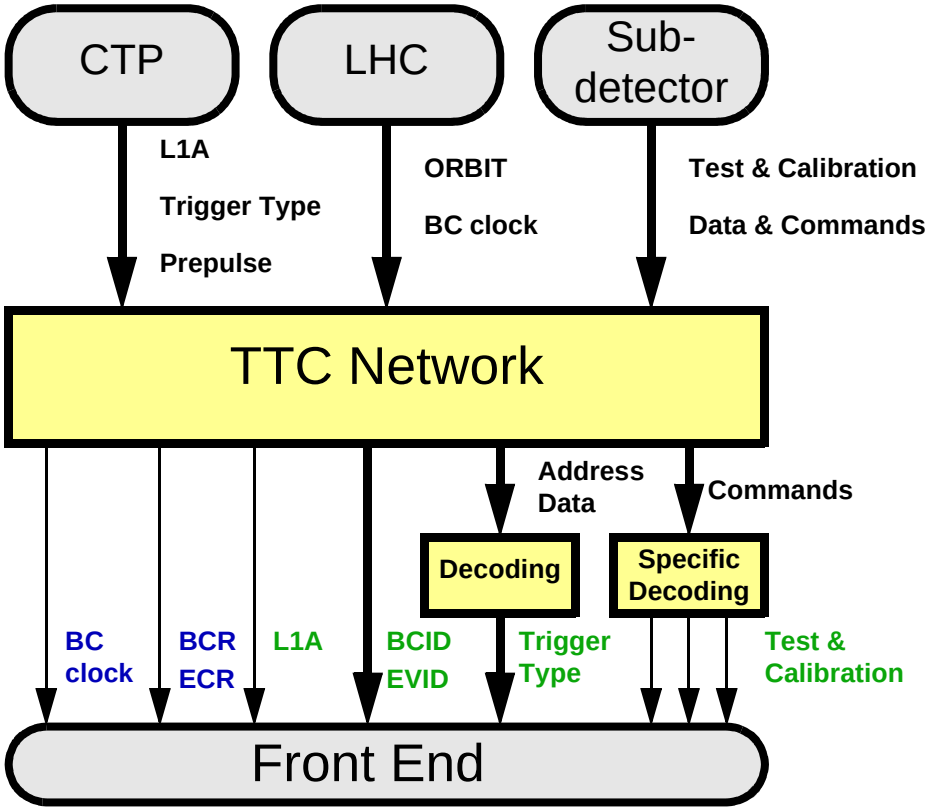
Timing, Trigger and Control, and Dead-time handling.

Ph. Farthouat, 20–11–98.

- TTC functionality.
- Dead-time handling.
- Partitioning.

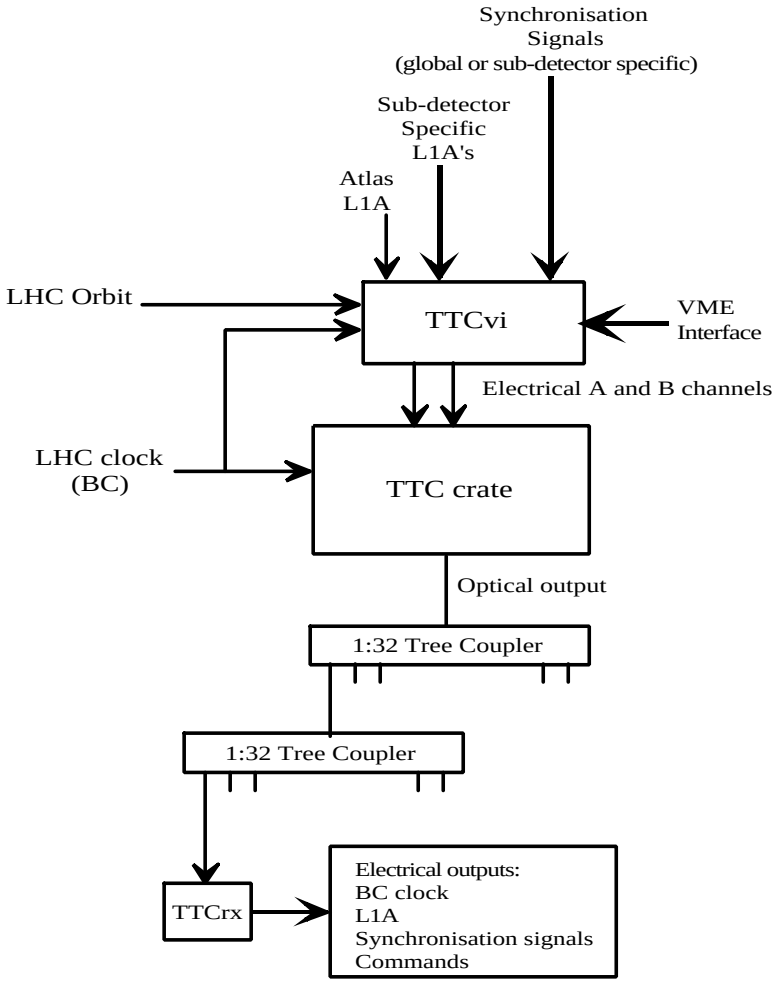
TTC Overview:

Optical Distribution system transmits Timing and Trigger signals to the front end.



