# A Sort of Knowledge Metadata Management Model in Semantic Grid Environment

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*Abstract*- **As a hot spot in today's research, the grid which applies the distributed management style in the knowledge management will integrate the existing resources to the maximum. In order to change the current disorder status of knowledge resource management and get effective management and sharing of education resources, this paper takes the knowledge classification standard in LOM as the division basis of the knowledge grid metadata community, and puts forwards a sort of grid community model based on knowledge resources metadata as knowledge management framework according to the characteristics of grid management architecture. In the paper, some key issues are discussed such as the construction of grid community interior structure, the news transmission mechanism, the algorithm between communities and so on. According to the classification principles of educational information in LOM metadata as well as the grid management system structure, the concept of Grid Community based on education resource is proposed to improve the efficiency of the organization and management of educational resources in the grid.**

## I. SEMANTIC GRID

Based on the advantages of semantic Web, the grid and Web services, the researchers proposes the concept of the semantic grid, and the relationship of Web, grid, semantic Web and semantic grid is shown as the figure 1. In the figure 1, the grid is the exaltation of Web on the computing power, and the semantic grid is the grid of expansion on semantic capacity. From the other points of view, the semantic Web enhances the semantic competence of the existing Web, and the semantic grid is an extension of computing power of the semantic Web.

In the UK e-Science program, it is found that the gap between the grid's existing efforts and e-Science ideas has existed. In order to obtain the ease of use in the e-Science and seamless automation, which needs possibly more machine processing as well as possibly less human intervention, so the idea of semantic grid was firstly proposed in 2001 and the Semantic Grid Study group
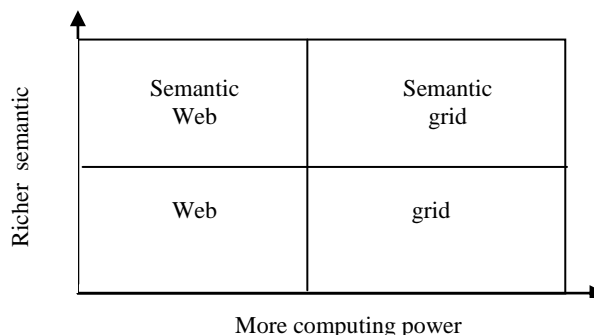


Fig.1.The develop schematic diagram of the semantic grid

SEM-GRD on the Global Grid Forum GGF was established in 2002. All of the resources, including services, are described in a way that the machine can handle to achieve semantic interoperability. To reach this goal, the semantic Web technologies is used in the development of grid computing, rang from the infrastructure to the grid. It is noteworthy that the "semantic" fills the whole grid from bottom to top, not only to add a semantic (knowledge) layer.

## II. THE GRID COMMUNITY BASED ON KNOWLEDGE METADATA

Community is a logical limited division of infinite space of the grid, and each community represents one division. Community is a self-control management space, so it has a resource sharing strategy that can achieve resource sharing and management control of community resource. After the community division, the nodes which have some similar characteristics compose a community, and some operations such as information search, node status updates and so on are carried out in the community in the first place.

To facilitate the knowledge management, several units are formed to classify the nodes according to some knowledge metadata standard, which is called Grid

Community based on Knowledge Resource by referring GC.

Definition 1: Physical nodes in the grid can store & transmit data, and perform terminal equipment in various physical meaning. The physical node has a unique identifier, so the users can access the node by use of the address.

Definition 2: The super-node sp is the node which concentrates the resources in the community. The super-node facilitates the search and management of resource information in the community in order to store community organizations information library and adjacent table to outline community organization information node.

Definition 3: The resource node rn is used to describe the resource node. All the resource nodes constitute the collection of educational resources which is R-Nodes.

$$R\text{-Nodes} = \{rn_1, rn_2, \ldots\ldots, rn_n\}$$

Definition 4: The classification of community R is a classification method which classifies the educational resources based on the learning object metadata standard LOM classification properties. R could ensure that all the educational resources nodes have community ownership. In addition, a node can be classified to multiple communities. Namely:

$$R = \{r_1, r_2, \ldots\ldots r_m \mid, \ rni \in R\text{-Nodes}, \ r_j, r_j (rn_i) = TRUE\}$$

Definition 5: The knowledge meta-data grid community i (denoted as GCi) means that the classification is done according to the study object metadata standard LOM classification method R.

$$GC_i = \{rn_j \mid rn_j \in R\text{-Nodes}, r_i(rn_j) = TRUE\}$$

Definition 6: The classification node S is the node that provides educational resources classification services in accordance with the LOM standard.

