Enhancment of Grid Scheduling using Dyanamic Error Detection and Fault Tolerance

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ABSTRACT

The computational grid solve most of the problems that arise in many scientific application with the help of the heterogeneous resources which is spread across the distributed environment .The challenges that arise in such case of utilization of the resources and scheduling of jobs can be overcome by the techniques of error detection mechanisms .The early error detection mechanism collects the entire information about the resources which are available in the heterogeneous distributed environment. The resource information can be used during the allocation of jobs to that resources so that the job gets executed successfully without any failure in the resource. But the error detection mechanism also has its own drawbacks like the remote host server may be down ,file transfer services may not supported by the host ,there may be any malfunctionality in the service protocols and the hardware failure which occurs during data transfer also cannot be tackled in error rectification .To avoid this we introduce fault tolerance mechanism to overcome the difficulty.

Keywords

Distributed systems, data aware scheduling, Error Detection, Fault tolerance, Grid computing, performance of systems, Scheduling

1. INTRODUCTION

Grid computing has emerged as a distributed methodology that coordinates the resources that are spread in the heterogeneous distributed environment. The resources can be categorized as computational resources and storage resources .The example for computational resource is CPU and an example for storage resources is all storage devices like hard disc and drives .Based on the need the resources can be scheduled .The management and scheduling of those resources is very difficult since it is owned by a different network or by an individual owner as well the policies also will differ. The latency and the throughput are the two main factors for Performance in the closely coupled distributed environment. The resource failure may occur on both the cases ie the computational resources as well the storage resources. Failure that occurs during the data transfer is very common for example the user may be unaware of the connectivity failure that occurs in the background network[1]. The importance of error propagation and categorization of errors in Grid computing has been mentioned clearly in [2]The users of the system or the distributed environment may not be aware of what has been went wrong during their data transfer. The main idea behind this work is to give out an efficient fault tolerance mechanism to avoid the drawbacks of the error detection mechanism. The rest of the paper is structured as follows. Section 2 gives a literature survey on the related works .Section 3 and its subsections addresses the data scheduling with failure detection and fault tolerance. Section 4 and its subsections presents the data aware scheduler ,with error detection and fault tolerance. Section 5 gives the simulator results and Section 6 gives the conclusion of the paper.

2. RELATED WORK

In the review of literature [3] reveals that they focus on storage resources and data aware schedulers like :Stork. The Stork scheduler is designed to understand the characteristics of data placement tasks ,which includes data transfer, allocation of data to the storage device,de-allocation and data removal. The Stork interacts with high level planners and work flow managers. The Stork dispatches both CPU resources and storage resources together. The work flow can categorize and schedule computational resource to the computational scheduler and data placements to the Stork. It gives out a better result on resource utilization and storage space management.

In [4] reveals that it is necessary to have an efficient error detection and error reporting methods to increase the usability of existing data transfer protocols . Many works were carried out related to error detection and fault tolerance like in Condor [5], Phoenix [6].

3. DATA SCHEDULING

There are many algorithms like genetic algorithms and heuristic techniques which are available to schedule data. In the previous work [7] of my research a comparison was made on those algorithms for their performance in the data scheduling and the best optimal algorithm was chosen .Even those algorithms work fine but they have their own drawbacks which was rectified by using the techniques like Stork which is specialized in data placement and data movement. This scheduler uses the job description language for data placement jobs .It also can interact with high level planners and workflow mangers in order to verify when and in which network to send to send the data. The Stork has also it s drawbacks like congestion in the network through which the data is transmitted to the destination node .This sort of problem is rectified using our methodology.

The work flow model of the data and grid resource scheduling is given in the clearly [8]As per the diagram the users job request is processed by the workflow management system which manages the job submission to the grid resource through the Gridway and the transfer of data through the data placement system.

3.1Failure Detection

The possible failures are the remote host server may be down, or file transfer service is not functioning in the host, or file transfer service is not supporting some of the features requested, there may be a mal-functionality in the service protocol, user credentials are not satisfied, any other problem occurred in the source server. In addition it is also necessary to verify whether destination host and the service is available or not so that data transfer to that particular destination will not be processed until the errors are rectified .As well the information about the active services in the node will help to choose the alternative protocols for transfer .It is important to update the available resource information at periodic intervals to avoid the delay in allocating the resource to the job.

3.2 Fault Tolerance

Providing fault tolerance in a distributed environment, to optimize resource utilization and job execution time, is a challenging task. Fault tolerance [9] is the ability to preserve the delivery of expected services despite the presence of fault-caused errors within the system itself .It aims at the avoidance of failures in the presence of faults. A fault tolerant service detects errors and recovers from them without participation of any external agents, such as humans to accomplish it, two techniques are often applied: job check pointing and job replication. Check-pointing" is the process of saving the state of a running application to "stable storage". In case of any fault, this saved state can be used to "resume" execution of the application from the point in the computation where the check-point was last taken instead of restarting the application from its very beginning [10].In this paper we compare the results obtained from the Grid Sim for the data scheduling using the data scheduler ,and the data scheduling using prior error rectification along with this fault tolerance.