Based on TTC backbone developed by RD12.

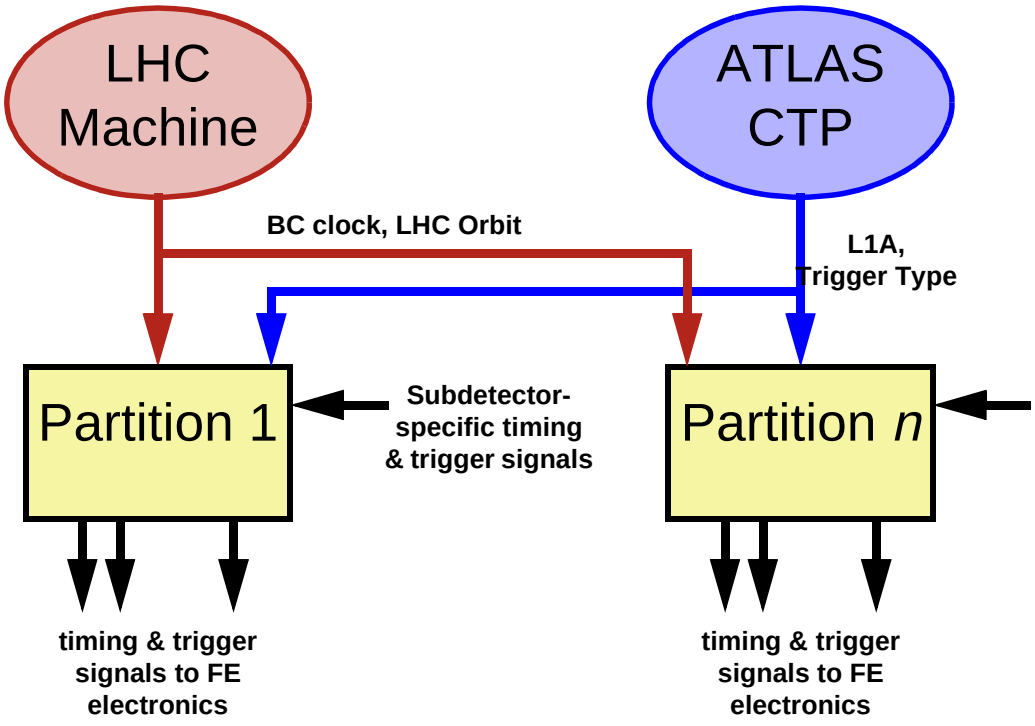
TTC RD12 backbone:



Backbone elements:

- TTC VME interface module (TTCvi),
- passive optical tree, 1→ *N* (< 1024) nodes,
- TTC crate,
- TTC receiver chip (TTCrx).
- PMC receiver (TTCsr)
- TTC crate in a VME board (TTCvx)

TTC Partitions (1):



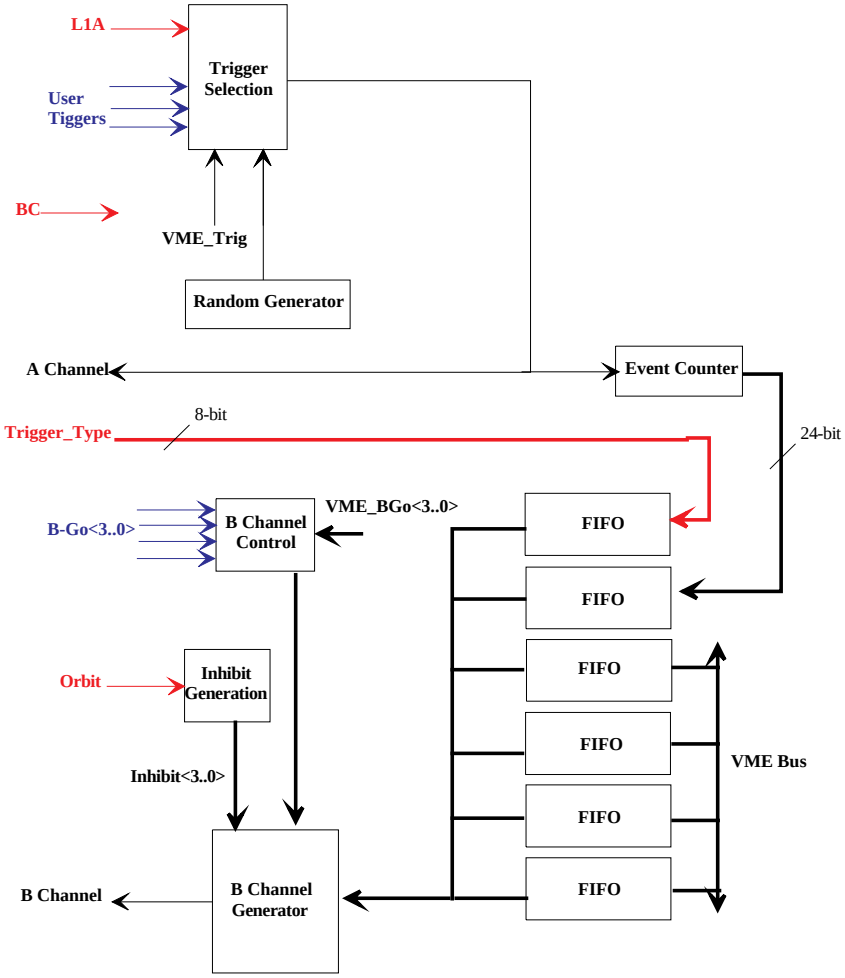
- Subsystems need to work independently;
- each subsystem requires partitions;
- partitions can be stopped in different places (FE, RODs).

