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Design of Video Compression Approach in Grid Environment

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***Abstract*—** Grid offers an optimal solution to problems requiring large storage requiring large storage and/or processing power. Grid provides direct access to computers, data, software and many other resources. Sharing between these resources is highly controlled and done with consensus of both resource providers and consumers. Video compression is a lengthy and compute intensive task, involving compression of video media from one format to another. Video compression refers t reducing the quantity of data used to represent digital video images, and it's a combination of spatial image compression and temporal motion compensation. Video compression system maintains high picture quality while reducing its quantity by removing redundancies. In Grid computing the task is split up into smaller chunks and the resources of many computers in a network can be applied to a single problem at the same time independently. These factors make the distribution of video compression viable in Grid environment. This paper provides a discussion of design of video compression in Grid environment, Grid environment and its globus toolkit 4.0.

Keywords*-Grid computing, video compression, spatial image compression, temporal motion compensation, standards.*

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I. INTRODUCTION

Grid computing is a technology that brings together a set of resources distributed over wide-area networks that can support large-scale distributed applications. Grid computing is the act of sharing tasks over multiple computers. Grid computing applies resources of many computers in a network to a single problem at the same time. Grid computing enables the virtualization of distributed computing and data resources such as processing, network bandwidth and storage capacity to create a single system image, granting users and applications seamless access to vast IT capabilities. Grid coordinates resource sharing and problem solving in dynamic, multi-institutional, virtual organizations[1]. Grid focuses on large-scale resource sharing, innovative applications and high performance orientation. The idea of Grid computing originated with Ian Foster, Carl Kesselman and Steve Tuecke[2]. They got together to develop a toolkit to handle computation management, data movement, storage management and other infrastructure that could handle large Grids without restricting themselves to specific hardware and requirements. The technique is also exceptionally flexible. [2]

Video is an integral part of multimedia. Video compression is a tradeoff between disk apace, video quality, and the cost of hardware required to decompress the video in a reasonable time. This allows a more efficient storage and transmission of data [3].

II. GRID COMPUTING GLOBUS TOOLKIT 4.0

It is a collection of open-source components. Many of components are based on existing standards whereas some components are based on evolving standards. Version 4 is the first version to support web service based implementations of many of its components[4].

GT4 provides components in the following five categories:-

1. Common runtime components
2. Security
3. Data management
4. Information services
5. Execution management

III. VIDEO COMPRESSION APPROCH IN GRID

The steps required for setting up a Grid environment and solving the compute intensive problem of video compression using Grid environment.

1. Prepare a Grid Environment.
2. Each node must be synchronized with Grid node.
3. Each node must have Mplayer and mencoder at each Grid node.

Our main task is to perform video compression in Grid environment. A true video compression system would require enormous storage facility accoutered with high-speed access and replication facilities. A centralized storage in a scenario has its own demerits and infrastructure costs. Thus, pre-splitting and distributing media content across various nodes with large storage capacities is a feasible solution.

Centralized environment are often hit by performance bottlenecks that arise as they doesn't scale enough while handling parallel connection-requests and maintaining sessions. On the other hand distributed environment is capable of efficiently handling the same.

Hence the compute intensive problems can be efficiently handled on a distributing environment. Grid computing is considered to be a highly scalable solution where compute intensive tasks are split up into multiple low-cost systems so that the overload is minimized and cost reduced. Grid computing works extremely well in parallel scenario where data can be split up in multiple nodes in Grid environment.

Grid proved to be an excellent solution for distributed video compression. Parameters for video compression are cost, time required for the compression, cost of the software and quality of the compressed video[5].

A. Challenges of Grid Design

A Grid environment designed for video compression is characterized by the efficiency, resource utilization, fault tolerance etc. it offers to its end users. Grid computing provides virtualization of a single system and complete control over the presentation session to its end users. Challenges which are needed to be address are:-

1. **Security-** for supporting heterogeneous Grid architecture, there is a need to secure the Grid resources from unauthorized access. So we need secure standard methods for authentication such as applying different passwords, firewall configuration, CA server configuration is required.
2. **Network Establishment-** As the network is already established in the laboratories we need to make a private network on the same infrastructure laid earlier. So we need to plan a network on the existing network.
3. **Fault tolerance and Robustness-** To support fault tolerance and robustness in the system there is a need to script replication of jobs to idle resources and facilitate fault tolerance and robustness in the system.
4. **Cost Effectiveness-** Design need to be cost effective in terms of resources and financial structure.
5. **Bandwidth Availability-** As the network link may not always be consistent, one needs to manage the bandwidth corresponding to network change and still maintain quality of the media.

