Paper model results

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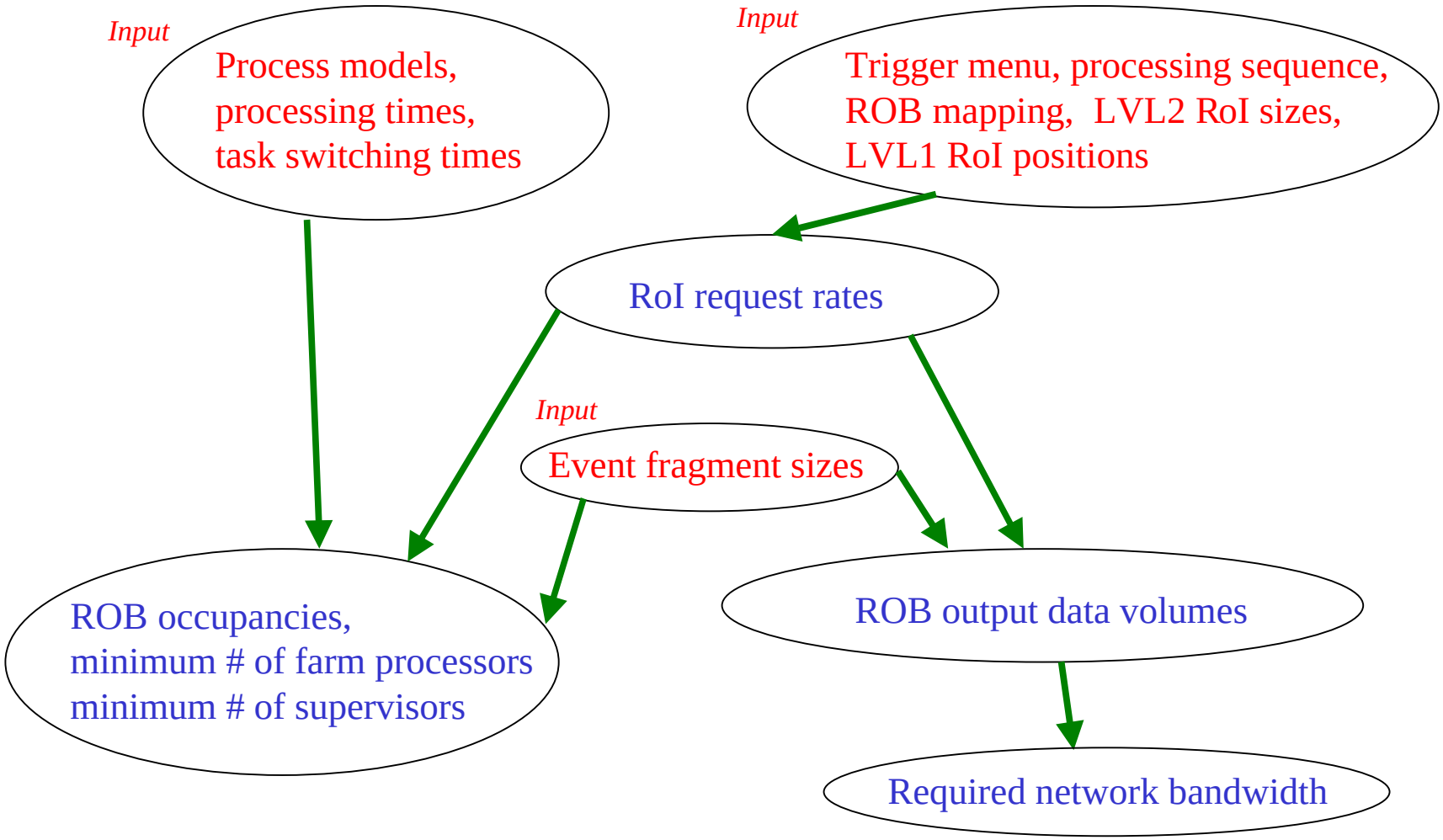


Low luminosity menu, rates in Hz (com-daq-99-010)

#1	**MU6**	**23000**
#2	**2*MU6**	**1000**
#3	MU6 + EM15I	60
#4	MU6 + EM20I	24
#5	MU6 + 2*EM15I	2.3
#6	MU6 + J180	1.3
#7	MU6 + 3*J75	2.8
#8	MU 6 + 4*J55	2.8
#9	**EM20I**	**11500**
#10	**2*EM15I**	**1600**
#11	EM20I + 4*J55	68
#12	2*EM15 + 4*J55	180
#13	J180	25
#14	2*J180	42
#15	3*J180	4
#15	3*J75	107
#17	4*J75	10
#18	5*J75	1
#19	4*J55	131
#20	5*J55	17
#21	6*J55	3
#22	J180 + 2*J75	63
#23	J180 + 3*J75	15
#24	J180 + 4*J75	7
#25	J180 + 3*J55	28
#26	J180 + 4*J55	7
#27	J180 + 5*J55	2
#28	2*J180 + 2*J55	8
#29	2*J180 + 3*J55	3
#30	**TAU20 + XE30**	**1340**
#31	2*TAU20 + XE30	320
#32	3*TAU20 + XE30	110
#33	4*TAU20 + XE30	4.0
#34	5*TAU20 + XE30	2.0
#35	J50 + XE50	148
#36	2*J50 + XE50	31
#37	3*J50 + XE50	10
#38	4*J50 + TAU20 + XE30	16
#39	4*J50 + 2*TAU20 + XE30	7
#40	4*J50 + 3*TAU20 + XE30	7
#41	5*J50 + TAU20 + XE30	3
#42	5*J50 + 2*TAU20 + XE30	2
#43	J50 + TAU20 + XE50	100
#44	2*J50 + TAU20 + XE50	45
#45	3*J50 + TAU20 + XE50	45
#46	4*J50 + TAU20 + XE50	4
#47	J50 + 2*TAU20 + XE50	18
#48	2*J50 + 2*TAU20 + XE50	8
#49	3*J50 + 2*TAU20 + XE50	4
#50	4*J50 + 2*TAU20 + XE50	2
#51	J50 + 3*TAU20 + XE50	2
#52	2*J50 + 3*TAU20 + XE50	1
#53	3*J50 + 3*TAU20 + XE50	2
#54	4*J50 + 3*TAU20 + XE50	2
#55	5*J50 + 3*TAU20 + XE50	1

LVL1 rate : 40.1 kHz

Accept rate : 2kHz

Processing sequences for low luminosity menu

Muons :

- confirm in μ detector
- 75 % : confirm in tracker
- 40 % : TRT scan
- 40 % : SCT-pixel data analysis
- 40 % : 2.0 RoIs in calorimeter and μ detector

