FE ELECTRONICS CHARACTERISTICS

ALICE Technical Board – CERN, July 15th 2002

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- **Purpose and scope of a model for the readout electronics of the ALICE Detectors**
- **Some examples of modeling the R/O electronics: TPC, SPD, SDD, HMPID, TOF, MUON-ARM**
- **Description of the general R/O Model**
- **R/O characterization table**

PURPOSE AND SCOPE OF A R/O MODEL FOR THE ALICE DETECTORS

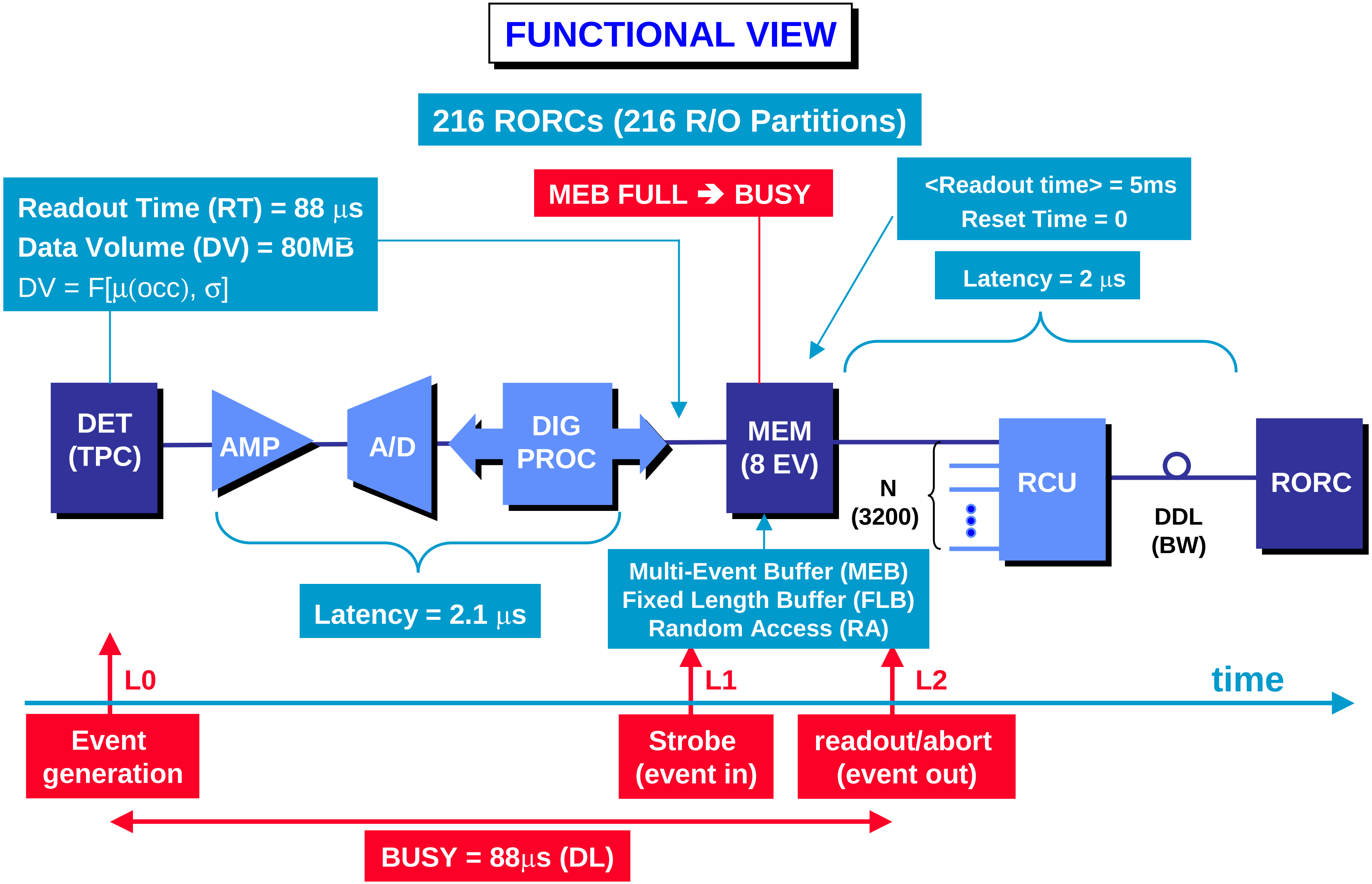
Purpose

- **Study the ALICE read out: consistency and performance**
- **Common description of the Detector R/O electronics**
- **Optimization of the readout electronics: the MEB and dataflow organization is, for some detectors, still open (programmable devices)**

