

Mengjie Qi

**Network Music Performance over IPv6:
Two Years CERNET2 Project to Create a Large Scale Piece**

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Abstract

Network music performance (NMP) has been developed since 90s with the cyber development, and the various involvements of media have enriched the presentation of this music performance. This paper will be a research update on the first year of a two-year CERNET2 grant and the periodical achievements in technical fields and artistic performances. The software *OSCGroups* was updated for the IPv6 platform in this project as a part of the goal in addition to the performances. The NMP brings musicians and composers into a community as Pauline Oliveros suggested that making music makes friends. This research is financially supported by CERNET Innovation Project.

Introduction

Network Music Performance (NMP) refers to a multi-locational live performance based on network platform for receiving and sending data within these locations at the same time, and musicians interact with each other just like in the same room. The latency between these spots and the stability of systems has been major issues for the live performance quality.

Our project “Network Music Performance and Multimedia Arts Based on IPv6 Network Platform,” granted to Ph.D. student Mengjie Qi at the Central Conservatory of Music in Beijing by the Chinese Educational Department, it was the only project out of 100 that was in the category of arts, and the main goals were to update the IPv4 version of the existing software, which is *OSCGroups*, to the IPv6 version for the new network platform, and to achieve a large-scale piece with nearly 10 performers from multiple places world widely. The more people get involved, the more complicated system it would be. The delay time from Internet and the audio interface is impossible to be resolved permanently. In our projects, we take the advantage of the delay time between different time zones, and to harmonize the parts with improvisation, rather than intentionally avoiding or trying to diminish it.

IPv6 vs IPv4 and updates

The main difference between IPv4 and IPv6 network platform is that IPv4 uses 32 digits but IPv6 uses 128 digits to localize the IP address. With the new version of Internet protocol, less traffic is going through IPv6, and the whole system stability is on a new level as well. The most common network platform has being IPv4 in many countries; in the recent years, more and more institutions have updated their national network platform into IPv6. In the first year of our project, we updated the *OSCGroups* to be compatible with IPv6, to meet the needs of

newly upgraded IPv6 for more stable systematic processing and more uncompressed data via network and it turned out well and productive in the performance.

OSCgroups

OSCgroups is a system for routing OSC messages between a group of collaborating users and has been widely used and taught around the world. It is designed to make joining and leaving a group simple, and to overcome the problem of connecting multiple users behind different NAT routers using a NAT traversal server with the usual “NAT hole punching” scheme¹. OSCgroups utilizes the UDP (User Datagram Protocol) to provide the less delayed data; therefore a high stability of the Internet environment is required. The packet loss ratio at the Central Conservatory of Music network was more than 90 percent on IPv4 network; After the OSCgroups updated on IPv6 network, the packet loss ratio for data transmission between international locations became less than 3 percent, which was a very large amount of improvement. The reason why packet loss ratio went to this small amount was that the performance data did not occupy much bandwidth, so the whole data system was more stable. This improvement will surely bring more possibilities for professional performance and research.

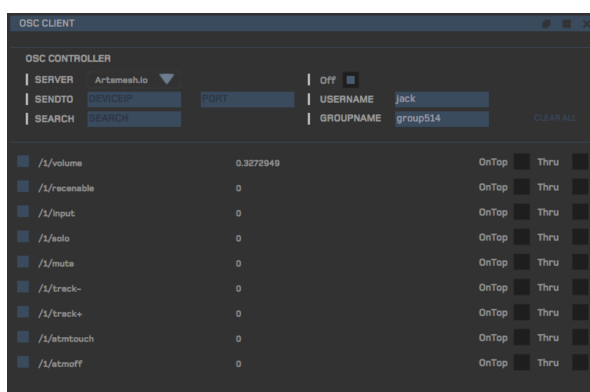


Figure 1: OSCgroups panel in Artsmesh

Jacktrip

Jacktrip² is a system for high-quality audio network performance over the Internet developed by Chris Chafe and SoundWIRE group at CCRMA. It is used for multi-machine network performance over the Internet of bidirectional, high quality, uncompressed audio signal streaming. Pauline Oliveros used it for her network music performance in the 2006; she discovered that much better CD quality audio signals could be transmitted via this software. It is the main signals transmission software we apply in the network music performance projects for sending and receiving the uncompressed audio data.

