Studio One 3.5 Audio Dropout Protection and Low-Latency Monitoring

Handbook

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Revision History:

1. Initial Release 5/23/2017
   1.1. Added LLM plugins behind the scenes logic and clean up 5/24/2017
   1.2. Added LLM Punch-in Procedure and more logic on Instrument buffering 6/1/2017
   1.3. Added additional options for Audio Punch-in 6/27/2017

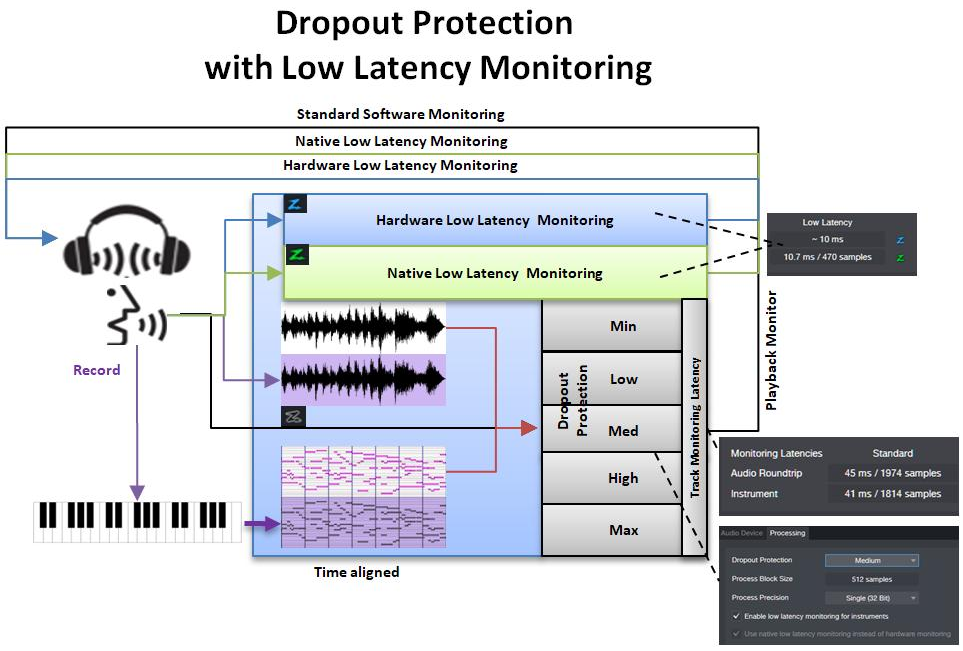
Contents

Optimization Overview

With the introduction of flexible **Dropout Protection** in version 3.5, Studio One *reduces overall CPU load and prevents audio dropouts.* In addition, a new standard for software low-latency monitoring "Native Low Latency Monitoring" adds to your Z-mix options. This new Z-mix mode solves one of the biggest problems of software and hardware DSP-based systems: *monitoring latency of virtual instruments*. With a dedicated low latency monitoring mode, virtual instruments can be played live with typically unnoticeable latency - *even in CPU-heavy songs*.

Monitoring Paths

All customers of Studio One now have the ability to monitor and record audio and virtual instruments with effects at the lowest latency levels of the hardware interface while protecting your songs playback from dropouts with **Audio Dropout Protection and Low-Latency Monitoring.**



The optimum settings for you is dependent on your interface, workflow and situation.

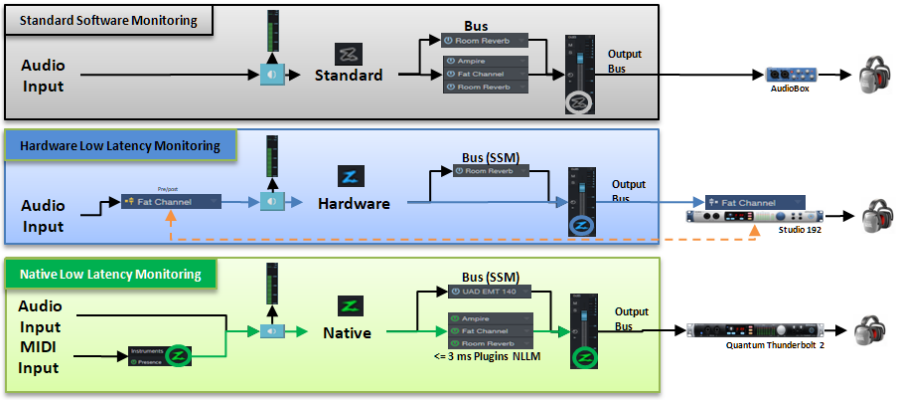
Because monitoring and playback optimizations are now independent:

- Set Device Block Size for the latency you want for monitoring and recording.
- Set Dropout Protection depending on the complexity of your songs to avoid dropouts

There are three Studio One Monitoring Modes:

- Standard Software Monitoring (SSM)
- Hardware Low Latency Monitoring (HLLM)
- **NEW** Native Low Latency Monitoring (NLLM)

This table describes the primary monitoring methods available in Studio One, and the conditions that must be met to use them.



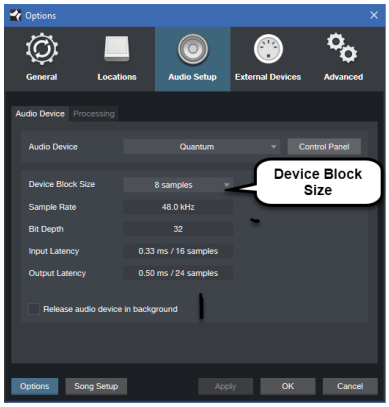
Native Low Latency Monitoring (NLLM) allows the user to stay in the native processing domain throughout the entire production process. It gives you the best latency for recording vs. playback dropout protections while allowing you to use any plug-in that has lower than or equal to 3 milliseconds latency in you record monitor signal flow. With this feature, there is no longer a need for a hardware based DSP solution for recording audio with monitoring FX. It can all be done native to Studio One.

Audio Processing Tab

Device Block Size vs. Process Block Size

Device Block Size

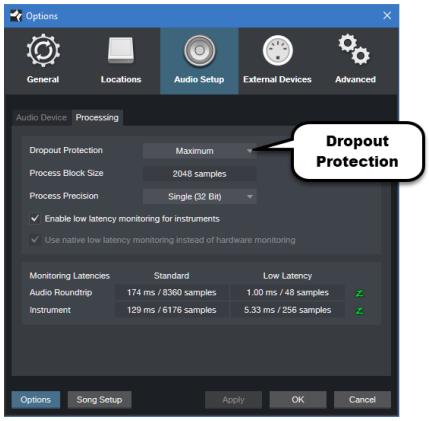
The latency that you hear when monitoring audio inputs or playing virtual instruments is based primarily on the Device Block Size that you specify in the ***Studio One/Options/Audio Setup/Audio Device*** (Mac OS X: *Preferences/Audio Setup/Audio Device*) window. For the lowest latency, Device Block Size should be set to the lowest setting that provides the performance you need without overloading the CPU.



Audio Dropout Protection

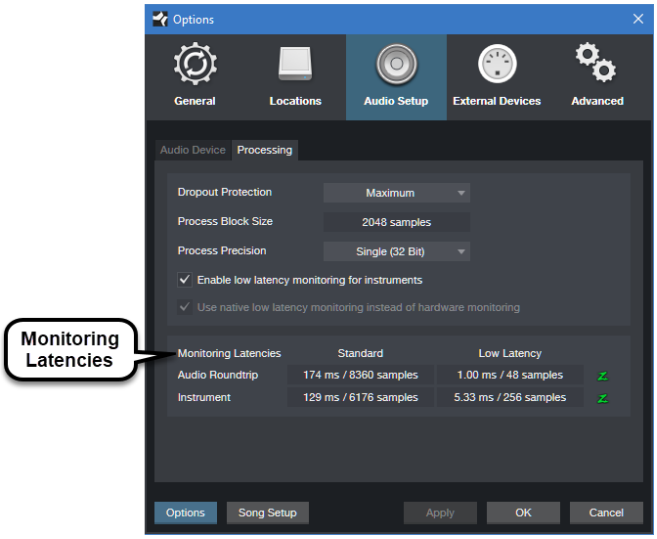
The Audio Dropout Protection system uses its own buffer for playback and processing of audio tracks, distinct from the Device Block Size setting. The size of this buffer (also known as the Process Block Size) depends on the Dropout Protection level that you specify in the *Studio One/Options/Audio Setup/Processing* (Mac OS X: *Preferences/Audio Setup/Processing*) window. If you use Native or Hardware Low-Latency Monitoring, the Dropout Protection level has no effect on audible latency, though higher levels can affect the responsiveness of onscreen meters and displays.

