Caitlin Hammer
October 31, 2011

Tracks, Mixes, Masters, and More!:
Analyzing Preservation Priorities for Multitrack Recordings

Over the past half-century, multitrack recording has become the lynchpin of the modern recording industry. In fact, the analog multitrack technology that was developed in the late 1950s and popularized in the 1960s and 70s would later become the foundation of digital audio production. Within a preservation workflow, working with these early multitrack recordings might seem daunting, but this careful examination of multitrack recording workflows will reveal that preservation priorities are actually quite clear-cut. These recommendations will be reinforced through a case study of 10cc's "I'm Not In Love".

Multitrack recording saw its first wide adoption in the mid 1960s; however, it was actually invented several years earlier. While accounts vary as to the exact origin of the concept of multitrack recording, its invention is inextricably linked to the career of Les Paul. In the mid 1950s, Paul's garnered great acclaim for his experimentation with overdubbing. By using two modified Ampex 300 recorders, Paul devised a means of laying down each element of a song in succession, allowing him to perform all of the parts of a composition himself. This inspired Ampex engineer Ross Snyder to develop a machine that could use a similar process while minimizing generation loss and allowing for flexibility. The result was the "Octopus" Sel-Sync 8-track machine, which would use stacked heads to record eight separate, but perfectly synced tracks of audio onto a single piece of audio tape. These tracks could then be manipulated separately before being combined onto a single track. While the prototype was offered to a number of musicians, the only one who accepted was Les Paul. Paul garnered much acclaim for his use of multitracking, and is often credited (wrongly) with having invented the machine. However, the appeal of multitracking was still somewhat of a novelty.[1]

In an industry that was still acclimating to the concept of stereo, multitrack recording was too much too fast. In fact, it challenged some of the basic assumptions that underpinned the recorded music industry of the era. First of all, many thought that multitrack recording, or more specifically the practices it enabled - overdubbing, punching in, and comping - were somewhat disingenuous, cheapening the quality of recorded music by undermining the standards of authenticity and craftsmanship. This early reluctance actually highlights one of the most radical impacts of multitrack recording. Previously all recorded music had been predicated on the idea of live performance; however, multitrack recording shifted the locus of creation from the stage to the studio, situating the recorded song, not the performance, as the definitive instance of the artistic work.[2] Throughout the late 1960s to and 1970s, new developments in multitrack recording such as the introduction of 8, 16, and 24 track machines, noise reduction technology, and more complicated mixing consoles expanded the possibilities of multitrack recording and spurred a wave of experimentation

[1] http://www.aes.org/aeshc/docs/sel-sync/snyder_sel-sync.pdf
[2] Moorefield, 3.

with new production practices, especially in popular music. The arc of multitracking techniques employed by the Beatles over the 1960s provides a handy indicator of the slow adoption of multitracking in mainstream pop music. The group first experimented with Abbey Road's 4-track machine in 1963 when they used it to record four separate mono performances of "I Want to Hold Your Hand" and then select their favorite. In 1964, they used the machine to record the vocals, drums, and backing track of "A Hard Day's Night" on separate tracks. On 1966's *Revolver* they began to experiment with bouncing and by 1967's *Sgt. Pepper* the group was using synched four-track recorders to create elaborate textures and sounds that could not be reproduced in a live performance. [3] By the early 1970s, the role of the producer was widely recognized as being every bit as integral to the sound of a band as the performances of its musicians and multitrack recording had become the mainstay of the popular music industry.

Because multitrack recording is less a specific method than a basic technology underpinning most of modern music recording, it is difficult to describe it in terms of a set process. Multitracking can imply a wide range of techniques that may result in different physical elements. All multitrack recording is, however, premised on a basic workflow which can be broken down into six distinct phases. It should also be noted that prior to creating a multitrack recording a substantial amount of preplanning must be carried out. Since there are a limited number of tracks on a given tape (most likely significantly fewer than the total number of instruments to be recorded), the tracks must be assigned and documented. This will result in track assignment diagrams and other production documents that provide crucial metadata.