4. DATA AWARE SCHEDULER

In the Data aware scheduling the resource may be of either an CPU resource or storage resource .The user submits the job to the resource based on the work There will be poll of resources available. Based on the availability of the resource the job is allocated with the resource. In this work first we have worked with the data transfer mechanism and with the code we developed the scheduler activity which is shown in Fig 1.using the Grid Sim Simulator. we have selected the input for the CCR as 0.1 which is calculated prior and the other fields are filled up the values to compute the resource allocation for the jobs. We have also used the following acronyms in the generated input screen to carry out the allocation which is shown in table 1

Table 1: Showing few of the acronyms used in the screen

CCR	Communication to computational ratio
PE	Processing Elements
Poll time	Search time of the resource
Baud rate	Number of instructions processed per second
Propagation delay	Delay in communication

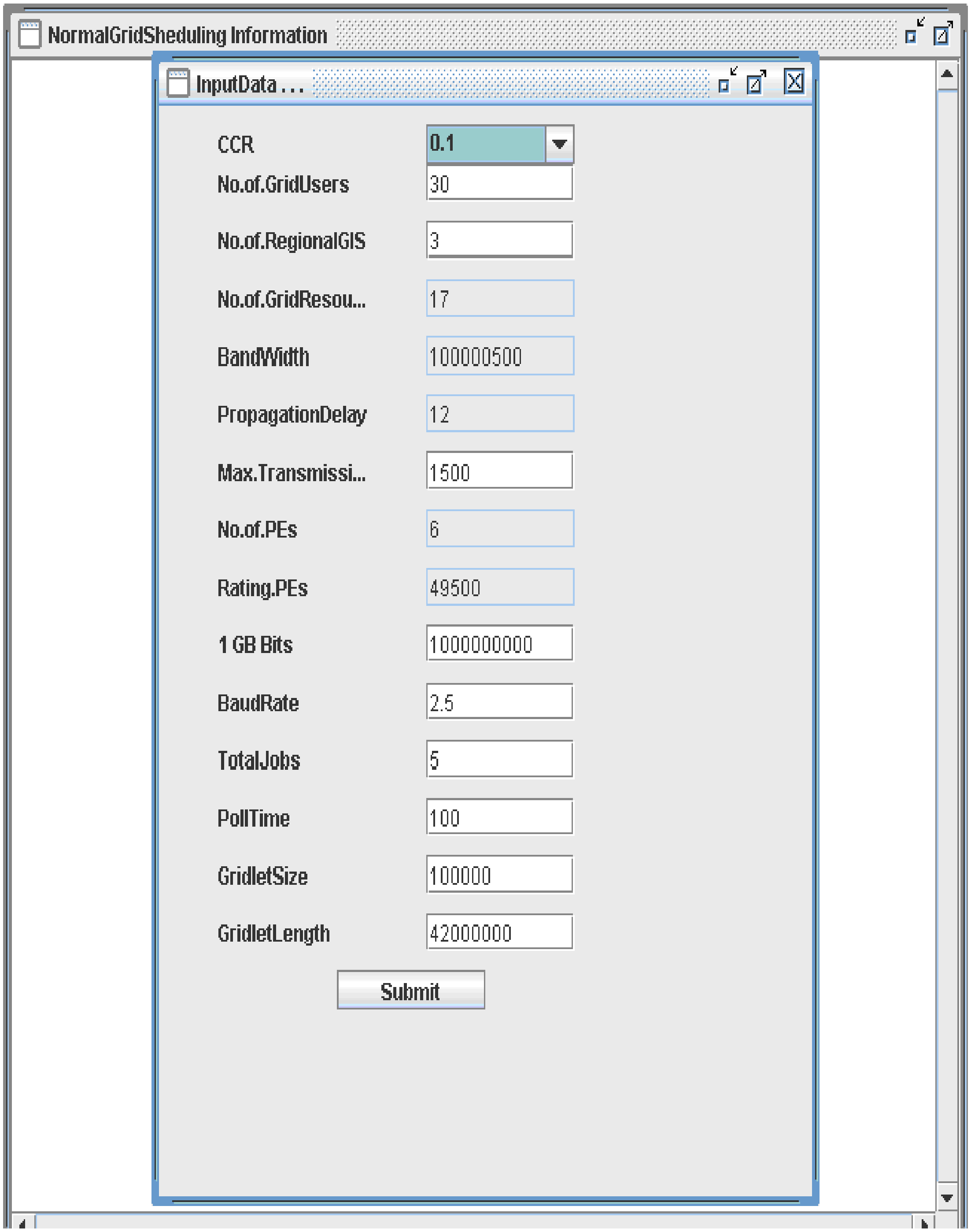

Fig 1: This picture represents the Normal grid scheduling with the CCR value as 0.1

The output for the above input is taken from the simulation result as shown in Fig 3.which predicts the number of resources which are available and gets allocated to the job and shows the execution of the job .

