

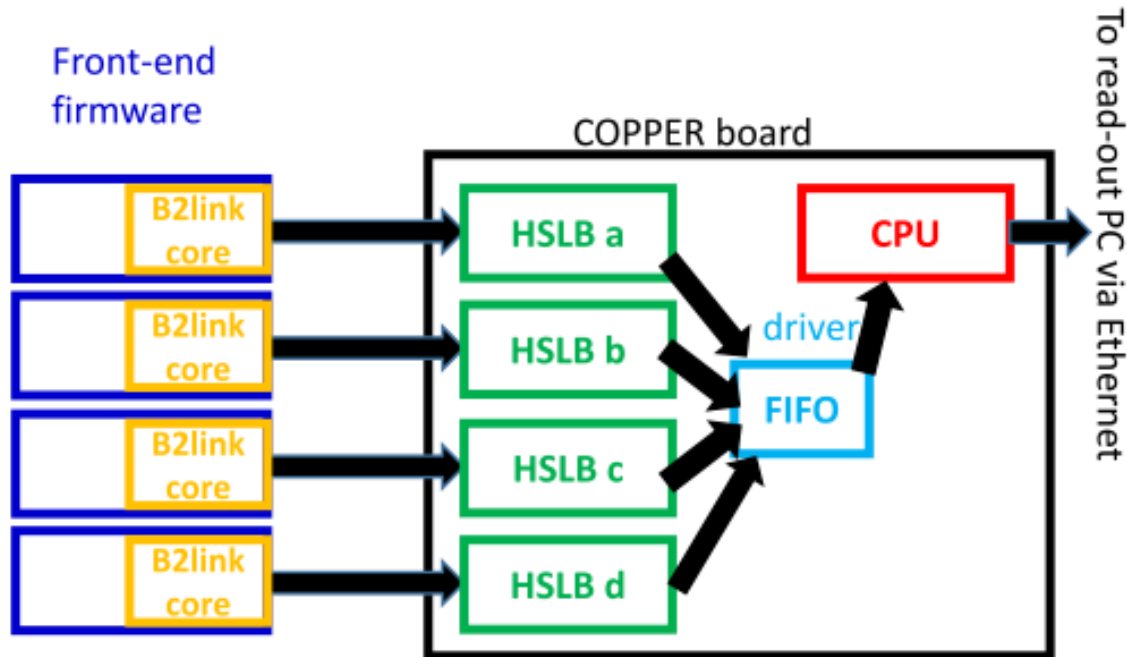
# RawCOPPER data format

July 31, 2014 (svn rev. 11926)

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

RawCOPPER header/trailer	-> See Sec. 2
COPPER header/trailer	-> See Sec.3
B2link(FEE+HSLB) header/trailer	-> See Sec.4
Detector buffer	-> Untouched by DAQ

