

A GUIDE TO PRODUCING STEMS

1. CONTEXT

This document is intended for composers/producers who wish to send a set of stems, rather than a final mix, to a mastering studio. This increasingly common technique lets the engineer make optimal use of reference acoustic and audio tools in the mastering studio, and allows for the focussed treatment of those portions of the audio that are in need of correction.

...from *The Practice of Mastering in Electroacoustics*:

... the studio receives on a data CD-ROM a set of synchronized stereo tracks, each containing an entirely premixed subgroup of instruments, also called *stems*. The original mix is exactly reconstructed by syncing each of these subgroups to a single reference point in time, reproducing each at unity gain. The engineer may then treat each of the instrument groups separately, each intervention now being less prejudicial to the ensemble while permitting more in depth work;

The mastering engineer never attempts to do the work of the mixer. His actions are restricted to precise interventions in a manner that does not affect the entire mix. In the past, situations would arise where, for example, the equalization of a voice which was too piercing could lead to the dulling of a guitar which had been well mixed, but close to the voice in the frequency domain: in this case, one can now intervene uniquely on the voice, which permits the conservation of a larger proportion of the original mix.

2. PREPARATION

2.1 Finish the mix

Mix your piece exactly as you want it to be heard, with the absolute maximum volume between -1 dB and -0.3 dB, without using normalization. If possible, avoid applying effects to the "master" output. The mix and effects should be realized on individual tracks or on subgroups. Do not use treatments such as "home-mastering" on the whole mix.

It is not a good idea to make even a slight change at the master level, since the available plug-ins generally do not offer sufficiently good digital resolution for a final mix that does not seriously damage sound quality. Be particularly wary of compressors, even if they are multi-band, or of equalizers, even if they boast "minimal phase displacement", or indeed all effects which claim any form of sound optimisation.

If, however, you insist on bathing all sounds in reverb, apply the effect track-by-track or to subgroups -- varying the parameters governing the distance of the virtual source. This will always give cleaner results than applying the effect just once to the entire mix.

2.2 Produce a Reference File

When you have finished mixing, create (software permitting) a 24-bit stereo AIFF file (interleaved, if possible), without changing the sampling rate of your session. Note that even if your soundcard can't play a 24 bit file, you may still be able to produce a file at this resolution. This will serve as a reference during mastering, ensuring that the sum of your stems exactly reconstructs your stereo mix.

