

Engineering an Accessible Music Library: Technical and Legal Challenges

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1 Introduction

Digital music has provoked a shift in the way music is sold. Instead of purchasing a compact disc recording, consumers may now copy one illegally from a stranger via file-trading networks that are themselves barely legal.¹ As a result, the major music distributors have invested millions of dollars in combating illicit distribution by offering their own services to sell music to consumers digitally and instantly.²

But digital music has not provoked a change in the way music is traditionally shared, that is, the technology of music libraries and radio stations. This is partly because it is not clear how libraries and stations can take advantage of the benefits of digitization under existing copyright law. Public libraries still distribute physical compact discs, audio cassettes, and vinyl records. With limited exceptions for material used in music classes, university libraries are in the same boat. Indeed, the only reason libraries are allowed to share audio recordings at all is because of a special exemption in the copyright law: the sharing or renting of audio recordings by for-profit entities is forbidden.³ Similarly, the only radio stations to have taken advantage of new ways of broadcasting made possible by digital technology, XM Radio and Sirius Radio, were provided with a special exemption in the Copyright Act that is no longer available to newcomers,⁴ and even so XM appears to have exposed itself to possible copyright infringement liability on a massive scale.⁵

In this paper, I outline a new distribution scheme appropriate for university and public libraries that provides significant benefits in accessibility of music to patrons. This system—a combination of a library, a radio station, and a

¹MGM Studios, Inc. v. Grokster, Ltd., No. CV-01-8541, 2003 U.S. Dist. LEXIS 6994 (C.D. Cal. April 25, 2003) (“Grokster” and “Fasttrack” services not contributory infringers); *In re Aimster Copyright Litig.*, No. 01-c-8933, 2002 U.S. Dist. LEXIS 17054 (N.D. Ill. Sept. 4, 2002) (“Aimster” or “Madster” service found likely contributory and vicarious infringer); *A&M Records v. Napster, Inc.*, 239 F.3d 1004 (9th Cir. 2000) (“Napster” service infringes).

²Universal Music and Sony have launched Pressplay, since sold to Roxio, the company that bought the Napster name. EMI, Bertelsmann, and Warner Music founded a similar service, MusicNet. And Apple Computer launched the iTunes Music Store earlier this year. Amy Harmon, *Deal May Raise Napster From Online Ashes*, N.Y. TIMES, May 19, 2003, at C1. These services operate under license from the major labels and music publishers and provide music with varying degrees of software restrictions.

³17 U.S.C. § 109(b)(1)(A) (2000). This produces the amusing situation where it is legal for a business to rent out a book, and legal to rent out a video recording of someone reading the book, but not legal to rent out an audio recording of someone reading the book.

⁴Exemption for “preexisting satellite digital audio radio service[s],” 17 U.S.C. § 114(d)(2) (2000).

⁵See section 4.2 below.

jukebox—is made possible by digital music compression and the Internet, but at the same time rests critically on analog distribution. I discuss the hurdles implementing this system at the Massachusetts Institute of Technology, where I expect to launch our new digital music library, known as the Library Access to Music Project, by this fall.

The goals for LAMP were to provide on-demand access to a wide range of music to students at MIT. The system, now in beta testing, allows students and faculty to “check out” a channel on the MIT cable television system for their exclusive use for 80 minutes. During that period, they may request, via a Web site, any CD or individual track from the system’s repository, and it will play over the TV channel allocated to the user. (Additionally, a simple video display shows the title of music playing on each of the channels allocated to the project and the name of the user controlling the channel.⁶) Anyone may listen to the music, but only the user controlling the channel may fast-forward, rewind, skip tracks, or select additional music. With the resources MIT Cable has allocated for the project, 16 channels may each be individually controlled by a different user at a time.