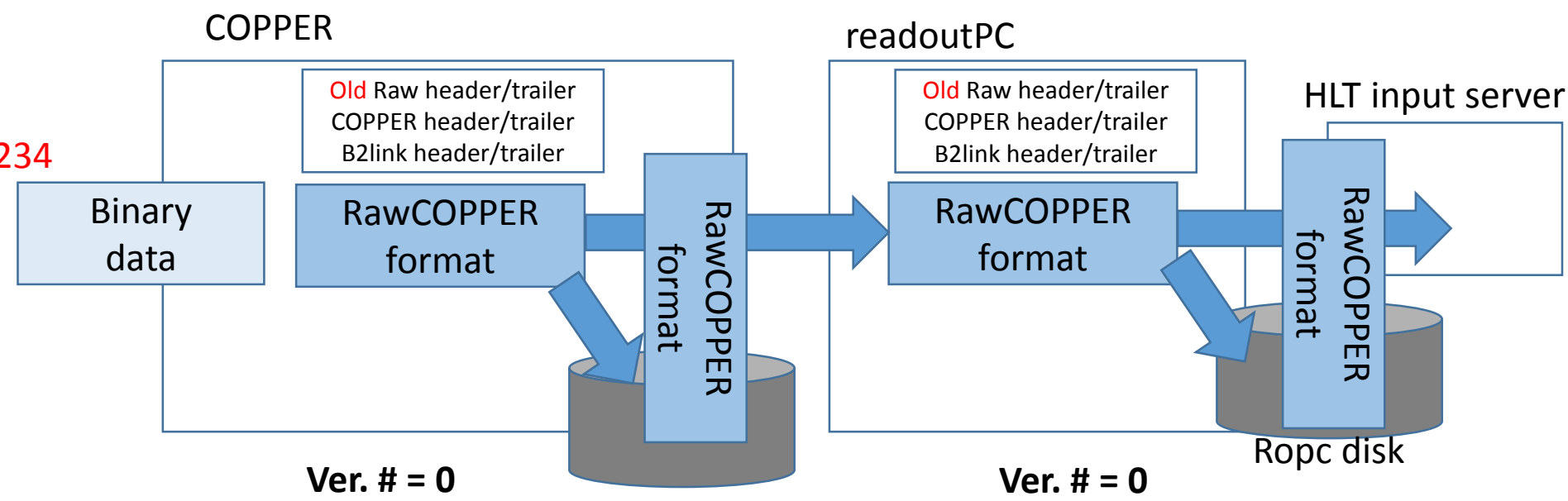


- **RawCOPPER header**
  - **COPPER header**
    - **B2link HSLB header (slot A FINNESSE)**
      - **B2link FEE header(slot A FINNESSE)**
        - **Data contents(Detector buffer) (slot A FINNESSE)**
      - **B2link FEE trailer (slot A FINNESSE)**
    - **B2link HSLB trailer (slot A FINNESSE)**
 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

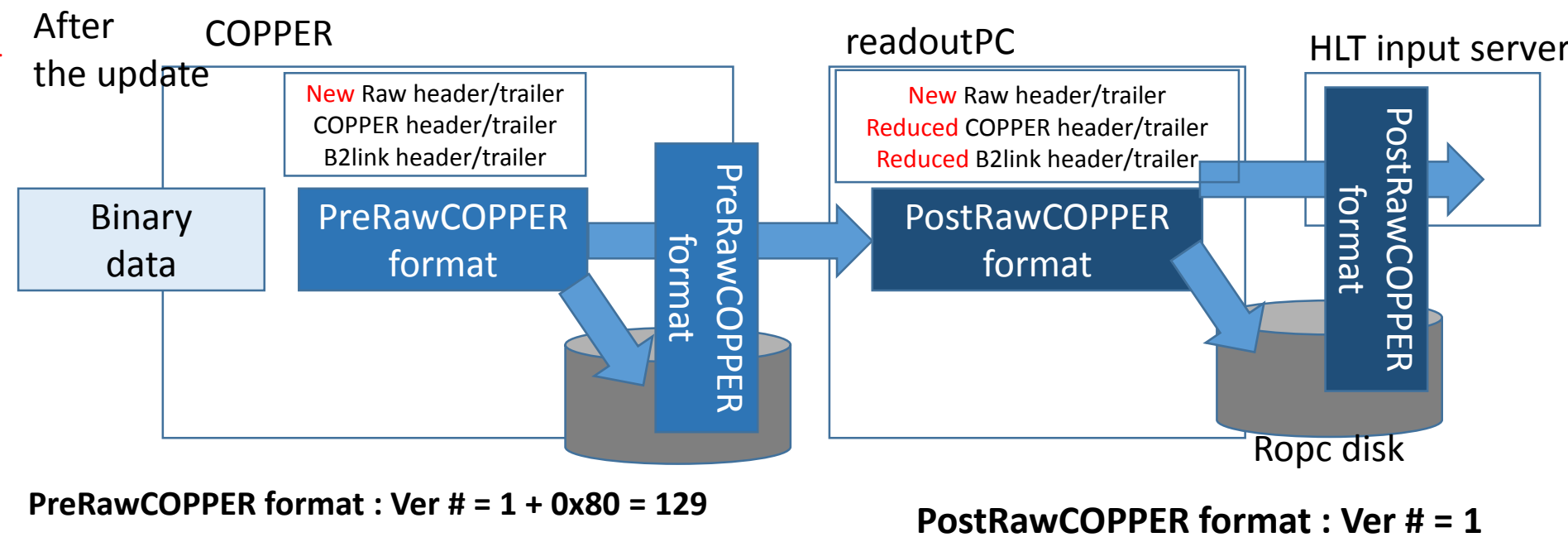
HSLB : High speed link board

# 1-1, Online header/trailer reduction

Before rev. 11234  
( June, 2014)



