CERN
CH-1211 Geneva 23
Switzerland

LHCb Project Document No
EDMS : 704084 v. 1.0
LHCb subsystem
TFC

Dedicated Experiment for CP violation Study at LHC

Date: 2006-02-16

Specification

ODIN Raw Data Format

R. Jacobsson, PH-LBC

ABSTRACT

The Readout Supervisor 'ODIN' records global information about each event which is sent to the event building in the form of a standard event fragment. This note specifies the format of the ODIN raw data bank.

Keywords: raw data, ODIN, TFC, LHCb

Distribution Lists

For approval:
O. Callot, M. Cattaneo, J. Christiansen, M. Frank, B. Jost, N. Neufeld

Document Status Sheet

Version	*Date*	*Pages*	*Comments or Description of Changes*
0.0	2005-04-07		First version (including L0 + L1 information)
1.0	2006-02-15		Update with only L0 trigger

1 ODIN Front-End

ODIN[1] incorporates a Front-End analogous to a TELL1/UKL1 board in order to record local event information and provide the DAQ system with the data on an event-by-event basis. The "ODIN Raw Data Bank" contains centrally recorded information about the identity, the source and some information about the quality of an event. The event fragments are packed as standard Multi Event Packets (MEPs) [2] and they are merged with the rest of the event data during the event building.

The ODIN front-end processing is shown in Figure 1. The data recorded at each L0 trigger accept is transmitted to the ODIN Front-End via the Front-End Buffer (FEB). Additional non-synchronous information is added during the preparation of the MEP. The MEP is transmitted upon reception of the IP destination from the MEP Destination Broadcaster implemented on ODIN.