A variety of analogies describe the project: a music library with 16 seats, an array of 16 jukeboxes that anyone may listen to across campus, a pool of CDs shared among dormitory residents, a music library where you can call up the librarian and ask to have a CD played into the telephone, a city with 16 radio stations, each taking requests. But the particular architecture chosen for LAMP was motivated by technical and legal challenges in three areas: playing the music, responding to requests for music-on-demand, and loading music on the system. I discuss each in turn.

2 Playing Music

2.1 Technical Challenges

The technical requirement for LAMP was to be able to play audio of as high fidelity as possible over the MIT cable television system on 16 channels at once. With the assistance of MIT Cable, we purchased a PC-compatible 1.8 GHz Pentium 4 rackmount server⁷ with two M Audio Delta 1010 sound cards.⁸ Each provides eight channels of 24 bit 96 kHz audio output. The outputs from each sound card feed into 16 Blonder Tongue AMCM-806 rackmount modulators,⁹ and into a 16-channel combiner¹⁰ and finally into amplifiers for the MIT cable system.

⁶See *Privacy*, below.

⁷\$3,900 total, including the sound cards.

⁸\$1,000 each at purchase.

⁹\$240 each. The modulators support stereo audio input using the FCC-recommended EIA TVSB No. 5 specification, but do not produce stereo audio from separate channels by themselves.

¹⁰\$190.

On the software end, we needed to be able to saturate 16 channels at once. We chose the Ogg Vorbis audio compression system because it is believed to be unencumbered by patents and is designed by an MIT alumnus and acquaintance.¹¹ Using the provided `vorbisfile` API, I implemented a single-threaded 16-channel stereo decoder that outputs monophonic audio. When all 16 channels are in use, the system CPU is approximately 80% non-idle (including the video display, discussed below).

The system's quality is acceptable but not stellar. We have measured total signal-to-noise ratio, on a cheap television, at approximately 45 dB, or between 7 and 8 bits of resolution. Bandwidth extends from about 30 Hz to 13 kHz. We are optimistic that fancier FM-reception hardware, such as in a modern VCR, will produce better results. We have not yet begun to implement the stereo standard (including noise reduction), which requires either \$200-per-channel stereo encoders or implementing the EIA specification in software (and using the 96 kHz capability of the sound cards).

2.2 Legal Challenges

Does playing copyrighted music over the MIT cable television system require the permission of the copyright owner? To answer this question, we must first note that there are generally two copyrights in a piece of recorded music. There is the copyright on the underlying *composition*, known as a “musical work.” And there is a separate copyright on the *sound recording*.

For instance, Jesse Harris won the 2003 Grammy award for song of the year for writing the song “Don’t Know Why.” Under the federal Copyright Act, he (or anybody he has assigned the copyright to; in this case Sony/ATV Songs) owns the copyright on this “musical work” as soon as he writes it. And in general, the copyright owner’s permission is necessary to perform any of the so-called “exclusive rights” of the copyright owner, enumerated in 17 U.S.C. § 106 (2000):

Subject to sections 107 through 122, the owner of a copyright under this title has the exclusive rights to do and to authorize any of the following:

1. to reproduce the copyrighted work in copies or phonorecords;
2. to prepare derivative works based upon the copyrighted work;
3. to distribute copies or phonorecords of the copyrighted work to the public by sale or other transfer of ownership, or by rental, lease, or lending;
4. in the case of literary, musical, dramatic, and choreographic works, pantomimes, and motion pictures and other audiovisual works, to perform the copyrighted work publicly;
5. in the case of literary, musical, dramatic, and choreographic works, pantomimes, and and pictorial, graphic, or sculptural works, including the individual images of a motion picture or other audiovisual work, to display the copyrighted work publicly; and

¹¹Christopher M. Montgomery '94.

6. in the case of sound recordings, to perform the copyrighted work publicly by means of a digital audio transmission.

