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Research Goal

Build an infrastructure for interactive multi-channel, multiparty, multimedia applications

- Loss-resilient transport over the Internet
- Precise global synchronization between participants (less than 1 ms)
- Scalability to any number of participants anywhere in the world

Role in IMSC

Infrastructure component of RMI

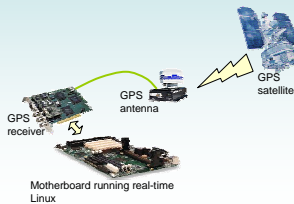
- Reliable transmission of multipoint *and* multi-channel haptic, audio and video streams
- Highly precise synchronization of the constituent streams using GPS

GPS Synchronization

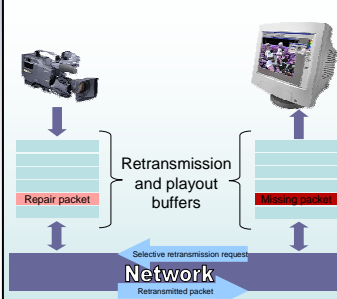


GPS synchronization
 -Participants have GPS clock
 -Conductor played-back at same time
 -Delay between participants remains constant

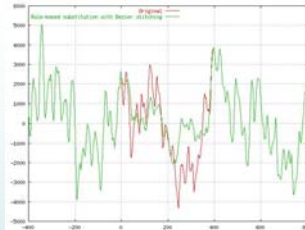
- Global synchronization among participants using GPS
- Real-time operating system for accurately triggering timed events
- Orders of magnitude more accurate than a network time protocol



Loss Recovery



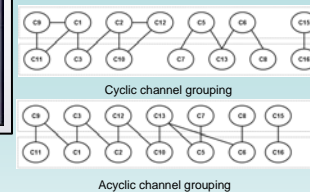
Loss Concealment



- Even single-packet loss is disruptive in concert environment

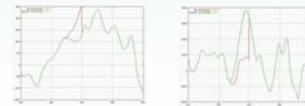
A novel method to conceal losses in multi-channel audio

Exploit redundancy between channels due to spatial proximity of channels. However, dividing channels into proper dependency groups is important.



Novel stitching method based on Bezier curves

- Fast approximation suitable for real-time operation



Examples of Bezier curve stitching



- Retransmission-based
- Timer-less schemes for multiple retransmissions
- Solves problems with RTT estimation
- Recovery in one RTT

Accomplishments

- Publications:
- "Loss Concealment for Multi-Channel Audio" in NOSSDAV 2003
- "An Adaptive Multiple Retransmission Technique for Continuous Media Streams" in NOSSDAV 2004
- Low-latency streaming of 8-channel audio

Five-Year Plan

2004-2005	2005-2007	2008-2009
<ul style="list-style-type: none"> •Prototype multicast protocol. •Implement synchronization algorithms for musical performance. 	<ul style="list-style-type: none"> •Implement multicast protocol, evaluate and test. •Prototype synchronization platform for distributed musical performance. 	<ul style="list-style-type: none"> •Release multicast version of retransmission protocol. •Deploy distributed musical performance platform to other sites. •Evaluate deployed version of distributed musical performance.