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Conservatorio di musica Giuseppe Tartini Trieste

LOLA

(LOw LAtency audio visual streaming system)

A LOW LATENCY, HIGH QUALITY AUDIO/VIDEO TRANSMISSION SYSTEM FOR NETWORK MUSICAL PERFORMANCES AND INTERACTION

LOLA

(the team working to make the dream come true)

Production

Conservatorio di musica G. Tartini - Trieste

Implementation

Paolo Pachini: general coordination

Carlo Drioli: programming

Nicola Buso: testing and musical advice

Claudio Allocchio (Consortium GARR): testing and networking advice

Massimo Parovel: conception and supervision

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Musical Requirements to Play Together

- Audio Latency below ~75ms (depends on music gender)
- Eyes Contact to synchronize
- Spatial Sound immersion for expression
- Room Reverbering
- Continuous Presence of all musicians
- Non distracting environment

CCRMA

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Motivations and Objectives

- Target applications:
  - interactive musical tasks
    - Network musical performances
    - Network music education and training

... but also...

  - interactive on stage performances
    - Network Dance performances
    - Network Drama performances
    - Network performing arts education and training
    - ...

Motivations and Objectives

- ... and beyond:
  - remote real time surgery
  - virtual space immersion
  - ... you name it...

Let the user invent new possibilities...

Motivations and Objectives

- Challanges
  - Management of synchronous audio video streams over packet networks
  - Minimal delay requirements for interactive task and music performances
  - Optimal balance between AV presentation delay and quality
  - The speed of computer/networking equipments
  - ... and beyond: the speed of light...

Motivations and Objectives

- Targets of the project
  - A system suitable for musical performances relying on both audio and visual communication (but also other applications)
  - A Transparent and Natural end-user interaction
  - Providing lowest possible delay using available technology
  - Low cost and portable equipment
  - Oriented to dedicated high performance networks (LightNet Project, GARR, GÈANT, Internet2,...)

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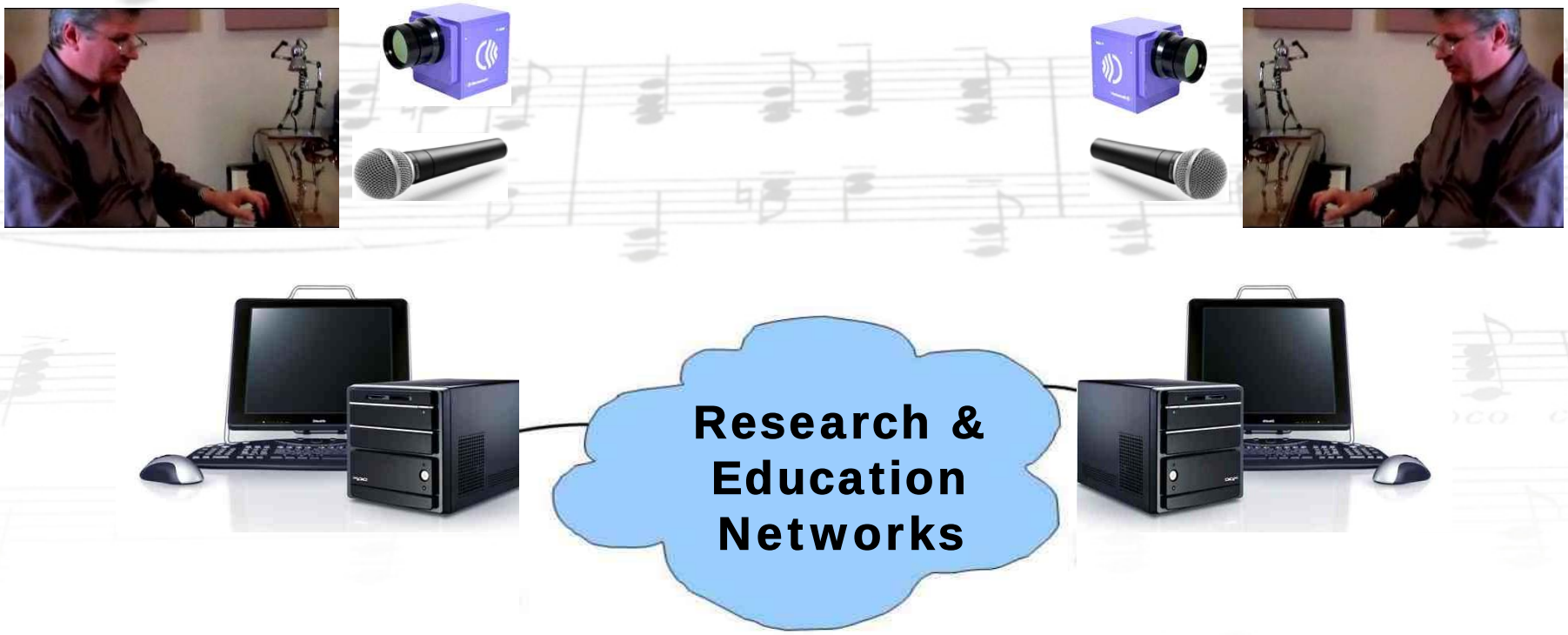
The LOLA system