So, for instance, to reproduce “Don’t Know Why” in copies or “phonorecords” (e.g. compact discs), you need Jesse Harris’ permission. And to “perform the copyrighted work publicly,” you also need his permission. Would playing “Don’t Know Why” over the MIT cable television system without his permission infringe this right to perform “publically”? Although it is not crystal-clear that it would,¹² transmitting a song over MIT Cable probably does constitute a public performance.

Fortunately, for purposes of licensing public performances in America, virtually all songwriters and composers have delegated the power to license these performances to one of three organizations: the American Society of Composers, Authors & Publishers (ASCAP), Broadcast Music, Inc. (BMI), and SESAC, Inc., formerly the Society of European Stage Authors and Composers. All three are in New York City within four blocks of Columbus Circle, and all three are happy to issue blanket licenses to universities. In fact, most universities already have licenses from all three organizations.¹³

MIT now pays 5.25 cents per student per year for blanket cable television rights from ASCAP and BMI. SESAC includes on-campus cable television rights in their standard university license. The total price for performance rights paid by MIT is about \$4,000 a year.

But this is not the only copyright to contend with. There is also the separate copyright in each *recording* of Jesse Harris’ song. The most popular recording of this song, by singer Norah Jones, won the 2003 Grammy for best female pop vocal. The copyright on the recording is owned by Norah Jones or anybody she has assigned it to: in this case, the Blue Note Records division of EMI Music.

Do we need EMI’s permission to play “Don’t Know Why” over MIT Cable? Here the critical language is subparagraph 6 of § 106: “in the case of sound recordings, to perform the copyrighted work publicly *by means of a digital audio transmission*” (emphasis added). As long as our transmission (over MIT cable) is analog (like most television), we do not need Norah Jones’ or EMI’s permission to play her song, nor do we need their permission to play the song over the radio. If we were to transmit the music to students digitally instead (e.g., over MIT’s computer network), we would have to seek permission (which we believe would be excruciatingly difficult to obtain for most songs, with no acceptable bulk-licensing procedure available) or try to obtain a “mandatory” license under 17 U.S.C. § 114 (2000), which forbids “interactive” or on-demand services.

This is the critical reason LAMP has a hybrid structure: it is controlled over the Internet, but the actual audio is played over cable television.

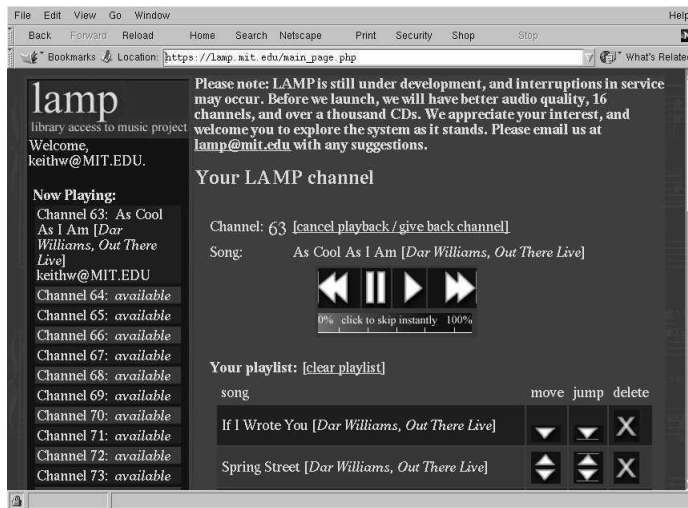
¹²The question for purposes of the transmit clause is at least partly whether the relationship between MIT and its students is a “commercial, ‘public’ one.” *On Command Video Corp. v. Columbia Pictures Indus., Inc.*, 764 F. Supp. 1372 (N.D. Cal. 1991).

¹³Note that university broadcast radio stations receive a special government-set price, currently \$578 per year, in the copyright regulations, at 37 C.F.R. § 253.5. Most performances by university orchestras and bands do not require a license because of the exception for in-person free performances by unpaid performers at 17 U.S.C. § 110(4)(A) (2000).

