RIBFDAQ Cook ES

This document shows how to make a event sender (ES) for RIDFDAQ.

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March 3, 2009

Contents

Chapter 1

Introduction

1.1 Software package

For RIBFDAQ, there are three software packages of *babirlDAQ*, *NBBQ*, and *ANAPAW*. *babirlDAQ* has been developed for RIBFDAQ, and it includes:

- Information manager,
- Event builder,
- Event sender,
- DAQ controller,
- Analysis front-end.

NBBQ is a DAQ software package for a small system. It includes:

- Device driver,
- DAQ controller,
- Analysis front-end.

Device driver is used by not only *NBBQ* but also *babirlDAQ*. *ANAPAW* is an analysis software based on PAW. This software is developed by S. Takeuchi.

1.2 Trigger

Dead time (Busy time) should be shared with all front-ends. Typical VETO circuit is shown in Figure 1.1 VETO signal is OR of "Busy signal of each front-end" + "DAQ Start/Stop signal". While RUN is stopping, the trigger should be inhibited by "DAQ Start/Stop signal". The pulse from the output register has non negligible width, it should be also input OR circuit of the VETO signal.

1.3 Installation of babirlDAQ

You can install in the following way:

1. su
   Switch to super user.
2. cd /usr
   Installation directory is '/usr/babirl'.

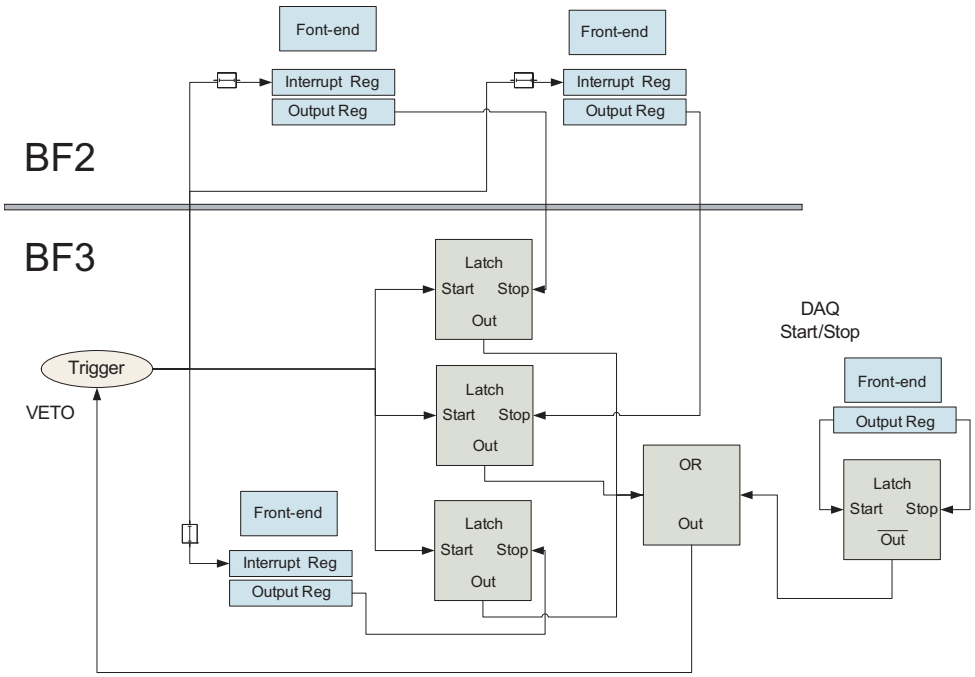


Figure 1.1: Typical VETO circuit

3. tar zxvf /tmp/babirl-*date-year*.tar.gz

4. ln -s /usr/babirl/babirl-*data-year*.tar.gz /usr/babirl

5. cd /usr/babirl

6. make clean

7. make

1.3.1 Debug mode

With the compilation option of '-DDEBUG', DAQ processes will run with debug mode. With this mode, you will see many verbose comments. To use this option, edit '/usr/babirl/common.mk'

common.mk (original)

```
CC = gcc
#CFLAGS = -Wall -O2 -I../include  -D_FILE_OFFSET_BITS=64 -D_LARGEFILE_SOURCE -DDEBUG -g
CFLAGS = -Wall -O2 -I../include -D_FILE_OFFSET_BITS=64 -D_LARGEFILE_SOURCE
```

common.mk (debug mode)

```
CC = gcc
CFLAGS = -Wall -O2 -I../include  -D_FILE_OFFSET_BITS=64 -D_LARGEFILE_SOURCE -DDEBUG -g
#CFLAGS = -Wall -O2 -I../include -D_FILE_OFFSET_BITS=64 -D_LARGEFILE_SOURCE
```

And then, do 'make clean' and 'make'.