The first step of the actual recording process is tracking, the process by which tracks of individual instruments are laid down, one at a time, using a multitrack recorder. The output of each instrument is as isolated as possible form other sounds and is recorded onto its own track at the highest level possible without distortion. These tracks are then played back in unison to get a sense of the resulting sound. During this phase, tracks can be erased and recorded either in whole or in part until the desired sound has been attained; however, several tracks must be left empty in order to accommodate the next step: "bouncing" or "mixing down". Here groups of tracks (usually of similar instruments) are combined and recorded together onto the empty tracks resulting in what is known as a submix or stem. Typically, instruments that are integral to the timing and structure of the piece of music (such as percussion) are the first to be recorded and mixed down – this track is then used as the foundation for the rest of the work. In some cases this might be a rough reference track that will later be erased – in other cases it will become the backing track to the song. The process of layering additional tracks over existing tracks is called overdubbing. There is no set method or limitation to overdubbing and bouncing down – these two steps can be repeated ad infinitum; however, with each bounce comes generation loss and an increase in noise (approximately 3dB)[4], so bouncing is generally kept to a minimum (hence the necessity of careful preplanning). Generally, tracking, bouncing, and overdubbing are all actions performed on the original 4, 8, 16, or 24-track tape. In order to utilize more tracks

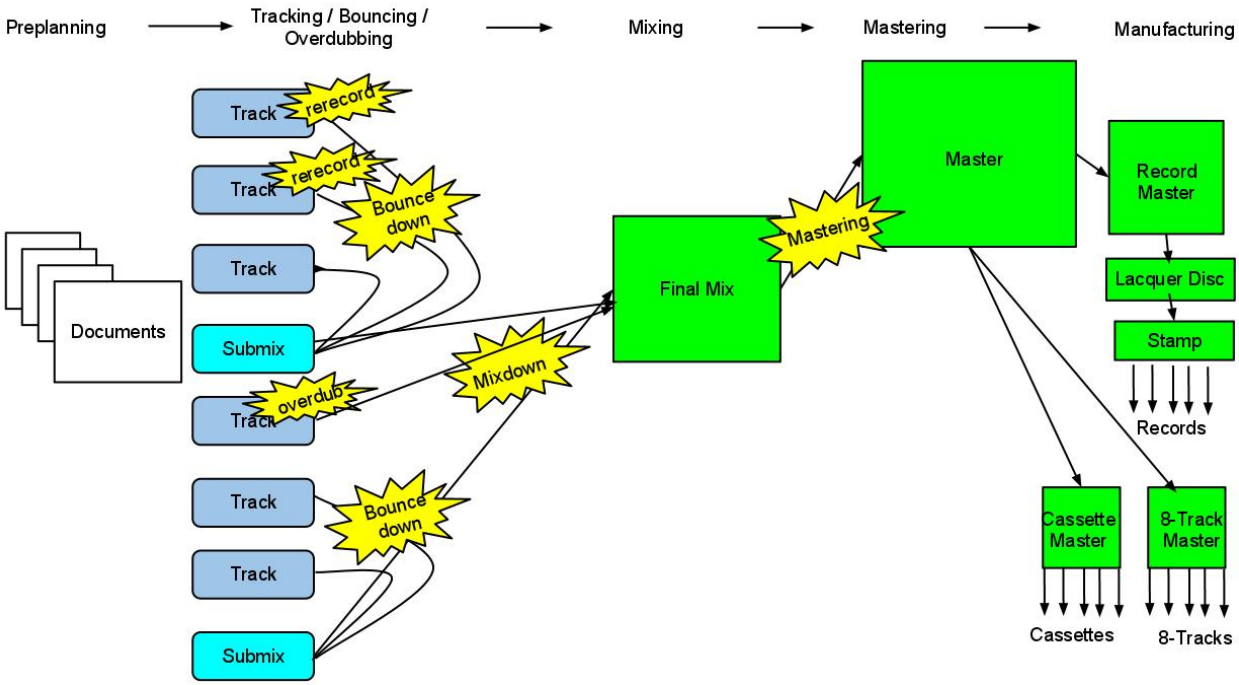
[3] Milner, 156-158.
[4] Bartlett, 171.

than are accommodated by a single multitrack machine, producers frequently erase original tracks after they have been mixed down. Another means of using more tracks is syncing multiple machines together. In this case, one track of each tape would be dedicated to time code and the tracking / bouncing / overdubbing stage of production would result in multiple original multitrack tapes (as many as there are multitrack machines in use).

