RawCOPPER data format

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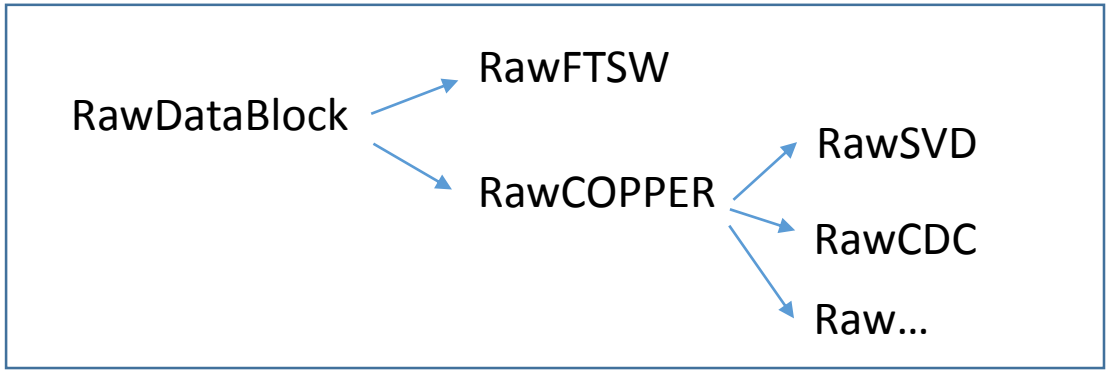
1, RawDataBlock object (to handle Raw data from COPPER board)



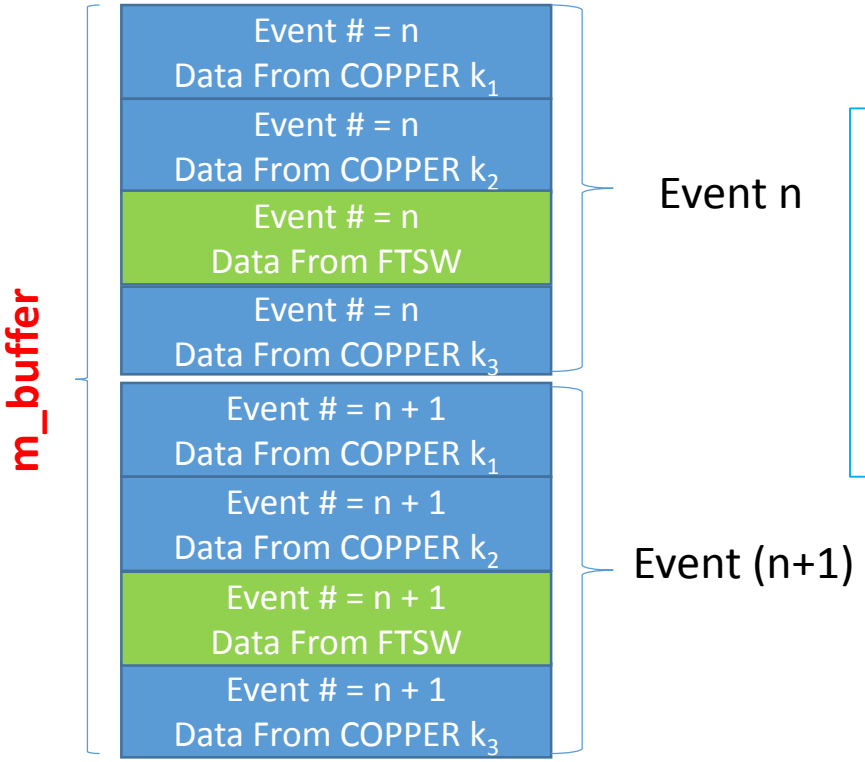
Source code :

https://belle2.cc.kek.jp/svn/trunk/software/daq/dataobjects/include
https://belle2.cc.kek.jp/svn/trunk/software/daq/dataobjects/src

```
RawDataBlock{
        methods to access data;
        int m_num_nodes; // # of nodes
        int m_num_events;// # of events

        int* m_buffer;  -> buffer for data
}
```

Example of data structure



In this example,
M_num_nodes = 4
M_num_events = 2.