The figure 2 is the basic structure of the community organization model. The below is a brief description of each layer in the model, and the details of each layer will be discussed later.

(1) Physical Layer: It is made up of educational resources nodes which are distributed actually in various regions, and these nodes found the material basis of educational resources.

(2) Community Layer: It is the logical organization which is on the classified physical layer according to educational resources learning objects. Assuming that the grid G contains m communities, each community GCi holds a number of physical resources, community virtual resources from the actual resource mapping. The different virtual resources can be mapped to the same physical resources. The different communities can share physical resources, and the actual physical resources are transparent to users. The connection among resource nodes of community organizations has the following characteristics:

◊ The classification is done according to the same LOM property, which makes the highest concentration and most authoritative nodes to be super nodes.

◊ The other resource nodes which contain the resources of the community are gathered around the super nodes;

◊ The division of the community should take the regional of nodes distribution into account, and be brought about based on the partitioning strategy of the super-node in the community.
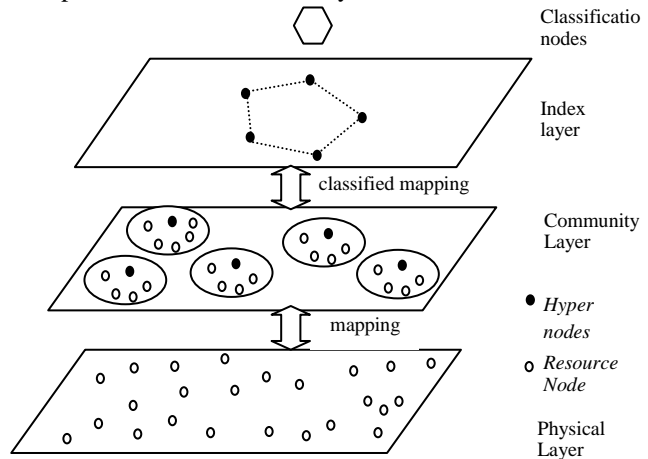


Fig.2.The grid community model diagram of three-layered structure

(3) Index layer: The division of community is based on the classification information of teaching resources standards LOM. However, because the distribution of educational resources around the world is quite different, a community cannot accommodate all of similar Educational resources; as well as because the division of LOM is only a coarse-grained classification, the educational resources based on the same classification can have more similar communities - community groups according to the difference of its key index [1].These community groups have similar educational resources properties, the service type and property which are provided by the community have similarities.

Index layer provides the logical relationship among the educational resources communities by using the same classification method, and an index relationship can be established between communities that have the same class educational resources, which provides a basis for quickly researching resources.

III. THE DIVISION OF KNOWLEDGE GRID META-DATA

Grid Community (GC) which bases on the knowledge metadata is to facilitate the metadata management. It has formed a number of virtual groups after sort physical resources of the node based on metadata standards. Among them, the classified information which is named to be classification describes the attributes and the location of knowledge objects in a system, which would serve as the basis for division of the community.

According to the definition form of RDF [2]:

{Subject，Predicate，Object}

Information norm that are described by learning resources can be represented as the form of a triple:

(LO, P, V)

where LO represents the learning-resource, the predicate is used to distinguish the different attributes of learning resources, and the object is the value. The figure 3 is a block diagram which describes the information of learning resources with the LOM subentry (Because of the limited space, it has been simplified):

The instance can be described by the RDF form of the triples:

(LO1,"lom/general/title","developerWorks: XML") , …… ,

(LO2, "lom/classification/taxon/id", "A01")

As the community is the basic unit of management, sharing, publication and searching of teaching resources, the formation of community is a core issue. Taking the knowledge characters of teaching resources into account, the paper proposes the classification of the community based on the resources shared by the node.