Once all of the desired tracks have been recorded and mixed down as needed, the producer arranges them, adjusts levels, adds effects and distortion, and performs other actions that affects the overall feel of the song in a process called mixing. Some producers may create a number of rough pre-mixes prior to creating the final product. When the desired sound has been attained, the mix is output to a 2-track stereo machine as the mixed master. Generally, this is on ¼ inch tape, but it could be wider. Often a duplicate mixed master would be created as back up.

The final creative step in the creation of a multitrack recording is mastering. This step might include adjusting levels, correcting errors, removing unwanted noises, and a number of other manipulations of the combined signal of the mixed master resulting in a *mastered* master, or final master, a finished product that is ready to output to manufacturing. If the song being recorded is part of a larger album, it would be assembled at this point. Depending on the intended target formats of the recording, additional masters might be made for different media. Throughout the 1960s and 1970s, the primary target media would have been the vinyl LP, and the final master would have been optimized for vinyl; however, additional masters may have been created for 8-track or compact cassette. In many cases the different masters might actually be different versions of the work, tailored to fit the running-time and physical constraints of individual media, the period the vinyl master would be the most complete and the highest quality – in short, the definitive version of the work. Like the mixed master, the final master would typically be duplicated for back-up. Additional copies may also have been sent to regional manufacturing plants.

The final phase of the creation of a multitrack recording is manufacture. Here, the optimized masters are used to create consumer media. In the case of vinyl, the master is used to cut a laquer disc, which in turn is used to create a stamping mold. Depending on the popularity of the work, there could be many of these in record factories across the world. Stamping molds are, in turn, used to make records.



Archivists working with multitrack recording materials may feel overwhelmed by the number of physical objects associated with a given work and the seeming ambiguity of naming conventions. In particular, the co-existence of multiple items labeled "master" might seem to be cause for alarm. The Grammy Foundation defines a master as *collection* of all the original recording elements for a given production in their original format, ready to the next stage of production. As such the Foundation includes all masters, and duplicate masters, as well as additional flattened BWF files in its specifications for a preferred delivery package.[5] Short of such exhaustive completeness, preservation priorities can still be made. When determining preservation priorities for pre-1980s multitrack recording elements, the primary factors to consider are quality (or generation) and completeness of the work. Unlike contemporary multitrack recordings, which may contain both analog and digital elements, all multitrack master elements from the 1960s and 1970s would all be on open reel audio tape and therefore should be considered equally unstable. In a preservation environment they should be preserved as physical objects but would also be high priority candidates for preservation reformatting.[6] Thus the stability of the media and the cost of preservation become negligible factors in this evaluation.

Among the physical elements created in the course of a multitrack recording, the highest preservation priority is the final (mastered) master. All elements created prior to this point are less complete; everything created after this point are diminished versions of the

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5 http://www2.grammy.com/PDFs/Recording_Academy/Producers_And_Engineers/DeliveryRecs.pdf

6 IASA TC-04

master are therefore lower priority. The mixed master should be a close second – although mastering does add a creative element to the recording, in general it is performed according to set conventions and might be recreatable at a later date, especially if extensive documentation exists detailing the actions performed during the original mastering process. Likewise a commercial recording could act as a guide if documentation is unavailable.

