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xxHash32 Project - Timing

By design, those operations that use the multiplier are designed to take 2 cycles per word, except for the byte processing of remaining bytes, which takes 2 cycles per bytes. Other major operations take 1 cycle.

In summary:

Initialize = 1 cycle

Receive Input = 1 cycle per word

Stripe Process = 2 cycles per word = 8 cycles (Stripe is always 4 words)

Convergence = 1 cycle

Add Input Length = 1 cycle

Consume Word = 2 cycles per word

Consume Byte = 2 cycles per byte

Avalanche = 2 cycles

Throughput:

Since the unit spends most of its time receiving input and processing stripes, for increasingly large inputs the effect of other operations can be ignored, hence the throughput for large inputs (i.e >1kB) can be expressed as

Throughput = 3 cycles per word.

Since word size is 32 bits, this can be expressed as:

Throughput $=\frac{32}{3 \cdot T_{min}}$, where T_{min} is the minimum clk period = 14.734ns

So, Throughput = 723.95 Mbit/s

For smaller inputs, i.e when the input is 63 bytes, then we must consider all stages. Then the total amount of cycles is receive input x 16 + stripe x 12 + convergence + add length + 3 x consume word + 3 x consume byte + avalanche.

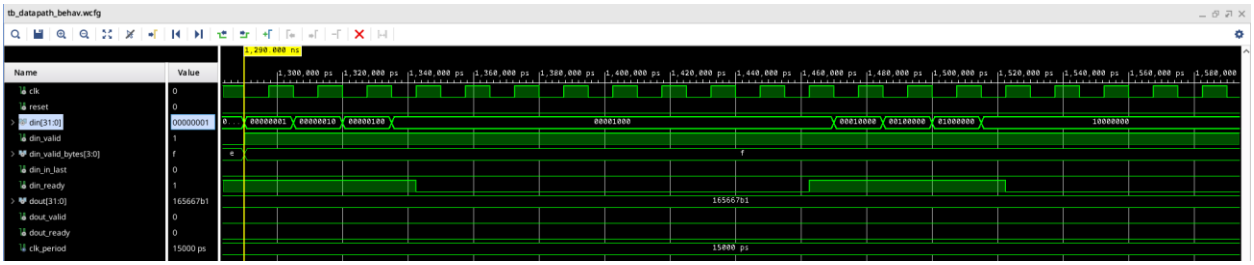
Substituting: 1x16 + 2x12 + 1 + 1 + 3x2 + 3x2 + 2 = 56 cycles

Throughput = $\frac{63 \cdot 8}{56 \cdot T_{min}}$ = 610.83 Mbit/s.

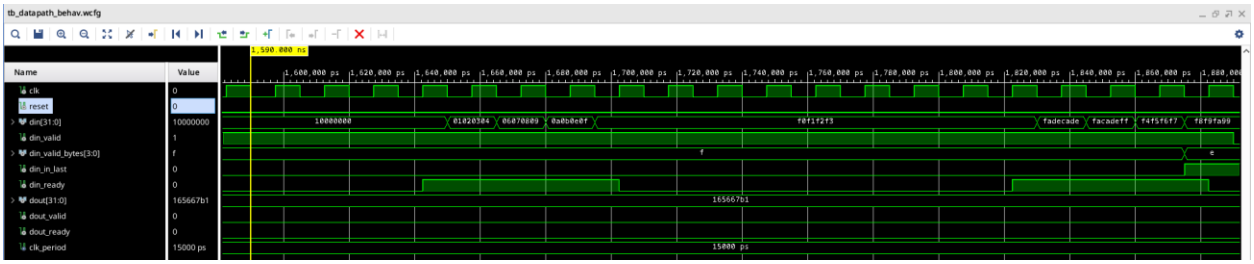
This case is deliberately chosen as its one of the scenarios verified through functional simulation, and it covers a realistic worst-case scenario, note that in this example the input is relatively small, hence the difference from the previous throughput mentioned. As the size of the input increases, it will approach **Throughput = 723.95 Mbit/s.**

The waveforms for this scenario (63 bytes) are shown on the following page

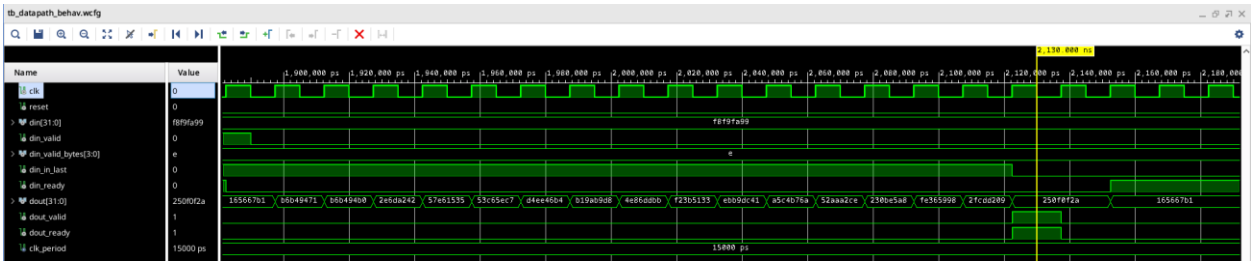
Start, din_valid = 1. Timestamp: 1290 ns



Processing



End, dout_valid = 1. Timestamp: 2130 ns



End and Start timestamps are aligned at falling edges for accurate cycle count.

(2130 ns – 1290ns) / 15 ns = 56 clock cycles. This aligns with our previous calculations, thus verifying that the formulas are correct. To verify specific formulas individually one may also look at time stamps for intermediate steps on the window.