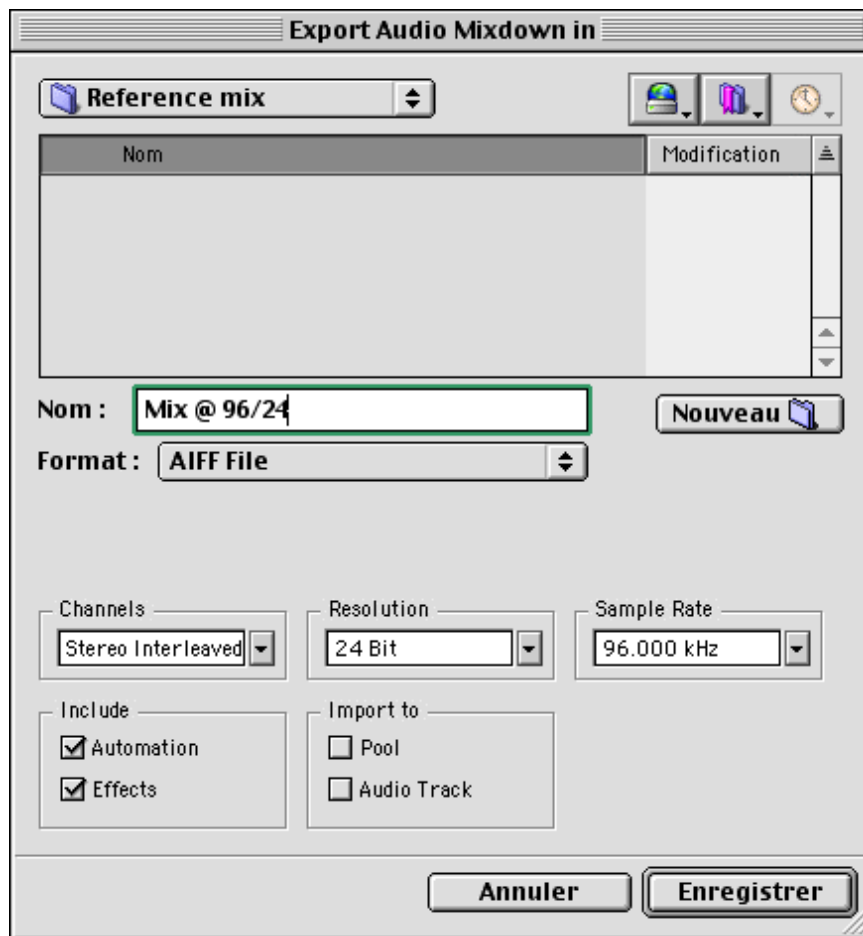


Fig 1

The screen capture opposite, as with most others in this document, comes from the Mac version of Nuendo 1.5.2. It is shown here only for illustration: the terminology, along with the exact display, will of course be different in other hardware/software configurations.

This window illustrates the proper settings for generating a reference mix, but it is equally applicable to the production of individual stems, as we will see later. The sample rate in this session is 96 kHz; the mix will be exported at this sample rate in order to minimize digital manipulations, which create approximations in calculations, and thus distortion.

It is important to note that, since Nuendo has a 32 bit internal resolution, a 32-24 bit dithering has been applied here as a master insert. The same process will remain in place when the stems are exported.

In order to avoid confusion, be sure to deselect any options related to reimporting the file.

2.3 Organizing the Stems

Returning to your session, and without changing a single parameter, listen to your piece to determine how many stems you will need. Remember that a stem is easiest to use in mastering when its frequency content and distribution of audio elements over time is as "isolated" as possible. Typically, 8 stereo stems are enough for adequate separation. Sometimes you will be able to use fewer, and sometimes you will need more. The absolute maximum is 12 stereo pairs.

An analogy to follow for building stems could be taken from pop songs:

- The lead vocal should be alone on a stem, accompanied with its effects - reverb, compression, etc;
- All backup vocals are on another stem;
- The drums are separated into at least two stems containing contrasting frequencies: e.g. the bass drum with the cymbals, the toms with the hi-hat, etc.
- If there are many guitars, group the highest-pitched with the bass, rather than let it drown amongst its relatives;

We could equally refer to orchestral instruments:

- The kettle drums should be grouped with the triangle, rather than the bass drum;
- The double bass is grouped with the violins, rather than with the cello;
- The flute is grouped with the bassoon, rather than with the clarinet

The criteria for the distribution of audio elements over time are equally important. Sound events separated by silences are always easier to work with than uninterrupted stems. Consider the case of two sonic units, each perhaps with different frequency content, that respond to each other through successive cross-fades: each of these units should be on a different stem. Or again, it would be preferable to group a double bass and cello in a piece in places where they don't play together, rather than grouping double bass and violin where they are always playing simultaneously...

3. PROCEDURE

3.1 Isolating the Stem

Do not isolate tracks by soloing them.

- Certain programs/mixers raise the gain of a soloed track, in some cases by as much as 10 dB;
- Other programs automatically set the track centre-mono;
- There are also cases where all of the effects linked to the track are automatically muted.

A better method is to mute each track which will not be part of the stem.

