Deployment of the Physical Analysis Farm with Workflow Management Application in Data Center

Byungyun Kong, Heejun Yoon, and HeeJune Han

Abstract—Nowadays, the large scale data and big data are big issues in information technology. High energy physics experiments also require analysis facilities for analyzing large scale data from large equiment exeriments. So that in large experiment such as LHC has been using linux clusters and grid systems for such analysis. However, there is a quota limitation on the usage of the grid system for the distribution of resources, therefore a cluster farm without such restriction is needed for domestic researchers. Nevertheless, the analysis macro used in the two systems were different from each other, which made it difficult to use cluster farm. We have built a physical analysis farm that enhances user convenience by using a workflow management application for HTCondor, called DAGMan, and confirmed that the number of complicated job processes in the farm has increased compared to the previous farm

Research Keywords— Analysis farm, DAGMan, HTCondor, Linux cluster

1 INTRODUCTION

Recentuly the trend is changing into large scale data, big data. High energy physics also produces huge amounts of data and many scientists are analyzing these data. The ALICE experimental collaboration about the heavy- ion physics produced a large amount of data from a large accelerator and analyzed the data using the grid system called WLCG. However, due to the limitation of the user quota and the queue waiting time in the operation policy of the grid, the necessity of the farm which can be used only by domestic researchers has been raised.

The international organization CERN, to which ALICE belongs, provides the open source frameworks for physical analysis through a file system called CVMFS[1]. So the tools needed for analysis are ready. What we need to consider here is analysis resources and data management. In the case of data management, it is solved by developing staging command using with XrootD[2] as described in the previous study[3]. The remaining part is managing resources efficiently during data analysis.

This paper is composed as follows: related work is in section 2, practical application example and result are in section 3, and the last section 4 includes the conclusions.

2 RELATED WORKS

2.1 Analysis farm based on PROOF

Previous korean ALICE farms were using the PROOF and PoD for analysis[4]. However, the researchers faced to difficult cause the analysis macro was different from the grid system and the PROOF system. In the case of a grid, all of the data is located in each system, so users can use it without requiring additional data staging. Therefore, even if the use constraint through direct management is minimized, the user must directly request data staging and write the new analysis macro for the PROOF. As a result, it can be

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assumed that the analysis of the constraint situation of the grid is that only a few operations are analyzed in the previous farm. Based on these assumptions, we decided to improve this part by judging that activation of the farm is belong to solves the difficult part of the writing the new analysis macro.

2.2 Workflow management application

Because physical analysis is to calculate multiple data with the same analysis code, performing batch jobs using HTCondor can be used for this kind of task. Futhemore, if you only do to divide the job as small input data, you can use code for local mechine that is not for PROOF system. The small size of the analysis code uses the local machine rather than the grid network, so it does not burden the user to write the macro again. In the end, the problem of writing macro is solved by suggesting solutions to how to divide and perform tasks. And the result of the work must be gathered together, and the flow is fixed in this work.

The HTCondor has a Directed Acyclic Graph Manager application called DAGMan[5]. This helps us to work step by step because we can define the order according to dependency of work with this application. We can make the following configuration with this application. First, to divide the data needed for the analysis macro into several pieces. This is done by splitting the input file list through a bash script. Prepare macros to merge the results of the following tasks. Finally, we define the priority of the task to perform a macro that combines the resulting files into one after the individual tasks are done using DAGMan. In this way, the user's analysis job will be divided into several small tasks, and then the results will be merged into one. This allows researchers to get the results they want without writing special macro.

3 PRACTICAL APPLICATION EXAMPLES

Based on the results of the previous research, the input files of the user's task is listed, and this list is divided and the this workflow is applied to the newly constructed korean analysis farm, called KIAF[6]. This farm can be a good example to apply the workflow management application. The KIAF was based on HTCondor has been successfully built and has been in service since last July and released the User guide in August. Initially, the ratio of HTCondor work to PoD work was 1: 1.7, but last December work ratio is 85: 1. The ratio is increased significantly with HTCondor work. Simply, the number of complicated job processes increased from 519 to 84,163 during same period. The number of complecated job processes in the currently installed farm shows that it has processed many analysis tasks due to the increased convenience. In the future, there is work to tune these tasks to be more efficient. The actual users' requirement was the need to monitoring the analysis work, not the condor job.

4 CONCLUSIONS

By understanding the patterns of existing analysis, we have completed the creation of actual scripts and macros from the design of batch job creation and applied them to the actual running farm. The result of the application is the increase of analysis rate using Condor and the increase in the total number of work processes. It is expected that the goal is to revitalize the Palm by improving the accessibility of the user that was expected.

In the future work, we aim to increase user convenience by developing efficient farm management through operational policies and batch job monitoring tools.

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REFERENCES

[1] Buncic, P., Sanchez, C.A., Blomer, J., Franco, L., Harutyunian, A., Mato, P. and Yao, Y., “CernVM–a virtual software appliance for LHC applications”, Journal of Physics, IOP Publishing, Vol. 219, No. 4, p. 042003, 2010

[2] Dorigo, Alvise, et al. "XROOTD-A Highly scalable architecture for data access." WSEAS Transactions on Computers 1.4.3, 2005

[3] S.U. Ahn, S.O. Park, J.H Kim, B.Y. Kong, “Implementation of Dataset Staging Process in a New Analysis Facility for ALICE Experiment”, The 6th International Conference on Convergence Technology 2016, vol. 6, no. 1, pp. 830-831, 2016

[4] S.U. Ahn, I.Y. Yeo, S.O. Park, "Secure and efficient high-performance PROOF-based cluster system for high-energy physics", The Journal of Supercomputing, Springer, vol. 70, no. 1, pp. 166-176, 2014
[5] Frey, James, "Condor DAGMan: Handling inter-job dependencies", University of Wisconsin, Dept. of Computer Science, Tech. Rep, 2002
[6] B.Y. Kong, S.O. Park, S.U. Ahn, "Deployment of a New Analysis Facility on Demand upon The Existing Resource Management System in Data Center", The 6th International Conference on Convergence Technology 2016, vol. 6, no. 1, pp. 833-834, 2016

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