SVD (un)packer

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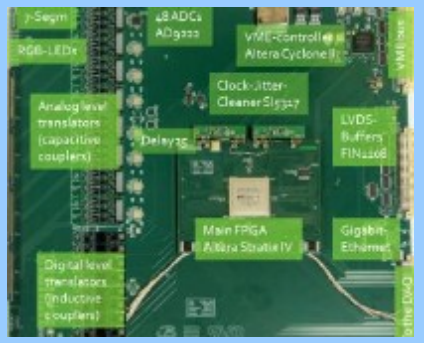
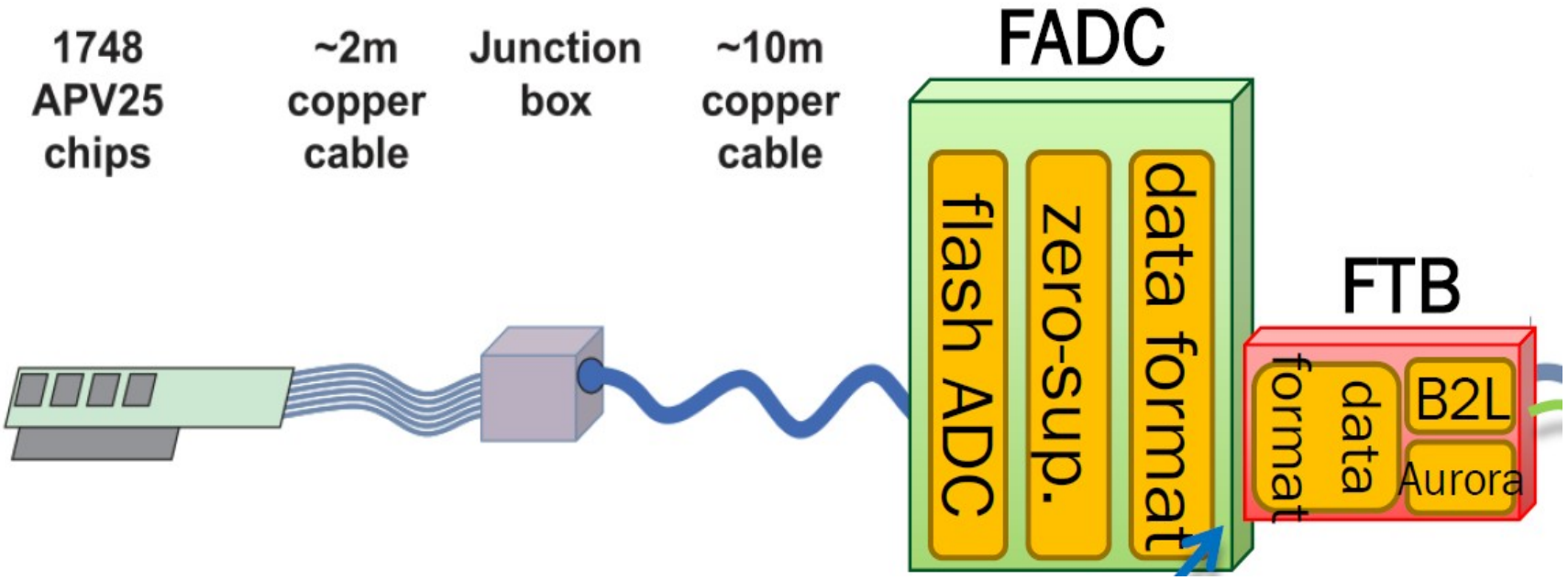


22.01.2015

TASK



Conversion between FADC / FTB data format (RAW DATA) and SVDdigit (simulated DATA) format