# of data blocks = 4 * 2 = 8

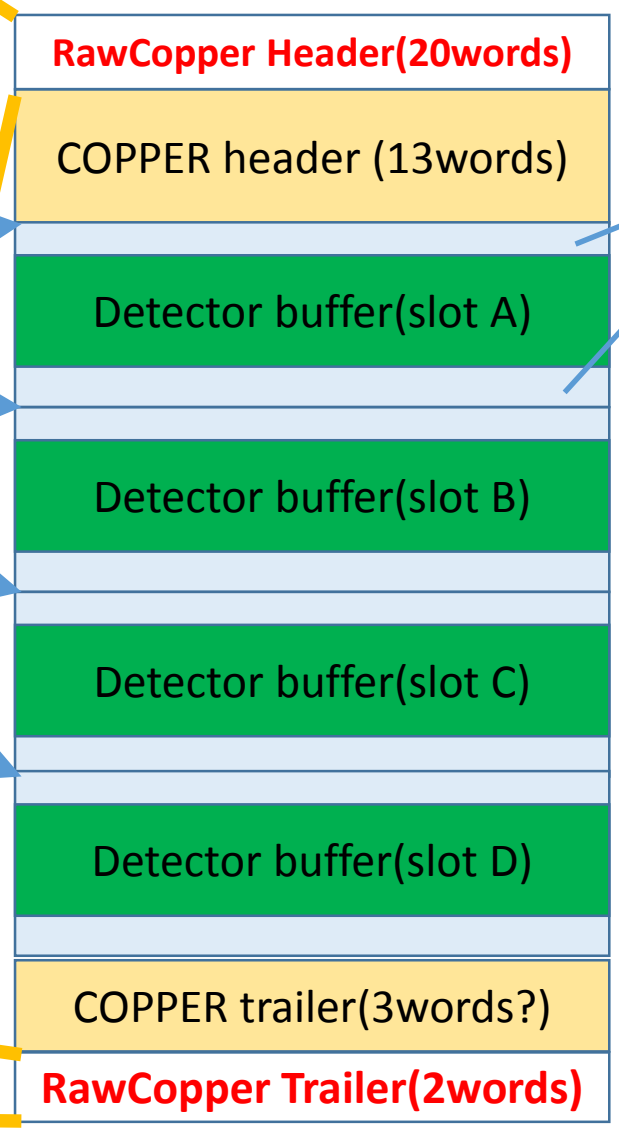
Overview of RawCOPPER format (one data block from a COPPER board)

- RawCOPPER header
  - COPPER header
    - B2link HSLB header (slot A FINNESSE)
      - B2link FEE header(slot A FINNESSE)
        - Data contents(Detector buffer) (slot A FINNESSE)
      - B2link FEE trailer (slot A FINNESSE)
    - B2link HSLB trailer (slot A FINNESSE)
    - B2link HSLB header (slot B FINNESSE)
      - B2link FEE header(slot B FINNESSE)
        - Data contents(Detector buffer) (slot B FINNESSE)
      - B2link FEE trailer (slot B FINNESSE)
    - B2link HSLB trailer (slot B FINNESSE)
    - B2link HSLB header (slot C FINNESSE)
      - B2link FEE header(slot C FINNESSE)
        - Data contents(Detector buffer) (slot C FINNESSE)
      - B2link FEE trailer (slot C FINNESSE)
    - B2link HSLB trailer (slot C FINNESSE)
    - B2link HSLB header (slot D FINNESSE)
      - B2link FEE header(slot D FINNESSE)
        - Data contents(Detector buffer) (slot D FINNESSE)
      - B2link FEE trailer (slot D FINNESSE)
    - B2link HSLB trailer (slot D FINNESSE)
  - COPPER trailer
- RawCOPPER trailer

2, "RawCOPPER header" and trailer format : 2013/8/26 (Not yet confirmed)

1	Number of total words
2	Number of words in this block (= 20)
3	exp no. (10bit=1024), run no.(22bit=4194304 including subrun)
4	event number(32bit)
5	From B2link FEE header 1
6	From B2link FEE header 2
7	subsystem ID (ID, crate no, slot no)
8	truncation mask (truncated or not) / type of data (compressed, calibration, ...)
9	offset to 1st block of user's data(FEE data)
10	offset to 2nd block of user's data(FEE data)
11	offset to 3rd block of user's data(FEE data)
12	offset to 4th block of user's data(FEE data)
13	reserved
14	reserved
15	# of nodes
16	node ID 1
17	node ID 2
18	node ID 3
19	Node ID 4
20	Termination word of this block = 0x7fff0005