Note: ***As long as the Process Block Size is larger than the Device Block Size you've specified, you have the option to use Native Low-Latency Monitoring***.

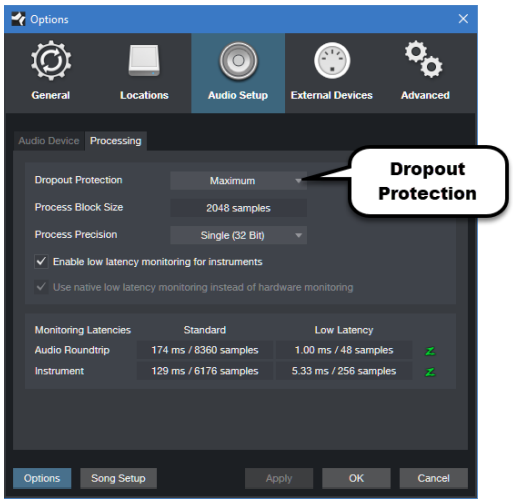


Monitoring Latencies

The Monitoring Latencies display shows you the latency values for audio inputs (round-trip, from input to output) and virtual instruments, based on the current Device Block Size and Dropout Protection settings. The "Standard" column shows the latency for the current settings if you choose not to use Low-Latency Monitoring, while the "Low Latency" column shows values for the Native Low-Latency Monitoring system.



Configuring Audio Dropout Protection and Low-Latency Monitoring (Native or Hardware)



To configure Audio Dropout Protection and Low-Latency Monitoring, do the following:

1. Navigate to the *Studio One/Options/Audio Setup/Processing* (Mac OS X: *Preferences/Audio Setup/Processing*) settings window.
2. Choose your desired level of protection from the Dropout Protection drop-down menu. The Process Block Size display shows you the corresponding processing buffer size. If you want to use Native Low-Latency Monitoring, choose a Dropout Protection level that sets the Process Block Size to a value that is higher than the Device Block Size you have selected.
3. For low-latency performance when playing virtual instruments, enable the **"Enable low latency monitoring for instruments"** option. If you run into performance issues when using a virtual instrument with particularly high CPU usage, you may want to disable this option.
4. If using a supported DSP-enabled audio interface, you have the choice to use its onboard Hardware Low Latency Monitoring (and hardware DSP-based effects when available, as with the PreSonus Studio 192) for incoming audio inputs, or to use the Native Low Latency Monitoring that Studio One provides. Enable "Use native low latency monitoring instead of onboard DSP" to use Native Low-Latency Monitoring, or disable it to use Hardware Low-Latency Monitoring.
    - Note that when using Hardware Low-Latency Monitoring to monitor an audio input, Insert FX does not function on the related channel, since the audio input is being monitored before it reaches Studio One. If Insert FXs are needed while tracking, use Native Low-Latency Monitoring instead. To do this, navigate to *Studio One/Options/Audio Setup/Processing* (Mac

OS X: *Preferences/Audio Setup/Processing*) and enable the "Use native low-latency monitoring instead of hardware monitoring" option.

