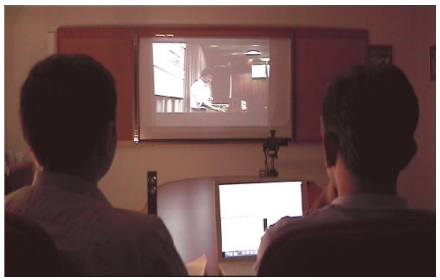
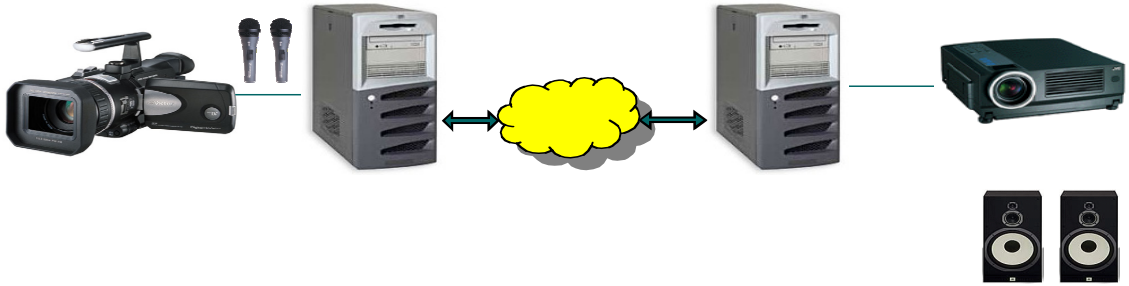
INTEGRATED MEDIA SYSTEMS CENTER
A National Science Foundation Engineering Research Center at the UNIVERSITY OF SOUTHERN CALIFORNIA

PRINCIPAL INVESTIGATOR

Prof. Roger Zimmermann

Streaming: HYDRA - High-performance Data Recording Architecture with support for Live HD Streaming





USC STUDENTS (EXPECTED DEGREES):

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BRIEF DESCRIPTION OF TECHNOLOGY DEMONSTRATION

HYDRA is a **High-performance Data Recording Architecture** for streaming media. The goal of HYDRA is to improve current and enable new applications by acting as an efficient media stream coordinator that manages the transmission, recording, and playback of many different data streams simultaneously. The objective of HYDRA is to use a unified paradigm that integrates multi-stream recording, retrieval and control in a synergetic manner. HYDRA aims to provide the same services for all media, independent of their bandwidth requirements, resolution or modality.
The HYDRA architecture is based on a scalable cluster design. The server software manages the storage and network resources to provide real-time service to the various clients that are requesting media streams. HYDRA is also capable of **high definition live video streaming**. For example, video at 1280x720 pixel resolution (in HDV format) is transmitted at approximately 20 Mb/s over traditional IP networks such as the Internet.

The following list of media types have been successfully demonstrated:

- DV via FireWire (NTSC resolution)
- HDV via FireWire (1280x720p resolution) and HD video via DVB-ASI input (either 1920x1080i or 1280x720p)
- 16 channels of synchronized audio (10.2 channel system)
- Rendering via software or hardware HD MPEG-2 decoders and software DV decoder; both 4x3 and 16x9 aspect ratios

UNIQUE OR DISTINGUISHING CHARACTERISTICS RELATIVE TO STATE-OF-THE-ART

- Fully-distributed cluster architecture
- Low-cost commodity hardware components
- Universal media support
- Component scalability and fault-tolerance

APPLICATIONS

- Corporate Teleconferencing
- Surveillance & Security
- Distance Education
- Multi-stream Data Recording and Playback

RECENT HIGHLIGHTS, LEVEL OF DEVELOPMENT, UPCOMING MILESTONES

- Successful demonstration of a two-way HYDRA live streaming setup between the University of Hawaii and USC on January 29, 2004.
- Permanent HYDRA live camera installation at the New World Symphony in Miami Beach, FL
- Successful demonstration of HYDRA at the CENIC 2004 conference in Marina Del Rey, March 17, 2004

UNDERLYING TECHNOLOGIES

- Linux-based, scalable cluster organization
- Adherence to industry standards: RTP, RTSP
- Distributed, deadline-driven scheduling
- Random placement of media objects for load balancing
- Software or hardware-based real-time MPEG-2 HDTV rendering
- Advanced admission control algorithm
- Unified memory and resource management mechanisms

LIST OF PUBLICATIONS, REFERENCES, URLs

- K. Fu and R. Zimmermann. "Memory Management for Large Scale Data Stream Recorders." Proceedings of the *6th International Conference on Enterprise Information Systems* (ICEIS 2004), Porto - Portugal, April 14-17, 2004, http://dmrl.usc.edu/pubs/iceis04-web.pdf.
- R. Zimmermann, K. Fu and D. A. Desai. "HYDRA: High-performance Data Recording Architecture for Streaming Media." Book chapter in *Video Data Management and Information Retrieval*, editor Sagarmay Deb, University of Southern Queensland, Toowoomba, QLD 4350, Australia. Published by Idea Group Inc., publisher of the Idea Group Publishing, Information Science Publishing and IRM Press imprints, 2004.
- R. Zimmermann and K. Fu. "Comprehensive Statistical Admission Control for Streaming Media Servers." Proceedings of the 11th *ACM International Multimedia Conference* (ACM Multimedia 2003), Berkeley, California, November 2-8, 2003, http://dmrl.usc.edu/pubs/acmmm03-web.pdf.

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