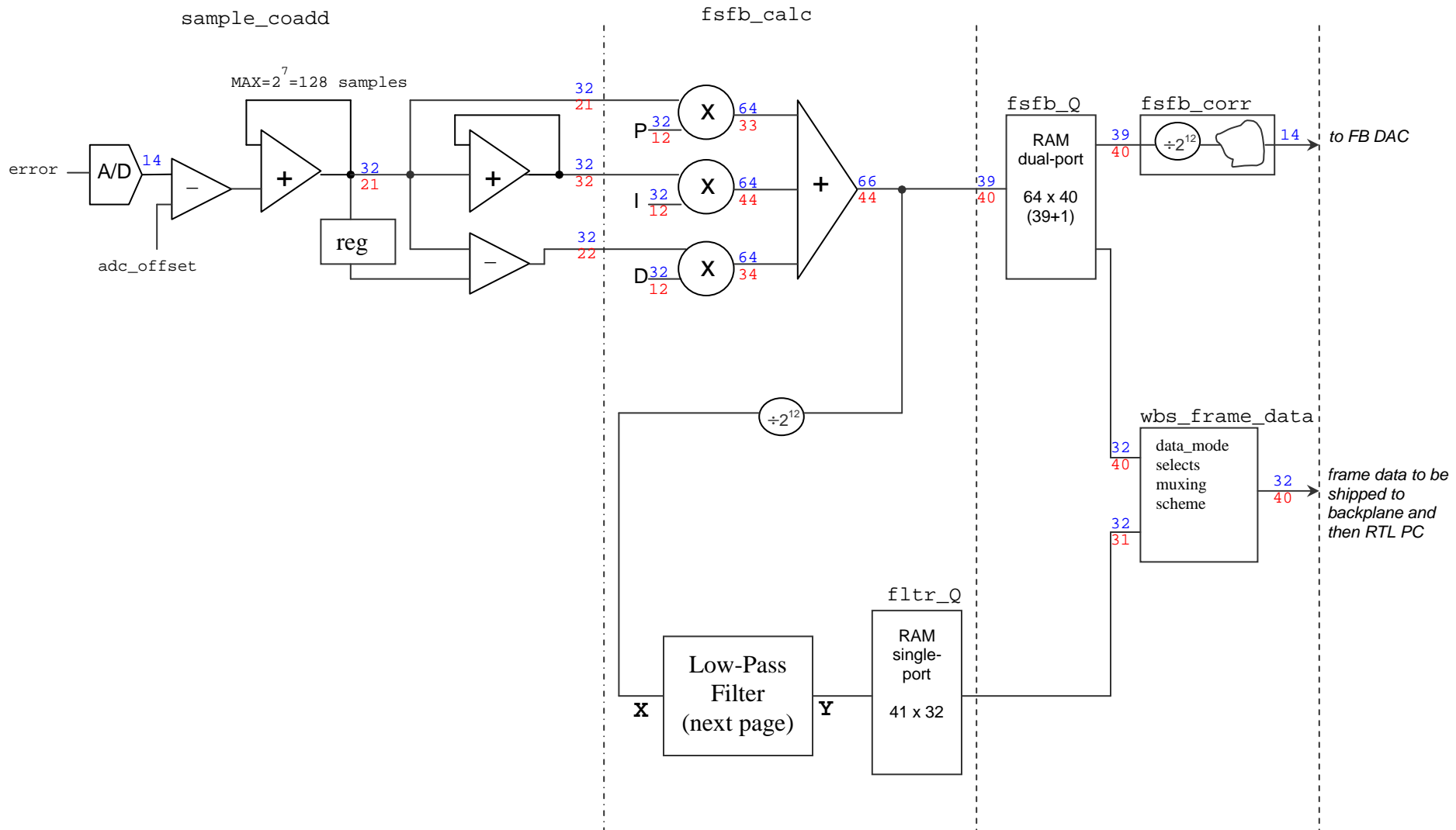
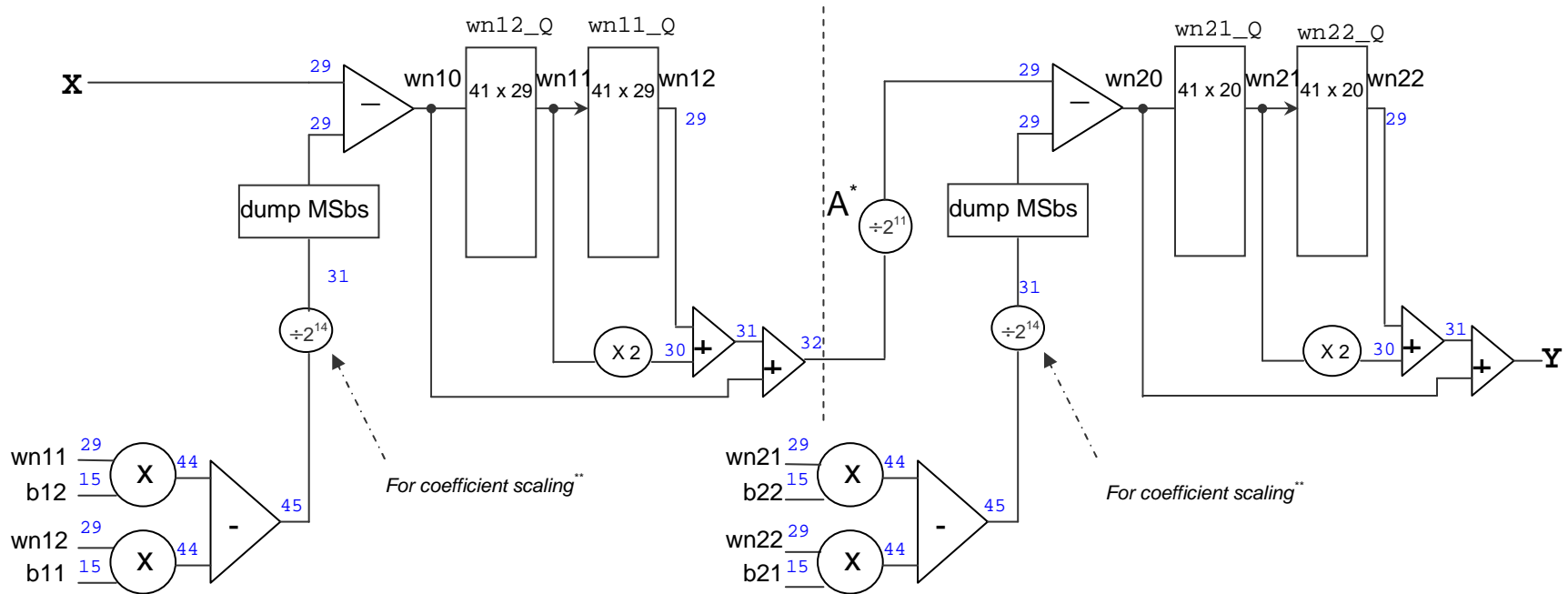