3 Music on Demand

Having resolved the question of playing audio over MIT cable, few additional conceptual challenges are presented by the requirement to play it on demand.

My partner Joshua Mandel implemented, using the PHP Web-programming language, an online queueing system to schedule music on each of the 16 channels made available by MIT cable. It communicates (pause, play, stop, skip, etc.) with the 16-channel Vorbis decoder, discussed above, using an ad hoc protocol over Unix domain sockets. Students and faculty visit <http://lamp.mit.edu>, present their MIT-issued SSL certificates (to prevent outsiders from hogging a system they wouldn't be able to listen to anyway, and to keep a one-channel-per-student rule in place), and are allowed to enqueue songs similar to any MP3 player:



Meanwhile, the television is displaying a status display listing each of the channels and what song, album, and user are on each, along with the time position in the song and the amount of time in the user's 80-minute allocation. I implemented the display (also signalled via Unix-domain sockets) in C++ and raw Xlib.



The display is typeset in Computer Modern Sans Serif, part of the standard \TeX suite of fonts designed by Donald Knuth. We use the Adobe Type 1 version of the font produced by Blue Sky \TeX Systems.

The display scrolls right-to-left for song titles too long to fit in one screen. (Every line scrolls one revolution in eight seconds. We found this far preferable to a constant speed for each line.) The display is synchronized to the NTSC vertical retrace, producing smooth motion with no retrace lines, using two methods.

First, the Xlib client is synchronized to the video card's retrace using a nonportable method: reading the raw I/O port corresponding to the monitor's retrace. This requires going into a special non-protected access mode under Linux.

```

if ( realtime ) {
myparams.sched_priority = sched_get_priority_max( SCHED_FIFO );
if ( sched_setscheduler( 0, SCHED_FIFO, &myparams ) == -1 ) {
    perror( "setscheduler" );
    exit( 1 );
}
if ( mlockall( MCL_CURRENT | MCL_FUTURE ) != 0 ) {
    perror( "mlockall" );
    exit( 1 );
}
rtc = open( "/dev/rtc", O_RDONLY );
if ( rtc == -1 ) {
    perror("/dev/rtc");
    exit(errno);
}
ioctl(rtc, RTC_IRQP_SET, 8192);
ioctl(rtc, RTC_PIE_ON, 0);
if ( iopl( 3 ) != 0 ) {

```

```

    perror( "iopl" );
    exit( 1 );
}
}

```

And later, to synchronize with the retrace, we busy-wait on that I/O port (after sleeping to approximately the right place in time):

```

if ( realtime ) {
    while( 1 ) {
        if( (inb( 0x3da ) & 8) ) break;
    }
    while( 1 ) {
        if( !(inb( 0x3da ) & 8) ) break;
    }
}
}

```

4 Loading Music

Having resolved the problems inherent in playing music to users and allowing them to select that music, there remains the significant problem of loading that music onto our system so as to be playable on demand. It is this problem that has held up the actual launch of LAMP at MIT since November 2002.

4.1 Technical Challenges

There are two ways to load music onto the LAMP server: by purchasing compact discs and copying their contents, compressed with Ogg Vorbis, onto the hard disc (“ripping” them), or by purchasing recorded music already “ripped,” compressed, and aggregated onto a hard drive.

The first method is advantageous because MIT already owns 7,000 CDs in its music library, and we could rip these for little expense. (With \$1,500, we have constructed a ripping station that can rip and compress 200 CDs with about 2 hours of work and five days of waiting.)

However, this is much less convenient than sending a list of CDs to a wholesaler and receiving, the next week, a hard disc containing those CDs already compressed and ripped. As far as we are aware, there is only one company in the country, Loudeye Corp. of California, that offers this service. This is the company that XM Radio used to build a hard disc array containing 120,000 CDs.

A third method, of keeping an actual CD jukebox connected to the LAMP broadcast equipment with hundreds or thousands of physical CDs in it, we have concluded is likely not practical for reliability, space, and financial reasons.

