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Decentralized Fault Tolerance on Grid Environment

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ABSTRACT*:* Grid computing is one of the technology for solving huge scale scientific problem utilizing heterogeneous and geographically distributed resource. Scientific problem is a major challenge in grid computing environment. In a grid environment potentially thousands of nodes connected to each other, the reliability of individual node cannot be guaranteed. Hence the occurrence of fault highly in grid computing. Therefore fault tolerance technique is essential in grid. In this paper, we propose a fault tolerance model for DCG(dynamic coloured graphs) on decentralized environment. In our colouring technique, set of colours (RED, BLUE, GREEN) assigned to each node based on its level of attribute performance. We classify each node in a three category identical, more efficient and less efficient based on attribute and assign RGB colours. The simulation result shows that very well perform and reduce the ART and AWT in huge grid environment.

KEYWORDS: Dynamic coloured graph, Decentralization, Grid environment, Fault tolerance, scientific problem

I. INTRODUCTION

In grid computing is a software system that provide uniform and location independent large -scale resource sharing and access, wide area communication, etc., In [9] major challenge in a grid is fault tolerance. Thus the grid application using some fault tolerance technique .The FT service essentially satisfy the Quantity of service(QOS) requirements in grid and deals with various types of failures, which include process, processor and network failure. Fault tolerance in grid computing have three technique:1.replication(maintaining a enough number of copy)[7]; In [2]Rescheduling (finding alternate path) 3.checkpointing(save the process in particular interval point)(23).Different strategies have been researched to detect and correct faults in network figuring framework. In [2] decentralization system play each node (site) alternatively the role of client or server.[1] The proposed system to eliminate the need of centralized server , because the central server would become a bottleneck problem. In [8] RMS was the 'brain' of the grid computing, its plays an important role in managing the pool of shared resources, in matchmaking the programs to their requested resources, and in controlling them to access the resources through wide-area network. The programs can reach the remote resources and exchange information through the connections. The grid security mechanism then operates to control the resource access through certification, authorization, and authentication, which constitute various logical connections to cause dynamicity in the network topology. In [14] comprehend fault tolerance mechanisms; it is important to point out the difference between faults failure, errors and crash. Fault is a condition that causes the software to fail to perform its required function. Error refers to difference between actual output & excepted output. Failure is inability of a system or component to perform required function according to its specification. Crash: when nothing happens. Graph colouring is one of the most important concepts in graph theory and used in many real time applications in computer science. In this paper, we propose dynamic coloured graph for each node in a grid environment. If an application fails, for example because the computing node goes down, it must be ensured that the application can be successfully restarted on a different computing node using DCG. In [14] monitor the status of the nodes in the grid environment, therefore a weight is assigned to each node (refer table 1)

II. RELATED WORK

In DCG fault tolerant technique support the grid node for successful deployment of computational grids. Grids are also usually loosely connected, often in decentralized network, rather than contained in a single location, as computer in cluster often are. In decentralized technique overcome the limitation of centralized system [12]. The main objective of this strategy is to reduce the time to find the best substitute for a failed node. Various fault tolerance strategy using for best node selection. In [14] PFTJS algorithm follows, "prevention is better than cure". Consider the faulty nodes after scheduling the job, this technique minimize the fault and reduce ART and AWT in grid. In[5] a fault tolerant model has been proposed that checkpoint tasks immediately to light balanced computing nodes. 'Perfect information algorithm' [5] is selecting a node with minimum finish time and migrating a task. Grid environment [4] is extremely unpredictable: processor capabilities are different and usually unknown, computer may connect and disconnect at any time, and their speeds may change over time. In grid vertices of the graph will have reassigned colour based on grid environment. Load balancing is the important concept in grid [4][12]. A good load balancer compare the nearest neighbour node capacity (heaviest and lightest node) after transfer the load. In our model consist of parameter (Node parameter, Communication parameter, QOS parameter) and its either static or dynamic value based on grid environment. In the parameter are classify the identical, more efficient, and less efficient in terms of performance and capabilities. In case of node failure, the selection of its alternates based on this classification.

