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A Cloud Service Model Based on Indirect Addressing

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Abstract

The cloud service is a new type service way to provide the users in distributed environment, but the service model, service package and the knowledge searching methods trouble it popularizing. Aiming at the problems, a cloud service model based on indirect addressing is proposed in the paper. It analyzed the new problems serving in cloud firstly, then comes out a recourse and service invoking model based on indirect addressing, gave out the service actors of the model in detail, studied the package method of the cloud interfaces, produce the knowledge step in the indirect addressing mode of resources distribution. Proposed a knowledge discovery strategy based on Chord ring to resolve the knowledge retrieval problem and introduced the Chord ring in detail. The case studies proved the method with some advantages, and it proposes a new way to resolve the service problem in cloud.

Keywords: *Cloud service, knowledge engineering, indirect addressing service, Chord ring*

1. Introduction

With the development of services globalization, more and more new needs coming out in distributed environment, but the service quality to service the customers is limited by time, space and other factors. How to make a breakthrough among those factors is the new challenge and research subject of market competition.

Recently, the cloud computing is step into our life and work. Wiki suggests that cloud computing is a style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet. U.S. National Institute of Standards and Technology defines that cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (*e.g.*, networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. The cloud computing is an Internet-based method of computing, the sharing hardware and software resources and information available on demand to any computers and other devices. Typical cloud computing providers often provide common business network applications, the users maybe access the services through the browser or other Web services, while the software and data are stored on the server, Cloud computing services usually provide universal access through a browser online business applications, software, and data can be stored in the data center. The cloud computing is an important service model in distributed environment, and it attract more and more users attention. Yu Kan researched the era of cloud computing data center construction and development [1-3]. Pan Chunyan researched how to migrate the data center to the cloud environment

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[4]. Baliga, J research on the Green Cloud Computing technologies, include balancing energy in processing, storage,and transport problem[5]. Bein,D and Bein,W researched on the efficient data centers of cloud computing in the future of distributed computing problems[6]. Mohammad researched on the performance evaluation of server virtualization in data center applications [7]. Guorong Chen researched on the relationship network analysis method of manufacturing system limited by business lines [8].

On the other hand, knowledge engineering is be defined in 1970s firstly by the artificial intelligence expert E.A. Fagin Baum, it suggested that knowledge engineering is the principles and methods of artificial intelligence, it may provide the solving means for those who need expert knowledge to solve these problems, Proper use of expert knowledge acquisition, representation and reasoning processes of formation and interpretation, knowledge-based systems are designed to important technical issues. Fagin Baum suggests the knowledge based engineering includes three subjects; those are knowledge acquisition, knowledge representation and knowledge application.

Because it may combine with expert knowledge and artificial intelligence method, and has some advantages to settle the knowledge applications, so, it is promotes very quickly in recently years. So, some scholars focus their energies on the topic to improve the theories and develop the applications. According E.A. Fagin Baum's theories, Gonzalo Ramos-Jiménez, José del Campo-Á vila, Rafael Morales- Bueno designed an incremental algorithm driven by error margins [9, 10]. Jin Qian, Feiyue Ye and Ping Lv proposed an incremental attribute reduction algorithm in decision table [11], Wang Zhihai put out the knowledge acquisition method based on the concept lattice incremental algorithm[12]. Fayyas U M and Smyth P research on the knowledge acquisition technologies based on the incremental dynamic database knowledge [13], Tsumoto S and Tanaka H proposed a Bayesian classifier to settle the knowledge acquisition problem[14]. Feng Zhiyong and Li Wenjie researched on the knowledge representation problem based on Ontology [15]. John F Sowa published his researches Knowledge Representation philosophical and computational foundations in Thomson Asia pre ltd [16].

How to combine the knowledge engineering and cloud computing is the recently research hot problem, but some problems troubles it popularizing, such as the service model, service package, service searching, knowledge treatment and so on. Based on those researches mentioned above, this paper focuses on those problems, and propose an indirect addressing cloud service method which fit the needs in distributed cloud-compute environment.