a very basic schema

(well, what's the difference with DVTS, CXP?)



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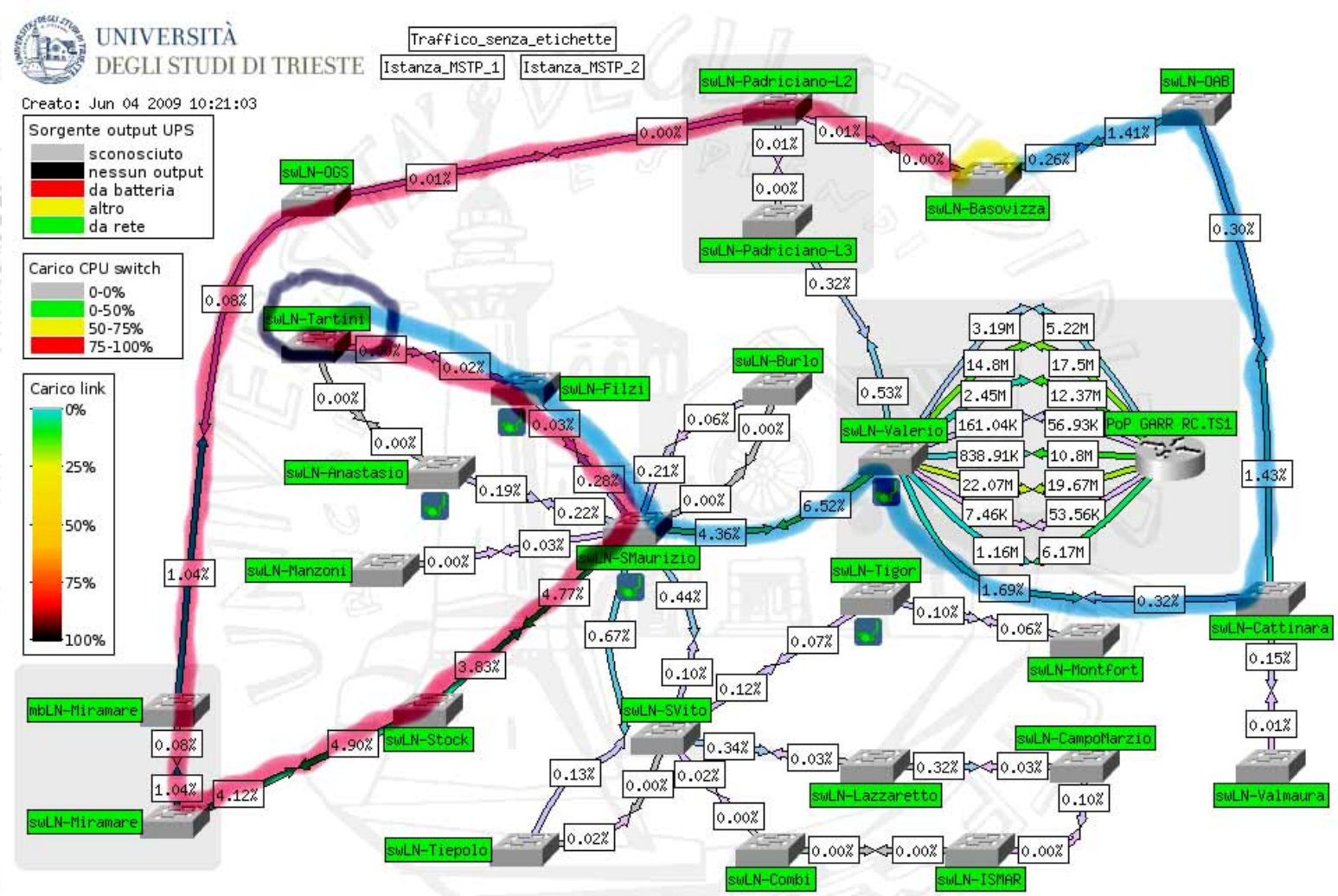
First results: 110km, 15 switches, 60fps, B/W