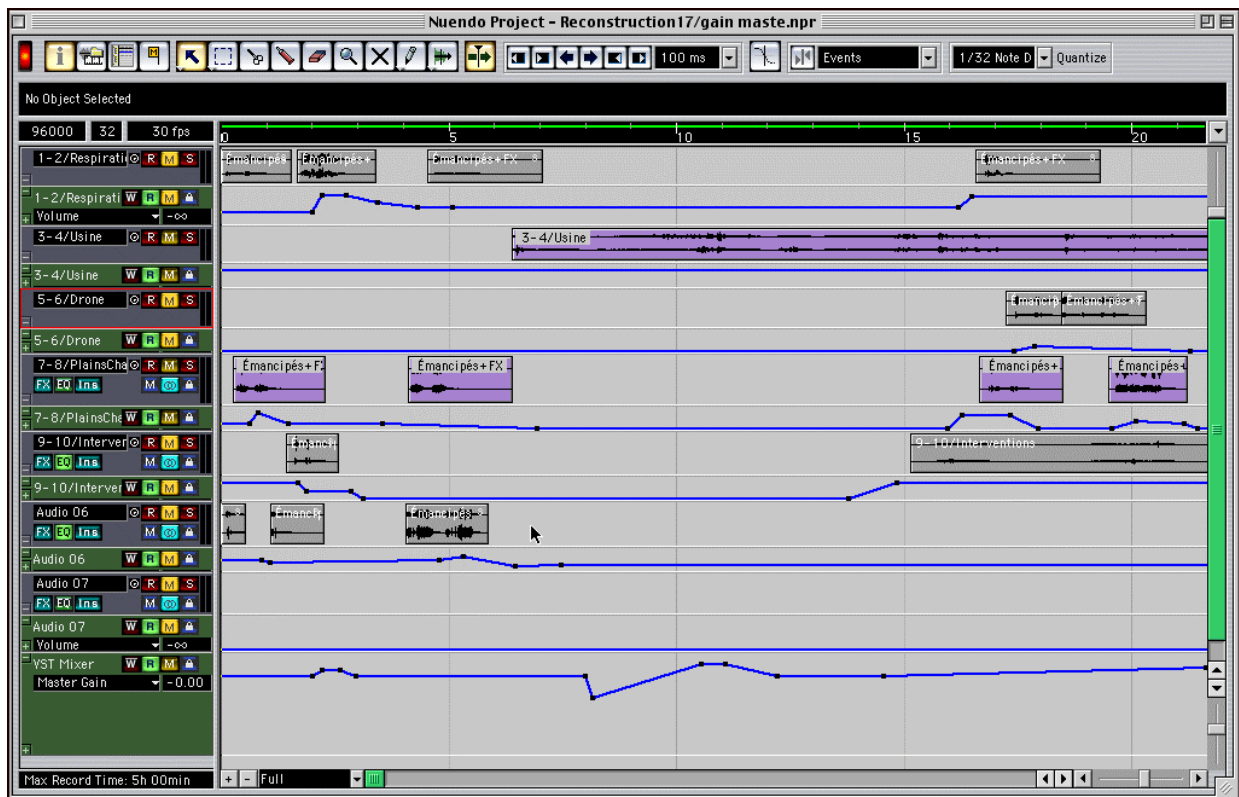


Fig 2 The tracks chosen for stem 1 are coloured magenta. The "mute"/M button is on for all other audio tracks (in dark gray) and for all other control tracks (in green). Important to note: the track on the bottom, called "VST Mixer", remains on, and will for each of the stems, since it serves as a control track affecting the overall volume, which must be applied to each stem.

3.2 Verifying the Effects Routing

In certain configurations, effects in "pre-fader" mode don't take account of the fact that the track that feeds them has been muted! If this is the case with your software, remember to block the effects "send" on each track that you are muting!



Fig 3 This configuration is without danger, since the "Pre" buttons on the effects are deactivated. We are thus in "post-fader" mode: by muting the track, the effect send will also be blocked.



Fig 4 Here, to overcome the danger that the "Pre" output is being used, we have used the "Bypass" function, which will turn off all the effect sends from this track. This is confirmed by the fact that the "FX" indicator is dimmed.

3.3 Determining the Length of the Stem

Once this step is finished -- you have still in no way changed your mix -- you should now determine the length of the stem. Each stem must begin from time zero, even if the first sound on it is in the middle of the piece! It must also continue without interruption until there are no more sounds on it. It may seem absurd to produce an audio file that begins with three minutes of silence, followed by 20 seconds of sound, followed by two further minutes of silence. But perfect re-synchronization of your stems requires that they all begin at time zero. You can, however, cut a stem short at the point where it contains no more sound.