Artsmesh

Artsmesh is a professional software routing the uncompressed multichannel audio data to multiple locations, it is a complete toolkit for network performances of any kind. It functions

¹ <http://www.rossbencina.com/code/oscgroups> (last accessed 01/18).

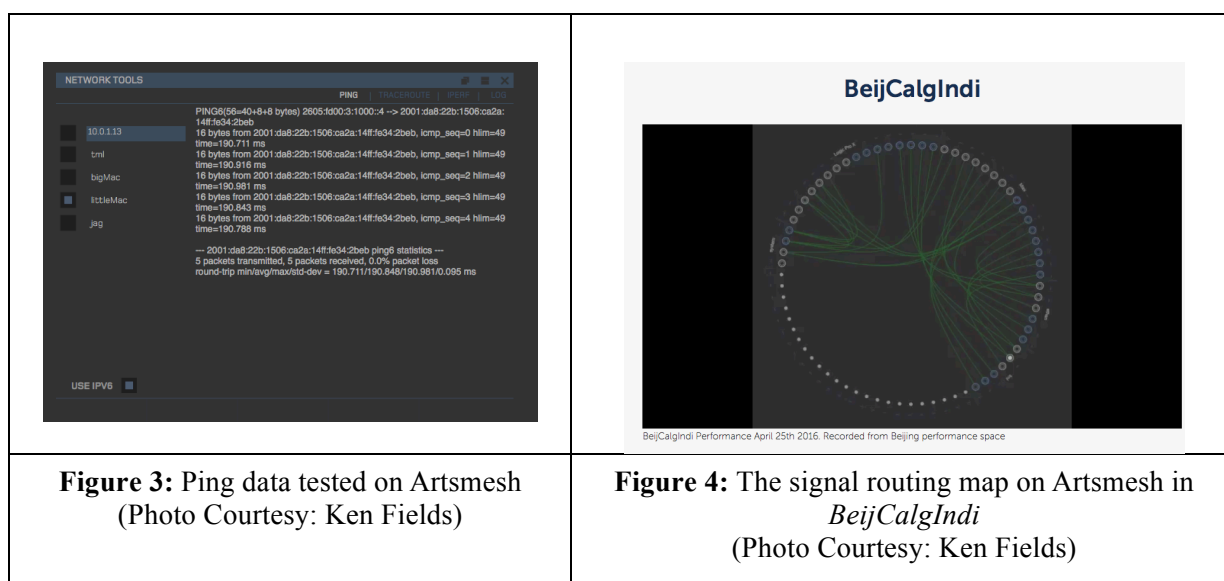
² <https://ccrma.stanford.edu/groups/soundwire/software/jacktrip/> (last accessed 01/18).

in many ways, such as live network music performance, P2P broadcasting, open source audio control interface, score sharing and data streaming. In our project, it is the main interface to communicate with performers in multiple locations and to stream the performance to the Internet live.

The modules of Artsmesh are specially designed for the network music performance regarding to the time zone difference and delay time, it has the world clock, OSC panel, network tools, score, mixer, data mapping, broadcasting and social panels, etc. As long as the signal routing has connected with each other, the ping data will be detected.



Figure 2: Artsmesh user interface



Based on the tests in the past two years, the delay time between Beijing, Calgary and Indiana are as shown below:

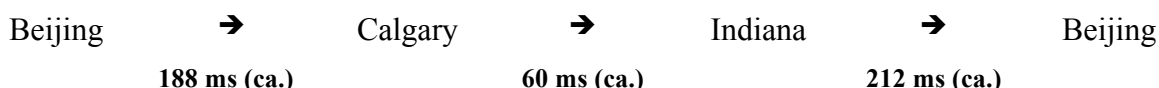


Figure 5: Latency between three locations on IPv6

Two performances had been streamed in the last two years, one was the *BeijCalIndi* composed by Ethan Cayko in 2015 and the *Grit for 3 or more distributed performers and electronics* by Naithan Bosse in 2016. As an example of the performance, we will briefly discuss the *Grit* and introduce how the performance usually arranged in this art form.

