



# Computing Model Status

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- **Computing-physics needs**
  - Event rates, event sizes, nos. of strippings, reduction factors, ...
- **Computing Model**
  - Distribution of data/resources
  - Computing infrastructure reqts

- Since November LHCb s/w week Technical Board met:
  - endorsed increased trigger rate 200Hz  $\rightarrow$   $\mathcal{O}$ (kHz)
  - concept of data reconstruction/processing external to CERN
  - concept of event stripping
- **Motivation:**
  - Data mining
  - CP violation in D-system
  - Di-muon & D\* samples for systematic studies
- **LHCC presented with increased trigger rate during LCG comprehensive review week**

## 2008 Baseline Numbers

Event Size	kB
RAW	25
rDST	25
DST	75
Evt processing	kSI2k s
Reconstruction	2.4
Stripping	0.2
Analysis	0.3

CPU requirements  $\approx$  same as those presented in April

People confident that (r)DST size could be reduced to  
this

## 2008 Baseline Numbers

	b- exclusive	Di- muon	D*	b- inclusive	Total
HLT rate (Hz)	200	600	300	900	2000

Total rate assumed 2kHz - b-inclusive "tops" other 3 up to total

First quasi-online reconstruction during data taking

Second reconstruction in 2 month at end of data taking

## 2008 Baseline numbers

Stripping 4 times per year - twice outside of recons periods in a 1 month time

Stripping yields of the 4-categories

Only rDST stored for "calibration" channels+RAW i.e. 50 kB;

RAW+full DST for "b" channels\* - i.e. 100kB

	Exclusive-b	dimuon	D*	Inclusive-b	Total
Input fraction	0.1	0.3	0.15	0.45	1.00
Reduction factor	10	5	5	100	9.57
Event yield per stripping	$2 \times 10^8$	$1.2 \times 10^9$	$6.0 \times 10^8$	$9.0 \times 10^7$	$2.09 \times 10^9$
Storage requirement per stripping (TB)	20	60	30	9	119

\* - "b" channels are reconstructed again

## 2008 Baseline Numbers - simulation

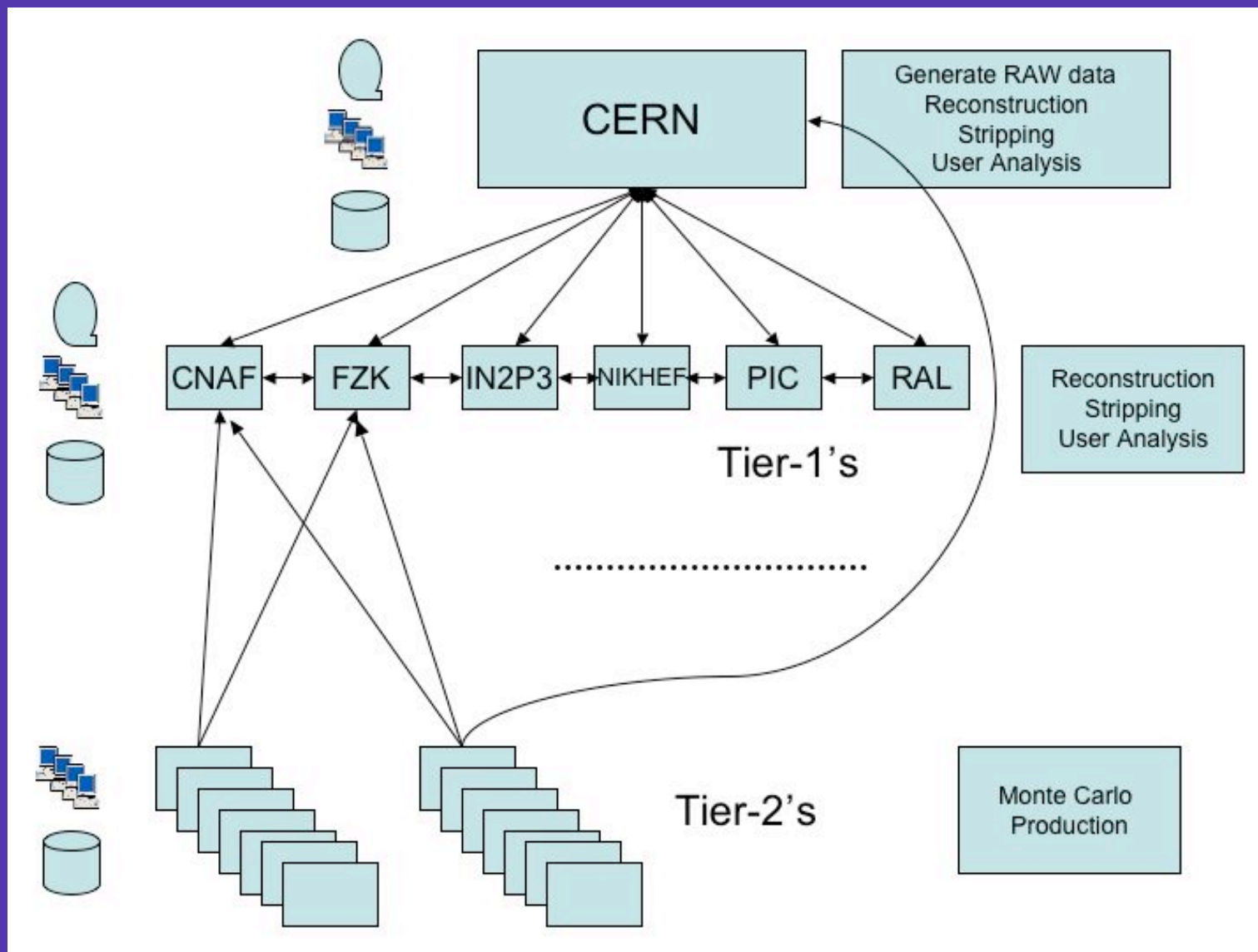
Monte Carlo needs reduced since April - order of magnitude

