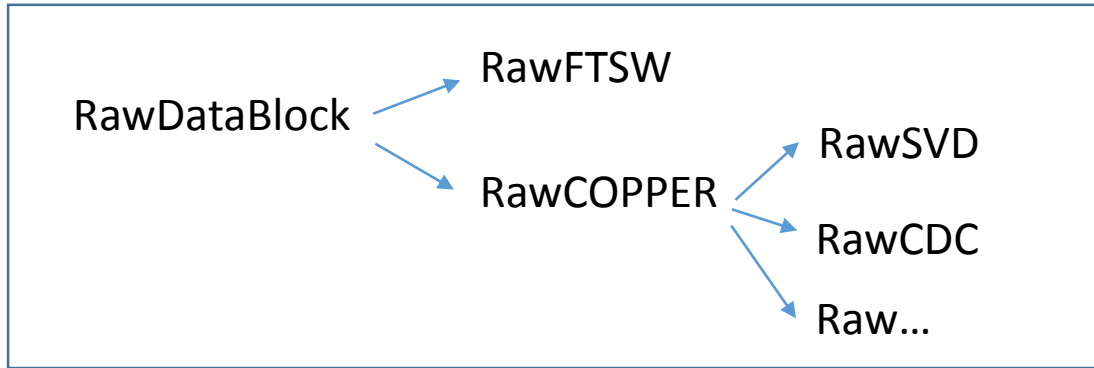


RawCOPPER data format

July 25, 2014 (svn rev. 11234)

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



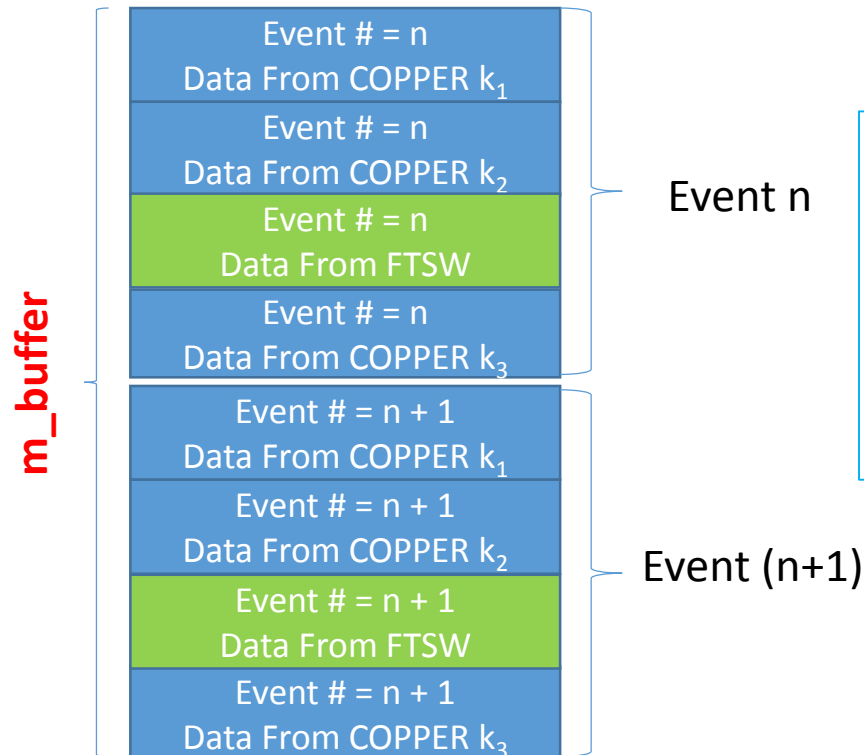
Source code :

