TriDAS
for KM3-ITA detector
(aka Phase 3)

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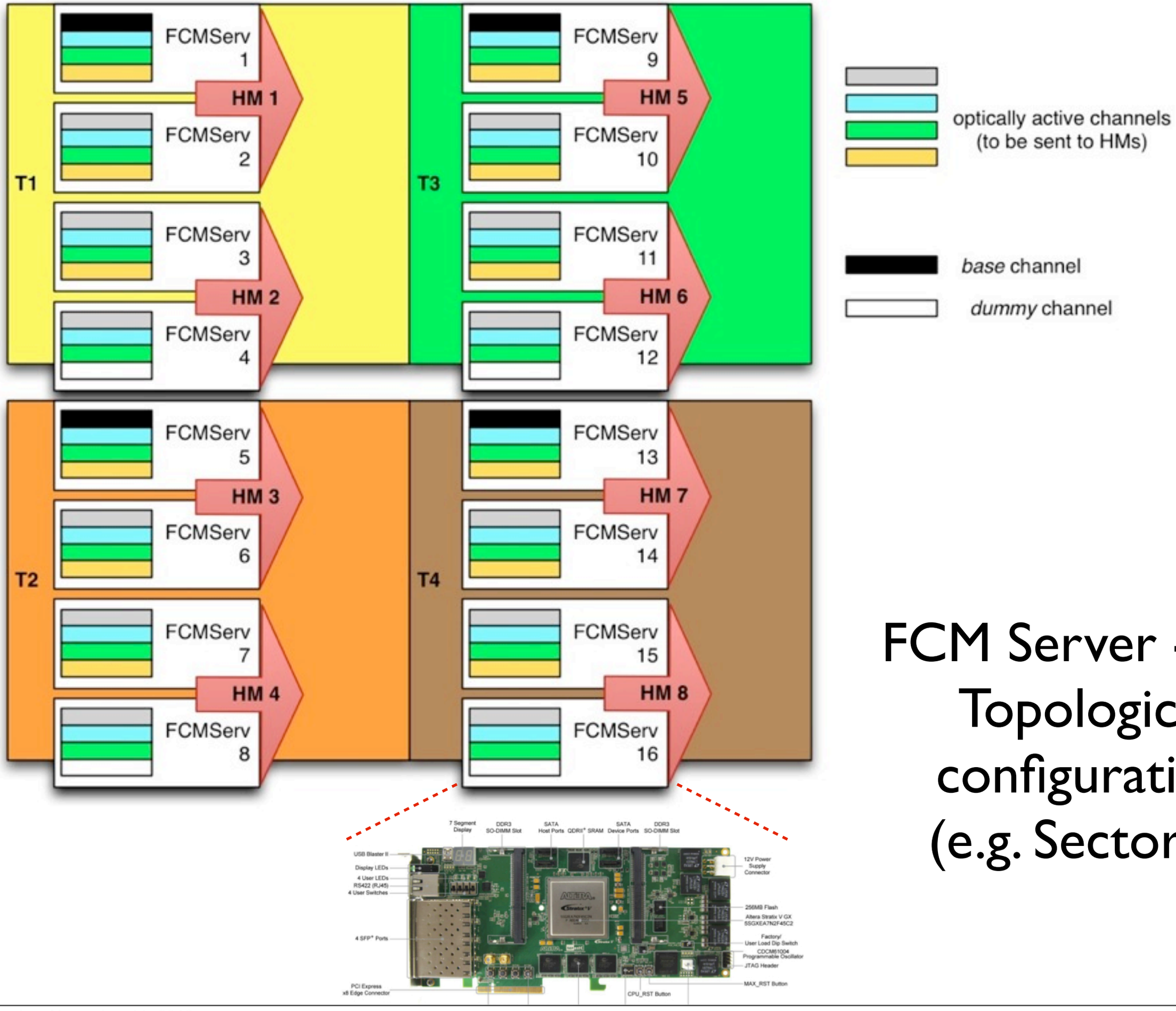
for the On-shore station WG

KM3 - SC Meeting - ROMA 11/11/2013



FCM Server - HM Topological configuration (e.g. Sector 1)

HM

I HM to serve ½ of a KM3-ITA tower,
i.e. to receive data from 2 FCMServer

20 HMs for prompt fault solutions

HM input throughput (Gbps)	HM output throughput (Gbps)
2(4) FMCserver/HM x 1 Gbps = 2(4)	2-4

TCPU

REVISED

Simple conservative consi
- From a trivial rescali ase 2 (2 TCPU) such as having 8 independent DAQs → CPUs (factor 2.6/Tower)

conse ive:
50 Us
(multi rocesses)

REVISED

TCPU input throughput (Gbps)	TCPU output throughput (Mbps)
≤ 10	< 2

EM

Let's do very conservative assumptions:

i) continuous single hit rate : 150 kHz / PMT
ii) muon trigger rate: 800 Hz
iii) hit size: 200 bit
iv) event window duration: 6 μs

