Chapter 2  Related Work

Several methods have been proposed for overcoming the lack of network audio functionality in the X Window system and for implementing audio applications in UNIX-based operating systems, such as Basic Network Audio System, Network Audio System, Enlightened Sound System and The Broadway Audio System, we describe them in section 2.1-2.4 respectively.

2.1. Basic Network Audio System (BNAS)

BNAS is a basic client/server solution to forward any audio stream through a TCP connection and play it from another computer. It was developed because all other implementations (NAS, XAudio) require some kind of specific support compiled into all the audio applications.

However, the BNAS cannot support multiuser operation, so that all the audio data delivered by the programs of different users must be forwarded to the same destination. Besides, the ioctl system call is not allowed.

2.2. Network Audio System (NAS)

The Network Audio System was developed by Network Computing Devices (NCD) for playing, recording, and manipulating audio data over a network. The NAS consists of a server which drives the hardware and an programming interface library against
which client applications are linked.

The NAS allows easy use of audio over the network, but audio applications must be
designed to invoke the subroutines in the new network audio library. It is said that the
program cannot use any audio data format or device types that are not defined in the
network audio library.

2.3. Enlightened Sound System (Esound)

The Enlightened Sound System has a stand-alone sound daemon which abstracts the
system sound device to multiple clients. Under Linux using the Open Sound System
(OSS), as well as other UNIX systems, typically only one process may open the sound
device. The Esound runs as a background process and allows several audio streams to
use one device. It connects to the sound device and accepts connections from multiple
clients, mixing the incoming audio streams and sending the result to the sound device.

Applications wanting to contact the Esound daemon do so using the libesd
library.(See Figure 2) For a Esound client local to the machine which the Esound
daemon is running on, the data is transferred through a local socket, then written to the
sound device by the Esound daemon. For a client on a remote machine, the data is sent
by libesd on the remote machine over the network to the Esound daemon. The process
is completely transparent to the application using Esound.
The Esound allows multiple clients to use one device, but only in single-user mode.

2.4. The Broadway Audio System (Xaudio)

The Broadway Audio System uses a client-server architectural model, where audio hardware is abstracted into the server, and the application becomes a client of that server to obtain audio services. The application becomes a client of the server by opening a connection to the server. The System defines three components: the API that the client uses to interact with the library, the protocol that the library uses to interact with the server, and the objects that the application manipulates via the library and protocol. Objects exist on both the client and server sides, depending on what services they abstract. But this system hasn’t been developing since 1995.
Table 1: A compare table of network audio systems

<table>
<thead>
<tr>
<th></th>
<th>Multi-user</th>
<th>The audio application needs to call a new audio library.</th>
<th>Multi-open</th>
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</thead>
<tbody>
<tr>
<td>BNAS</td>
<td>×</td>
<td>√</td>
<td>×</td>
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<tr>
<td>NAS</td>
<td>√</td>
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<tr>
<td>Esound</td>
<td>×</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>XAudio</td>
<td>√</td>
<td>×</td>
<td>?</td>
</tr>
<tr>
<td>MuNAS</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

In Table 1, we could know that BNAS don’t need additional library like our system, but it don’t support multi-user and multi-open, i.e. the audio mixing. In the aspect of multi-open, Esound support this but there is an additional library need and it is in single-user mode. Though there is multiuser functionality in NAS and XAudio, they also need added libraries in order to implement.