<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



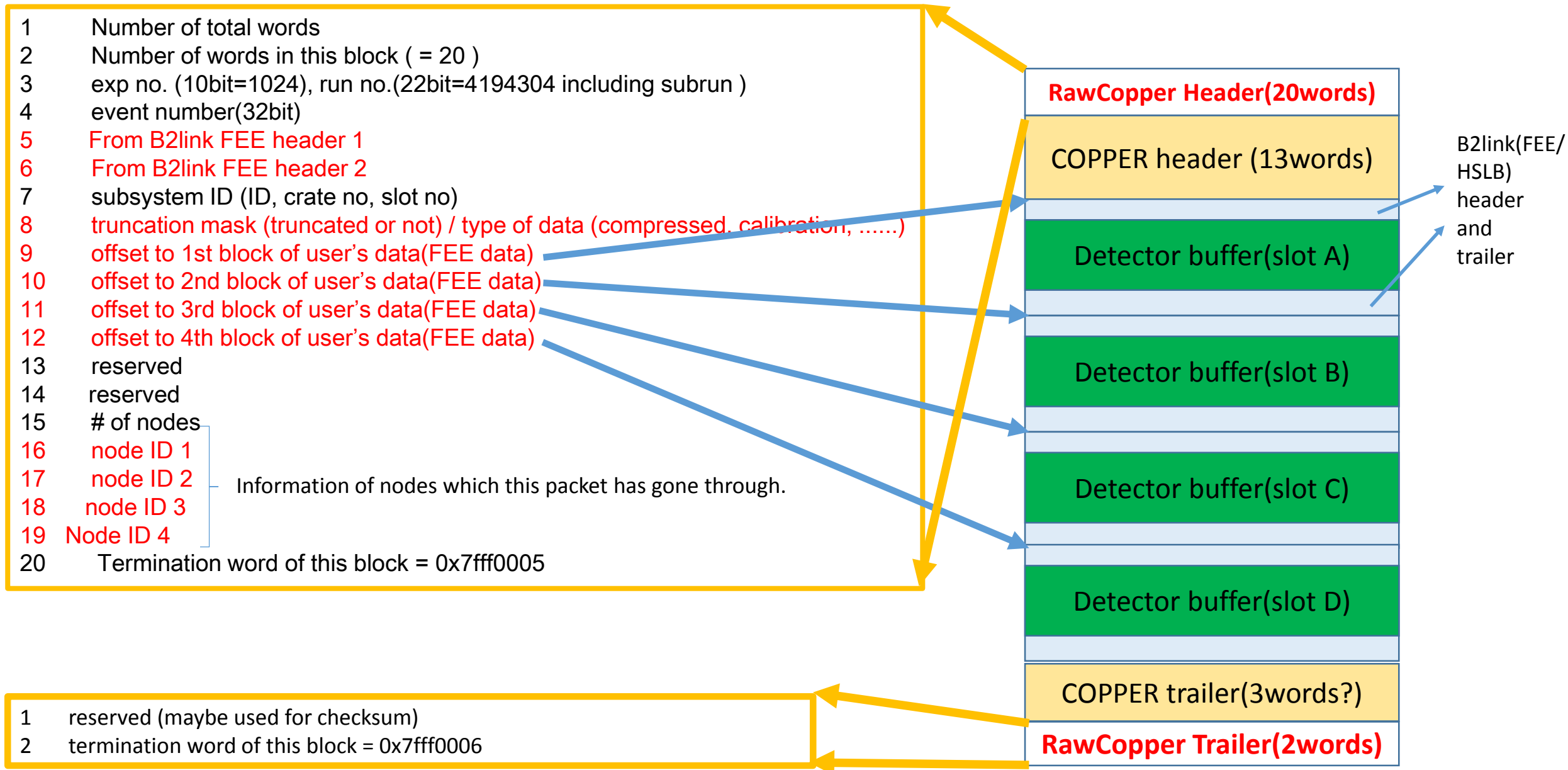
In this example,
 $M_num_nodes = 4$
 $M_num_events = 2$.

of data blocks = $4 * 2 = 8$

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)



2-1, 32bit Subsystem ID (A.K.A. node ID)

(31-24) Detector ID : 8bit=256 : detector & DAQ nodes
(23-17) CRATE ID : 7bit=128 :
(16-12) SLOT ID : 5bit=32 :
(11-0) N.A. : 12bit (4096) COPPER S/N?

SubsystemID = “TTD ” = 0x54544420 and is reserved by FTSW ID now.

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

- #define SVD_ID 0x01 // tentative
- #define CDC_ID 0x02 // tentative
- #define BPID_ID 0x03 // tentative
- #define EPID_ID 0x04 // tentative
- #define ECL_ID 0x05 // tentative
- #define KLM_ID 0x06 // tentative
- #define PXD_ID 0x07 // tentative