Scope

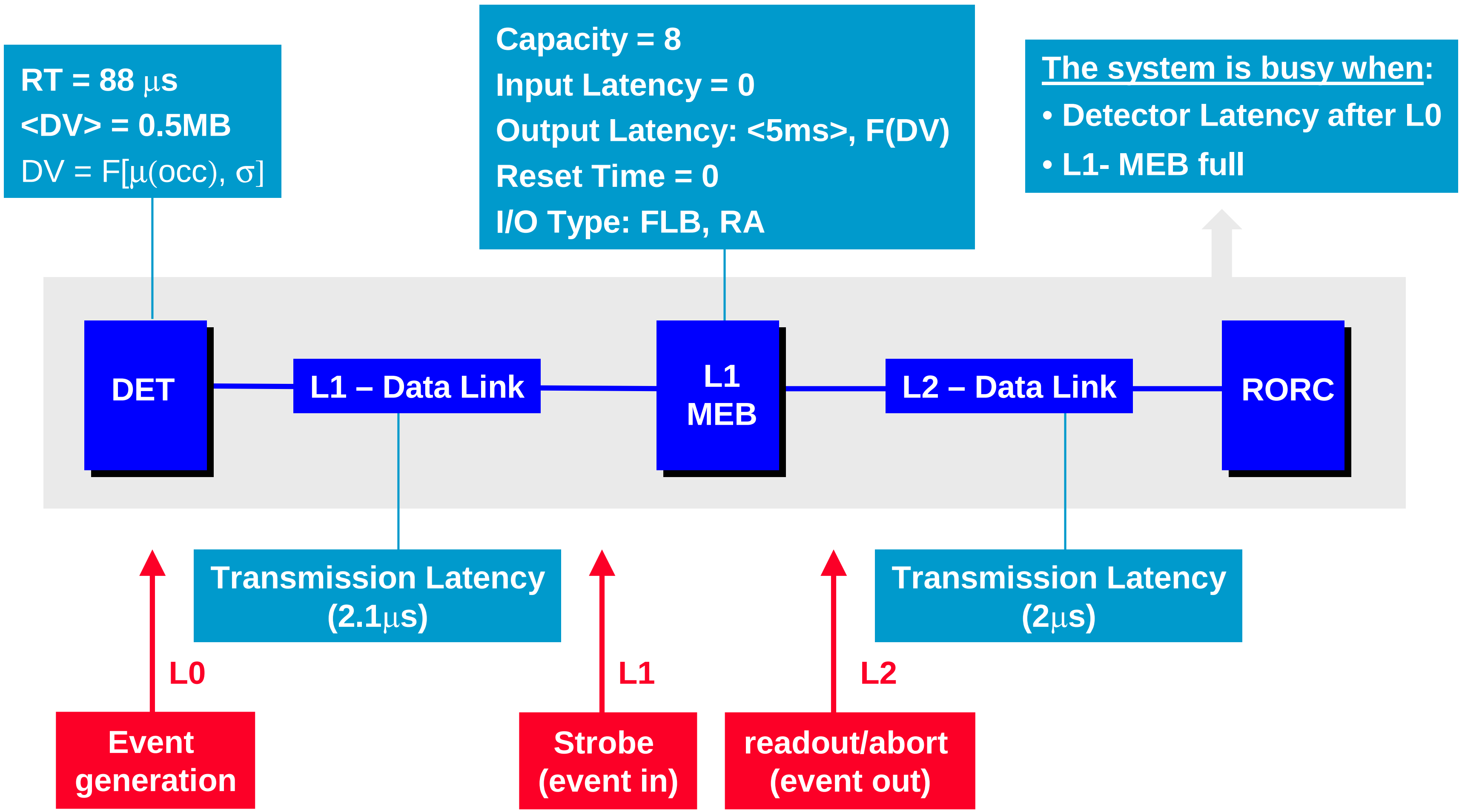
- **Model for the data Readout from the DETECTOR to the RORC**
- **Basic Readout Partition: readout electronics combined to one RORC**
- **Description Model: RTL (Register Transmission Level), algorithmic, stochastic**

MODELING THE TPC READOUT ELECTRONICS (1/2)

