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(54) Title: A CONTINUOUS MULTI - AGENT CONVERGENCE PROCESS THROUGH PEERING UPDATE IN A GRID RESOURCE MONITORING SYSTEM

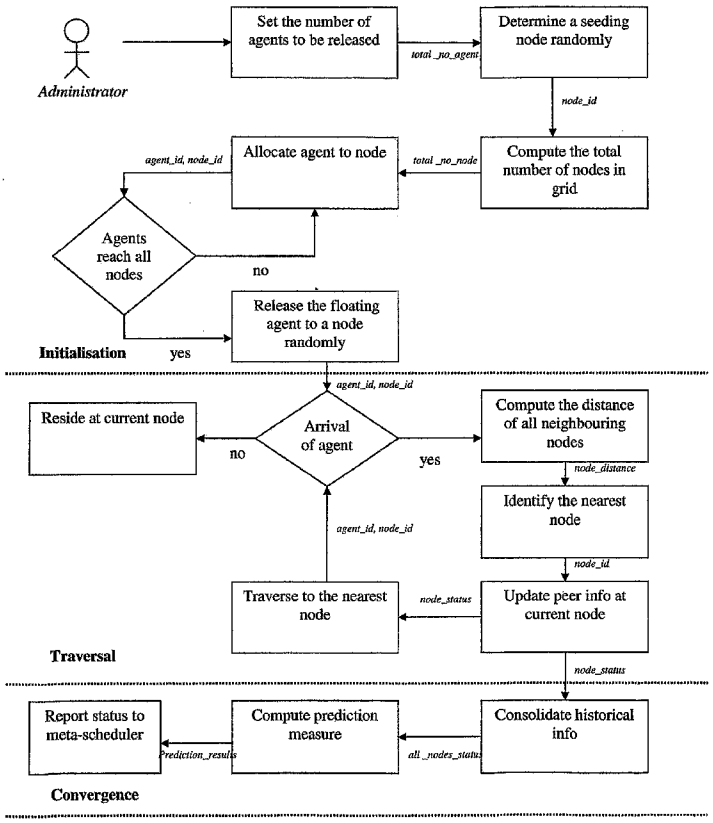

Figure 2

(57) Abstract: The present invention relates to a continuous multi agent convergence process through peering update for grid resource monitoring characterized in that wherein the process that is utilized by using a continuous multi agent convergence through peering update wherein said process is designed to allow more efficient monitoring of current and recent status across grid sites by using multiple agents to keep track and consolidate information of the adjacent nodes and wherein said process uses a random updating process that is triggered by arrival of agent, rather than bases on predefined threshold and periodic invocation to accommodate the frequent changes of nodes information in grid environment.

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A CONTINUOUS MULTI – AGENT CONVERGENCE PROCESS THROUGH PEERING UPDATE IN A GRID RESOURCE MONITORING SYSTEM

FIELD OF THE INVENTION

The present invention relates to a continuous multi agent convergence process through peering update in a grid resource monitoring system.

BACKGROUND OF THE INVENTION

Grid computing is a collection of distributed systems that involves heterogeneous computing platform across different geographical boundaries. This computing environment requires up – to – date information among the grid nodes to ensure the availability and efficiency of the system to deliver its optimum resource monitoring result. Keeping the latest information of each grid node has been a great challenge due to its dynamic nature and continuous extension. Despite having more alternatives, the availability of different grid technologies such as Globus, Legion, Unicore and etc, has also increase the complexity.

The problem with the current technology is that monitoring resources in grid environment often takes presumption of the status and the optimization level based on the most recent information. However, due to the nature of the grid computing platform, acquiring the latest information on the status of each resource may be procrastinated by various delaying factors such as network bandwidth, resource over subscription and etc.

As a result of the delayed information, job may be submitted to grid nodes with large amount job queuing while resources which are recently completed all the jobs will be left idle. Thus, optimizing the utilization of resources with the job submission loads would be a major hurdle to overcome. Moreover, the scalability and adaptability of the grid would also be relentlessly affected due to this varying condition.

Therefore, it is an objective of the present invention to overcome or reduce the above-mentioned problems by introducing a continuous multi – agent convergence process through peering update in a grid resource monitoring system.

SUMMARY OF THE INVENTION

The present invention relates to a continuous multi agent convergence process through peering update for grid resource monitoring characterized in that wherein the process that is utilized by using a continuous multi agent convergence through peering update wherein said process is designed to allow more efficient monitoring of current and recent status across grid sites by using multiple agents to keep track and consolidate information of the adjacent nodes and wherein said process uses a random updating process that is triggered by arrival of agent, rather than bases on predefined threshold and periodic invocation to accommodate the frequent changes of nodes information in grid environment.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows a flow chart of a disperse nodes in a grid environment

Figure 2 shows a flow diagram of the process according to the present invention

DETAILED DESCRIPTION OF THE PRESENT INVENTION

The present invention would be described with reference made to the accompanied figures but limited thereto therein.

