JackTrip Network Music Technology

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Network Performing Arts Production Virtual Workshop
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Overview of JackTrip

JackTrip is a system for high-quality audio network performance over the internet that supports bidirectional, low-latency, multichannel, uncompressed audio streaming.

Developed by Chris Chafe and his team at the Center for Computer Research in Music and Acoustics (CCRMA) in Stanford University, JackTrip has been in use since the early 2000's for live contemporary network arts performance. Pioneering artists in contemporary acoustic and electronic music fields utilize JackTrip with artistic practices including improvisation, composition, and gesture designed for the network arts medium.

Since the Covid-19 pandemic, JackTrip has been adapted for use on home internet connections with wide applications for professional music and music education. The pandemic has ushered in a new phase of development driven by musicians seeking solutions during lockdown. Many developers and musical practitioners have joined in the cause of finding adequate solutions.

What’s Changed that Makes Home Networks Possible

Historically, **JackTrip** has been used between institutions with access to research networks.

- Connecting from home had issues
  - insufficient throughput for even one uncompressed channel
  - router configuration challenges
  - lag was greater than research networks, paths were odd
- Those issues are gone
  - 3000 packets-per-second using commercial ISP's
  - plenty of bandwidth, often much more than two channels worth
  - cloud-based Hub servers are geo-located
  - lag is as good as research networks
  - hosted servers eliminate need for port opening on home routers

JackTrip Organizations

JackTrip is a software application with a **GitHub project** site and a number of contributing developers. It is now complemented by dedicated solutions including numerous Raspberry Pi-based systems, standalone physical web devices, and browser-based WebRTC and Pure Data versions. Major improvements have focused on ease of use and the ability to scale across worldwide cloud infrastructure.

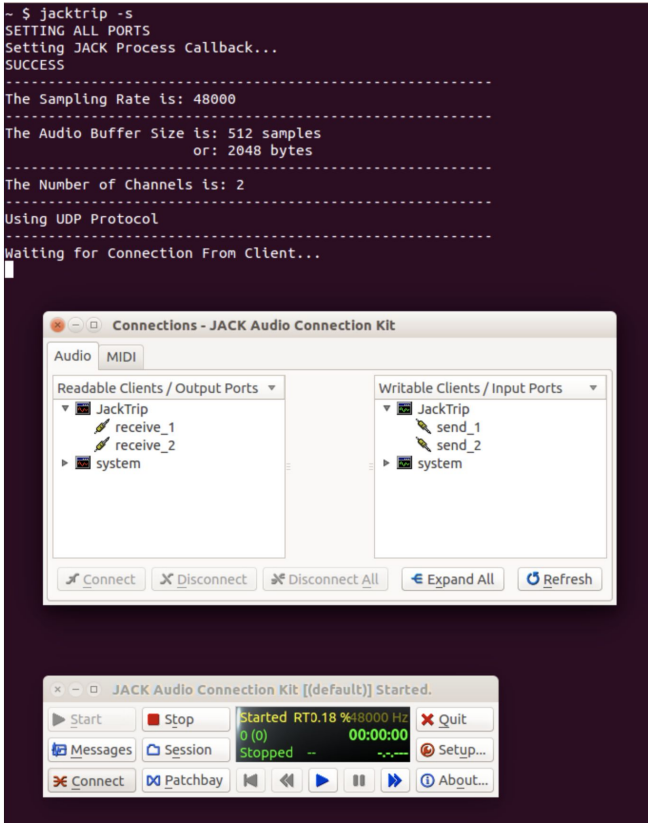
JackTrip Foundation and **JackTrip Labs** have been established for ongoing support, training, and development of the technology and network arts field. https://www.jacktrip.org

Within this ecosystem, we will discuss **JackTrip Open Source** and **JackTrip Virtual Studio**.

JackTrip: Open Source

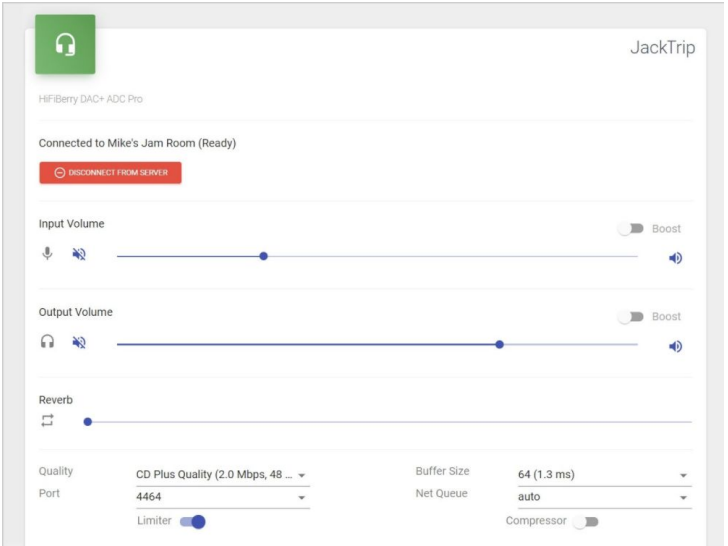
JackTrip Open Source software runs on Linux, Mac, Raspberry Pi, and Windows. It's best suited for trained professionals and researchers (who are comfortable with command line operation) while new GUI-based projects are broadening its accessibility.

JackTrip operates together with physical and cloud servers in either **Hub** or **Peer-to-Peer** mode for a variety of configurations depending on the priorities of the project. Presently for home use, Hub mode with remote servers (physical or cloud) allows small and large ensemble sizes to connect with low bandwidth for each user (1Mbps for mono, 2Mbps for stereo) and low latency. This model will be demonstrated in the Network Arts Ensemble performance today.



JackTrip: Virtual Studio

JackTrip Virtual Studio is a plug-and-play commercial service version of JackTrip consisting of Virtual Studio hardware device and JackTrip Web Service servers.



Scenarios for Use

- **Anyone** -- professional, amateur and educational
- **Any size** -- from duos to chamber groups and large ensembles
- **Anywhere** -- from metro regions (ultra-low-latency, < 10msec one-way) to intercontinental

- **JackTrip Open Source** (trained operators)
  Linux, Mac (High Sierra or later), Raspberry Pi, Windows 10
  Ethernet with 5Mbps+ each direction
  Audio interface, headphones, microphone(s) appropriate for instrument

- **JackTrip Virtual Studio** (public participants)
  Virtual Studio device and kit
  Ethernet with 5Mbps+ each direction
  Computer or device to access web application