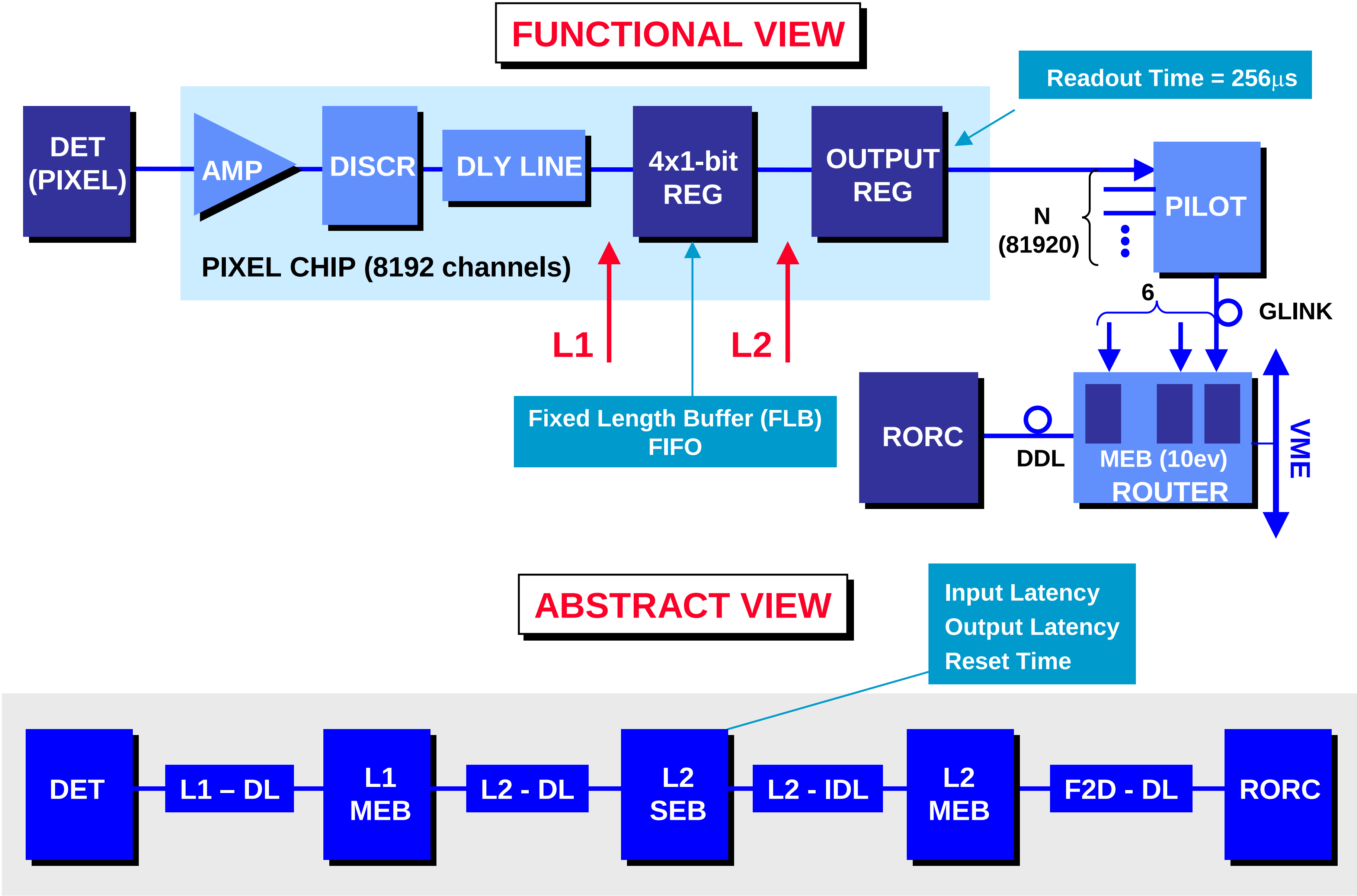


MODELLING THE TPC READOUT ELECTRONICS (2/2)

