B-factory Programme Advisory Committee
Comments on Offline Computing Resource Requirement

8th meeting, 9 – 11 February 2014 at KEK

G. Buchalla (München), D. Cassel (Cornell), P. Collins (CERN)*,
M. Demarteau (ANL), M. Kuze (Tokyo Inst. Tech.), H. Lacker (HU Berlin),
Z. Ligeti (Berkeley), P. Mato (CERN)*, N. Neufeld (CERN),
B. Ratcliff (SLAC)*, E. Sexton-Kennedy (FNAL)*, J. Schwiening (GSI)*,
T. Sugitate (Hiroshima)*, M. Sullivan (SLAC),
and chaired by T. Nakada (EPFL)
* Expert members

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1 Overview

During the 8th review meeting, the committee received a presentation of the first ideas for the Belle II offline computing model. The model consists of two large "raw" data centres at KEK and PNNL with tape capability and high network bandwidth, a small number of regional data centres for mDST (the result of reconstruction) analysis, and possibly a fairly large number of sites for MC production implemented as Grid or Cloud resources or as local computer clusters. This is a radical change with respect to the current Belle computing model, which has been based on a single centre, the KEK data centre, providing most of the resources for the collaboration. To schedule jobs and manage the workload they plan to use the DIRAC system, which has been developed originally for LHCb and is now used by several other experiments. This is a system that maps well on different types of resources and allows implementation of the proposed heterogeneous computing system by mixing Grid, Cloud and local resources.

The committee also received a detailed presentation with the first estimates for the Belle II computing resources for the years 2014 to 2022. The resources include tape space for the raw data, disk space for generated and derived data (mDST, analysis objects such as n-tuples, Monte Carlo data) and CPU resources required for processing real data and the Monte Carlo data to produce the physics results. The committee has been asked to judge whether or not the resource estimation for 2015 up to 2017 is reasonable and provide any suggestions or comments.

The total resource requirements for the years 2015 to 2020 are summarised in Table 1. The committee has found sufficient details of the calculations and the assumptions that have been used are explicitly stated. The most important parameter in the resource

Table 1: Total resources required

	2015	2016	2017	2018	2019	2020
$\int Ldt$ (ab^{-1})	0.0	0.16	0.41	3.9	9.4	11
Tape (PB)	0.0	0.6	2.4	18	56	104
Disk (PB)	4.0	6.0	6.0	20	44	80
CPU (kHEPSpec)	130	170	400	600	800	1100

estimates is the number of events that are expected to be collected by the Belle II experiment. Here the collaboration has used the foreseen integrated luminosity delivered by SuperKEKB and has multiplied it by a set of fairly justified cross sections, which include the real physics processes as well as some estimates of the various background sources. The second most important ingredient is an estimate of the mean event size for raw data and mDST, and finally the estimate of the CPU seconds required to process one event for the different processing phases. This latter number is very difficult to justify since the only way to estimate it is to run the existing software, which is still in a development phase, thus its functionality is neither complete nor fully optimised. Probably adding the remaining functionality will add additional computation time. On the other hand, optimising the code will somewhat compensate the additional time added with new functionality when implemented.

The storage and CPU resources for 2015 and 2016 are dominated by the needs of the foreseen data challenges, while for the year 2017 the requirements from the expected collected luminosity and the data challenges contribute at the same level.

2 Comments from the committee

In general, making estimates for the period 2015 to 2017 is the hardest since the experimental situation will change very rapidly during that period. The luminosity performance of the accelerator (and the experiment's ability to collect all the data) during the commissioning phase is uncertain. On the other hand, the scale of the foreseen data challenges (between 2 and 6×10^9 events) is equivalent to the expected collisions to be recorded in 2018. As a result, the total needs result in a rather flat profile for the years 2015 to 2017. Overall, the committee finds this is very good. A flat profile to start building and loading with resources for the Belle II computing system will be helpful for the funding agencies.

Estimating the resources for the years of nominal operation of the accelerator is in principle easier, but these estimates are dominated by the assumptions on the number of MC streams, number of reprocessings over the integrated dataset, number of analyses and the required resources for each analysis, etc., which are still not well understood. Once the experiment is in a steady operation, it will be much easier to evaluate the needs extrapolating from one year to the following ones. The committee noticed that in some calculations for the CPU requirements the operation was done by summing the CPU power required for each activity. The CPU power is obtained by the required CPU seconds divided by the duration of the activity (e.g., MC productions, reprocessing, mDST production). This method results in a slight overestimate of the CPU resources, while it would be better to smoothen the CPU needs over the calendar year if possible.

The proposed computing model with two large centres and a limited number of regional centres seems very reasonable. The committee recommends to avoid splitting the resources in a too large number of small data centres. If possible, it is more efficient to concentrate resources in larger data centres, particularly for the event reconstruction, by joining the contributions from the collaboration into larger infrastructures.

The composition of the Computing Steering Group and its interactions with the Executive Board and Program Advisory Committee was presented. The Steering Group puts together the resource provider's representatives and the consumers, represented by the collaboration coordinators. The representation of the large data centres and resource providers is very welcome. The committee noticed, however, that KEK data centre representative and the Belle II computing coordinator is the same person. This may pose some conflicts of interest and therefore the committee advises identifying a different KEK data centre representative.

The committee responds positively to the question whether the resource estimations for 2015-2017 are reasonable. The amount of tape is negligible. The disk requirement is non-negligible but will be a good step towards building-up the resources that will be needed for the following years when Belle II will be in full production. Same thing for the CPU requirements. It is worth noting that the CPU requirements of ATLAS for 2015 (first year of LHC Run 2) is estimated to be 1200 kHEPSpec and the same for CMS. This is an order of magnitude more than Belle II. For what concerns disk space, ATLAS requires 108 PB (combining T0, T1s and T2s) for year 2015 and CMS 73 PB, which makes the needs of Belle II a factor between 25 and 18 less than ATLAS or CMS.

3 Follow up

After the BPAC meeting, the committee has received the following responses from the Belle II collaboration to its comments.

In the review meeting, the required CPU resources were estimated by assuming a processing duration of 8 months for real data and five months for Monte Carlo data. The committee felt that it would be better to spread them over one year for more smooth CPU usages over the calendar year. The revised CPU requirement assumes 11 months of process duration for both real and Monte Carlo data in order to keep $\sim$10% contingency in CPU power. Given the uncertainties in the current assumption on the processing time and luminosity evolution, the committee finds this approach reasonable. The committee notes that this resulted in a reduction of required CPU power by $\sim$ 20% or so. The revised resource requirements are shown in Table 2.

The group addressed the uncertainty in the assumed luminosity evolution of SuperKEKB by scaling the KEKB and PEP-II performances. The two scalings start to

Table 2: Revised total resources required

	2015	2016	2017	2018	2019	2020
$\int L dt$ (ab^{-1})	0.0	0.16	0.41	3.9	9.4	11
Tape (PB)	0.0	0.6	2.4	18	56	104
Disk (PB)	4.0	6.0	6.0	20	44	80
CPU (kHEPSpec)	130	160	320	440	550	830

diverge after 7 to 8 years due the the difference in luminosities of the two machines in the later years, but they agree well at early years. And the study shows that Belle II requirement is clearly not overestimated.

In conclusion, the committee would like to confirm its full support for the revised computing resource requirement presented by the Belle II collaboration.