Chapter 2

Cook Event Sender

2.1 Communication of DAQ processes

Main components of *babirlDAQ* are *babild* and *babies*. *babild* is an event-builder, *babies* is an event-sender. Figure 2.1 shows the brief schematic of the data way. *babicon* is a DAQ controller. *babier* is internal thread of *babild*. *babirldrv* and *babirtdrv* are the device driver for Linux and RTLinux, respectively. *ddrv* is a user program for *babies* with the dummy mode.

To realize the common dead-time for all, the start/stop sequence is strictly defined. Figure 2.2 shows the timing chart of the start/stop sequence. The detail sequence is described below. *babissm* is a start/stop manager which controls the veto signal for the trigger. *babinfo* is a information manager which calculate scaler information, mainly. For start sequence:

1. Veto signal for the trigger is high.
2. Put start command to *babild* from *babicon*.
3. *babild* puts start command to each *babies*, by turns.
4. Each *babies* puts start command to own *driver*.
5. Each *driver* replies start-ack to each *babies*.
6. Each *babies* replies start-ack to *babild*.
7. When *babild* receives all start-ack from all *babies*, *babild* puts start command to *babinfo*.
8. *babild* puts start command to *babissm*.
9. *babissm* clears the veto signal for the trigger.

For stop sequence:

1. Put stop command to *babild* from *babicon*.
2. *babicon* waits to get stop-ack from *babild*.
3. *babild* puts stop command to *babissm*.
4. *babissm* set the veto signal for the trigger.
5. *babild* puts stop command to each *babies*, by turns.
6. Each *babies* put stop command to own *driver*.
7. Each *driver* returns the last event-fragment-data to each *babies*.
8. Each *babies* transfers the last event-fragment-data to *babild*.

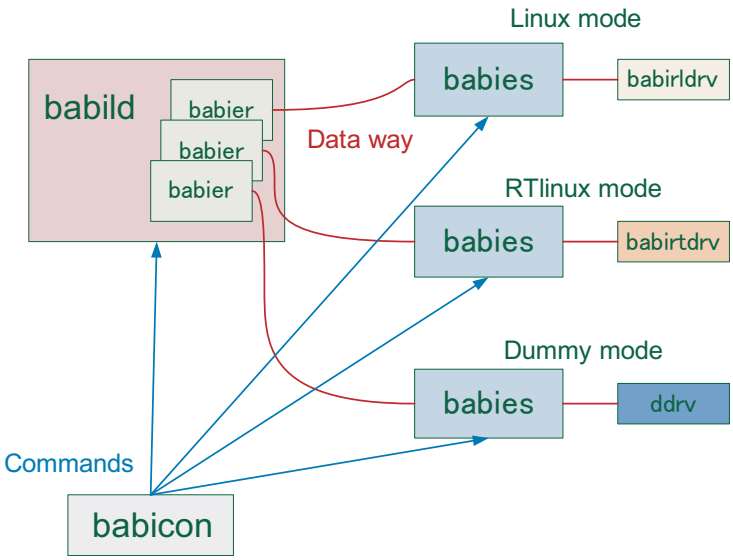


Figure 2.1: The data way of *babirlDAQ*.