ABSTRACT VIEW

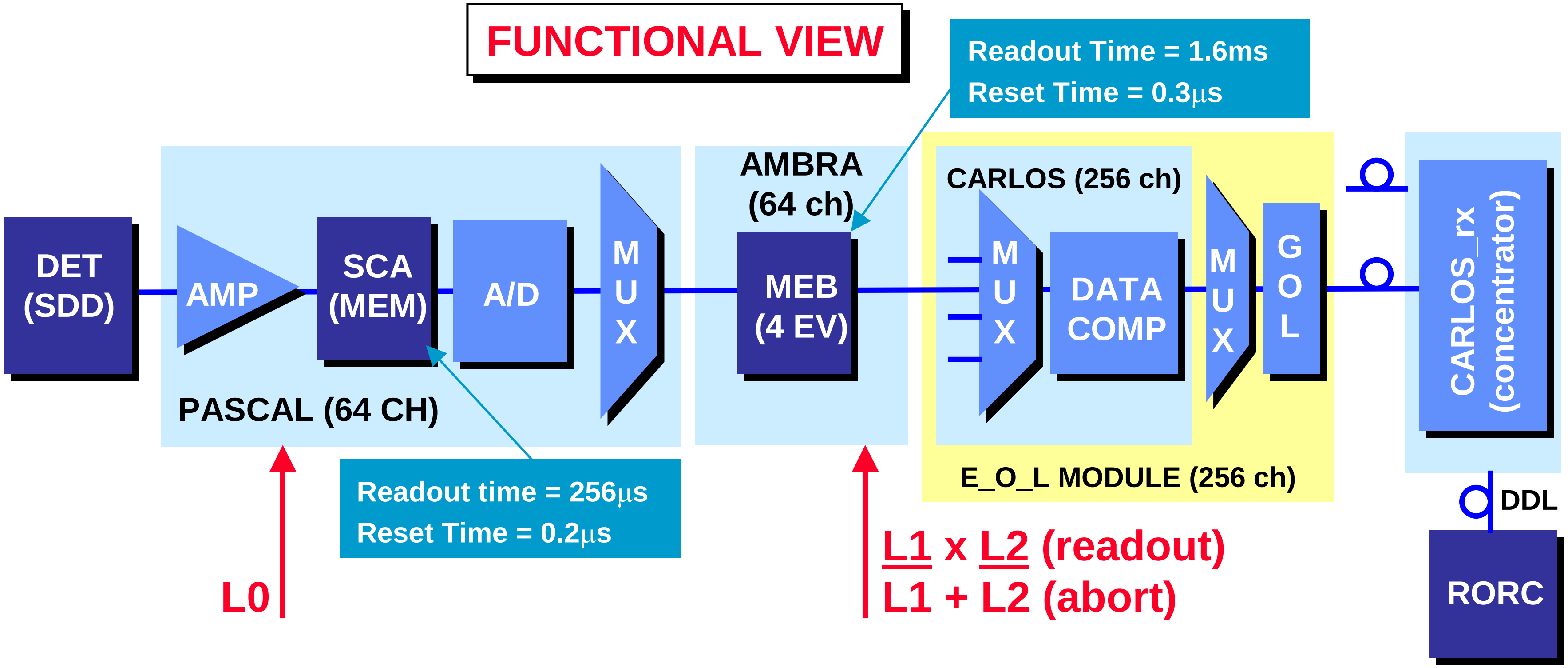


MODELLING THE SPD READOUT ELECTRONICS

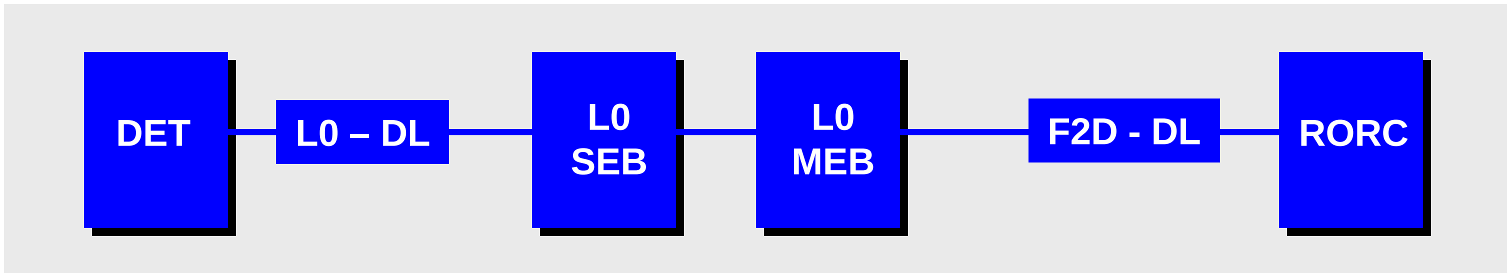


MODELLING THE SDD READOUT ELECTRONICS

FUNCTIONAL VIEW

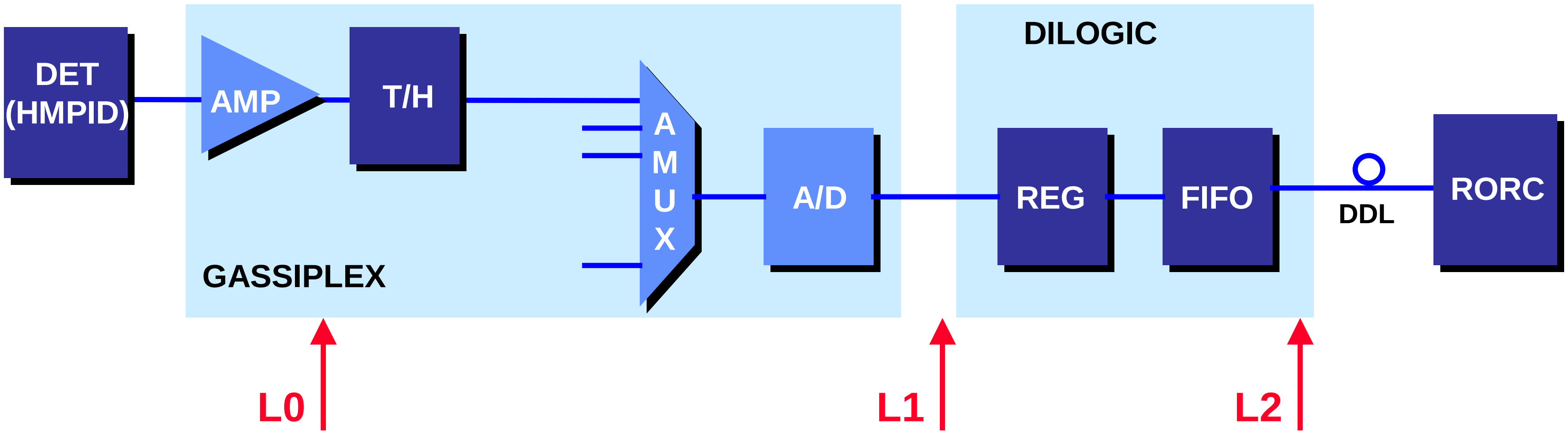


ABSTRACT VIEW