How to combine the knowledge engineering and cloud computing is the recently research hot problem, but some problems troubles it popularizing, such as the service model, service package, service searching, knowledge treatment and so on. Based on those researches mentioned above, this paper focuses on those problems, and propose an indirect addressing cloud service method which fit the needs in distributed cloud-compute environment.

2. New Problems of Knowledge Engineering need to be Solved in Clouds

While the knowledge engineering used in distributed environment, the application objects and the application environment decide it has some new characteristics, such as geographical dispersion, time asynchrony, control dispersion, information communication inconvenience and so on, if we can't resolve those, the application affection will decrease:

(1) Semantic Ambiguity

Because the information comes from different way and with different representation, the same meaning using different expression, or the same express means different transaction, it may trouble us understanding, and create obstacles to the resource provider, knowledge manager and the operators. So, it needs a series of rules to normalize the knowledge, reduce the semantic ambiguity, and eliminate the difference of understanding.

(2) Grammatical Ambiguity

If all of the nodes in distributed environment may provide the resources without formation negotiation, the problem of grammatical ambiguity will trouble the users and providers, and the knowledge with low compatibility will flood the network. It may act a few users, but it may trouble the most users. So, to eliminate the difference of understanding is very urgent. Expressed in human language syntax is not the same as the same transaction, different individuals express the same things using different way, the same information in the distributed environment may produce some different ways using different grammar.

(3) The Trust Ambiguity

In the network, all the service participants are virtual members only with an ID; they maybe don't know each other, maybe partners or competitors; the knowledge and cloud services maybe suppositious or valuable. So, it is necessary to create the trust relationship each other. The relationship and the rules need credibility and equality to all the participants.

(4) Safety Ambiguity

Internet is an open system, and the cloud service may face all kinds of risks, the risks maybe caused conscious come from the competitors, hackers, or caused inadvertently of merely negligent, but the risks should be eliminated. All the participants should be protected safety using technical ways and management methods and so on. Typically, it needs to establish a network security framework to ensure the security of the behaviors.

(5) Independent Ambiguity

The users have the right and freedom to select the services in the internet, their selections and the behaviors cannot be restricted by the Internet service provider or the knowledge providers. The services should independent and impartial to all the service participants. On the other hand, the cloud service will like the water from the pipes, the user does not need to know where it comes from, only knows that it is what they just need.

3. Pretreatment of Knowledge

Before the knowledge providing service to the customers, it should be pretreatment to eliminate the semantic and grammatical ambiguity. Knowledge discovery in databases (KDD) may discover and extract the available information from the vast amounts of data. It is not only a simple database-specific retrieval and invoking way; it may treat to the data from micro and macro statistics, analysis, synthesis and reasoning, to guide the actual problem solving, trying to find the correlation between events, even the use of existing data to predict future events. It may acquire knowledge through data collection, pre-processing, selection,

transformation, extraction, evaluate, using discriminate analysis, cluster analysis, exploratory analysis and other statistical methods.

Step 1: Data Preparation

Data preparation is an important stage of knowledge discovery, this phase should be completed the following works: firstly, should complete the pre-processing of the data, eliminate the contradictory data, solve the compatibility of the information, unified data dimensionless, eliminate the dada noise, calculate missing value data derived, eliminate duplicate records and so on. Secondly, to save the data into basic data sets as the resources further processing.

Step 2: Data Selection

Data selection is the process of determining and finding the object data set, the object data set is the data sets to extract from the original database depending on the application, which is the operation target of knowledge discovery process. The data selection operation must be keep discriminating data, the selection sets will directly impact on the results of subsequent operations. If the results of selected data cannot achieve the intended purpose, it may re-select the data as the feedback information.

Step 3: Data Transform

In order to adapt the collected data compute processing, the selection data must be collected for data conversion. The common data transformation tasks include: firstly, to convert the data type, for example, to convert the data type from the binary representation to the ASCII representation, or to convert the continuous signal to the discrete data. Secondly, it must to reduce the data dimension, or to reduce the dimensions of the data analysis and processing. That is, from the initial feature to find really useful feature to reduce data analysis and data mining features.