Enabling Low-Latency Monitoring in the Console

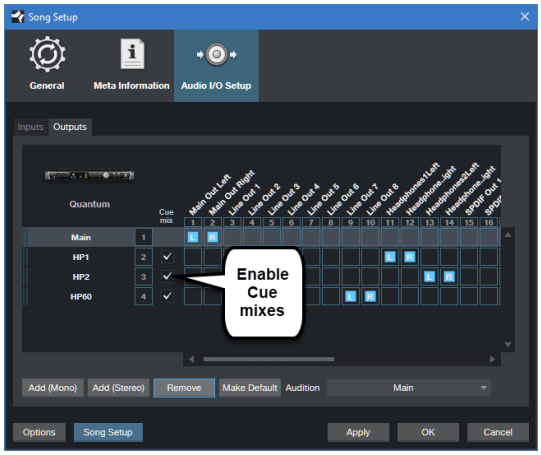
Once you've configured your system to use Native or Hardware Low-Latency Monitoring, you can toggle low-latency monitoring on and off for the Main output as well as any **Cue Mix** outputs you've specified, by clicking the Enable Low-Latency Monitoring button ("Z", short for Z-Mix) below the volume fader for the related output. When low-latency monitoring is disabled, the "Z" button goes dark. When Native Low-Latency Monitoring is enabled, the "Z" button turns **green**. When Hardware Low-Latency Monitoring is enabled, the "Z" button turns **blue**.

Creating a Cue Mix Output

In Studio One, it is possible to quickly and easily create multiple cue mixes. A cue mix is separate from the main mix and is usually provided to musicians for monitoring purposes during recording.

For instance, when recording vocals, the engineer and vocalist probably want to hear different mixes. Most vocalists want to hear more of their vocals in the mix, possibly with some reverb to make it sound natural, while the engineer might focus on how the performance balances with the rest of the mix. The cue mix functionality in Studio One makes this task easy.

The first step in building a cue mix is to create another Output Channel. To do this, open the *Song/Song Setup/Audio I/O Setup* menu in a Song, switch to the Outputs tab, and add a new Stereo Output Channel. Next, specify that this output is a cue-mix output by clicking on the Channel's Cue Mix checkbox. You can create as many cue mixes as your audio interface has available stereo outputs.



The Main Output as a Cue Mix

The Main Output is always available as a Cue Mix in Studio One 3.5

Monitoring Live Input in a Cue Mix

Cue mixes are normally used in a recording situation in which one or more live inputs need to be monitored. This is where the Cue Mix feature in Studio One is very useful. Monitoring with very low latency can be achieved using the **Native Low-Latency Monitoring** system in Studio One.

You can also achieve low-latency cue mixes by using Hardware Low-Latency Monitoring and integrated control of the interface pre-amps with a compatible audio interface that provides that feature, such as a PreSonus Studio 192 Series or Quantum Series.

ASIO DM 2 interfaces such as AudioBox VSL or FireStudio series interface and other brands of ASIO DM 2 interfaces can use Hardware Low-Latency Monitoring.

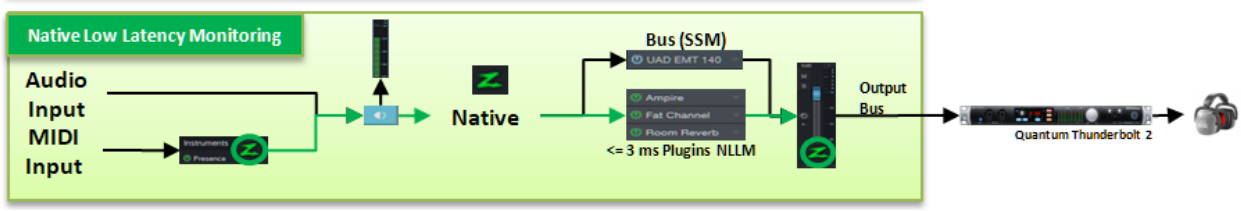
Plug-in Use with Native Low-Latency Monitoring

When monitoring an audio input or virtual instrument through the Native Low-Latency Monitoring system, any inserted FX on the corresponding Channel continue to function and can be heard when monitoring, provided that they add 3 ms or less of latency. Plug-ins that meet this latency requirement show a green power button in the Console (rather than blue or grey). Any inserted plug-ins that introduce more than 3 ms of latency are not audible in the monitoring path while a Channel is armed for monitoring or recording under Native Low-Latency Monitoring. They begin functioning again when recording/monitoring mode is disengaged. They can still be heard – with latency – on the main mix.