RAW DATA

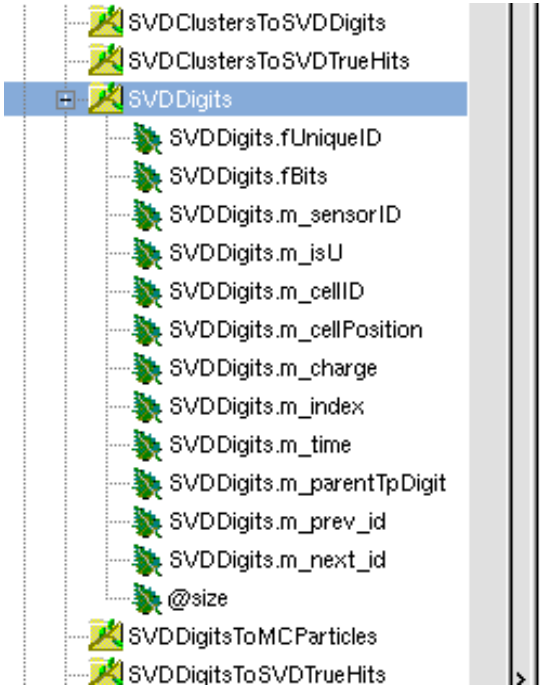
simulated DATA

FADC (zero-suppressed mode)

bit	Main Header	APV Header	0-suppressed data	0-suppressed data	Trailer
31	1	1	0	0	1
30	1	0	Strip number (0…127)	Strip number (0…127)	1
29	0	APV # (0…47)			1
28	Run type				0
27					Detection error
26					Frame error
25	Event type				FIFO full OR
24					APV error OR
23	FADC # (0…255)	Pipeline address (0…255) *	Data sample 2 ***	Data sample 5	Emulated pipeline address (0…255)
22					
21					
20					
19					
18					
17					
16					
15	Trigger timing & type (from TTD)	APV Error **	Data sample 1 ***	Data sample 4	CRC16 checksum
14		Detection Error			
13		Frame Error			
12		FIFO full Error			
11		CMC2 (signed half-byte) *			
10					
9					
8					
7	Trigger number (D7:D0)	CMC1 (signed byte) *	Data sample 0	Data sample 3	
6					
5					
4					
3					
2					
1					
0					

unpacker

packer



- **48 FADC (FTB),**
- **1748 APV25,**
- **128 readout strips per one APV**

ASSIGNMENT

XML file
(Abdul Basith)

- **172 DSSD's (read from both sides)**
- **Up to 768 strips on each DSSD side**

Mapping from xml file

svd_mapping.xml

```
<layer n="3">
        <ladder n="1">

                <sensor n="1">
                        <side side="u">
                                <chip n="0" FADCn="1" strip_number_of_ch0="000"
                                <chip n="1" FADCn="1" strip_number_of_ch0="128"
                                <chip n="2" FADCn="1" strip_number_of_ch0="256"
                                <chip n="3" FADCn="1" strip_number_of_ch0="384"
                                <chip n="4" FADCn="1" strip_number_of_ch0="512"
                                <chip n="5" FADCn="1" strip_number_of_ch0="640"
                        </side>

                        <side side="v">
                                <chip n="0" FADCn="129" strip_number_of_ch0="000
                                <chip n="1" FADCn="129" strip_number_of_ch0="128
                                <chip n="2" FADCn="129" strip_number_of_ch0="256
```

Filled by SVDOnlineToOfflineMap constructor

KEY VALUE

Unpacker:

std::unordered_map < ChipID::baseType, SensorInfo > m_sensors;

Packer:

std::unordered_map < SensorID::baseType, std::vector<ChipInfo> > m_chips;

SVDPackerModule.cc:

```
const SVDOnlineToOfflineMap::ChipInfo& CHIP_info = m_map->getChipInfo(layer,ladder,sensor, isU, cellID);
```