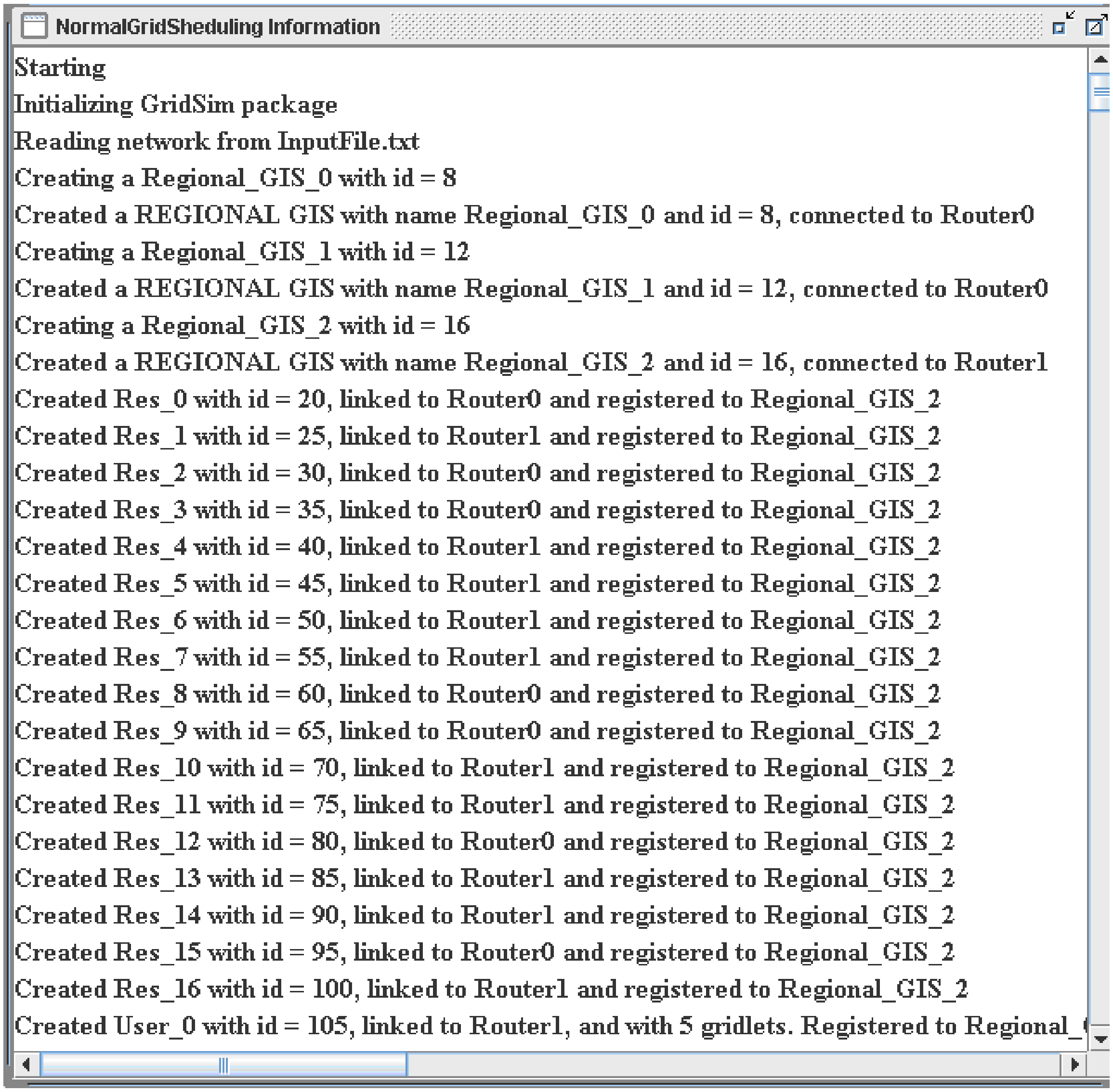

Fig 2: This Picture gives the simulation result for CCR value 0.1

Like wise for the various CCR values we haven taken the output and comparision is done.