III. DESIGN OF THE SYSTEM ENVIRONMENT

The open Grid Services Architecture (OGSA)[11] has enabled the integration of services and resources across distributed heterogeneous dynamic virtual organisation(VO). [15]Grid portal are interfaces interconnection between grid resources ad users. Job scheduling [16][10]is the core value and aim of grid technology, its aim is to use all kinds of resources. It can divide a huge task into a lot of independent and no related sub task, and then let every node do the jobs(see Fig 1). Even one node crashes, the task it should do will be reassigned to other nodes. A grid can be viewed as a widely distributed server, and the interaction between users and the grid is simply based on set of service request and response. When service request arrives at the resource management system (RMS), a corresponding service is initiated to execute a certain job under the sharing is highly controlled by the RMS. In[9][12]RMS play an important role in managing the pool of shared resources, in matchmaking the programs to their requested resources, and in controlling them to access the resources through a wide area network them to access the resources through a wide area network.

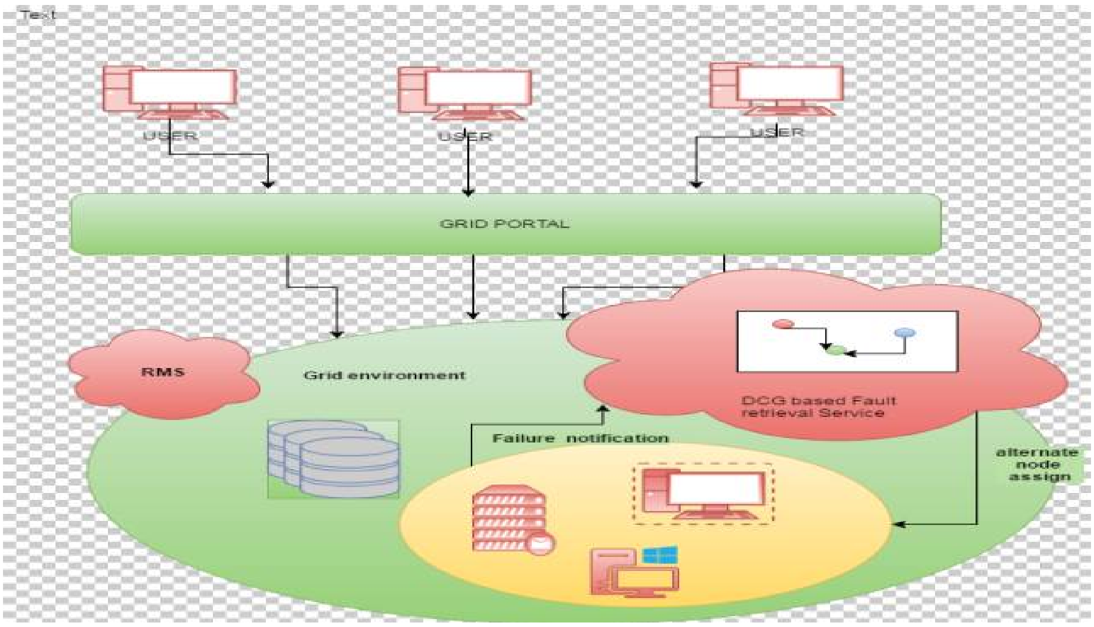

Figure 1 DCG Architecture

Graph colouring algorithms can be used to colour nodes in network according to the interval performance. we model a grid undirected graph G=(V,E),where the set of vertices $V=\{v_1,....,v_n\}$represents the nodes of the grid, and $E=\{e_1,....,e_m\}$ represents the links(edges) between nodes.
Distance between two nodes v_i and v_j are

$D(v_i, v_j)$

The sum of the weights of the edges along the shortest path between vi and vj compute using Dijkstra algorithm [7]. In grid is a dynamic nature, the graph G is dynamic, i.e.. At any time t, the graph may be subject to addition and/or deletion of vertices or edges. $G_t=(V_t,E_t)$ represent the dynamicity of graph.

IV. INITIALLY ASSIGED COLOUR BASED ON GRID ENVIRONMENT

We assign each node have unique colour based on the node attribute interval value. Each node consist of attribute namely memory, disk space, CPU speed, CPU workload, Bandwidth, Latency, Stability, MTBF, MTTR

COLOURIG RULES

We define for each attribute a_j, a unique interval of performance (ref table 1), noted $I_{a\,j}$= [vj1,vj2], which is predefined for all grid nodes. The values of two vertices (vj1 and vj2) are called respectively, the left end point and the right end points of the interval. In state vector monitor the graph and assign the colour.

