Towards the Design of Network Structure of Data Transmission System Based on P2P

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Abstract. The emerging technology of P2P realizes the peer computing by utilizing nodes in Internet. The applications of P2P lie in many fields such as file sharing, distributed computing, collaborative work, Internet storage and so on. The overload of servers and the occupation of bandwidth are mitigated. This presents a wide and deep promise of applications. However, the ever-increasing nodes present some research and technical challenges, such as the stability of the target system, the latency of forward of nodes among multiple layers, the dependability of communications among nodes and so on. The paper presents a novel hierarchy of data transmission system based on P2P by the management of nodes. The super node is coined to optimize the structure of network of P2P.

Keywords: Data Transmission, P2P, Super Node, End Agent.

1 Introduction

The emerging technology of P2P realizes the peer computing by utilizing nodes in Internet. P2P fully taps the idle resources of Internet and has the potential advantages in terms of utilization of resources, extensibility and fault tolerance. The applications of P2P lie in many aspects such as file sharing, distributed computing, collaborative work, Internet storage and so on. If P2P was applied into the data transmission system under the environment of game playing, the role of client machines would be found by buffering a part of information acting as a role of server and thus scattering the services. By this way, the overload of servers and the occupation of bandwidth are mitigated. This presents a wide and deep promise of applications.

However, the ever-increasing nodes present some research and technical challenges as follows.

- The system should adjust and monitor the action of nodes.
- To ensure the stability of the target system.
- To decrease the latency of forward of nodes among multiple layers.
- To guarantee the dependability of communications of nodes.
- To provide the good extensibility of the target system.

The key approach to resolve these challenges is to design better networking structure of data transmission system based P2P technology. Some literatures contribute to the

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field for these challenges. Chi-Feng proposes a DLNA-based Multimedia Sharing System [1]. A method for classifying broadband users into a P2P- and a non-P2P group based on the amount of communication partners ("peers") is presented in [2]. The self-structured organization combines the benefits of both unstructured and structured P2P information systems [3]. Relevant research is presented in [4-6]. Gorodetsky proposes virtual peer-to-peer (P2P) emulation environment intended for testing and verification of implemented mobile P2P agent applications in [7]. An algorithm which creates a random overlay of connected neighborhoods providing topology awareness to P2P systems is put forward in [8].

The paper presents a novel hierarchy of data transmission system based on P2P by the management of nodes. The super node is coined to optimize the structure of network of P2P.

2 The Hierarchy of Data Transmission System

The hierarchy of the data transmission system based on P2P is divided into four aspects: application layer, notification layer, networking transmission layer and physical layer as illustrated in Figure 1.

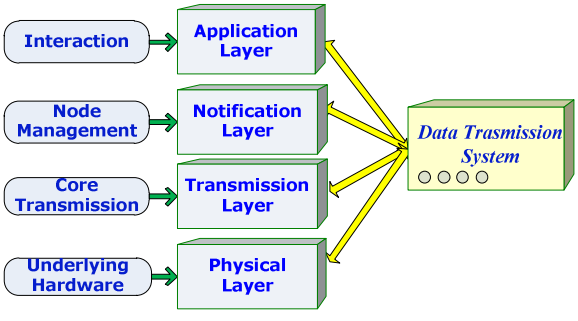

Fig. 1. The Hierarchy of Design of Data Transmission System based on P2P

(1) Application Layer
The application layer provides the interface between users and the system. Users share a virtual file space, which provides some basic functions associated with files. Application Layer shields the technical detail of routing and transmission.

(2) Notification Layer
The layer implements the node and directory management. The structure of the transmission system is designed and realized. The primary function is the choice of super node. When a normal node logs on, basic information is written into the super node. The inner networking is constructed by utilizing the hashed IP address. The indexing data is stored into the relevant node after computing key words by Hash functions.

(3) Transmission Layer
The layer is the core one in the whole system. The functions include that nodes search resources and upload and download resources. The overload balance, QoS

(Quality of Service) and security model is added into this layer to improve the efficiency and security of the system.

(4) Physical Layer

Physical layer is composed of computers with storing space and computing ability, nodes and underlying physical elements. The user node constitutes the elementary unit of P2P storage system by contributing the storage space and computing resources. The layer is the lower entity of file storage and the physical basis of the entire system.