Step 4: Data Refinement

Data refinement is the process to find reasonable data from a large number of data needing to be done. We must determine the purpose of the task in the phase, such as data classification, summary, clustering, association, etc. we must decide what kind of refinement algorithm after determining the extraction task. The same tasks can be implemented using different algorithms, selecting the algorithm should to consider the characteristics of the data, the actual problems and other issues. After completion of the data preparation work, you can implement data refinement operation. There are some similar between data selection and data refinement, they are all the operators that selected the available data from a large number of data. But there are different, the former is the initial screening of the data, the second is the further operation based on the data extraction, the latter usually requires more precise data manipulation and processing algorithms.

Step 5: Evaluation of Results

The results of data extraction also may be errors, redundant or irrelevant information, knowledge or patterns, after the given evaluation methods, the data maybe excluding redundancy, discriminating further. The result also possible does not meet the user requirements, it necessary go back to the data retrial process, such as the use of new data transformation method, re-select the data, set new data mining parameter values, and even the introduction of new data mining algorithms. Additional, As KDD is user-oriented operation; it may need the mode should to be transformation or to be visual representation to facilitate the understanding and use.

The data may be saved into knowledge data and to be used in the further applications.

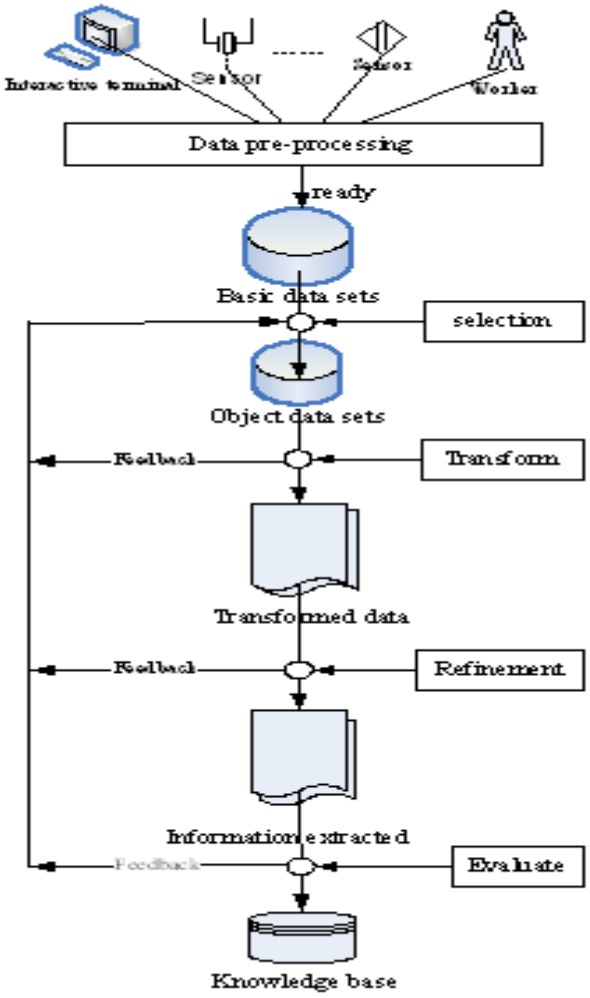

Figure 1. The Schematic Diagram of Knowledge Discovery in Databases

4. The Knowledge Services Model Based on Indirect Addressing

After pretreated and eliminate the semantic and grammatical ambiguity, the knowledge may be used to provide to the customers. But the trust problem troubles the application too. Because the knowledge providers and the customers do not know each other, there are no ways to certify them, and protect their information safety and the independent.

In order to resolve the problems mentioned above, and based on the schematic diagram of knowledge discovery in databases as shown in figure 1, a knowledge services model based on indirect addressing is proposed in the paper as shown figure 2.