The next tier of priority is somewhat subjective and may vary depending on the character of the recording. Submixes and original track recordings may provide significant insight into the creation of the work and could be useful in restoration; however, they are not constitutive of the work itself. In some cases, especially from the later 1970s when experimentation with multitrack technology was rampant, the original tracks and submixes may have very little in common with the final work, as the example below will demonstrate. In other cases, particularly with earlier recordings, the original tracks and submixes might be very similar to the final recording and thus more useful for preservation. Pre-mixes and other elements that do not contribute directly to the final master should likewise be considered useful references but ultimately separate from the final work. On the other end of the spectrum, while consumer media versions of the work are lower quality and higher generation, they do represent a complete version of the work. Within the elements produced in the manufacturing phase of production, vinyl record should be given highest priority. While it is several generations away from the master, it still accommodates a wide range of sound and is the media for which the majority of recordings from the late 1960s and early 1970s were intended. Furthermore, high-quality playback equipment for records is still readily available and if stored correctly, vinyl will last much longer than the polyester tape on which the masters were recorded. The lacquer disc and stamps used to make vinyl records also have preservation value. While not particularly robust or easily playable, the laquer disc is a lower generation copy of the master. The negative master stamp is just one more generation removed and while not playable, can still be scanned and virtually played, thanks to inventions like the Library of Congress's IRENE. While this is certainly not an efficient solution at this point in time, the stamp will far outlast any of the original magnetic media used to create a multitrack recording, and in the absence of other options, it would prove quite valuable. Compact cassettes and 8-tracks are too low-quality and high generation to be considered for preservation unless no other version of the complete work is immediately available or they have artifactual value.

That said, the preservation priority of any item is, of course, dependent upon its condition. The hierarchy outlined above assumes that all items are in good condition; however, there are some very real risk factors that might complicate that. First of all, professional tape manufactured in the 1970s would likely have been polyester with a polyurethane binder and back coating: high risk for both hydrolysis and sticky shed. [7] Also, in the late 1970s manufactures were experimenting extensively with new oxide formulations such as the dual-layer ferri-chrome, which promised to optimize both high and low frequencies.[8]

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[7] Casey, 5.
[8] Rumsey, 157.

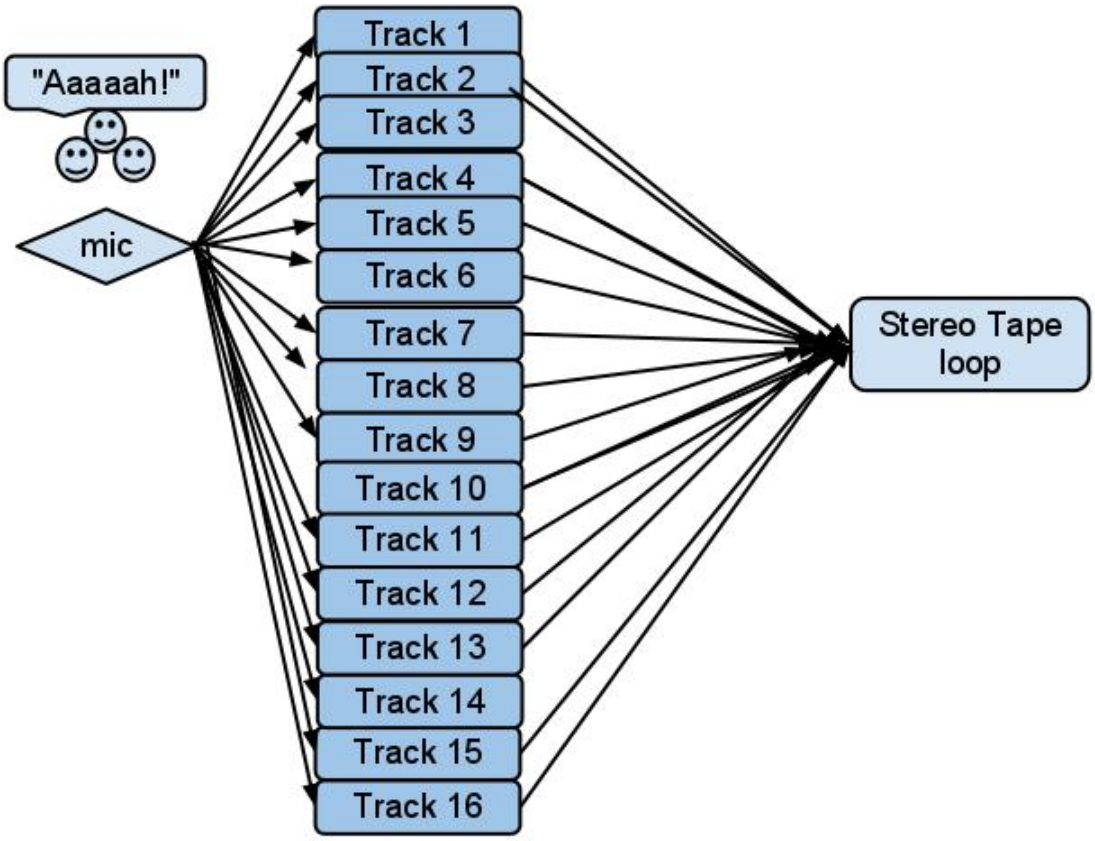
While this was an attractive option in cramped world of multitrack tape signal, these tapes have since been found to be vulnerable to delamination and base-binder adhesion failure (BBAF).[9] Archivists should also take into account that most multitrack recordings employed noise reduction technologies such as Dolby A and dbx, many of which rely on un-degraded audio levels in order to work properly. Additionally, as decoders become harder to come by, it will become more difficult to reproduce these recordings accurately.[10] Furthermore, the availability of functional open reel audio equipment will soon be an issue for most archives. For these reasons, and for those listed above, tape masters should receive top preservation priority – they are most complete, highest quality version of the work as well as the most immediately threatened.