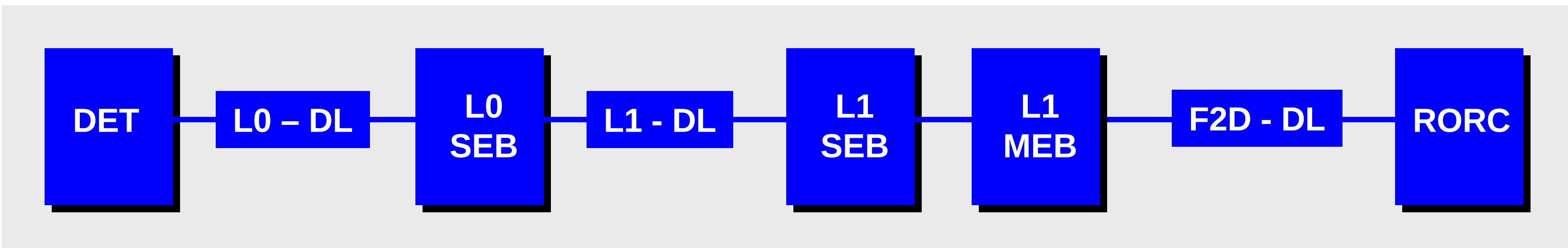


MODELLING THE HMPID READOUT ELECTRONICS

FUNCTIONAL VIEW

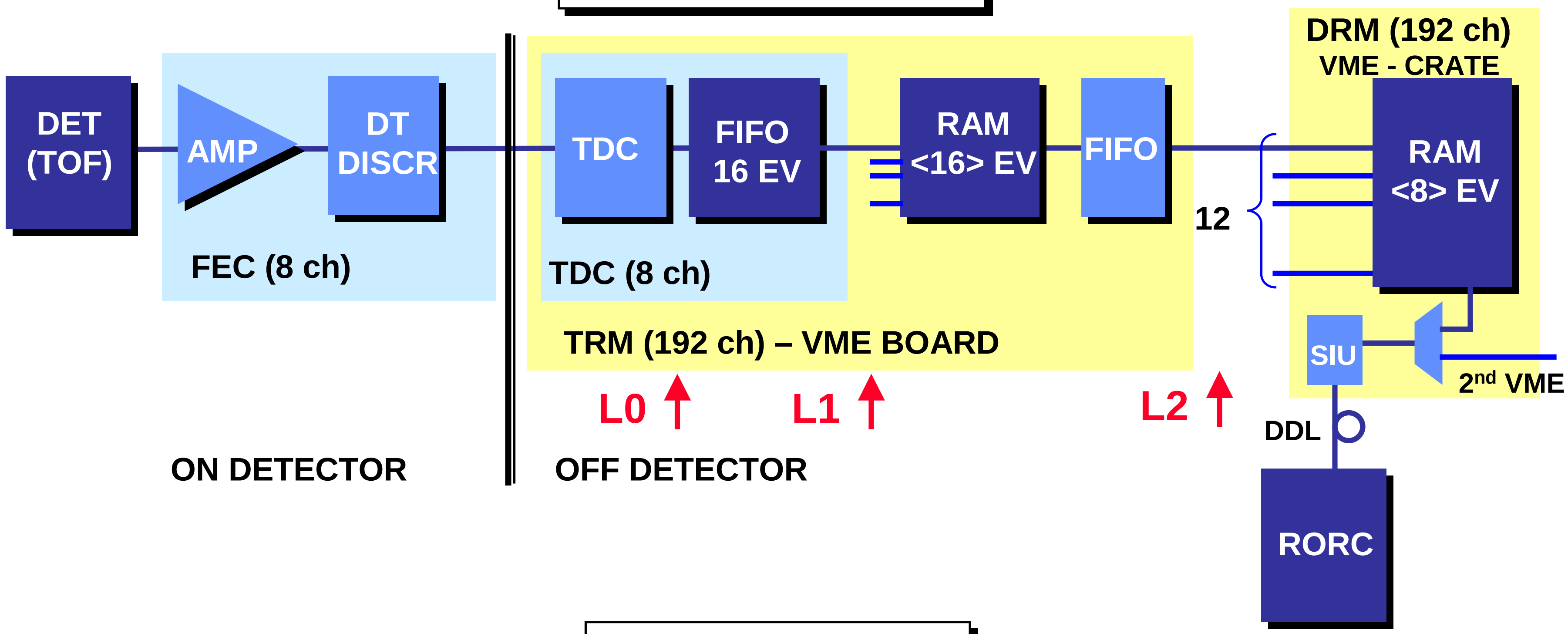


ABSTRACT VIEW

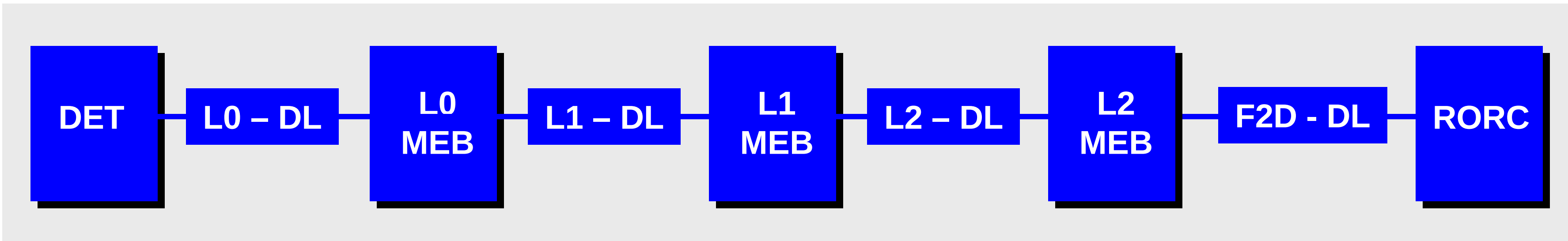


MODELLING THE TOF READOUT ELECTRONICS