In the resource and service invoking model based on “indirect addressing”, the customers and the knowledge providers do not exchange their information directly, the information exchanging should be based on a credible institution. The participants mainly include the providers, users and the cloud service customers.

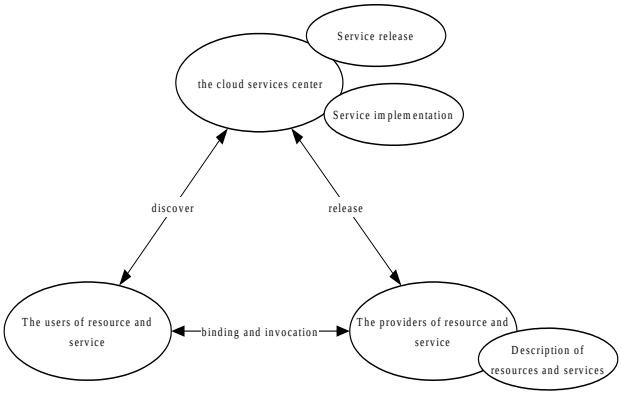

Figure 2. The Resource and Service Invoking Model Based on "Indirect Addressing"

(1) The Users

The users include all of the clients who need the service. They maybe the end-users or intermediaries, they search the knowledge in distributed environment using the professional retrieval system. Especially, they should be authorized or paid before they obtain the services. Most individuals do not clearly know or do not care about the concept of cloud computing, there are many users are already use the cloud service in fact, such as e-mail (such as Microsoft's Hotmail, Google's Gmail), online office software (such as word processing, spreadsheets), network drives, instant messaging (such as MSN, QQ), *etc.*, considering the spending habits, some consumers shop around while they accept the service, and often pay attention to service reputation. In making decisions, they often appear tendency to herd, and prefer for those high market shares of the brand even more preference.

(2) The Providers

They are the entities with the resources, including the internet infrastructure or the knowledge. They register their resources firstly before they provide the cloud services. Then the resources will invocated on the bulletin board, and the resource services should be using indirect addressing method. That is, though all the resources are come from the providers, the resources services should package and service from the cloud services center. The resources and services are limited by grammatical and semantic. The resource owners provide resources directly to end users did not suggest strongly, it is necessary to provide the resources to customers thought the cloud service centers.

(3) The Cloud Services Centers

The cloud services centers have amount of resource pools, they express the resources and services with standard protocols. The protocols are the service and express rules, and it is fair to all of the participations. Firstly, the resources should be registered in cloud center, post them on the bulletin board, and service the users with the resources neutrally.

5. The Cloud Services Package Method Based on Indirect Addressing

In order to resolve the grammatical and semantic ambiguity, the cloud services should to be package and provide a unified interface to other applications. The user

can not consider the specific implementation details of the current service while invoking a service; it only need provide the interface compatible with the resources, attributes and the service interface, as shown Figure 3.

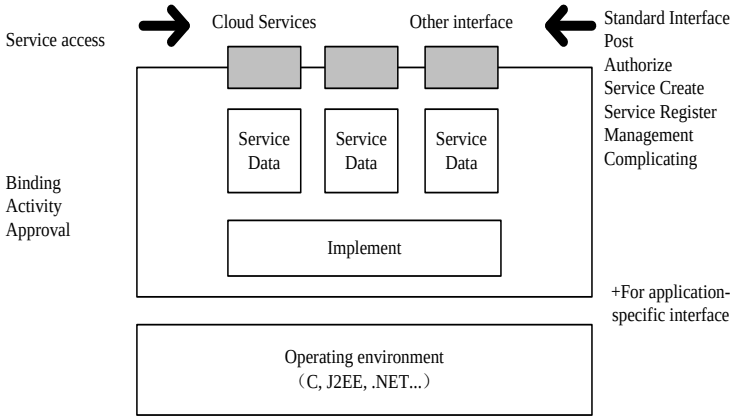

Figure 3. The Package of Cloud Services

The cloud services model and the interface package method based on indirect addressing have some advantages:

(1) Its a better way to solve the problem of semantic ambiguity

The cloud center announces a serial rule of servicing firstly. The owners of knowledge should register and post their resources as the rules before they service the users, the users should accept the rules while they obtain the services.

