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Invention:

Expandable, decentralized audio signal mixing system based on standard network technology for real-time audio applications with integrated multi-track recording capability.

Abstract:

The invention is an expandable, decentralized audio signal mixing system that utilizes standard network technology (e.g. Ethernet) as a backbone, and standard network hardware (e.g. Ethernet switches) for system unit interconnectivity. In contrast to a centralized system, there is no master unit required for functionality and no fixed number of mix busses. As more system units are added, the number of mix busses increases respectively. Additionally, placing the inputs directly onto each system unit allows the addition of as many audio inputs (or channels) as the network standard will accommodate. Every system unit gives an operator individual control over all available system input signals. Consequently, each system unit operator can create a unique stereo mix and can decide how their specific mix is to be reproduced (head-phones, in-ear monitors, loudspeakers, etc). All signals existing on the network are available in an unaltered state (unmixed, unprocessed) for additional uses (e.g. multi-channel output device connected to a traditional mixing console). In addition, the mixing system allows for instantaneous multi-track recording of those unaltered signals without additional external recording devices.

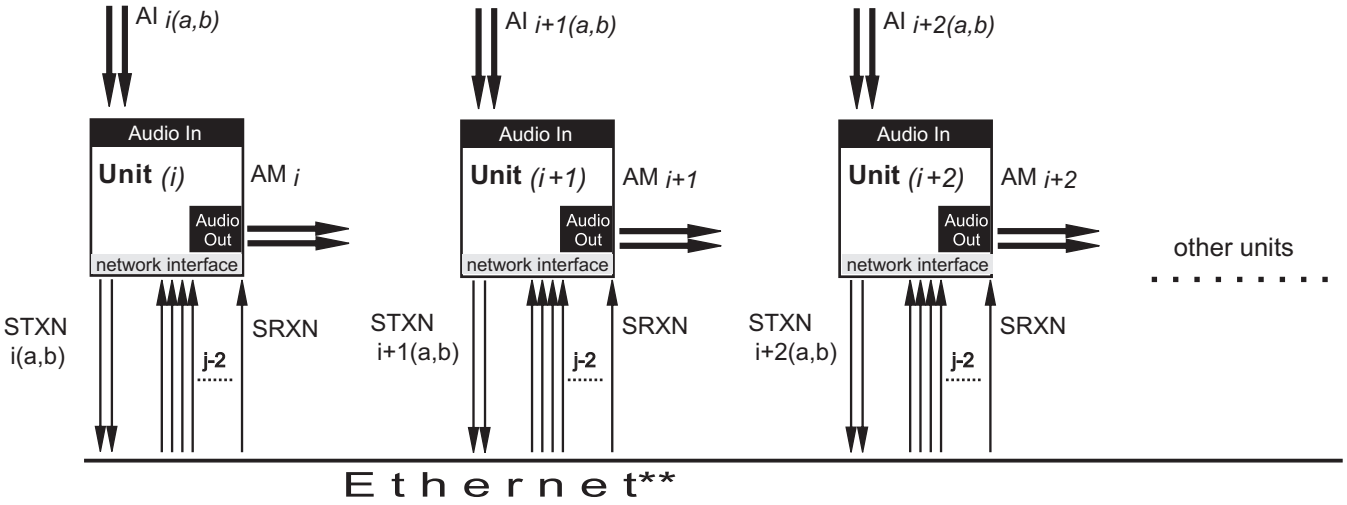
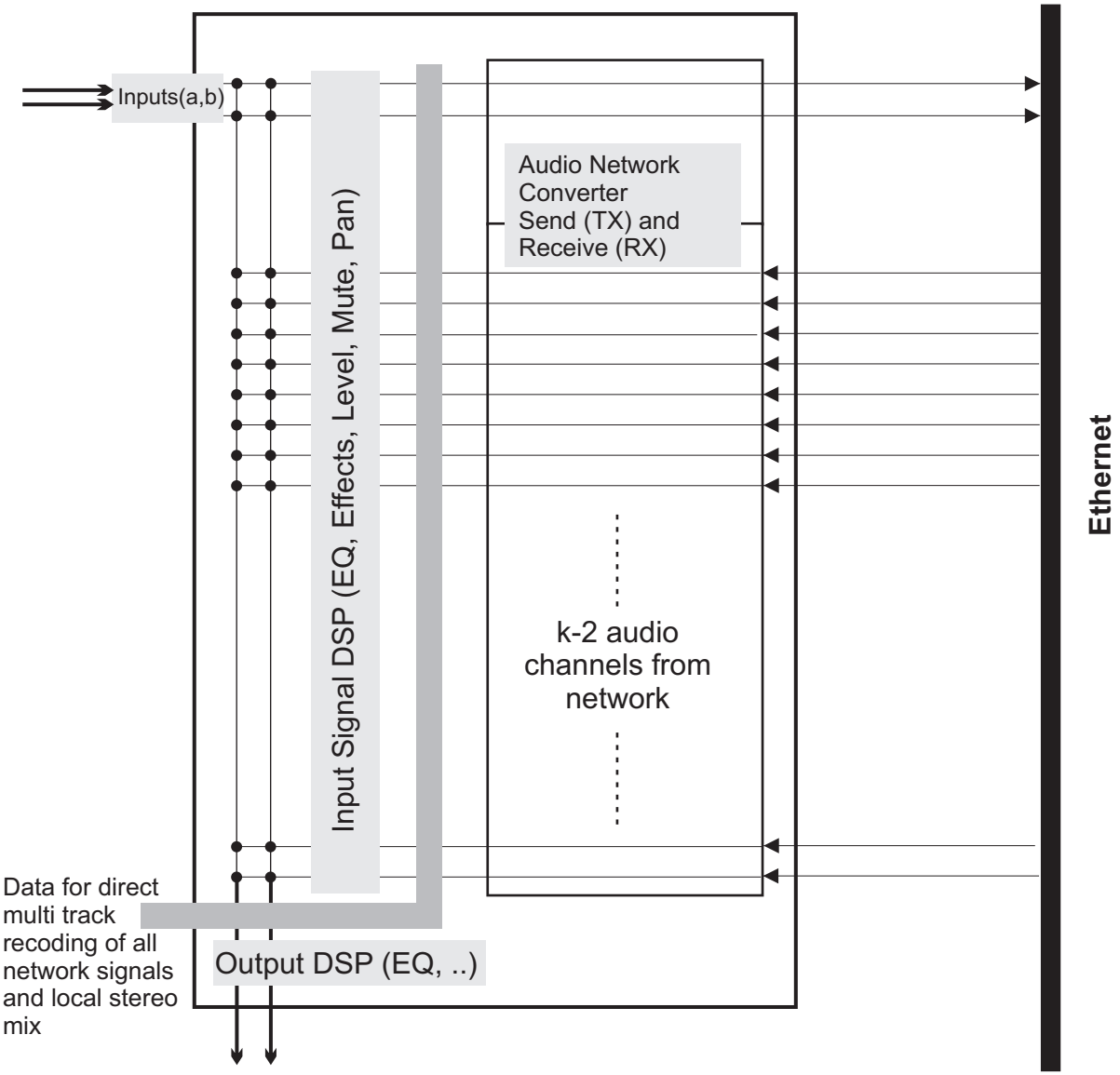