By examining how these priorities stand up when applied to a real-world (and perhaps less typical) production history, one can see that while multitrack recording practices may vary, the preservation priorities laid out above still apply. Take for example the band 10cc's 1975 hit, "I'm Not In Love". While it is perhaps not the most highly esteemed example of the dynamic experimentation with analog multitrack recording during this time period, its history presents an interesting case study and illustrates some of the inherent technical traits of the technology. Contrary to standard practice, producer / band member Eric Stewart decided to start the composition by building a unique vocal backing track that would essentially turn the mixing console into a musical instrument. The idea was to use multitracking technology to multiply the voices of his fellow band members to create a choral effect; however, instead of having the band members overdub to a pre-recorded track, he would use thirteen different tracks, each containing the voices of his bandmates singing a single note of the chromatic scale, and then "play" the multitrack machine using the faders to move from note to note (and even create chords), creating the foundation of the song.

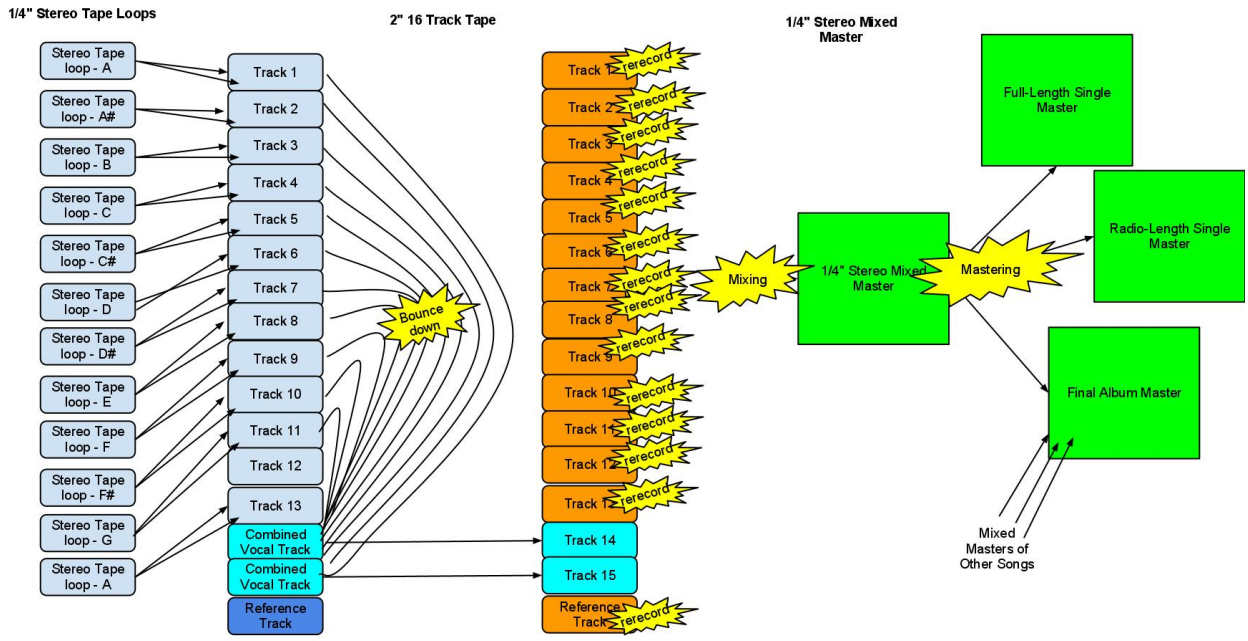
In order achieve this effect, Stewart recorded the other three band members singing the phrase "ah" at constant note into a single mic which recorded simultaneously onto all 16 tracks of a 2-inch tape using a 3M 16-track recorder. He then mixed down all 16 tracks to a single track on a 2-track Studer (each stereo track represents a mixdown of all 16 tracks) and used that recording to make a tape loop several minutes long. He repeated this process for each note of the scale, resulting in the creation of thirteen tape loops, each of which reflected the cumulative sound of three voices multiplied times sixteen, or forty-eight voices.