4.1 Data Scheduling with Prior Error Notification and Rectification

In the data Scheduling with the Prior error detection mechanism we get the information about the resource to which the job is submitted .Based on the information of the resources the job gets submitted so that in future if any failure occurs with resource the user may be aware of the failure and can proceed further .From the simulation result we give the same value for the CCR and the result is taken and shown in Fig 3.The importance of error detection is clearly mentioned in [11]

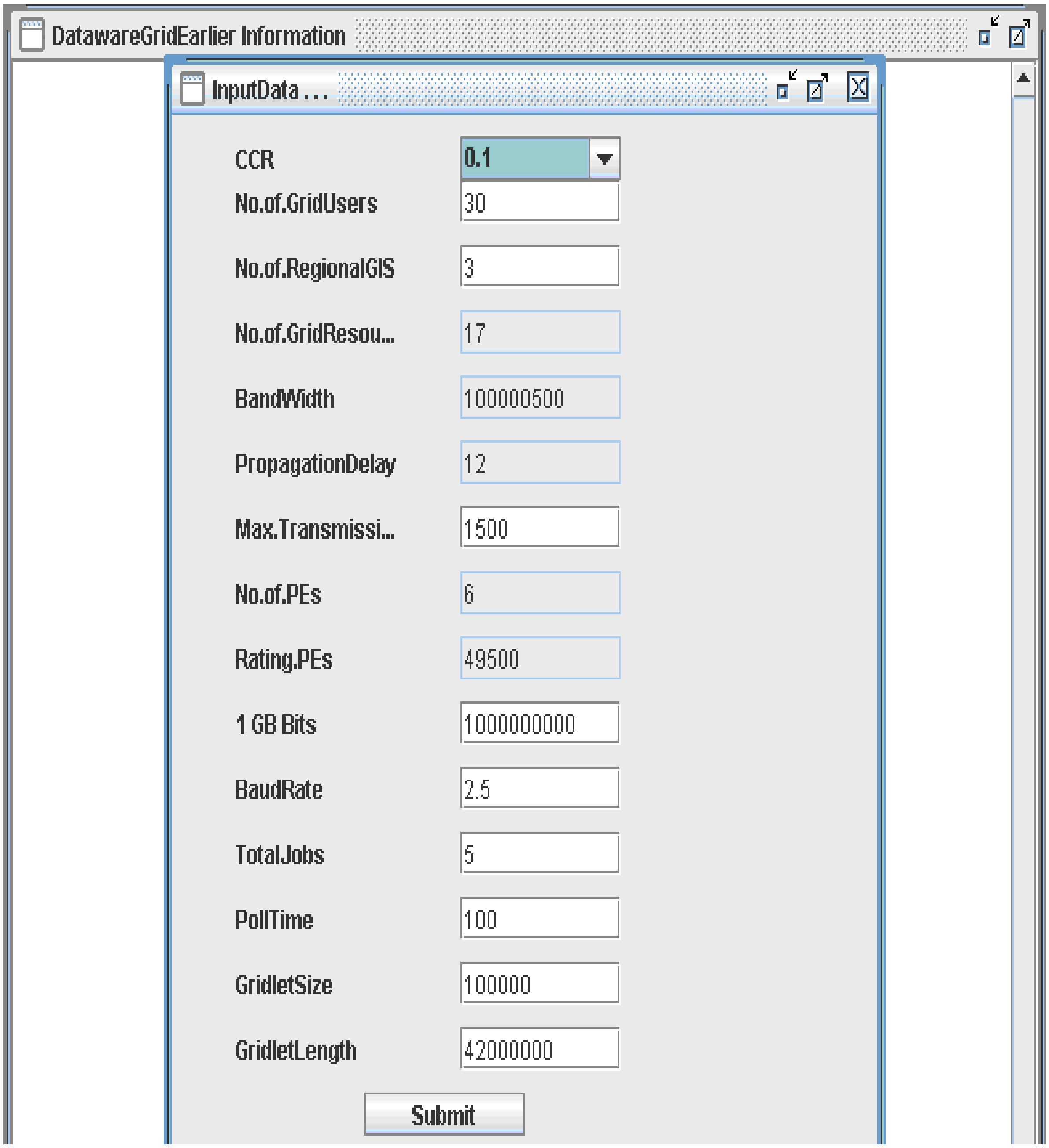

Fig 3: The picture shows the simulation where an input for CCR is given as 0.1for the second case.