Assuming that all the learning resources use one classification system, the description of the classification in the LOM standards can be divided into m broad categories, and the entire system can be divided into m communities, which could be recorded as: GC1, GC2 ... ..., GCm. Community classification method can be recorded through sorting category in the classified nodes, and calculate based on it for ownership for the community.

According to the definition of community classification, $R = \{r_1, r_2, ... ..., r_m\}$, where $r_j$ corresponds to the community GCj, rj (rni) is calculated as: rni contains q shared learning resources LOk, and the position of the classification system can be described as: (LOk,"lom/classification/taxon/id","Tk".The conditions that should be satisfied are:

$$if\,[[\sum_{k=1}^{q} T_k \in GC_j\,?1:0] \geq Thresholk\,]\,,$$

$r_j(rn_i)$=TRUE else $r_j(rn_i)$=FALSE

## IV. THE INTERNAL STRUCTURE OF THE KNOWLEDGE GRID COMMUNITY
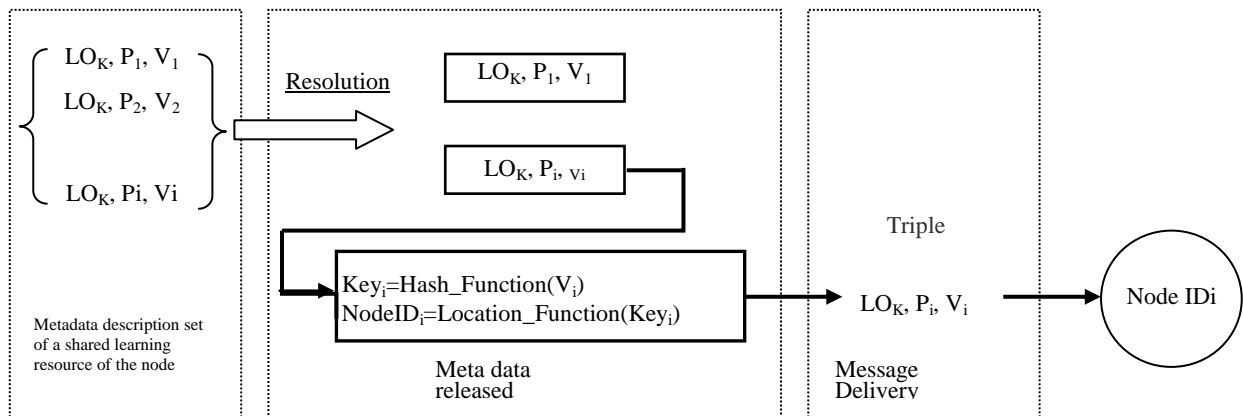
Metadata resources in the community are distributed on each resources node rn in the community, which is convenient to manage but needs classify educational [3]. Resources on the node, as metadata resources are represented by the triples that based on LOM metadata standard, and each triple has a property value [4]. Therefore, the Hash address can be formed on the basis of these triples, and the retrieved resource object can be found by visiting the node.

The calculation process of Hash can be expressed as:

Key$_i$ = Hash_Function (resource object of a certain characteristic value)

NodeID$_i$ = Location_Function (Key$_i$)

In practice, each node can store multiple types of metadata resources, the same or similar resources can exist in different nodes. Therefore, the classification is on the basis of meta-data resources, one node can belong to different communities. Community ownership of learning resources should follow the standard below:

For ( LO$_k$, "lom/classification/taxon/id","T$_k$")

If  T$_k \in$ GC$_i$

The figure 3 shows the structure mode of resource nodes in the community. Then LO$_k$ should be stored in Community GC$_i$.

The searching about educational resources of the node can be described as: "in the community Ci, the values of Pk and Vk which are in the given (X, Pi, Vi), by seeking the value of X on the node ".

During the resources retrieval, when the Node k is visited, each triple (LOi, Pi, Vi) of node resource metadata set would be compared through visit metadata set of node management. If Vi = Vk, then LOi is the required solution, it would be named to be X = X ∪ {LOi}.

As knowledge metadata resources have characteristics of distribution, dispersion and so on, in order to facilitate the resource information management of all nodes in the community and grasp resources distribution of relevant community in the whole net community, a super-Node sp should be set up for each community organizations which is used to store the information library of the community and resource information adjacency table [5].