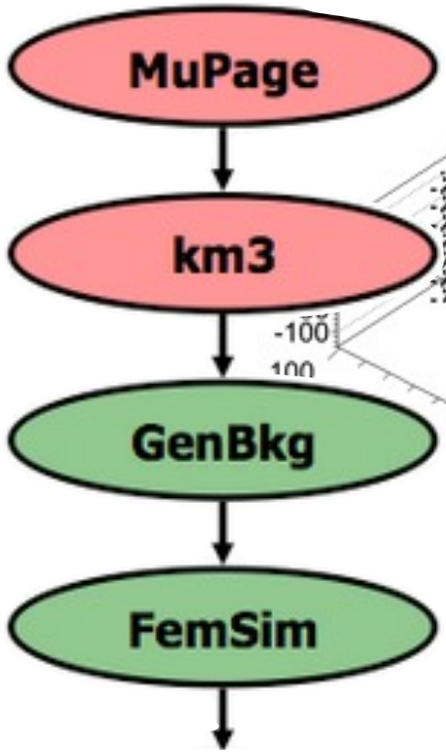
EM input throughput (MBps)	EM output throughput (MBps)
≤ 12	< 12

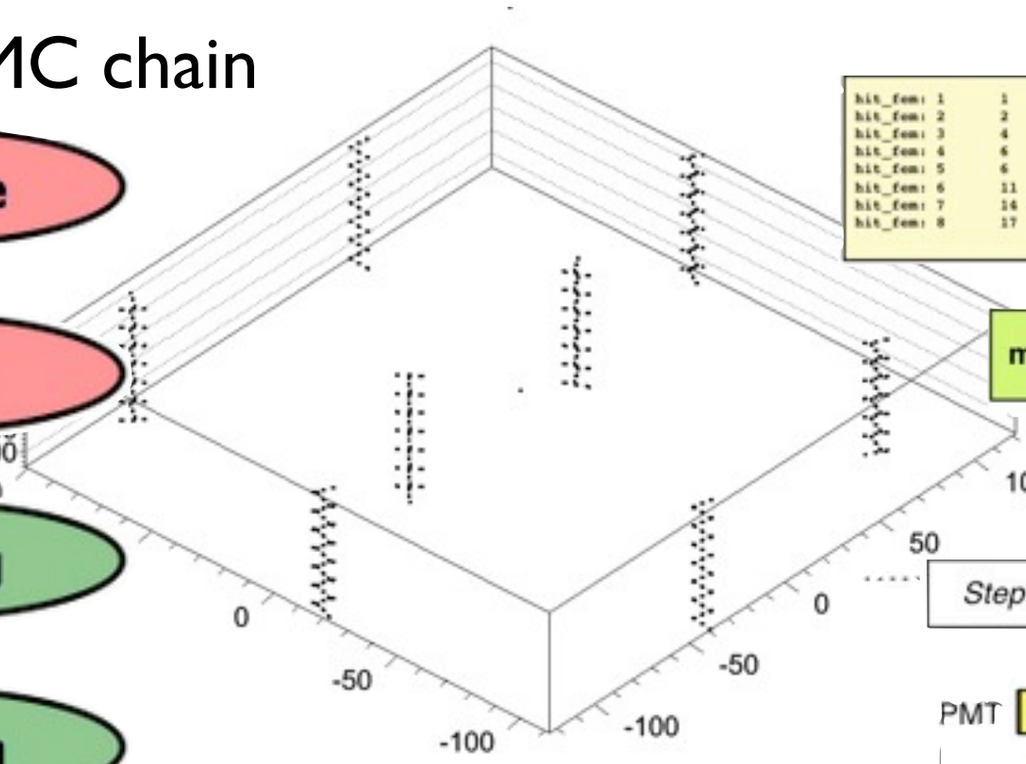
