# Network Music Performance in 5G Networks

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# NMP needs what only 5G can provide

| | |
|---|---|
| Ultra-low latency | • NMP requires 30-40 ms one way |
| Very high bandwidth | • Especially with volumetric video |
| Processing at the edge | • To relay or process media streams |

# The TENeMP project @ SPIRIT

## Feasibility analysis of NMP over 5G

- Can we do NMP over 5G? Is the latency low and the bitrate high?

## Performance gains of edge-computing

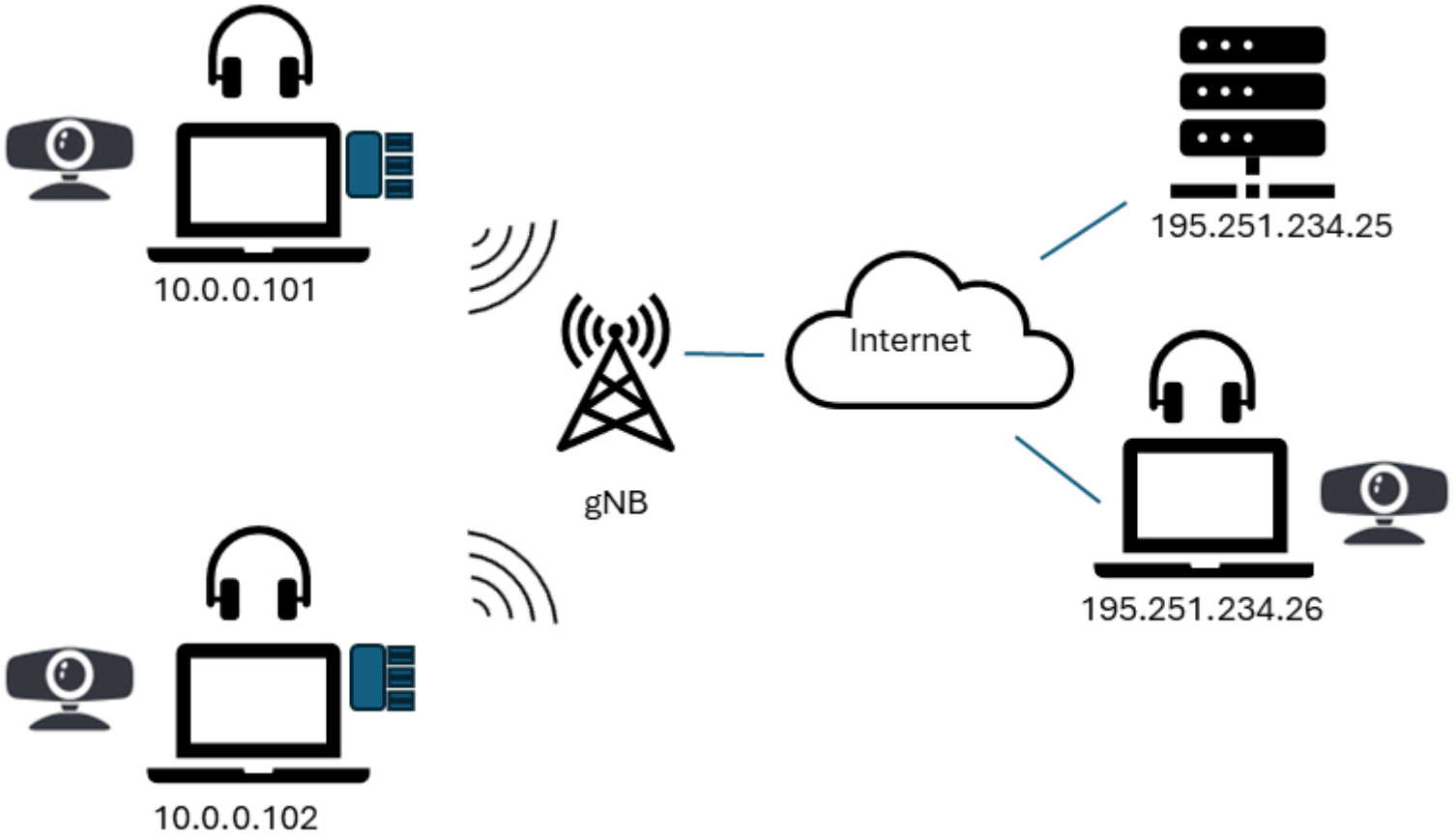
- Can we do multiparty NMP if we put the SFU in the MEC?

