IEEE802.3aq Channel model ad-hoc

Task2: TP3 - ISI Generator Block for Stressed Sensitivity Test

Petre Popescu

Quake Technologies

1. ISI Generator Block for Stressed Sensitivity Test

Goals

- different impulse response shapes will exercise actual equalisers in different ways, more than one “synthetic” stressor will likely be needed,
- we can group the modelled channel responses into groups such as precursor-heavy, quasi-symmetrical, and postcursor-heavy (can be a mirror image of precursor-heavy),
- analysis of three possible implementations (BT LPF, two peak impulse response, and three peak impulse response) as proposed in [aronson_2_0704],
- define reference fibre pulse response to be used for analysis based on available channel models (see Note),
- define optimum pulse shape to be used for two or three peak impulse response,
- find a minimum range of values for A1, A2 and Δt and A0, A1, A2, $\Delta t1$ and $\Delta t2$, respectively, that will satisfy the majority of impulse response as defined by the channel model.

Note: We have to start with a limited number of selected fibres in order to understand the feasibility of implementation and how many sets of variables have to be defined. We can decide if we want to cover all channels or limited number of significant cases, based on the complexity and importance.

2. ISI Generator Block for Stressed Sensitivity Test

Evaluation methodology

- evaluate the possibility of using a BT LPF for ISI generator block.
- select a limited number of fibres with performance at the limit allowed in the current link budget. I will use representative fibres from the 65 fibres (Cambridge model, 300m) having PIE-L values between 4 and 5 dB).
- the use of 300m models instead of 220m will give the margin for other impairments not accounted for (connectors, transmitter and receiver nonlinearities).
- use pulse shapes that can be generated in the lab with minimal new equipment.
- optimize A1, A2, and Δt (A0, A1, A2, $\Delta t1$ and $\Delta t2$) for minimum square error (MSE), with reasonable resolution (2 or 3 digits).
- the optimization will be based on minimizing the peak error (errpk) and the relative error signal area (PSR)

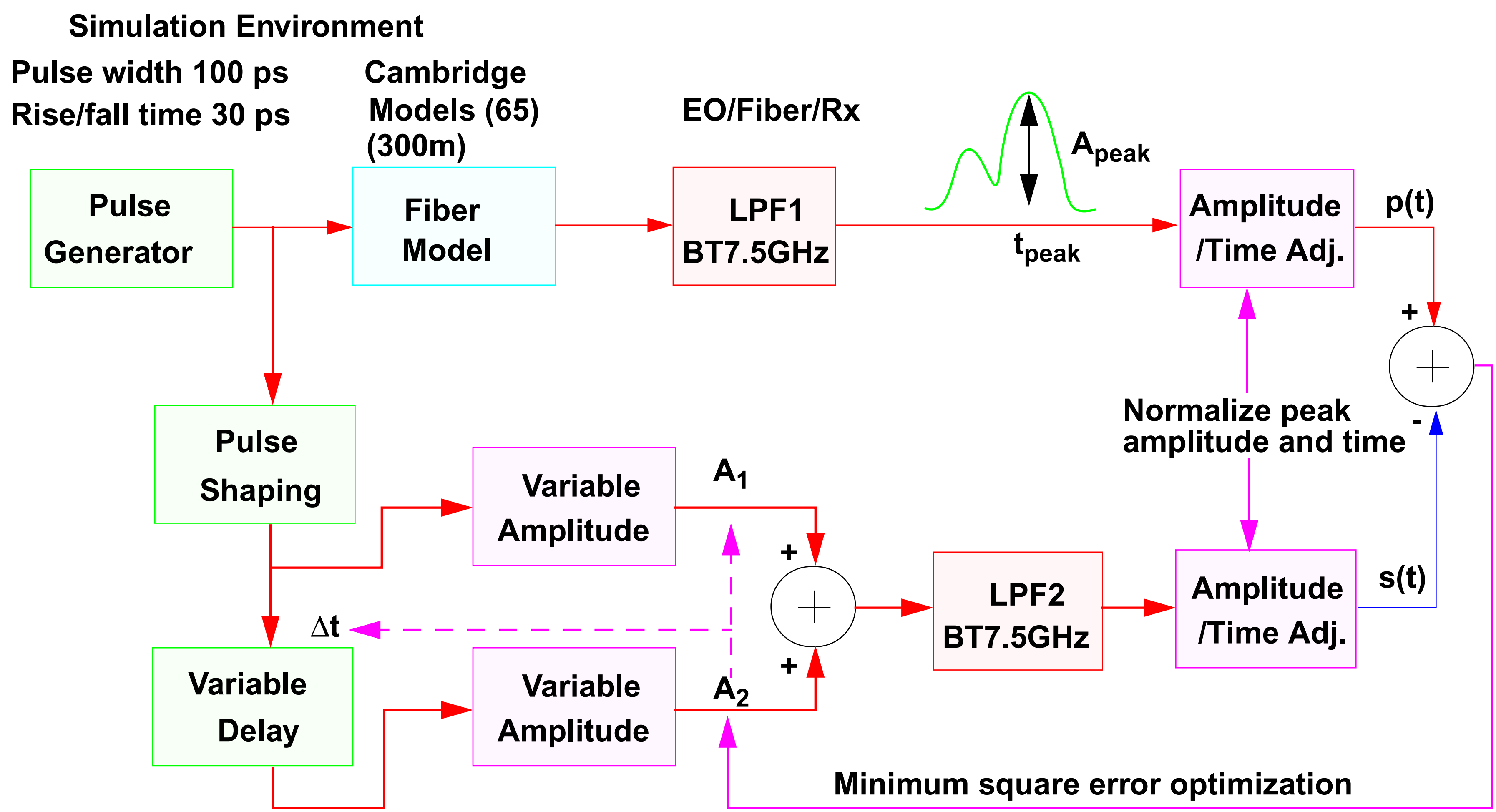
$$\text{errpk} = \frac{|p(t) - s(t)|_{pk}}{|p(t)|_{pk}}$$

