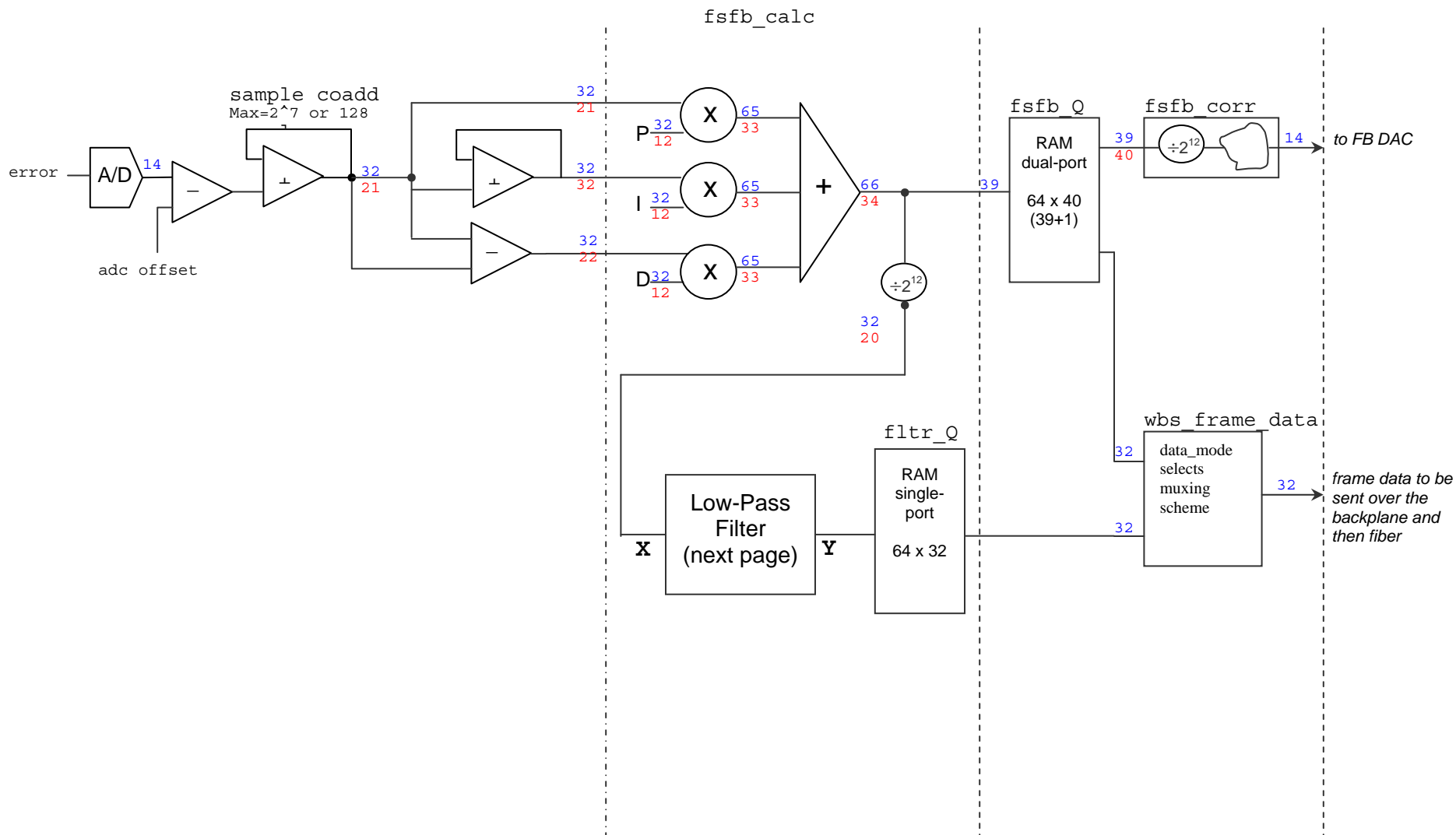
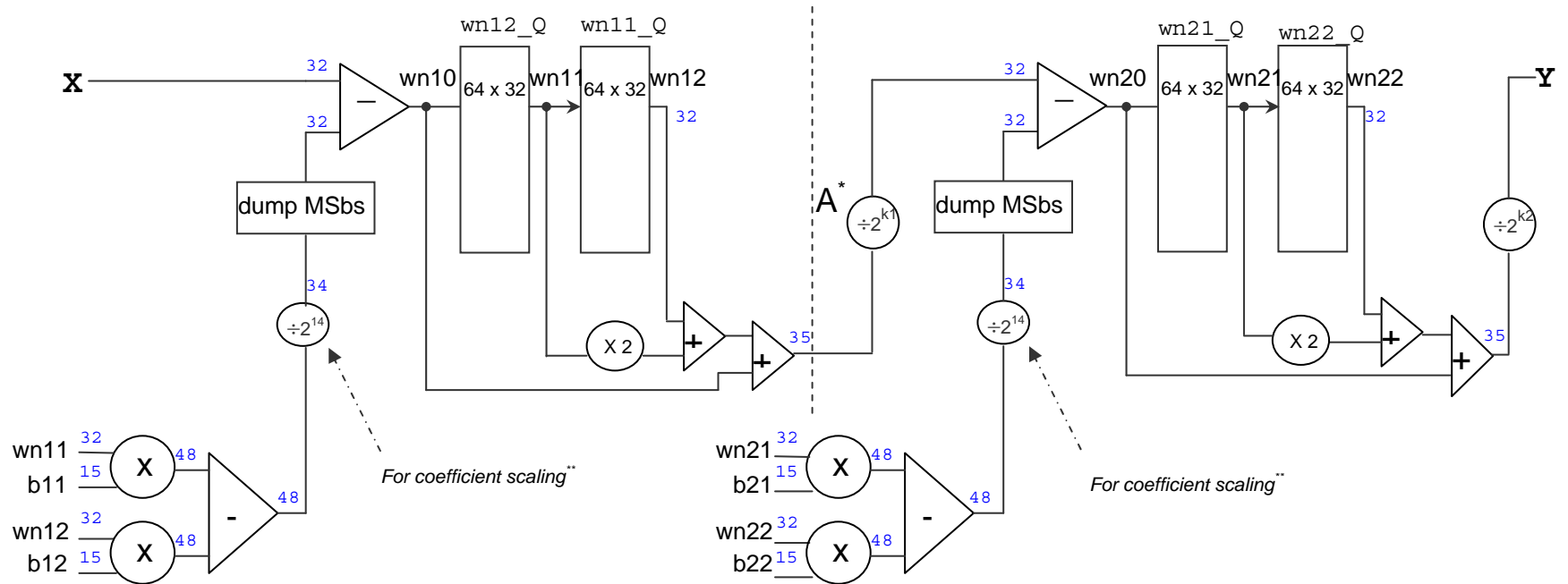