The following plug-in types and configurations are currently not supported on Channels that utilize Native Low-Latency monitoring:

- External effects, routed into the system using the Pipeline plug-in
- Analyzer plug-ins
- FX Chains that incorporate Splitter devices

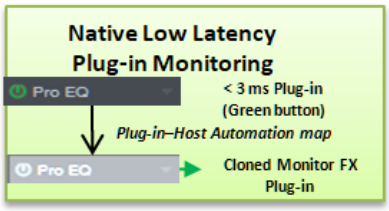
What is going on behind the scenes of Native Low Latency Monitoring?



Remember there are three different monitoring paths in Studio One 3.5.

- Standard Software Monitoring (SSM)
- Hardware Low Latency Monitoring (HLLM)
- **NEW** Native Low Latency Monitoring (NLLM)

Here is shown the new Native Low Latency mode. In order to make plug-ins available to this path the plug-in that you see in the GUI must be cloned to the NLLM path. These two plug-ins are in essence mirrored in terms of controls by automation commands that are sent to the host.



Note: *If you are missing the ability to hear a parameter change, your third party plug-in developer may not be exposing that parameter to the host. In that case you should contact the plug-in manufacturer and ask for an update or use an equivalent Presonus plug-in for the recording phase.*

Monitoring Mode Attributes

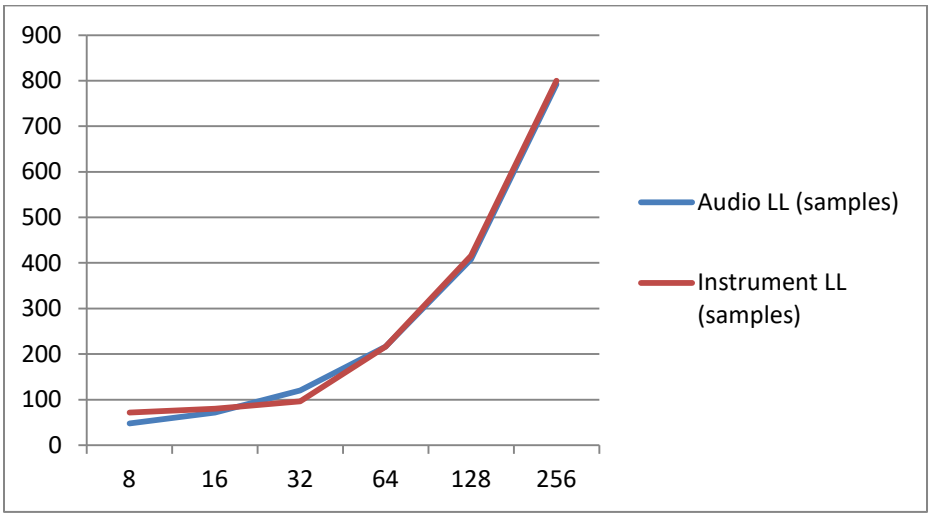
Native Low latency Monitoring is dependent on the relationship between your Device Block Size and you Process Block Size (Dropout Protection). When Device Block Size is smaller than Process Block Size (Dropout Protection) the Green Z will be automatically turned on.

Type	Z-Mix	Necessary Conditions	Monitoring	Insert FX	Send FX
Standard Software Monitoring	Disabled	Large Device Block Size, low Process Block Size (Dropout Protection)	Standard latency	All function	All function
Native Low-Latency Monitoring	Enabled	Process Block Size (Dropout Protection) must exceed Device Block Size	Native low-latency	Plug-ins with 3ms or less of latency function normally, all others are disabled	All function
Virtual Instrument Low-Latency Monitoring	Enabled	Process Block Size (Dropout Protection) must exceed Device Block Size	Native low-latency	Plug-ins with 3ms or less of latency function normally, all others are disabled	All function
Hardware Low-Latency Monitoring	Enabled	"Use software low-latency monitoring instead of hardware monitoring" option must be disabled	Hardware low-latency	No Insert FX function	All function

Native Low Latency Instrument Monitoring

Points of Native Low Latency Virtual Instrument Monitoring.

