Proposal for Past-Future Protection Handling in ALICE

(The maximum number of permitted interactions increased from 32 to 64. The updated proposal approved by the ALICE Technical Board on 26 November 2002.)

The Interaction Signal

1 The interaction definition is used to activate the past-future protection circuits and for the interaction record, written every orbit.

2 The interaction signals shall be programmable logic functions (using ANDs & inversions only) of a subset of **4** out of all **L0** trigger inputs.

3 There shall be **three** such interaction circuits.

Proposed Past-Future Protection Handling

1 The CTP shall include the logic to check the violation of the past-future protection. Both the duration of the protection interval and the number of permitted interactions during the interval shall be programmable. The selection of the interaction signal shall also be programmable.

The maximum duration of the protection interval shall be **±100 μs** with a step size of about **1%** and a jitter of less than **1%.**

The maximum number of permitted interactions shall be **64.**

Note 1: The condition "no interaction" during the protection interval might be required for calibration; single interaction is a normal requirement; in certain modes, some detectors could tolerate several interactions.

2 The past-future protection circuits shall be associated with detector clusters. Each past-future protection circuit can be used simultaneously by any number of clusters.

3 The past-future protection circuits shall have two interaction inputs and shall use either one or both to set the past-future protection.

Note 2: The past-future protection circuits shall be able to differentiate between low multiplicity and high multiplicity interactions so that, for example, several low multiplicity interactions could be allowed in the past-future protection period but no other type of interaction.

4 There shall be 4 independently programmable past-future protection circuits; all will allow multiple interactions.

5 A schematic diagram of such a circuit is shown in Figure 1. The circuit shall consist of two blocks each with its own interaction signal input.

Each block shall have two programmable *protection thresholds* (from 0 to 32) and a *protection interval* (0 to ±100 μs). The *time resolution* shall be expressed in terms of number of bunch crossings, N. N will be programmable between 1 and 32 (giving a resolution of between 25ns and 800ns).

Note 3: The time resolution parameter, N shall be chosen to give a resolution of at least 1% of the protection interval.