TTC Partitions (2):

System	Number of partitions
Pixel	2
SCT	4
TRT	4
EM LAr calorimeter	4
HEC	2
Tile calorimeter	4
Forward calorimeter	2
TGC	2
RPC	2
MDT	4
CSC	2
LVL1 cal trigger	1
LVL1 μ trigger	2

Total of 35 partitions

TTCvi:



One per partition, controlled by DAQ or locally.

L1A source: CTP / 3 local inputs / internal random.

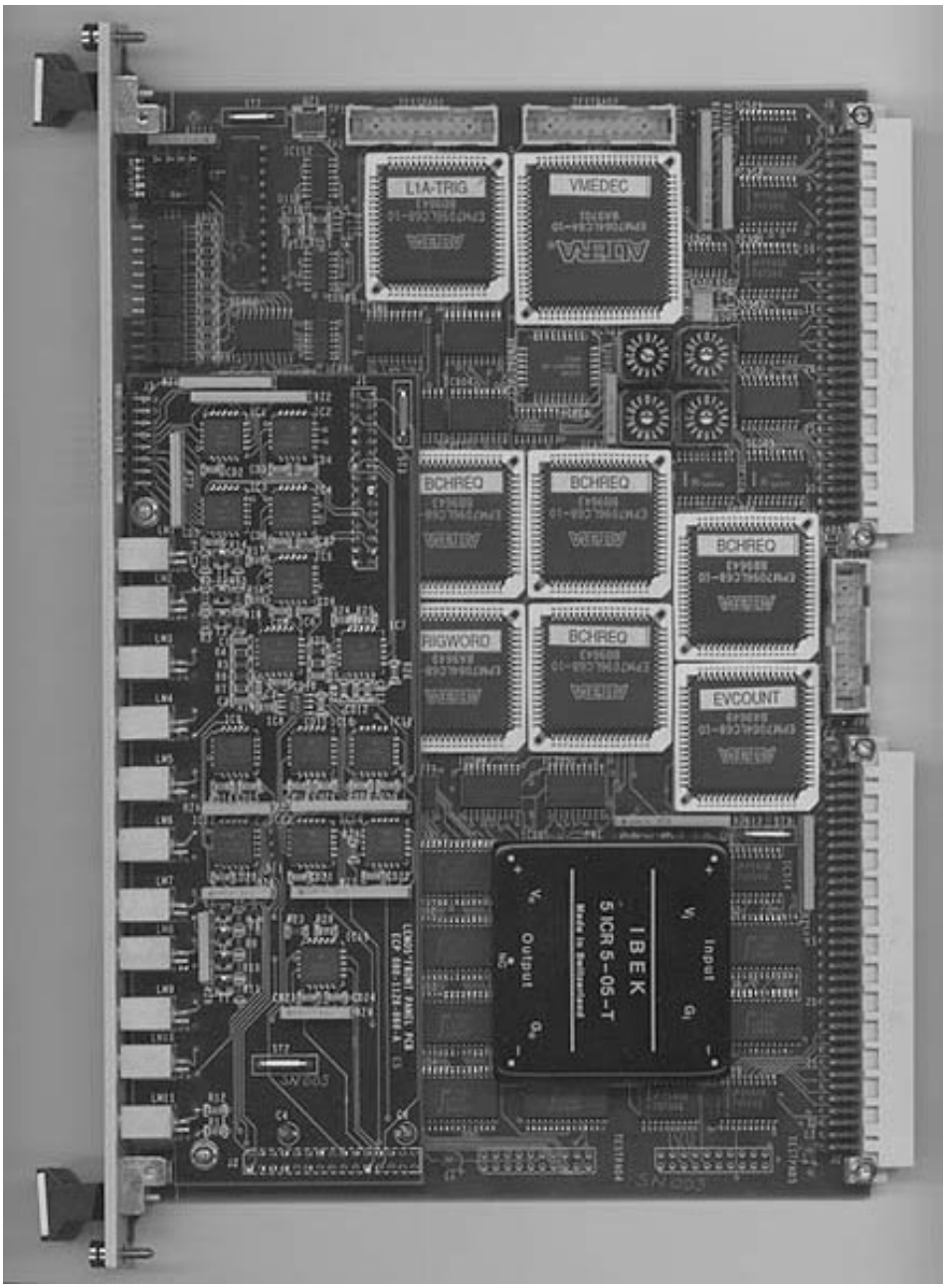
Encoded, electrical outputs:

- A Channel: L1A;
- B Channel: synchronous and asynchronous commands and data (eg, BCR, EVID).