The contents in the super-node which needs to be stored are the information libraries and resources



Fig.3. Metadata distribution structure diagram of internal resource node in the community

adjacent tables. As the number of resources in the community is relatively large, the storage of the information libraries and resources adjacent tables needs enough space. At the same time, researching relevant information in the nodes is a crucial step while grid resource is discovered, which requires considerable stability, so super-node needs to be steady and the vast storage [6] [7].

The main types of data structure which describe the main types of community can be expressed as the figure 4 shown.

```
Community GCi
{ GCid
    // The identifier of the current community；
name;
    // The name of the current community；
LdapServer；
    // LDAP Server address of the current community sp；
LdapPort；
    // LDAP Server port sp  of the current community；
Description；
    // The description of  the current community;
GCi-Type;
    // the identity of types of educational resources in
current community
TotalNum；
    // the total number of educational resources that the
current community possesse
NodeIP；
    // the node IP address of corresponding resources in the
current community
MaxNum
    // the total number of nodes of allow accommodate in
current community
 }
```

Fig4. The drawing of hierarchical structure of LOM

## Ⅴ. THE CONSTRUCTION OF GRID EDUCATION RESOURCES COMMUNITY GROUP

### A.  The Definition Of Reciprocal Communities

All the learning resources in the grid use the same classification system, so it can be divided into m categories according to the description which is called classification of LOM standard [8], and the entire system can be divided into m communities, which is recorded as: GC1, GC2 ... ..., GCm . If the factor of geographical distribution is considered while communities are divided, there may be multiple educational resources communities of the same type. To build linkages and communication among the same kind of educational resources, it need to establish reciprocal community of a grid on the type of education    resources  in grid    and   establish the information sharing mechanisms   and communication mechanisms between communities to  facilitate the quick search of resources.
Definition 1: In the grid, the classification of the communities is based on the classification standards of educational resources LOM. Supposing that several communities such as C1,C2,……,Cn, if all the educational resources in community C1,C2,……,Cn

belong to the same class on the LOM classification (set i-type ), C1, C2, ... ..., Cn are reciprocal written as GCi = {C1, C2, ... ..., Cn}.

Definition 2: community set {C1, C2, ... ..., Cn} which is composed by congeneric educational resources constitute the community group of educational resources of this type.

Definition 3: If the two communities in the grid are equal, they are adjacent.

$f_A$：U→[0，1]，u→$f_A$(u)

Definition 4: Set $C_i$={$Node_1$,  $Node_2$......$Node_m$}, where $Node_1$, $Node_2$ ... $Node_m$ have the type of property classification of the same educational resources LOM.

Definition 5 $Node_i$=($Id_i$ , $Id_{ci}$ ) expresses that any node is composed of two parts where $Id_i$ is the node identifier and $Id_{ci}$ is the community identifier.

Definition 6: The definition of the membership function is a fuzzy assemblage of the given region U, which means that a number of $f_A$ (u) ∈ [0,1] is specified for arbitrary u ∈ U as well as $f_A$ (u) is called the U of A's membership, and a map would be made:

$f_A$: U → [0,1], u → $f_A$ (u)

The  membership  function  can  describe  the application or possession extent of certain type of educational resources of the node, and classify the node according to the value of the membership function. The division  results  are  stored  in  the  corresponding community [9] [10].

To sum up the points, it is known that the nodes select  the  corresponding  community  based  on membership function. Since it is hard to form a community, if there were only one people live in groups in human society, it is impossible to constitute the grid system of the resources share and team working if there were only isolated communities. So there are the following properties between reciprocal communities.

Property 1: For any two communities Ci and Cj, if Ci ∩ Cj ≠ φ (i ≠ j), they are called the reciprocal communities that constitute the grid system have connections

Property 2: For any two communities Ci and Cj, if Ci ∩ Cj = φ (i ≠ j), they are called the reciprocal communities that constitute the grid system have no connections (which is isolated).

### B.  Construction Of Grid Community Groups

The super-grid node sp exists in grid community that constitutes the education resources, which stores IP addresses of all the nodes in the community. In order to establish community groups, the super-node sp in the community should find classified community that have the same educational resources in the index layers through classify nodes and by calculating membership function of the community [11], and join in the community index. Therefore, the design process of the grid system is based on reciprocal virtual communities.