### Systematics from "real" data

	Application	Nos. of events	CPU time/evt (kSI2k s)	Total CPU (kSI2k year)
Signal	Gauss	$2 \times 10^9$	50	3171
	Boole	$2 \times 10^9$	1	63
	Brunel	$2 \times 10^8$	2.4	15
Inclusive	Gauss	$2 \times 10^9$	50	3171
	Boole	$2 \times 10^9$	1	63
	Brunel	$2 \times 10^8$	2.4	15
Total				6499

	Output	Nos. of events	Storage/evt (kB)	Total Storage (TB)
Signal	DST	$2 \times 10^8$	400	80
	TAG	$2 \times 10^8$	1	0.2
Inclusive	DST	$2 \times 10^8$	400	80
	TAG	$2 \times 10^8$	1	0.2
Total				160.4

# Computing Model



## Computing Model

- Assuming 14 Tier-2 centres for LHCb (not necessarily LCG Tier-2's)
  - 1xBrazil
  - 2xPoland
  - 6xRussia
  - 1xSwitzerland
  - 4xUK
- assume local analysis performed at local institute (and not discussed here)



## Computing Model

2 copies of RAW - 1 @ CERN; 1 across Tier-1's on MSS

1 copy of output from recons - distributed across CERN and Tier-1's on MSS

2 copies of each stripping on MSS - 1 @ CERN; 1 across Tier-1's on MSS

2 copies of MC each on MSS - 1 @ CERN; 1 across Tier-1's on MSS

## Computing Model

1 copy of latest stripping on disk at CERN & Tier-1's

Next-to-latest stripping of "B" channels on disk at CERN & Tier-1's

4 copies of MC data (inclusive & signal) on disk - 1 @ CERN; 3 across Tier-1's

Analysis storage

## Computing Model

Reconstruction across CERN & Tier-1's

Reprocessing 5.4 MSI2k available for 2 months using event filter farm → >50% of re-processing @ CERN

Stripping distributed across CERN & Tier-1's

Analysis foreseen at Tier-1's (75%) & CERN (25%)

100% of MC production at Tier-2's

Analysis should not be proscribed at larger Tier-2's:  
minimum disk, bandwidth & CPU reqt

CERN and Tier1's could contribute to MC filling gaps  
between data processing tasks