- They Follows the Device Block Size, but runs on a separate buffer
- The lowest limit is 64 samples (for best CPU performance and accurate note timing)
- With device block size lower than 64 samples, instruments have their own buffer, its size determined by the fixed instrument latency (64 samples) plus 1 x device block size.
- With Device Block Size at 64 samples or higher, both audio monitoring and instrument monitoring will run on approximately the same buffer



Procedure for Native Low Latency Audio Monitoring:

1. Set up a Cue Mix output for the vocalist. Remember the Main is always in a cue mode.
2. Record-enable and monitor-enable the vocal track.
4. Verify/Engage the Enable Native Low-Latency Monitoring (Green "Z") button on the Cue Mix output being used by the vocal channel. This enables low-latency monitoring through Native Low-Latency Monitoring.
5. The vocalist hears the live low-latency input with any insert plug-in FX 3 ms or less, as well as the rest of the cue mix.
6. The engineer hears the complete FX chain with all plug-ins and their respective latency on the main mix.
7. If you need to hear a plug-in FX with greater than 3 ms latency you can create a Send on the vocal channel to an FX Channel with the > 3 ms plug-in.

Procedure for Native Low Latency Instrument Monitoring:

1. Set up a Cue Mix output for the instrument. Remember the Main is always in a cue mode.
2. Record-enable and monitor-enable the Instrument.
3. Verify/Engage the Enable Native Low-Latency Monitoring (Green "Z") button on the Cue Mix output being used by the vocal channel. This enables low-latency monitoring through Native Low-Latency Monitoring.
4. Verify/Engage the Enable Native Low-Latency Monitoring (Green "Z") button on the Instrument Rack and the instrument itself should have a green power button.
5. You will hear the live low-latency input of the virtual instrument along with any insert plug-in FX 3 ms or less, as well as the rest of the cue mix.
6. The engineer hears the complete FX chain with all plug-ins and their respective latency on the main mix.
7. If you need to hear a plug-in FX with greater than 3 ms latency (such as a DSP based reverb or delay) you can create a Send on the instrument channel to an FX Channel with the > 3 ms plug-in and you will hear it at SSM latencies.

Procedure for Hardware Low Latency:

1. Set up a Cue Mix output for the vocalist.
2. Record-enable and monitor-enable the vocal Track.
3. Engage the Enable Low-Latency Monitoring (Blue "Z") button on the Cue Mix output being used by the vocal channel.
4. Create a Send on the vocal channel to an FX Channel with your favorite reverb effect.
5. The vocalist hears the live low-latency input, as well as the rest of the cue mix, including the output of the reverb.

Note that when monitoring with Hardware Low-Latency Monitoring engaged, you do not hear Insert FX on that channel, as you are monitoring the signal before it is processed in the software.

Instead, you may be hearing the hardware DSP FX provided by the audio interface (for example, Fat Channel XT with PreSonus Studio 192 or StudioLive AI and Series III mixers).