, where p(t) is the fibre pulse response and s(t) is the stressor

$$\text{PSR} = 10\text{x}\log\left(\frac{\int_t |p(t)|^2 dt}{\int_t |p(t) - s(t)|^2 dt}\right)$$

- the initial resolution step for Δt is 5ps.
- for a given set of amplitudes and delay times, we can calculate the effective errpk and PSR.

3. Two peak impulse response ISI generator block

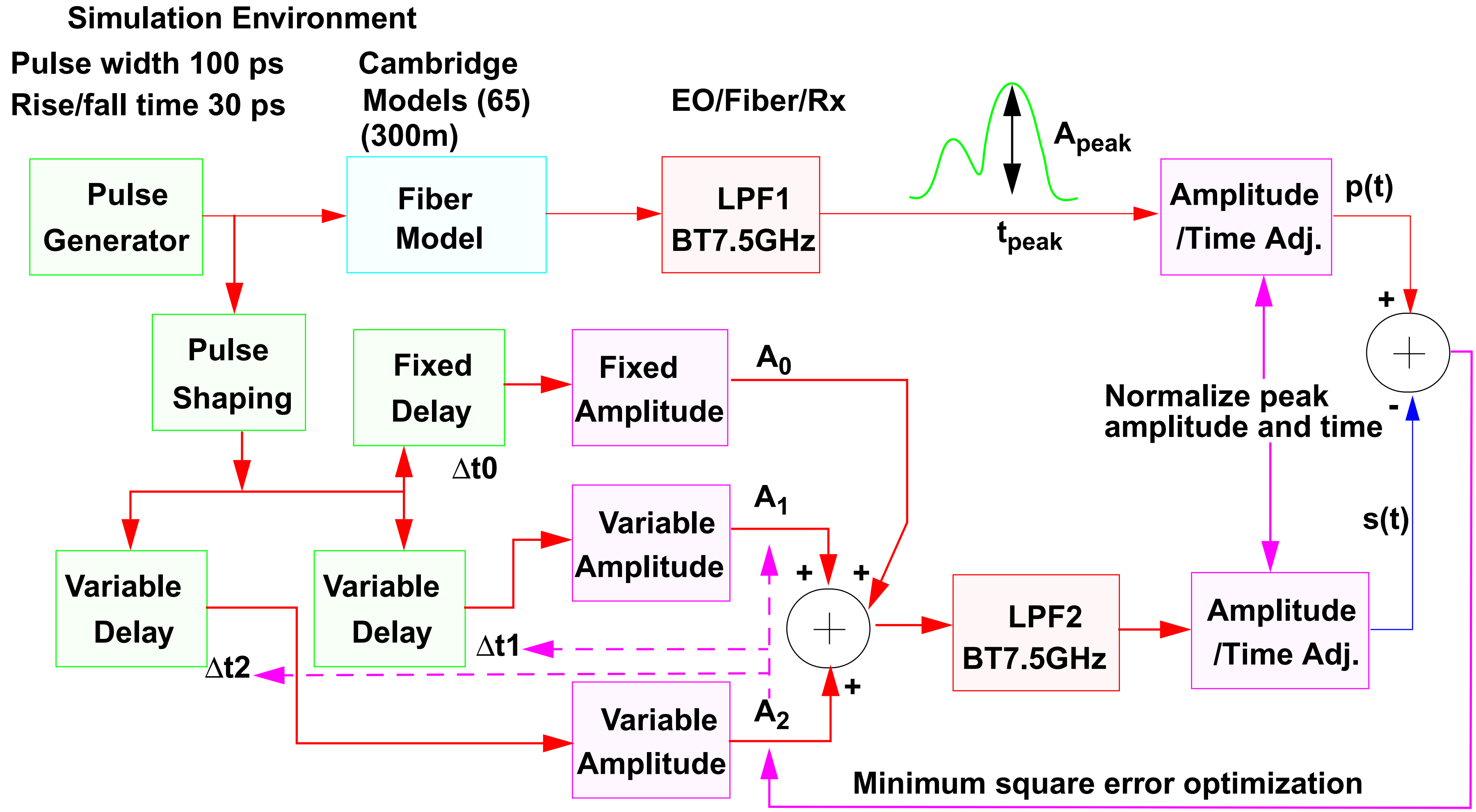


The simulation environment for fiber path consists of the fiber model (Cambridge model), a BT LPF 7.5 GHz and a normalization block to adjust for peak amplitude value and time.