## Integration of telepresence in NMP

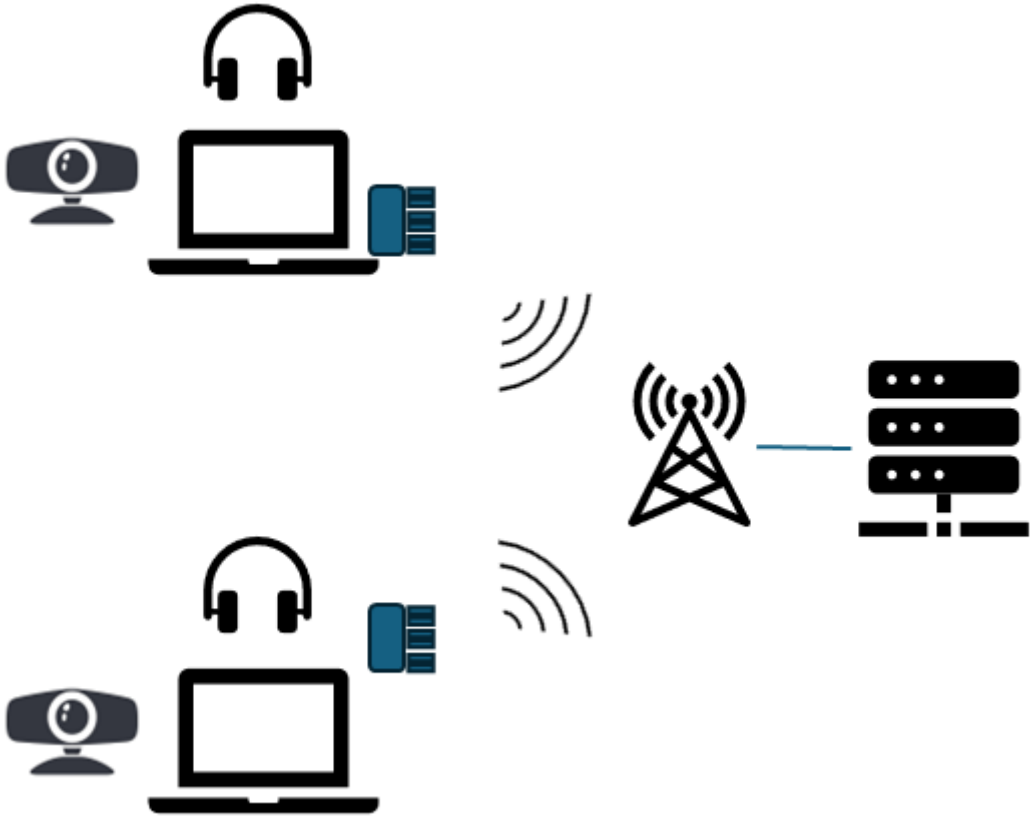
- Can we offer volumetric video along with the audio?