Dimensioning the TCPU procs

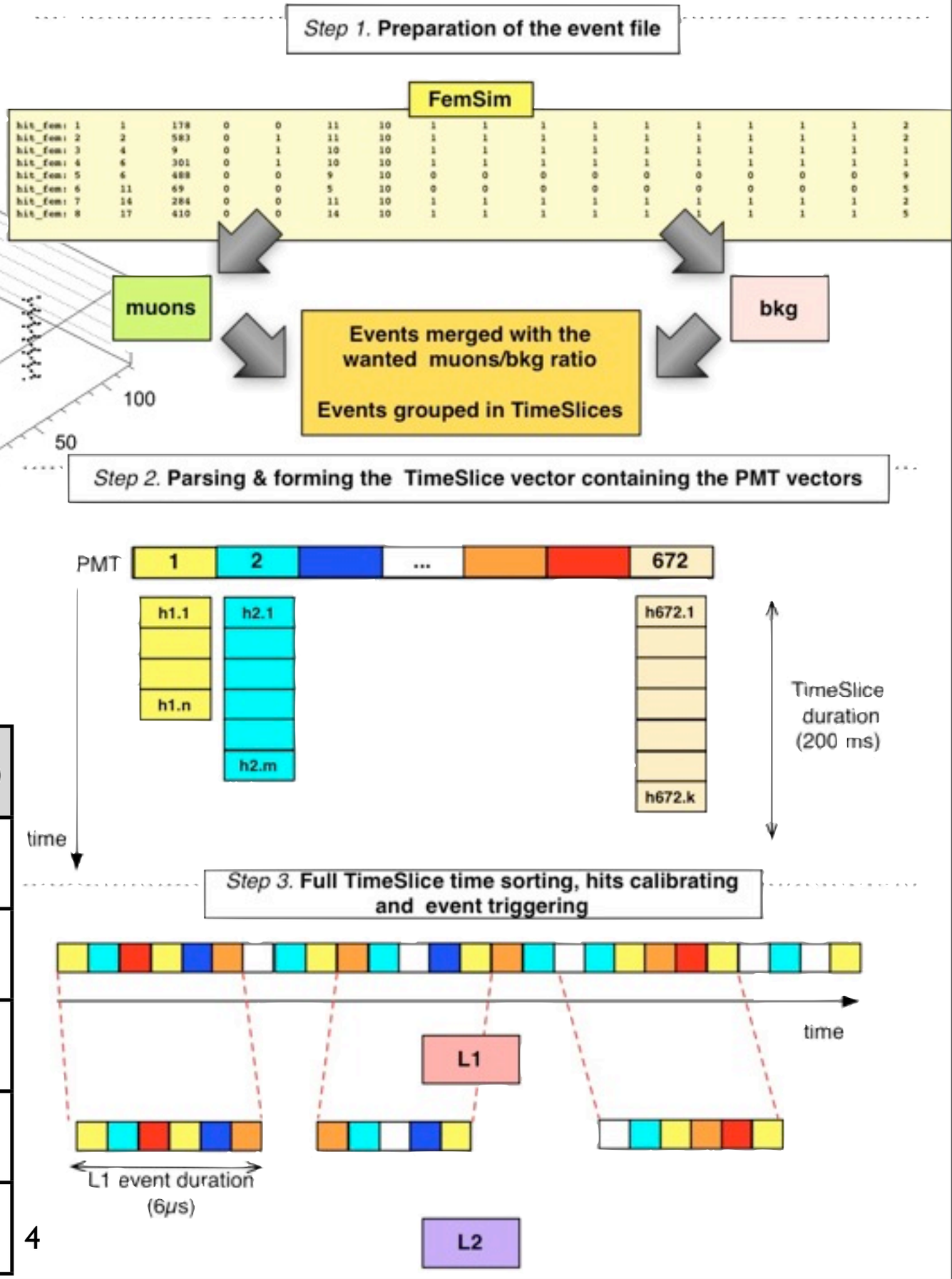
with M. Manzali, F. Giacomini (CNAF), L. Fusco (Sez. BO)

(see Internal Note @ Indico)