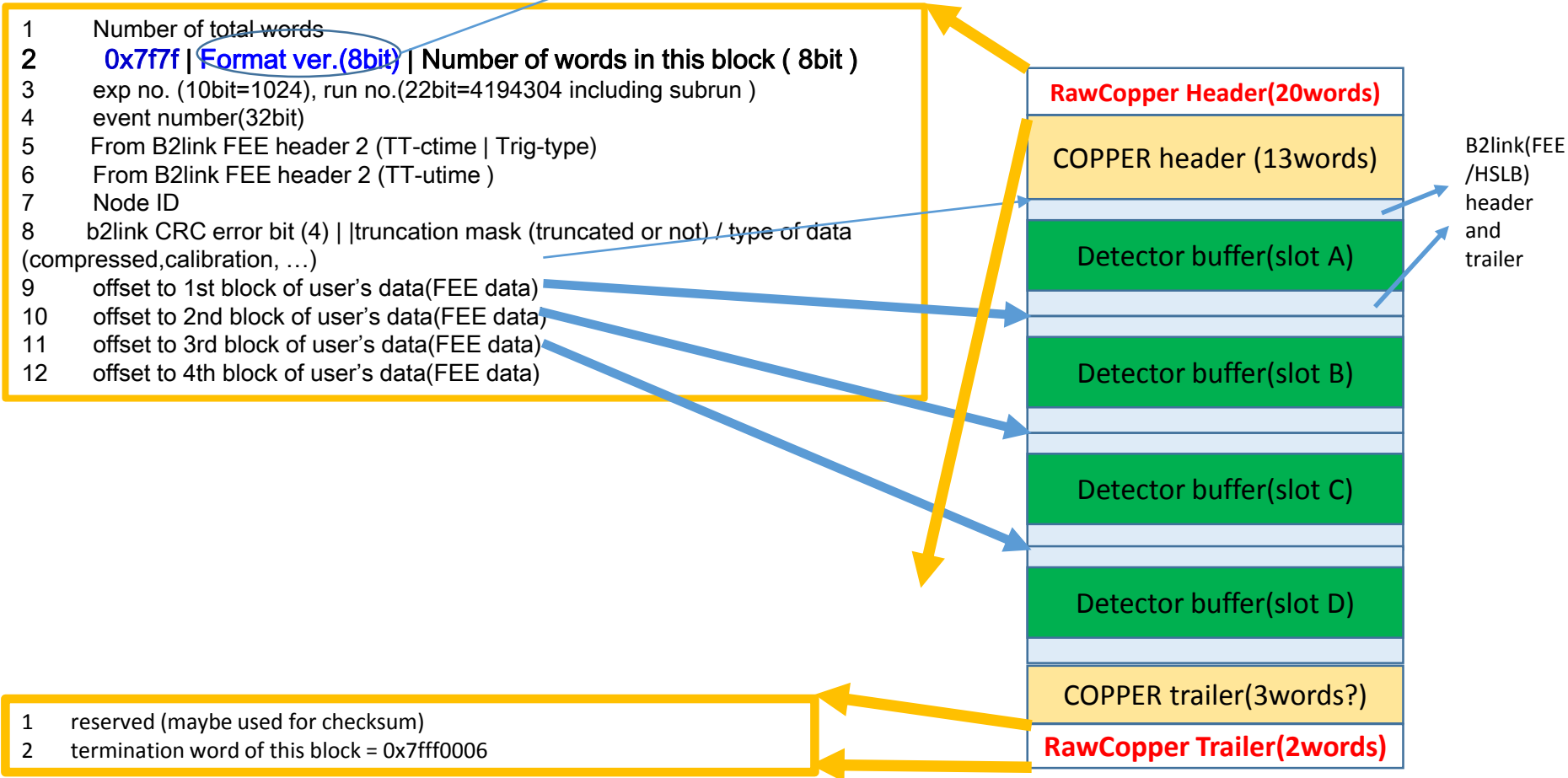
After rev. 11234  
( June, 2014)