The idea of this piece is to use polyrhythms. There are five sections in this piece; each performer is assigned a number from 1 to the total number of performers. Instruments capable of sustaining long tones should be assigned lower numbers. Numbers should be assigned in an order that alternates between the sites as evenly as possible.

Sections 3-5 can be performed in any order. These sections are cued using three signaling gestures. These signal gestures should be familiar to all the performers and each section could be repeated while playing. Once the pulse is brought into alignment between the three, then it

may still have the approximately 3:1 (Calgary/Indiana to Beijing is about 200ms); Indiana to Calgary is 66ms delay.

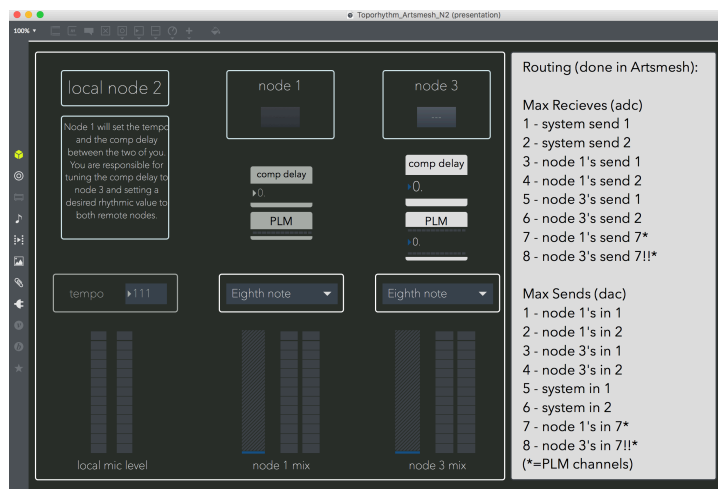


Figure 6: Max patch for counting delay and arrange the section orders
(Photo Courtesy: Naithan Bosse)

Global Loops

Global Loops is a large-scale network music piece for performers from multiple locations. It is interactive and collaborative work, the idea of this piece is from that gears are connected altogether to work at the same time, but each of them is in different size and working in different phase. In this piece, we compare each gear as a location with particular network situation and delay time. Some of the locations might still use the IPv4 network, which means the bandwidth and the latency are different with other places using IPv6. Our modus operandi is to not add artificial delay and to feature the irrational inter-nodal latency ratios that determine the rhythmic and harmonic features that are serendipitous to any particular configuration of participants and will be unique in every networked case. We define the performers involved in the project as a whole ensemble, every location presents for one or several parts of the music.

Generally speaking, the music materials of this piece consist of two categories, which are loops and instrumental live music performance. Even though the structure of this piece is open and flexible, with the arrangements beforehand, each part of the music will start in a certain order, as long as the first loop is playing, the other performers will be ready to jump in the loop cue and play the live instrument on their sides at any time. The participants will come from Asia, North American (New York, Indiana, Calgary are participating.), Europe and New Zealand. Every region will rehearse with the other institutions in the first phase, then all the participants will rehearse together and perform the piece.

From the technical perspective, all the loop materials from each location will be in stereo channel for a better sound quality and a more enjoyable playback situation for all the participants, and the instruments will be in mono channel because most instruments will use one microphone to pick up the sound. The performers will communicate with others over the Artsmesh, which will provide a way to separate the talk from music signals. The structure of this piece is quite open and flexible, every musician could come in and drop out, and come back in again as they improvise.

The performance will be live streaming online, and the teleconference system will collect the real time video signal from every place and project on stage. With the visual assistance, the audience will be easier to have a sense about what is going on and where each part of music is coming from, the multisensory perception might be distracting the attention from the audience, but beyond all doubt, it surely is helpful for the audience and musicians to conceive the music and performance.

Conclusion

The IPv6 network has provided the advantage for a better quality of the data transmission, and also meets the need of the composers and musicians to collaborate and experiment. The two years' research of network music performance on IPv6 we are conducting is one of the practices, and it is a well beginning for a promising domain. We believe that more involvement of this project, the better of the music will be presented, and the network music community will bring more fresh energy to the new music and multimedia world.

References

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