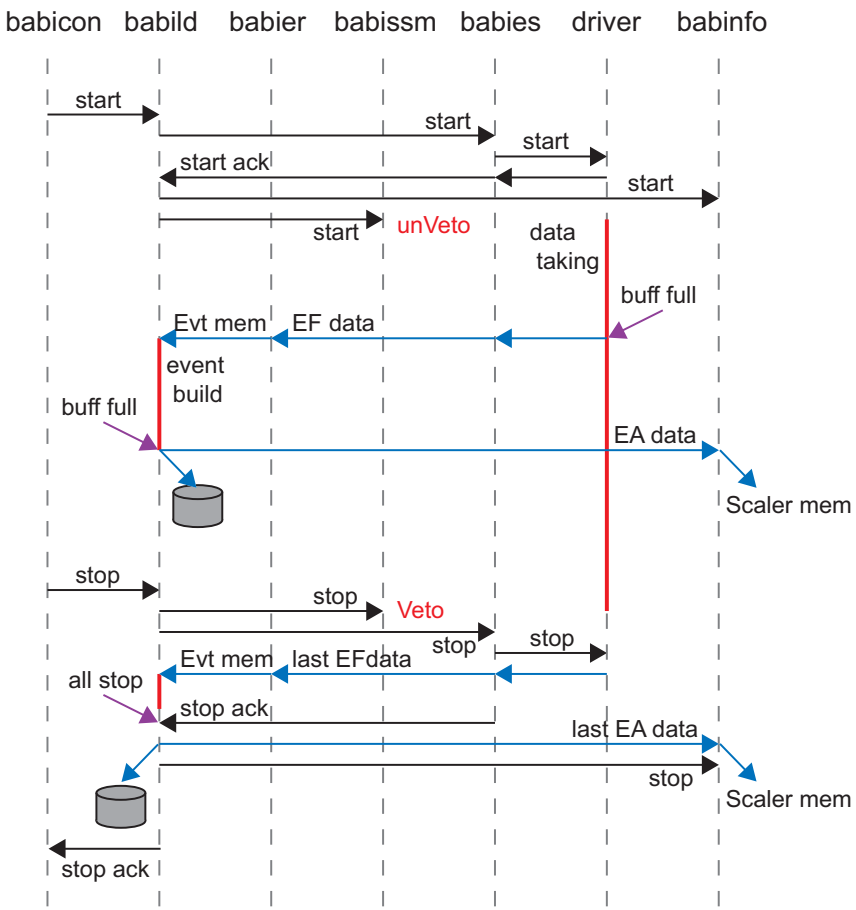


Figure 2.2: The timing char of the start/stop sequence.

9. Each *driver* returns stop-ack to each *babies*.
10. Each *babies* returns stop-ack to *babild*.
11. When *babild* receives all stop-ack from all *babies*, *babild* puts stop command to *babinfo*.
12. *babild* returns stop-ack to *babicon*.

2.2 babies with dummy mode

It can run with dummy mode, then you can check the communication between event sender and event builder. Abaout the installation of *babirlDAQ*, please refer Sec. 1.3.

2.2.1 Run DAQ processes

You can run DAQ processes by following commands (super user privige is required):

- Event-builder computer
  1. /usr/babirl/babinfo/babinfo
  2. /usr/babirl/babild/babild -l 1

  The last argument of *babild* is EFN. This number will be stored into event-built data.
- Event-sender computer
  1. /usr/babirl/babies/babies -d 2

  The last argument of *babies* is EFN. This number is important to communicate with the event builder.

To stop DAQ process, please use:

- Event-builder computer
  1. kill -2 'cat /var/run/babild'
  2. kill -2 'cat /var/run/babinfo'
- Event-sender computer
  1. kill -2 'cat /var/run/babies'

2.2.2 Make dummy data

You can make dummy raw data file on event-sender computer:

- /usr/babirl/devtool/mkdummyridf 2 50 100 2 32 /tmp/dummy.ridf

The synopsis of 'mkdummridf' command is:

```
mkdummyridf EFN EVTSIZE BLKN SCRID SCRN OUTFILE

 EFN     : Event fragment number
 EVTSIZE : 1 event size (in short word)
 BLKN    : Number of creating blocks
 SCRID   : Scaler ID
 SCRN    : Number of scaler channel
```

2.2.3 Setting by DAQ controller

From event-builder computer or event-sender computer, run *babicon*.

1. /usr/babirl/babicon/babicon EBHOSTNAME
   EBHOSTNAME is a hostname of event-builder computer or IP address. With this command, you can connect event builder.

2. BABICON> getconfig
   Show event builder configuration. If you find some list in 'Event fragment', please delete. For example, if you see:

   ```
   Event fragment
    ID Hostname   Nickname   on/off
    11 172.27.224.169 rtl        (on)
    12 172.27.224.45 scr        (scr)
   ```

3. BABICON> seteflist 11 del

4. BABICON> seteflist 12 del
   With these two commands, the list of event fragment will be deleted.
   Then, create new event fragment (sender) information.

5. BABICON> seteflist 2 add ESHOSTNAME NICKNAME
   EBHOSTNAME is the hostname or IP address of event-sender computer. NICKNAME is just a nickname.