So, the providers and users form agreements by using the resource and service invoking model based on "indirect addressing", it minimizes the problem of semantic ambiguity.

(2) Its the best way to solve the problem of trust ambiguity

As the center has credibility, though the users and the providers may not trust each other, the services may continue because the participants all trust the center. So, it's the best way to solve the problem of trust ambiguity.

(3) Platform independence

The providing, registering and retrieval of the resources or services follow open standards; it has nothing to do with the specific implementation methods and protocols. The customers are independence from the resources providers, and they can access the knowledge in any platform.

(4) The reusability of services

On one hand, the registered template maybe using to format all kind of resources and services, on the other hand, the resources and services registered in the cloud service center, they can package and service all the legitimate users. All the participants reach agreement by using the indirect addressing.

6. A Knowledge Discovery Strategy Based on Chord Ring

There are some resource node in the network, how to identify the node quickly? How do the customers access the just nodes and the services? So, it needs a serial of strategy to identify the services.

A structured distributed hash table node in the paper is proposed to resolve the problem of identifying the nodes and services. Distributed hash table works as the step following:

(1) Identify the key resource node using IP address or numbers of no repetition. The symbol should include the IP address and resource type, if the node is a resource node, then flay=0, then, if the node is a register, then flay=1.

$$Hash=hash\ (IP\_Address) \quad (1)$$

$$Flag=if\ (node\ type==resource,\ 0,\ 1) \quad (2)$$

So, id may be identified as：

$$Id=function\ (hash,\ flag) \quad (3)$$

(2) Using unique data object as a data object key attribute. For example, the attribute of key data objects can be expressed as:

$$Key=hash\ (name) \quad (4)$$

(3) based on the certain rules, establish key from the key mapping to the data object id. In other words, prior to store a data object key to the key routes in the location identified as id.

(4) Form the route table of each resource nodes from the key nodes mapping graph. Based on the data recording key indentify the id of address information.

(5) To implement the functions such as data searching, adding and nodes deleting according to the registered center routing table.

According the steps mentioned above, an improved Chord protocol based on link resource discovery process can be described as follows:

(1) To build Chord ring

If the nodes in the system are n , and the registers in the system are m , the functional relationship between they are $m = \log_2(n)$. Supposing all the nodes connected together and forms a Chord ring, if the next of node i is the register online in the ring (including node i itself). For example, there are 8 nodes in the ring, the register nodes is 3. If nodes 0, 1 and 3 are the registers, the Chord ring may be expressed as figure 4. In the figure, the grad nodes are the registers, the other nodes are the resource nodes, and the arrow indicates the direction of Chord ring.

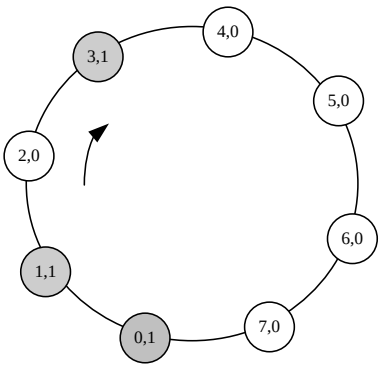

Figure 4. The Schematic Diagram of Links Based Chord Protocol

(2) Create the key-id mapping of resource node

Rules of Chord protocol require the data object with values of the key will be registered in the routing table of index i, there, i=key. Given in Figure 4, after calculated by the hash function, the data value key is 4. The next node of node i with hash value of 4 is node 0, so, the router information of node i will be stored in node 0. Similarly, the hash value of other two node can be calculated using the same

method, they were 1 and 3, that is to say that the router information are 1 and 3, as shown figure 5.

(3) The router table of register node

The routing table refers to a router or storage of other Internet network equipment in the table, the table has a path to a special network terminal, and metrics associated with these paths. By means of the concept of routing table here, a resource table for querying node lookup table is established.