- PreRawCOPPER format
  - If you store data by COPPER CPU, then output data will be in Pre(reduction)RawCOPPER format.
- PostRawCOPPER format
  - Store the data downstream from readout PC, the output data will be in Post(reduction)RawCOPPERFormat

# 2-1, “RawCOPPER header/trailer” format in PreRawCOPPER format (ver. 1+0x80)

Use this version number to distinguish  
Different data format.  
Ver.0 : to 2014. June(including DESY test)  
ver.1 : from June.2014



## 2-2, “RawCOPPER header” and trailer format in PostRawCOPPER format (ver.0x01)

Same as PreRawCOPPER format

## 2-3, tentative format of 32bit node ID (A.K.A. subsystem ID)

### **Format :**

(31-24) Detector ID : 8bit=256 : detector ID  
(9-0) lower bits of COPPER ID : 10bit (1024)

### **Detector ID :**

Detector ID (Defined in rawdata/dataobjects/include/RawCOPPERFormat.h)

- #define SVD\_ID 0x01000000 // tentative
- #define CDC\_ID 0x02000000 // tentative
- #define BPID\_ID 0x03000000 // tentative
- #define EPID\_ID 0x04000000 // tentative
- #define BECL\_ID 0x05000000 // tentative
- #define EECL\_ID 0x06000000 // tentative
- #define BKLM\_ID 0x07000000 // tentative
- #define EKLM\_ID 0x08000000 // tentative

### **Full COPPER ID :**

Full COPPER ID can be reconstructed by “( Detector ID >> 24 ) \* 1000 + COPEPR ID(12bit) “