6. BABICON> getesconfig 2
   You can see parameters of event-sender (*babies*).

7. setesconfig 2 host EBHOSTNAME
   With this command, *babies* will send data to EBHOSTNAME.

8. BABICON> esconnect 2

9. BABICON> getesconfig 2
   If it works well, you can see the line of 'connet : 1'.

10. BABICON> esdisconnect 2

11. BABICON> getesconfig 2
    You will be able to find 'connect : 0'.

2.2.4 Start test run

You can start test run with no-save mode by *babicon*:

1. BABICON> nssta
   With this command, run will be started.

2. BABICON> getevtnumber
   This command shows the event-built number. Now, you will see 'No event build'.

If run is starting, at event-sender computer, you can put dummy data to *babies*.

1. /usr/babirl/devtool/ddrv 2 /tmp/dummy.ridf
   This *ddrv* command put data to *babies* from file. The number of 2 is EFN.

2. ENTER
   With ENTER key, you can send next block data.

You can confirm event-built number by *babicon*.

1. BABICON> geteventnumber

To store data into file:

1. sethdlist 0 path /tmp/
2. sethdlist 0 on
3. setrunname testdata
   Stored file name will be 'testdata****.ridf'.
4. setrunnumber 0
   Next runnumber will be 1.
5. BABICON> wth
   Write header.
6. BABICON> start
7. BABICON> stop
   Ender will be required.

With these commands, raw data will be stored into /tmp/testdata0001.ridf. To check raw data, you can use:

```
chkridf /tmp/testdata0001.ridf
```

2.2.5 Stop test run

To stop run:

1. BABICON> stop
   babicon will be blocked.

To complete the stop sequence, please terminate *ddrv* process running on event-sender computer.

1. Ctrl-C

Then, run will be stopped. With this dummy mode, you will find these line at the stop sequence:

```
Last event number
EFN Nickname   EVTN
  2 nickname   0
```

EVTN is the event number counted by event sender. With this dummy mode, event sender do not count the event number. The 'getevtnumber' command of *babicon* shows event-built number in event builder.

2.3 Programming of event sender

2.3.1 Command and structure

Here, commands and some useful structures for event sender are listed.

Receive start command

```
#define BABIRL_COM_SIZE    1024*10 ///< Buffer size for babirl tcp commands

/** 17601       : for receiver */
#define ERRCVPORT   17601
/** 17651-18000 : for babies communication port */
```

```
#define ESCOMPORT   17651

/** babies tcp commands */
#define ES_SET_CONFIG    1
#define ES_GET_CONFIG    2
#define ES_RUN_START     3
#define ES_RUN_NSSTA     4
#define ES_RUN_STOP      5
#define ES_RELOAD_DRV    6
#define ES_GET_EVTN      8    // Get last event number
#define ES_CON_EFR      11    // Connect EFS to EFR
#define ES_DIS_EFR      12    // Disconnect EFS to EFR
#define ES_QUIT         99
/** babies tcp arguments */
#define ES_EF_ON    0x00000000    // Join event build
#define ES_EF_OFF   0x80000000    // Not join event build

/*! Structure for event fragment resource */
struct stefrc{
  int efid;          ///< EFID
  char runname[80];  ///< Run name (RIDF file name)
  int runnumber;     ///< Run number
  short erport;      ///< ER port
  short comport;     ///< ES communication port
  char erhost[80];   ///< ER hostname
  int hd1;           ///< Flag for HDD1
  char hd1dir[80];   ///< Path of HDD1
  int hd2;           ///< Flag for HDD2
  char hd2dir[80];   ///< Path of HDD2
  int mt;            ///< Flag for MT
  char mtdir[80];    ///< Path of MT
  int connect;       ///< Connectivity of ER (0=disconnected., 1=connected)
};
```

2.3.2 Messaging method

Messaging and data transfer is done with TCP/IP protocol except for on-line analysis. Basic protocol is:

```
Send   : Length (4 Bytes) + Command (4 Bytes) + Content (X Bytes)
Return : Length (4 Bytes) + Content (X Bytes)
```