Std. NEMO MC chain

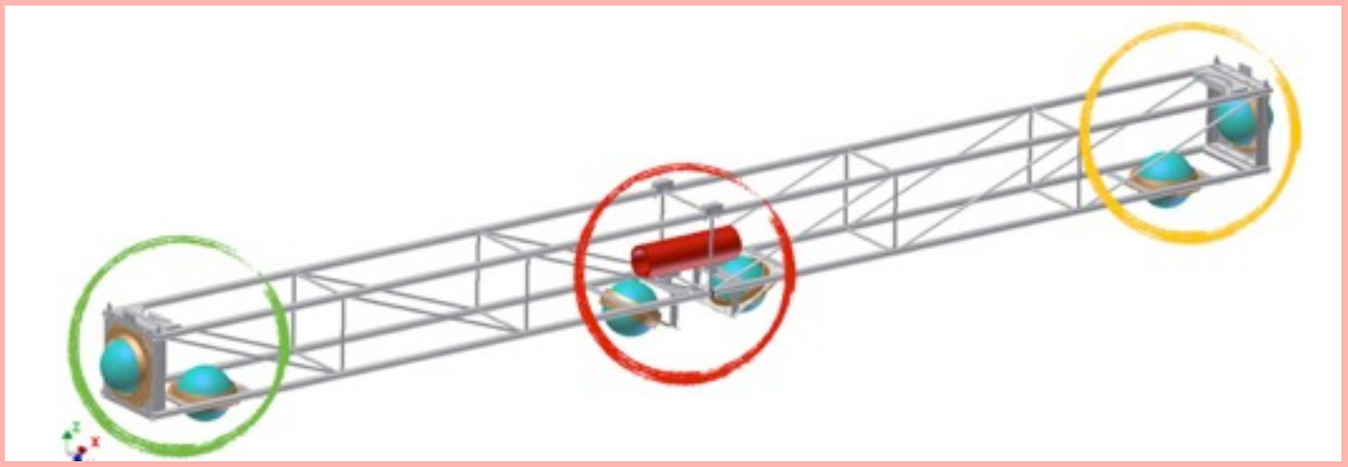




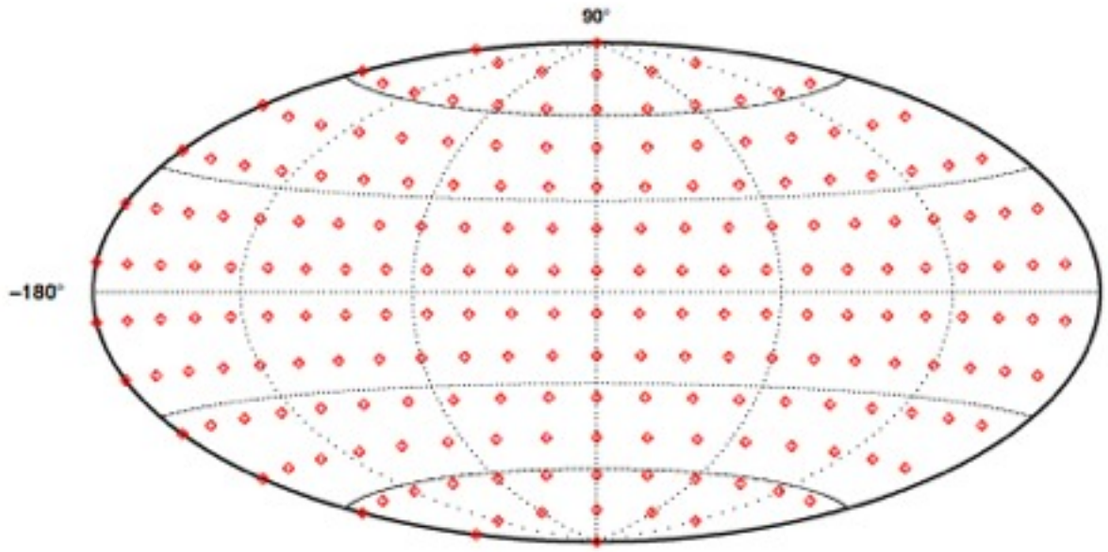


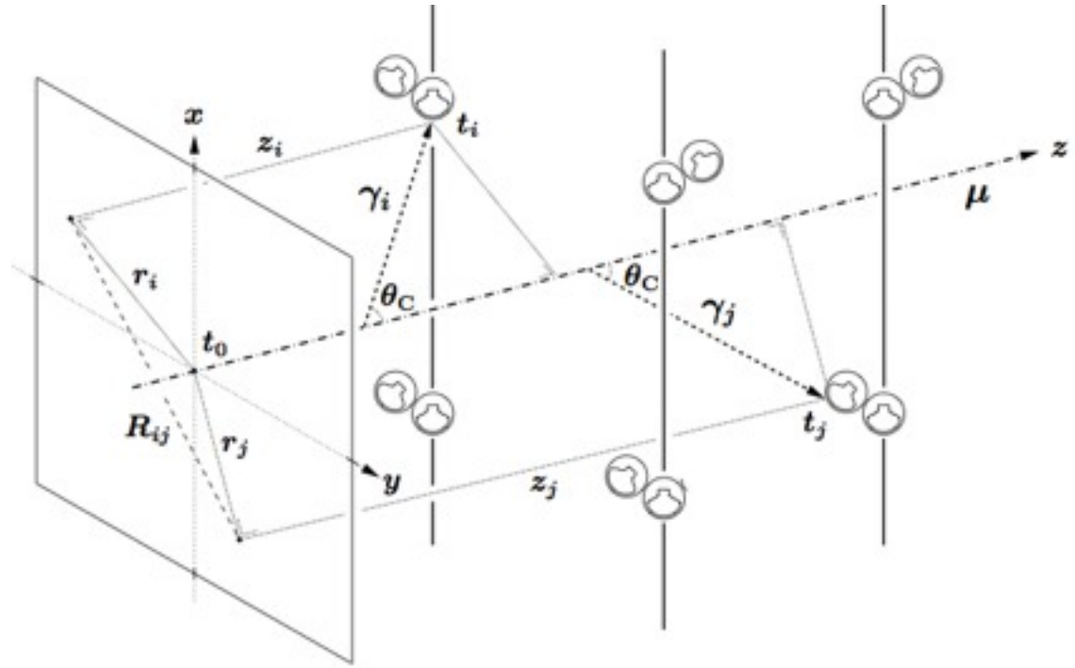
	APPROACH	rate μ (Hz)	rate BKG (kHz)
A	Realistic	27	50
B	Hardly realistic	270	50
C	Condensed	25×10^3	50
D	Heavy BKG	27	110
E	Heavy BKG Hardly Realistic	270	110

L_1 and L_2 Trigger algorithms



If
$\Delta t \leq 20$ ns → **L1**





$$|(t_i - t_j)c - (z_i - z_j)| \leq \tan\theta_c \sqrt{[(x_i - x_j)^2 + (y_i - y_j)^2]} = \tan\theta_c \, |R_{ij}|$$