B-physics trigger

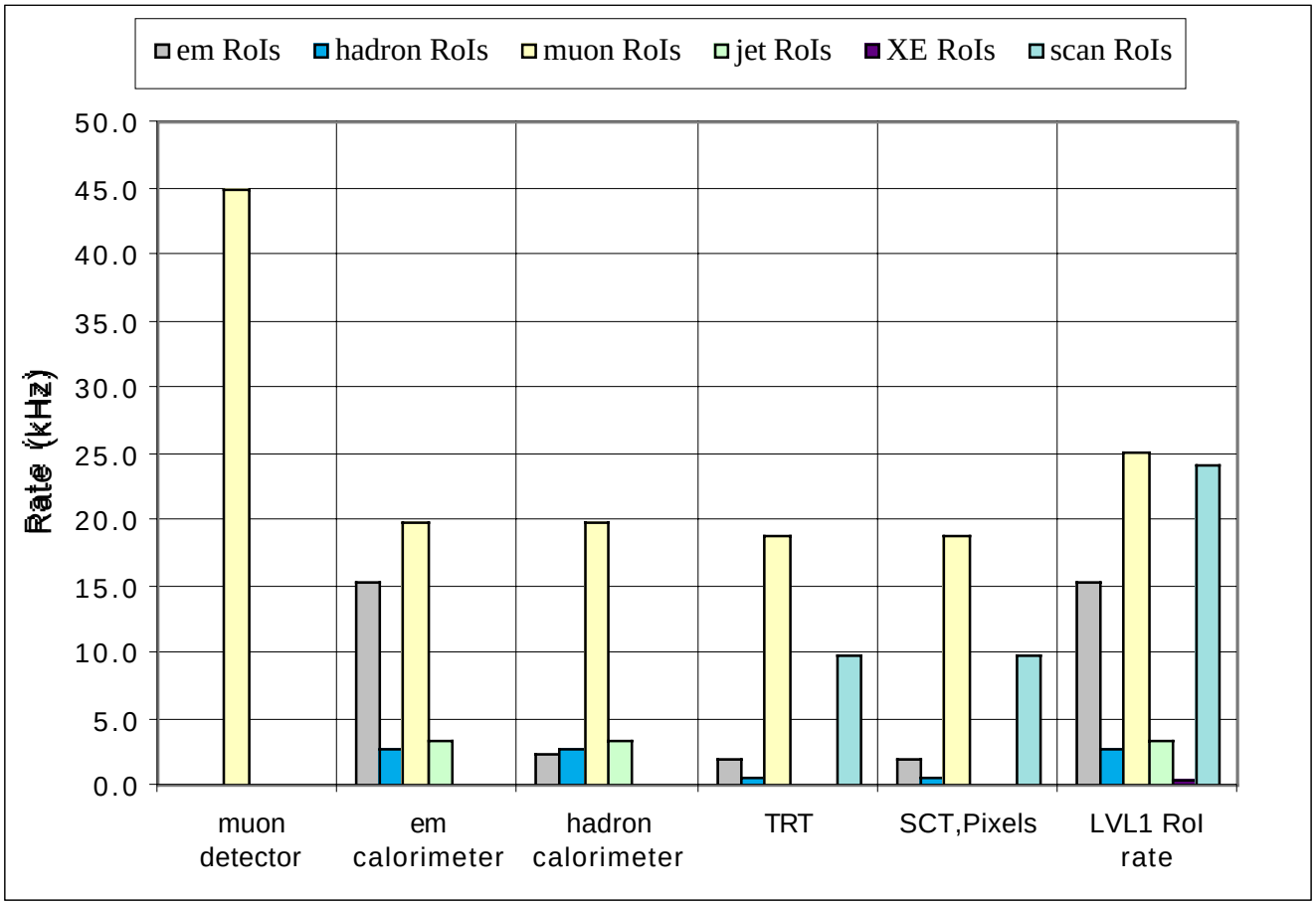
Em/gamma :

- confirm in em calorimeter
- 16 % : confirm in hadron calorimeter
- 13.5% : confirm in tracker
- (1.8 % left after track find and match,
  1.6 % left after tighter calo cuts)

Hadron :

- confirm in calorimeters
- 20 % : confirm in tracker

Low luminosity : total RoI rates



Average number of sequential steps = 2.07

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High luminosity menu, rates in Hz (com-daq-99-010)

#1	**MU20**	**3900**
#2	2*MU20	300
#3	**2*MU6**	**4000**
#4	**EM30I**	**24300**
#5	**2*EM20I**	**4900**
#6	J290	47
#7	2*J290	49
#8	3*J290	2
#9	3*J130	130
#10	4*J130	8
#11	5*J130	1
#12	4*J90	141
#13	5*J90	15
#14	6 *J90	5
#15	J290 + 2*J130	52
#16	J290 + 3*J130	8
#17	J290 + 4*J130	1
#18	J290 + 3*J90	27
#19	J290 + 4*J90	5
#20	2*J290 + 2*J90	9
#21	2*J290 + 3*J90	1
#22	TAU60 + XE60	910
#23	2*TAU60 + XE60	48
#24	3*TAU60 + XE60	3
#25	J100 + XE100	166
#26	2*J100 + XE100	54
#27	3*J100 + XE100	10
#28	4*J100 + XE100	10
#29	4*J100 + TAU60 + XE60	2
#30	4*J100 + 2*TAU60 + XE60	2
#31	4*J100 + 3*TAU60 + XE60	1.2
#32	5*J100 + TAU60 + XE60	2.2
#33	5*J100 + 2*TAU60 + XE60	2.2
#34	5*J100 + 3*TAU60 + XE60	1.4
#35	J100 + TAU60 + XE100	142
#36	2*J100 + TAU60 + XE100	74
#37	3*J100 + TAU60 + XE100	10
#38	4*J100 + TAU60 + XE100	16
#39	J100 + 2*TAU60 + XE100	10
#40	2*J100 + 2*TAU60 + XE100	10
#41	3*J100 + 2*TAU60 + XE100	10
#42	4*J100 + 2*TAU60 + XE100	9

LVL1 rate : 39.4 kHz

Accept rate : 2 kHz

Processing sequences for high luminosity menu

Muons :

- confirm in μ detector
- 75 % : confirm in tracker
- 40 % : check calorimeter data for isolation

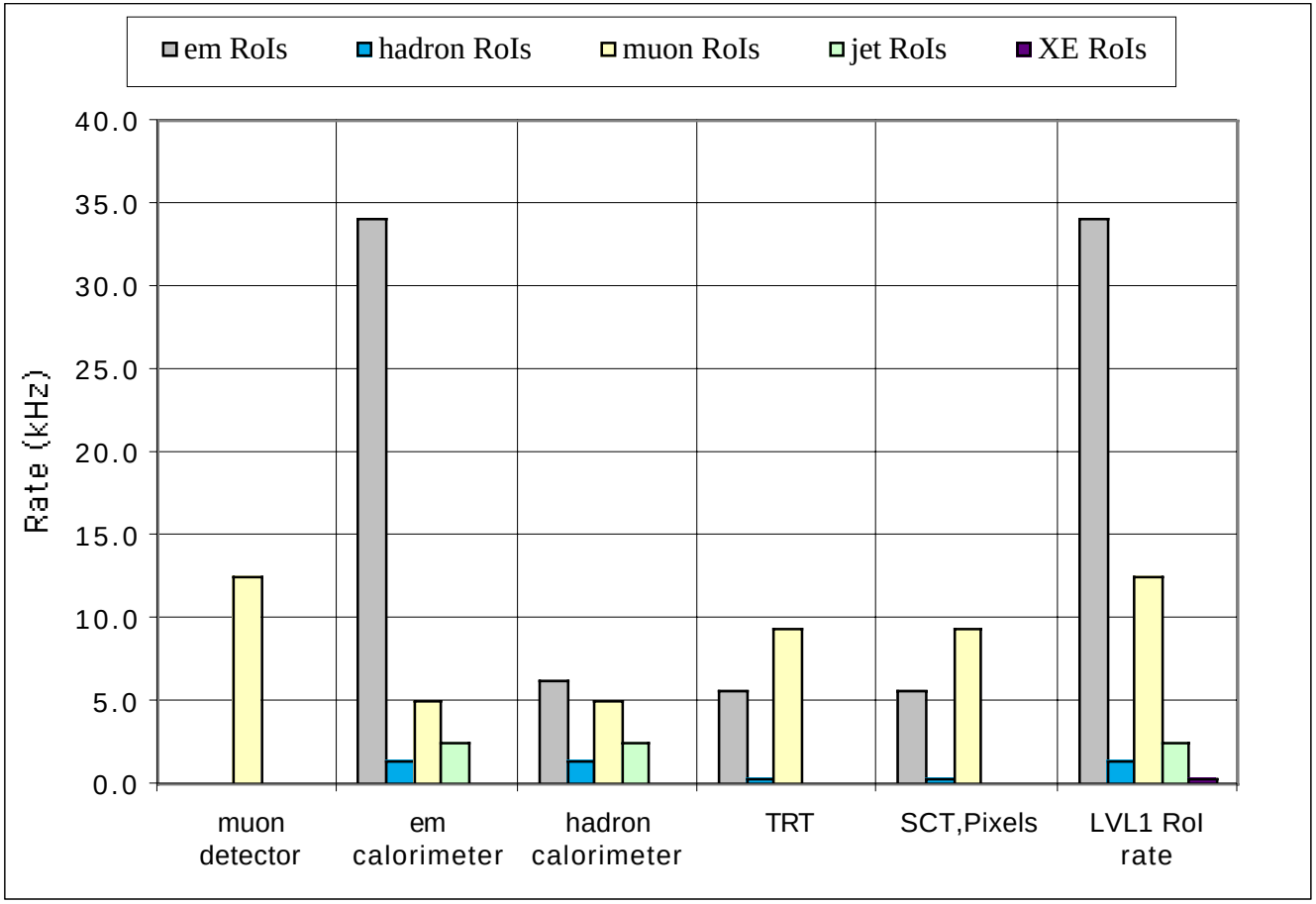
Em/gamma :