'Length' is the byte count of 'Command' + 'Content' for sending, 'Content' for returning. It dose not includes sizeof 'Length'. To send 'ES_SET_CONFIG' command which set the configuration of an event sender:

```
int com, len;
struct stefrc efrc;
char buff[1024];

com = ES_SET_CONFIG;
len = sizeof(com) + sizeof(efrc);
send(sock, (char *)&len, sizeof(len), 0);
send(sock, (char *)&com, sizeof(com), 0);
send(sock, (char *)&efrc, sizeof(efrc), 0);
```

```
recv(sock, (char *)&len, sizeof(len), MSG_WAITALL);
recv(sock, buff, len, MSG_WAITALL);
```

2.3.3 Receive start command from event builder

When run is started, *babild* puts start command to event senders. The point is that do not return start-ack until VME/VXI is ready to accept the trigger. Receiving and replying sequence is as follow:

Receive start command

```
Main loop:
  /* Global variables */
  int efsock, comfd;
  struct stefrc efrc;


  memset((char *)&efrc, 0, sizeof(efrc));

  efrc.efid = EFN;    // Event fragment number;
  strcpy(efrc.erhost, "EBHOSTNAME"); // Hostname of event builder
  efrc.runnumber = -1;
  efrc.erport = ERRCVPORT;
  efrc.comport = ESCOMPORT + efrc.efid;

  /* Make command port */
  if(!(comfd = mktcpsock(ESCOMPORT + efrc.efid))) quit();

  while(1){
    commain();
  }


int commain(void){
  char buff[BABIRL_COM_SIZE],
  int len, com, clen, sock;
  struct sockaddr_in caddr;

  clen = sizeof(caddr);
  if((sock = accept(comfd, (struct sockaddr *)&caddr, (socklen_t *)&clen)) < 0){
    return 0;
  }

  memset(buff, 0, sizeof(buff));
  recv(sock, (char *)&len, sizeof(len), MSG_WAITALL);
  recv(sock, buff, len, MSG_WAITALL);

  memcpy((char *)&com, buff, sizeof(comm));

  switch(com){
  case ES_RUN_START:
    memcpy((char *)&arg, buff+sizeof(com), sizeof(arg));
    if(arg == ES_EF_OFF){
      break; /* noop */
    }
```

```
    /* Startup function for ADCs should be done here */
    // open_drv();

    ret = 1;  // Start-ack
    len = sizeof(ret);
    send(sock, (char *)&len, sizeof(len), 0);
    send(sock, (char *)&ret, len, 0);
  break;
  .
  .
  .
  }



  return 1;
}



/** Make TCP server socket (receiver), automatically bind and listen.
 *  Return socket number.
 *  @param port port number should be bound
 *  @return socket number
 */
int mktcpsock(unsigned short port){
  int sock = 0;
  int sockopt = 1;
  struct sockaddr_in saddr;

  memset((char *)&saddr,0,sizeof(saddr));
  if((sock = socket(PF_INET,SOCK_STREAM,0)) < 0){
    perror("bi-tcp.mktcpsock: Can't make socket.\n");
    return 0;
  }
  setsockopt(sock, SOL_SOCKET, SO_REUSEADDR,
       &sockopt, sizeof(sockopt));

  saddr.sin_family = AF_INET;
  saddr.sin_addr.s_addr = INADDR_ANY;
  saddr.sin_port = htons(port);
  if(bind(sock,(struct sockaddr *)&saddr,sizeof(saddr)) < 0){
    perror("bi-tcp.mktcpsock: Can't bind socket.\n");
    return 0;
  }
  if(listen(sock,100) < 0){
    perror("bi-tcp.mktcpsock: Can't listen socket.");
    return 0;
  }

  return sock;
}
```

2.3.4 Connect to event builder

Before send event-fragment-data to *babild*, TCP connection have to be established between event sender and *babier*.

Connect to event babier

```
int efr_connect(void){
  int ret;

  ret = 0;

  if(!efrc.connect){
    /* Make data port */
    if(!(efsock = mktcpsend(efrc.erhost, efrc.erport))){
      return 0;
    }
    send(efsock, (char *)&efrc.efid, sizeof(efrc.efid), 0);
    recv(efsock, (char *)&ret, sizeof(ret), MSG_WAITALL);
    efrc.connect = 1;
  }else{
    return 0;
  }

  return 1;
}


/** Make TCP client socket (sender), automatically connect.
 *  Return socket number.
 *  @param host server hostname
 *  @param port port number should be connected
 *  @return socket number
 */
int mktcpsend(char *host, unsigned short port){
  int sock = 0;
  struct hostent *hp;
  struct sockaddr_in saddr;

  if((sock = socket(AF_INET,SOCK_STREAM,0)) < 0){
    perror("bi-tcp.mktcpsend: Can't make socket.\n");
    return 0;
  }

  memset((char *)&saddr,0,sizeof(saddr));

  if((hp = gethostbyname(host)) == NULL){
    perror("bi-tcp.mktcpsend: No such host");
    return 0;
  }

  memcpy(&saddr.sin_addr,hp->h_addr,hp->h_length);
  saddr.sin_family = AF_INET;
  saddr.sin_port = htons(port);

  if(connect(sock,(struct sockaddr *)&saddr,sizeof(saddr)) < 0){
    perror("bi-tcp.mktcpsend: Error in tcp connect.\n");
```

```
    close(sock);
    return 0;
  }

  return sock;
}
```