June 4th 2009 - Trieste fiber optics metropolitan network Lightnet



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Yes, we can try to play together!

First test with music: September 21st 2009

- Two Pianos, in two studio rooms at Tartini, linked over the loop with LOLA
- Round Trip Latency ~90ms

- monitor on the music score, “as if the other pianist was in his canonical ‘duo position’, e.g. in front”

- Tests performed:

  - One piano plays alone, with the return audio channel open; sound was coming back, but **no echo cancelling** needed;
  - Two pianos play together some scales and easy execises;
  - Two pianos play together some canone by J.S. Bach;
  - The latency is artificially increased to test interaction limits;

- We can try with a full setup and a real Piano Duo to get feedback

Bach Brandeburgh Concerts

Trevisan-Zaccaria Piano Duo: November 5th 2009

•Two Pianos, in two Concert Hall at Tartini, linked over the loop with LOLA
• Round Trip Latency ~80ms, mostly due to CODECs

• Sound Rendering, Room Environment, musician interaction with LOLA environment.

• Tests performed:

- Play Bach Branderburgh Concerts
- Roundtrip Latency tests
- Remote sound in (insulating) earphone vs audio monitors
- Adaptation techniques to delay

• They can play together, but too much attention is payed to handle the delay. No confortable environment for artistic performance.
• We need to go further down with CODECs delays

The Triangle Test

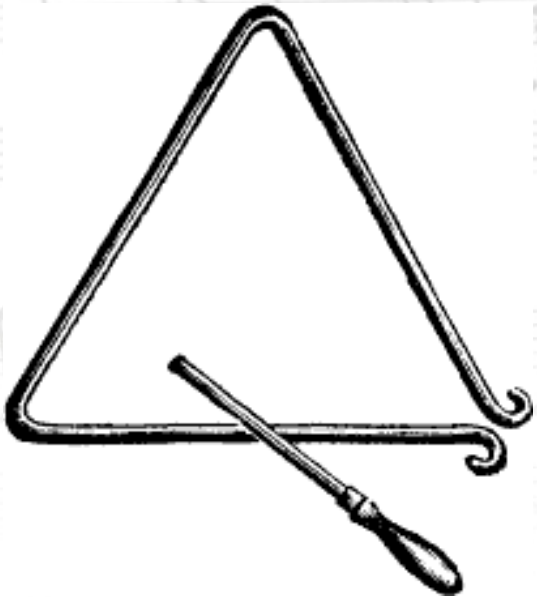
Experiments without WinSock: December 21st 2009

- Just a Triangle, to make accurate latency measurments
- New Round Trip Latency ~20ms !