- confirm in em calorimeter
- 18.3 % : confirm in hadron calorimeter
- 16.7 % : confirm in tracker
- (2.6 % left after track find and match,
  1.5 % left after tighter calo cuts)

Hadron :

- confirm in calorimeters
- 20 % : confirm in tracker

High luminosity : total RoI rates



Average number of sequential steps = 1.59

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RoI sizes used by the LVL2 system

Em RoIs
- 0.4 x 0.4 in calorimeters
- 0.2 x 0.2 in trackers

Hadron RoIs
- 0.4 x 0.4 in calorimeters
- 0.2 x 0.2 in trackers

Jet RoIs
- 0.8 x 0.8 in calorimeters

Muon RoIs
- 0.3 x 0.16 - 0.26 in pixels and SCT
- 0.4 x 0.3 - 0.4 in TRT
- 0.4 x 0.3 - 0.4 in calorimeters
- 0.3 x 0.26 or 0.52 or 0.8 in muon spectrometer

Number of ROBs, size of event fragments

Pixels : 84 ROBs * 80 Bytes (low luminosity), 800 Bytes (high luminosity)

SCT : 92 ROBs * 250 Bytes (low luminosity), 1600 Bytes (high luminosity)

TRT : 256 ROBs * 750 (*300 with pre-processing*) Bytes (low luminosity),

1000 bytes (high luminosity)