2.1 The Management of Nodes

In fact, the management of nodes is the process of communications among nodes, which includes several steps.

(5) The logon of nodes

When a new node wants to join in the target P2P system, it is necessary for it to logon the super node, i.e., to establish the relationship between the super node and the new node. The IP address and username of the new node will be registered into the super node to get service and relevant management provided by the super node. On occasions, the new node will evolve into a super node and waits for the request of another nodes. The super node maintains a local table that records all the information of another nodes having connected into the super node. The necessary information contains IP address, username, connection status, the reputation value and the factor of resource consuming.

(6) The construction of the structure of shared files in the same cluster

Once added into the target system, the node uses the hash function to compute the key words of files existing in the shared directory. The index information is placed into the matched node. The information is dynamic with different size and the shared content can be modified at any time. Accordingly, the index information is not stored in the database, but the new memory space is employed with table-driven method recording the information of key words. The method decreases the time consuming of read data and improves the searching efficiency.

(7) Establishing the connection while nodes are downloading

After registration of nodes, they can use the downloading function. Users enter the filename to be searched. Then, the system computes the keywords and queries the routing table. At the same time, the keywords are submitted to super nodes who forward the query to other super nodes. The super node firstly searches the local database. If not matched, the super node sends the request package to another super node by corresponding routing algorithm. The address of source node having the resource requested is returned to the query node. If the source node does not exist, the timeout information is informed to the query node.

(8) The exit of nodes

The exit of nodes is classified into two categories of normal nodes and super nodes. When super nodes exit, the factor of resource consuming is queried to judge the node that can replace the exit node. The information of memory database and the routing information of other super nodes are sent to the replacing node. The system broadcasts the exit of the node and the change of the super node.

When normal nodes exit, the information of key words is sent to the neighbor nodes. In the meanwhile, the relevant super node is informed to disconnect with the exit node. The super node deletes the relevant entries of the exit node and sends the information to other nodes to update the routing tables.

3 The Architectural Design of Data Transmission System

The data transmission system based on P2P consists of *Web service*, *Controller*, *Media Server* and *End Agent*. Also, *Stream Reporting Bus* and *Aggregate Bus* are designed based on bus technology, as illustrated in Figure 2.

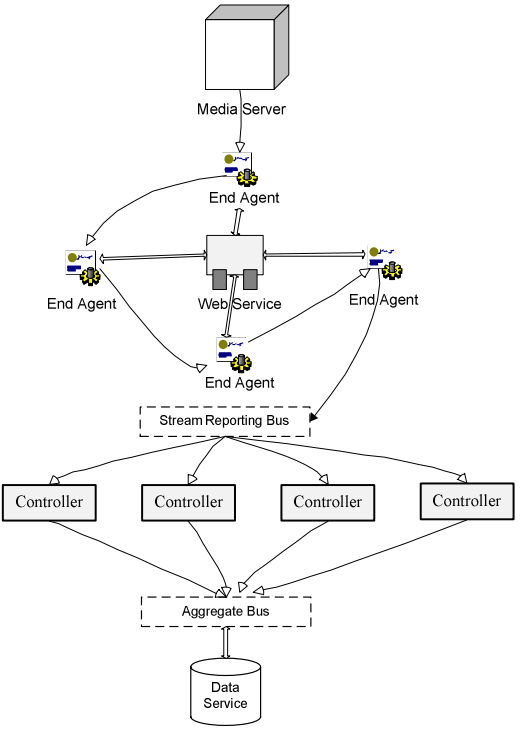

Fig. 2. The Architectural Design of Data Transmission System based on P2P

Controller server is employed to monitor user behavior and is charge of the networking structure of nodes. Controller server is composed of Controller program and Date Service. Media server intercepts the media stream and furthermore coding them. The real stream is provided for the root user node by the Media Server. The user node has two categories: End Agent and Stream Consumer. The End Agent is a basic unit, which forms the entire system networking. An End Agent is responsible for its father node to get the real stream and provides for child nodes. Furthermore, the Agent has the transmission function of control information between user and

controller. In order to balance the overload of the underlying system, controllers are composed of Controller Front and Data Service center. The Streaming Reporting Bus reports the streaming information from End Agent to controllers and the Aggregate Bus collects stream resulting from controller interacting with Date Service.