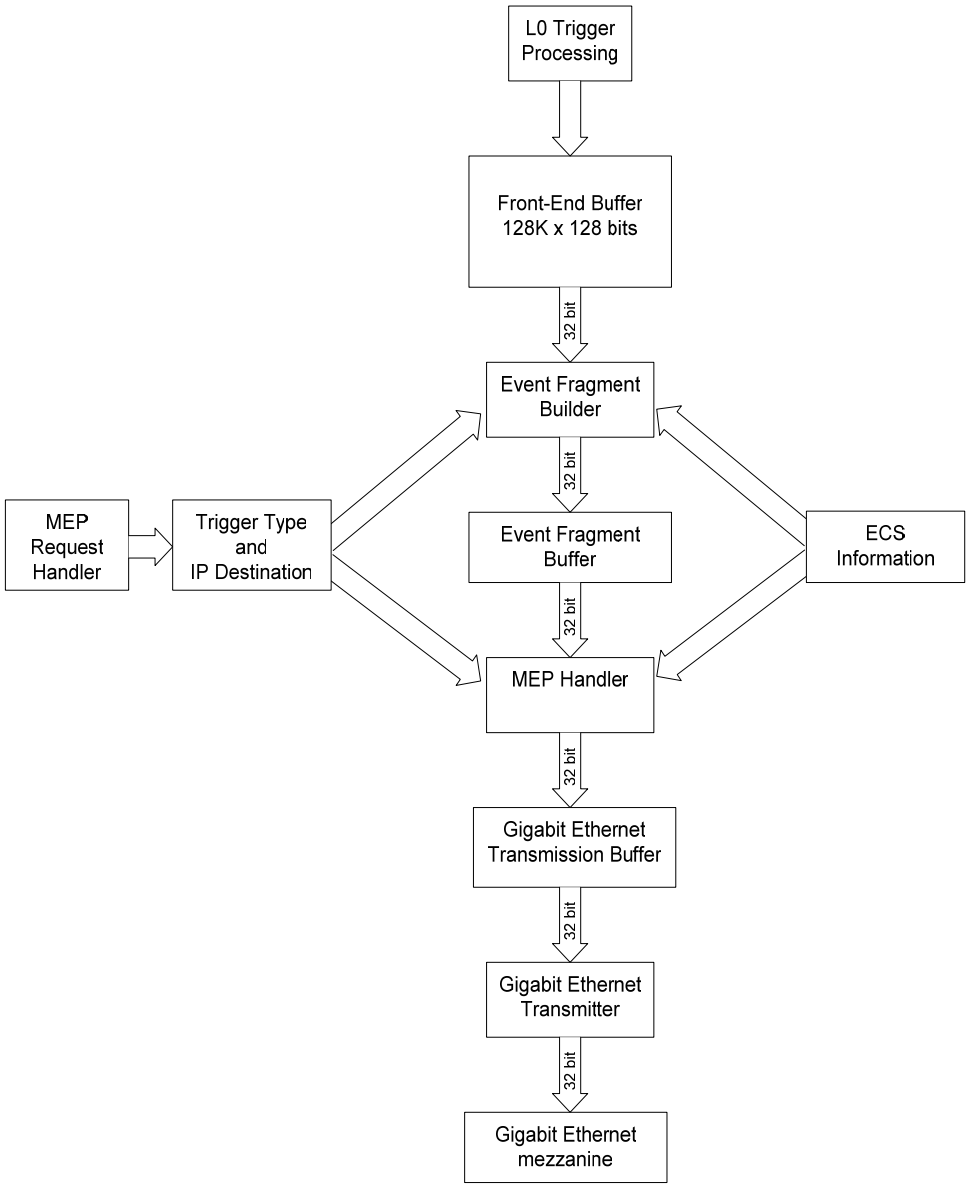

Figure 1: Block diagram of the front-end processing

2 ODIN Raw Data Format

The MEP transport format is described in [2] and all details concerning the information and preparation of the ODIN MEPs are described in [1]. ODIN organizes the event fragment data according to the common raw data format [3]. Table 1 shows a completely expanded view of the ODIN raw bank header and the contents of the data bank.

Table 1: Contents of the ODIN event fragment raw data bank. The first two words contain the standard raw bank header.

Word	31 .. 24	23 .. 16	15 .. 8	7 .. 0
#H0	Size in bytes		Magic Patter = 0xCBCB	
#H1	Source ID = “ODIN S/N”		Version = 2	Type = 0x10
#D0	Run Number			
#D1	L0 Event ID (31 .. 0)			
#D2	L0 Event ID (63 .. 32)			
#D3	Orbit Number			
#D4				Bunch ID
#D5	GPS Time (31 .. 0)			
#D6	GPS Time (63 .. 32)			
#D7	Error Bits (see below)	BX Type	F	Trigger Type
#D8		Detector Status		
#D9				Bunch Current

Partition ID: The partition ID is contained in the MEP header and “2” for the TFC system.

Source ID: The source ID is set by the ECS and will most likely be the serial number of the ODIN board driving the readout partition.

Type: The type field is used by the offline to know the type of the event bank. For ODIN it is defined to be 16.

Run Number: The run number is set by the ECS on a start of a run.

L0 Event ID: The L0 Event ID is incremented on every L0 trigger accept and starts from 0 at a start of a run. In the current scheme the L0 Event ID is reset on a front-end electronics reset which means that, unless the run number is changed, several events may have the same L0 Event ID within a run, that is a set of events marked with the same Run Number.

Orbit Number: The orbit number is incremented on each turn of the LHC beams as marked by bunch crossing 0. The orbit number is currently reset on each start of run. Together with the Bunch ID they form an exact definition of the relative time of an event with respect to the start of run. It may be used as an alternative during times when the GPS time is not available.

GPS Time: The GPS time is received as a 64 bit UTC time via the Beam Synchronous Timing system [4] every turn of the LHC. For this reason an offset must be calibrated and applied locally in

LHCb. The purpose of the GPS time is to allow correlating the physics events to slow control events. Therefore, even if the GPS time is given as the number of microseconds since 1970-01-01, it should be considered to have a resolution of the order of an LHC turn (~100 μs).

Trigger Type: The trigger type is encoded on three bits and indicates the source of the trigger [1].

Force Bit (F): The force bit is used to ensure that some events, typically for test and calibration, may be forced to be accepted by all triggers and logged.

BX Type: The expected bunch crossing type is encoded on two bits (no beam, single beam left, single beam right, beam crossing) and is produced by an internal sequencer which is loaded by the ECS system.

Error Bits: Currently only two error bits have been defined:

- Bit 0: Synchronization error on the Bunch ID between the L0DU and ODIN.
- Bit 1: The event with synchronization error has been forced irrespective of the trigger decision.

Detector Status: ODIN has a 24-bit input which allows each sub-detector to provide 2-bit encoded status information [5].

Bunch Current: Normalized bunch current per bunch crossing as measured by a Beam Phase and Intensity Monitor [6] connected to the local beam pick-ups at point 8. The information is encoded on 8 bits which would allow recording a relative measurement with a 4-bit resolution per beam. The information will be delayed by exactly one entire LHC turn.

The total size of the ODIN raw bank is thus 48 bytes. Including the MEP sub-header, the MEP header, the IP protocol, and aligning it to a multiple of four bytes this means 100 bytes per single event MEPs and 880 bytes for MEPs with a packing factor of 16.

References

[1] Z. Guzik and R. Jacobsson, LHCb Readout Supervisor 'ODIN' – Technical Reference, EDMS 704081-v1, Feb 2006.

[2] B. Jost and N. Neufeld, Raw-data Transport Format, EDMS 499933-v5.0, Sep 2004.

[3] O. Callot et al., Raw-data Format, EDMS 565851-v4.0, Oct 2005.

[4] R. Jones, The interface and structure of ther Machine Beam Synchronous Timing Message for the LHC Experiments, EDMS 638899-v1.0, Feb 2006

[5] R. Jacobsson, LHCb Detector Status Bits, EDMS XXXXXX-v1.0, Feb 2006.

[6] Z. Guzik and R. Jacobsson, Beam Phase and Intensity Monitor, LHCb 2006-???,