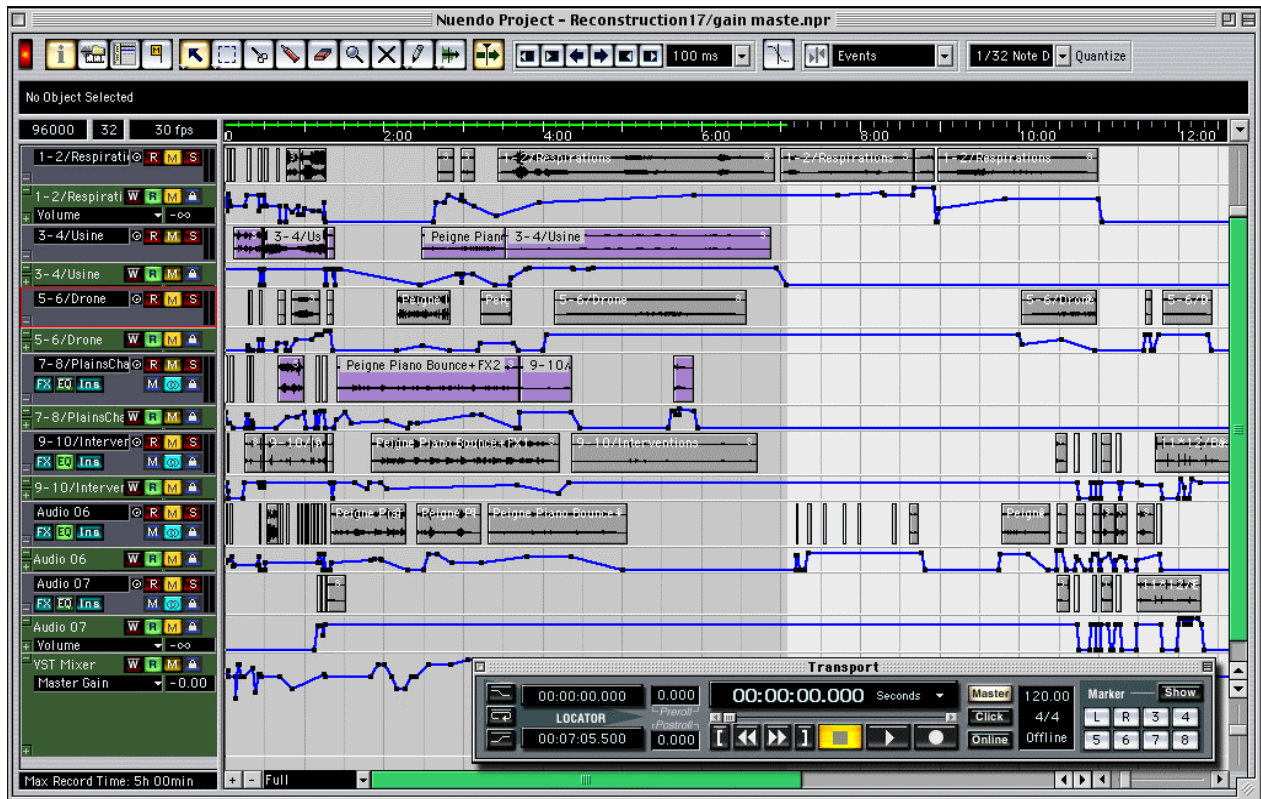


Fig 5 For this piece, of total duration exceeding 12 minutes, the stem being exported, which begins several seconds into the piece, contains no audio after 7 min.

In the "Transport" window, we can see that the section being exported begins regardless at 00.00.00.000 (indicated just above the word "LOCATOR"), and finishes at 00.07.05.500 (just below "LOCATOR").

Here, the length of the stem is confirmed, in the main window, by the pale grey background of the selected section, and also by the green line in the black bar indicating the time scale in minutes, near the top of the window.

3.4 Generating the Stems

The rules for generating stems are the same as those in **Fig 1**: same sample rate as the session, 24-bit resolution, AIFF interleaved stereo file. Use a naming system that is understandable and systematic, and export the first stem. If your configuration only allows the creation of mono files, verify immediately the memory sizes of the ".L" and ".R" files: these must be absolutely identical.

Now open the first stem in a stereo editing program, or, if you can't, in a new file in the same program. Listen to the entire stem, and make sure that everything is correct.

If all seems in order, we can now proceed to the next stem. One way to do this is to mute the tracks which have just been used, and then to unmute those which will be used in a subsequent stem, without forgetting the control tracks. But this way of proceeding is prone to error: we may forget about one element, or include the same element in a number of stems. The method proposed here helps avoid both omissions and duplications:

- Copy and rename the file containing the mix, carry out the steps below on this copy.
- After generating the first stem as described above, delete all of the elements that make up the stem; preserve if need be, the "master" control track; [see the explanation of **Fig 2**];
- Activate the elements which will be part of the second stem, along with any control tracks related to these elements;
- Generate the second stem, delete the corresponding elements, and proceed in this way until the final stem has been produced. With this method, it is easy to see which elements have not yet been included in a stem.

Once all the stems have been generated, do a final verification to confirm that nothing has been omitted. Create a new file in the multitrack software, and import first the reference mix (section **2.2**), and then all of the stems that you produced. All of these elements must be lined up to begin at time 00.00.00.000. Make sure that each stereo pair is correctly panned **hard left/hard right**, and that each track is at unity gain, by deactivating automation and setting all faders on the mixer to 0 dB. Then compare, in blocks of 15-20 seconds, the reference mix with the sum of all the stems. These should sound exactly the same, and have identical average and peak output levels.