TTCvi used by several sub-systems

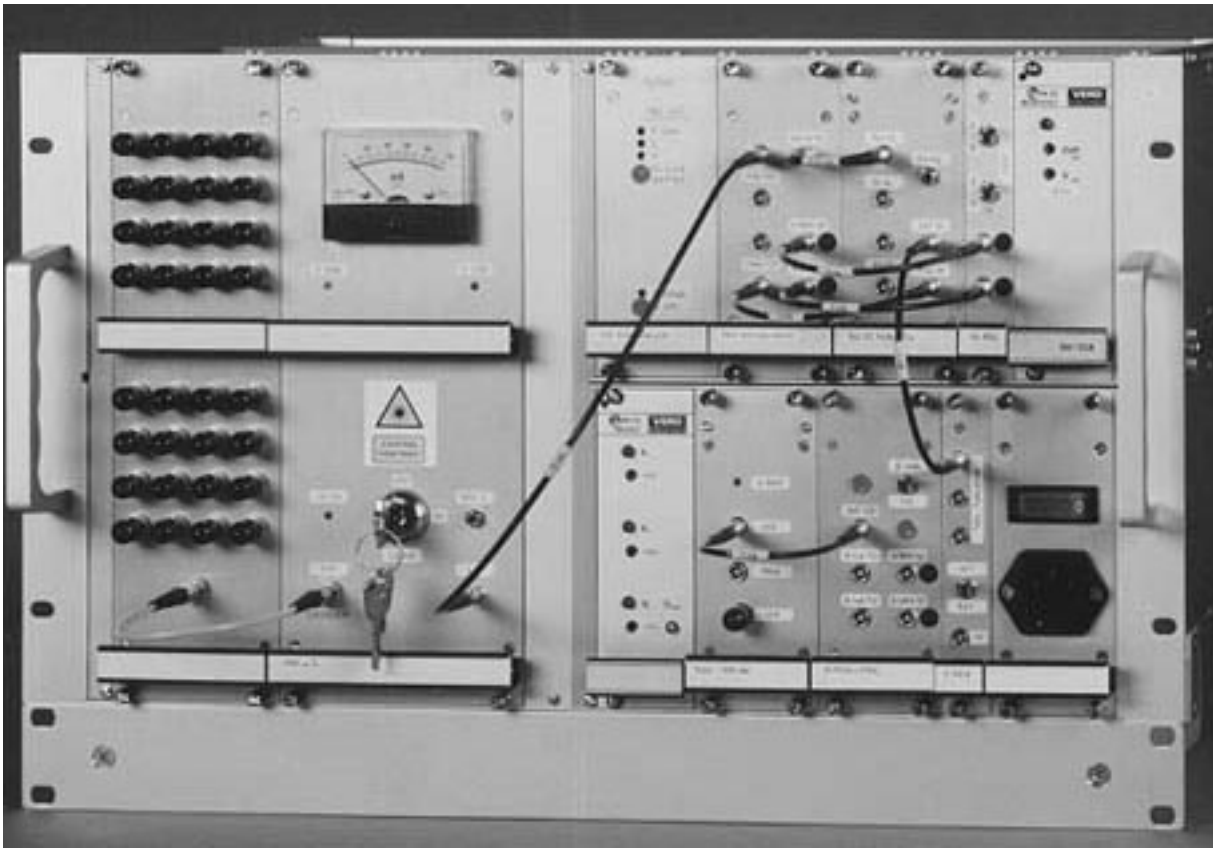
Feedback expected

TTCvi:



20 modules built and distributed
New batch being done
Per.Gallno@cern.ch

TTC crate:



Receives:

- A channel & B channel from TTCvi;
- BC clock from LHC.

Performs:

- final encoding of data;
- time-division multiplexing of data on to single link;
- electrical-to-optical conversion.

TTCvx:

Compact replacement for TTC mini-crate

40.08 MHz clock generator & fanout

Narrow bandwidth PLL for ext clock cleanup

A/B channel multiplexer

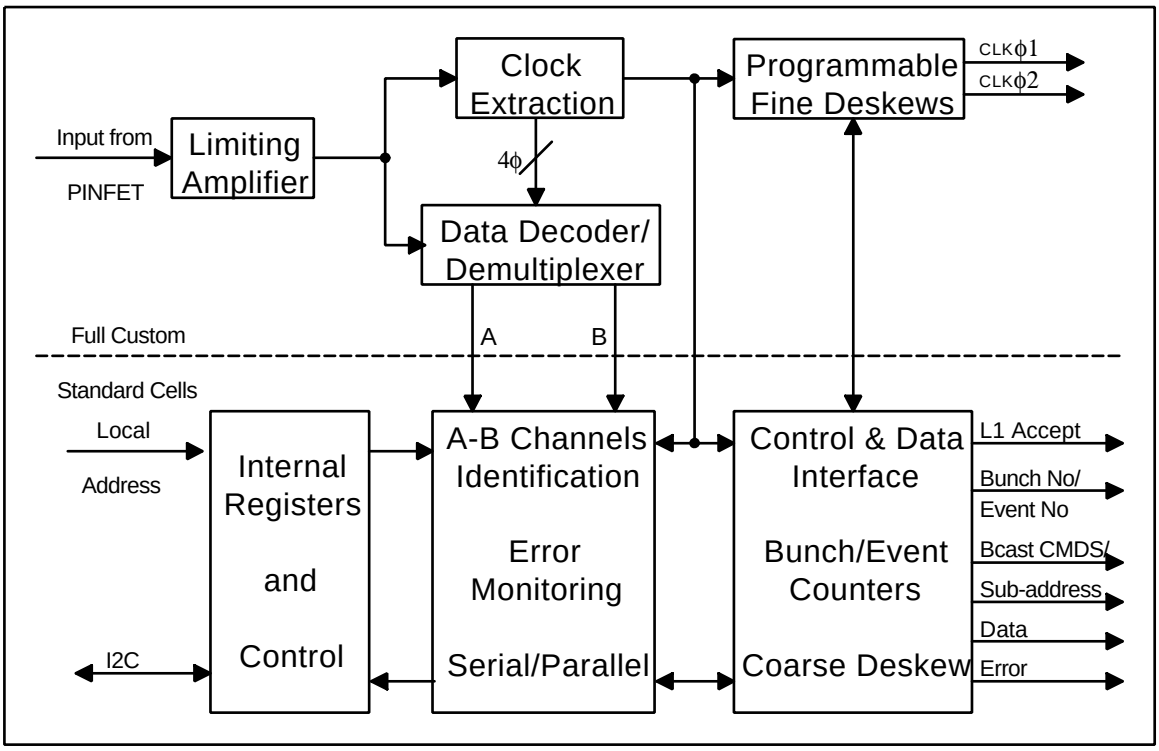
Bi-phase mark encoder

4 optical outputs

Available in spring 99

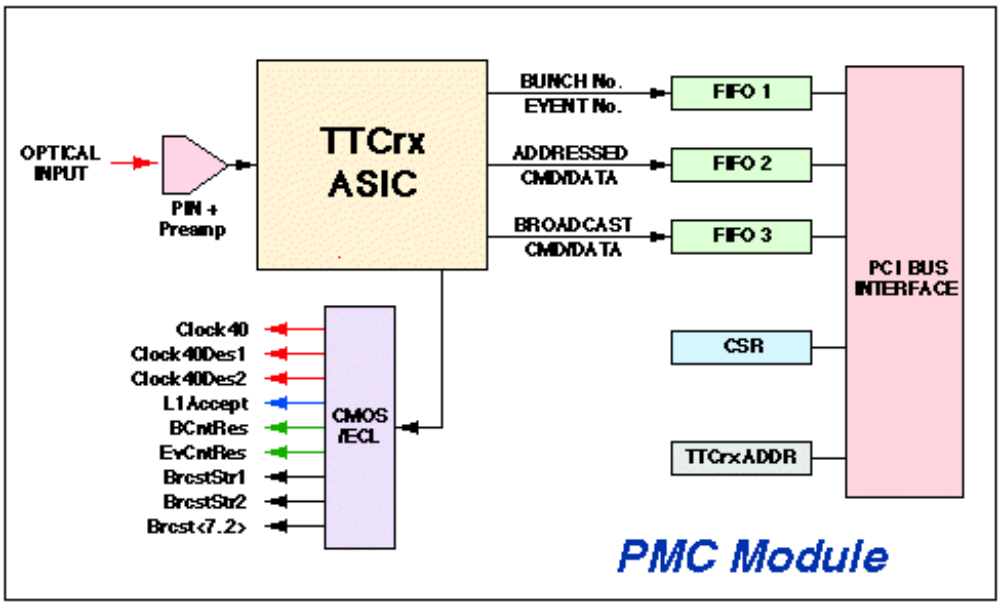
Per.Gallno@cern.ch

TTCrx:



- Rad-hard ASIC.
- Receives control and synchronization info from TTC after optical-to-electrical conversion.
- Recovers BC clock (~100 ps precision).
- Makes available to FE L1A, BCID, EVID, etc.
- Timing adjustment to compensate for particle times of flight and propagation delays.

TTCsr:

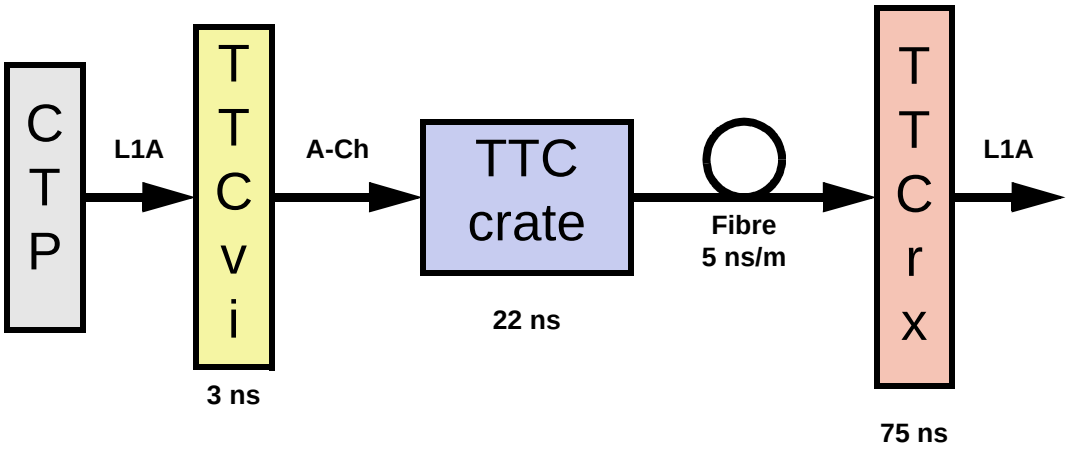


PMC board

Fast ECL outputs

- 3 FIFOs to PCI bus

Latency:

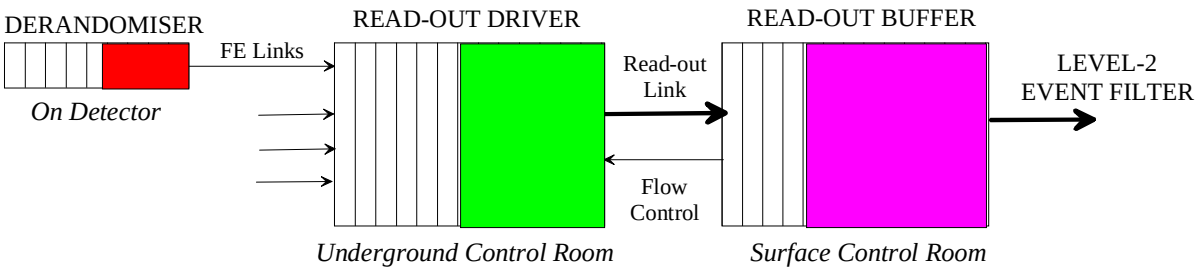


Element	Delay	Remark
TTCvi	3 ns	3 ECL stages
TTCvi to TTC crate	3 ns	Cable
TTC crate	22 ns	Modulator, etc....
TTCrx	75 ns	Receiver
Total delay excluding cables and fibres	**103 ns**	**TTCvi + TTC crate + TTCrx**

To which sub-systems must add:

Element	Remark
CTP to TTCvi	Depends on where TTC is
TTC crate to destination	- TTC crate to Front-end - TTC crate to ROD crate + ROD crate to Front-end
Change of protocol	If any

Deadtime Handling:



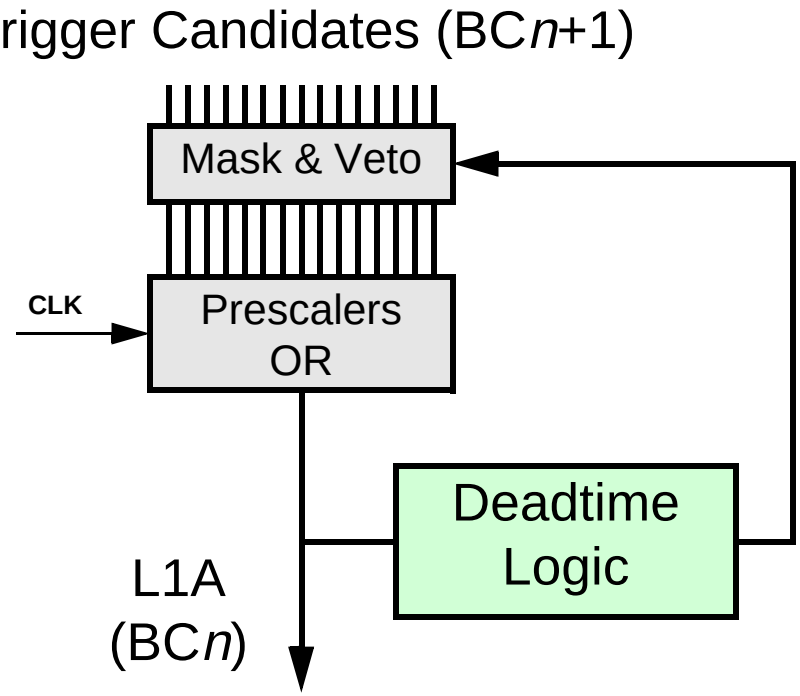
Buffers are filling in different places

Deadtime to be introduced as necessary

Handling in three different manners

Derandomiser:

In the CTP



Simple algorithm:

x dead BCs after each L1A ($0 \leq x \leq 16$)

Complex algorithm:

L1As $\leq n$ in time t

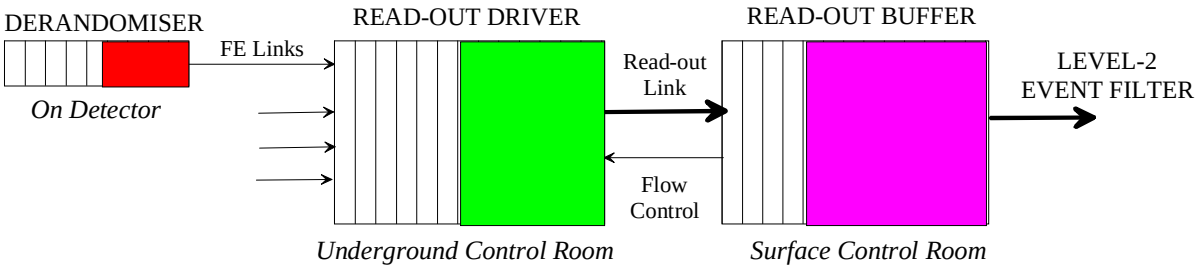
$1 \leq n \leq 32$; $0 \leq t \leq 1.6$ ms

Expected parameters:

- 4 BCs deadtime after each L1A;
- max rate: 8 L1As in 80 μs;

$\rightarrow$ < 1% events lost at L1A rate of 75 kHz.