The ISI generator block path consists of a pulse shaping block, a variable delay block, two variable amplitude blocks, an adder and the same BT LPF and normalization block.

The second Low-Pass Filter (LPF2) may not be needed, depending on the pulse shaping chosen.

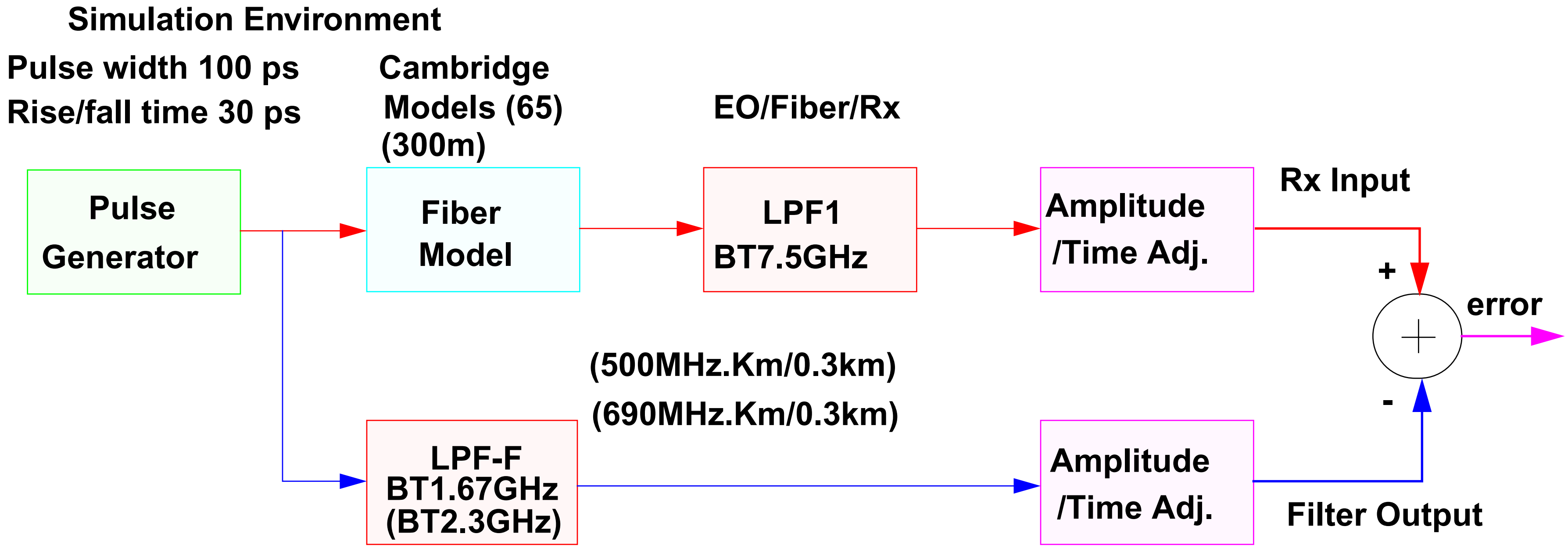
4. Three peak impulse response ISI generator block



There are three delay blocks in the simulation environment. We can adjust Δt1 and Δt2 relative to Δt0 such that the two peaks can be symmetrical relative to the main pulse A_0, or on the same side (pre-cursor or post-cursor).

The second Low-Pass Filter (LPF2) may not be needed, depending on the pulse shaping chosen.