The input for the CCR is given as 0.1for the data scheduler with prior error notification .The output for the given value of CCR is given in the Fig 4

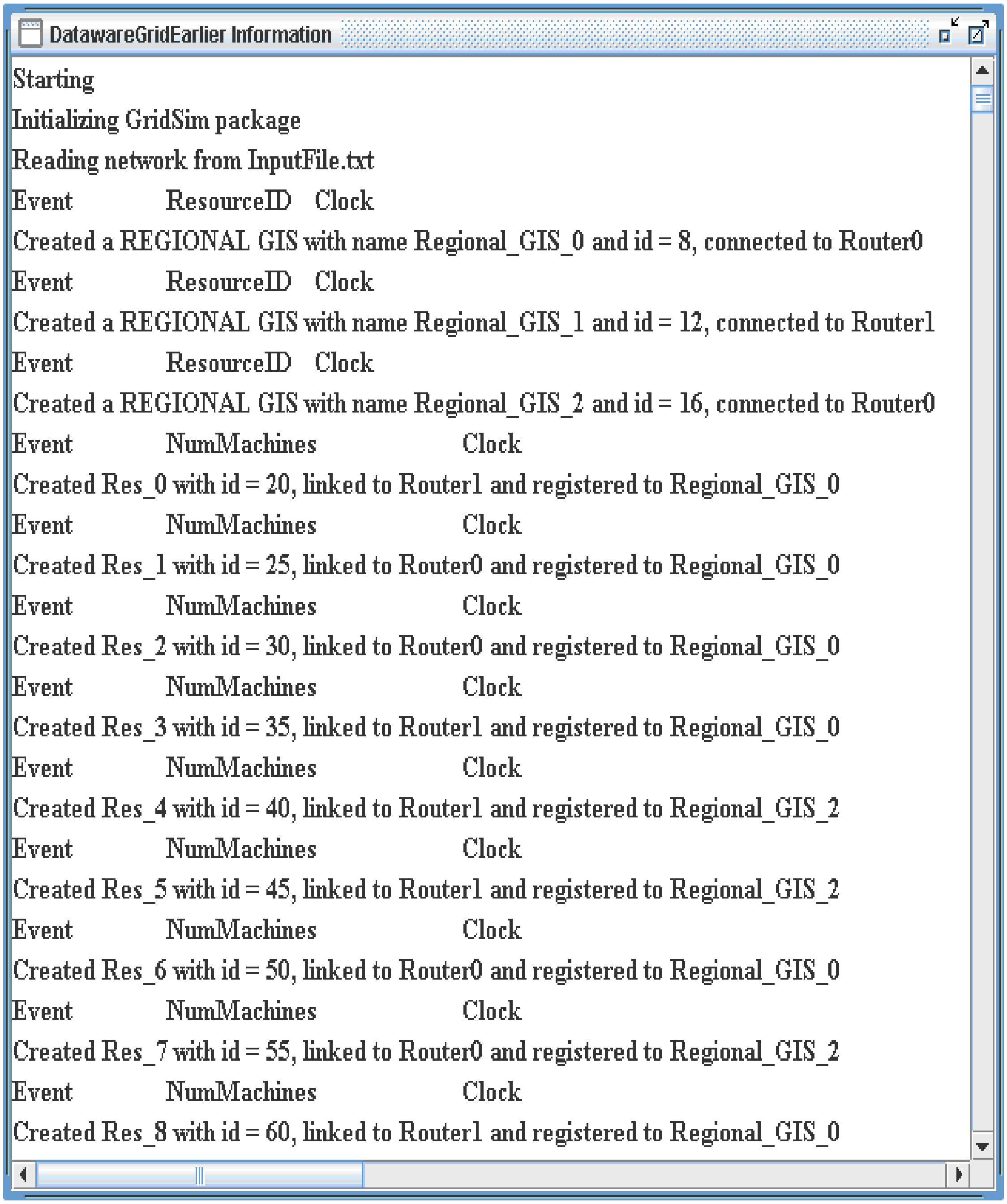

Fig 4: The Picture showing the result for the value 0.1

4.2 Data Scheduling with Fault Tolerance

With this data scheduling we introduce the fault tolerance concept with the same set of input in the simulation .we combine the fault tolerance which we mean here as the hardware failure like node failure in the network ,and how it works very efficiently is proved through the result shown in fig 5