First-stage Feedback Calculation Block Diagram



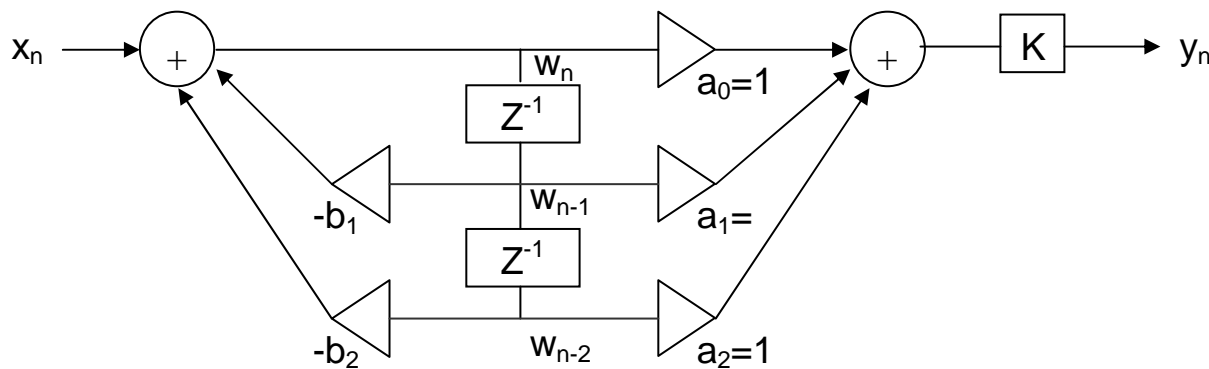
**Legend**  
 VHDL block  
 Bus width  
 Maximum number of potential non-zero bits

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)

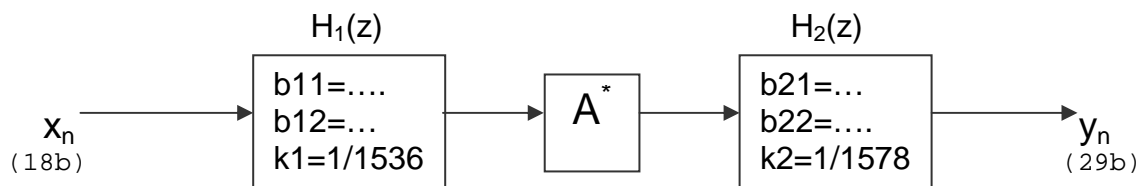


$$y(n) = x(n) + 2 \cdot x(n-1) + x(n-2) - b_1 \cdot y(n-1) - b_2 \cdot y(n-2)$$

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

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

## 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  $\sim (1536 \cdot 1578 \cdot 2^{-11})$