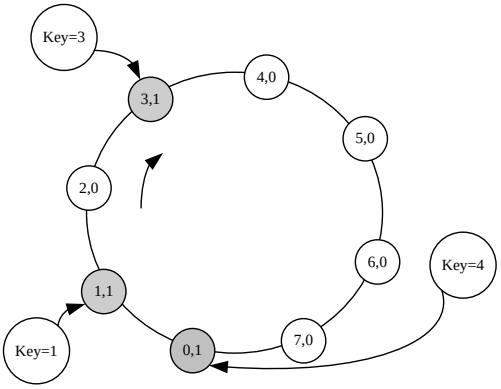

Figure 5. The Key-id Map of the Resource Nodes

In order to express the locations of resource nodes, and know which resources should be stored in an online node, the k router node index routing tables index[k] may be packaged as a set with 4 parameters:

$$index[k] = \{hash\_node, router\_start, router\_end, router\_node\} \quad (5)$$

There:

$hash\_node$ is the nodes with key obtained by hash function, the node may be resource nodes, also maybe routing node or register center.

$router\_start$ is the specified resource storage node with the minimum hash value, the index range is composed by it and the $router\_end$ node.

$router\_end$ is the specified resource storage node with the maximum hash value, the index range is composed by it and the $router\_start$ node.

$router\_node$ is the resources should be found for the specified registry routing nodes, namely to find registered index node there.

If i is the flag of current router node, n is the number of resource nodes (include the router nodes and the register nodes), the $index[k](k \geq 0)$ of node k may be calculated as the following algorithm:

```
int array_router[m],j=0;
for(int k=0;k<=n;k++)
{
if (id[k].flag==1)
array_router[j]=k;
j++;
}
```

The algorithm above calculated the location of all the register nodes and router nodes, the locations of the resource node may be calculated similarly, as shown in Table 1.

Table 1. The Value of $index[k](k \geq 0)$ in Chord Link of Figure 4

hash _ node	*router _ start*	*router _ end*	*router _ node*
0	0	0	0
1	1	1	1
2	2	3	3
3	3	3	3
4	4	0	0
5	5	0	0
6	6	0	0
7	7	0	0

In the above calculation, the number of entries in the table is n, if the value of n is very large, the registry values in the routing table entry is very much, in order to simplify the Table 1, Often used *router _ node* as standard of router node, another table structure shown in Table 2 is constructed. Clearly, in Table 2, the item of numbers is m=log2n, apparently, table 2 shows the high efficiency of the routing in the practical application.

Table 2. The Index of Chord Link as Router-Node

router _ node	*router _ start*	*router _ end*	Resource node range
1	1	1	(0,1]
3	2	3	(1,3]
0	4	0	(3,0]

Based on Table 1 and Table 2, the entire router table may be created, as shown in Figure 6.

(4) Data searching

In the cloud service, if any resource node receives a retrieval request, the register node retrieves the first line, if the item "resources" has the just resources, the search request will be sent to the corresponding router_node, else retrieves the next line, or not, continue to retrieve the third line and so on, until it finds the resources so far.

For example, if we want to find the node of key key=5, firstly, it retrieves the first row in Table 2 to determine whether 5 in (3,0], if not found, continue to the second row, and so on, when it finds the third row, found 5 is just in the node range of (3,0], the resource node range corresponding to router_node is 0, and thus the retrieve command to the node 0, and find the node in the node 5 to register resources or services, and then directly to find command delivered to the processing node 5 to find the just resources.

(5) The join and leave process of resource nodes

If you want to add a node (including resource nodes and routing nodes or registry node) i, firstly, we must know the location of the node to join, for example, it want to act as the next of node j. Node j generates a resource notice token, looped to notify all the other nodes in Chord ring, all the routing nodes update the routing table, and adds a new node in the route, while other node want to access the resource, the new node may provide resources to the node.

If you want to delete a resource node i, node i notices the token, notify all the nodes about his exiting, and a pointer to itself can point to his successor. If you want to delete the registry routing node, you need to inform other registry router

updates the routing table information, and entrust their registration information to other nodes.

