

# DAQ Upstream2Trigger Protocol V0\_1

## 1. PRELIMINARIES

In the following, a "word" means a 32-bit word transmitted through the 32-bit aurora interface.

The bits in a word are indexed from 31 down to 0, with bit[31] as the most significant bit.

## 2. PROTOCOL

### 2.1. *Transmission words*

Two kinds of transmission word are specified:

- a) Single hit-event transmission word;
- b) Status&control data transmission word.

### 2.2. *Single hit-event transmission word*

This kind of word is used by the upstream board to transmit single events to the trigger board. The format of the word is defined as:

Bit[31]='0';

Bit[30-29]: "PMT number". Since each fiber link instruments 4 PMTs, 2 bits are reserved for the PMT number. Bit[30] is the most significant bit.

Bit[28-25]: "Channel number". Since each PMT has 16 channels, 4 bits are reserved for the channel number. Bit [28] is the most significant bit.

Bit[24-0]: Timing information of the event. Bit [24] is the most significant bit.

### 2.3. *Status&control transmission word*

There are two types of status&control transmission word: link initialization word and flow control word.

- a) Link initialization word

This type of word is sent by the upstream board to inform the trigger board the basic information of the link. The format of the

word is defined as:

Bit[31]='1';

Bit[30-28]='000';

Bit[27-24]: "Bar number". Since there are 16 bars, 4 bits are reserved. Bit [27] is the most significant bit.

Bit[23-21]: "Fiber link number". Since the hit events in a bar are transmitted through 8 fiber links, three bits are reserved. Bit[23] is the most significant bit.

Bit [20-0]: Reserved but have not been defined.

b) Flow control word

This type of word is sent by the trigger board to stop the upstream board sending more event data. The format of the word is defined as:

Bit[31]='1';

Bit[30-28]='001';

Bit[27-23]: the minimum number of clock cycles the upstream board has to wait before sending the next single hit-event data, as defined below.

0001: wait 8 cycles;

0010: wait 16 cycles;

0011: wait 32 cycles;

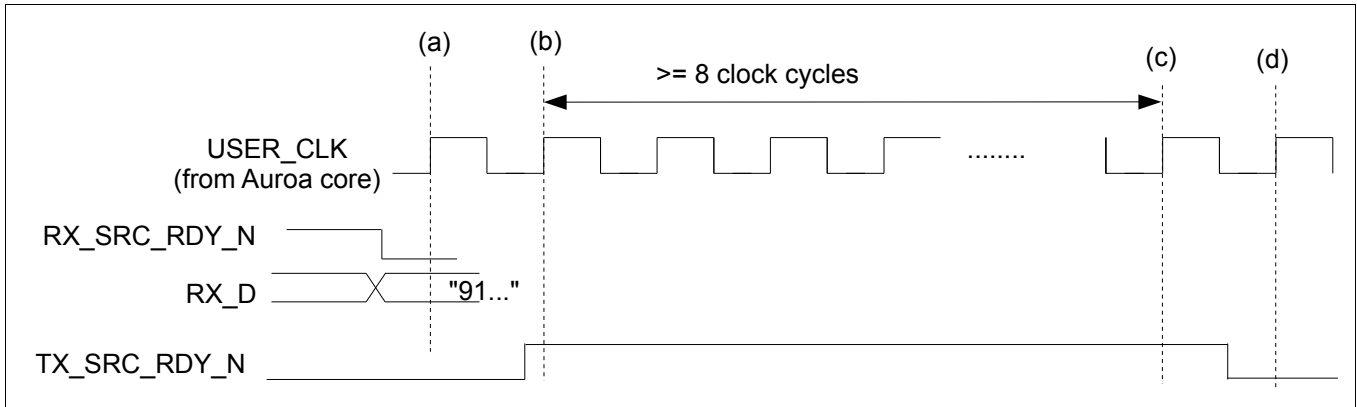
0100: wait 64 cycles;

0101: wait 128 cycles;

Other combinations: reserved but not defined.

Bit[22-0]: Reserved but have not been defined.

An example is shown below.



In the example, at clock edge (a), a data is received at the aurora interface of the upstream board. The most significant eight bits of the received data are  $x'91'=b'1001001$ . So this means the received data is a flow control word which requires the upstream board to stop sending event data for at least 8 clock cycles. Therefore, before the positive edge (b), “TX\_SRC\_RDY\_N” is deasserted. After waiting for no less than 8 clock cycles, “TX\_SRC\_RDY\_N” is allowed to be asserted again to transmit the remaining event data.

c) Other combinations are reserved but not defined.

### 3. COMMENTS

- 1) The link initialization word is typically sent only once (when the fiber link is powered) to tell the trigger board the basic information of the link.
- 2) The flow control word can potentially increase the latency of the trigger. So, the trigger board will send this word only when it is really necessary to stop the sending process at the upstream board side.
- 3) No frame transmission mode is defined. This is because frame transmission typically trades latency for throughput. However, in our case, I think the throughput is high enough (75M/s events per fiber link). Therefore, the single hit-event transmission mode is used to have a small latency.

4) No error detection mechanism is used. This is because the Aurora interface already has the ability to detect all single bit errors and most multi-bit errors in the channel.

5) More transmission words can be defined by using the reserved combinations in the status&control data transmission word.