Em calorimeter : 760 ROBs * 1800 (*1024 with "pre-processing"*) Bytes

Hadron calorimeter : 98 ROBs * 1800 (*1024 with "pre-processing"*) Bytes

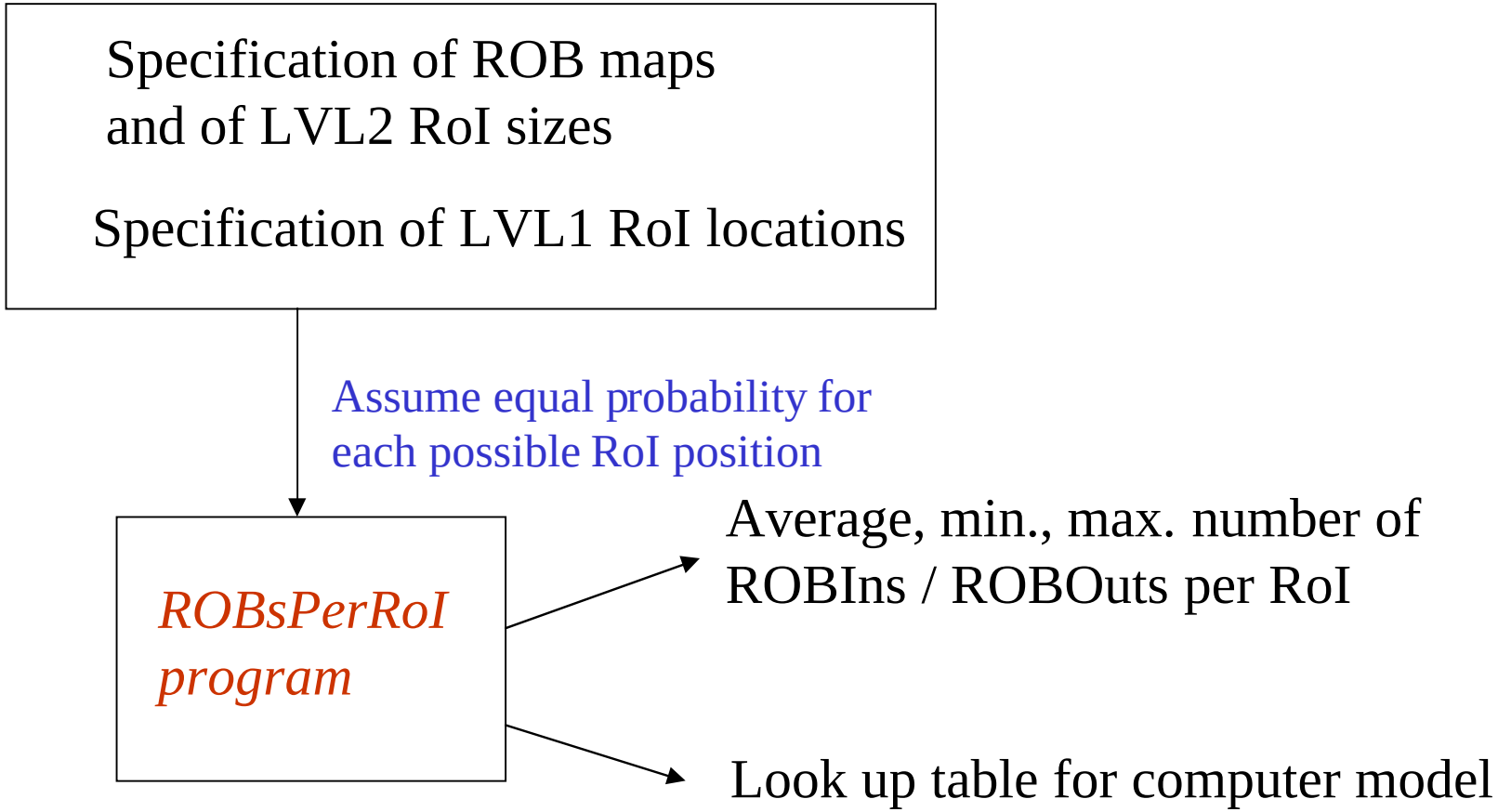
μ-trigger : 48 ROBs * 380 bytes

μ-precision : 192 ROBs * 800 bytes

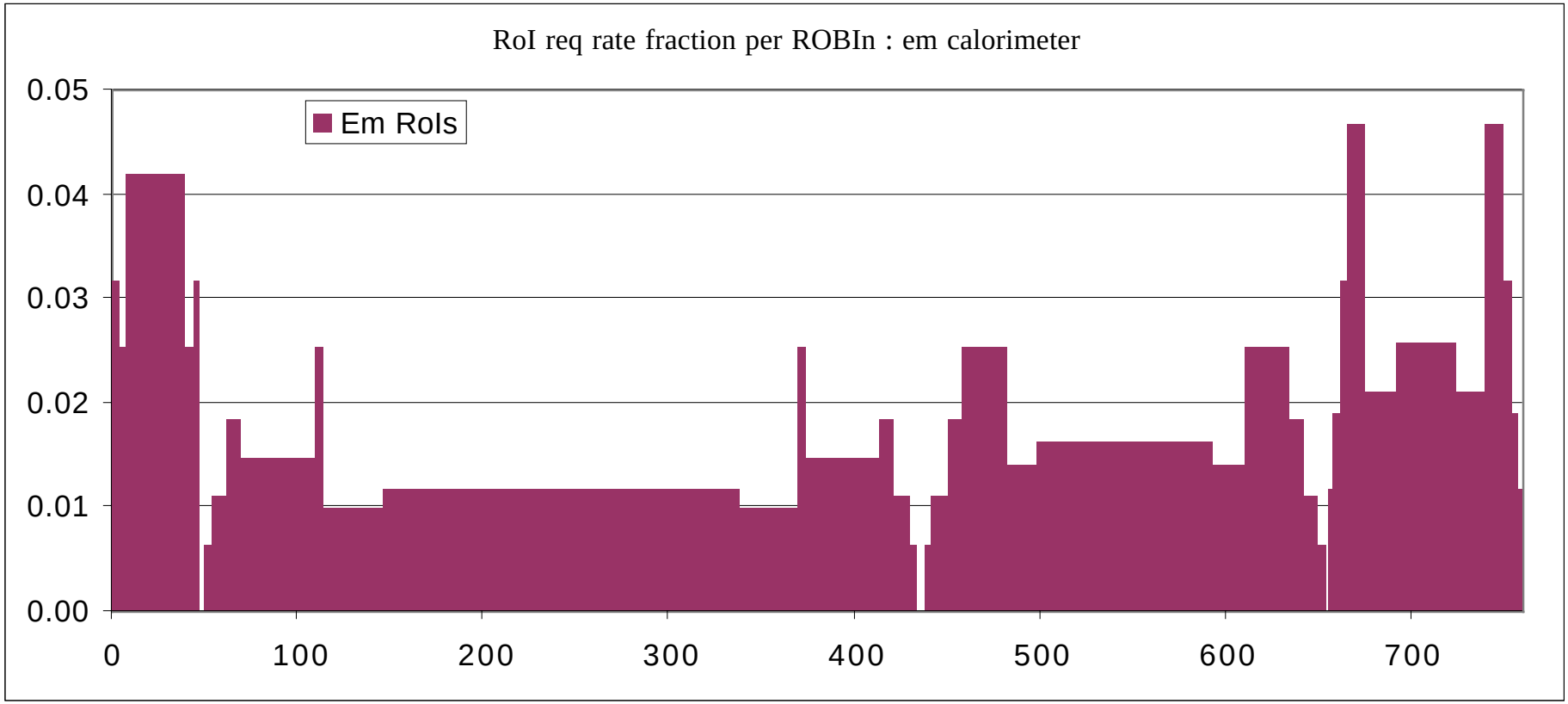
Per ROBIn a 32 Bytes header is added to the raw data

"pre-processing" for the calorimeter consists of straightforward selection of first 1024 Bytes

Calculation of average number of ROBIns per RoI



RoI request probability per ROBIn for em/gamma RoIs for em calorimeter



pre-sampler front layer middle layer back layer

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Assumptions

No analysis of jets in tracker

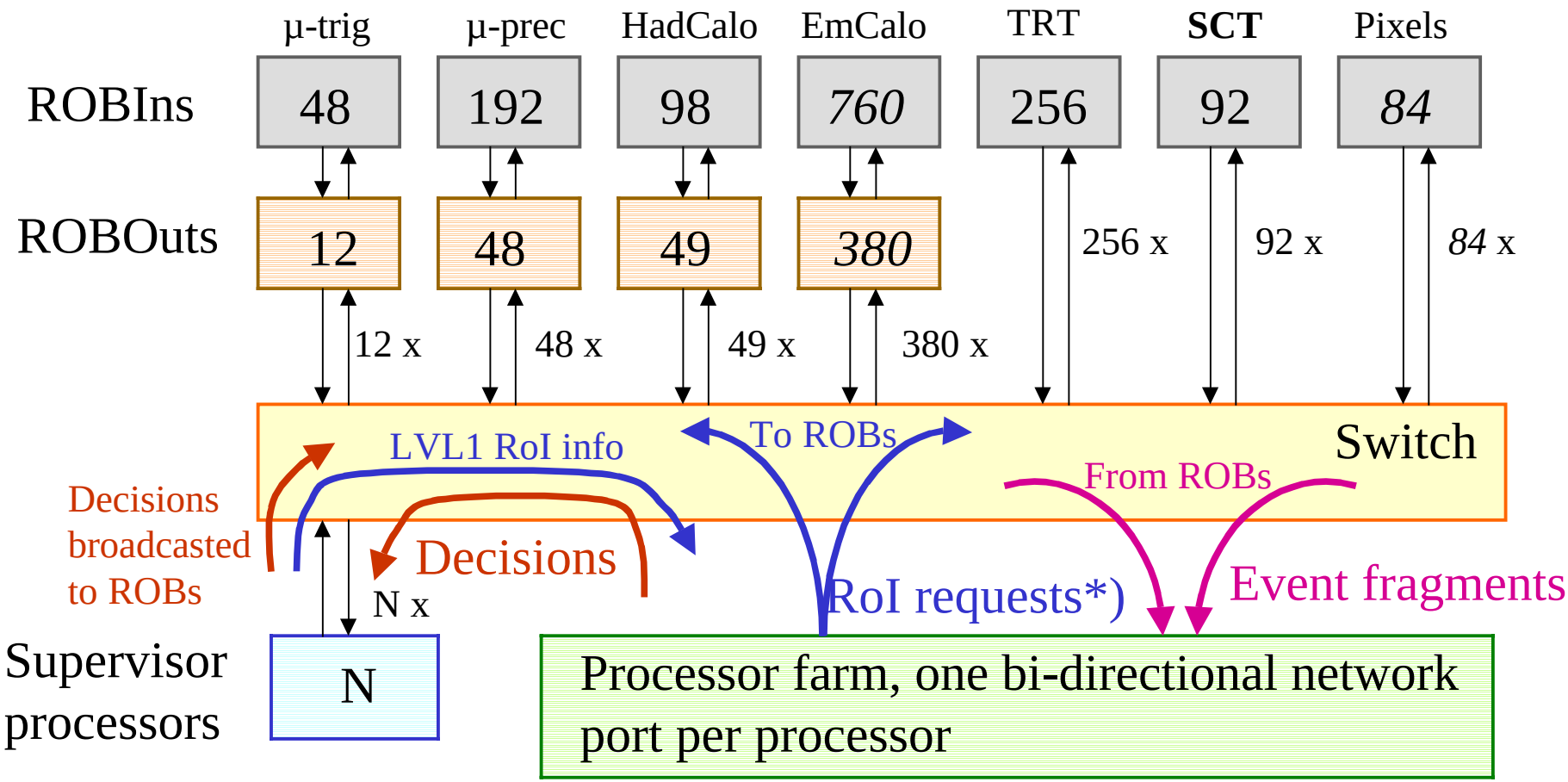
TRT scan leads to requesting all data from SCT and pixels

Processing parameters and process models as agreed on in January ‘99 meeting

Accept decisions combined with reject decisions in blocks of 20 decisions multicasted to all ROBIns

TRT, SCT and pixel scan RoI requests multicasted

No missing energy trigger



*) Scan and Emiss RoI requests are multi-casted

ROBIn processing times (µs)

Time per decisin block	55.5555
Indexing time	5.0
Processing time per RoI	11.111

FEX processing times (µs)

Pixels / SCT : EmRoI	277.775
Pixels / SCT : MuRoI	277.775
Pixels / SCT : ScanRoI	22222.22
TRT : MuRoI	327.775
TRT : EmRoI	172.22
Calorimeter : MuRoI	55.555
Calorimeter : EmRoI	55.555 for hadrons
Calorimeter : JetRoI	55.555
Calorimeter : EMissRoI	55.555
Muon detector : MuRoI	55.555
TRT : ScanRoI	27777.75

