LHCb Computing Resources: 2015 first estimates

LHCb Public Note

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Abstract

This document presents the first estimates of LHCb computing resources for 2015. It follows on from the most recent estimates for the years 2012-14, presented in LHCb-PUB-2012-014, and presents a first scenario for the LHCb data-taking after the LS1 long shutdown of the LHC.

Detailed estimates of event sizes and processing times are still to be worked out. The estimates presented here are based on the expected increment of the physics data rate due to the new running conditions.

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1. Introduction

There are still many unknowns in respect of the running conditions for 2015. After some months of commissioning starting at the end of 2014, LHC is expected to resume operation in stable mode for physics in the spring of 2015. As was already the case during the 2010 startup, LHCb plans to run with an open trigger initially, which will be tightened when the machine reaches the nominal LHCb luminosity. Because of luminosity levelling at the LHCb interaction region, it is expected to reach the nominal LHCb luminosity rather quickly.

Therefore, for the purpose of this document, we will assume that LHCb will take data at its nominal rate throughout the 2015 running period, which we assume to be a total of $5 \cdot 10^6$ seconds of stable beam stretching over approximately 7 month of machine operation.

The parameters used for the 2015 computing resources simulation are presented in Section 2 and the resulting estimates are summarized in Section 3.

2. 2015 model parameters

In order to estimate the LHCb RAW data rate in 2015 we need to take into account the many changes that will take place compared to 2012:

- The average multiplicity of single pp interactions will be greater, due to the higher collision energy
- The effect of pileup on RAW event size is difficult to predict. If the LHC operates at 25ns bunch spacing the multiple interaction rate will be lower, but the left over signal from out of time events will be greater.
- LHCb may run at a higher (up to 50%) luminosity, that may translate into a higher High Level Trigger (HLT) output rate
- The allocation of HLT bandwidth to different trigger selections will depend on studies to be performed during LS1. It is too early to say whether this will lead to a significant change in the HLT output rate.

For this document we assume that the combined effect of the above changes will lead to an output rate of 700 MB/s, a factor of 2 larger than the maximum rate observed during the 2012 run, and close to the current hardware limitations of the HLT farm.

The total reconstruction time of events in LHCb has been shown to roughly scale with the total size of the RAW data sample, so for this estimate we use the same reconstruction time per MB as measured on 2012 data. As a first approximation the same retention rates as in 2012 are assumed for the Stripping.

Following the current processing model, data will be promptly Reconstructed using the resources from the Tier0 and the Tier1s. Then starting in September a Reprocessing campaign starts with updated alignment and calibration constants. This Reprocessing is expected to end by January 2016.

The estimated size of the 2015 RAW data is 3.5 PB while the reconstructed FULL.DST sample (including a copy of the RAW) is estimated to be 7.5 PB. This is to be compared with the corresponding estimates for 2012 data taking: 1.7 PB and 3.1 PB respectively.

The simulation and user activity are assumed to be at the same level as in previous years since the effect of the new data is only expected to have a significant impact in 2016 when the full sample has been reprocessed. Note however that in 2013 and 2014 a significant fraction of the CPU requirement for simulation is expected to be provided by the HLT farm. When data taking resumes, this resource will no longer be available, so the requirement for CPU will increase at Tier2 sites that are dedicated to simulation.

3. Summary of 2015 resource estimates

Using the parameters presented in Section 2 and results from the last estimates for 2014 a profile of the CPU and Storage requirements is calculated. An example of such profile is given in Figure 3-1. It shows the activity related to the prompt processing, the start of the reprocessing (before the end of the data-taking) and its execution until January 2016.

From these detailed profiles the corresponding CPU, and Storage requirements for 2015 are extracted. They are presented in Table 3-1, Table 3-2 and Table 3-3. These tables represent a significant increase with respect to previous years.

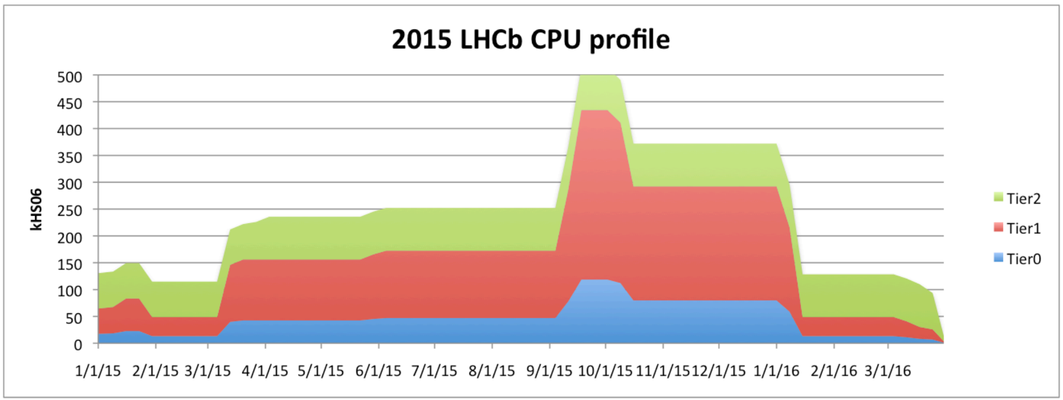

Figure 3-1: Estimated CPU profile for 2015.

Power	2015	
	kHS06	%
Tier0	87	22
Tier1	232	58
Tier2	80	20

Table 3-1: Estimated CPU power needed during 2015.

Disk	2015	
	PB	%
Tier0	10.8	34
Tier1	21.1	66

Table 3-2: Estimated Disk Storage requirement for 2015.

Tape	2015	
	PB	%
Tier0	16.4	43
Tier1	21.3	57

Table 3-3: Estimated Tape Storage requirement for 2015.