2.3.5 Send data to event builder

It is simple to send event-fragment-data.

Send data to event builder

```
char *buff;
int len;

send(efsock, (char *)&len, sizeof(len), 0);
send(efsock, (buff, len, 0);
```

2.3.6 Receive stop command from event builder

Do not return stop-ack until VME/VXI finishes stop functions.

Receive stop command

```
int commain(void){
  .
  .
  .

  switch(com){
  case ES_RUN_START:
  .
  .
  .
  case ES_RUN_START:
  ret = 1;  // Pre-stop-ack
  len = sizeof(ret);
  send(sock, (char *)&len, sizeof(len), 0);
  send(sock, (char *)&ret, len, 0);

  /* Here, do stop functions for ADCs */
  // daq_stop()

  /* send last (residual) data */
  send(efsock, (char *)&len, sizeof(len), 0);
  send(efsock, (buff, len, 0);

  /* send stop-ack */
  len = -1;  // len=-1 means stop-ack
  send(efsock, (char *)&len, sizeof(len), 0);


  break;
  }
```

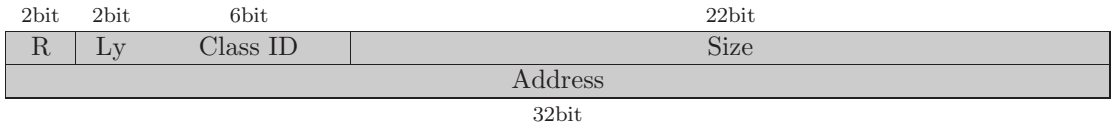
Chapter 3

Data format

The data format in RIBFDAQ is RIDF (RIBF Data Format). Current version of RIDF is 1.3.

3.1 Header rule

In RIDF, all blocks have header word as follow:



- Revision (R)
  Revision bit, 0 = Version 1.x

- Layer (Ly)
  The layer depth of this block. This layer depth is not important.

- Class ID
  Definition of this block. Data format of this block is determined by Class ID.

- Size
  Block size of this block including this header. Unit is short word (22 bit = 4 M). Then maximum size of 1 block is 8 MB. However, for programing reason, it is recommended to use less than 128 kB = 65536 short word.

- Address
  Address indicates that who made this block. It is equal to Event Fragment Number (EFN). The bit length of address is 32 bits, but for now, lower 8 bits are used only. So then, address (EFN) should be 0–255.

For example, 1 block data is constructed as shown in Figure. 3.1.

3.2 Class ID

There are some kinds of Class ID (Table. 3.1).

–	0	1	Size
Address			
–	1	8	Size
Address			
–	1	3	Size
Address			
Event Number			
–	1	4	Size
Address			
Segment ID			
Segment Data			
–	2	4	Size
Address			
Status ID			
Status Data			
–	1	9	Size
Address			
Size of this block			

Figure 3.1: An example of 1 block structure.

3.2.1 Global block header

3.2.2 Global block ender

3.2.3 Global block number

3.2.4 Event data header

3.2.5 Segment data

3.2.6 Scaler data

3.2.7 Status data

3.2.8 Comment data

Table 3.1: The definition of Class ID

Class ID	Group	Detail
0	Global block header	Event fragment data
1	Global block header	Event assembly data
2	Global block header	Event assembly fragment data
3	Event data header	Event data
4	Segment data header	Segment data
5	Comment data header	Comment data
8	Global block number	Global block number
9	Global block ender	Global block ender
11	Scaler data header	Scaler non-clear 24bit
12	Scaler data header	Scaler clear every buffer
13	Scaler data header	Scaler non-clear 32bit
21	Status data header	Status data