Task switching time : 10 µs

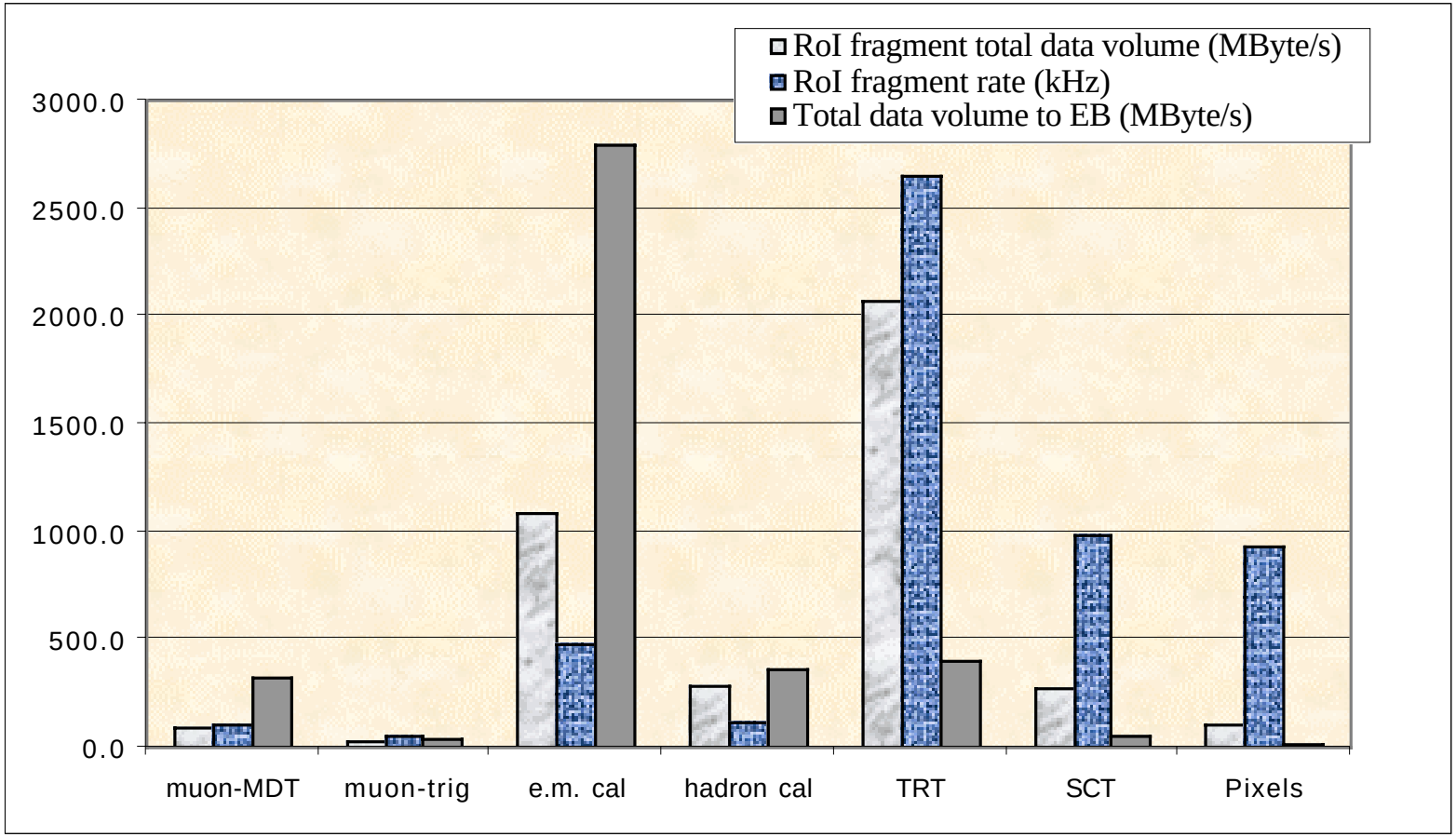
Em RoIs : 44.444 µs for emcal data, 11.111 µs for hadron cal data (for 16,667 % of em RoIs)

Processing times other processes in farm (µs)

RoI formulation time	11.11111
Decision processing time	5.555
Merge speed	80 MByte/s
Global	55.55

Low luminosity, with B-physics trigger,

no pre-processing, nominal LVL1 rate



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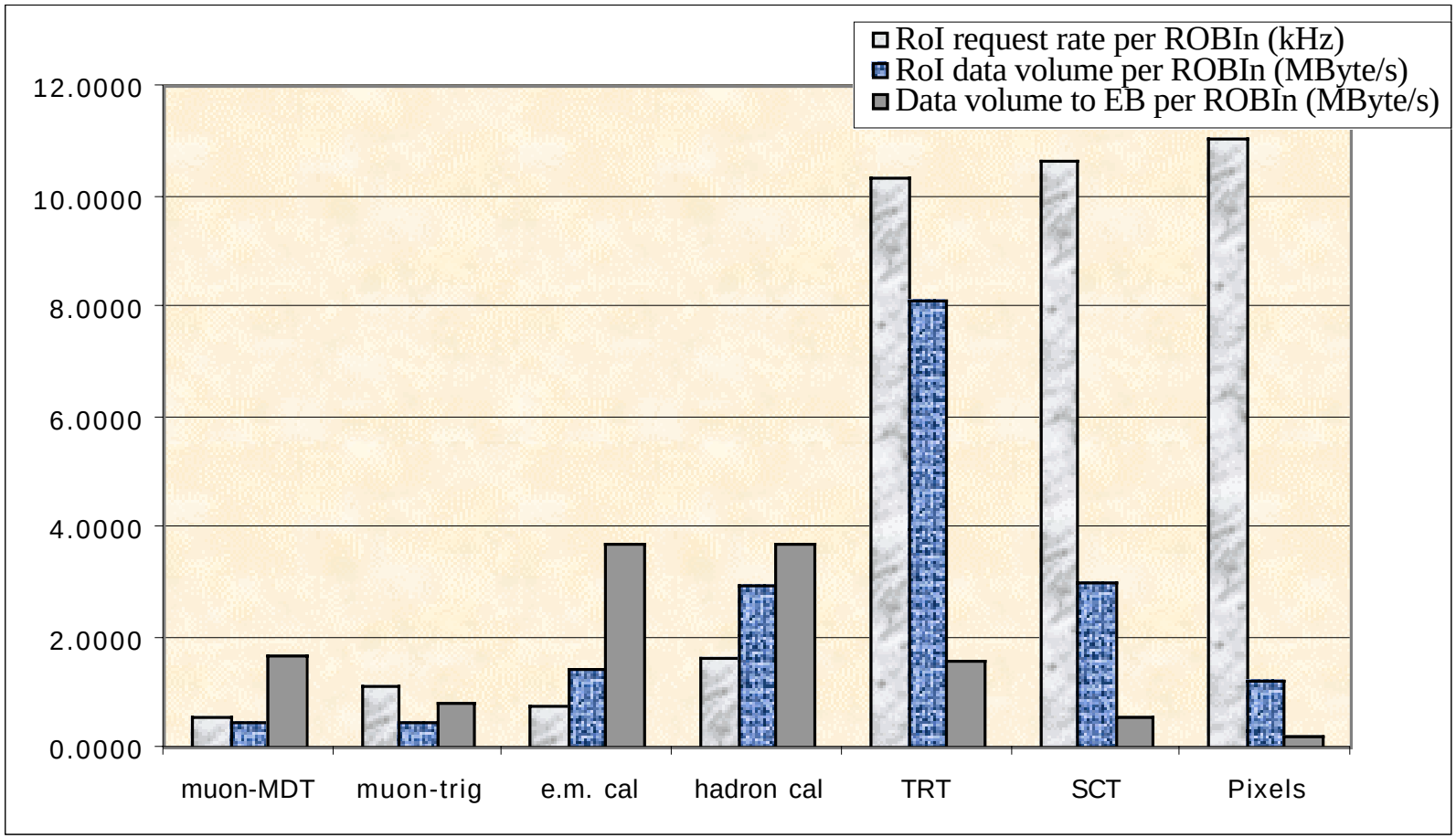
Low luminosity, with B-physics trigger,

no pre-processing, nominal LVL1 rate



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Overview requirements ROBINs for low luminosity

LVL1 rate = 40 kHz or LVL1 rate = 75 kHz (all rates scaled up from LVL1 rate = 40 kHz, except for B-physics trigger and event building).