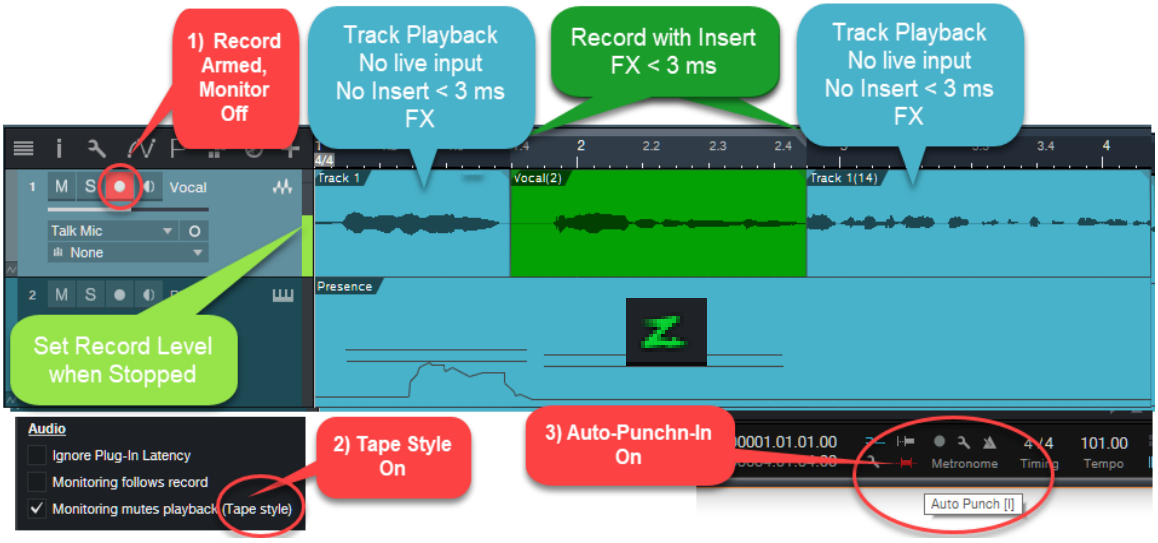
Procedures for Audio Punch-in Recording

Native Low Latency Audio Monitoring for Punch-in

Tape style monitoring does not internally engage when in NLLM mode for technical reasons. Fortunately there are various alternative approaches in this mode. Each approach is conditional on how complex your project is and whether you are recording guitars through amp simulators, or vocals/acoustic instruments, with or without FX.

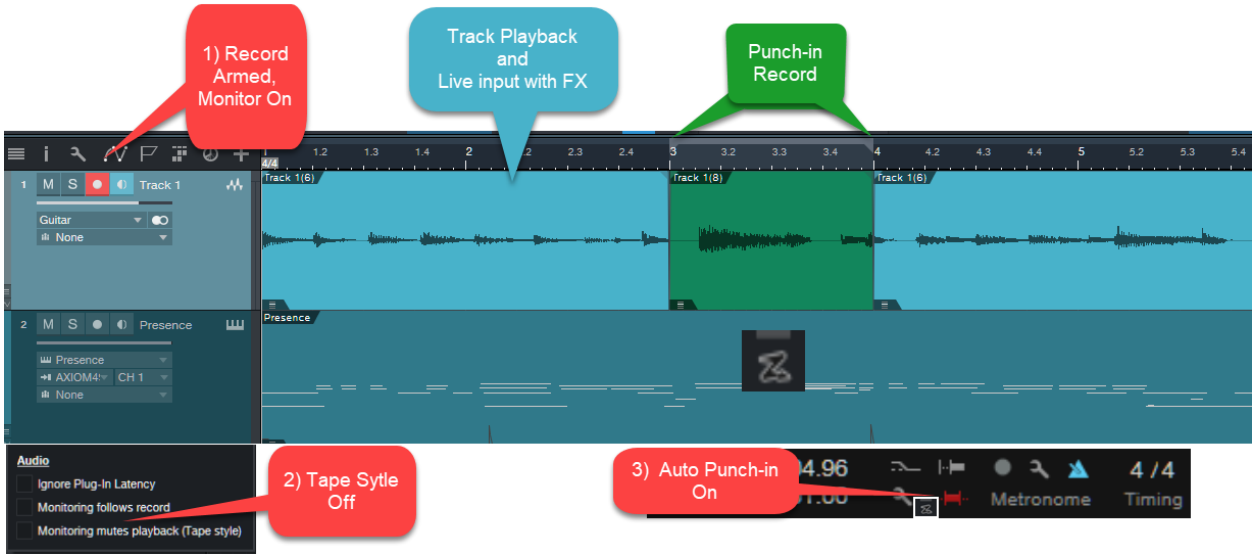
This first picture is how it works. At a stop prior to record you can monitor and adjust your instrument but as soon as you start the transport it will mute the sound until the punch in point is reached. This is typically used if the musician does not need to hear their instrument though a plug-in, and can play acoustically along with the track until the punch in point.