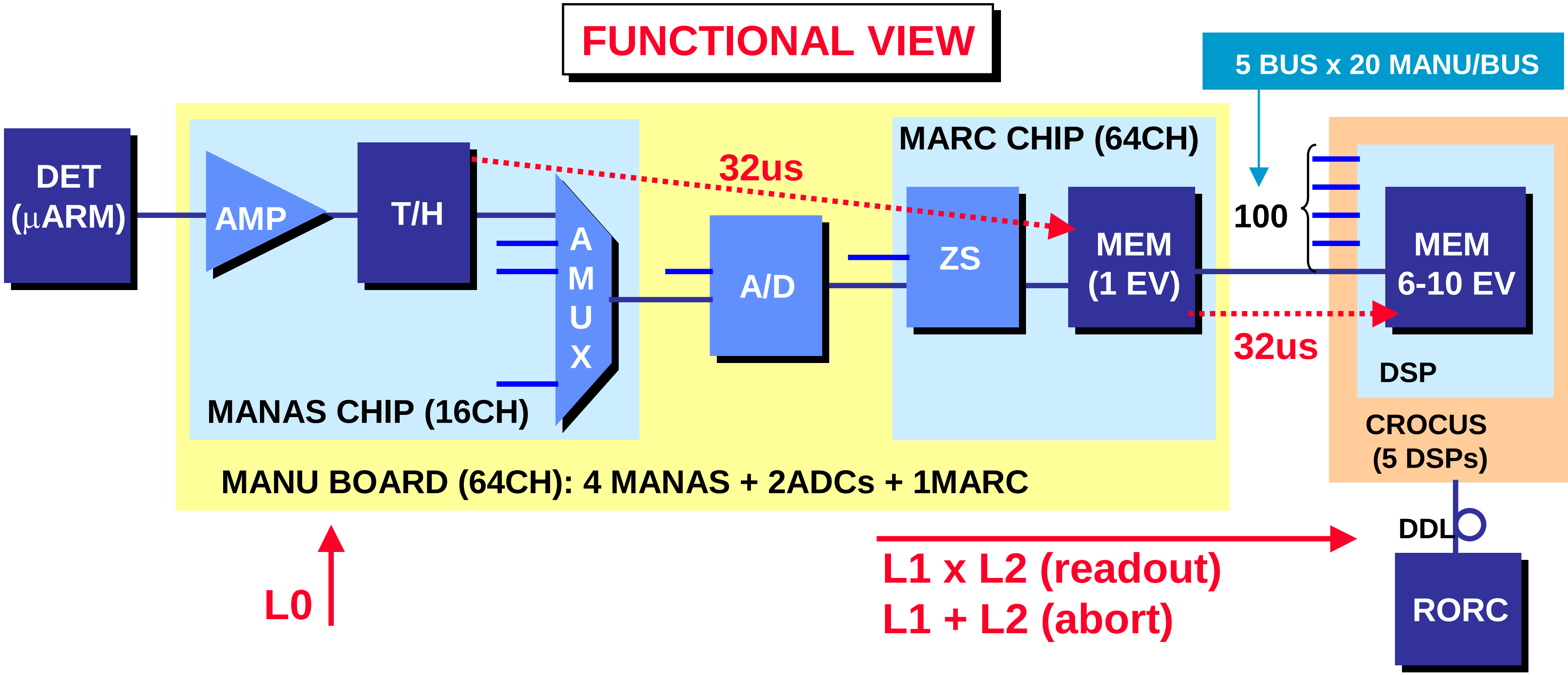
FUNCTIONAL VIEW

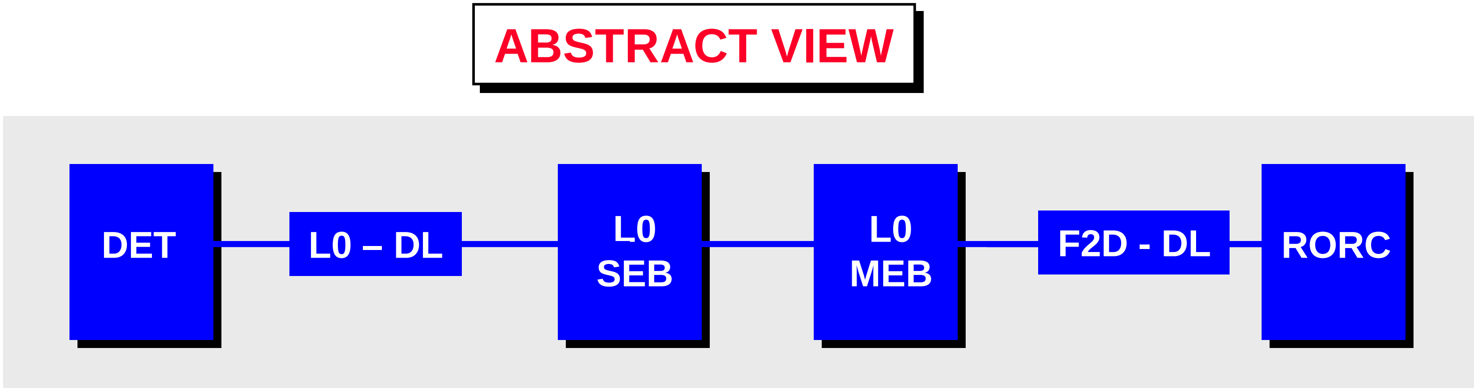


ABSTRACT VIEW

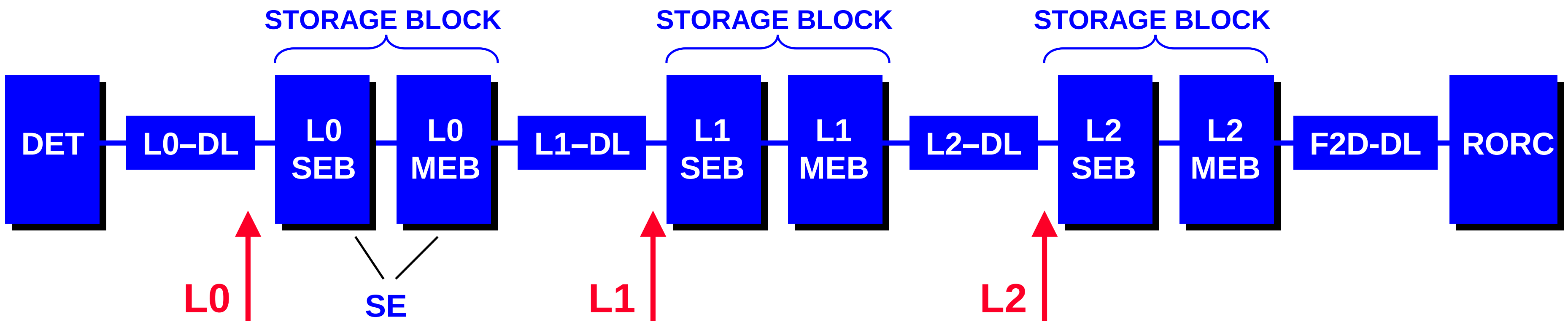


MODELLING THE MUON ARM READOUT ELECTRONICS





MODEL FOR THE ALICE READOUT ELECTRONICS (1/2)



