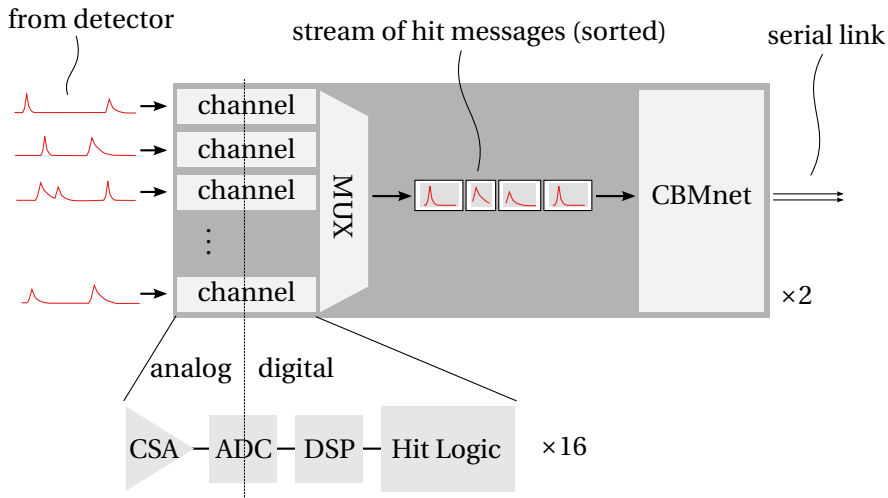


SPADIC/GBTX readout scenarios

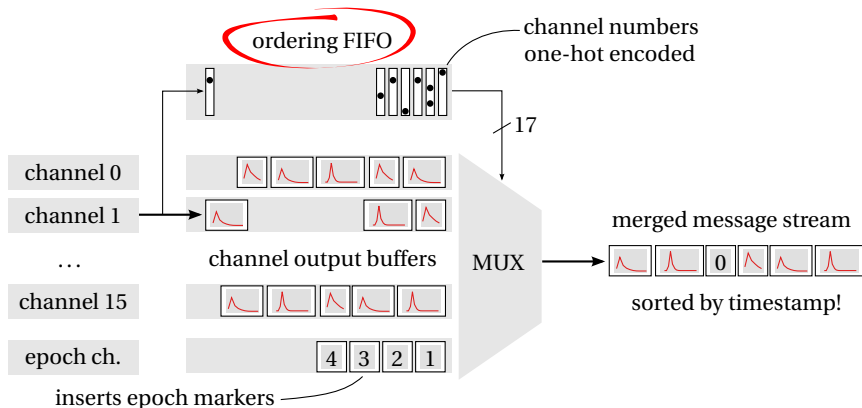
Michael Krieger

CBM FEE/DAQ Workshop
17.02.2014

Reminder: SPADIC 1.0 architecture



Merging hit messages



Data rate

What is the data rate one SPADIC generates?

- $\text{data rate} = \text{trigger rate} \times \text{message size}$

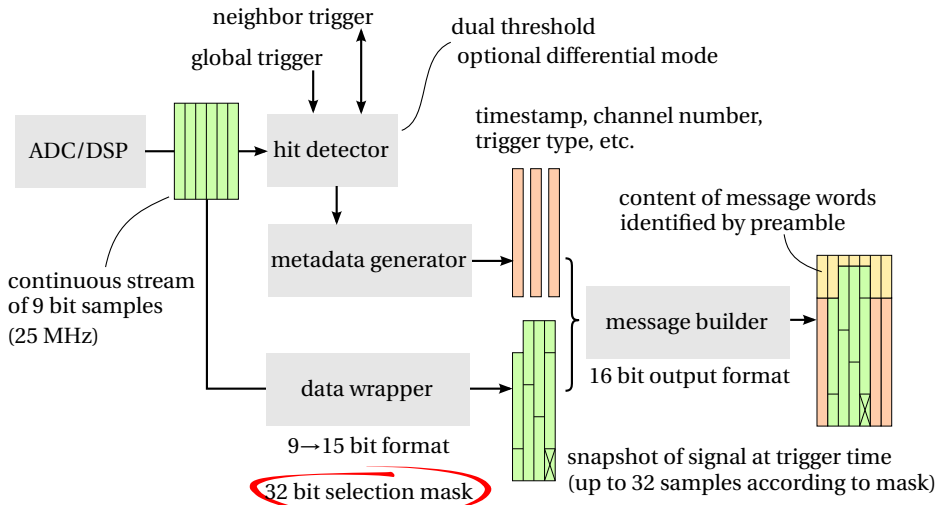
What is the trigger rate?

