REAL-TIME TEACHING OF MUSICIANSHIP AND AUDIO ENGINEERING USING LOLA – 'LOW LATENCY AUDIO/ VIDEO STREAMING'

LoLa demonstration video clip:

Steve Waterman – Trumpet (playing in Edinburgh Napier University)
Jazz quartet (playing in Maastricht, Holland 200Km away)

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LOLA

- LOLA (LOw LAtency audio visual streaming system) is a joint development by Conservatorio di Musica Giuseppe Tartini in Trieste (Italy) in collaboration with GARR, the Italian National Research and Education Network (NREN) to allow music performance to take place between two connected sites

- It achieves network round trip latencies in the order of 20ms to 50ms depending on distance compared with the >200ms typical of competing video conferencing systems and thus does not require echo cancellation.

- Impressive but how?

Assumption #1: The sites will be connected via high bandwidth (100Gb/s) Research and Education backbones such as JANET6 with optimised routes and low jitter

Assumption #2: There will be no transmission errors!

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JANET, THE UK NREN

What is JANET? – The UK's National Research and Education Network (NREN) – Provided by JISC. basically our ISP, linking establishments with a 100Gb/s backbone

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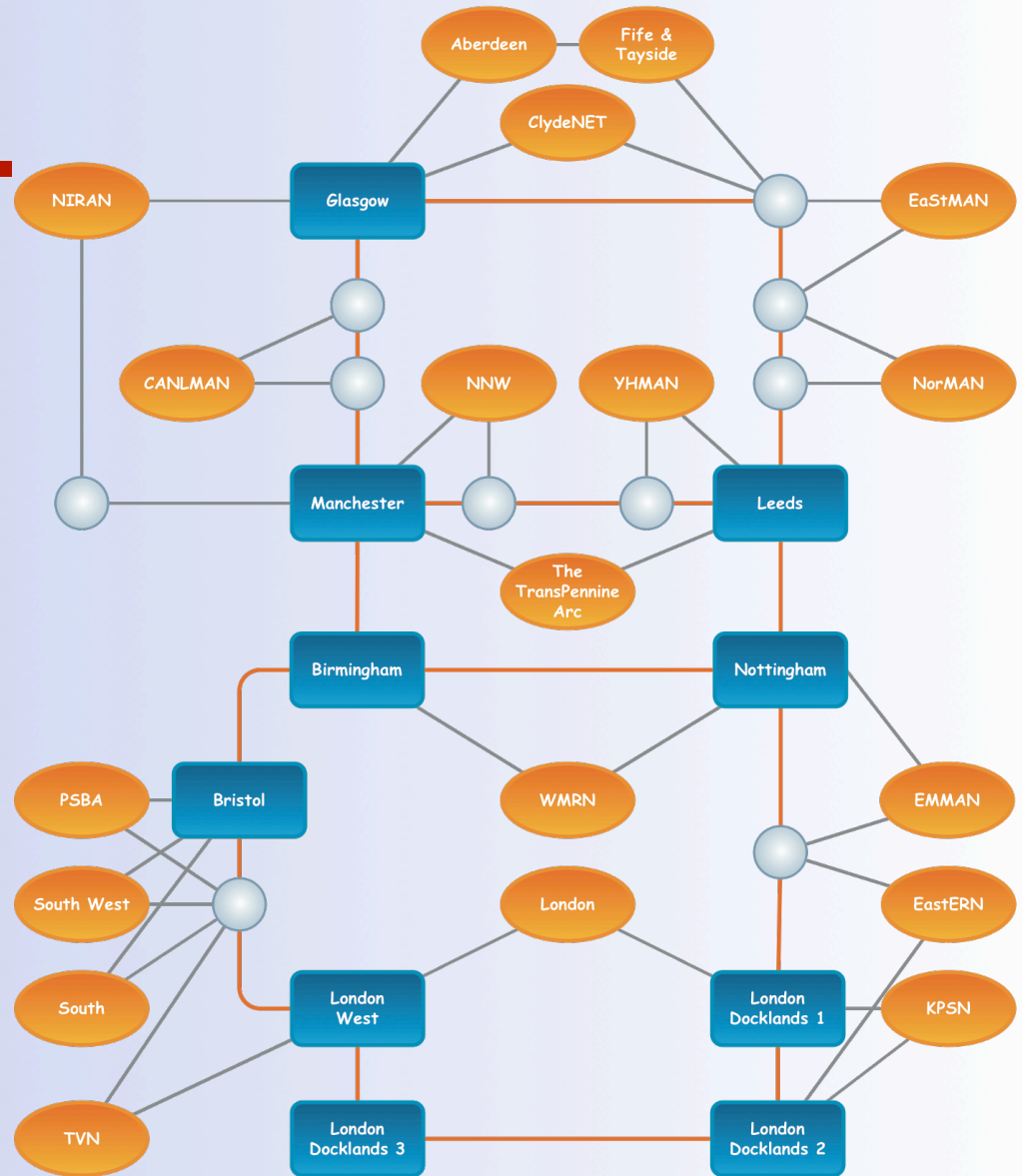
No firewall or traffic shaping !!

