Gullfaxi Design Specifications – V1.2

1. Introduction

Gullfaxi has one input port that uses GIP (Gullfaxi Input Protocol) and three output ports that use GOP (Gullfaxi Output Protocol).

Gullfaxi reads packets from the input GIP port, stores them in an internal buffer and sends them out to the right output GOP port based on the information contained in the GIP header.

Gullfaxi also converts the protocol from GIP to GOP.

2. Changelog

V1.0: initial version
V1.1: fixed 2 typos:
    GIP: I_ready must be 1 for starting sending message, not 0
    GOP: payload length=1 corresponds to total packet length 1 (no header in GOP)
V1.2: fixed 1 typo in the changelog entry of V1.1

3. Interface

Gullfaxi has the following ports:

- clk: clock signal
- reset: reset (active low)
- GIP port 0:
    - I0_valid: data in valid
    - I0_data [7:0]: data in
    - I0_end: packet end
    - I0_ready: ready to receive
- GOP port 0:
    - O0_start: start of packet
    - O0_length [5:0]: packet length
    - O0_data [7:0]: data out
    - O0_end: end of packet
    - O0_req: request of sending
    - O0_grant: grant for sending
- GOP port 1, 2:
    - Identical interface as GOP port 0, prefixes “O1_” and “O2_”

4. Gullfaxi Input Protocol

Gullfaxi Input Protocol (GIP) is used on Gullfaxi input port I0. GIP packets are transfered at the rate of one byte per cycle and are composed of a 1-byte GIP header and a payload. The minimal payload size is 1 byte (total packet length 2), the maximum payload size is 12 bytes (total packet length 13).

The line I_ready indicates whether Gullfaxi has space in his internal buffer to accommodate an entire maximal-length packet. A transfer can be initiated only when the line I_ready is 1.

A transfer is initiated by raising the I_valid line and, at the same time, sending out on I_data the GIP header, which is composed as follows:

- bits [7:2] : payload length (only values 1-12 are legal)
- bits [1:0] : output port on which Gullfaxi should output the packet (only values 0-2 are legal)

Message transmission continues with the sending of the payload words on port I_data. The signal I_valid is kept to one at any time in which a new payload word is output.

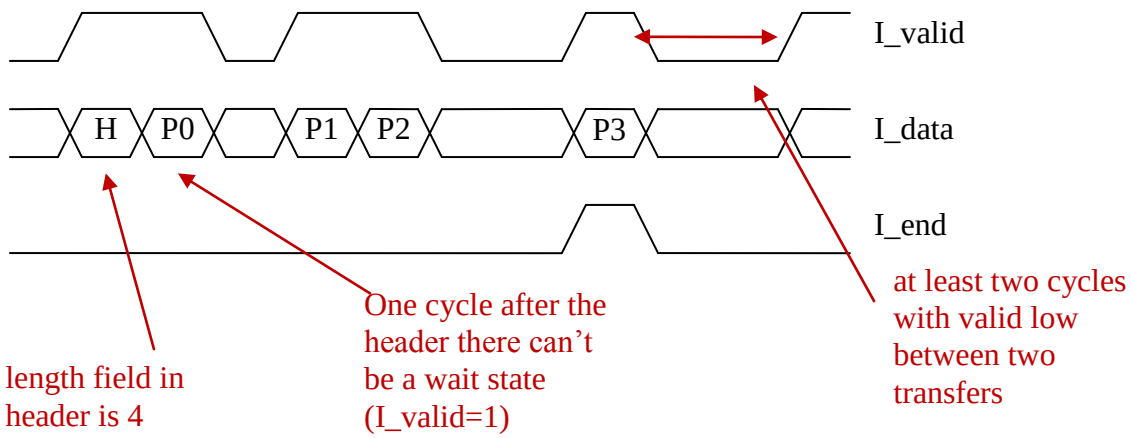
Wait cycles, in which I_valid is zero and no payload word is transfered, can be inserted at any time during the transmission except between the header and the first payload word.