Fig. 01 Schematic Network of k units creating a mixing systems with 2*x k inputs and k/2* stereo mixes

Each unit (i) is connected via a common connection (which has to fulfill the requirements for live audio) to a IT network (e.g. Ethernet. It provides local audio inputs (e.g. two*) and a stereo audio output. The unit transmits the local input signals (e.g. two “a,b”) to the network, from which it receives all other input signals, transmitted by the other system units. The units DSP block allows equalization, level, mute, panorama and effects for each available signal, so that with each unit an individual mix, comprising all network signals can be created. That stereo mix signal is available on the audio output of the unit. There is no central master module needed. With the expansion of the system by adding units, also mix busses are added, which allows per unit a completely separate and independent mix utilizing all the same signals on the network. For user friendliness it is recommended to have a auto-detection on the network. The protocol used in the system needs to allow the data traffic on network that suitable for real time live audio especially with respect to audio frequency bandwidth and signal latency . There are several protocols available, for example Fast Ethernet100BASE-T with Ethernet AVB, or Dante as audio protocols.

Fig. 02 Individual unit with e.g. 2 audio inputs and k-2 other input signals



The individual system unit has e.g. two (or more) audio inputs (either analogue, microphone or line level, or digital, depending on model), which are converted according to the network protocol (e.g. Ethernet AVB). The unit receives all other input signals on the system via the same network interface. The DSP in the unit allows each signal (the local inputs as well as the network signals) to be edited in sound (e.g. Eq, effects, dynamics,...) and via level control and panorama control brought into the individual mix of the unit. That mix can e.g. be used from an individual musicians to create the exact monitor mix of all signals available how he/she would like to hear it to allow for maximum performance and musical feeling. In addition that mix, as well as all the other individual input signals are available separately and can easily be recorded locally (e.g. on a SDHC card) for further use.

Footnotes and indices

AI	Audio Input , for simplification two signals shown: (a,b), could be multiple if wanted.
AM	Audio Mix, locally mixed with all j signals, stereo
STXN	Audio signals (a,b) sent to network (two signal for simplification, could be multiple signals if wanted)
SRXN	Individual signals from other units received from network:

i	index for unit and it's signals, i=n+1, with 0<= n <= j
j	number of units used in a system, j = l-k with l being the maximum of nodes in the network (e.g. 1024 with Ethernet) and k being the number of switches used.

*) NOTE: two inputs per unit (e.g. a,b) are just used as an example. The system can also allow units with more then two local inputs. It's also not a requirement to have the same amount of inputs per unit, e.g. units with two, four, eight can all work in the same system.

**) Ethernet is used as an example for a network that fulfills the requirements for applications in live, real-time, full bandwidth audio, however the system is not necessarily limited to Ethernet.