According to the present invention, the technique that would be utilized herein would address the earlier mentioned disadvantages by using a continuous multi agent convergence through peering update. This process would allow more efficient monitoring of current and recent status across grid sites by using multiple agents to keep track and consolidate information of the adjacent nodes. In addition, this technique uses

a random updating process that is triggered by arrival of agent, rather than bases on predefined threshold and periodic invocation to accommodate the frequent changes of nodes information in grid environment.

The steps according to the present invention comprises of:-

1. A node disperses a predefined number of agents, A, to its adjacent nodes, N, in the grid environment. An agent, a_i, will reside at a node, n_i that it traverses if there is no existing agent reporting.

2. Each node keeps a record, R, to record its neighboring nodes' status, S, such loads, bottleneck bandwidth, CPU and memory utilization. This record will be updated by any agent that carries the latest tine, t and shortest path, P..

3. Agent that resides at each node will continue to traverse across the nearest path to the node's neighbors with the latest information of the resided node. For example, agents at n_2 travel to n_3, n_4 and n_5. As n_5 has a nearer path to n_1, information in R will be updated according to agent traversing from n_1.

4. As agent travel back by passing through other nodes, the information of other nodes will be updated together before reaching the agent's source, for example n_1.

5. R will provide the information to facilitate agent for routing submitted job from overloaded local queue to neighboring under utilized resources.

6. R will also provide a historical record as predicted measure, if the convergence takes longer time to achieve.

Record, R is information kept in each node. It consists of list of statuses, S such as loads, bottleneck bandwidth, CPU and memory utilization, disk utilization and queue availability. The updating of the record, R will be carried out by agent with the latest

time, t and shortest path, P. Once the convergence is achieved, record, R of each node will be able to have status, S of its neighboring nodes.

Reference is made now to Figure 2 wherein a detail process according to the present invention which reference to Figure 1 comprises the steps of:-

1. During the initiation of the Grid Resource Monitoring system, the administrator who understands the topology of the grid computing system determines the amount of agents to be released.

2. A seeding node is determined randomly based on the topology of the Grid deployment.

3. The number of nodes in the Grid deployment is computed and the agents are released into the Grid through the seeding node.

4. Each agent will travel to its designated node and response to the seeding node once it reaches its destination. In occurrence of loss agent, sufficient agents will be released to make sure each node has an agent.

5. Floating agents are released randomly through a specific node.

6. When a floating agent, a_1 reaches a node that does not have a residing agent, it will reside at the current node.

7. If there is already a residing agent, a_2 at a node, the floating node, a_1 will take the place of the residing agent.

8. Before leaving the current node, the residing agent, a_2 computes the distance of all the neighboring nodes and identifies the nearest node as the next destination.

9. The residing agent, a_2 travel to the next designated node together with the information (status, S) gathered during dwelling in the previous node. The residing agent, a_2 turns into a floating agent until it reaches the targeted node.

10. Once the floating agent, a_2 reaches the targeted node, step 6-9 repeats. In addition, the floating agent, a_2 updates the record, R of the targeted node with status, S of the previous node.

11. When the state of convergence is achieved, record, R in each of the node in Grid will have the status, S of each of its neighboring node.

12. Record, R can be consolidated in historical manner to serve as prediction measure for Grid meta-scheduler or to facilitate rerouting of job at overloaded local queue to other under-utilized resources.

CLAIMS

1. A continuous multi agent convergence process through peering update for grid resource monitoring characterized in that wherein the process that is utilized by using a continuous multi agent convergence through peering update wherein said process is designed to allow more efficient monitoring of current and recent status across grid sites by using multiple agents to keep track and consolidate information of the adjacent nodes and wherein said process uses a random updating process that is triggered by arrival of agent, rather than bases on predefined threshold and periodic invocation to accommodate the frequent changes of nodes information in grid environment.

2. A method of monitoring peering update in a grid resource monitoring system as claimed in Claim 1 characterized in that wherein the method comprises of a continuous multi agent process through peering update and wherein the method comprises of:-

   (a) A node disperses a predefined number of agents, A, to its adjacent nodes, N, in the grid environment and wherein an agent, a_i, will reside at a node, n_i that it traverses if there is no existing agent reporting.