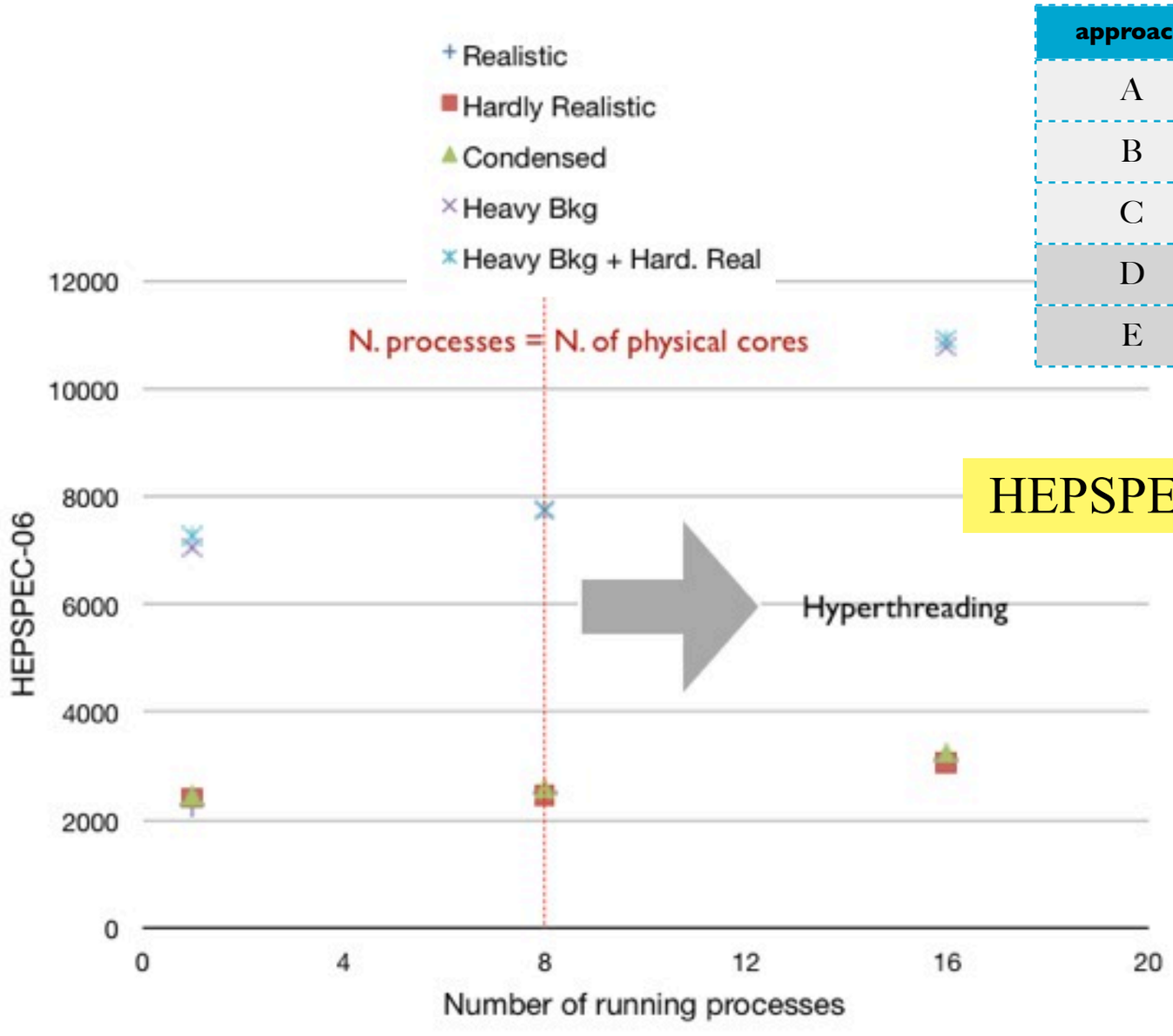
If # L_1 hits satisfying ≥ 5 → **L2**

```
Hostname: wn-204-03-25-02-b.cr.cnaf.infn.it
OS: Scientific Linux release 6.4 (Carbon)
Kernel: 2.6.32-358.18.1.el6.x86_64
CPU type: Intel(R) Xeon(R) CPU E5520  @ 2.27GHz
Cores: 8 x 2    (2 CPU ->  4 Core/CPU)
CPU MHz: 2268.000
Cache size: 8192 KB
Memory: 24 GB
HEPSPEC version: hs06 sl6-32bit (hyperthreading on)
HEPSPEC score: 128.12
```

BENCHMARKED WORKER-NODE

- $T_p + T_{ma}$: **parsing data from the TimeSlice file** and **allocating the necessary memory** to host all the hits in a TimeSlice;
- T_{cal} : **calibrating** the hits ;
- T_{sort} : **time-sorting** all the the hits of each TimeSlice;
- T_{L1} and T_{L2} : **applying the L_1 and L_2** trigger level;
- $T_{HM} = 175$ ms

$$T_{tot} = T_{HM} + T_{ma} + T_{ca} + T_{sort} + T_{L1} + T_{L2}$$



approach	$T_p + T_{ma}$ (ms)	T_{ca} (ms)	T_{sort} (ms)	T_{L1} (ms)	T_{L2} (ms)
A	11280 ± 123	61 ± 1	1176 ± 12	596 ± 7	171 ± 2
B	11251 ± 118	57 ± 1	1167 ± 12	588 ± 7	174 ± 2
C	11318 ± 111	57 ± 1	1146 ±11	579 ± 6	400 ± 4
D	24792 ± 227	134 ± 2	2626 ± 24	1693 ± 18	5526 ± 49
E	24904 ± 212	139 ± 2	2624 ± 21	1685 ± 17	5529 ± 46

$$\text{HEPSPEC-06} = \text{HEPSPEC-06}_{\text{SCORE}} \times T_{tot} \times (\Delta T_{TS})^{-1}$$

approach	T_{tot} (ms)	HEPSPEC-06	N. TCPU processes
A	3880 ± 23	2483 ± 15	**20**
B	3862 ± 22	2472 ± 14	**20**
C	4058 ± 21	2597 ± 13	**21**
D	12064 ± 60	7721 ± 38	**61**
E	12062 ± 56	7720 ± 36	**61**