In the context of game playing, the media data will be handled. The decoding of media data is integrated into the Player. The End Agent is distributed into the networking structure acting as a communicating module. Agents are the main unit composing the structure of networking tree. Tasks of agents are the receipt and forward of media stream and the instruction interaction with controller servers. The End Agent will buffer the stream of father nodes and retain the service status. Controlling instructions should be added between agents and control servers to strengthen the management of users.

When a user wants to join the network, some tasks must be done as follows. Firstly, the potential user send a request named Get to Web Service to get the server address of the responding controller. Secondly, the TCP connection is established according to the address. If the user is a new one, registration activity is invoked. If the user is an old one, a validation process is invoked. This information is stored in the public Data Service center. After the success of validation, the data provided by the Media Server can be requested through the Controller Server. The Controller can choose 10 neighbor node addresses, which are nearer to the node chosen, according to the IP address. The user node can get a data stream required by a TCP connection.

In order to find the optimized father node, the ping sensor method is employed to select the ideal father node. The ping sensor algorithm works as in the Figure 3.

Algorithm: ***Ping Sensor***

```
1  TRACE_ADDRESS=NULL; //Initialize the address list to be null
2  N0=Current user node;
3  Ns=Neighbor node set; //the number of neighbor nodes is 10
4  i=2;
5  mintc=ComputeTimeConsuming(Ns1,N0);
6  //compute the ping time of the current to N0
7  while(true){
8    if(i=9){
9       break;
10    }else{
11       tci=ComputeTimeConsuming(Nsi,N0);
12       //compute the ping time of the Nsi node to N0
13       if (tci<mintc){
14          mintc=tci;
15          minnode=i;} //maintain the minimal ping time
16     i++;
17   }
18 return minnode; //return the node with the minimal ping time
```

Fig. 3. The Algorithm of Ping Sensor

The algorithm returns the node information that has the minimal ping time between the initial node and the target node. The computing process is done by the iterating all the 10 father nodes. The algorithm detect the time of returning ping package. The node with the minimal time of returning time is the optimized node. The exception is that nodes protected by firewalls cannot be detected. This can be resolved by detecting nodes when they apply to join the system. The detection is executed during the user online.

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References

1. Chin-Feng, L., Yueh-Min, H., Han-Chieh, C.: DLNA-Based Multimedia Sharing System for OSGI Framework With Extension to P2P Network. IEEE Systems Journal, 262–270 (2010)
2. Kettig, O., Kolbe, H.: Monitoring the Impact of P2P Users on a Broadband Operator's Network over Time. IEEE Transactions on Network and Service Management, 116–127 (2011)
3. Forestiero, A., Mastroianni, C.: A Swarm Algorithm for a Self-Structured P2P Information System. IEEE Transactions on Evolutionary Computation, 681–694 (2009)
4. Xiaosong, L., Kai, H.: Collusive Piracy Prevention in P2P Content Delivery Networks. IEEE Transactions on Computers, 970–983 (2009)
5. Kantere, V., Skiadopoulos, S., Sellis, T.: Storing and Indexing Spatial Data in P2P Systems. IEEE Transactions on Knowledge and Data Engineering, 287–300 (2009)
6. Chuan, W., Baochun, L., Shuqiao, Z.: On Dynamic Server Provisioning in Multichannel P2P Live Streaming. IEEE/ACM Transactions on Networking, 1317–1330 (2011)
7. Gorodetsky, V., Karsaev, O., Samoylov, V., Serebryakov, S., Balandin, S., Leppanen, S., Turunen, M.: Virtual P2P Environment for Testing and Evaluation of Mobile P2P Agents Networks. In: The Second International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies, UBICOMM 2008, pp. 422–429 (2008)
8. Papadakis, H., Roussopoulos, M., Fragopoulou, P., Markatos, E.P.: Imbuing unstructured P2P systems with non-intrusive topology awareness. In: IEEE Ninth International Conference on Peer-to-Peer Computing, P2P 2009, pp. 51–60 (2009)