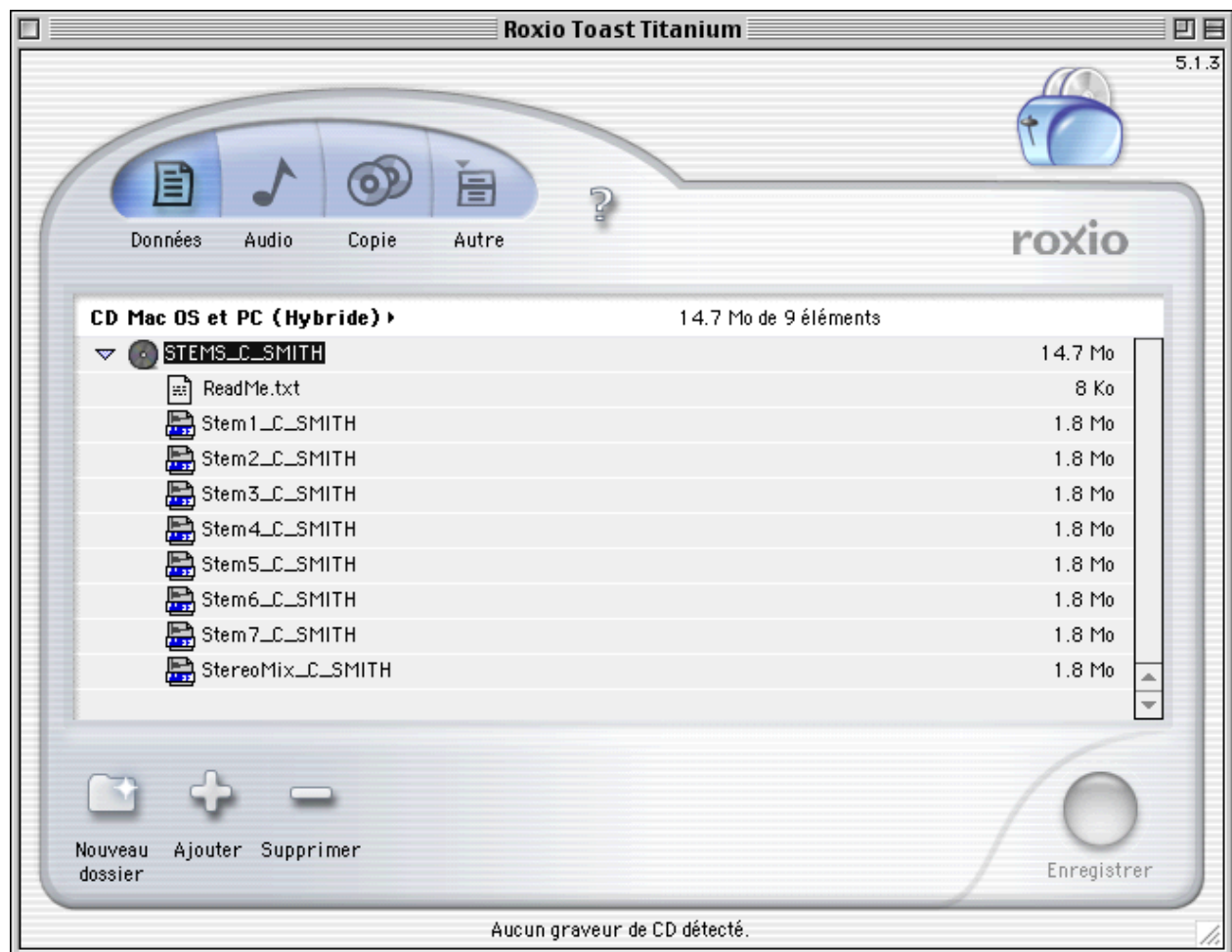
4. DELIVERY

If necessary, write up an explanatory text, in Word or SimpleText, to make the mastering team's work easier. Explain in detail any deviations from the procedure described here that you may have found necessary -- organization of stems, alternative versions, mono stems, etc. You might wish to describe aesthetic goals clearly and practically, but try to restrict yourself to audio terminology. Any request for a particular "sonic signature" should be explained as soberly as possible: *"Please make the link between the ecological inspiration in the introduction and the urban planning of the city of Khartoum more vague"* risks producing less tangible results than *"Please enlarge the stereo image only in the high frequencies."*

Finally, deliver all of the stems accompanied by the reference mix, either by CD-ROM or ftp. The procedures and verifications specific to these two delivery methods are explained here.