N. machines ? ← constraints from
CPU power + MEMORY (3 GB RAM/core; 10-16 HEPSPEC/Core).

- Note: 1 TS size: ranging within **180 - 400 MB/TS.**
- Further triggers, beyond the muon tracks - (**) memory consuming
  - showers
  - monopoles (**)
  - Galactic center
  - sources
  - transient phaenomena (follow-up triggers) (**)

- **Limit to 2 the number of processes / server**.
- each process will be **multithreading** → probable strong **parallelism among L2 triggers**

- the computing power scales if the n. processes (or threads) does not exceed the n. of physical cores.
- 24 GB di RAM could allow us to buffer about 30 secs (in the realistic case) . Probably necessary to do I/O to solid /state memory.

TCPU

Template server: 128 HEPSPEC/server (8 core, 24 GB RAM)

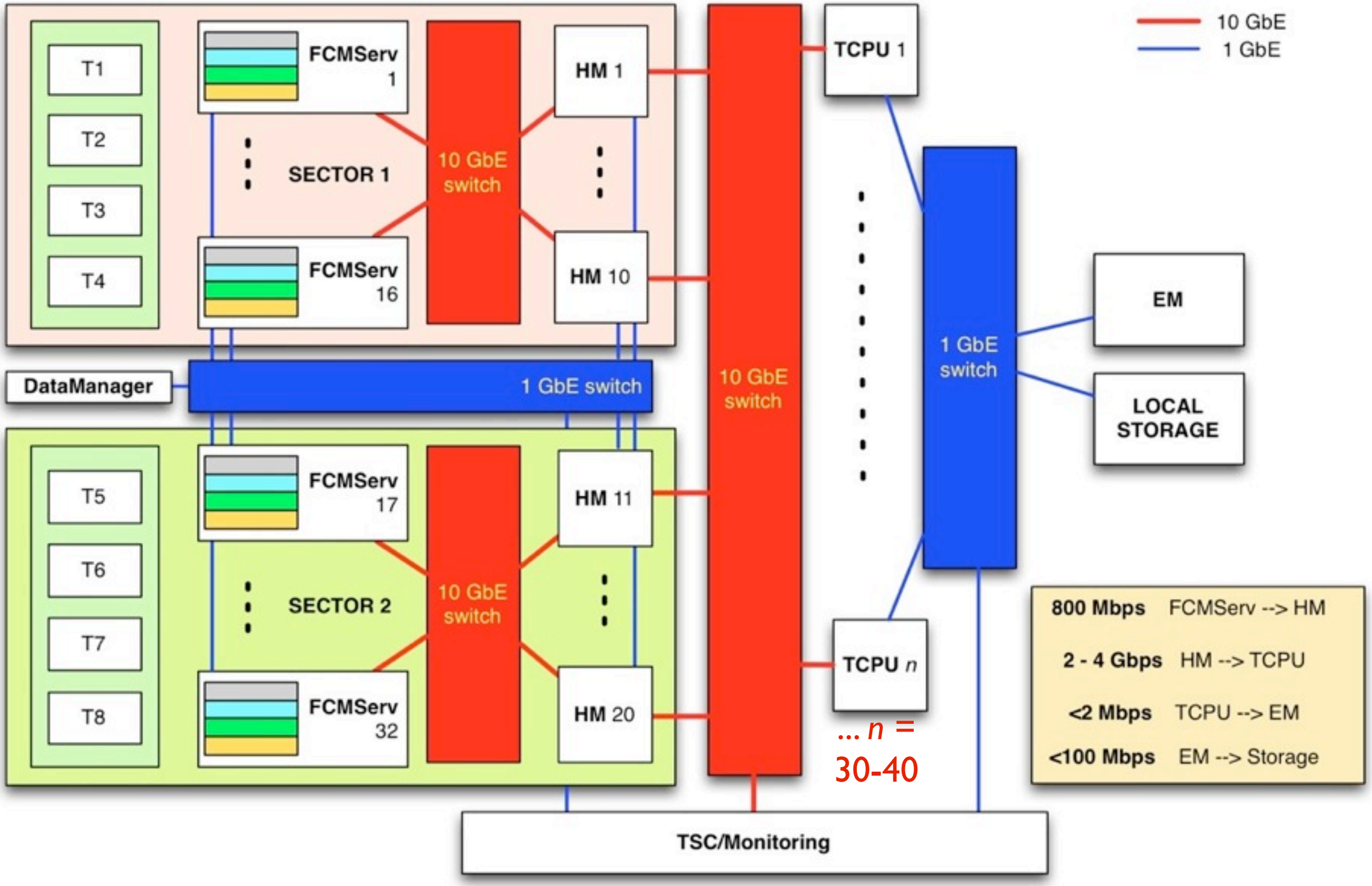
TCPU input throughput (Gbps)	TCPU output throughput (Mbps)
≤ 10	< 2

NEW

conservative:
30-40 TCPUs
(multi processes)

On shore DAQ networking 1/4

Basic Configuration



SWITCHES ...