Event building rate : 2 kHz

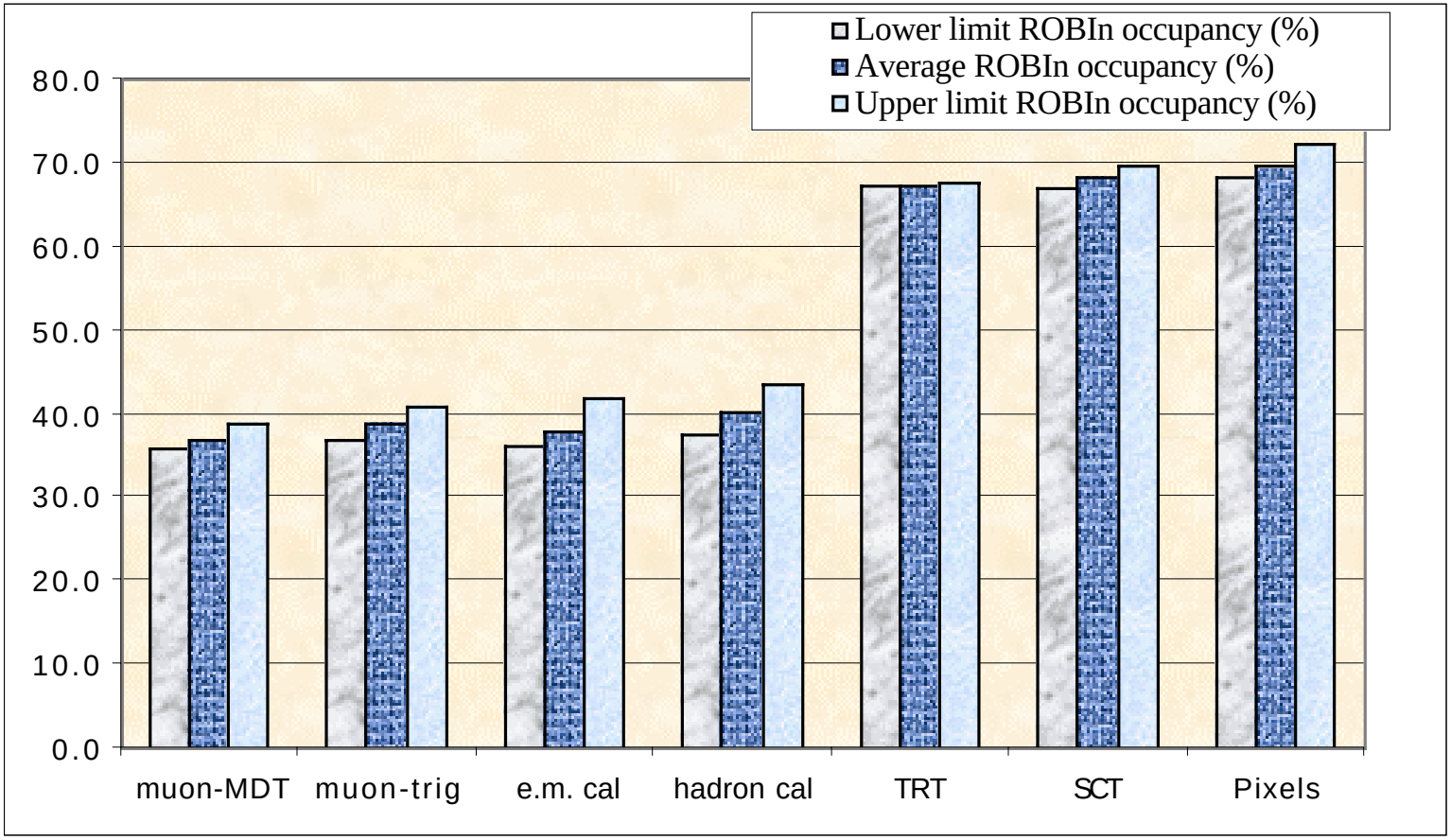
Requirements 40 / 75 kHz LVL1 rate:

	ROIRs from LVL2	ROIRs from LVL1
Maximum input bandwidth (MByte/s)	72 / 135	72 / 135
No pre-proc. : maximum data vol out (MByte/s)	9.7 / 12.8	51.5 / 54.6
Pre-proc : maximum data vol out (MByte/s)	6.5 / 9.0	31.2 / 33.1
Pixels 112 Bytes : max. RoIR rate (kHz)	11.9 / 13.7	28.3 / 31.9
SCT 282 Bytes : max. RoIR rate (kHz)	11.1 / 12.1	26.4 / 28.4
TRT 332 / 782 Bytes : max. RoIR rate (kHz)	10.4 / 10.8	25.0 / 25.8
Cal.meters 1056 / 1832 Bytes : max. RoIR rate (kHz)	2.7 / 5.0	26.1 / 27.8

NB : data vol out = volume of data for LVL2 and EB
RoIR = Region of Interest Request

Low luminosity, with B-physics trigger,

no pre-processing, nominal LVL1 rate



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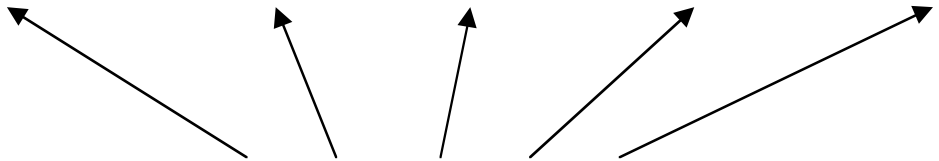
Processing resources required for low luminosity trigger

LVL1 rate	# of processors, sequential, B-physics	# of processors, parallel, B-physics	Min. # of processors, 15 MB/s links, seq, B-physics	# of processors, sequential, no B-physics	# of processors, scan : 0% processing time	# of supervisors
40.1 kHz	631 *609*	2090 *1850*	263 *144*	53 *47*	137 *115*	2
75 kHz	686 *657*	2143 *1897*	356 *201*	99 *88*	193 *164*	3



With pre-processing

Task switching times (assumption : 10 µs) responsible for about 10 / 30 % of processing requirements (with / without B-physics trigger)