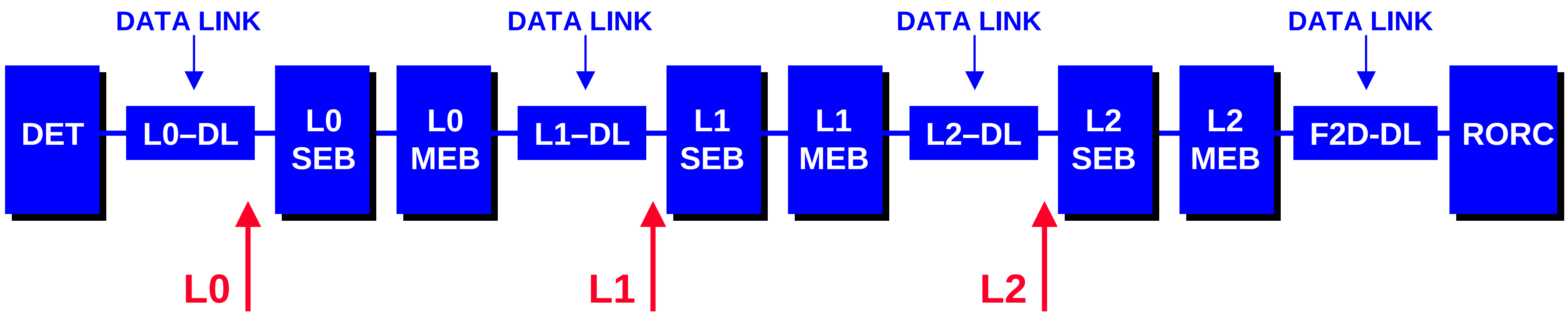
Data flows from the **Detector** (Data Source) to the **RORC** (Data Destination) through a number of analogue and digital **Storage Blocks** (SB). The Storage Blocks are organized in three levels: L0, L1 and L2. Upon arrival of the trigger signal, data is registered in the corresponding Storage Block.

Each storage block is composed by two **Storage Element**s (**SE**): a Single Event Buffer (**SEB**), which has the capacity to store a single event, and a Multi Event Buffer (**MEB**), which has the capacity to store several events.

The Storage Elements can be either analogue (track/hold, switched capacitors, etc.) or digital (flip-flop, RAM, FIFO, Circular Buffer, etc.). Each **Storage Element** will be characterized by the following parameters:

- **Capacity** (**CY**): the number of events it can contain
- **Input Latency** (**IL**): time to input an event in the SE
- **Output Latency** (**OL**): time to output an event form the SE
- **Reset Time** (**RT**): time to clear the SE after the event has been output or after a trigger abort

MODEL FOR THE ALICE READOUT ELECTRONICS (2/2)



Subsequent Storage Blocks are linked by a **Data Link** (**DL**). There are in general four DLs: the level-0 DL (**L0-DL**), the level-1 DL (**L1-DL**), the level-2 DL (**L2-DL**) and the Front-end to DAQ DL (**F2D-DL**). The DL is characterized by its **Transmission Latency** (**TL**).

The **IL**, **OL** and **TL** parameters depend in general on the **Data Volume** (DV).

Other relevant parameters, for the characterization of the readout model, are the type and the input/output mechanism of the MEB.

MEB TYPE:

1. **Fixed Length Buffer** (**FL**)
2. **Variable Length Buffer** (**VL**)

I/O Mechanism. Two main schemes seem, so far, representative of all those employed in the different ALICE sub-detectors.

1. **Random Access** (**RA**)
2. **First-In First-Out** (**FIFO**)

MODEL FOR THE ALICE READOUT ELECTRONICS (2/4)

TPC (L. Musa)

		DL (μs)	ES	Y/N	CPY (Nr. Ev.)	IL (us)	OL (us)	RT (us)	TL (us)	I/O TYPE
DETECTOR		**88**	**1 MB**							
L0	**SEB**			NA						
	MEB			NA						
	DL			NA						
L1	**SEB**			NA						
	MEB				8	0	5000	0		FL/RA
	DL									
L2	**SEB**			NA						
	MEB			NA						
	DL			NA						
F2D-DL									0.1	

HMPID (P. Martinengo)

		DL (μs)	ES	Y/N	CPY (Nr. Ev.)	IL (us)	OL (us)	RT (us)	TL (us)	I/O TYPE
DETECTOR										
L0	**SEB**				1	0	4.8	0.2		
	MEB			NA						
	DL								0	
L1	**SEB**				1	0	<8.2>	0		
	MEB				4000	0	?	0		VL/FIFO
	DL								0.1	
L2	**SEB**			NA						
	MEB			NA						
	DL			NA						
F2D-DL									0.1	

Preliminary!

DESCRIPTION OF THE DETECTOR READOUT (1/4)

SPD (A. Kluge)

		DL (μs)	ES	Y/N	CPY (Nr. Ev.)	IL (us)	OL (us)	RT (us)	TL (us)	I/O TYPE
DETECTOR		0	?							
L0	SEB			NA						
	MEB			NA						
	DL			NA						
L1	SEB			NA						
	MEB				4	0	0.1	0		FL/FIFO
	DL									
L2	SEB				1	0	256	0		
	MEB				10	0	384	0		VL/FIFO
	DL								0.2	
F2D-DL									0.1	

Preliminary!