6 The outputs of each block shall pass through a delay in order to align the signals (see Figure 1).

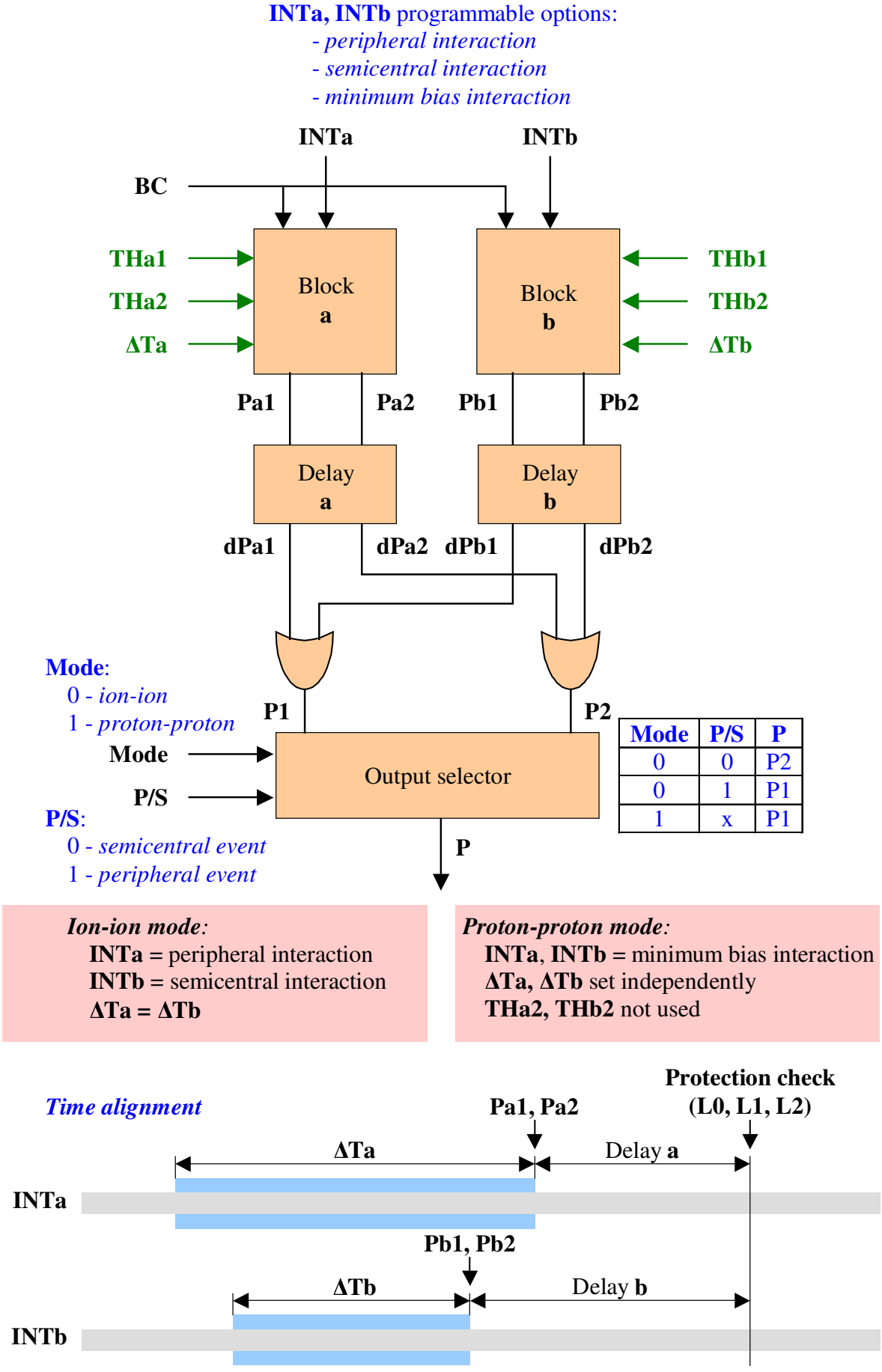
7 The output selector (see Figure 1) shall select either the signal P1 or P2 for the past-future status. The output selector shall have two other inputs, Mode and P/S, which determine whether P1 or P2 is selected. The mode input shall be set to 0 for ion-ion running and 1 for proton-proton running. In proton-proton mode, the input P/S is ignored and the signal P1 is always selected. In ion-ion mode, P/S shall be set to either 0 or 1 depending on the interaction type that triggered the event. In this mode, the value of P/S shall determine whether signal P1 or P2 is selected.

8 Each past-future protection circuit shall generate, in each bunch-crossing interval, the protection status bits required for L0, L1 and L2 trigger decisions.

Ion-Ion Running Mode:

An example of how the past-future protection circuits could be used in ALICE in ion-ion mode is given below:

- INTa = semi-central interaction (SC) and INTb = peripheral interaction (MB.SCbar).
- The protection interval shall be the same in each circuit i.e. $\Delta Ta = \Delta Tb$.
- A detector cluster containing all detectors could be connected to a past-future protection circuit that allows, for example, one semi-central and up to five peripheral interactions within ± 88 μs in order to protect the TPC. It would be possible, however, that two or more of the peripheral interactions could occur within 10 μs of each other and cause pile-up in another detector (e.g. Silicon drifts). This would result in an unusable event being recorded.
- Calculations suggest that the number of such unusable events will be less than 4%.



Block diagram of the past-future protection circuit - *new version*

Figure 1 Schematic diagram of a past-future protection circuit.

Proton-Proton Mode

An example of how the past-future protection circuits could be used in ALICE in proton-proton mode is given below:

- In p-p mode there will only be one definition of an interaction *i.e.* INTa = INTb = INT.
- The protection interval will, in general, be different in each block.
- As there will only be one type of interaction, the selector will be set at P1. Thus thresholds THa2 and THb2 will not be used in practice.