BUSY signals:



RODs and ROBs contain buffers which can be full, necessiting dead-time introduction

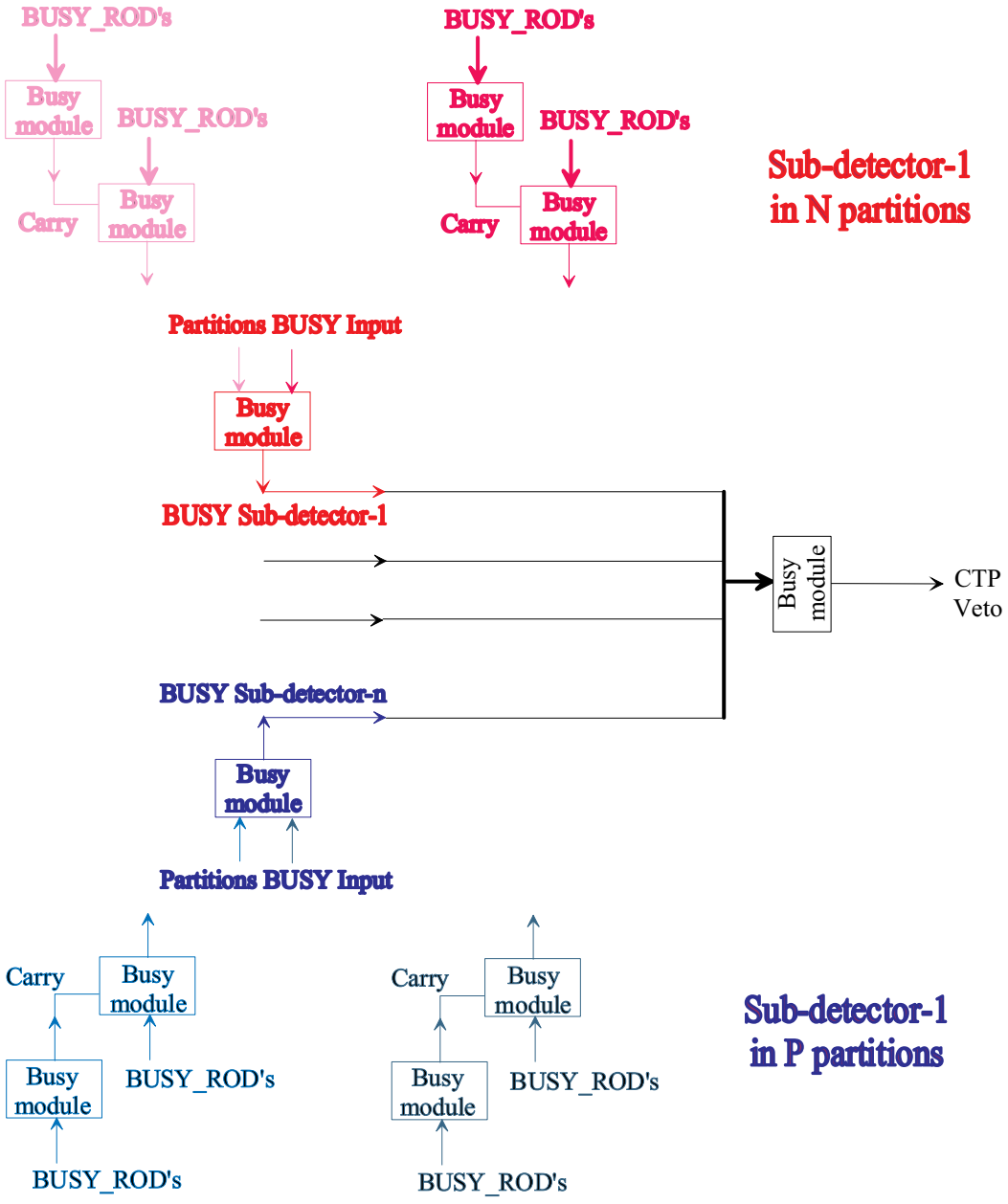
ROB: back-pressure on the ROD with XON/XOFF mechanism on the read-out link

- if *N μs* are necessary for the XOFF to reach the ROD and *X words/μs* are transmitted when less than *N*X words* are available

ROD: generation of a BUSY signal when the buffer is nearly full

- when there is just enough space to accomodate the maximum number of events (or data) which can be stored in the front-end derandomiser

BUSY tree:



BUSY signals to be gathered in a tree structure up to the CTP.