FADC, APV, APV channel

(un)packer module

SvdPacker.h

- structures containing bit fields

Main Header	APV Header	0-suppressed data	0-suppressed data	Trailer

```
struct MainHeader {
    unsigned int trgNumber : 8; //LSB
    unsigned int trgTiming : 8;
    unsigned int FADCnum : 8;
    unsigned int evtType : 3;
    unsigned int runType : 2;
    unsigned int check : 3; //MSB
  };

struct APVHeader {
    unsigned int CMC1 : 8; //LSB

    unsigned int CMC2 : 4;
    unsigned int reserved : 3;
    unsigned int errorBit : 1;

    unsigned int pipelineAddr : 8;

    unsigned int APVnum : 6;
    unsigned int check : 2; //MSB
  };
```

```
struct data_A {
    unsigned int sample1 : 8; //LSB
    unsigned int sample2 : 8;
    unsigned int sample3 : 8;
    unsigned int stripNum : 7;
    unsigned int check : 1; //MSB
  };

struct data_B {
    unsigned int sample4 : 8; //LSB
    unsigned int sample5 : 8;
    unsigned int sample6 : 8;
    unsigned int stripNum : 7;
    unsigned int check : 1; //MSB
  };

struct FADCTrailer {
    unsigned int FTBFlags: 16; //LSB

    unsigned int emPipeAddr: 8;

    unsigned int wiredOrErr: 1;
    unsigned int error0: 1;
    unsigned int error1: 1;
    unsigned int error2: 1;
    unsigned int check : 4; //MSB
  };
```

SvdPacker.cc

- utilization of union

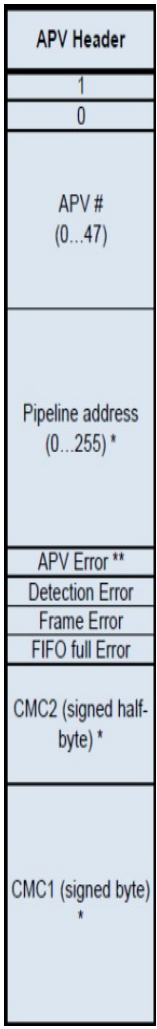
ex: APV Header construction

```
union
{
 uint32_t data32;
 MainHeader m_MainHeader;
 APVHeader m_APVHeader;
 data_A  m_data_A;
 data_B  m_data_B;
 FADCTrailer m_FADCTrailer;
};
```

output

input

```
m_APVHeader.CMC1 = 0;
m_APVHeader.CMC2 = 0xf;
m_APVHeader.reserved=0;
m_APVHeader.errorBit=1;
m_APVHeader.pipelineAddr=0;
m_APVHeader.APVnum=(unsigned int)(charge[0]/128);
m_APVHeader.check = 2;
```



RAW data: FADC and FTB format

FADC formatting

bit	FADC Main Header	Channel Header	FADC DATA	FADC Trailer
31	1	1	0	1
30	1	0		1
29	0			1
28				0
27				
26				
25				
24				
23				
22				
21				
20				
19				
18				
17				
16				
15				
14				
13				
12				
11				
10				
9				
8				
7				
6				
5				
4				
3				
2				
1				
0				

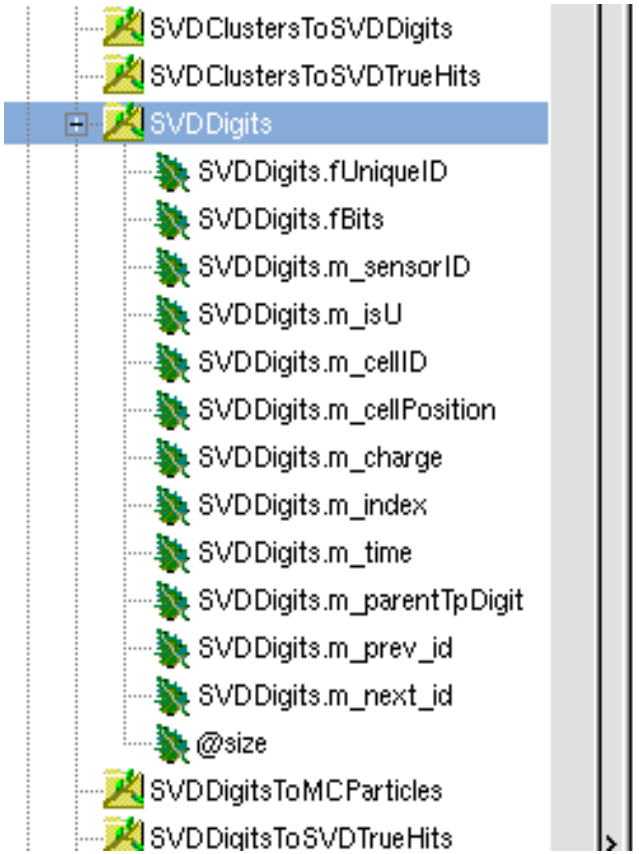
FADC Event Number FADC Main Header DATA | FADC Channel Header DATA | FADC DATA | FADC Trailer | FADC CRC16 code

