Research on the Mobile P2P VOD System of JXME

LIU YUNPENG
The College of Computer Science and Information Technology
Zhejiang Wanli University
No.8 ,South Qianhu Road. Ningbo
CHINA

Abstract: Building and realizing the mobile P2P VOD system based on JXME is a brand-new research work. Firstly, the main problems in the mobile P2P VOD system are analyzed. Then the related solutions on JXME are presented, and the basic architecture of the system is given. JXME platform and the key technology of P2P streaming media applying on JXME are researched and analyzed. The advantage of the technology and the feasibility of the realization are verified.

Key-Words: P2P, JXME, VOD, Streaming media, J2ME, Mobile peer

1 Introduction

In the current wireless mobile networks, cellular networks, WLAN, Blue-tooth technology, satellite communications are the main forms. With the development of wireless mobile network technology, it can provide more and more business of Which mobile multimedia is the important one. Not only voice, image and other conventional multimedia business need be provided in the mobile networks, but also good video streaming services. The transmission of digital media of the streaming media is by the form of "flow" mode by which people can enjoy continuous online high-quality audio and video programs in a certain bandwidth environment. The mobile streaming media business, such as mobile VOD will become the mainstream of the wireless application in future.

2 Problem Formulation

Mobile VOD services now have a certain development, but there are some problems. (1) The narrow wireless network bandwidth: respectively as the mainstream of 2.5G wireless network technology of China Mobile and China Unicom, GPRS and CDMA-1X have improved the network bandwidth much more than before, but the improvement is still very limited. Along with the increase of users, the network performance will decrease further. (2) The processing and memory capacity of the mobile terminal is limited. (3) The system platform of terminal and LCD has a wide diversity.

Faced with such problems, there are three solutions, or the integration of the three options. (1) On the development of 3G wireless network itself. The greatest feature of 3G technology is the sufficient bandwidth, and the processing and memory capacity of 3G mobile phone will be significantly enhanced too. The narrow bandwidth problem can be resolved in a certain degree, the problem of the decreasing bandwidth with the increasing users can not be resolved;(2) P2P services only based on the current GPRS wireless network itself. It hardly relies on the Internet. Now some wireless service providers and the P2P technology company have developed a number of related applications. Although the technology has no large-scale promotion and the service is quite limited, according to the P2P principle, if the technology is applied to the wireless VOD system, the problem of the decreasing bandwidth with the increasing users can be resolved. (3) In this paper a new solution is presented. We need not the special wireless network on the P2P exchanging technology, mainly rely on the Internet and the existing wireless network. The P2P mobile VOD can be realized based on JXME (JXTA for J2ME). The problem referred above can all be largely resolved.

In the following description, the structure of the whole system will be introduced first, then the key technology and the related discussion will be presented, Finally, we refer the further research work.

3 Problem Solution

3.1 System structure

Streaming media applications are supported by setting up a three-tier structure in each node of the

P2P system: network communication layer, media control layer, media playing layer[3]. (Fig.1).

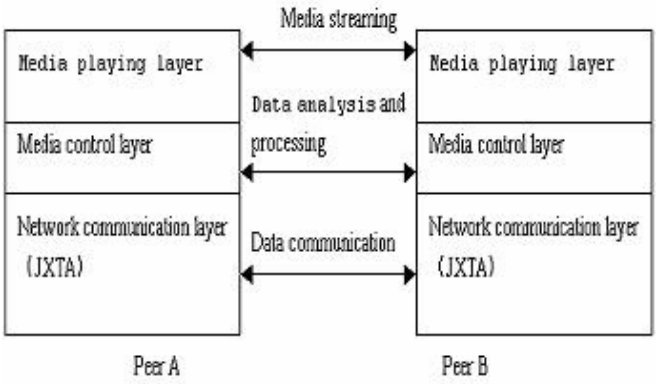

Fig.1 System structure

Network communications layer is responsible for establishing the link between the mobile peers, finding peers, self-organization, communication and monitoring. The mobile P2P bottom communication problems can easily been resolved by JXTA platform.

Media control layer is responsible for scheduling data, cache, and serving transferring the data to media playing layer and the other peers which request the media data..

Media playing layer is responsible for playing the streaming media data, do not care about data sources[3].

The mobile P2P VOD server and the cable P2P VOD server are essentially the same, including the streaming media server and the directory server. The streaming media server provides the original video data, the directory server maintains the peers' information and all media servers' information. Topology is shown in Fig.2.