Step1: Initialization is to set the collection of resource requirements and application requirements as well as the values range of the membership function by monitoring historical data by use of the network.

Step2: Category is to compute the membership function value of resource requirements and application requirements. The nodes which have certain types of resources and applications to appropriate community are based on the value of membership function.

Step3: To create routing information of super-node sp;

Step4: By using the routing information of sp and established a link through other educational resources communities of same type, the educational resources category nodes are added to the index of educational resources communities of same type to create reciprocal community groups.

Step5: To modify the corresponding items in sp according to the dynamically joining and leaving of the node;

Step 6: Map is to map the grid system to the corresponding physical node.

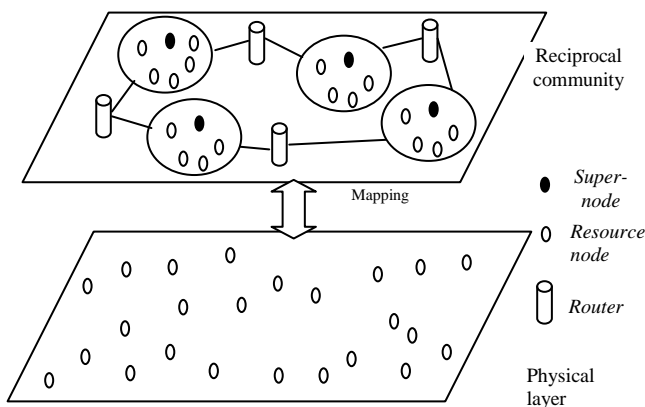The figure 5 shows the structure of reciprocal community groups:



Fig.5. The structure diagram of reciprocal community

## VI. THE MECHANISM OF DELIVERING THE MESSAGE BETWEEN COMMUNITIES

### A. The Algorithm Of Delivering Message Between Communities

Based on the traditional Gossip algorithms, this paper proposes an improved two-tier message diffusion mechanism according to the characteristics of the grid community, which is to spread the message among the different communities.

The two important parameters of Gossip[12] [13] that includes the number of messages diffusion k and the rounds of message forwarding i are determined by the scale of the grid (the first-class is based on the number of nodes within the community，and the second-class is based on the number of adjacent community in the grid). The initial launch node of Gossip sets the rounds of forwarding through the super-node of the community, and then Gossip algorithm would be started by randomly

selecting k objectives from neighbor community. Gossip algorithms are shown in the figure 6.

```
Algorithm Gossip
Input: Gossip message (information of RDF), k, i
Output: Gossip message
while (Time_curren t-Time_lst_receive> Tk) do
  send message to k neighbors;
end while
whenever a Gossip message arrive do
  if (have received this message previously) then
    discard this message;
  else
    update local information;
    if (message's number of rounds<i) then
      send Gossip message to k neighbors randomly;
    end if
  end if
end whenever
```

Fig.6. The algorithm for message transmission among the

The figure 7 shows the two rounds diffusion of standard Gossip Algorithm. The figure 8 is an improved diffusion diagram based on community two-stage Gossip Algorithm after two rounds. Assume k = 4 in first stage, k = 3 in second stage.

It can be seen from the figure 8, if the node is in the
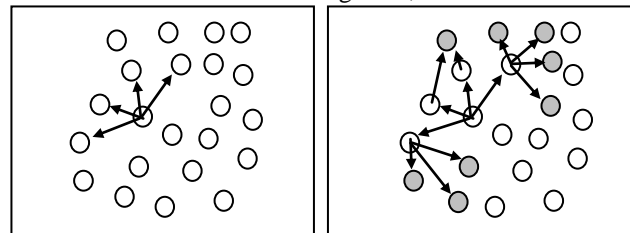