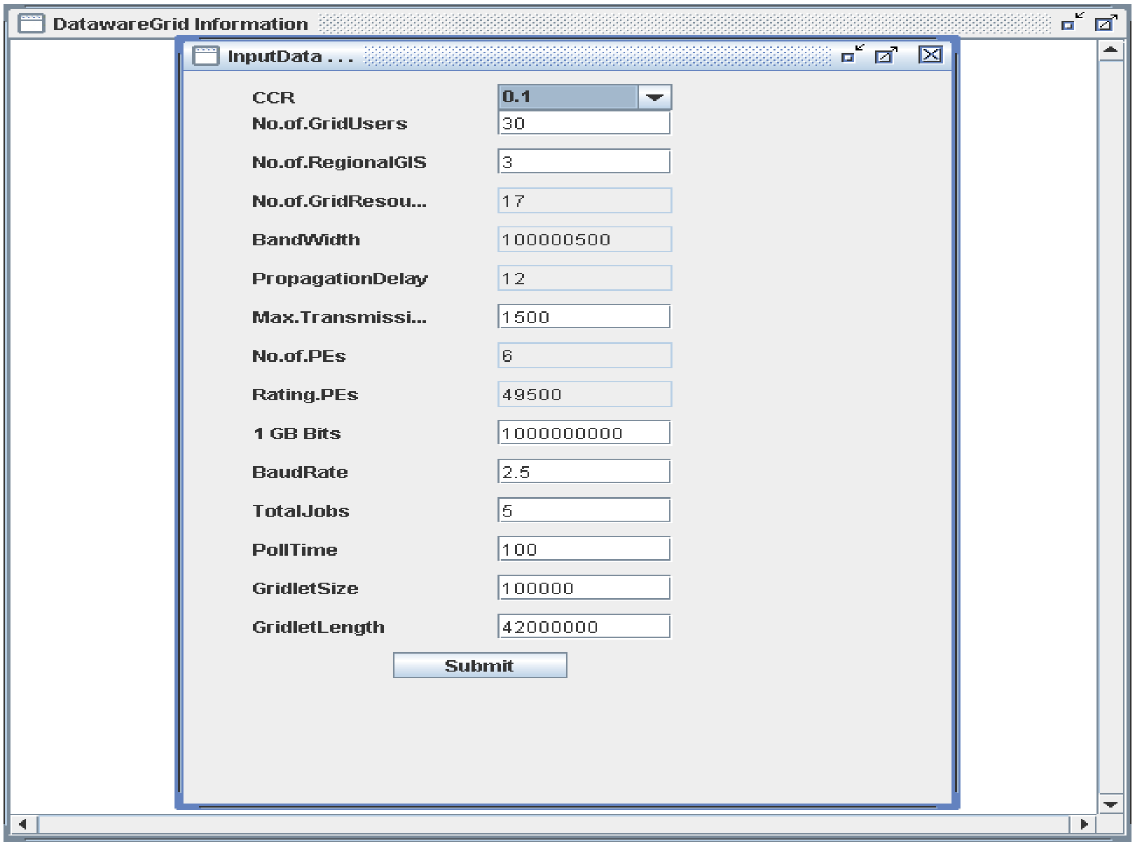

Fig 5: The picture shows the simulation where an input for CCR is given as 0.1for the third case

The out put for the above input is given as below in fig 6

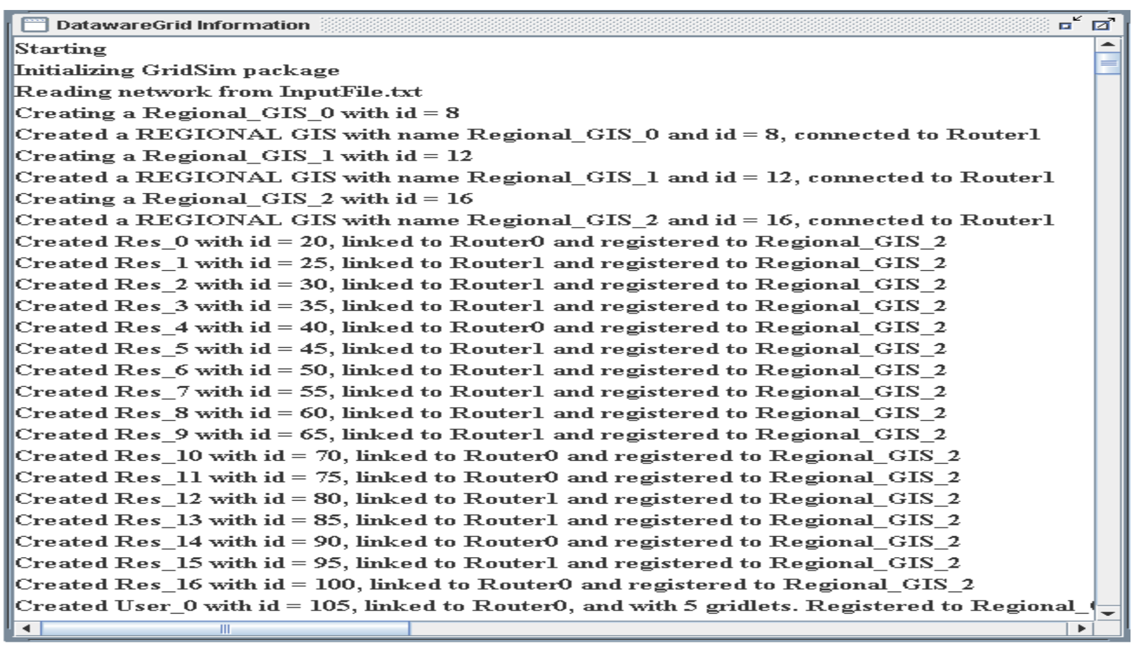

Fig 6: The simulation result of the fault tolerance grid

Different values in correspondence with CCR is given for the three constraints and it is represented in the form of table in Table 2.