- Shown by Cyrano. Includes neighbor trigger.

What is the message size?

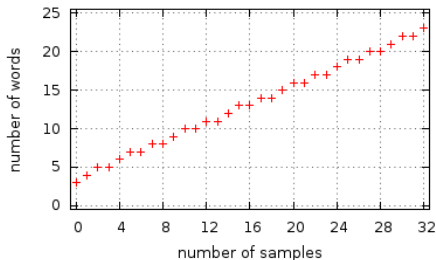
- See next slides.

Hit logic (per channel)

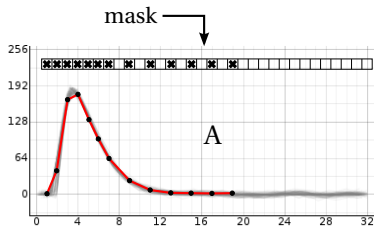


Message size (selection mask)

- $n_{\text{words}} = 3 + \left\lceil \frac{9 \times n_{\text{samples}} + 3}{15} \right\rceil$ for $1 \leq n_{\text{samples}} \leq 32$
- $n_{\text{words}} = 3$ for $n_{\text{samples}} = 0$
- minimal message: 3 words (no samples, only metadata)



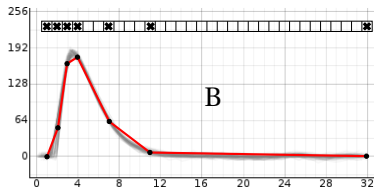
Example: different selection masks



message data (hex)

```
801F
9082
AEEF
5AFF
3FDF
73E1
2840
007E
0F77
47E2
B350
```

13 samples contained
→ 11 words, 176 bits



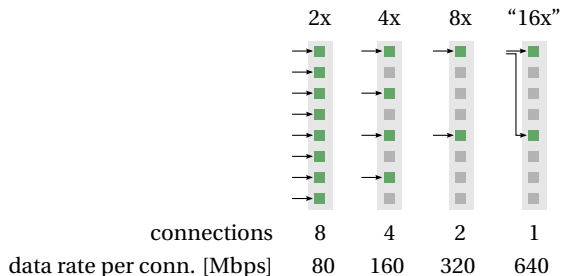
```
801F
9E4D
AF0F
52FF
3FCA
404F
4200
B1D0
```

7 samples contained
→ 8 words, 128 bits

GBTX: e-port basics

Relevant GBTX facts:

- GBTX has 5 groups of up to 8 usable e-ports
- each group can be set independently to one of 3 modes (here: +1 virtual mode, using 2 e-ports)
- between 5 and 40 connections per GBTX



GBTX: counting configurations

- in principle, $4^5 = 1024$ combinations
- ignoring the order of the groups: 56 relevant configurations
- later: restrict to a few most commonly used

“density index”	group modes					connections
0	2x	2x	2x	2x	2x	40
1	4x	2x	2x	2x	2x	36
2	4x	4x	2x	2x	2x	32
...
54	16x	16x	16x	16x	8x	6
55	16x	16x	16x	16x	16x	5

GBTX readout scenarios

TRD composed of modules and FEBs (see Cyrano's presentation)

two scenarios can be distinguished:

1 GBTX on FEB

- at least 1 GBTX per FEB
- at most 10 SPADICs per GBTX

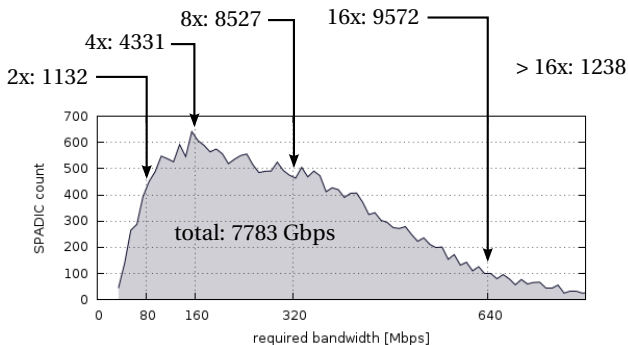
2 GBTX on separate board (per module)

- potentially up to 40 SPADICs per GBTX
- fewer GBTX than FEBs possible

Data rate requirements

assumptions:

- 6 samples per hit → message size: 112 bits
- 2/3 bandwidth utilization
- distribution of trigger rates (including neighbor trigger) as shown by Cyrano



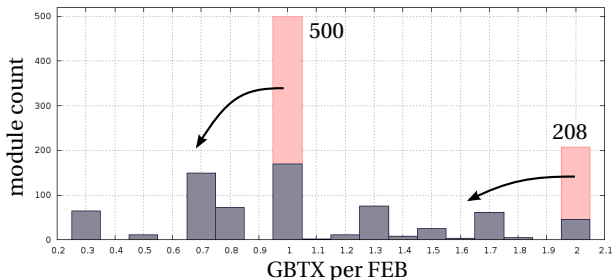
Assign GBTX according to data rate distribution

1 GBTX on FEB

- for each FEB: choose 1 or 2 GBTX
- result: 4484 (maybe outdated, investigate again)

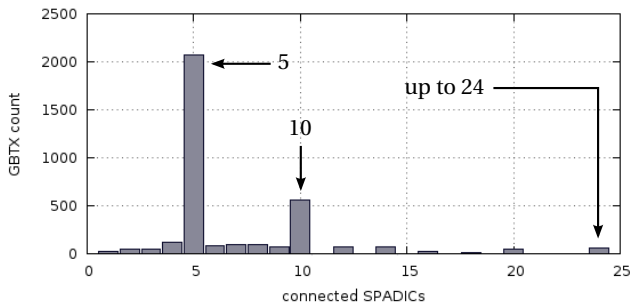
2 GBTX on separate board per module:

- for each module: add GBTX and increase their “density index” until bandwidth requirements are met
- result: 3559 GBTX (down to 1 per 3 FEBs)



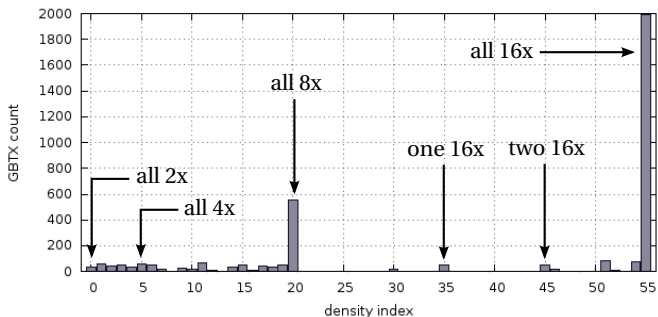
How many SPADICs are connected to one GBTX?

- 1 GBTX on FEB:
 - 4, 5, 8 or 10
- 2 GBTX on separate board per module:
 - roughly the same, but sometimes more
(also less, when there are e-ports left over)



Which GBTX configurations are used?

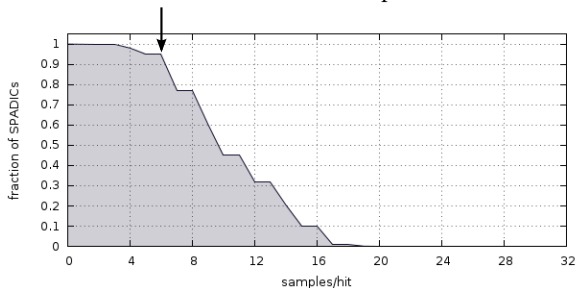
- 1 GBTX on FEB:
 - either all 8x (10 SPADICs/GBTX) or all 16x (5 SPADICs/GBTX)
- 2 GBTX on separate board per module:
 - mostly the same, but some with <8x



How many samples per hit are possible?