a. The diffusion of the first round of the normal Gossip

b. The diffusion of the second round of the normal Gossip G

Fig.7. The diffusion of the two rounds of the normal gossip
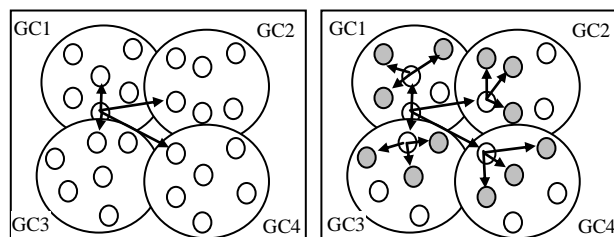


c. The diffusion of the first round of two-stage Gossip

d. The diffusion of the second round of two-stage Gossip

Fig.8. The diffusion of the two round of Two-stage Gossip based on Grid Community

state of being in the edge of the grid or having less neighbor nodes, the message will be able to reach a very limited number of nodes, but the scope of the message diffusion increased significantly in the improved algorithm.

### B. Algorithms Of Performance Analysis

The parameters that affect the performance of Gossip algorithms include the size of the grid n, the number of message diffusion k, probability of the message spread successfully and so on[14] [15]. Literature which can obtain the conclusion of Gossip algorithms is based on the analysis of the relationship of parameters.

The number of messages sent out by each node is k = log n + c (where n is the total number of grid nodes, c is a constant), and the probability to obtain the message of each node is exp(-exp(-c))。

In the two-stage community, the gossip algorithm can still be used to analyze with the above conclusion. In the formula k = log n + c, if select c = 2, then exp (-exp (-c)) = 0.873, the probability to receive the message of each node is 87.3%. In the large-scale grid system, it means that there would be 4 / 5 or more nodes which can obtain the message, so the success rate of diffusion is much higher than actual demand[16] [17].

Assuming that the community holds the average size, the number of nodes with education resources of the same type in the grid is n. The number of nodes in each community is m, and the number of sub-grids with similar educational resources in the entire grid is n/m. According to the diffusion mechanism of two-stage gossip algorithms [18] [19] [20], Gossip spreads in two layers - firstly spread among the communities, and then spread in the community. So it can be analyzed as follows:

(1) Gossip diffusion among educational resources of same kind in the grid is the number of messages sent each time k=log (n/m)+c.

(2) Gossip diffusion among nodes within the community is the number of messages sent by each node is: k '= log m + c.

Thus the expected value of messages sends of each nodes E is:

$$[(\log(n/m)+c)+(\log m+c)]/n=((\log n/m+c)/m)+(\log m+c)$$

Aim at the grid environment of several cases, here is the result of calculating and comparing of Gossip diffusion for two types that are divided communities and undivided communities, and the size of the grid is set to be n=107，c=2. The table 1 shows the results of simulation.

TABLE Ⅰ.
The effect of division of the community on messages spread

| m | n/m | k | k' | expected value |
|---|---|---|---|---|
| 1000000 | 1 | 18.118 | 18.118 | 18.118 |
| 20000 | 500 | 18.118 | 11.904 | 11.903 |
| 10000 | 1000 | 18.118 | 11.211 | 11.101 |
| 5000 | 2000 | 18.118 | 10.519 | 10.415 |
| 1000 | 10000 | 18.118 | 8.919 | 8.608 |
| 500 | 20000 | 18.118 | 8.239 | 8.015 |

It can be seen in the table 1 that the less the number of the nodes m in each community, the finer the grid community is divided. Two-stage Gossip algorithms can divide the Gossip in the whole grid into Gossip diffusion in smaller areas in reincarnation, which makes the load of the news spread is smaller. When m = 500, the number of nodes within the community is 500, the number of messages sent by each node is 45% of pre-classification.

Theoretically, if message sends more than six steps in the circumstances, the number of Internet messages failure will be increased significantly. In the gossip algorithm by increasing k value control diffusion's turn such as 10,000 nodes, k will increase to 15 to ensure the error rate under 1%. If grid scale continued to grow, as in the scale of 107, the gossip algorithm and other distributed algorithm is no guarantee about a low failure rate. Grading Gossip algorithm will divide the large-scale nodes in the logical into a small area, and make life cycle control news become possible.

## VI. THE SYSTEM SIMULATION EXPERIMENT AND EVALUATION

A simulation experiment environment was constructed for the grid community by use of Grid Simulator GridSim toolkit, and the performance of two stages gossip dissemination mechanism were also analyzed at the query response rate. In the simulation test, compared with the traditional gossip diffusion mechanism, the message dissemination overhead and the resources match number inquire the response time etc.