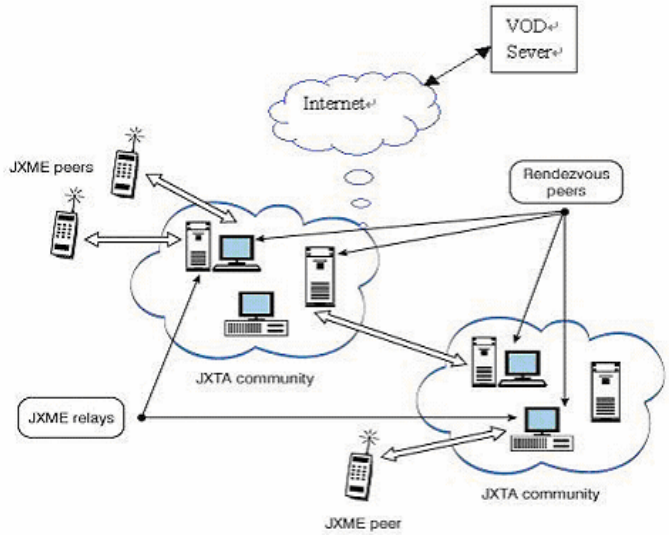

Fig.2 System topolgy

3.2 Key technology

3.2.1 JXME

The greatest potential of wireless equipment lies in its ability to access the network formed by large computers and storage systems. P2P computing is very suitable for the dynamic environment of the wireless devices. It has the ability to create, join the other group with which to operate, or to seek and request resources by publishing advertisements. P2P applications can dynamically find what they need, therefore are more suitable to the "lifestyle" of wireless environment. For the greatest development and application of P2P, the best option is to choose JXTA platform of SUN designed for P2P network. JXTA provides a consistent bottom platform for the P2P network application developers.

JXME is the abbreviation of JXTA for J2ME. The basic aim of JXME is to achieve the basic function of JXTA in the small terminal equipment and embedded electronics products (such as cell phones, PDA) and provide the bottom platform for the upper P2P application developing. Fig.2 also demonstrates the architecture of JXME. J2ME terminal equipment can participate in the interactive P2P network through JXME, communicate with both the J2ME terminal equipment peer and the PC, workstation and server.

The core of JXME method is the HTTP method coming from JXTA based on the Relay mechanism. This is because HTTP is the only network protocol supported by MIDP, the wireless peer can communicate with the wireless peer and the cable peer by HTTP.

JXME is a very suitable platform for design and implementation of the mobile P2P VOD system, the following advantages.

(1) JXME platform supports all kinds of service and function on Group Management. And we know that the application layer multicast、node management and many other applications require the group management in the P2P VOD system. So it can help improve the overall performance.

(2) Because the difference of the devices is canceled on JXTA, mobile equipment can communicate with any device by JXTA. It can use the resource of Relay、PC、server etc to serve for it. This can resolve below several important issues in the VOD system.

<1>Data caching: data caching capability of mobile terminal are very limited. Relying on the memory capacity of the Relay agents, more media data can be stored. Relay is just like a Proxy Cache or CDN server.

<2>Computing power: some complex algorithms of the streaming media control, such as searching resources, can rely on Relay. The computing burden of the terminal is alleviated.

<3>Internet barriers: NAT, firewall and proxy server. JXTA can resolve these well.

3.2.2 Streaming media technology

From the system architecture of Fig.1, we know that media playing layer is only responsible for playing the streaming media data. There are two ways for J2ME terminal equipment playing: one is based on the RTSP/MMS protocol, if the terminal supports the protocol, it can play streaming media just like using MMAPI. Media data can be played according to the URL format "rtsp://streaming media file path". The other is not based on the protocol, media data is played by the user-defined algorithm that controls the real-time download data in sequence and assures when a piece of data is played the back data is downloading in GPRS environment. The corresponding algorithm and source code are provided by some websites. It is entirely possible to use the algorithm for media playing layer of the mobile P2P VOD system, the difference lies in the caching data coming from more peers that is handled by media control layer.

3.2.3 Data redundancy strategies

Caching a amount of media data when playing or storing some pieces of data files in each peer make it possible to exchange data between peers. Media data should be separated into small pieces by size or time that facilitate the data exchanging and the distribution of resources throughout the system. On the basis of the above, data redundancy strategies are discussed below.

Strategy 1: distributed storing the media resources by disk or other external memory.