There remains the problem of how to decide which CDs to purchase. We ran a three-week online survey that collected about 2,000 suggested albums from dormitory residents. We plan to supplement these with the complete works of various classical and romantic composers.

4.2 Legal Challenges

The legal challenges of loading music onto the system are much more difficult. Method one, ripping, involves making systematic reproductions of thousands of compact discs. This necessarily implicates the exclusive reproduction right (17 U.S.C. § 106(1) (2000)), and we must look to exemptions.

The only exemption that is clearly applicable is known as the “ephemeral recording” exemption, 17 U.S.C. § 112 (2000).¹⁴ The gist of the exemption is that a party with permission to *perform* or broadcast a copyrighted work (such as a radio station with an ASCAP/BMI/SESAC license) may make a so-called “ephemeral” recording of the work for the purpose of aiding the licensed performance or broadcast.

Using this exemption, most commercial radio stations in the country now use tools such as “Magic,” “AudioVault,” and “Prophet” to rip the CDs they plan on playing for scheduled broadcast later.¹⁵ Our own ripping appears to be covered under the exemption as well. But under the actual text of the section 112, it is not clear that either we or the radio stations would be following the law.

In particular, the provision allows licensed broadcasters to make “no more than one copy or phonorecord of a particular transmission program embodying the performance.” A “transmission program,” in turn, is “a body of material that, as an aggregate, has been produced for the sole purpose of transmission to the public in sequence and as a unit.”¹⁶

Although our song-by-song on-demand copies would be identical under the law to those made by most commercial radio stations, MIT is not confident that these constitute copies of an “aggregate” “transmission program.”¹⁷ This appears to be another quirk in the statute: did Congress really intend to make every radio station be breaking the law by copying songs internally before broadcasting them? Nonetheless, MIT is not willing to depend on this exemption.

¹⁴There are actually two relevant exemptions: the exemption for licensed performances in subsection (a), and the exemption for nonprofit institutions in subsection (b). Subsection (b) is more favorable because it would allow us to retain ripped copies for seven years instead of just six months. But on its terms it does not give permission to copy musical works even though we have a performance license. We would still have to obey the six-month limitation when the musical work is in copyright, even though we have licenses to broadcast the musical work. Was it really Congress’s intent to exclude the presence of a performance license as a qualifying reason for subsection (b), and thus effectively legislate a six-month limit for universities making ephemeral recordings of non-classical music where the musical work is still in copyright? This would not be consistent with Congress’ stated intent in the legislative history for subsection (b), but it does appear to be the law.

¹⁵Most radio stations do not appear to follow the six-month limit.

¹⁶17 U.S.C. § 101 (2000).

¹⁷The legislative history is unclear. See H.R. Rep. No. 105-796 (1998) (accompanying the Digital Millennium Copyright Act, Pub. L. No. 105-304, 112 Stat. 2860 (1998)), which says that the purpose of the DMCA’s 112(e) amendment is to allow webcasters “to reproduce multiple copies of a sound recording,” and that webcasters would need this amendment because “Under section 112(a), as amended by this bill [the DMCA], a webcaster with a section 114(f) statutory license is entitled to make *only a single copy of the sound recording*” (emphasis added) (no mention of “transmission program”).

This leaves only the option of buying the music already in digital format. There is one company in the country, Loudeye, that we are aware of that provides this service under license from the music labels.¹⁸ Loudeye, however, does not have permission from the copyright owners in the musical works it sells. It was until recently Loudeye's position that the permission of songwriters was not necessary for them to sell us recordings. Since the songwriters and music publishers have sued over a very similar situation,¹⁹ we were not willing to purchase recordings from Loudeye until we could receive permission from the songwriters and music publishers.