SDD (F. Tosello)

		DL (μs)	ES	Y/N	CPY (Nr. Ev.)	IL (us)	OL (us)	RT (us)	TL (us)	I/O TYPE
DETECTOR		4	?							
L0	SEB				1	0	250	0.2		
	MEB				4	0	1600	0.3		
	DL								0	
L1	SEB			NA						
	MEB			NA						
	DL			NA						
L2	SEB			NA						
	MEB			NA						
	DL			NA						
F2D-DL									0.1	

Preliminary!

DESCRIPTION OF THE DETECTOR READOUT (1/4)

MUON ARM (P. Courtart)

		DL (µs)	ES	Y/N	CPY (Nr. Ev.)	IL (us)	OL (us)	RT (us)	TL (us)	I/O TYPE
DETECTOR		0	?							
L0	SEB					0	32	0		
L0	MEB				6-10	32	?	0		VL/RA
L0	DL								0	
L1	SEB			NA						
L1	MEB			NA						
L1	DL			NA						
L2	SEB			NA						
L2	MEB			NA						
L2	DL			NA						
F2D-DL									1	

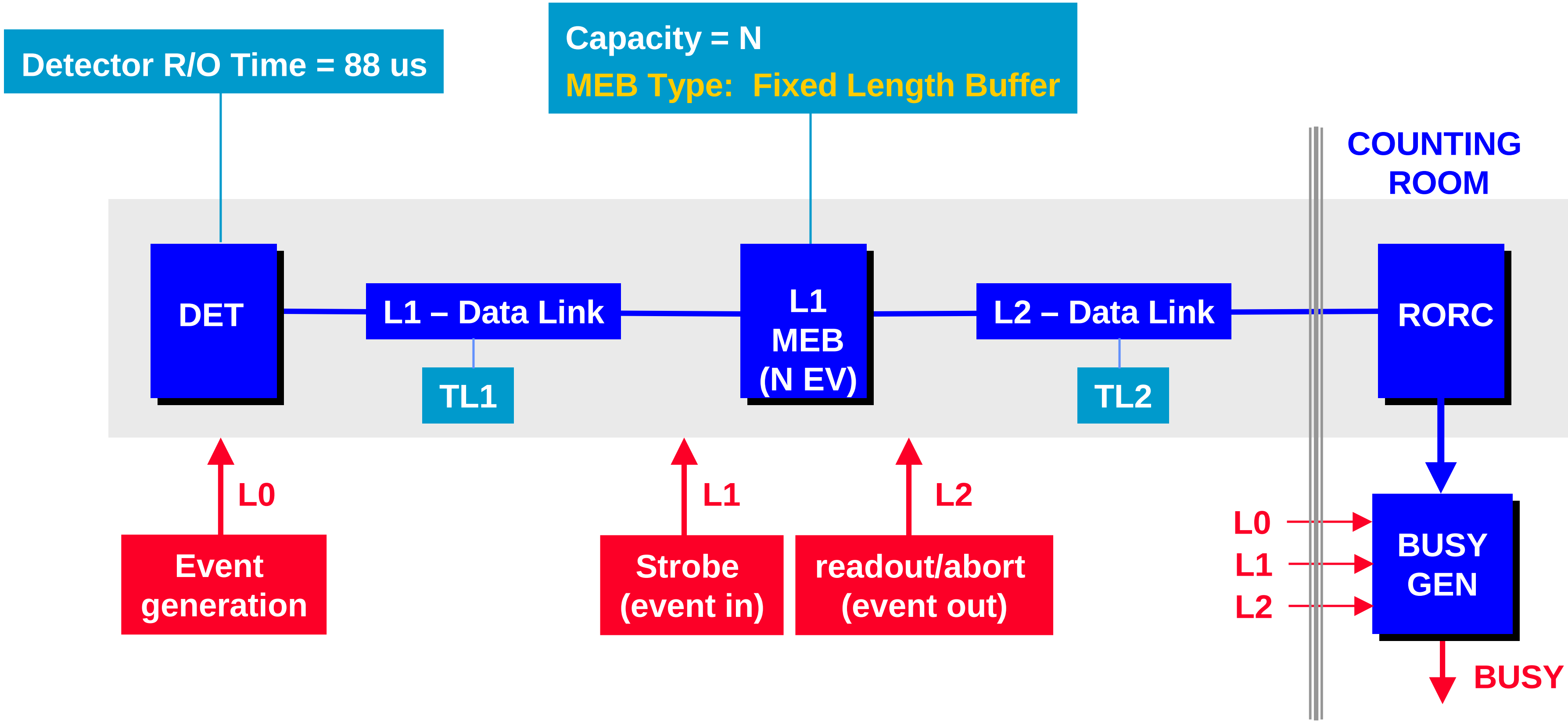
Preliminary!

TOF (F. Cindolo)

		DL (µs)	ES	Y/N	CPY (Nr. Ev.)	IL (us)	OL (us)	RT (us)	TL (us)	I/O TYPE
DETECTOR										
L0	SEB			NA						
L0	MEB				16	0.1	3	0		FL/FIFO
L0	DL								0	
L1	SEB			NA						
L1	MEB				<16>	0	<60>	0		VL/FIFO
L1	DL								0.1	
L2	SEB			NA						
L2	MEB			NA						
L2	DL			NA						
F2D-DL									0.1	

Preliminary!

GENERATION OF THE BUSY SIGNAL



The system is busy when:

- after L0 for a time interval equal to the Detector Readout Time
- L1- MEB full

L1-MEB is full if: (Nr. of L2/accept) – (Nr. Of Events in RORC) = N