First-stage Feedback Calculation Block Diagram



**Legend**  
 VHDL block  
 Bus width  
 Maximum number of potential non-zero bits

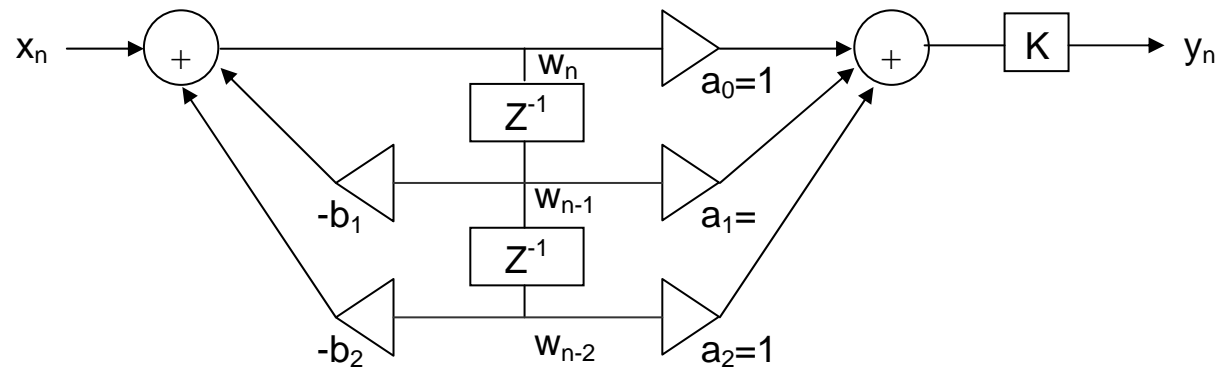
Low Pass Filter



\* A is the gain introduced between 2 biquad sections of the filter

\*\* coefficients are currently implemented as SBF 1.14 (sign-bit fractional)

## 2<sup>nd</sup>-order Butterworth Filter (biquad)

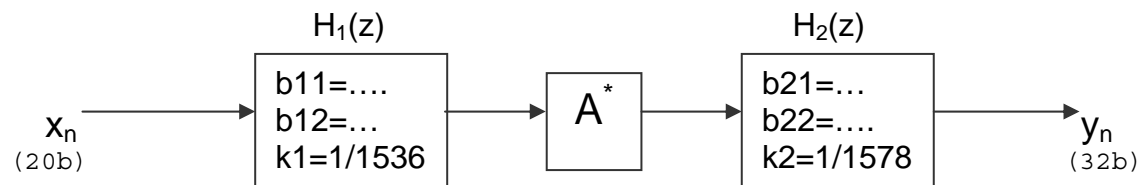


$$y(n) = x(n) + 2*x(n-1) + x(n-2) - b_1*y(n-1) - b_2*y(n-2)$$

$$H(z) = \frac{1 + 2*z^{-1} + z^{-2}}{1 + b_1*z^{-1} + b_2*z^{-2}}$$

$$\begin{aligned} w_{temp} &= b_1 * w_{n-1} + b_2 * w_{n-2} \\ w_n &= x_n - w_{temp} / 2^{14} \\ y_n &= w_n + 2 * w_{n-1} + w_{n-2} \end{aligned}$$

## 4<sup>th</sup>-order Butterworth Filter realized as series biquads



Gain-stage A is added to rescale in order to regain resolution, currently  $A=2^{-11}$   
 The overall gain is  $\sim (1536*1578*2^{-11})$