5. BT Low Pass Filter Option



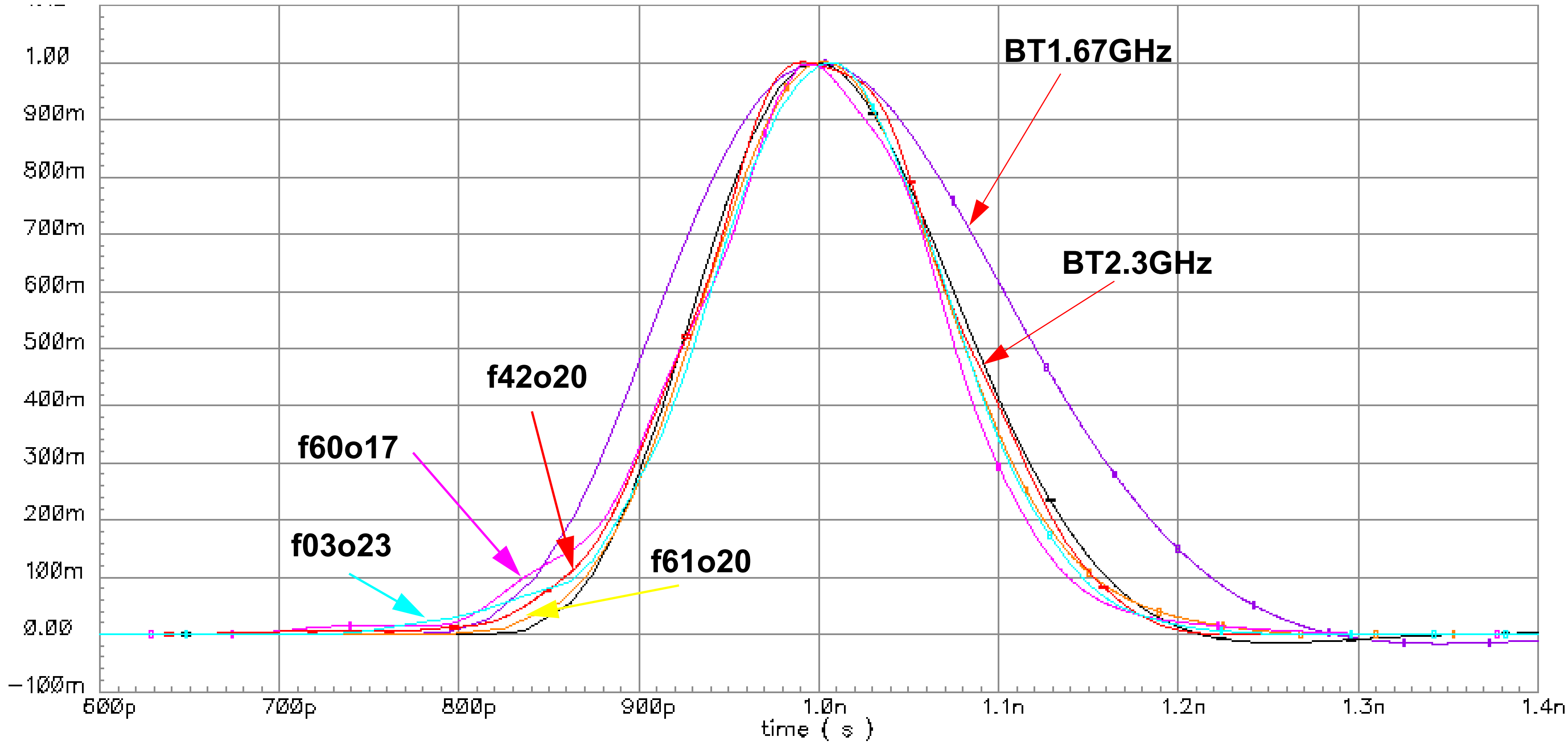
Two simulations using selected models based on PIE-L value 4 to 5 dB and quasi-symmetrical impulse response, and two low pass filters (BT1.67GHz and BT2.3GHz).

Note: The second Low-Pass Filter (BT7.5GHz LPF) is not needed, the fiber emulator filter (LPF-F) has a much lower bandwidth.

The amplitudes and timing are adjusted for minimum error value and minimum error signal area.

The error signal is evaluated relative to the signal peak amplitude (%) and signal area relative to the error signal area (SNR*).

6. ISI Generator Block using BT Filters and quasi-symmetrical pulse response



- For quasi-symmetrical pulse response fibres, the filter approximation BT1.67GHz is to pessimistic.
- The error for filter approximation using BT2.3GHz

Fiber model	f03o23	f42o20	f60o17	f61o20
Peak Error	8.6%	7%	12%	6%
PSR	19.7dB	23.2dB	16.1dB	23.2dB

7. Three Peak Impulse Response Approximation

8. Summary

- The low pass filter option BT2.3GHz, can be used as a first approximation for quasi-symmetrical pulse response fibres having the PIE-L 4 to 5 dB.
- The low pass filter option BT1.67GHz is too pessimistic for the same group of pulse response fibres.