4.1 By CD-ROM

Burn the CD-ROM in hybrid mode, so that it can be read by a Mac. Burn a closed CD, and not a session. The software window may resemble the following:

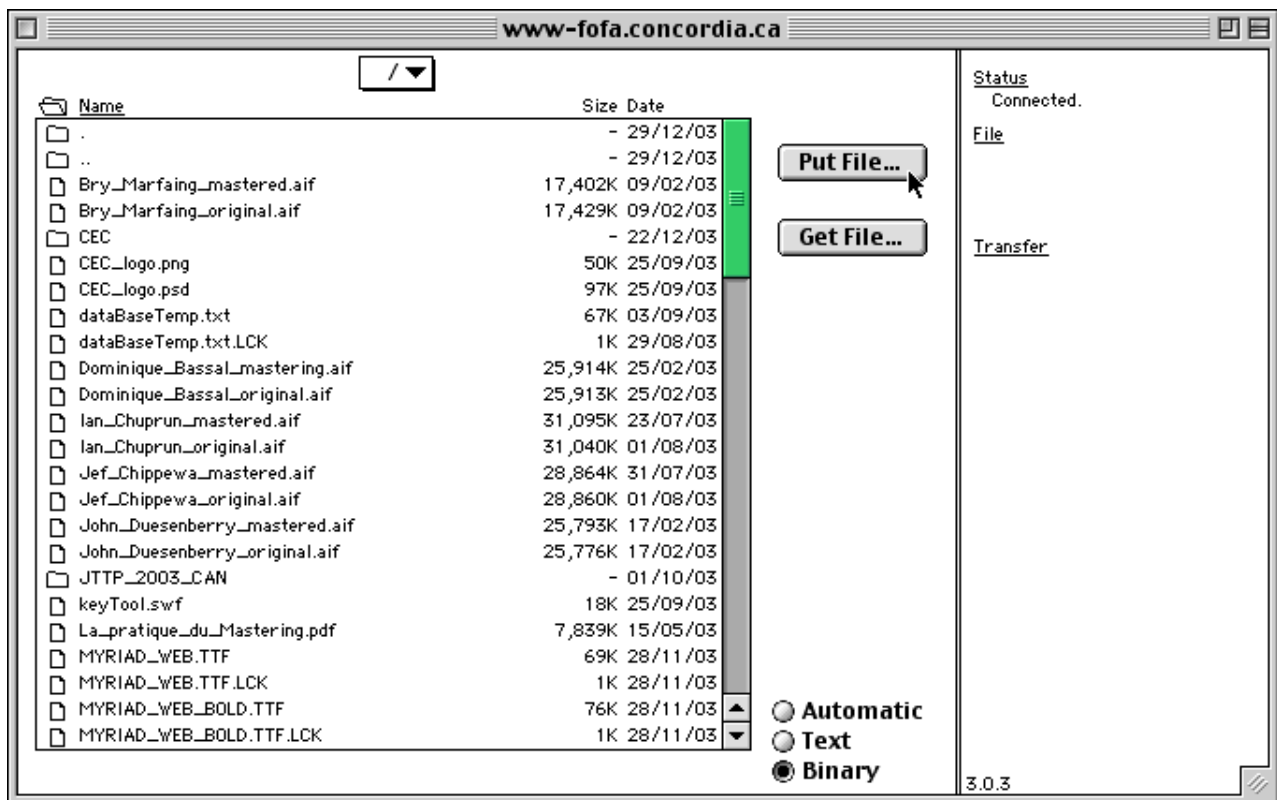


4.2 By FTP

Ftp is simple, fast and economical, but it requires an FTP program, and large files require a high-speed Internet connection. As we see in the example below, the destination folder for the files has a high probability of being overloaded with other files showing the necessity of using an effective file-naming system for your stems. In the example "C_Smith" from the previous page, it would be best to rename the files beginning with the name of the composer or of the piece, so that they all appear together in the list:

- C_Smith_ReadMe.doc
- C_Smith_StereoMix.aif
- C_Smith_Stem1.aif / C_Smith_Stem2.aif, etc.

The use of filename suffixes is obligatory here. Further, AIFF files must be sent in "Binary" mode, and not "Text" or "Automatic", or else they will be unreadable. Of course, this instruction does not apply to the explanatory text document.



The postal or ftp co-ordinates will be communicated by those responsible for the mastering. Specific questions about the content of this document can be sent by email to the author, at the following address:

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