e.g. NodeID = 0x0600000a -> COPPER ID = cpr6010

NodeID = 0x0100000a -> COPPER ID = cpr1010

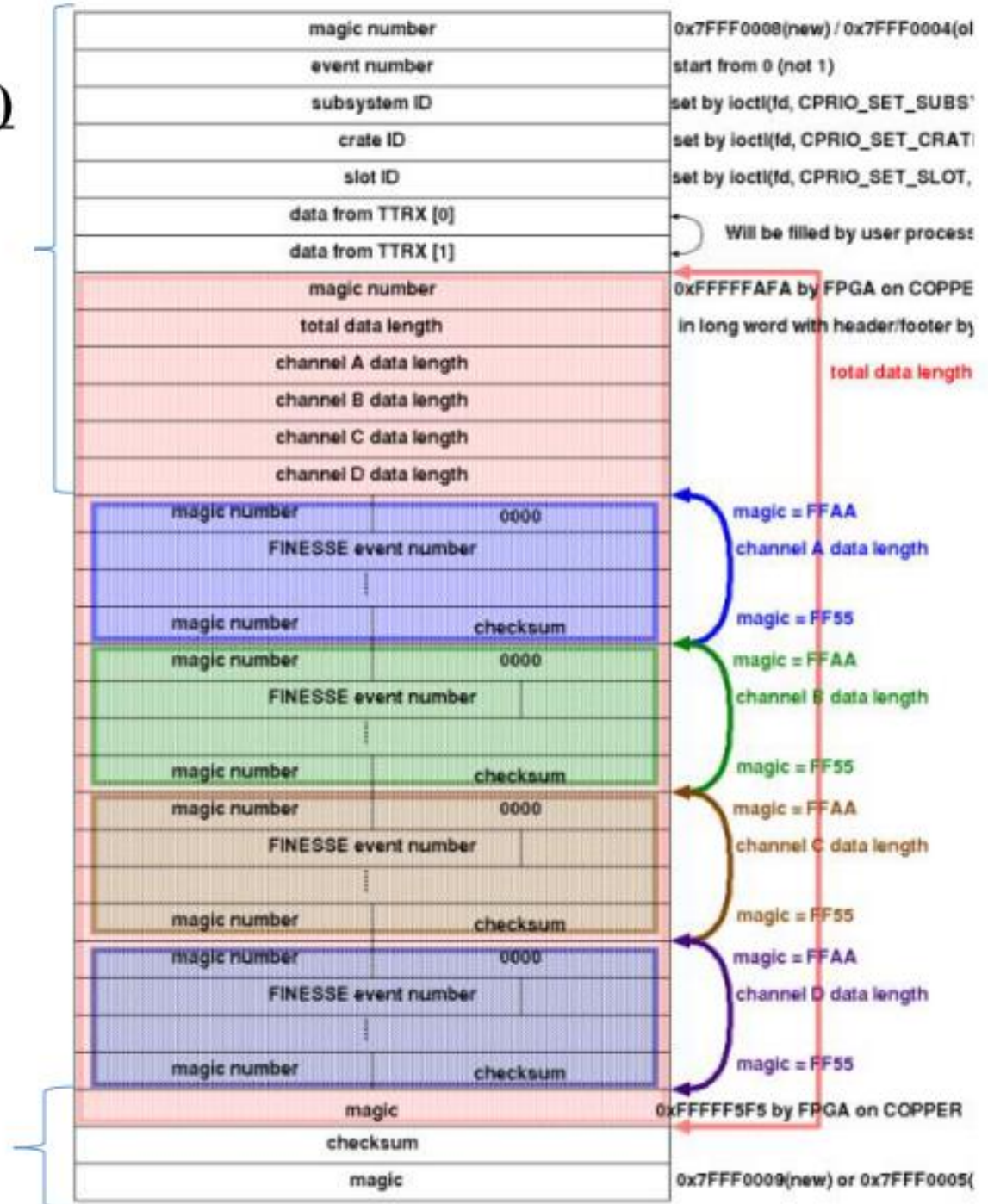
A label of COPPER ID will be attached on the front of a COPPER board

Node ID = “TTD ” = 0x54544420 and “FTSW” are reserved for VME CPU and FTSW now.

### 3-1, COPPER header and trailer in **PreRawCOPPER** format (ver. 1 + 0x80)

COPPER header

COPPER Trailer





### 3-2, COPPER header and trailer in PostRawCOPPER format (ver. 0x01 )

No COPEPR header and trailer in Post reduction rawcopper format.

## 4-1, B2link FEE header/Trailer, B2link HSLB header/Trailer in PreRawCOPPERFormat (ver. 0x01 + 0x80)

From Nakao-san's Belle2link User guide (June 10, 2014):

You can download from 18 th B2GM indico page

<http://kds.kek.jp/getFile.py/access?contribId=132&sessionId=28&resId=0&materialId=0&confId=15329>

