# PING PONG DELAY

## BUFFER DESIGN EXPLANATION

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# Introduction:

This document should provide an explanation of the design and functionality of the stereo buffer used in class PingPongDelay::PingPongDelayUnit. We will also have a look on the purpose of the main PingPongDelayUnit stereo sample processing method called GetSample.

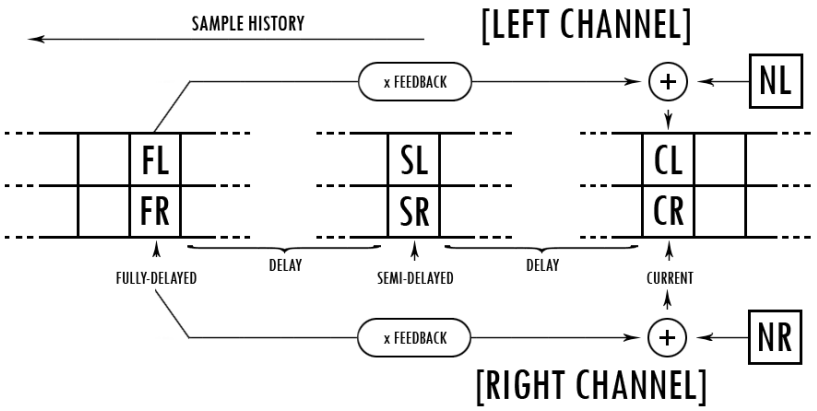
# Data representation:

Firstly we get to know how individual samples are represented in the VST technology. They are all either 32-bit (single precision) or 64-bit (double precision) floating-point data. Their default used range is [-1.0, +1.0] (where 1.0 corresponds to 0 dB, 0.5 to -6 dB and 0.0 to –inf dB).

Now lets have a look on used stereo buffer. It is a pair of circular arrays of floats, one for each channel. In the code they are called leftBuffer_ and rightBuffer_ and their size is stored in the field called bufferSize_. These arrays represent the history of samples effected only by delay separatly on both channels. This means that neither wet/dry nor panorama settings affects the samples int the buffers.

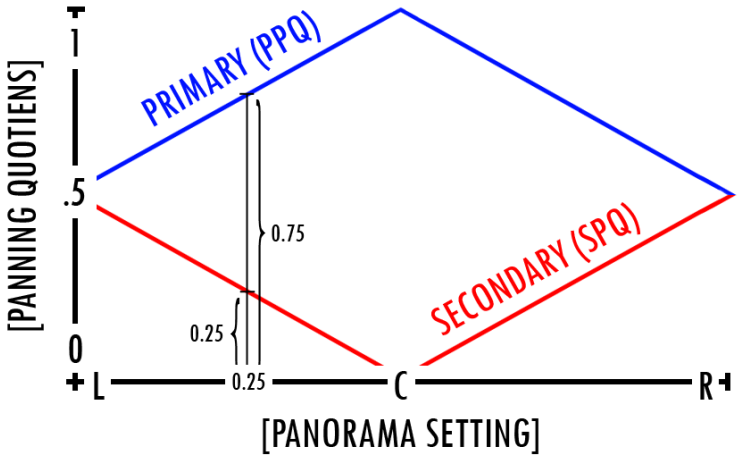
# GetSample Method:

When a PingPongDelayUnit method GetSample is called, first thing the unit do is it calculates the delay in number of samples. Here it matters weater the unit is synchronized within provided time info or not. With a calculated delay it calculates the offset cursors semi-delayed and fully-delayed in next step as shown in the picture below.




Now the history is updated into the buffer. For the left/right channel it takes the newly got left/right sample and adds the fully-delayed left/right sample multiplied by feedback. Result is stored into current left/right sample (CL = NL + FL . FEEDBACK; CR = NR + FR . FEEDBACK).

After the unit updates the history, it calculates the left and right output samples. But first we have to talk about the primary (PPQ) and secondary (SPQ) panning quotiens. They are complementary, their sum must be equal to 1 (PPQ + SPQ = 1). They both depend on panorama setting. They formulas for their calculations are SPQ = 1 - |0.5 – panorama|, where for panorama is from interval [0, 1] (0 ~ L; 0.5 ~ C; 1~R). Here is the graph of the PPQ and SPQ according to value of panorama setting.

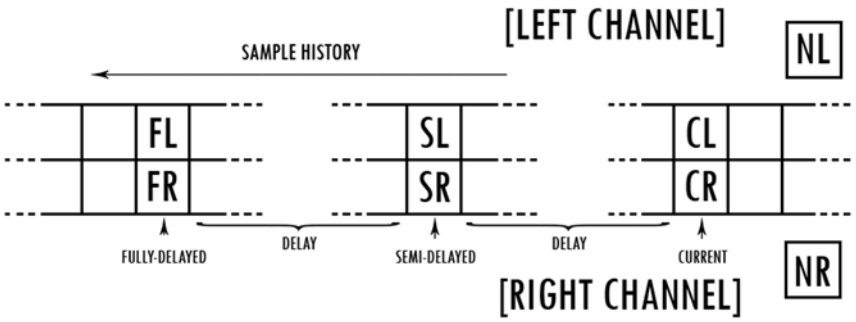



These quotients help stereo delaying. Lets say that the panorama is set to 0. This means that first delay (first PING) should be situated whole in the left channel. After this the second delay (first PONG) goes whole to the right channel. Intention of this delay is to played both delayed samples in every delay repetition, but that goes either to only right or only left channel. Solution of this delay is to mix those channels in corresponding ratio as seen on graph (in this case 0.5:0.5).

Now that we know all the arguments of formulas for left and right output channel calculations, we can have a look on them.

LEFT = dry . NL + wet . [pan_c . (PPQ . SL + SPQ . SR) + pan . (SPQ . FL + PPQ . FR)]

RIGHT = dry . NR + wet . [pan . (PPQ . SL + SPQ . SR) + pan_c . (SPQ . FL + PPQ . FR)]




where the NL, NR, SL, SR, FL, FR are samples as marked on the picture, PPQ and SPQ are mentioned panning quotients, dry is ratio of the uneffected signal on output (value from [0, 1]), wet is the ratio of the effected signal on input (value from [0, 1]), pan is a panorama setting (value from [0, 1]) and finally a pan_c is a complementary panning to the panorama setting (pan_c = 1 - pan).