Tools like ping, ipConfig, traceRoute, iPerf and the Task Manager may give us some insight into out network data but ultimately the success is in the hands of the IT departments along the route

Mark Yonge February AES London lecture – "AES67 and Audio Networking" *"start building a relationship with your IT people"*

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LOLA UPDATE

- LoLa is now HD
- USB3 machine vision cameras can be used (XIMEA 720p colour camera is approx €350 excluding lens)
- Video compression via the CPU or GPU (NVIDIA CUDA) can reduce the 750Mb/s data down to as low as 20Mb/s *but adds 5ms to the latency*

- Intel Gigabit Network Interface Card (NIC) preferred
- RME Hammerfall PCI or PCIe audio interface preferred. (Isochronous data transmission – the two ends are not synchronised)

- LoLa 2.0 will add multi-camera and multi-site in Q4 2015

For any video over IP the final TV, monitor or projector is still the weak link… care must be taken to avoid the one or two frames of additional latency introduced by some displays. Look for low-lag gaming modes.

RECENT LOLA TESTING

- April 2015 The Hebrides Ensemble working with composer James Macmillan become the first professional ensemble to use LoLa in their work

- December 2014 – out first test using LoLa for teaching sound engineering between countries

- July 2014 Brian Alexander, former Senior drum major of the British Army led a drum core in Edinburgh and was joined by a piper and audience in Chicago – why was this particularly significant?

  - This was the first multi-channel use of LoLa - we sent the drum core in 5.1 surround

  - The latency was 120ms and we would not expect musicians to be able to perform with this amount of lag