In addition to the above parameters, such a setup needs to be highly user friendly to ensure ease of use and user satisfaction. Our Video Compression Grid system uses distributed technique to take this problem under consideration and develop an efficient solution.

B. Different steps involved in Video Compression

1. Test that each node of the Grid is properly connected with each other and synchronized with CA server.
2. Check that each node has required software.
3. First task is to select a video. Now using Mencoder we will first split the video and with the help of python the splitted video would be distributed.
4. Now further using mencoder compression will performed and after the compression the performed, each node will send the compressed video to the job submission node. It will recombined into one video.
5. To test the quality of video we use mplayer to play and test[3].

C. Challenges of Video Compression

A video compression system basically characterized by flexibility it offers to its users. Video compression service must provide its local or remote users complete control over the presentation session[3].

Challenges which are needed to be address are:-

1. Load distribution on server- To support multiple connection requests from user, and facilitate minimum response time.
2. Media content management- It consists high storage space, effective content management, replication strategy etc.
3. Rate control- For adapting to network, the system may need to vary the transport and encoding rates.
4. Scalability and cost effectiveness- Design need to be easily scalable and cost effective in terms of resources and financial structure.

IV. DESIGN AND PERFORMANCE ANALYSIS

In our experiment we have 3 nodes, each node can perform video compression independently.

Node B: - CA Server.
Node A: - PBS Cluster node.
Node C:- SGE Cluster node.

If video compression is performed on a single node it takes a long time. While if used distributed Grid the time of compression will be reduced. To compress any video without changing its format the task of compression has been performed and three results have been taken:-

Node.	Actual Size of video in MB	Size after Compression	Time taken on single System in Minutes	Avg. Time taken on Grid in Minutes
A	897	834	58	43
B	897	834	56	48
C	897	834	64	44

Average time of compression (in Grid) = (T1+T2+T3)/3
= (43+48+44)/3
=45 min.

Average time of doing compression on a single node
= (T1'+T2'+T3')/3
= (58+56+64)/3
=59.33 min

Thus on average 14.33 minutes are saved in video compression.

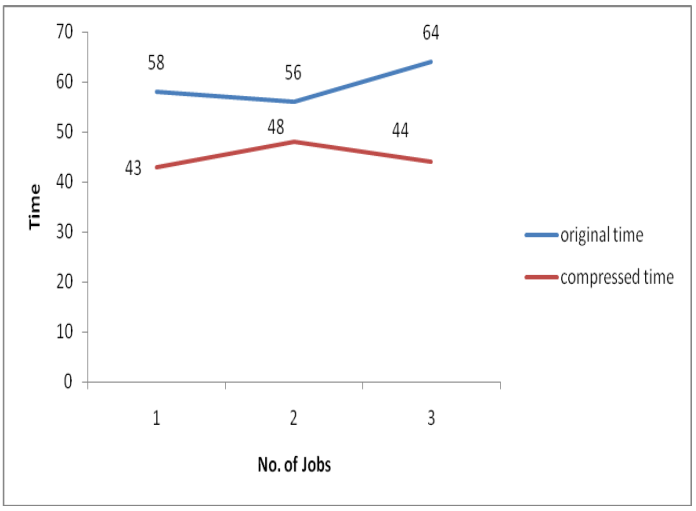

Figure 1. PLOTTING OF ORIGINAL TIME VERSUS COMPRESSION TIME

After conducting around 12 runs as above the following factors are affecting performance of compression:-

1) Size, video format, output format.
2) Bandwidth.
3) Grid Load, Grid Scheduling.
4) Node's local processing and availability.

V. CONCLUSION

Grid computing is an efficient tool for sharing tasks over multiple computers. Tasks can range from data storage to complex calculations. Hence video compression can be done

more efficiently using Grid computing than on single system. Resources can be better utilized and time complexity of a video compression is reduced by distributing it on number of clients using Grid computing. Hence it's an ideal approach for computing large computational tasks through Grid computing.

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