- Tests performed:

  - Various buffers configuration to identify optimal results
  - Sound Quality check (sending recorded audio tracks)

- We can give Bach another chance to meet technology!



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Bach Brandeburgh Concerts (bis)

Trevisan-Zaccaria Piano Duo: February 4th 2010

- Two Pianos, in two Concert Hall at Tartini, linked over the loop with LOLA
- Round Trip Latency 20ms (artifically up to 70ms)

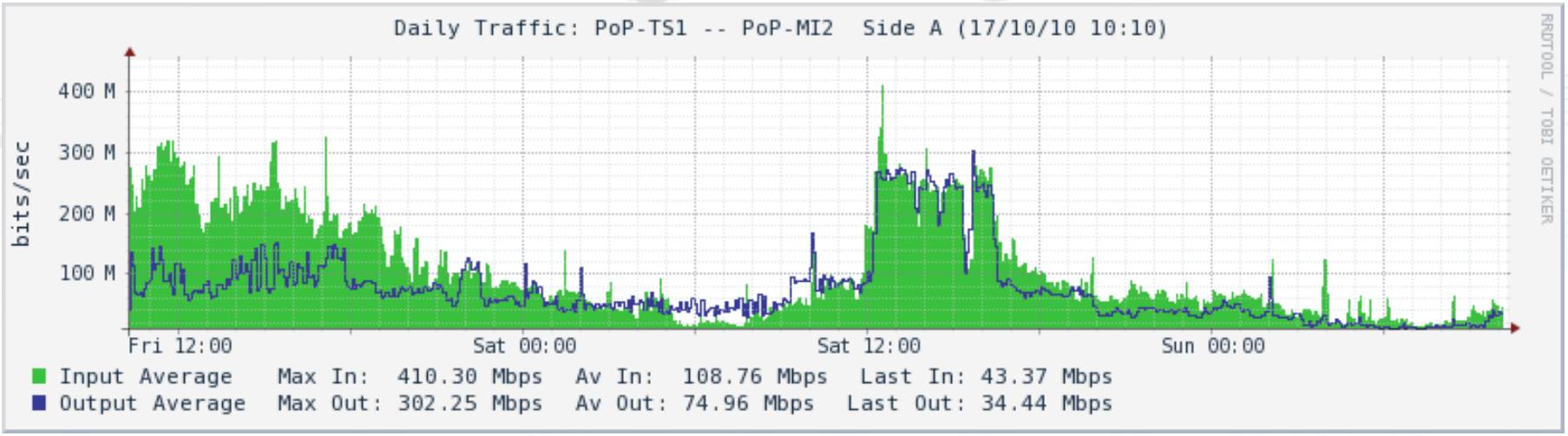
- Tests performed:
  - Play Bach Branderburgh Concerts

- They started to play... and played them all!
- Natural interaction
  - Many tests to refine the Sound Rendering of the remote piano.

Let's Try a shared real production network

Trevisan-Zaccaria Piano Duo: October 16th 2010
Trieste-Milan-Trieste loop; ~40ms

- Sound equalisation and spatialisation tests for the "remote" piano;
- it seems to run safely in the middle of the highway:



The Work In Progress...

- make further tests with musicians;
- make further tests on different network configurations:
  - longer distances;
  - routed networks;
- color impact (on h/w and network bandwidth);
- QoS implementation through DiffServ
- further optimize graphic card rendering;
- “simple” user interface;
- to develop a users’ community and to build common projects;
- to liaise with other potential users
- spatial audio rendering (multichannels)

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Questions?

http://www.conservatorio.trieste.it

Nicola.Buso@conts.it

http://www.garr.it

Claudio.Allocchio@garr.it