

Anhalt University of Applied Sciences

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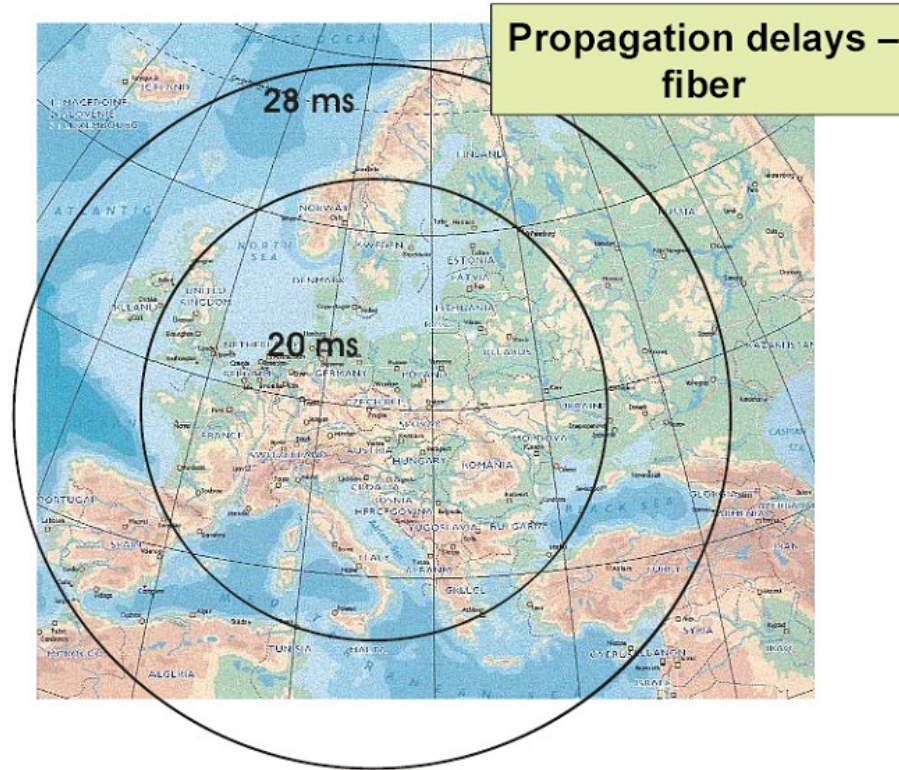


Conductor Andrea Molino, string section and audience in Dresden/Germany / other sections in 11 european cities

Requirements

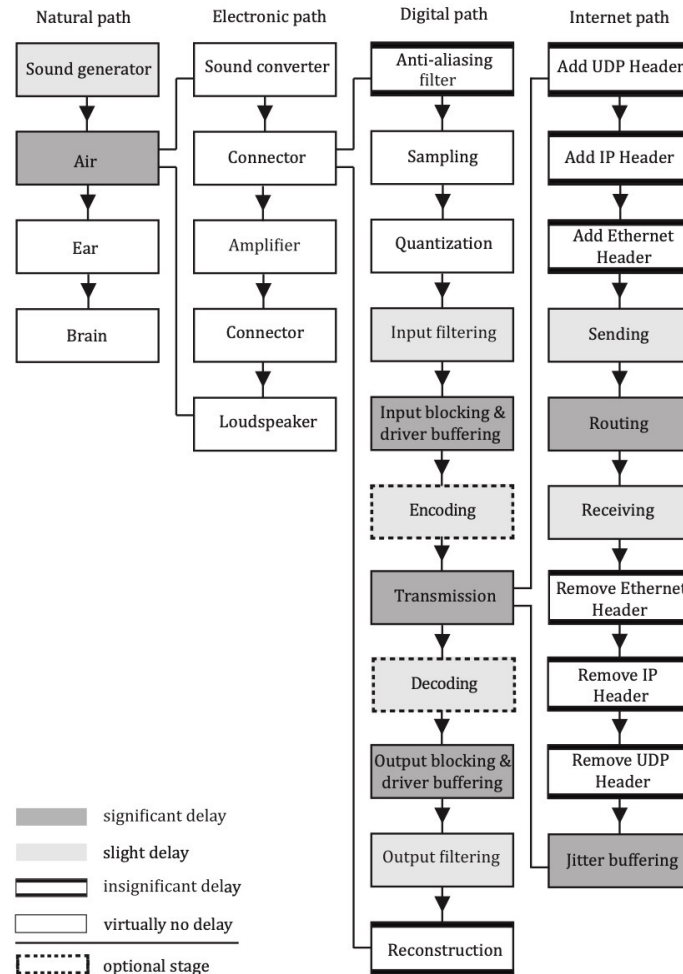
- Audio Quality → full range audio (20 Hz to 20 kHz)
- Audio Latency → < 25 ms for rhythmical interaction (RIA) → perceived as synchronised
→ < 60 ms for leader/follower (LFA) → no latency for the follower / RTT for the leader
- Video Quality → as good as possible (audience)
→ as good as necessary (conducted musicians)
- Video Latency → as low as necessary (audience – audio/video synchronisation)
→ as low as possible (conductor /conducted musicians – ahead conducting)