   (b) Each node keeps a record, R, to record its neighboring nodes' status, S, such as loads, bottleneck bandwidth, CPU and memory utilization. This record will be updated by any agent that carries the latest tine, t and shortest path, P.

   (c) Agent that resides at each node will continue to traverse across the nearest path to the node's neighbors with the latest information of the resided node.

(d) As agent travel back by passing through other nodes, the information of other nodes will be updated together before reaching the agent's source, for example n_1.

(e) R will provide the information to facilitate agent for routing submitted job from overloaded local queue to neighboring under utilized resources.

(f) R will also provide a historical record as predicted measure, if the convergence takes longer time to achieve.

3. A method as claimed in Claim 1 wherein the method further comprises of:

a. During the initiation of the Grid Resource Monitoring system, an administrator who understands the topology of the grid computing system determines the amount of agents to be released.

b. A seeding node is determined randomly based on the topology of the Grid deployment.

c. The number of nodes in the Grid deployment is computed and the agents are released into the Grid through the seeding node.

d. Each agent will travel to its designated node and response to the seeding node once it reaches its destination. In occurrence of loss agent, sufficient agents will be released to make sure each node has an agent.

e. Floating agents are released randomly through a specific node.

f. When a floating agent, a_1 reaches a node that does not have a residing agent, it will reside at the current node.

g. If there is already a residing agent, a_2 at a node, the floating node, a_1 will take the place of the residing agent.

h. Before leaving the current node, the residing agent, a_2 computes the distance of all the neighboring nodes and identifies the nearest node as the next destination.

i. The residing agent, a_2 travel to the next designated node together with the information (status, S) gathered during dwelling in the previous node. The residing agent, a_2 turns into a floating agent until it reaches the targeted node.

j. Once the floating agent, a_2 reaches the targeted node, step 6-9 repeats. In addition, the floating agent, a_2 updates the record, R of the targeted node with status, S of the previous node.

k. When the state of convergence is achieved, record, R in each of the node in Grid will have the status, S of each of its neighboring node.

l. Record, R can be consolidated in historical manner to serve as prediction measure for Grid meta-scheduler or to facilitate rerouting of job at overloaded local queue to other under-utilized resources.

4. A continuous multi agent convergence process through peering update for grid resource monitoring as claimed in any of the preceding claims wherein the Record, R is information kept in each node and wherein it consists of list of statuses, S such as loads, bottleneck bandwidth, CPU and memory utilization, disk utilization and queue availability.

5. A continuous multi agent convergence process through peering update for grid resource monitoring as claimed in any of the preceding claims wherein the

updating of the record, R will be carried out by agent with the latest time, *t* and shortest path, *P*.

6. A continuous multi agent convergence process through peering update for grid resource monitoring as claimed in any of the preceding claims wherein the once the convergence is achieved, record, R of each node will be able to have status, S of its neighboring nodes.