- all ports non blocking
- latencies ~ few μs

DELL option

Variant	Sector Switch (x 2)	Trigger Switch (x1)	Cost	Power Cons. (kW)
Basic Config.	S4810	Z9000 (32 ports @ 40 Gbps → 128 ports 10 Gbps con breakout)	76	<2
Variant 3	Z9000 (32 ports @ 40 Gbps → 128 ports 10 Gbps con breakout)		50	1

Pros : it is about the cheapest solution, simple stand alone solution
Cons : not expandable, not redundancies

DELL Z4810

DELL Z9000

HP option

Variant	Sector Switch (x 2)	Trigger Switch (x1)	Cost (k€)	Power Cons. (kW)
Basic Config.	HP 5900 (48 port 10 GbE not blocking);	HP 10504 modular -slot 32 port 10GbE -slot 48 port 10GbE	64	0.6 + 2.5
Variant 3	HP 10504 modular 128 port (exp. >70)		70	<4

Pros : each optical port costs 337 € (the cheapest available in the market **and present in CONSIP**)
Cons : HP is new in switch production.

HP 5900

HP 10504

CISCO option

Variant	Sector Switch (x 2)	Trigger Switch (x1)	Cost (k€)	Power Cons. (kW)
Basic Config.	Nexus 5548 with 32 10GbE Ports	Nexus 7009 with 2 slot F2-Series 48 Port 1/10G (SFP+)	140	5
Variant 3	Nexus 7009 with 3 slot *F2e* non-blocking 10 GbE 48 port		140	5

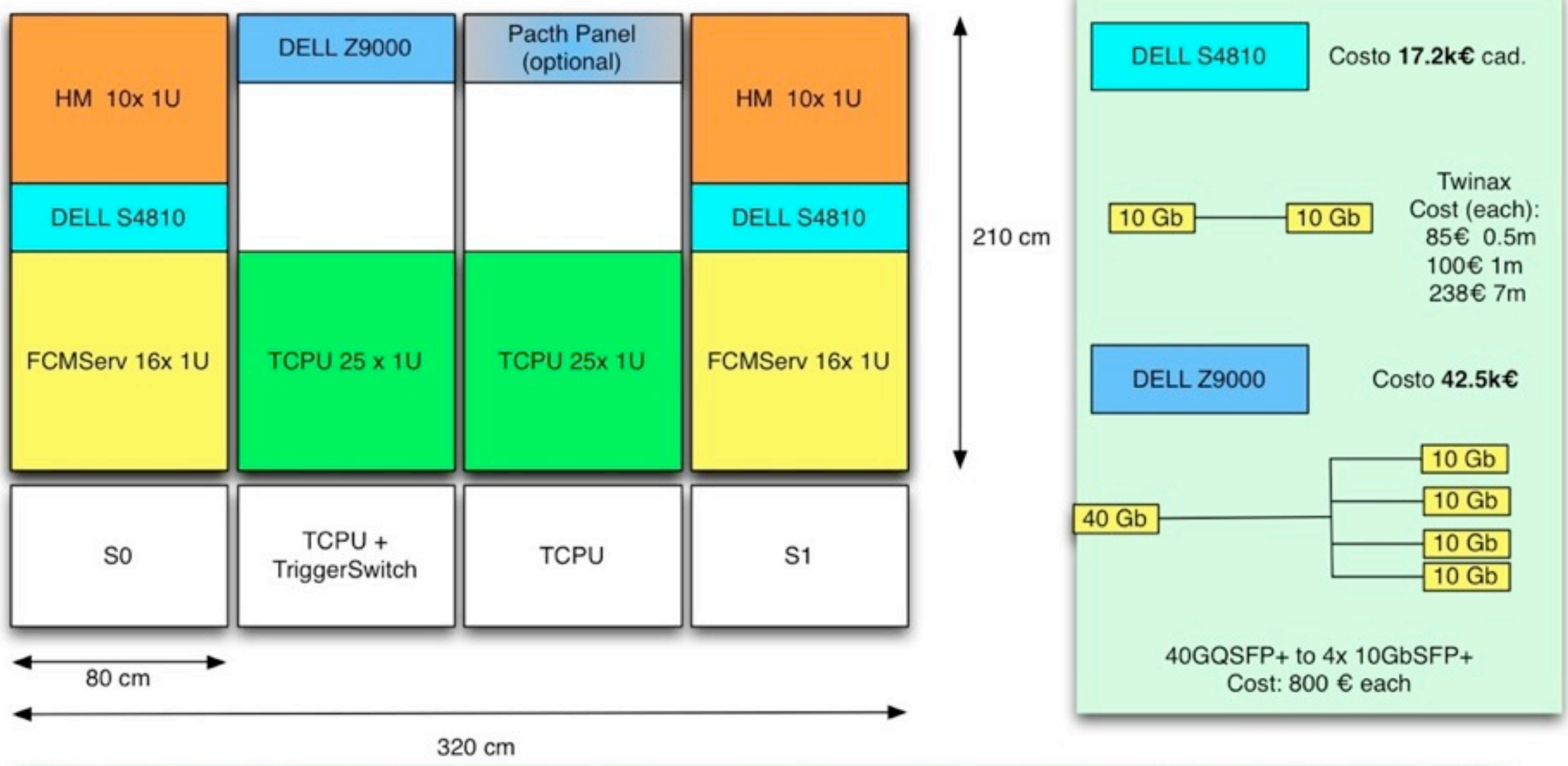
Pros : completely reliable, redundant, quick aid intervention (within 8h from the call) package for 1 year, expandable for a detector rescaling.
Cons : it is expected to be about twice more expensive with respect to the other solutions.