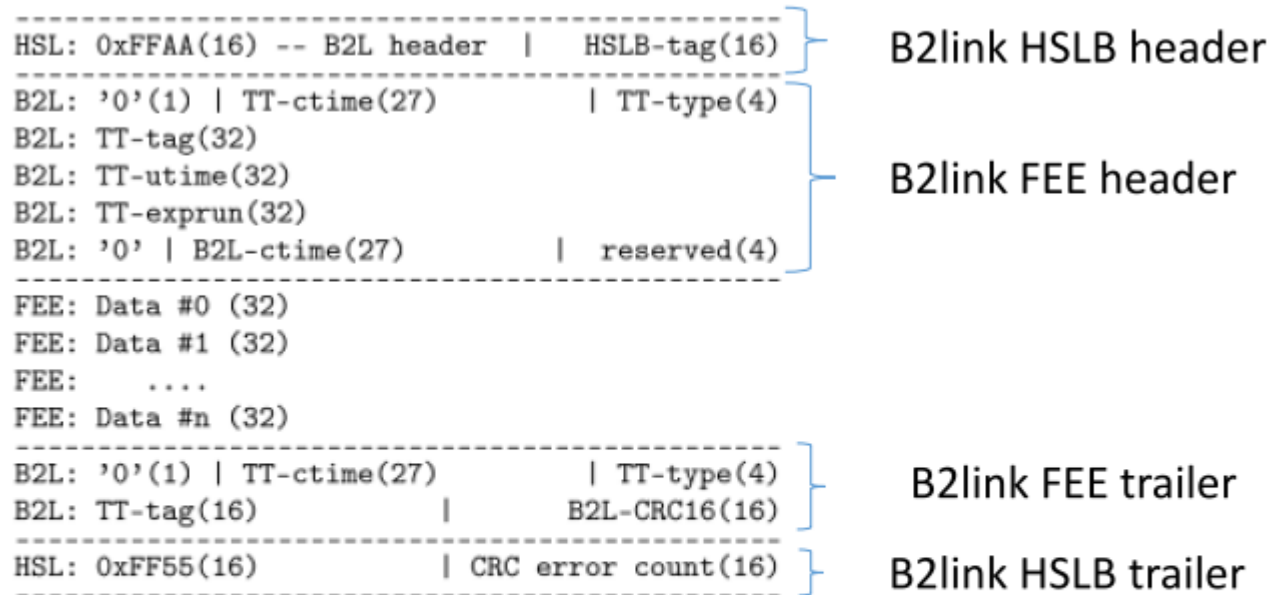


Figure 5: Data format as read out by the COPPER. The header and trailer words labelled with **HSL** are attached by HSLB, the words with **B2L** are attached by the belle2link component, and the words with FEE are those written into the belle2link component by the frontend firmware.

### NOTICE :

To produce this format, the b2tt core used in the FEE firmware should be the latest.

Please see Nakao-san's following e-mails :

[b2link\_ml:0143] Belle2link version 0.01 - SVN update

And

[b2link\_ml:0144] Re: Belle2link version 0.01 - SVN update .