Unfortunately, the organizations that represent virtually all of those songwriters and publishers, the National Music Publishers Association and its licensing arm, the Harry Fox Agency, have never before been asked to approve this kind of transaction.²⁰ Five months after first receiving our request for a license to buy these CDs (on a hard disc) from Loudeye, the Harry Fox Agency concluded that no license was necessary. Four hours later, Harry Fox's "New Media Coordinator" called me back to say they had changed their mind and decided Loudeye *did* need a license from them.

In fact, it appears that when XM Radio hired Loudeye to perform a legally equivalent service; selling XM 120,000 compact discs on a hard drive array,²¹ XM became liable for massive copyright infringement. Neither Loudeye nor XM received permission from the songwriters to make these copies, according to the general counsel of Harry Fox, and XM appears to have indemnified Loudeye for liability for copyright infringement²². Indeed, Harry Fox appears not to have been aware of this practice until alerted by MIT. In any case, Loudeye and Harry Fox are now negotiating a license that will likely be approximately 8 cents per song. When that license agreement is concluded, which we expect to happen by July 2003, we will be able to purchase compact discs (at Loudeye's price of \$8 per CD) in MP3 format from Loudeye and launch LAMP.

¹⁸They have automatic authorization from Universal, EMI and Warner; we will need supplementary authorization from Sony and BMG.

¹⁹Rodgers & Hammerstein Org. v. UMG Recordings Inc., No. 00 Civ. 9322, 2001 U.S. Dist. LEXIS 16111, 60 U.S.P.Q.2d (BNA) 1354 (S.D.N.Y. Sept. 25, 2001).

²⁰Remember that ASCAP, BMI, and SESAC represent songwriters and publishers for purposes of *performance rights*; the Harry Fox Agency deals with *reproductions*, typically under the 17 U.S.C. § 155 (2000) "compulsory license" not at issue here.

²¹Craig Johnston, *XM Radio's Music Is Massive*, RADIO WORLD NEWSPAPER, http://www.rwonline.com/reference-room/trans-2-digital/05_rwf_xm.1.shtml (accessed May 26, 2003) (on file with author)

²²Redacted Loudeye-XM Aug. 25, 2000 "Encoding Services and Compact Disc Purchase Agreement" § 8.2, available at <http://contracts.corporate.findlaw.com/agreements/loudeye/xmsat.encode.2000.08.25.html> (accessed May 26, 2003) (on file with author)

5 Further Work

5.1 Privacy

There are substantial questions as to the appropriate amount of privacy when using LAMP, especially because anyone may listen to anyone's channel and, currently, anyone may see the names of who is controlling each channel. The following is an e-mail received by the author after playing Dvorak's Seventh Symphony on the LAMP prototype:

Dear Keith,

I just happened to be up at three in the morning because I'm pathetic and don't have a life, and I was flipping through the channels and saw that you had selected a beautiful symphony piece. Obviously, you're a man of great taste and intelligence. I'd like to get to know you better. E-mail me if you're interested.

Sex depraved freshman.

P.S. Could you send me a photo of yourself?

Clearly, many users would be uncomfortable receiving e-mails like the above as a result of playing music on LAMP. Is seeing the names of other users like being able to get a record of others' library use? Or is it like visiting a library and seeing who is there? There are significant benefits to community by seeing others' music preferences, but even so we plan an anonymity option before launching the service for real.

5.2 Replicating LAMP

I hope LAMP will be replicable at other universities and in some municipalities, but it remains to be seen whether this will be possible. If the performing rights organizations are unhappy with our use of licenses for an on-demand service, they may be less willing to grant cable television performance licenses to other universities or municipalities. Additionally, our purchase agreement involving Harry Fox appears to be the first of its kind, ever, even though other organizations (such as XM) have made purchases that appear to have required such an agreement. But if Harry Fox and Loudeye sign a general license, there should be no problem with other universities or municipalities also making purchases from Loudeye.

A more serious question concerns whether other universities or municipalities have the resources (and control of their own cable systems) to be able to devote cable channels to a project like this, and whether users at MIT will actually want to listen to music over their televisions. We will have to see.

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