RawData unpacker and packer

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1, Unpacker

1-1, Example : how to get information of RawCOPPER header

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

```
StoreArray<RawCOPPER> raw_cprarray; // When StoreArray is used
  for (int i = 0; i < raw_cprarray.getEntries(); i++) { //When StoreArray is used
    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("%.8x¥n", buf[ k ] );

      //        Get Detector Buffer (raw data from detector electronics)
      for( int finesse_num =0; finesse_num < 4; finesse_num++) {
              int* buf_slot = raw_cprarray[ i ]->GetDetectorBuffer( j, finesse_num );
              //              See contents of raw data from detector
              for( int k = 0; k < raw_cprarray[ i ]->GetDetectorNwords( j, finesse_num ); k++ ){
                printf("%.8x¥n", buf_slot[ k ] );              }
      }
    }
  }
```

1-2, 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 #.

1-3, How to assign a buffer to RawDataBlock, RawCOPPER, RawSVD…

```
int* buffer = new int[nwords];   // data
RawCOPPER raw_copper;
Int delete_flag = 1;  // if 1, raw_copper's destructor will call "delete buffer;"
Int num_event = 1, num_nodes = 1;  // If the buffer contains only 1 data block (usually so).
raw_copper.SetBuffer(buffer, nwords, delete_flag, num_event, num_nodes);
```

// When you want to convert a Raw*** type

```
{
        RawSVD raw_svd;
        delete_flag = 0;  // in this case, raw_copper will delete buffer. So delete_flag=1 may cause double-free.
        raw_svd.SetBuffer( raw_copper.GetWholeBuffer(), nwords, delete_flag, num_event, num_nodes);
        RawDataBlock raw_datablock;
        delete_flag = 0; // in this case, raw_copper will delete buffer. So delete_flag=1 may cause double-free.
        raw_datablock.SetBuffer( raw_copper.GetWholeBuffer(), nwords, delete_flag, num_event, num_nodes);
}
```

2, Packer

2-1, Function to store data in RawSVD(or other RawDetector) object

void RawCOPPER::PackDetectorBuf(int* detector_buf_1st, int nwords_1st, int* detector_buf_2nd, int nwords_2nd, int* detector_buf_3rd, int nwords_3rd, int* detector_buf_4th, int nwords_4th, RawCOPPERPackerInfo rawcprpacker_info){}

Input variables :

int* detector_buf_*** : pointer to the detector buffer that you want to store as ***th FINESSE data.

int nwords_*** : length of the detector_buf_*** (unit -> word = 4bytes)

RawCOPPERPackerInfo rawcprpacker_info : Information to fill RawHeader

```
struct RawCOPPERPackerInfo {
  unsigned int exp_num; // 10bit
  unsigned int run_subrun_num; // 22bit
  unsigned int eve_num; // 32bit
  unsigned int node_id; // 32bit
  unsigned int tt_ctime; // 27bit clock ticks at trigger timing distributed by FTSW. For details, see Nakao-san's belle2link user guide
  unsigned int tt_utime; // 32bit unitx time at trigger timing distributed by FTSW. For details, see Nakao-san's belle2link user guide
  unsigned int b2l_ctime; // 27bit clock ticks at trigger timing measured by HSLB on COPPER. For details, see Nakao-san's belle2link user guide
  unsigned int hslb_crc16_error_bit; // 4bit errorflag for CRC errors in data transfer via b2link. ( bit0,1,2,3 -> finesse slot a,b,c,d)
  unsigned int truncation_mask; // Not defined yet
  unsigned int type_of_data; // Not defined yet
 };
```

(#include <rawdata/include/RawCOPPERPackerInfo.h>)

2-2, test program to store data in RawSVD(or other RawDetector) object

- Module to fill dummy data in RawSVD

- rawdata/modules/src/DummyDataPacker.cc

- Script to run the above module

- $ rawdata/scripts/DummyDataPacker.py

Example of packed data

Red : detector buffers

```
===== DataBlock(RawSVD) : Block # 38
: Event # 3 : node ID 0x0100040e : block size 168 bytes
 0000002a 7f7f010c 00400002 00000003 71234560 f1234567 0100040e 00000000 0000000c 00000012
 00000019 00000021 ffaa0003 16543210 00000000 00000001 00000002 00030000 ffaa0003 16543210
 00000001 00000002 00000003 00000004 00030000 ffaa0003 16543210 00000002 00000003 00000004
 00000005 00000006 00030000 ffaa0003 16543210 00000003 00000004 00000005 00000006 00030000
 00000000 7fff0006
===== FINESSE Buffer(FINESSE A) 0x3 words
 ffaa0003 16543210 00000000 00000001 00000002 00030000
===== Detector Buffer(FINESSE A) 0x3 words
 00000000 00000001 00000002
===== FINESSE Buffer(FINESSE B) 0x3 words
 ffaa0003 16543210 00000001 00000002 00000003 00000004 00030000
===== Detector Buffer(FINESSE B) 0x4 words
 00000001 00000002 00000003 00000004
===== FINESSE Buffer(FINESSE C) 0x3 words
 ffaa0003 16543210 00000002 00000003 00000004 00000005 00000006 00030000
===== Detector Buffer(FINESSE C) 0x5 words
 00000002 00000003 00000004 00000005 00000006
===== FINESSE Buffer(FINESSE D) 0x3 words
 ffaa0003 16543210 00000003 00000004 00000005 00000006 00030000
===== Detector Buffer(FINESSE D) 0x4 words
 00000003 00000004 00000005 00000006
```

end

Revision history

- July 15, 2014 (rev.11616) : ver.1
- Aug. 8, 2014 (rev. 12158)
  - Add instruction about setting a buffer to Raw*** object.
- Dec. 5, 2014 (rev. 14322)
  - Modify to produce multiple COPPER events
  - Use RawSVD instead of RawCOPPER
  - As a result, m_nodeid in DummyDataPacker.cc should be hard-coded.