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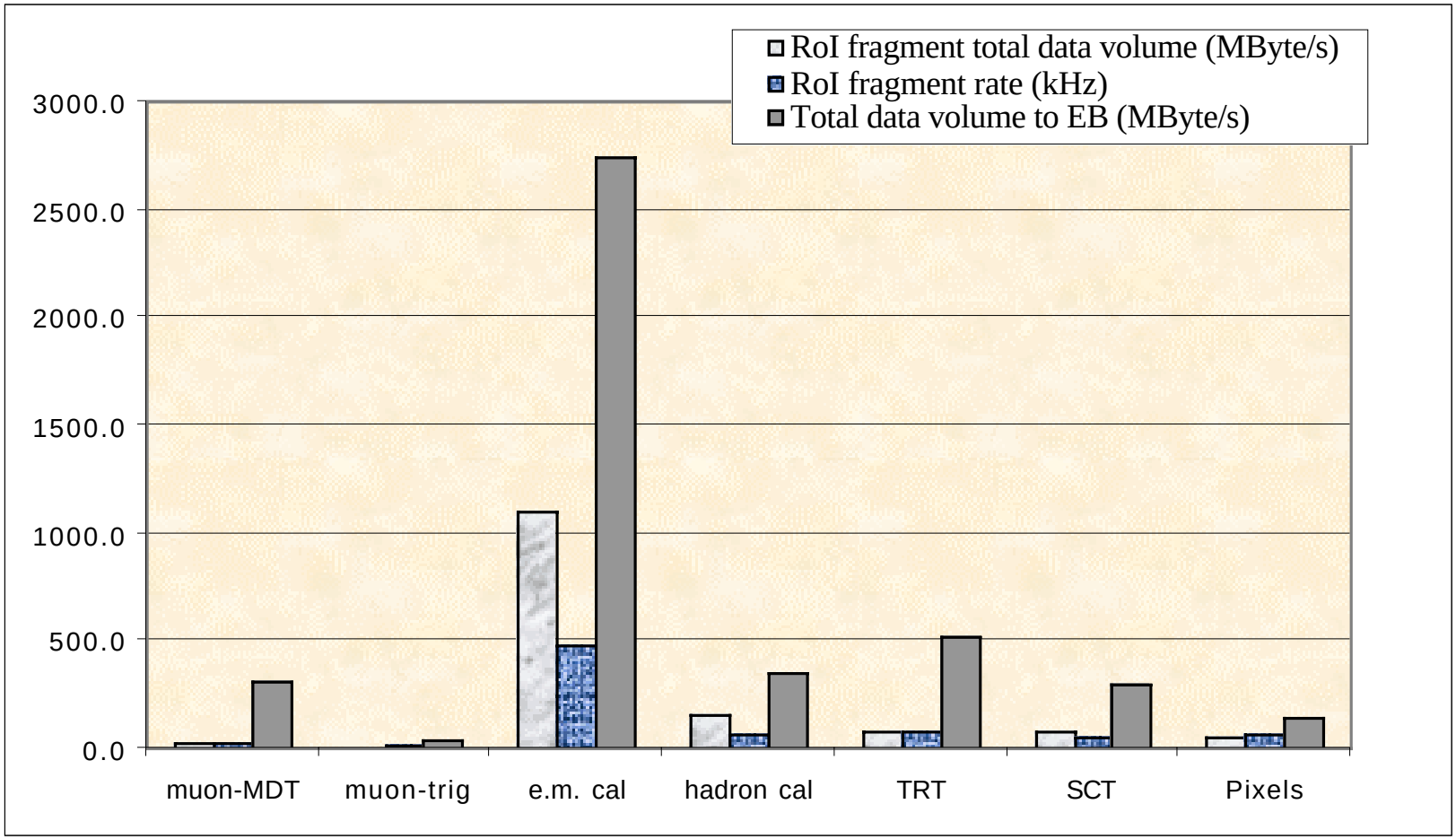
High luminosity,

no pre-processing, nominal LVL1 rate



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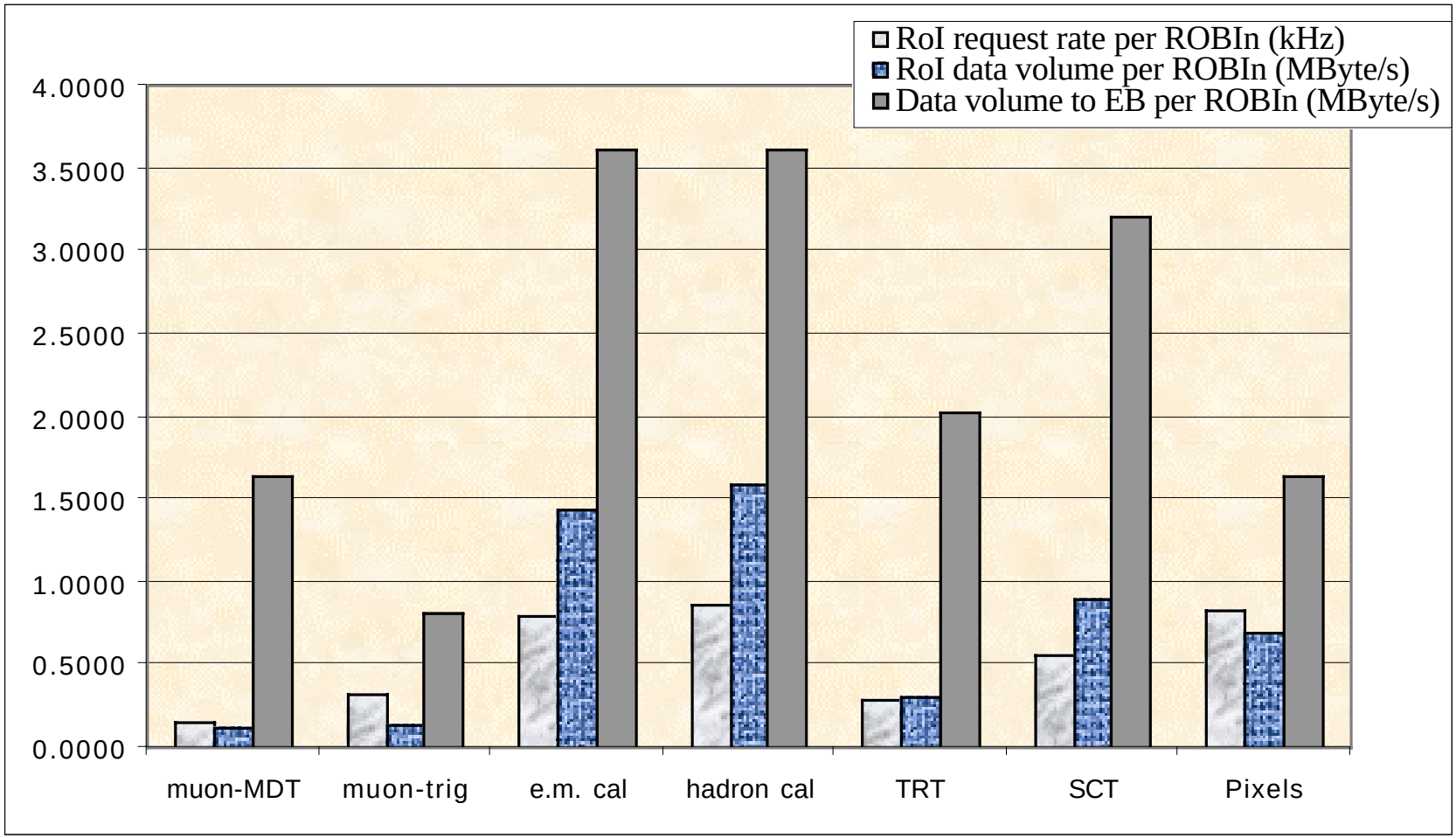
High luminosity,

no pre-processing, nominal LVL1 rate



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Overview requirements ROBINs for high luminosity

LVL1 rate = 40 kHz or LVL1 rate = 75 kHz (all rates scaled up from LVL1 rate = 40 kHz)