GridSim is a grid simulation tool based on java language development, which was published by Rajkumar Buyya of the University of Melbourne in Australia in 2001; and it was used to distributed computation environment machine scheduling algorithm model and simulate, such as cluster, peer to peer calculation and grid etc.

The section is based on GridSim, it was realized message spread simulation model and realized two-level grid resource management structure of simulation resource layer and community layer in the first level; as well implemented the corresponding information sharing mechanism and implemented the Gossip two-level message diffusion mechanism and resource inquires the mechanism by simulation.

### A. The Effect Of Different Lengths Of Grid Tasks (MI) On Simulation Mission Time

The grid task is set to be 200, the task length number is from 20 to 200, and each scheduling would add 20 a times. At the same time, the deviate percentage is 10, granularity time is 20, and overhead time for grouping is 10. Results show the table 2 and the figure 10 below.

TABLE. Ⅱ
The effect of different lengths of grid tasks (MI) on simulated time

| Average MI | Group | Total Simulation Time | Average MI | Group | Total Simulation Time |
|---|---|---|---|---|---|
| 20 | 4 | 232.19 | 120 | 23 | 531.20 |
| 40 | 7 | 263.33 | 140 | 26 | 563.07 |
| 60 | 10 | 306.81 | 160 | 31 | 627.14 |
| 80 | 15 | 383.75 | 180 | 35 | 692.91 |
| 100 | 19 | 439.43 | 200 | 39 | 762.06 |

The figure 10 shows that general simulation time increases with the increase average grid task length (MI). This is because resource processing load increase when the length of grid task increase, which is due to grid task group depend on the MIPS of the provided resources,
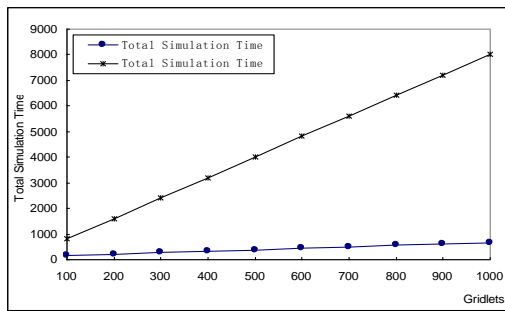
Fig.10.The effect of different lengths of grid tasks
(MI) on simulation time

therefore total grid task group number will increase when grid task increase. Grid tasks grouped quantity growth resulting in overall simulation time growth.

### B. The Effect Of Task Group On Simulated Time

We set average MI value as 20, Deviate percentage as 10, Granularity time as 10 and overhead time for grouping as 10. Results show that the table 3 and the Fig. 11.

TABLEⅢ
The effect of Group and Ungroup on simulation time

| Gridlets | Group | Group Total Simulation Time | Ungroup Total Simulation Time |
|---|---|---|---|
| 100 | 4 | 155.02 | 808.13 |
| 200 | 7 | 192.28 | 1613.65 |
| 300 | 13 | 288.28 | 2408.78 |
| 400 | 15 | 320.28 | 3207.18 |
| 500 | 18 | 368.28 | 4008.03 |
| 600 | 22 | 445.66 | 4810.52 |
| 700 | 25 | 480.60 | 5614.15 |
| 800 | 31 | 576.60 | 6411.73 |
| 900 | 33 | 608.60 | 7214.93 |
| 1000 | 36 | 656.99 | 8016.81 |

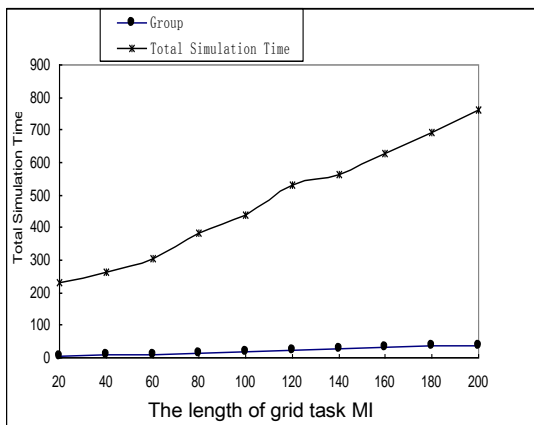The Fig.11 shows that the total time of simulation



