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DISK ARRAY SIMULATION MODEL DEVELOPMENT

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Abstract
This paper presents a detailed development process of dynamic, discrete event simulation model for disk array. It combines a hierarchical decomposition with the "bottom up" approach. This way, at the beginning, the focus is set on the elementary storage component – a single disk drive. Once when functional simulation model for disk drive has been achieved it is used as a basic storage element for disk array model development. Further on, it is explored how to simulate different interfaces inside disk array, toward underlying disks. The difference in throughput produced by developed model and measurements is from 1.5-3.16 % for writing and from 2.5-2.8 % for reading, depending on interface type. However, such results are limited on workload imposed by the requirements of the ALICE transient storage system, or more precisely, sequential storing and reading of large data files.
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Key Words: Discrete-Event Simulation, Disk Array Simulation, Disk Simulation, Disk Cache Model

1. INTRODUCTION

Many modern, data intensive applications, like scientific data logging in high-energy physics, are aggressively pushing demands for data storage. Consequently, it becomes an interesting issue to analyze and improve performance of storage media. In order to perform that, several approaches are possible. One of them, described in [1], is to perform a set of measurements on the existing storage system. It is advisable, if storage system really exists, but in many cases it can be too expensive in the terms of required hardware and measurements software and even too disruptive toward system itself. The other approach is to develop a model of the system and study it, as a surrogate for system optimization. Although model development is time-consuming process, once when it is developed optimal system configuration can be chosen simply by changing system components, their organization or input parameters without any additional expenses.

For storage systems, especially complex, data intensive storage systems, model development primarily means building up the model of its main storage element - a disk array or Redundant Array of Independent/Inexpensive Disks – RAID.

Its analytical models have been under study for more than decade. The earliest models discussed in [2], [3] approximated access latencies. These were followed by various contributions, each focused on a different aspect. For example, [4] considered the effect of the execution mode on performance, [5] investigated fault tolerance, [6] analyzed the effects of caching. Even so, the analytical model of arrays are still under study like in [7] where the performance of a multi-level array architecture is described, or in [8] where model is used for an analyses of disk-oriented rebuild processing in RAID5 arrays.

On contrary, simulation models for arrays are very rare. Till now, only one functional simulator has been developed - a RAIDframe [9], aimed for redundant array software development. Other ones simulate just a part of the array under study like in [10] where

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