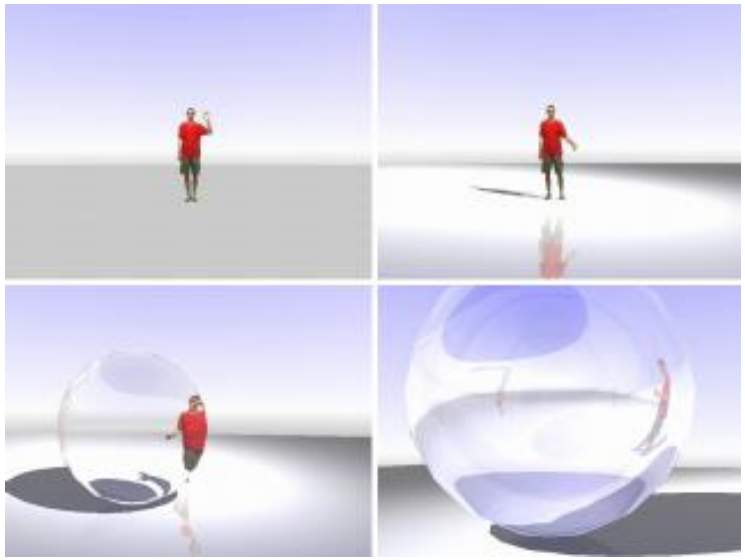
(1) Live Streaming Video Textures

Soft shadows produced by multiple virtual light sources on the TV screen.

Source: http://graphics.cs.uni-sb.de/MR/

(2) Integration of Video Scenes

Two actors with separate video streams



Refraction and reflections on a glass material

Source: http://graphics.cs.uni-sb.de/MR/

Application - II

Segmented real-time images for 3D contents

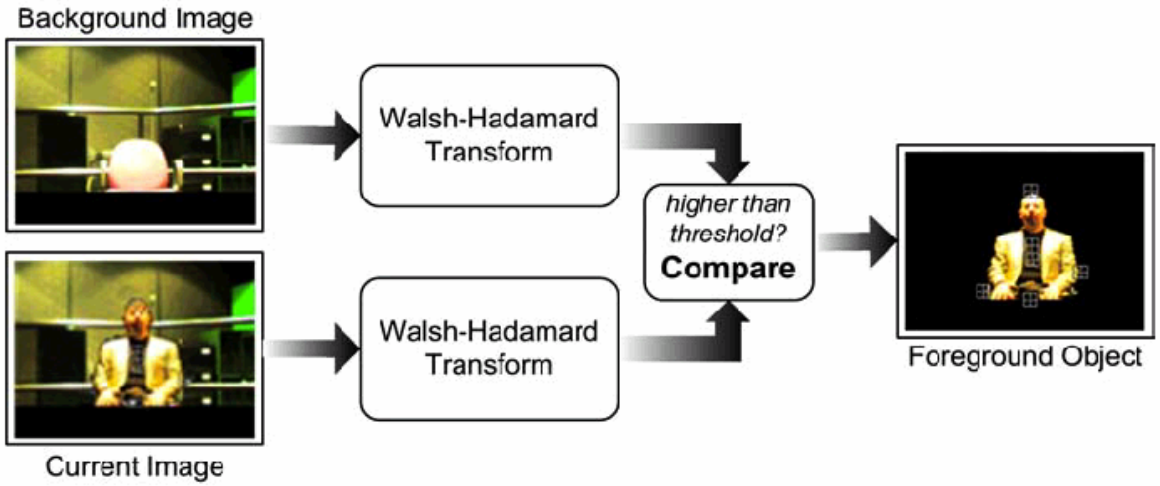
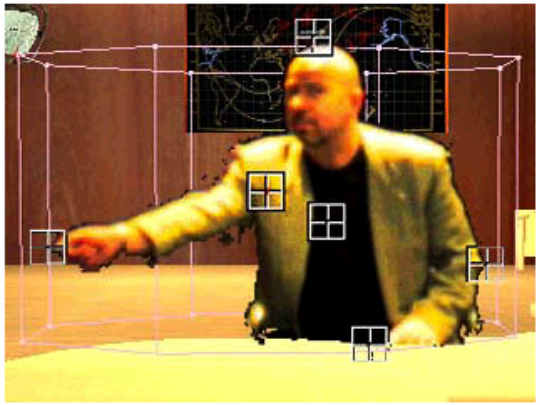


Fig. 3. Extracting the user's image from his background.



Source: International Conference on Virtual Storytelling 2003, Springer.

Conclusion

- The challenge in the mixed reality (MR) research arena is to create a realistic environment for the clients that requires a lot of bandwidth.
- Whether to use TCP-IP or UDP in media streaming is a question of reliability over scalability.
- Streaming is important to remedy transmission problems in MR environment.

References

Andreas Pomi, Gerd Marmitt, Ingo Wald, & Philipp Slusallek. *Streaming Video Textures for Mixed Reality Applications in Interactive Ray Tracing Environments.* http://graphics.cs.uni-sb.de/MR/

Marc Cavazza, Olivier Martin, Fred Charles, Steven J. Mead, Xavier Marichal: Users Acting in Mixed Reality Interactive Storytelling. International Conference on Virtual Storytelling 2003: 189-197.