Event building rate : 2 kHz

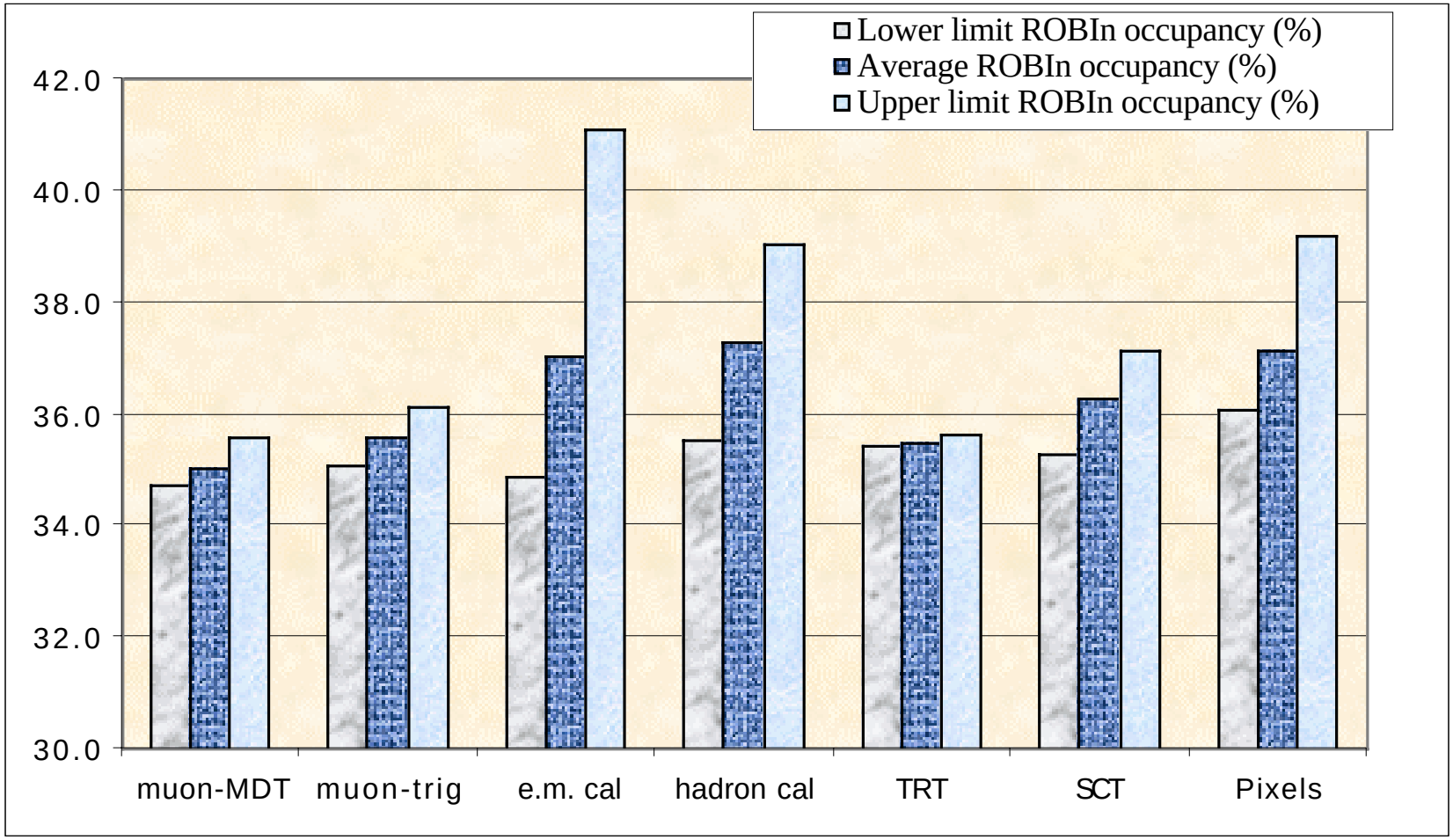
Requirements 40 / 75 kHz LVL1 rate:

	ROIRs from LVL2	ROIRs from LVL1
Maximum input bandwidth (MByte/s)	72 / 135	72 / 135
No pre-proc. : maximum data vol out (MByte/s)	7.5 / 10.9	11.8 / 19.2
Pre-proc : maximum data vol out (MByte/s)	5.8 / 7.8	8.3 / 12.6
Pixels 112 Bytes : max. RoIR rate (kHz)	1.5 / 2.8	4.7 / 9.0
SCT 282 Bytes : max. RoIR rate (kHz)	0.82 / 1.6	2.5 / 4.7
TRT 332 / 782 Bytes : max. RoIR rate (kHz)	0.33 / 0.63	0.9 / 1.7
Cal.meters 1056 / 1832 Bytes : max. RoIR rate (kHz)	2.1 / 4.0	4.5 / 8.5

NB : data vol out = volume of data for LVL2 and EB
RoIR = Region of Interest Request

High luminosity,

no pre-processing, nominal LVL1 rate



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Processing resource required for high luminosity trigger

LVL1 rate	# of processors, sequential	# of processors, parallel	Min. # of processors, 15 MB/s links, seq.	# of supervisors
39.4 kHz	51 *45*	91 *82*	100 *65*	2
75 kHz	97 *84*	172 *155*	190 *123*	3

With pre-processing

Task switching times (assumption : 10 µs) responsible for about 30 % of processing requirements

Paper model results, Beatenberg, 7 December 1999, JV

3 slides Jiri on sequential processing em calorimeter data for em/gamma and hadron RoIs

Grouping ROBs, advantages :

- Grouped ROBIn requests, reducing the number and frequency of requests
- Grouped ROI data, also reducing the number and frequency of messages
- Reduction in number of network ports required

Further advantages Active ROB Complex (AROBC) :

- an AROBC selects RoI-related data from inside ROBins,
  reducing bandwidth requirements on transmission;
- an AROBC performs preprocessing tasks depending on the detector,
  reducing again the volumes transmitted, and alleviating computing requirements
  for feature extractors;
- for some detectors and depending on topological constraints,
  an AROBC may execute the full feature extraction for a region of interest (RoI).

1 slide Jiri on reduction of message rates
as function of grouping factor

Paper modelling of Active ROB Complex

Low luminosity, B-physics trigger, nominal LVL1 rate

		Access frequencies [kHz]				Average required bandwidth [MB/s]			
Detector	#ROBin/ #AROBC	(ROBin)	average	upper limit	lower limit	(ROBin)	all data	with preproc.	Ev.Buil. (added)
Pixels	84/12	11.0	14.4	17.9	11.8	1.2	9.1	2.3	1.6
SCT	92/12	10.6	12.8	14.9	11.0	3.0	23.4	5.8	4.3
TRT	256/24	10.3	11.4	11.7	11.2	8.1	86.5	17.3	16.7
Ecal	760/56	0.7	1.7	2.1	0.6	1.1	15.0	7.5	49.9
Hcal	98/10	1.2	2.9	4.2	0.7	2.0	19.7	9.8	36.0
MuPrec	92/16	0.3	1.8	2.0	1.6	0.2	3.0	-	20.0
MuTrig	48/ 4	0.6	6.5	6.5	6.5	0.3	3.4	-	9.9

NB : no RoIs from scan, results for parameters as assumed in October

Paper model results, Beatenberg, 7 December 1999, JV

Paper modelling of Active ROB Complex

High luminosity, nominal LVL1 rate

		Access frequencies [kHz]				Required bandwidth [MB/s]			
Detector	#ROBin/ #AROBC	(ROBin)	average	upper limit	Lower limit	(ROBin)	all data	with preproc.	Ev.Buil. (added)
Pixels	84/12	0.7	2.8	4.9	1.1	0.57	4.1	1.0	11.5
SCT	92/12	0.4	1.8	3.1	0.7	0.75	5.8	1.4	24.7
TRT	256/24	0.3	0.9	1.1	0.8	0.26	2.8	2.2	21.7
Ecal	760/56	1.0	2.2	2.9	0.7	1.44	19.6	9.8	49.0
Hcal	98/10	0.9	2.2	3.3	0.4	1.53	15.1	7.6	35.4
MuPrec	92/16	0.2	0.9	1.0	0.8	0.12	1.5	-	19.7
MuTrig	48/ 4	0.3	3.3	3.3	3.3	0.13	1.7	-	9.7

NB : results for parameters as assumed in October

Paper modelling of Active ROB Complex

Detector	#active ROBins/ AROBC	average frequency (hi/lo L)	computing load, high L (prepr.)	computing load, low L (prepr.)	computing load (appr) (feat.ex.)	probab.of RoI contained
Pixels	84/12	2.8 / 14.4	2.4	12.3	28 / 144	0
SCT	92/12	1.8 / 12.8	0.4	3.2		0.4
TRT	256/24	0.9 / 11.4	0.3	3.4	1 / 11	0.5
Ecal	760/56	2.2 / 1.7	0.2	0.1	0.2 / 0.2	0.1
Hcal	98/10	2.2 / 2.9	0.1	0.1	0.2 / 0.3	0.7

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Further results of paper modelling

- Number of boards / crates needed for ROB system for different configurations
- DAQ-1 crate model

Conclusion

- Paper model <-> computer model comparisons provide check on correctness computations : OK
- Validity results dependent on validity input of model
- There is no reason to see the input as problematic : -> the results provide support for the pilot project model
- Set of paper model results and spreadsheet available : http://www.nikhef.nl/pub/experiments/atlas/daq/modelling.html