One BUSY per sub-detector partition

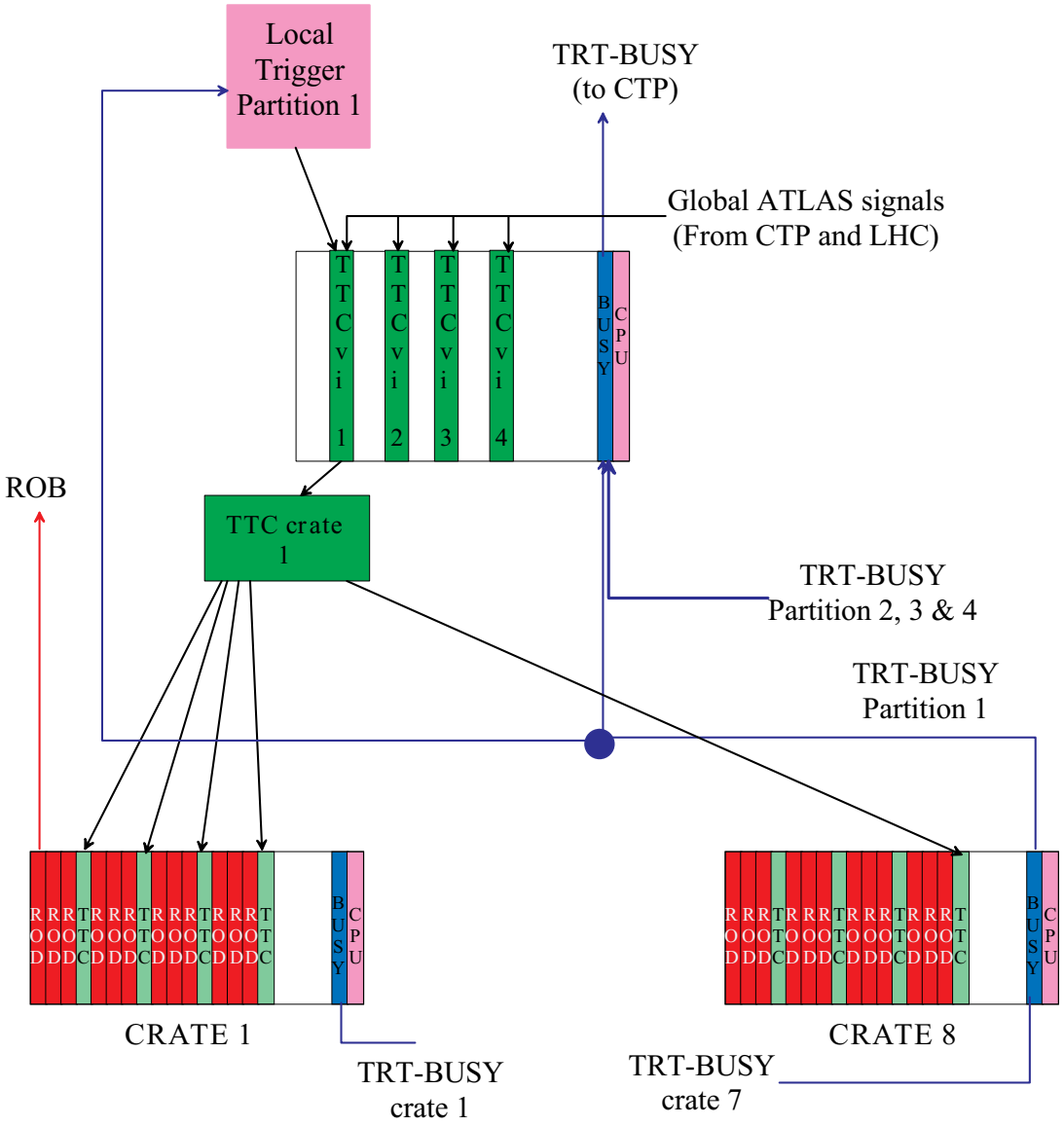
One BUSY per sub-detector

Partition (1):

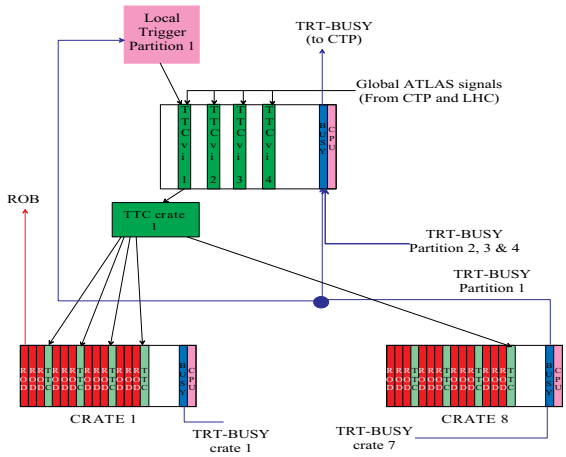
TTC
BUSY handling

Example: TRT 4 partitions (2 EC and 2 Barrel)

- EC: 160000 Channels, 96 RODs in 8 crates
- Barrel: 50000 Channels, 32 RODs in 3 crates



Partition (2):



Defining TRT partition 1:

- TTCvi1 in local mode. Selection of the input
- TRT-BUSY Partition 1 out of TRT-BUSY
- Local trigger generator dead-time control by TRT-BUSY partition 1

Local Trigger Handling:

- Detector specific
- Can we extract common functionality?
- Include it in TTCvi?

Busy handling:

- Two outputs required

TTC:

- TTC signals to reach all elements of the partition (including ROBs)