## 4-2, B2link FEE header/Trailer, B2link HSLB header/Trailer in PostRawCOPPERFormat (ver. 0x01)

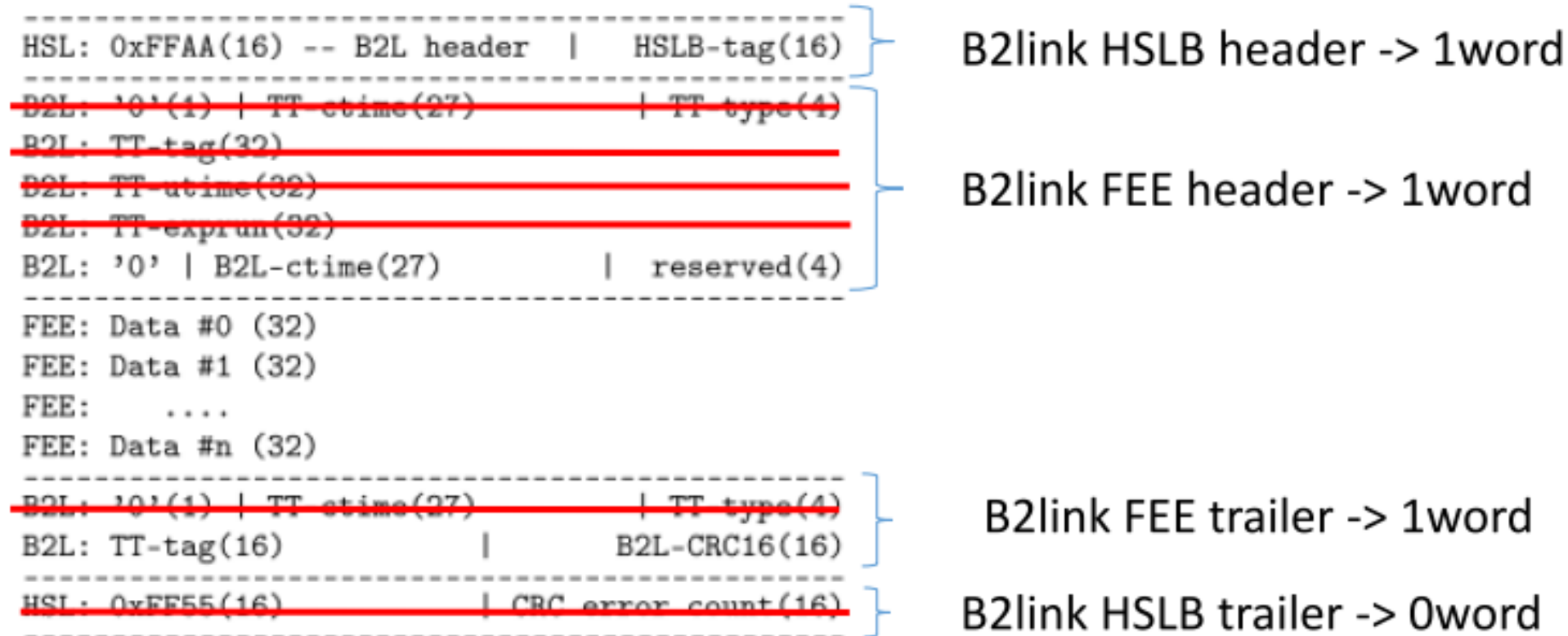


Figure 5: Data format as read out by the COPPER. The header and trailer words labelled with **HSL** are attached by HSLB, the words with **B2L** are attached by the belle2link component, and the words with FEE are those written into the belle2link component by the frontend firmware.

## 4-3, Older B2link header/trailer formats

At DESY test in January of 2014

From Nakao-san's B2GM slides:

<http://kds.kek.jp/getFile.py/access?contribId=143&sessionId=38&resId=0&materialId=slides&onfId=13911>

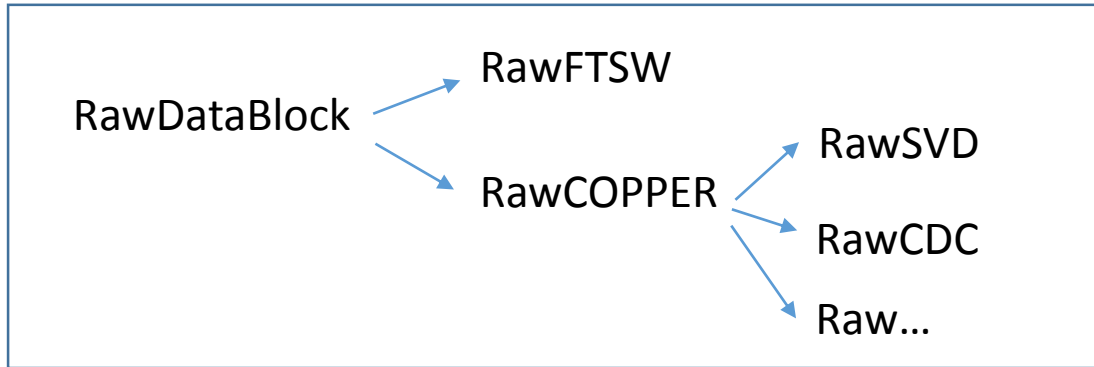
### Data format (Final?)

#### The format used at the telescope test

```
-----  
HSL: 0xFFAA(16) --- B2L header | HSLB-tag(16)  
-----  
B2L: '0'(1) | TT-ctime(27) | TT-type(4)  
B2L: TT-tag(32)  
B2L: TT-utime(32)  
B2L: TT-exprun(32)  
B2L: '0' | B2L-ctime(27) | debug-flag(4)  
-----  
FEE: Data #0 (32)  
FEE: Data #1 (32)  
FEE: ....  
FEE: Data #n (32)  
-----  
B2L: TT-tag(16) | B2L-checksum(16)  
-----  
HSL: 0xFF55(16) | HSLB checksum(16)  
-----
```

- tag (event number) and utime to be increased to 32-bit (done),  
HSLB-checksum, B2L-checksum to be added