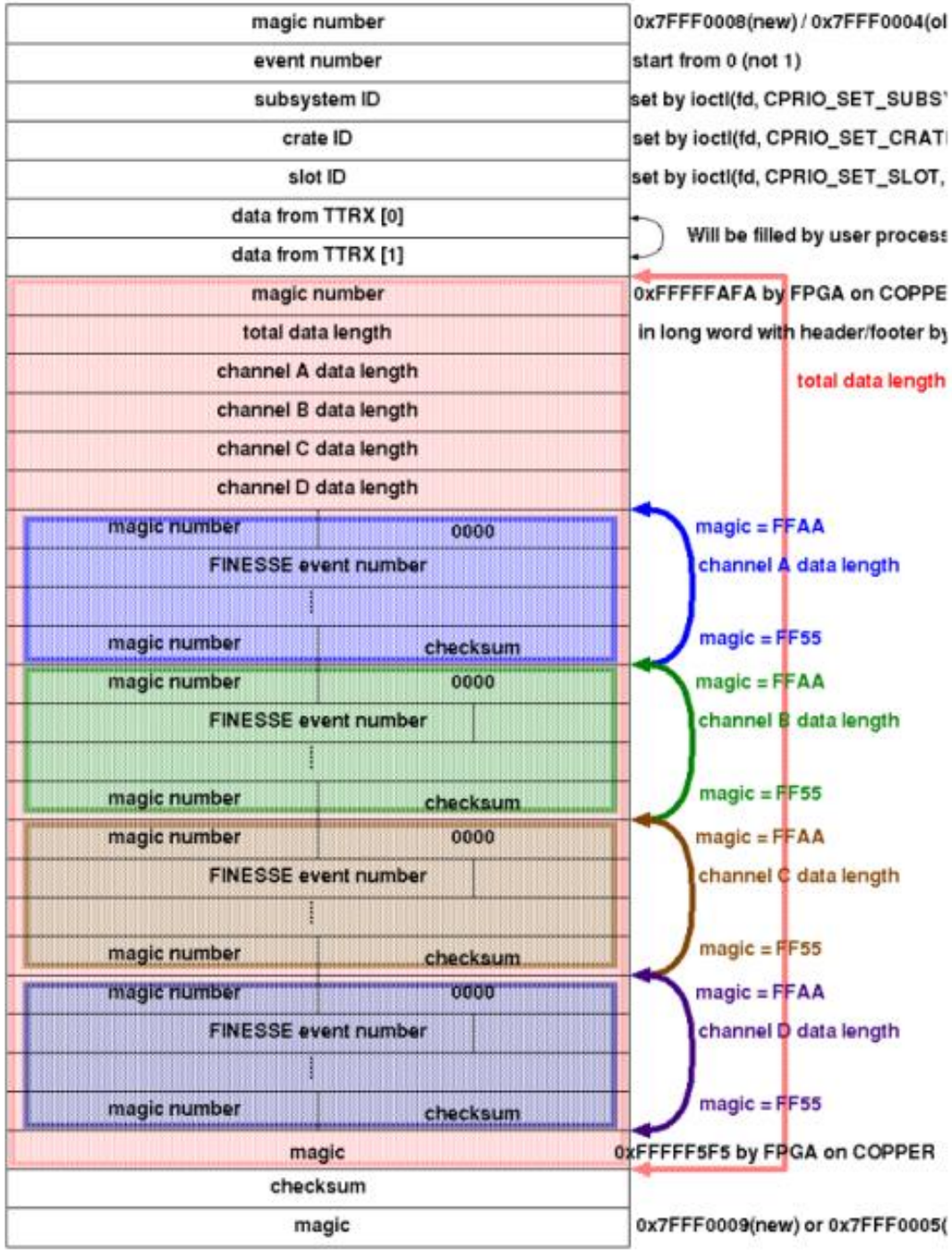
Information of nodes which this packet has gone through.



B2link(FEE/ HSLB) header and trailer

1	reserved (maybe used for checksum)
2	termination word of this block = 0x7fff0006

3, COPPER header and trailer from Belle document



4, B2link FEE header/Trailer, B2link HSLB header/Trailer (tentative)

1: 0xffaa****

1: ftsw_data[0];
2: ftsw_data[1];
3: (exp_number << 22) | (run_number << 0);
4: b2l_time;

ftsw_data[0] bit [31] (1-bit) --- always 0
ftsw_data[0] bit [30:4] (27-bit) --- ctime (127 MHz counter)
ftsw_data[0] bit [3:0] (4-bit) --- trigger type
ftsw_data[1] bit [31:16] (16-bit) --- utime (lower 16 bit of unix time)
ftsw_data[1] bit [15:0] (16-bit) --- event tag (start from 0)

1: ftsw_data[1] (copy)

1: 0xff55****

5, Example : how to get information of RawCOPPER header

You can get event # info from RawCOPPER object like this;

```
for ( int i = 0; i < raw_copper.GetNumEntries(); i++) {
//          Get Event number
            unsigned int event_no = raw_copper.GetEveNo( i );
//          Get RawCOPPER data block
            int* buf = raw_copper.GetBuffer( i );
//          See contents of a data block (from RawCOPPER header to RawCOPPER trailer)
            for( int j = 0; j < raw_copper.GetBlockNwords(); j++ ){
                        printf("%d¥n", buf[ j ] );          }
//          Get Detector Buffer (raw data from detector electronics)
            int* buf_slot_a = raw_copper.Get1stDetectorBuffer( i );
            int* buf_slot_b = raw_copper.Get2ndDetectorBuffer( i );
            int* buf_slot_c = raw_copper.Get3rdDetectorBuffer( i );
            int* buf_slot_d = raw_copper.Get4thDetectorBuffer( i );
//          See contents of raw data from detector
            for( int j = 0; j < raw_copper.Get1stDetectorNwords( i ); j++ ){
                        printf("%d¥n", buf[ j ] );          }
            for( int j = 0; j < raw_copper.Get2ndDetectorNwords( i ); j++ ){
                        printf("%d¥n", buf[ j ] );          }
            …..
}
```