FTB formatting

bit	FTB Header		FADC Main Header	Input Header	FADC DATA	FADC Trailer	FTB Trailer
31	F	FTB Event Number	1	1	0	1	F
30			1	0		1	
29			0			1	
28						0	
27	F						F
26							
25							
24							
23	A						5
22							
21							
20							
19	A						5
18							
17							
16							
15	0						
14							
13							
12							
11	0						
10							
9							
8							
7	0	Errors Field				FTB Flags Field	
6							
5							
4							
3	0						FTB CRC16 out
2							
1							
0							

FADC Event Number FADC Main Header DATA | FADC Channel Header DATA | FADC DATA | FADC Trailer

Packer



1111 1111 1010 1010 0000000000000000
00000000000000000000000 00000000 **FTB Header**

110 00000 00000001 00000000 00000000 FADC Header

10 000000 00000000 00000000 00000000 APV Header

0 0110101 00010001 00000100 00000100
0 0110101 00001110 00000000 00000100 DATA

10 000001 00000000 00000000 00000000

0 1010111 11110000 00001110 00000000
0 1010111 00000000 11111111 11111100

10 000010 00000000 00000000 00000000

0 0101110 00010110 00010011 11111111
0 0101110 00001000 00001011 00000110

0 0101111 00010011 00011000 00000001
0 0101111 11111101 00001111 00001100

0 0110001 00011111 00001110 11110111
0 0110001 00000110 00010000 00000101

.
.
.

10 101100 00000000 00000000 00000000
10 101101 00000000 00000000 00000000
10 101110 00000000 00000000 00000000
10 101111 00000000 00000000 00000000

1110 000000000000 0000000000011111 FADC Trailer

1111 1111 0101 0100 1000010110110101 **FTB Trailer**

CRC16 calculation

Packer & unpacker

SVD Digits printout:

```
cellID = 517, sensID = 3.1.2, isU = 1, chg = 2,  idx = 0
cellID = 517, sensID = 3.1.2, isU = 1, chg = 33, idx = 1
cellID = 517, sensID = 3.1.2, isU = 1, chg = 44, idx = 2
cellID = 517, sensID = 3.1.2, isU = 1, chg = 26, idx = 3
cellID = 517, sensID = 3.1.2, isU = 1, chg = 17, idx = 4
cellID = 517, sensID = 3.1.2, isU = 1, chg = 22, idx = 5
```

packer → FADC: 33, APV: 4, APVChannel: 5

SVDRaw printout

```
110 00000 00100001 0000000000000000
10 000100 00000000 0000000000000000

00000101 00101100 00100001 00000010
00000101 00010110 00010001 00011010
```

```
raw_svd->PackDetectorBuf(buf1, nwords_1st,
»                        buf2, nwords_2nd,
»                        buf3, nwords_3rd,
»                        buf4, nwords_4th,
»                        rawcprpacker_info);
```

unpacker → cellID, DSSD number, DSSD side

Saved SVD Digits data

```
cellID = 517, sensID = 3.1.2, isU = 1, chg = 2,  idx = 0
cellID = 517, sensID = 3.1.2, isU = 1, chg = 33, idx = 1
cellID = 517, sensID = 3.1.2, isU = 1, chg = 44, idx = 2
cellID = 517, sensID = 3.1.2, isU = 1, chg = 26, idx = 3
cellID = 517, sensID = 3.1.2, isU = 1, chg = 17, idx = 4
cellID = 517, sensID = 3.1.2, isU = 1, chg = 22, idx = 5
```

```
SVDDigit* newDigit =
m_map->NewDigit(fadc, apv, strip, sample[i], i);
```

OK

Summary

Main part of the work is done!

(preliminary packer & unpacker modules work fine)

To do:

- CRC16 checking by the unpacker
- Take into account changes in the software
- Improve the style of the code
- Perhaps many minor modifications and improvements ...

To be submitted in February 2015