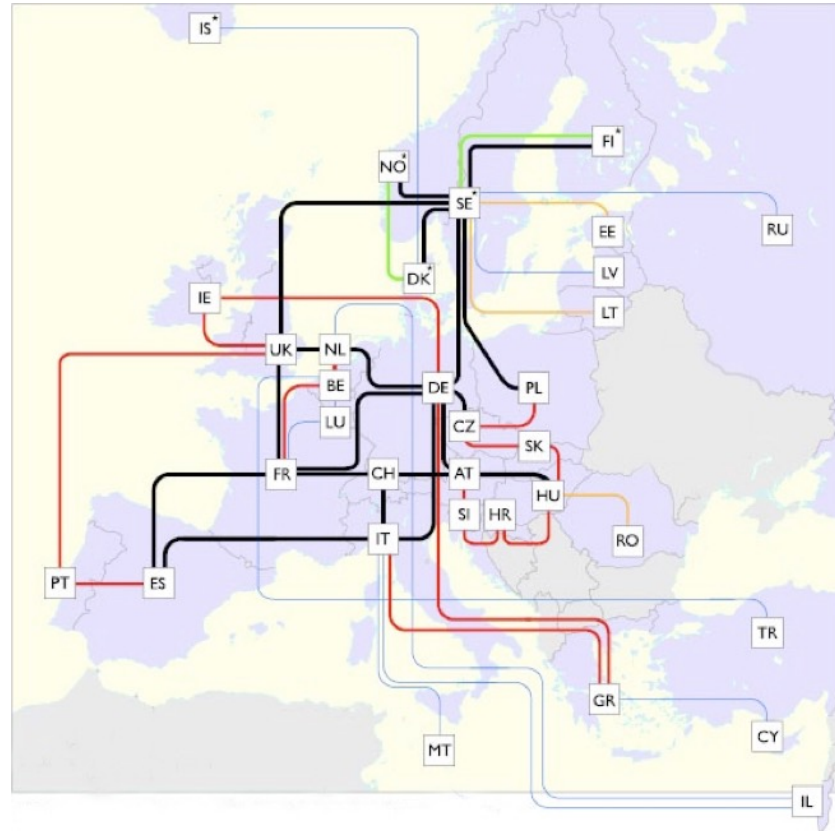
Precise latency values depend on the result of a currently ongoing composition competition



Looks promising but there are several more components involved

Technical principle:





final delay =

+ audio blocking delay

$$+ d_{\text{transfer}} = \sum^M d_{\text{propagation}} + \sum^N d_{\text{transmission}}$$

+ jitter buffer delay

to be as low as possible

The higher the final audio and video latency the higher

- 1.) the probability for LFA (leader/follower) rather than RIA (realistic/rhythmical interaction)**
- 2.) the necessity for conducting more ahead**

Options

1.) **best-effort**

maximum artistic flexibility required but cheapest solution

2.) **dedicated GEANT endpoints in european Universities**

overall performance will depend on the available bandwidth

3.) **Option 2 with ≥ 10 Gbps Europe-wide network + QoS (managed network)**

minimal latencies due to minimal buffer sizes but most expensive solution

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How to connect ?

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p2p

- 11 in- and outbound streams for every peer
- shortest routing (provider dependent)
- processing load on each client
- probably too complex
- 11 x video bandwidth might be problematic

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Mix server

- one single in- and bound stream
- processing load on the server
- participant count no problem
- routing detour – longer routes
- physically close peers suffer the most

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In discussion:

Server + p2p combination

- Only conductor video one-way via p2p
- Remaining streams via server

Conclusions

- 1.) Complex use case but **technical facts** are clear and obvious
- 2.) Actual **endpoints** determine the artistic frame conditions
- 3.) **QoS** preferred but probably too complex or not available or simply too expensive
- 4.) Overprovision with **maximum bandwidth** typically helps the most
- 5.) Extensive **evaluation** is required in any case

Details @ <https://europasinfonie.eu>