Position of Subsystem(node) ID in headers

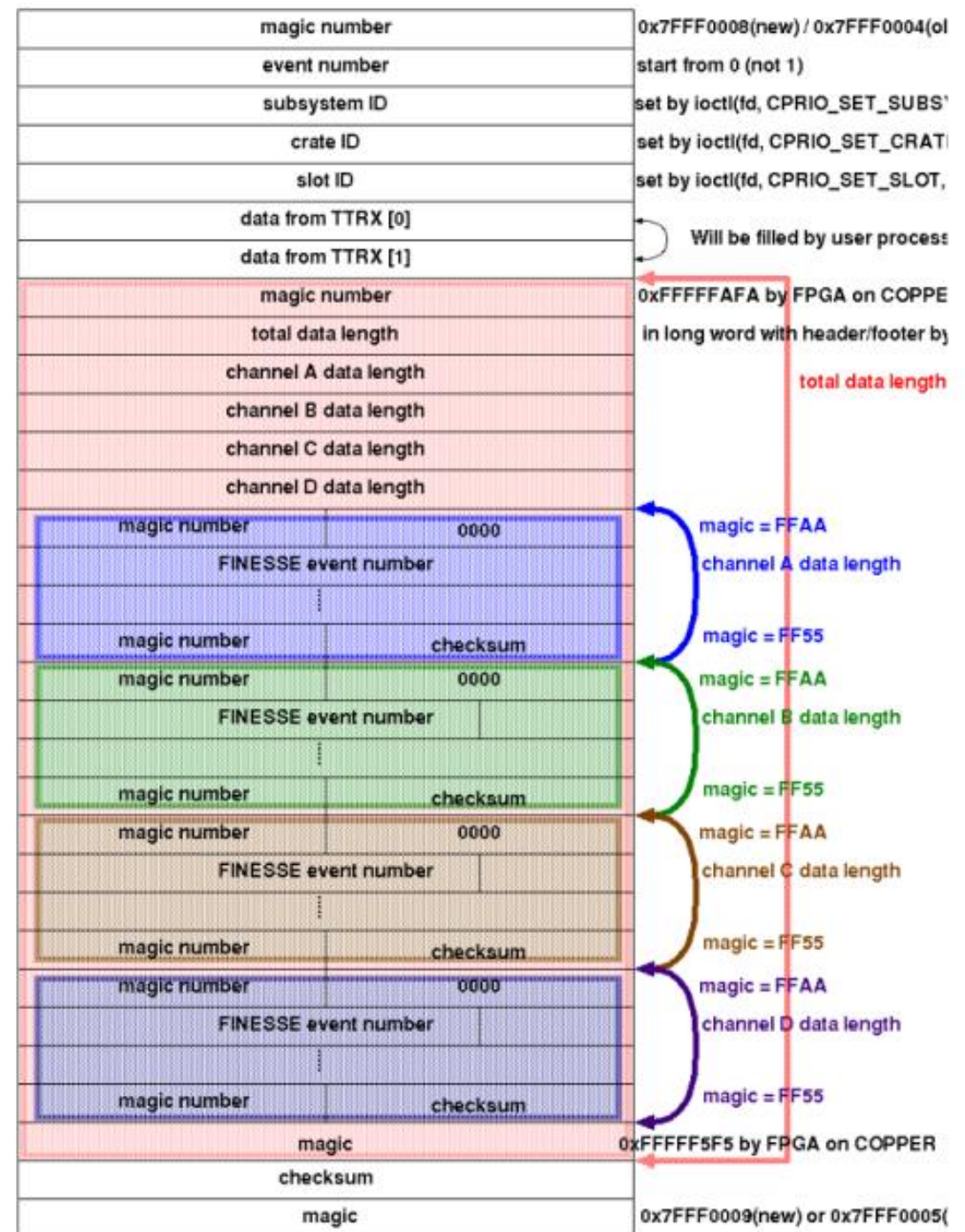
FTSW data format(2013/9/17)

- 1 Number of total words(=12)
- 2 Number of words in this header (=6)
- 3 Number of Events in this block(16bit) / # of boards(16bit)
- 4 exp no. (10bit=1024), run no.(22bit=4194304)
- 5 event number(32bit) of the first data block
- 6 **node ID(COPPER ID@COPPER, FTSW ID@FTSW, VMIC / ROPC ID@ROPC)**
- 7 Nakao-san word1
- 8 Nakao-san word2
- 9 Nakao-san word3 (0x00000000)
- 10 Nakao-san word4 (0x00000000)
- 11 SendTrailer1 (not used : maybe for checksum)
- 12 SendTrailer2 (magic word=0x7fff000?)

- 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

No one except Deserializer COPP ER fills this region now.

3, COPPER header and trailer from Belle document



4, B2link FEE header/Trailer, B2link HSLB header/Trailer

Data format (Final?)