Fig.11.The effect of Group on simulated time

corresponding is almost direct proportion increased with the number of grid task increased when the task is not

grouped method and the curve slope is steeper; by using the grid task group method, the total time of simulation is not corresponding increased with the number of grid task increased and the curve slope is relatively flat. One time only send a grid task when adopted method that the grid task is not grouped, and it led to increased transmission costs and grid task processing time. By using the method of the grid task group, the total transmission time of grid task is decreased due to a large number of grid tasks grouped as a small group of the grid task. Because only a small amount of grid task group is handled by grid resource, the grid task processing time is decrease.

### C. The Effect Of Different Granularity Time On Simulated Mission Time By Grouping Method Time

We set average MI value as 20, Deviate percentage as 10, overhead time for grouping as 10, and granularity time as 5，10，15，20，25. Results are shown in the table 3 and the figure 12.

The table 4 shows the effect of different granularity time on simulated time by grouping method time.

TABLEⅣ
The effect of Group and Ungroup on simulation time

| Gridlets | Total Simulation Time | | | | |
|---|---|---|---|---|---|
| | Granularity time：5 | Granularity time：10 | Granularity time：15 | Granularity time：20 | Granularity time：25 |
| 100 | 229.90 | 155.2 | 128.35 | 125.50 | 130.76 |
| 200 | 287.90 | 192.28 | 200.62 | 232.19 | 205.30 |
| 300 | 399.90 | 288.28 | 227.62 | 240.33 | 215.46 |
| 400 | 512.76 | 320.28 | 296.62 | 264.47 | 282.16 |
| 500 | 624.91 | 368.28 | 298.22 | 304.24 | 297.40 |
| 600 | 736.93 | 445.66 | 360.62 | 345.20 | 309.00 |
| 700 | 848.90 | 480.60 | 392.62 | 384.16 | 339.62 |
| 800 | 976.93 | 576.60 | 456.62 | 384.36 | 355.65 |
| 900 | 1088.93 | 608.60 | 486.25 | 408.97 | 424.29 |
| 1000 | 1184.93 | 656.99 | 504.62 | 442.79 | 424.29 |

Fig.12 shows that the higher the particle time when the grid tasks grouped, the shorter total simulation time.
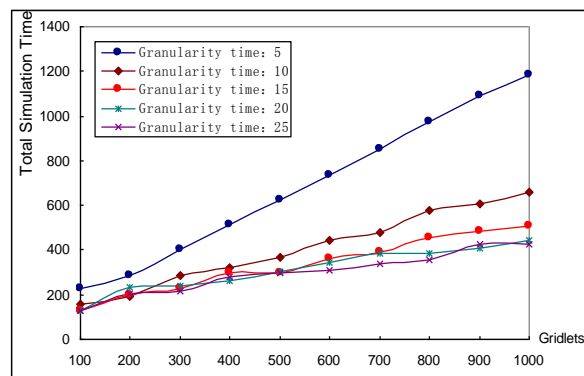


Fig.12.The effect of the different granularity time on
simulated time by grouping method time

Before the simulation start, the multiplication MIPS of

resource determine that MI of resources can be handled in given granularity time, so the taller granularity time, the more resources can support MI.

## VII. CONCLUSION

By introducing the concept of the grid community, unlimited knowledge grid resource system is divided into limited independent space – community. The community is knowledge meta-data collection that is classified based on standard of LOM, and it can meet the needs for knowledge of specific user. According to the characteristics of the grid community, this paper studies the construction of the knowledge metadata resource grid community and the internal structure of the community, and proposes the idea of structuring reciprocal grid community group based on the characteristics of resource spread in the grid. Community groups and the mechanism of the message spread, and the analysis of the simulation is conducted on the results.

Through learning community students can produce leadership role, the construction of community education resources grid for distance learning has more broad application prospects, because establishing a distance of the virtual learning community provides infrastructure, and designated learning community of the rules and norms of behavior produce a series of member role in learning community study group.

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