# 5-1, RawDataBlock object ( to handle Raw data from COPPER board )



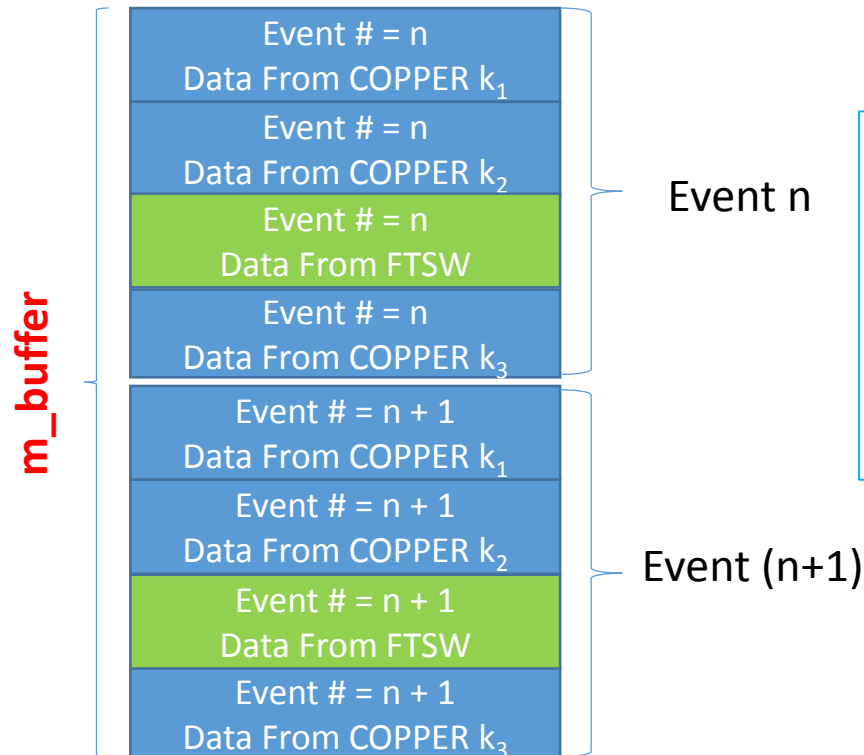
Source code :

<https://belle2.cc.kek.jp/svn/trunk/software/rawdata/dataobjects/>

```
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 =  $4 * 2 = 8$

## 2-2, Rawdata Unpacker for new and old data formats

Data taken at the DESY beam test(old format) can be read with the latest rawdata package  
-> by checking data ver. In header.

### New RawCOPPER class

- No change in style of the member functions -> No effect on derived class
- Does not have a format information in itself
  - Format class contains format information
    - RawCOPPERformat.cc -> the latest format
    - RawHeader.cc
    - RawCOPPERformat\_v0.cc -> an old format
    - RawHeader\_v0.cc
  - Assign a format class to `m_access` in `CheckVersionSetBuffer()`
  - Use `m_access` to access buffer contents

```
inline int RawCOPPER::GetExpNo(int n)
{
    CheckVersionSetBuffer();
    return m_access->GetExpNo(n);
}
```

```
inline int RawCOPPER::GetRunNo(int n)
{
    CheckVersionSetBuffer();
    return m_access->GetRunNo(n);
}
```

#### Notice :

- RawCOPPER class supports both formats for a while (0.5-1 year after the format becomes stable?).
- In that case, the latest RawCOPPER class cannot be used to read old format
- Of course, you can use old rawdata repository to read old format
- For ver.0 format, use rawdata repository before 11228



# Revision History of this document

- Jan.5, 2014 rev. 8376 : Add definition of tentative subsysID format
- Dec. 16, 2013 rev.7974 :
  - Add B2linkFEE header format
  - Add comments about handling StoreArray when unpacking Raw\*\*\* data.
- Oct.21, 2013 :rev.7133
  - Add instruction about Rawdata unpacking program
- Oct. 18, 2013 :rev. 7095
  - 1 st draft
- Jun. 23, 2014 : rev. 11234
  - Online (header/trailer) reduction scheme on readout PC is introduced
    - RawHeader format is changed
    - COPPER header/trailer format is changed
  - Nakao-san updated B2LFEE/HSLB header/trailer format
    - See [b2link\_ml:0144] Re: Belle2link version 0.01 - SVN update