Native Punch In Procedure



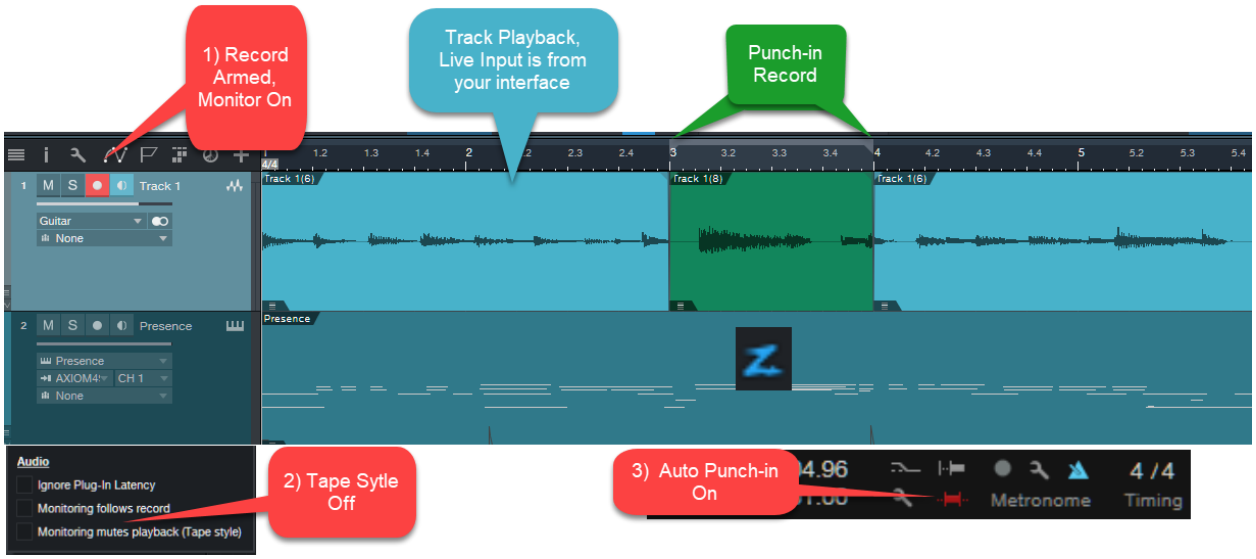
Standard Audio Monitoring for Punch-in

Studio One still works the old way if you don't use NLLM but rather the Standard Monitoring process. This works for songs that are not already too complex and you have an interface that can give you good enough latency for your performance. In other words, if this procedure worked for you in pre 3.5 it will work for you in post 3.5. There is no restriction on plug-in latency but just as in pre- 3.5 it does add to your overall monitoring latency.



Hardware Low Latency Audio Monitoring for Punch-in

Presonus interfaces such as the Studio 192 Series have integrated zero-latency monitoring which offers Hardware Low Latency Monitoring (Blue Z). In addition, 3rd party interfaces that have ASIO DM 2.0 drivers can also use (Blue Z).



Optional Audio Punch-in Approaches (suggested by the community)

If for some reason the standard non-Z monitoring does not work for you, then you can try a few alternative punch-in procedures that are more involved and have tradeoffs.

Option One: For vocal or acoustic overdubs; add a parallel input track

1. Add an empty track with the same audio input and put it in monitor mode.

Note: this has the side effect of making the punch monitoring level louder due to the doubling of monitoring paths during the stop mode and punch in time. This works better for vocals than an amp simulator situation due to the doubling of the amps during those two states.

Option Two: Parallel Outputs; one with Cue off

1. Set up a parallel output channels with the same outputs that you normally monitor on with Cue off.
2. Turn the monitor on for the punch-in track.
3. You will hear both sources Native Low Latency Monitoring and Standard Monitoring.

Note: This does require you to set the dual output in advance and because there are differences in signal latency during pre-punching, you might here some phasing (but not likely due to in ability to actually be exactly in sync with the other performance).

Option Three: Duplicate punch in track(s) and use auto mute plug-in

1. Duplicate the track(s) that the punch in will occur on.
2. Install the free plug-in Muteomatic (**https://www.soundradix.com/products/muteomatic/**).
3. Set it to play during playback but not during recording.
4. Use green Z mode for punch -in.

*Note: this **requires** duplicating the audio track and adding the plug-in. If you were doing a multi-track punch-in you would have to duplicate all the tracks or render a stereo mix down of the drums for monitoring.*

Recommendations:

1. Use Standard Monitoring procedure if standard latency and dropout is not an issue.
2. If dropout or latency is an issue:
    a. Use Option One for vocal punch-ins (side effect change in volume).
    b. Use Option Two for amp simulator punch-ins (side effect possible phasing/delay).
    c. Use Option Three for any single track punch-in if you have the time as there is no side effect.
    d. For multi-track punch-in use Option Two.