# Testbeds

# TENeMP topology @ MMlab testbed



# TENeMP topology @ SPIRIT testbed



# Tool Selection

# Existing tools

## Endpoints

- WebAPI based: Simple but slow
- Gstreamer based: Quicker and flexible
- Jacktrip/Sonobus/Jamulus/Soundjack: Audio state of the art

## SFUs

- Janus, Jitsi, MediaSoup: Slow for audio
- Janus seems to be the fastest

## Networks

- Local (no network), LAN
- COSMOTE 4G, COSMOTE 5G NSA
- SPIRIT Private 5GSA Network

# Tools

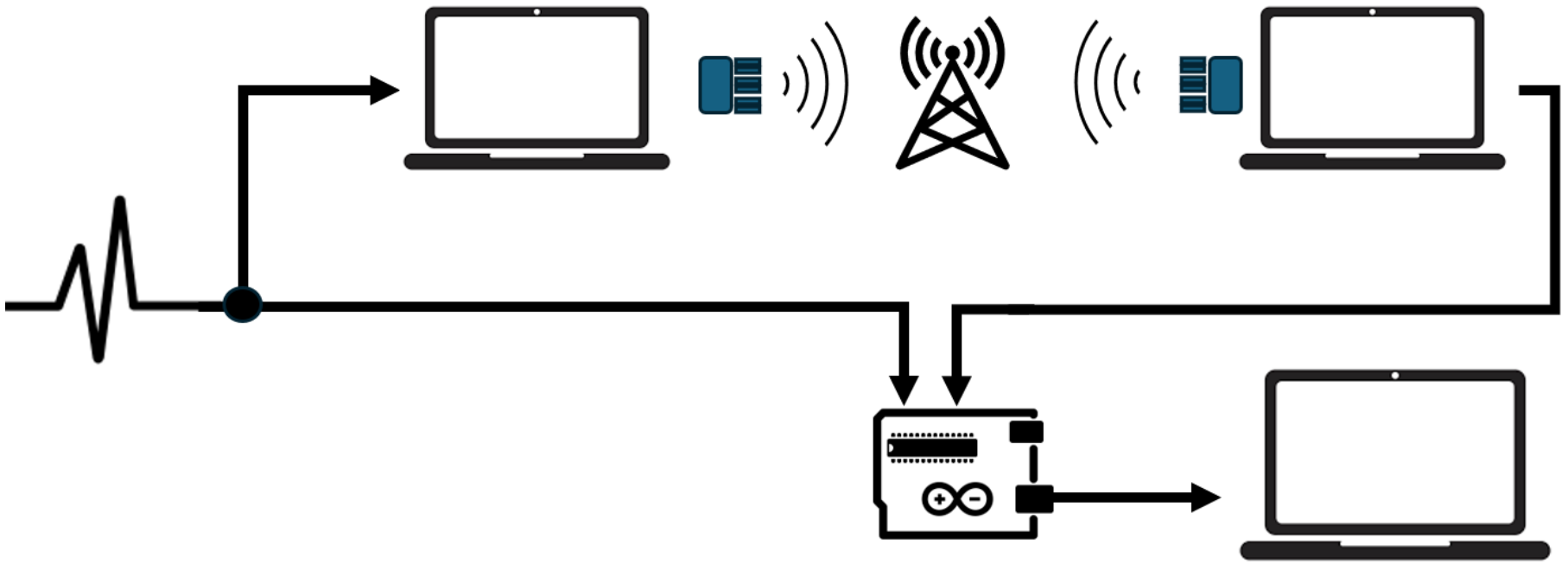
**Existing tools are not enough**

- No low-latency 2D video
- Audio SFUs very slow and no customizable

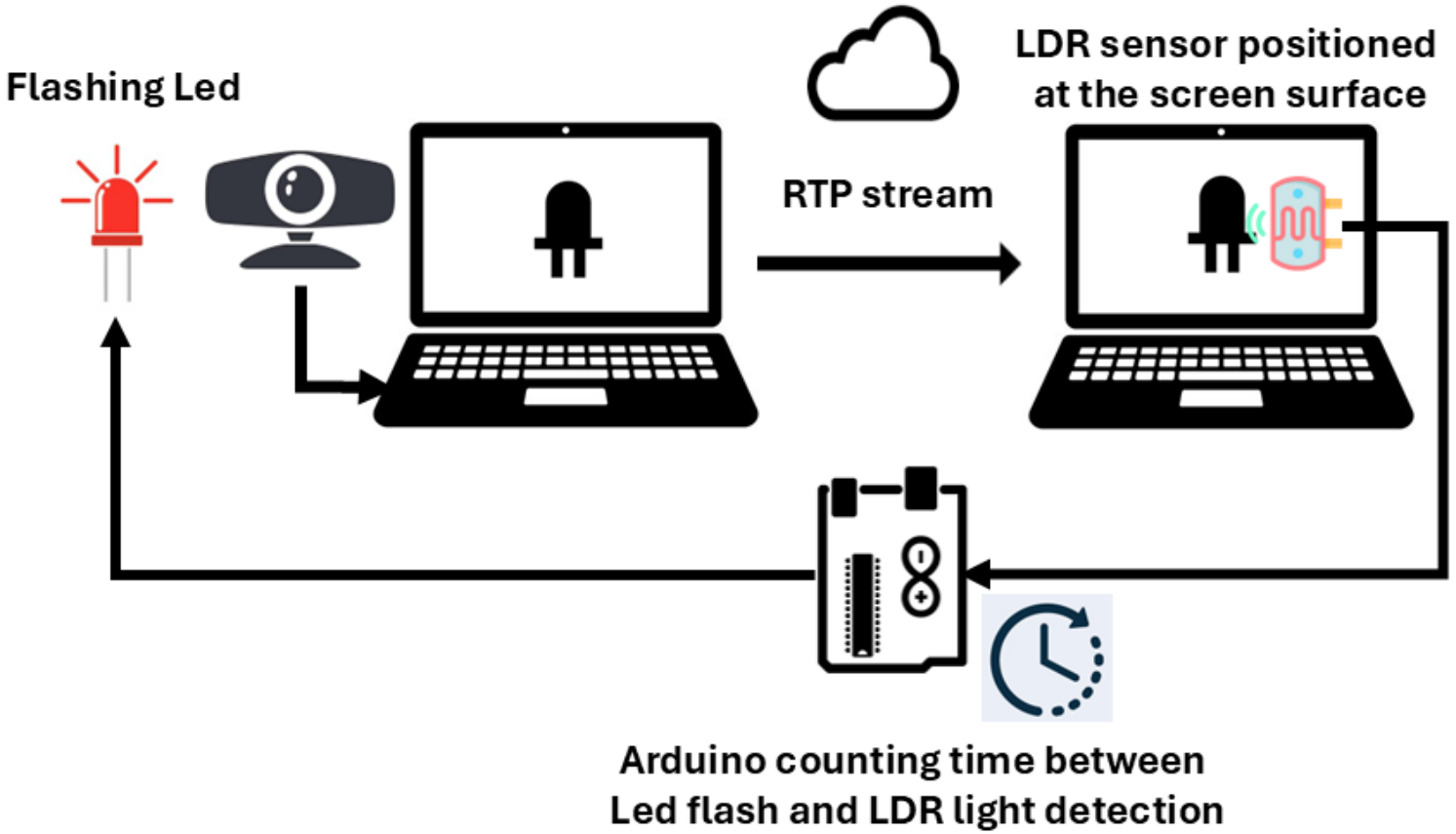
**Development of new tools**

- Prototyped with Gstreamer pipelines
- Simple server for signaling and SFU