From Nakao-san's B2GM slides:

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

The format used at the telescope test

HSL: 0xFFAA(16) --- B2L header | HSLB-tag(16)

} B2link HSLB header

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)

} B2link FEE header

FEE: Data #0 (32)

FEE: Data #1 (32)

FEE:

FEE: Data #n (32)

B2L: TT-tag(16) | B2L-checksum(16)

} B2link FEE trailer

HSL: 0xFF55(16) | HSLB checksum(16)

} B2link HSLB trailer

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

5, Example : how to get information of RawCOPPER header

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

```
StoreArray<RawCOPPER> raw_cprarray;
for (int i = 0; i < raw_cprarray.getEntries(); i++) {
    for ( int j = 0; j < raw_cprarray[ i ].GetNumEntries(); j++) {
//      Get Event number
        unsigned int event_no = raw_cprarray[ i ].GetEveNo( j );
//      Get RawCOPPER data block
        int* buf = raw_cprarray[ i ].GetBuffer( j );
//      See contents of a data block (from RawCOPPER header to RawCOPPER trailer)
        for( int k = 0; k < raw_cprarray[ i ].GetBlockNwords( j ); k++ ){
            printf(“%d¥n”, buf[ k ] );
        }
//      Get Detector Buffer (raw data from detector electronics)
        int* buf_slot_a = raw_cprarray[ i ].Get1stDetectorBuffer( j );
        int* buf_slot_b = raw_cprarray[ i ].Get2ndDetectorBuffer( j );
        int* buf_slot_c = raw_cprarray[ i ].Get3rdDetectorBuffer( j );
        int* buf_slot_d = raw_cprarray[ i ].Get4thDetectorBuffer( j );
        int* buf_slot[4]; for( int k = 0; k < 4;k++){ buf_slot[ k ] = raw_cprarray[ i ].GetDetectorBuffer(j,k) }
//      See contents of raw data from detector
        for( int k = 0; j < raw_cprarray[ i ].Get1stDetectorNwords( j ); k++ ){
            printf(“%d¥n”, buf_slot_a[ k ] );
        }
        for( int k = 0; j < raw_cprarray [ i ].Get2ndDetectorNwords( j ); k++ ){
            printf(“%d¥n”, buf_slot_b[ k ] );
        }
        .....
    }
}
```

Test program to read RawCOPPER(RawCDC) data

1, Get dummy data file (data from two CDC FEE boards connected to FINESSE A and C.)
login.cc.kek.jp : ~yamadas/rawdata/[root_output_RawCDC_rev7133.root](#)

2, See contents of the data

```
% cd ${BELLE2_LOCAL_DIR}/daq; svn update
```

```
% cd ${BELLE2_LOCAL_DIR}/daq/rawdata/examples/
```

```
% basf2 ReadStoreTemplate.py -i ./root\_output\_RawCDC\_rev7133.root | less
```

```
[INFO] Steering file: ReadStoreTemplate.py
```

```
>>> basf2 Python environment set
```

```
>>> Framework object created: fw
```



```
==== DataBlock(RawCDC) : Block # 0 : Event # 0 : node ID 0x00000000 : block size 224 bytes
```

```
== Detector Buffer(FINESSE A)
```

```
0x0094c13a 0x91000001
```

```
== Detector Buffer(FINESSE C)
```

```
0x0094c13a 0x91000001
```

```
==== DataBlock(RawCDC) : Block # 1 : Event # 1 : node ID 0x00000000 : block size 224 bytes
```

```
== Detector Buffer(FINESSE A)
```

```
0x0094c23f 0xf1000001
```

```
== Detector Buffer(FINESSE C)
```

```
0x0094c23f 0xf1000001
```

```
==== DataBlock(RawCDC) : Block # 2 : Event # 2 : node ID 0x00000000 : block size 224 bytes
```

```
== Detector Buffer(FINESSE A)
```

```
0x0094c30d 0x69000001
```

```
== Detector Buffer(FINESSE C)
```

```
0x0094c30d 0x69000001
```

```
....
```

In this data,

Detector buffer contains only 2words(=8bytes)
per/FINESSE/event.

Note that block # is a number used by DAQ software
for handling data and not related with **Event #**.

5-2, RawCOPPER class select proper “format class” depending on Pre/Post 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 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);
}
```


Revision History of this document

- 2014. July 25 : remove an example section
- 2014. July 8 : subsystem ID/ node ID -> unified to node ID
- 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
 - 1st draft