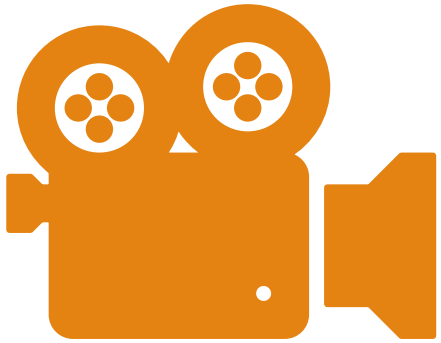

Adaptive Video Delivery for Network Music Performance

AVID-NMP

Project Team

MMLab team

- Postdocs: K. Tsioutas, Y. Thomas, A. Kefala
- PhDs: I. Pittaras, C.D. Nassar Kyriakidou, A.M. Papathanasiou

  MS: F. Bistas, I. Barous
- Faculty: G. Xylomenos (PI

Team experience

- Low-latency audio tools
- Ultra-low latency SFUs with netmap and P4
- Largest QoE NMP study with real musicians
- Fighting latency in NMP since 2012!

The AViD-NMP project

NMP is really hard to get to work

- Live performance requires <30-40 ms latency
- Teaching can work with more (how much?)
- Flat (2d) video is not really ideal

Can we do better with the 6G-XR platform?

- High bandwidth low latency testbed
- Edge resources available for processing
- Ability to switch between different visual representations

The TENeMP project

Funded by the SPIRIT project (August-May 2025)

Created an advanced AR testbed

- 5G modems, Depth cameras, AR glasses, GPU-enhanced laptops

Developed new audio, video, volumetric tools

- Clients and SFUs (Selective Forwarding Units)
- Optimized for ultra-low latency and open-source

Measured performance in SPIRIT 5G-SA testbed

- Not only latency, but bandwidth is also an issue for AR
- AR applications must adapt to available bandwidth
- This requires processing which affects latency

AViD-NMP Experiments

Experiment 1: P2P with Native Rendering

- Sender encodes XR stream
- Stream is sent to each receiver independently
- Receiver(s) decode each stream locally
- Advantages
  - Lowest possible latency
  - No need for MEC services
- Disadvantages
  - Sender needs to send multiple streams
  - Sender needs considerable processing power

AViD-NMP Experiments

Experiment 2: SFU with Native Rendering

- Sender encodes XR stream
- Stream is sent to SFU in MEC
- SFU relays the stream to each participant
- Receiver(s) decode each stream locally
- Advantages
  - Sender only needs to send a single stream
- Disadvantages
  - Additional latency to go through MEC
  - Sender needs considerable processing power

AViD-NMP Experiments

Experiment 3: SFU with Remote Rendering

- Sender does NOT encode the XR stream
- Stream is sent to SFU in MEC
- SFU encodes and relays the stream to each participant
- Receiver(s) decode each stream locally
- Advantages
  - Sender only needs to send a single stream
  - Sender does not need processing power
  - SFU can adapt encoding depending on conditions
- Disadvantages
  - Additional latency to go through MEC

Objectives

OBJ1: Compare the bandwidth, latency and processing requirements in the different experiment setups

OBJ2: Compare the QoE in the different experiment setups

OBJ3: Assess the feasibility of XR-enabled remote music teaching

OBJ4: Publish the results

OBJ5: Release the developed code

Usage of 6G-XR infrastructure

South experimentation pole (5TONIC)

- Use of MEC resources for relaying and rendering
- Use of 5G RAN for high bandwidth low latency transmission
- Exact requirements TBD with site managers

Visits to 5TONIC testbed

- Approximately four days
- Will bring along our own equipment
- 1st day: connection and configutation
- 2nd day: trial runs of experiments
- 3rd and 4th day: actual experiments

Expected Feedback to 6G-XR

Experimental perspective feedback

- Assess lifecycle of testbed use
- Reliability and usability
- Measure performance for specific scenarios

Platform engineering feedback

- Compatibility with NMP services
- Performance tuning and optimizations
  - For slicing of resources and MEC services
- Integration of XR apps with existing testbed