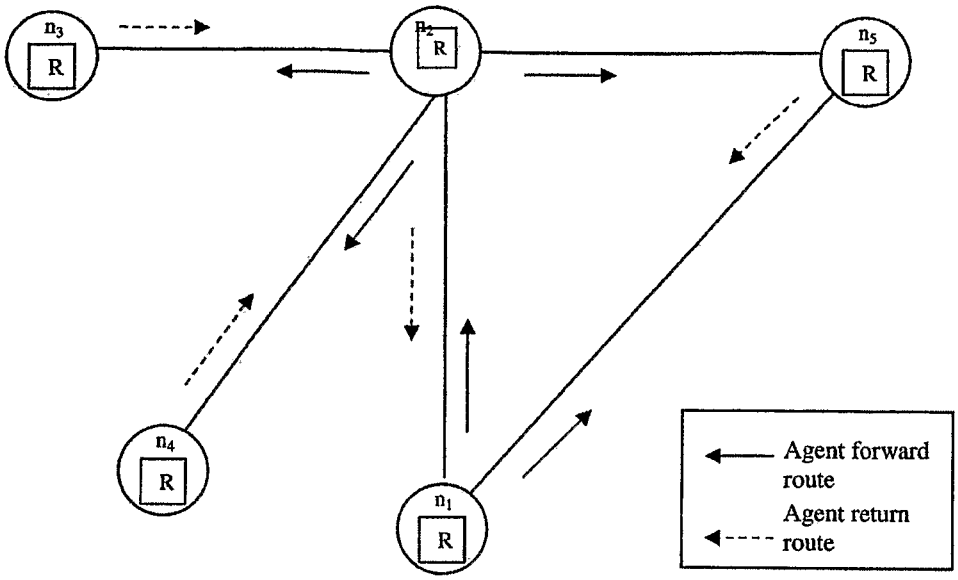

Figure 1

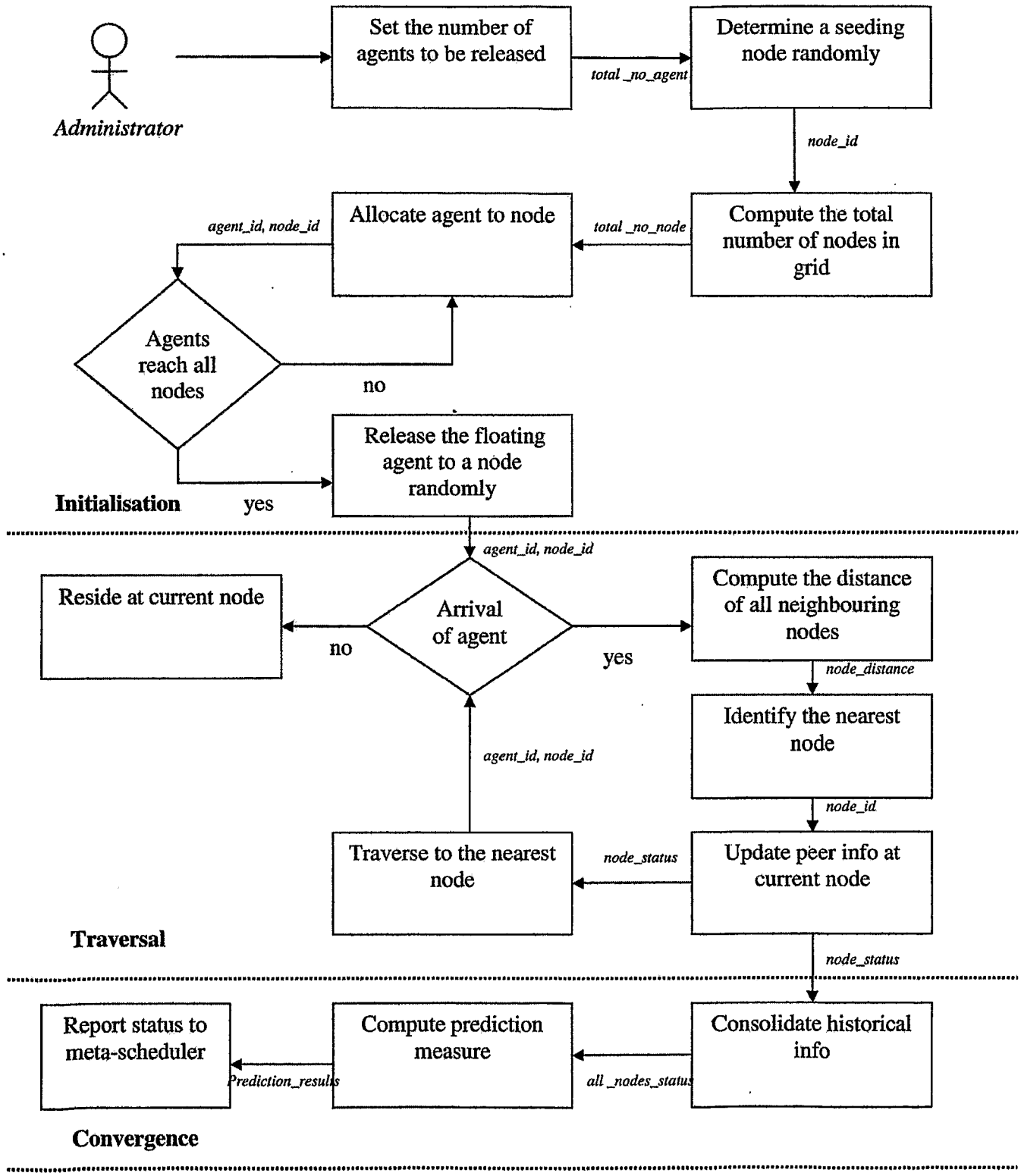
Administrator
Set the number of agents to be released
total _no_agent
Determine a seeding node randomly
node_id
Compute the total number of nodes in grid
total _no_node
Allocate agent to node
agent_id, node_id
Agents reach all nodes
no
yes
Release the floating agent to a node randomly
Initialisation
agent_id, node_id
Arrival of agent
Reside at current node
no
yes
Compute the distance of all neighbouring nodes
node_distance
Identify the nearest node
node_id
Update peer info at current node
node_status
Traverse to the nearest node
agent_id, node_id
Traversal
node_status
Consolidate historical info
all _nodes_status
Compute prediction measure
Prediction_results
Report status to meta-scheduler
Convergence

Figure 2