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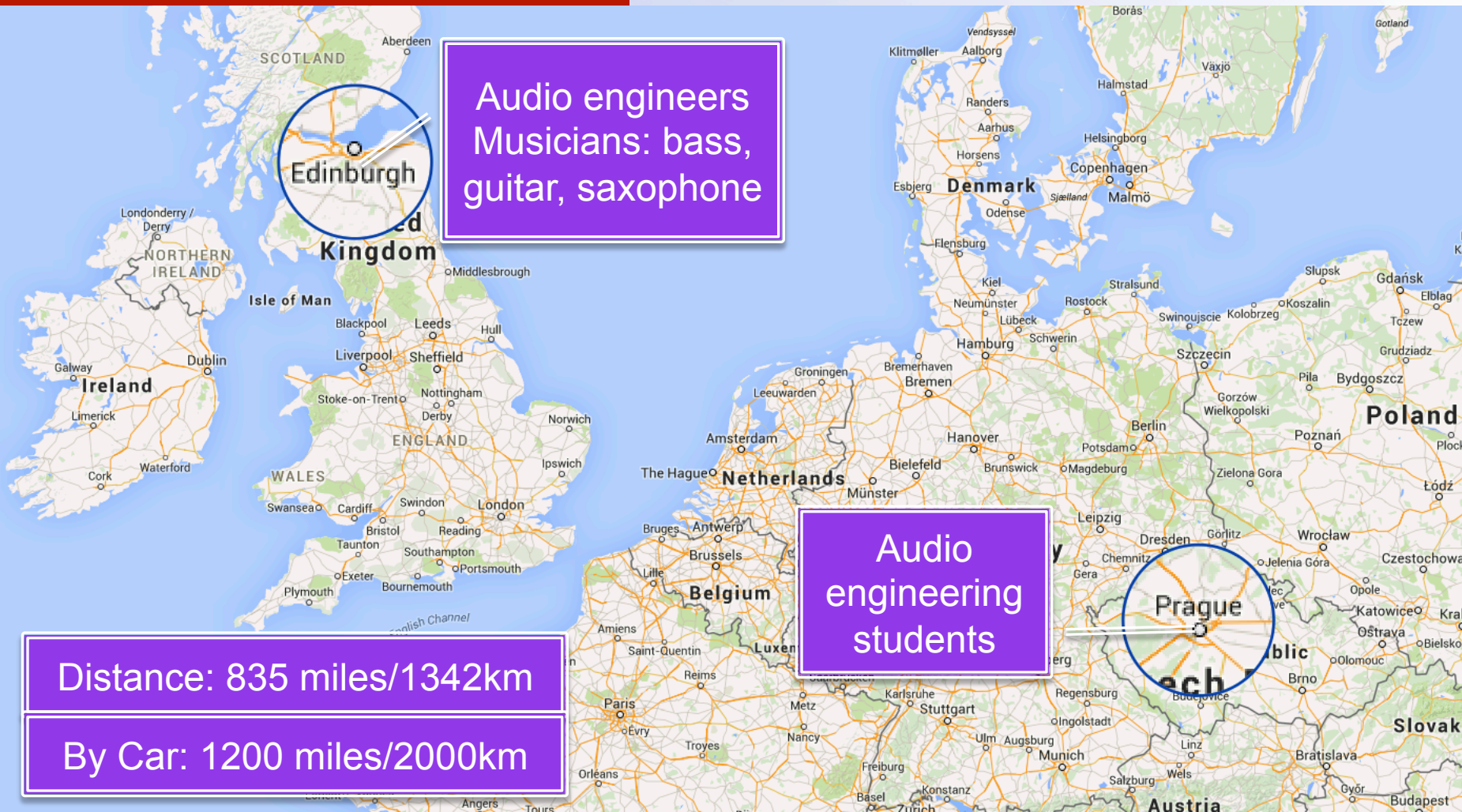UNIVERSITY

Modifying established workflows:

- BBC R&D successfully tested remote mixing during the 2014 Commonwealth Games:

    Their system, 'IP Studio' used Virgin Media Broadband and the Janet network to send 4K video and audio between production centres in Glasgow, Salford and London

    But……. the round-trip latency was close to two seconds requiring Producers to adapt their normal workflows

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Real-time remote mixing experiment:

Audio engineers
Musicians: bass, guitar, saxophone

Audio engineering students

Distance: 835 miles/1342km

By Car: 1200 miles/2000km

Edinburgh PC with LoLa software

- Eight microphones
- Mixing Console
- RME multichannel audio interface
- Bitflow video Frame Grabber card
- 1Gb INTEL-based NIC

- Eight channels of 24 bit 44.1KHz audio
- 60fps VGA colour video

- 500Mb/s data rate
- Bypassing firewall
- No Traffic shaping

- three channels of 24 bit 44.1KHz audio (stereo audio mix plus a communications channel)
- 60fps VGA colour video

- One microphone
- Mixing Console
- RME multichannel audio interface
- Bitflow video Frame Grabber card
- 1Gb INTEL-based NIC

Prague PC with LoLa software

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What about Latency?

□ Context: a 32 sample buffer in your DAW equates to 0.7ms at 44.1K sample rate (and the same again on the way out). A 256 sample buffer is 5.6ms – yesterday's connection test to Edinburgh showed 4ms each way

□ A working figure is 1mS latency per 100Km so 3000Km distances are feasible

□ Can musicians develop new skills to overcome latency?

In the Chicago test the distance was 6000Km with a round trip latency of 120ms, much more than the accepted maximum of 30ms to 50ms when musicians play together. (Chafe 2010)

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Do we need video?

- Many of the early users said video was not important to them but that has changed…

- HD picture and good lighting are key

- audio/video sync is important

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Continuing research

- Video compression to reduce the bandwidth requirement, HD video, LOLA between multiple sites - Done

- Pushing up the distance (partners in Italy and Czech Republic) - Done

- Teaching other creative mediums: modern dance with remote music ensemble – Done

- Simultaneous three-site collaboration – LOLA 2.0

- Immersive environments

- Better integration into professional workflows

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