**Dynamic Program Insertion in High Quality Video over IP**

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**Research Goal**

- Implementation of a dynamic advertisement insertion system using cueing protocols
- Achievement of high quality video without any glitch on program switching
- Consideration of reliability

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**System Overview**

**Ad Server Architecture**

**Base Platform**

- **RTP (Real-Time Protocol)**
  - Designed for real-time data delivery
  - Provides payload type, seq number, time stamp
  - RTPtools: record, play RTP packets
- **RTPtv**
  - Transmitting production quality video in MJPEG/RTP/IP
  - Provides synchronization, loss concealment

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**MJPEG/RTP Format**

- JPEG restart information (4 bytes)
- RTP-JPEG header (8 bytes)
- RTP header (20 bytes)
- UDP header (8 bytes)
- Payload
Motion JPEG Frame Format

- First field header (595 bytes) - First field data
- Start header (46 bytes) - Second field header (595 bytes) - Second field data

Cueing Protocol
- An application level signaling protocol
- Signals to insert pre-recorded advertisement
- Cue types:
  - EN: Event Notification
  - ET: Event Termination
  - EP: Event Pending
  - EC: Event Continuing

Cue Packet Format
- IP header (20 bytes)
- UDP header (8 bytes)
- RTP header (20 bytes)
- Event type
- Cue type
- Ver
- Number
- Duration
- Date
- Time
- Label

Experiment Setup
- Program provider
- Ad server
- RTP stream
- Ad clips
- 224.4.4.4

Experiment Scenario
- FP, FP, EN, EC, EC, ET
- Time: 7.5s, 0.5s, 1s, 1s
- Switching

State Transition Diagram
- ON-AIR
- READY
- EN
- EP
- ET, or duration = 0
- AD
- EN, or duration = 0
Program Switching Condition

- Switching to advertisement occurs,
  - If frame memory 2 is filled up and
  - EN is received or duration = 0
- Switching to on-air program occurs,
  - If frame memory 1 is filled up and
  - ET is received or duration = 0

Performance

- Error probability of switching to advertisement
  - \( p \frac{N(EP) + N(EN)}{N(EP) + 1} \)
  - \( p \) is the packet loss rate
- Error probability of switching to on-air program
  - \( pN(EC) + N(ET) = pN(EC) + 1 \)

Demo

- Demonstration area in the 1U center lab