# Audio Delay Measurement setup



# Video Delay Measurement setup

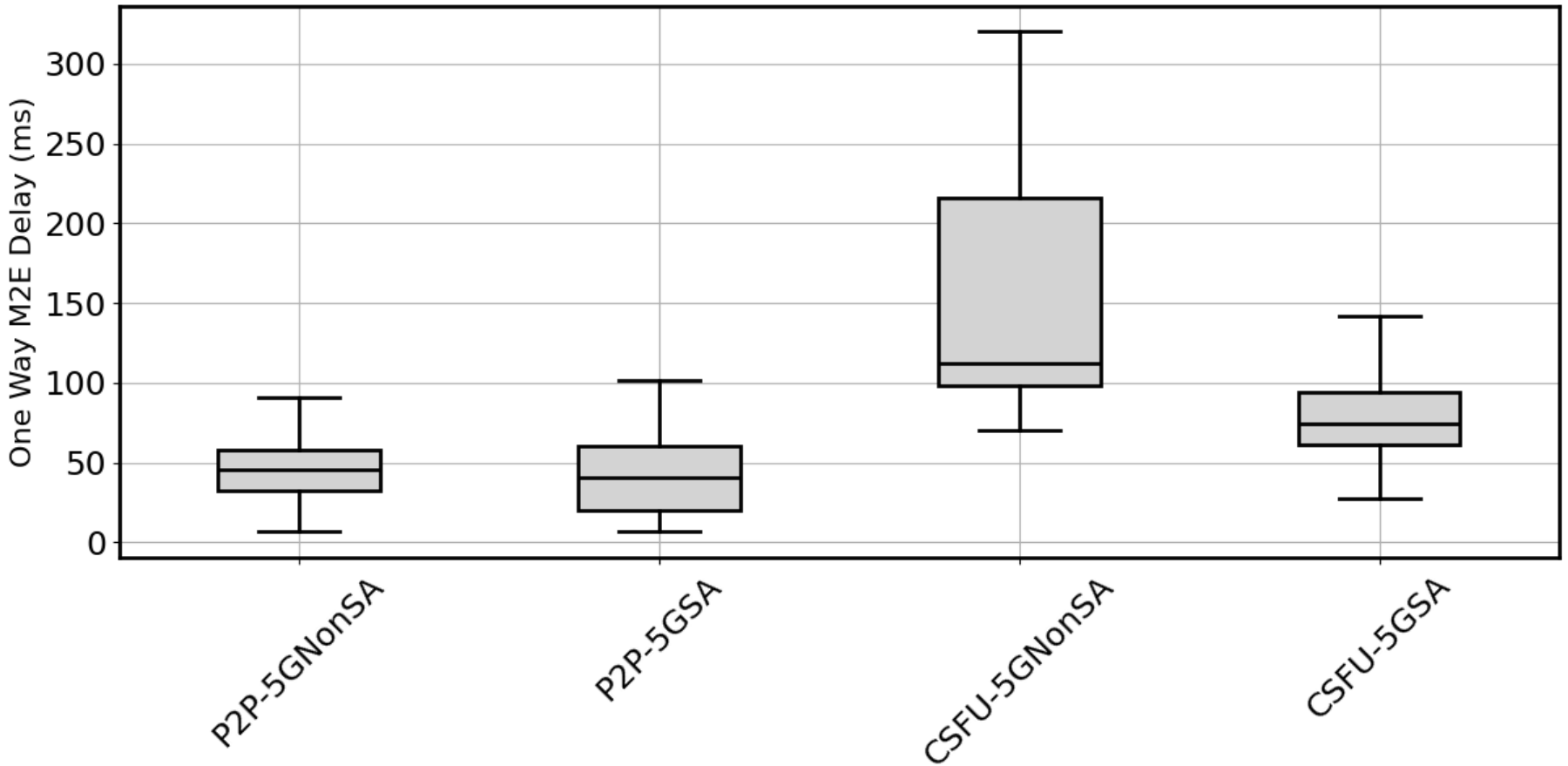


# Measurements

# Mouth to Ear delay

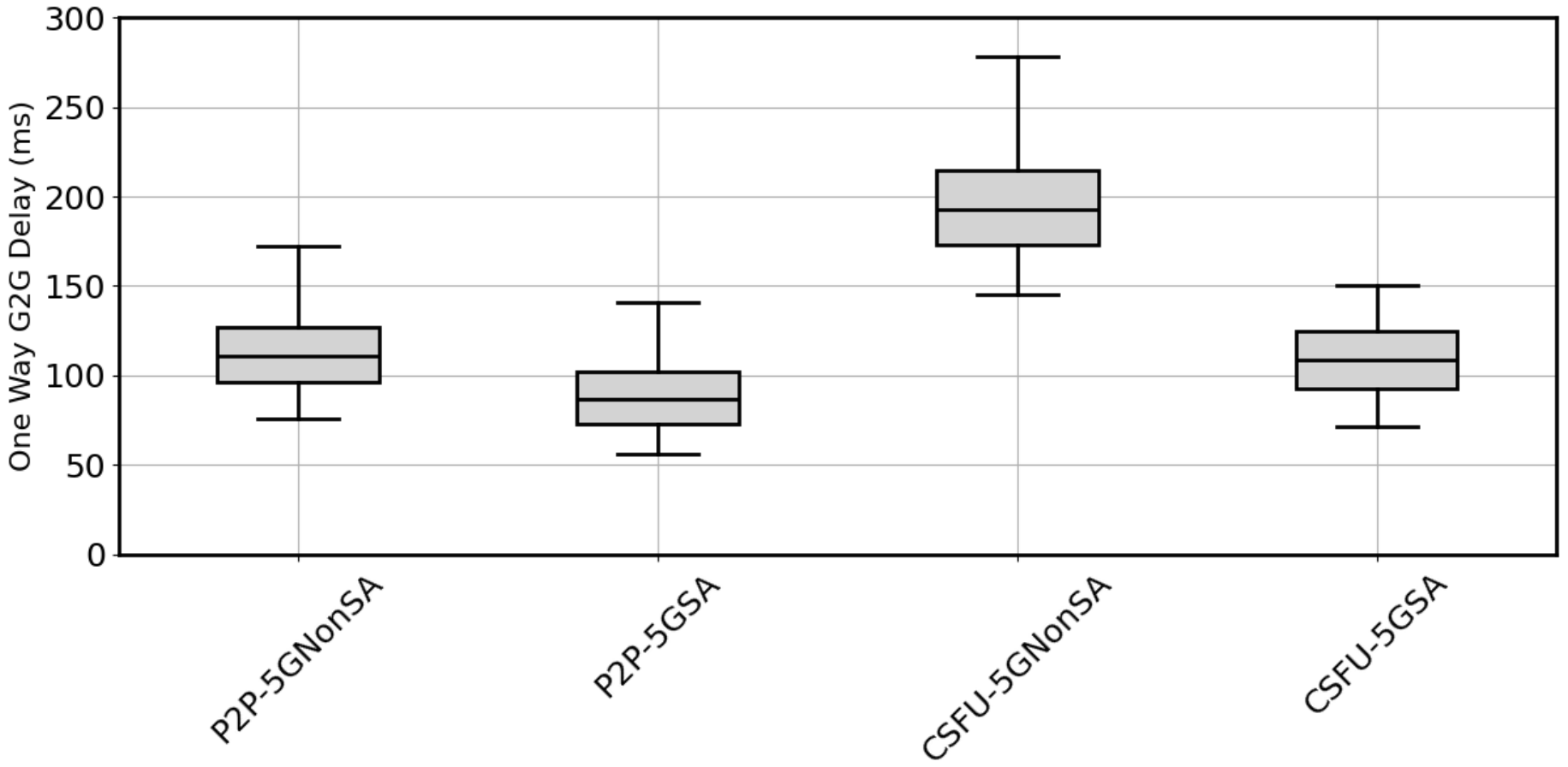
Gstreamer PCM raw audio

44100Hz , 16bit sample depth



# Glass to Glass video delay

Gstreamer H.264 codec



# Conclusions

**NMP feasibility in 5G**

- 5G can support NMP audio sessions in P2P mode
- Adding an SFU noticeably increases audio delay, but it is still acceptable for educational scenarios.
- Video latency is still very high.

# Next steps

# Future work

**Volumetric video**

- Design latency measurement method
- Complete volumetric tool

**Additional measurements**

- Assess benefits of SFU at 5G edge
- Test volumetric video tool


SPIRIT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AViD-NMP