The signal I_end is raised for one cycle when transfering the last payload word.

After the cycle in which I_end was one, there must be at least 2 cycles in which valid is low. Then a new transfer can start.

If Gullfaxi raises I_ready during a transfer, this change should be ignored, i.e. when a transmission has been initiated, Gullfaxi has no way to stop it. A transfer can be initiated only when I_ready is 1 (Gullfaxi lowers I_ready when it does not have the internal space to store a packet).

An example GIP transfer is shown below



5. Gullfaxi Output Protocol

The Gullfaxi output protocol is used on Gullfaxi Output ports O0, O1 and O2. GOP packets are transfered at one byte per cycle and are composed only of payload, no header is sent. The minimal payload size is 1 byte, the maximum payload size is 12 bytes.
To initiate a transfer, Gullfaxi raises the signal O_req and sets on O_length the number of bytes that compose the packet. O_length must remain to a constant value until the end of the transfer.

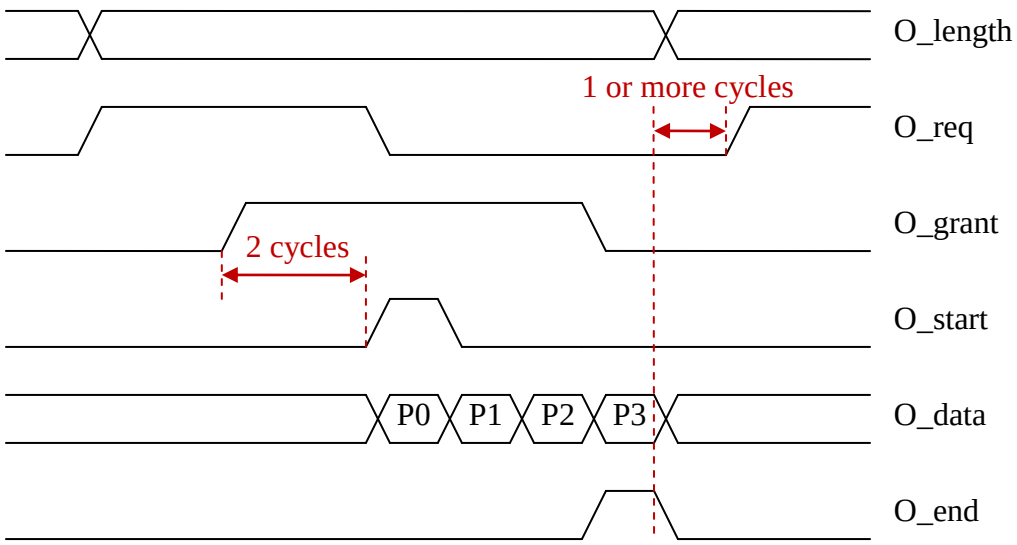
Gullfaxi then waits for a grant on O_grant. Once the grant has been received (two cycles exactly after it has been sent), Gullfaxi lowers O_req and starts immediately sending data items on O_data, one item per cycle without any waitstate.

There is no need for the O_grant signal to go to zero. If the block receiving GOP transitions is always ready to receive a item, grant can be kept fixed at one. It is sufficient for O_grant to be one for one clock cycle when O_req has been raised for Gullfaxi to start a transfer.

The signal O_start is raised for one cycle during the time in which the first byte is transfered and the signal O_end is raised for one cycle during the time in which the last byte is transfered.

If the packet contains a single byte, then O_start and O_end will be at one in the same cycle.

An example GOP transfer is shown below.



6. Gullfaxi Functionality

When receiving an input GIP packet, Gullfaxi stores it in an internal buffer whose capacity is 64 byte elements. It then dispatches the packets in the same order in which they were received to the GOP output ports. Every packet is stripped of the GIP header and sent to the GOP port that was specified in the GIP header.
The signal I0_ready is lowered when Gullfaxi has no space for a maximal-length packet in its internal buffer to inform the GIP transmitter that it cannot accept new packets, so that the buffer should never overflow.