Table 2:The values for X axis and Y axis for all the three constraints

Algorithm	X Axis	Y Axis
Data aware grid	0.1	103.99
	0.2	104.99
	0.3	105.98
	0.4	91.99
Data Grid with prior error detection	0.1	90.99
	0.2	95.96
	0.3	96.99
	0.4	91.99
Data aware grid with fault tolerance	0.1	88.99
	0.2	82.98
	0.3	80.98
	0.4	85.98

5. RESULTS

Based on the simulation results the values were plotted in graph and the result is given in different graphs based on CCR, PPI, and NRR, NM.

The first graph shows the execution time in milliseconds for CCR vs Time. The CCR here represents the communication to computation ratio in which both computation time and communication of the node is together considered for graph and is given in fig 7.

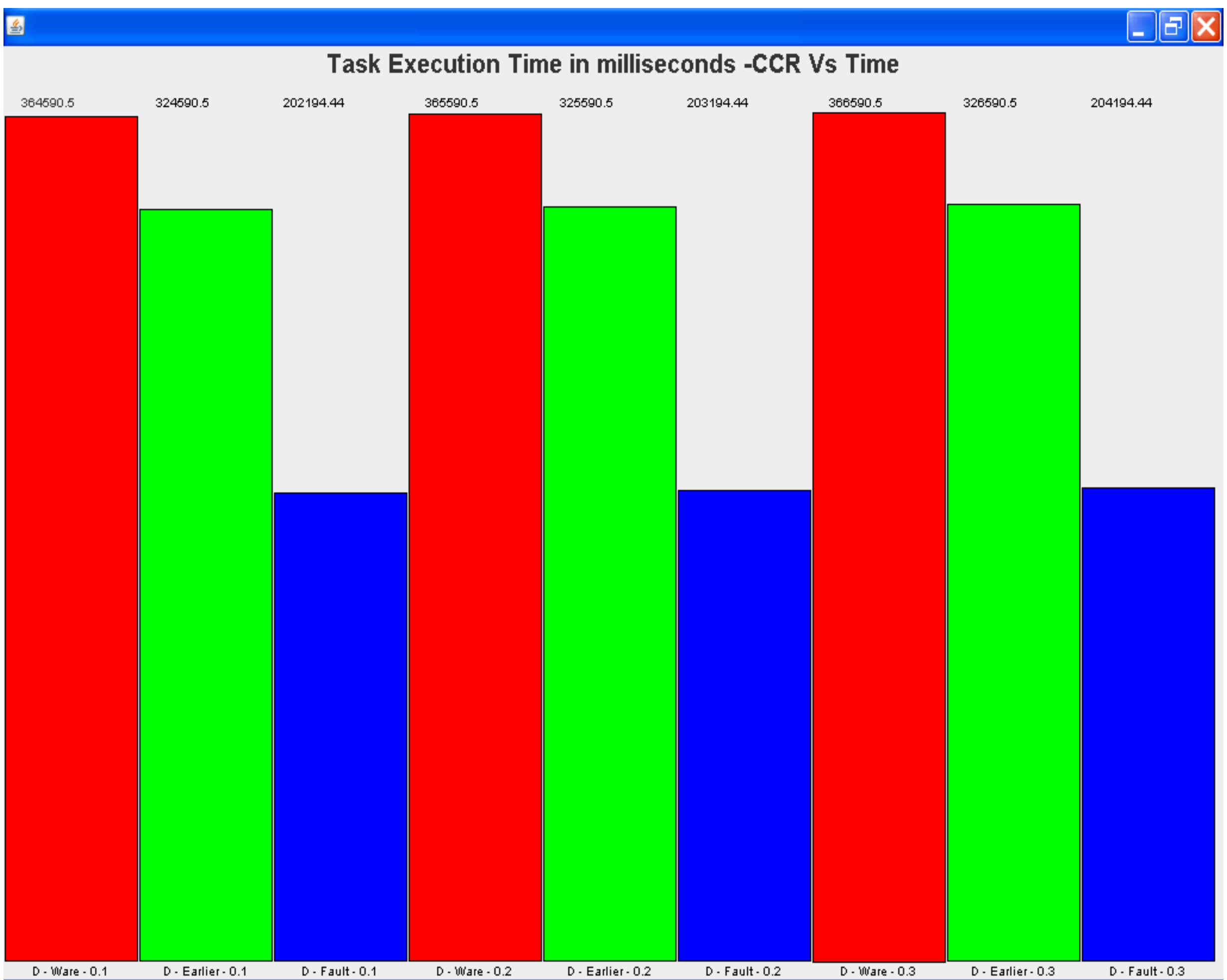

Fig 7: The graph showing the CCR vs. Time for datagrid , data grid prior error rectification and fault tolerance

From the above graph the execution time is found to be less for the grid with fault tolerance since even when there occurs a failure in the resource in a network an alternative resource is selected dynamically with minimum short span so that it does not affect the total execution time .