CISCO Nexus 5548

CISCO Nexus 7009

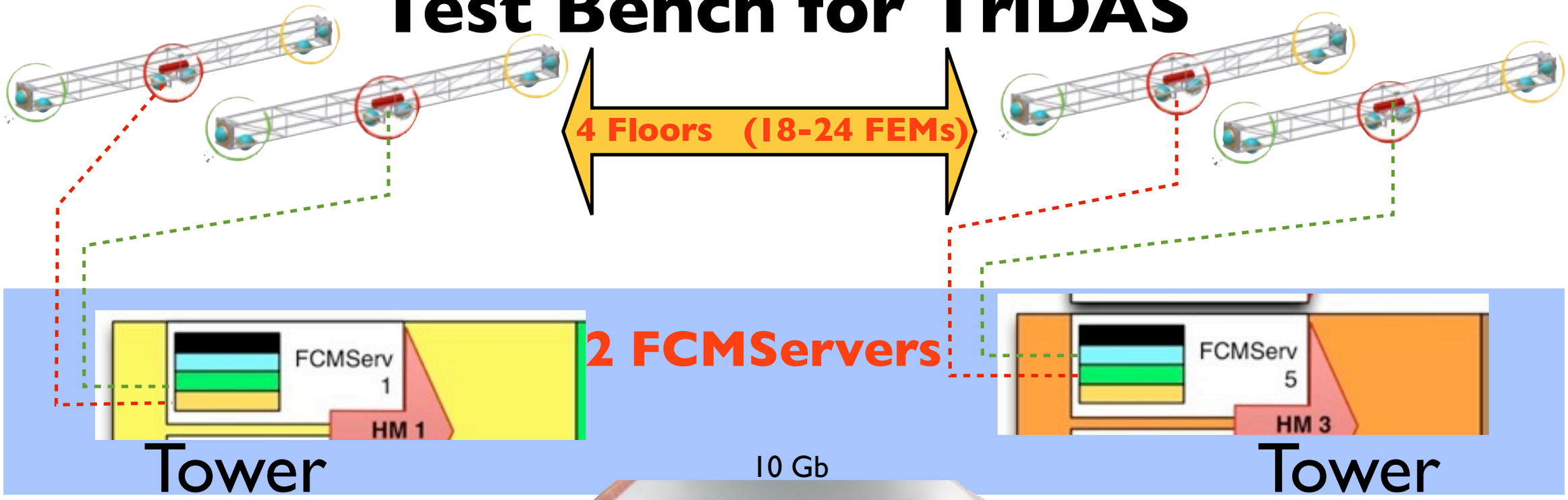
Possible solution and rack assembling

S. Zani of CNAF is contributing to define the technical specifications



COMPUTING	n. node	n. node / server	n. server	cost server (€)	sub total (€)
FCMServer	32	1	32	2500	80000
HM	20	4	5	11735	58675
TCPU	40	4	10	13555	135550
TSC+EM	2	2	1	5000	5000
					279225
ASIC	*n. ASIC*	*n. ASIC/server*		*ASIC cost (€)*	*costo tot (€)*
Terasic	32	1		3000	96000
					96000
SWITCH	*n. switch*			*costo switch (€)*	*costo totale (€)*
Dell z4810	2			17200	34400
Dell z9000	1			42500	42500
					76900
CAVI	*n. cavi*	*n. nodi/cavo*		*costo cavo (€)*	*costo tot (€)*
diretti 10 Gb preintestati	52	1		100	5200
Breakd. 10 Gb preintestati	60	4		800	12000
					17200
GRAND TOTAL					469325

Test Bench for TriDAS



e.g. Fujitsu - XG2000
(min 8 ports)

2 HM + 2 TCPU + 1 TSC + 1 EM

COMPUTING	*n. node*	*n. node / server*	*n. server*	*cost server (€)*	*sub total (€)*
FCMServer	2	1	2	2500	5000
2 HM + 2 TCPU	4	4	1	11735	11735
TSC+EM	2	2	1	5000	5000
					21735
ASIC	*n. ASIC*	*n. ASIC/server*		*ASIC cost (€)*	*costo tot (€)*
Terasic	2	1		3000	6000
					6000
SWITCH	*n. switch*			*costo switch (€)*	*costo totale (€)*
Dell z4810	1			3000	3000
					3000
CAVI	*n. cavi*	*n. nodi/cavo*		*costo cavo (€)*	*costo tot (€)*
diretti 10 Gb preintestati	6	1		100	600
					600
GRAND TOTAL					**31335**

SPARES

TriDAS & C. data flow