This idea comes from the reference [4]. It aims at the cable P2P mode VOD, but is suitable for the mobile P2P too. Below is the idea: It is unpractical to request each peer to store the whole media file after playing. But it is feasible to request a peer to store certain pieces of files according to its own resources.

As to mobile terminal, because of the limited resources, the best way is to keep more pieces of files into the Relay or the close PC.

When the using external memory is not enough, we can use LRU etc to replace the existing pieces.

Strategy 2: distributed storing the media resources by internal memory.

In fact, we can use strategy 2 on the base of strategy 1. Media data is transferred in advance to memory to accelerate the speed of data transmission.

In reference [5], a memory management model is brought forward: If the peer has set up a memory space which can receive S pieces of data block which then is divided into three parts: There are X pieces in the first part which preserves the beginning part of a media file from piece 1. Such an arrangement is because most of the VOD are chosen from the beginning, a great lot of redundancy for the little part of the beginning of the media data one side can enhance the opportunity of the peer obtaining the data to reduce the burden of server, the other side can reduce the delay of beginning playing and get more time to find other peers which can provide media data as a server. There are Y pieces in the second part which is decided by the current media data redundancy. Some related algorithms (such as choosing the least piece in backup) are needed to choose which pieces to backup. The part not only meets the playing needs, but also backups for the whole system. There are Z pieces in the third part which preserve a media cache for own playing.

As to P2P structure on JXME, this mode need a transformation. X part and Y part should be stored in the Relay or the close PC. So the mobile terminal can have more space to cache the playing media data. As the analysis before, backup the data need a standard. A common idea is to choose pieces of data which have a least backup. If the amount of backup of every piece is relatively balanceable, the beginning part is chosen firstly.

3.2.4 Data transmission scheduling mechanism

In multi-source P2P streaming media system, a number of different senders with providing different bandwidth send data to a receiver. In order to a small delay and ensure service continuity and stability. The transmission rate and data segment of each sender should be decided by the receiver, that is, the data transmission scheduling to the senders.

How to make a reasonable and effective scheduling for the data transmission of each sender is a challenging problem. Because the media is a continuous data and each sender may send different data segments, all these data segments will be combined into the originally continuous media stream by the receiver. The aim of the transmission scheduling is to receive every sender's data segment and revert to the continuous media data before the media data is played. And the sender's different

transmission ability makes the problem more complex[6].

In Reference[1], refer to multi-senders transferring data to one receiver, a solution that how to distribute the bandwidth and data among the multi-senders is put forward. They believe that it is most likely to ensure the continuous playing if each datagram's arriving moment to receiver has the greatest difference with its playing time.

In Reference[2],aiming at the minimal dropout rate, a algorithm on distributing the bandwidth and data among the multi-senders is brought out. The algorithm only adapts to the CBR, not suit to the VBR. It is still difficult to transmission scheduling in VBR.

Reference[7] presents a way by the dynamic segment selection. Firstly, the peer's average uploading speed is calculated, and it may be necessary to continuously adjust the dynamic calculation, then the uploading speed of other peers which can provide the data segments to download is calculated too. According to the result of comparison, we can distribute different segments to different peer to upload. So how to calculate a peer's uploading speed? When the peer is requested to upload in the first time, the speed cannot be gotten. This is only calculated after the real upload.

The way to allocate the last segments firstly can be adopted. The influence will be relatively small regardless of the fast or the slow speed. After download is over, the speed data can be regarded as the basis to segment selection. If the calculated speed is higher than the average upload speed, the front segments are chosen, else we need calculate again to find a suitable segment.

4 Conclusion

At present, P2P streaming media research just starts, the related study on the mobile P2P is more later. There are many problems that need to be resolved. How to realize the mobile P2P VOD system on JXME platform is a very new issue, by the analysis of this paper, the technical feasibility and its advantage are presented, at the same time some key P2P stream media technology are analyzed. After a little modification, the technology can be directly transplanted to mobile mode.

Further work includes three aspects: (1) Because of some technical problems in JXME, for example, the long time to search other peers, lack of support in XML, some auxiliary algorithms are needed to remedy these problems, such as the research on the rapid analysis of the XML format;(2) only a certain amount of research and analysis in this paper, the idea of the framework is very preliminary. We need a real structure of the whole P2P VOD system on JXME;(3) after adjustment, the key algorithms on P2P streaming media will be transplanted in the mobile platform, we need pay particular attention to the data transmission and process dividing between the mobile peer and its Relay.

The P2P model is well suited to the wireless mobile equipment, the mobile P2P VOD system will become a new research hotspot in future.

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