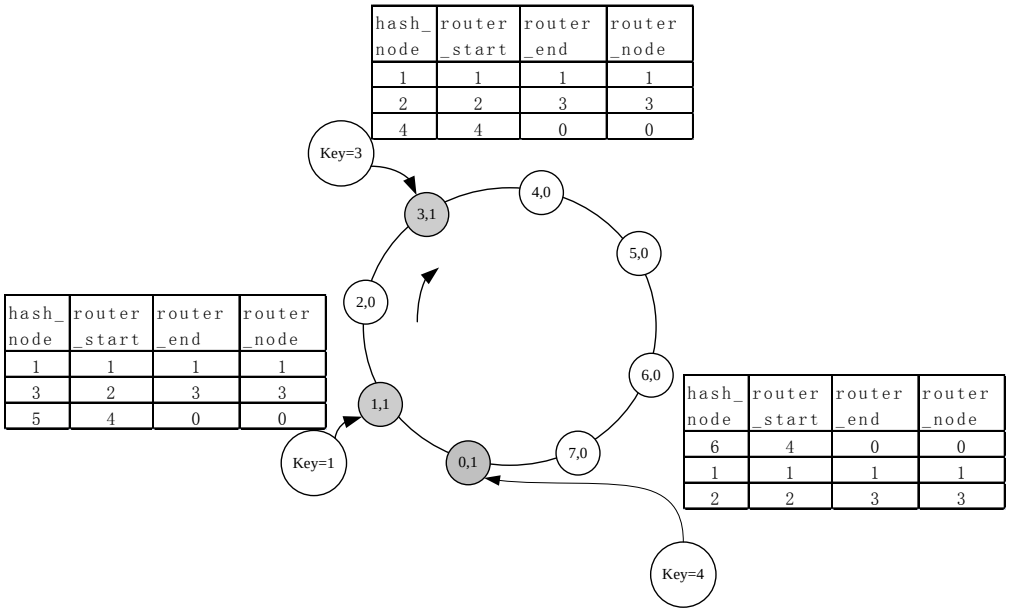

Figure 6. The Schematic Diagram of Chord Link

7. The Service Steps of Indirect Addressing Method

To give the service steps of indirect addressing method is very important to implement it. The mainly steps are those:

(1) Identify the objectives and scope of the problem in accordance with the scale of the problem

Firstly, we should clear that what resources we need to collect and what services need to provide, then clear the boundary conditions of the problem, and set the scale of the problem in accordance with the boundary conditions and constraints.

(2)To form the information of basic services unit

To describe the problem by using XML or other formal description language and form the basic services unit. It should to reduce the semantic ambiguity and grammatical ambiguity while we design the rules and express method.

(3) To post the services in Chord ring

To register the resources and services in cloud centers, and post the standard services to post bulletin boards. To post the information of resource node to the register nodes, and form the router table in order to discover the resources or knowledge.

(4) To discover and collect resources

The users discover and collect resources in cloud bulletin boards while they need them because the information has been posted in bulletin by using the hash faction in Chord ring, the discovery process become very easy.

(5) Knowledge reasoning to analyze information and reasoning the knowledge through a variety of reasoning mechanisms, and arrive the reasoning results.

(6) To apply the services to resolve problems to use the reasoning results from the knowledge and services to resolve the problems.

8. Results

In order to resolve the service model problem of cloud-based service in distributed environment, a cloud service model based on indirect addressing service method is proposed in the paper. We pointed the new problems serving in cloud firstly, then come out a recourse and service invoking model based on indirect addressing, gave out the service actors of the model in detail, studied the package method of the cloud interfaces, produce the knowledge step in the indirect addressing mode of resources distribution. Proposed a knowledge discovery strategy based on Chord ring, researched the algorithm of Chord ring, arrived the service steps of indirect addressing method finally. The analysis proves the method with some advantages, and it proposes a new way to settle the service problem in cloud.

Acknowledgment

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