[9] Casey, 35.
[10] Casey, 20.

Creating a Single Tape Loop for Vocal Backing Track of "I'm Not In love"



Each of the note loops was then output back to a single track on the 16-track machine, where it was run for about seven minutes (slightly longer than the total running time of the song). The result was a tape with 13 tracks of artificially-multiplied voices singing a note of the chromatic scale and three blank tracks. Stewart used one of these blank tracks to lay down a rough reference track of drums, piano, and a vocal to establish the timing of the song. Then Stewart the 13 note-tracks to the two remaining tracks of the tape, using the four members of the band work the faders on the mixing console to bring the levels up and down along with the basic chords of the song. A piece of tape was placed at the bottom of each fader to keep any of the band members from bringing the levels down too low and creating hiss. Interestingly Stewart claims that the audible "shh" sound in the background of this song was an intended outcome of his using the chromatic scale, when it seems more likely that it is the inherent noise of the tape multiplied over 18 bounces.



Tracking, Mixing, and Mastering "I'm Not In Love" (does not include cassette or CD masters)

From here on out the production of "I'm Not In Love" follows the typical arc of a multitrack recording quite closely. Once he was satisfied with the choral voice backing track, Stewart erased the 13 chromatic scale voice tracks to make room for several tracks of real vocals, bass solo, grand piano, rhythm guitar, and finishing touches such as woman's voice and a music box. The song was then compressed, mixed, and output back to the Studer as a 2-track mixed master. While Mercury Records was enthusiastic about the experimentation demonstrated by "I'm Not In Love", they were reluctant to release it as a single and it was released as part of the album *The Original Soundtrack* instead. However, the song received significant acclaim and Mercury released a significantly truncated 4-minute radio single later that year. After it reached 28 on the *Billboard* charts, the original 6:10 minute version was released on vinyl as a single. The album was also released on audiocassette (most likely also in1975) and was remastered for CD and rereleased in 1991. Ostensibly it has been remastered and rereleased for online distribution as well.

All told, the production of "I'm Not In Love" resulted in production eleven elements: the group of ¼ inch tape loops, the 16-track 2 inch tape of the mixed-down vocal backing plus all other individual tracks, the ¼ inch stereo mixed master, the final master, the album master for vinyl release, the four-minute master for vinyl, the six-minute master for vinyl, and the album master for cassette release, and (much later) masters for CD and MP3. This is not including any of the intermediate elements used during manufacture, or the end-product consumer recordings themselves.

As in the basic workflow detailed above, the full-length final master is the clear preservation priority. So much production went into this recording that any element preceding that point (tapes loops, individual tracks, mixed master) runs the risk of being a significantly different from the complete work. While these elements provide valuable

insight into the making of this work, they are low priority in terms of preservation. On the manufacturing side, the full-length vinyl masters for both the album and single represent complete, high-quality, low-generation versions of the work and should receive high priority if the original final master is not available. If all three are available, the differences between them are most likely negligible, and the master in the best condition should take precedence. The CD and audio-cassette masters would be lower quality and should receive low priority unless nothing else is available.

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