$a^t{}_j$ belongs to Ia_j

At time t, the attribute a_j is coloured with green colour.

$a_j{}^t < I\,a_j$

The attribute a_j is coloured with red colour.

$a_j{}^t > I\,a_j$

The attribute a_j is coloured with blue colour.

Fault Tolerance

In our proposed model, we define a fault tolerance module to find, for each failed node in the grid, a set of substitutes that can replace it to ensure availability. Fault may be occurred in the grid environment, in workload of the current failure node transfer their information to the another neighbour node using load balancing algorithm. Increase the neighbour node workload determine new colour using colour set algorithm.

Colour Set Algorithm

Our algorithm belongs to the family of colour set algorithms, but with significant modification to adopt to our algorithm. [13]We label each node with a colour and change colours sets as they arrive of the incoming job and left the job.

Nodes are different colour depend on the dynamicity of grid (based on workload of node).

To enter a job (j1) in the node (n2) or vertex (v1) already the n1 is green. If j1 is increase the workload of n2 because new job enter the n2. Node n2 changed the colour is blue, because more workload of the n2 node.

- Node n2 contain colour B in the graph
- Node n1 contain colours R in the graph

1. If n2 accept new job and send message the state vector, if the state vector compare between n2.
2. If the attribute are node belongs unique interval performance, the node is green, else than Ia_j colour is blue, else more than Ia_j the is red.
3. In graph G, all vertex connected to the state vector, monitor the graph dynamic
4. If node n2 have more workload, if state vector assign new colour based on node attribute

Procedure *assign new colour n(a).*

If (n1 is blue)

N (a) ← Δ n1-j1

If SV ($Iaj > a_jt$) // (compare n1 attribute and unique interval)

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Return TRUE
Assign “n1” GREEN
Else
Assign “n2” RED
End if
End assign colour

Our algorithm idea is to minimize application placement changes by adjusting the existing load distribution. In the following, we will describe the details of our algorithm. The algorithm belongs to the family of colour set algorithms, but with significant modification to adapt to our problem. In each node attribute value compare to the unique interval performance.

Table 1 Grid properties

CLASS	ATTRIBUTE	TYPE	DESCRIPTION	PERFORMANCE INTERVALS
C1 Node parameters	Memory	Static		2-4GB
	Disk Space	Dynamic		100-500GB
	CPU space	Static		2-3 Ghz
	Workload	Dynamic		0.5-1.0
C2 Communications parameters	Bandwidth	Static	Fixed	100 Mbps, 1 Gbps
	Latency	Dynamic		15-20ms
C3 QOS parameters	Stability	Dynamic	0:Very Unstable 1: Unstable 2:Stable 3:very stable	
	Degree of disconnectivity	Dynamic	0:Very Unstable 1: Unstable 2:Stable 3:very stable	
	MTBF	Dynamic	Mean Time between Failures	6-12h
	MTTR	Dynamic	Mean Time To Repair	20-30min

V. PERFORMANCE EVALUATION

Our simulation infrastructure is created by combining two discrete event simulators namely Graph stream [18] and simulation grid [10]. Graph Stream is a java library whose purpose is to create and manipulate dynamic graphs and to use them in simulations. SimGrid is a simulation toolkit that provides core functionality for the different kinds of heterogeneous resources, services and applications types. Our experimentations (ref fig 2), we remarked that the average of the more efficient substitutes is slightly greater than the less efficient ones, whereas the identical

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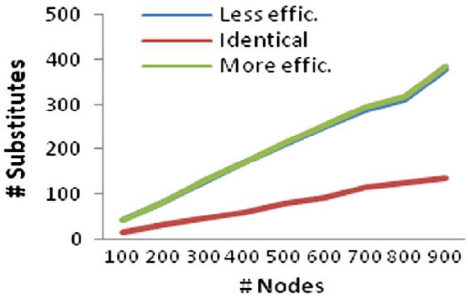

Fig 2: Dynamicity structure in the graph

VI. CONCLUSION

An "DCG" fault tolerance model was proposed the grid. This model compare with the existing load balancing and QOS model decrease ART and AWT of the system in three different types. The propose fault tolerance technique is scalable and can tolerant an increasing number of nodes without decreasing the performance. Experimental results show that our approach improves the performance and reliability of the grid computing environment.

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