The normalized value of the resource usage and the performance prediction information is compared in all the three cases and plotted in graph and is given below in figure8 .where the data grid with fault tolerance shows better performance than the data scheduler and error rectification.

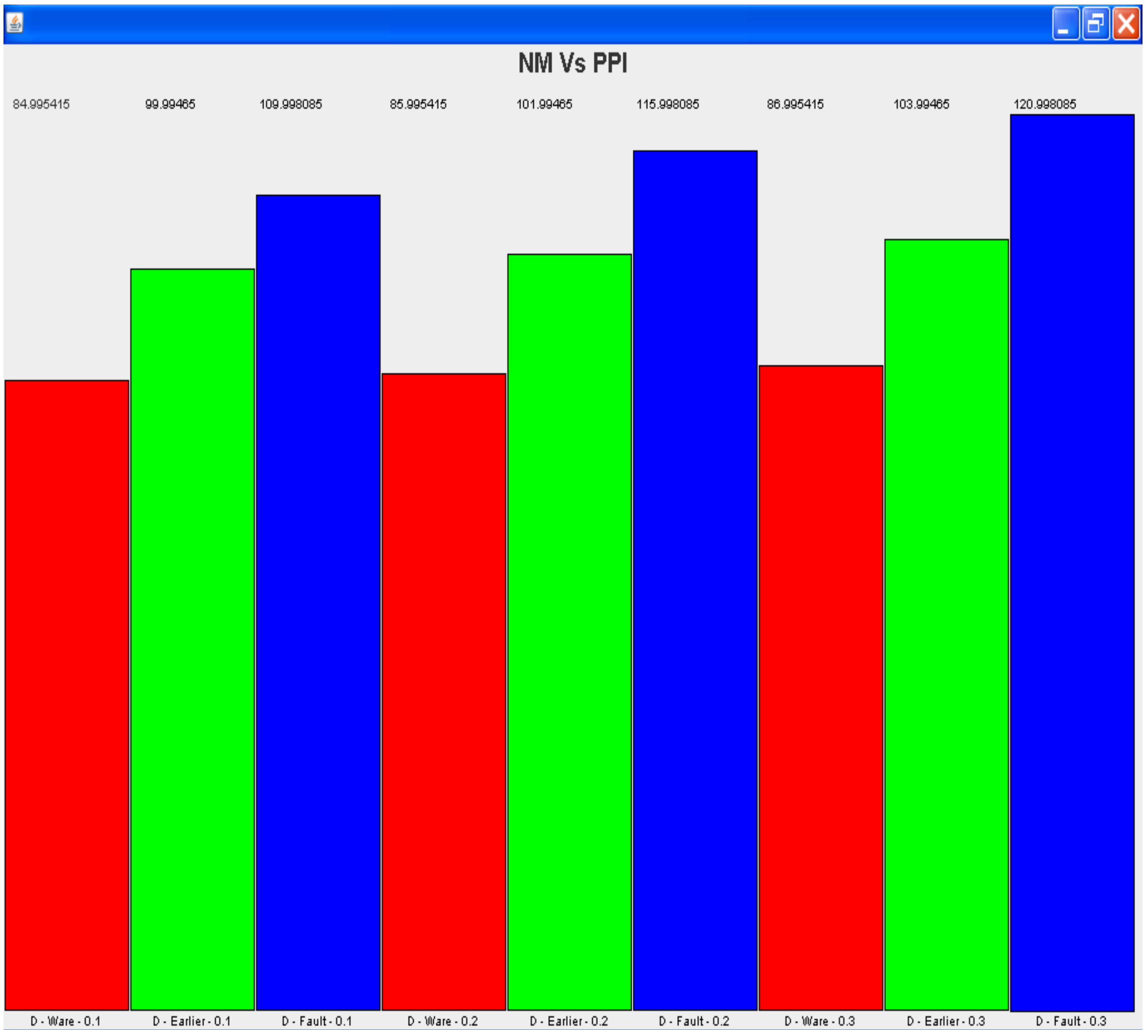

Fig 8: The Graph showing NM vs. PPI

6. CONCLUSION

In this paper we made a comparative analysis of the data scheduler grid with prior error rectification method and the experiment is implemented in the Grid Sim and the results are shown in the graph and from the results it is been proved that data scheduled with dynamic fault tolerance works more efficiently than the data grid scheduler and prior error detection All possible comparisons are made based on CCR ,PPI and NRU and based on those only the conclusion is given in this paper. In future the focus of further extension will be implementing check pointing with migration and replication technique to make the work more efficient.

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