## 2006-2008 Summary

Assuming ramp up 30-60-100%

CPU(MSI2k yr)	2006	2007	2008
CERN	0.27	0.54	0.90
Tier-1's	1.33	2.65	4.42
Tier-2's	2.29	4.59	7.65
Total	3.89	7.78	12.97
<b>Disk(TB)</b>			
CERN	248	496	826
Tier-1's	730	1459	2432
Tier-2's	7	14	23
Total	984	1969	3281
<b>Tape (TB)</b>			
CERN	408	825	1359
Tier-1's	622	1244	2074
Total	1030	2069	3433

## During data taking:

- 2000kHz 25kB + 200Hz (25+25kB) ~60 MB/s

## Re-reconstruction:

- Need to get data back to pit in 2 month period and processed data back out
- ~90 MB/s i.e. larger than during data taking!

## Network traffic

- Network traffic given - for original reconstruction, re-reconstruction, stripping
  - CERN in & out from/to Tier 1
  - "typical" Tier1 in & out from/to CERN
  - "typical" Tier1 in & out from/to other Tier-1's
  - Traffic involving Tier-2's small but connectivity not only to Tier-1's but also CERN
- Peaks during second reconstruction & stripping not data taking

## MSS i/o

- MSS i/o - for original reconstruction/data taking, re-reconstruction, stripping
  - CERN
  - integrated over Tier1's
- Again peaks during second reconstruction & stripping not data taking

## 2009

- Needs similar to 2008 except:
  - Analysis grows linearly i.e. disk & CPU resource double 2008
  - Latest copy of stripping remain on disk from previous year
    - "b" channels: 1 copy @ CERN + 2 copies around Tier 1's
    - "calib" channels: 1 copy @ CERN + 1 copy around Tier 1's
  - Re-construct last year stripped events during second re-processing
  - Data on MSS accumulates



## 2009

CPU(MSI2k yr)	2009
CERN	1.25
Tier-1's	5.55
Tier-2's	7.65
Total	14.45
Disk(TB)	
CERN	1095
Tier-1's	2897
Tier-2's	23
Total	4015
Tape (TB)	
CERN	2857
Tier-1's	4285
Total	7144

CPU: 11% increase  
compared to '08

Disk: 22% increase  
compared to '08

Tape: ~factor 2  
compared to '08

## 2010

- Needs similar to 2008 except:
  - Analysis grows linearly i.e. disk & CPU resource 3 times 2008
  - Latest copy of stripping remain on disk from both previous years
    - "b" channels: 1 copy @ CERN + 2 copies around Tier 1's
    - "calib" channels: 1 copy @ CERN + 1 copy around Tier 1's
  - Re-construct last year stripped events during re-processing
  - Reprocess ALL 2008 data in parallel to data taking
  - Data on MSS accumulate

## 2010

CPU(MSI2k yr)	2010
CERN	1.88
Tier-1's	8.35
Tier-2's	7.65
Total	18.05
Disk(TB)	
CERN	1363
Tier-1's	3363
Tier-2's	23
Total	4749
Tape (TB)	
CERN	4566
Tier-1's	7066
Total	11632

CPU: 35% increase  
compared to '08

Disk: 45% increase  
compared to '08

Tape: ~factor 3  
compared to '08

## Cost Comparison

		200Hz	2000Hz
		April - MoU taskforce 2008	Now 2008
CERN	CPU(MSI2k)	2.7	0.9
	Disk(PB)	0.3	0.8
	Tape(PB)	1.0	1.4
Tier-1's	CPU(MSI2k)	9.5	4.4
	Disk(PB)	1.4	2.4
	Tape(PB)	0.4	2.1
Tier-2's	CPU(MSI2k)	16.4	7.6
	Disk(PB)	0.06	0.02
<b>Relative Cost</b>		<b>1.0</b>	<b>0.88</b>

## Cost Comparison

		200Hz	2000Hz
		Hoffman 2007	Now 2008
CERN	CPU(MSI2k)	2.0	0.9
	Disk(PB)	0.3	0.8
	Tape(PB)	1.2	1.4
Tier-1's	CPU(MSI2k)	8.3	4.4
	Disk(PB)	1.6	2.4
	Tape(PB)	0.75	2.1
Tier-2's	CPU(MSI2k)	-	7.6
	Disk(PB)	-	0.02
<b>Relative Cost</b>		<b>1.0</b>	<b>0.91</b>