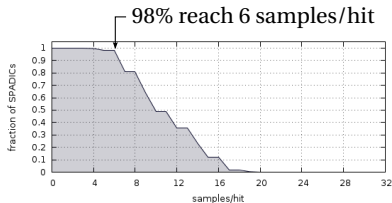
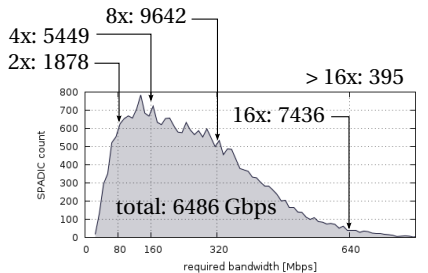
- when distributing the GBTX, we requested 6 samples/hit
- for some SPADICs, the 16x connection is still not enough
- other SPADICs have more bandwidth available than they need

95% of all SPADICs reach 6 samples/hit

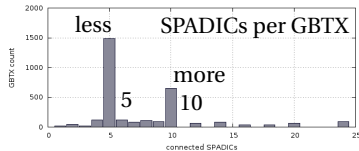
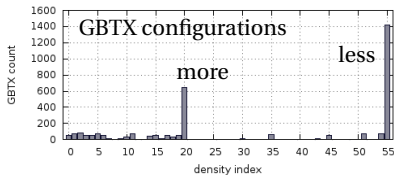
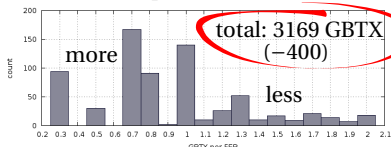


Let's be more optimistic

assume 80% bandwidth utilization (instead 67%)

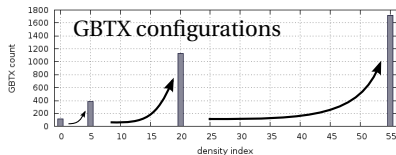
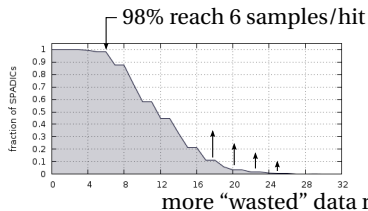
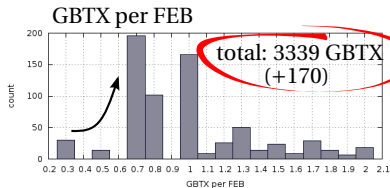
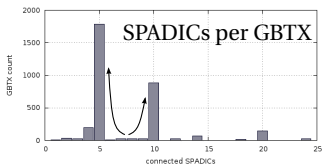


GBTX per FEB



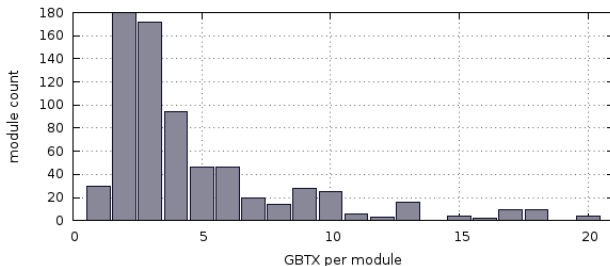
Let's be more realistic

- we cannot use all 56 GBTX configurations → limit to a few:
 - obviously: all 8x, all 16x
 - others? start with all 2x, all 4x (further investigation to optimize)
 - compared to previous slide:



More realism: GBTX-FEBs

- up to now: arbitrary assignment of GBTX to modules (only the GBTX configurations are constrained)
- resulting number of GBTX per module:



- build limited set of “GBTX-FEB” variants
 - how many GBTX per board? e. g. 1, 2, 4, 8
 - which combinations of GBTX configurations?

Summary

- save GBTX by using 2x and 4x modes (given low enough data rate requirements) — we need 3000–4000
- for current set of TRD modules → at most 24 SPADICs/GBTX
- more research needed: find optimal distribution of GBTX to TRD modules *with constraints* (small set of GBTX-FEB variants)

The End.