Supporting Mobile Devices in Peer-to-Peer Video-on-Demand Systems

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P2P 기반 주문형 비디오 시스템에서 모바일 장치 지원에 대한 연구

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Abstract

Peer-to-Peer (P2P) network has great potential on utilizing the network while reducing the server loads. Video on Demand (VoD) has become widely used since we can watch contents we like without having to download the overall file first. The mobile users may not need high quality of video; they only need good enough quality that can be played in the limited resource of physical device and network. So does with the devices with very limited network bandwidth. These issues emerge an idea of allowing Free-Rider in the P2P VoD system, where those low performance devices will only optimize the network utilization, affecting none to the performance of main system.

I. Introduction

Users' participations in the P2P networks help a lot speeding up content distribution and reduce server load. P2P can also be seen as distributed system, mostly unstructured architecture, since the nodes are joining and leaving independently without asking permission from any main server. This kind of relationship makes P2P is more loosely coupled and able to manage large number of users.

Many forms of P2P systems are available. One of the most popular is Bit Torrent. If a node wants to download a file through a Bit Torrent System, then it obtains the list of peers, that currently seeding their downloaded part of the file, through a tracker server. By selecting random seed peers than the seed peers will give their upload bandwidth to the nodes needing it. In the case of mobile devices, some P2P systems exist, such as MopiPhant, Symella and Symtorrent.

Current streaming technology commonly supports High-Definition (HD) content, for example Youtube and Vimeo. It is supported by the high availability of bandwidth in the network. Meanwhile, in the wireless network, especially in mobile devices, those features are limited to the form factor of the device itself and the unstable wireless network. It reduces the Quality of Service (QoS) required and obtained by the mobile devices.

II. Related works

If we discuss about P2P, then fairness issue will always emerge at the very beginning. Since each peer is helping other peers, then the performance of the overall P2P system depends on the contribution of peers in term of upload factor. The higher each peer's contribution, the healthier the system is. That is why, a fairness mechanism may be enforced like Tit-for-Tat or Give-to-Get [1]. It means, if a peer contributes more in the system, then it will obtain more bandwidth from other peers. The decision of giving peer's upload bandwidth may be placed in each peer or centralized in the server, depends on the architecture defined. The fairness mechanism may have some weakness as we will explain it in the next section. Some papers discuss about fairness are [1] and [2].

H.264 has many layers of encoding. The main layer is called Basic Layer and the other layers are Enhancements Layers (quality, frame rate, resolution) [3]. The video playback is constructed using Basic Layer combined with Enhancement Layers as options. .

A proposed method to do efficient streaming along P2P network is using Periodic Broadcasting (PB) [4]. PB places the mobile devices at the edge of the tree nodes. The mobile device will receive reduced quality of video after experiencing trans-coding previously in the tree node. The streaming itself will be given in periodic time, makes it more efficient.

This paper will be related to the replication mechanism in the P2P networks. By replicating some resource, the latency will be reduced and the network will be utilized more. Replication in this paper will be unrelated to popularity of the resource [5], but it will be executed in real time when a resource is being requested. We will discuss it later on in the next section.

III. Proposed Idea

The weakness of this fairness mechanism is when the joining nodes that truly unable to give above certain threshold of upload bandwidth, then the node will be

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rejected from the system. It gives less opportunity for users with low rate of upload enjoying the VoD service.

Without considering the self contribution of each peers, we tried to develop a system that has a positive attitude towards all peers. By doing so, the matter of fairness will may be neglected to some degree. We proposed Free-rider Supporting System, and Assisted Peer VoD.

III.1. Free Rider Supporting System

The system is constructed in tree manners, where packets are dispersed through the networks. It is divided into two zones, the Main Tree (MT) and Outer Tree (OT). Where each nodes joining will be at the outer tree at first, and after it fulfills certain criteria it will join the Main Tree.

The MT consists of dedicated peers and peers that are willing to give certain contribution above threshold. MT is guaranteed to receive high quality of streaming considering their high contribution to the server. There are some manager servers that validate each tree in the MT, accepting OT's peers who want to join and discard peers that are under requirements from the MT.

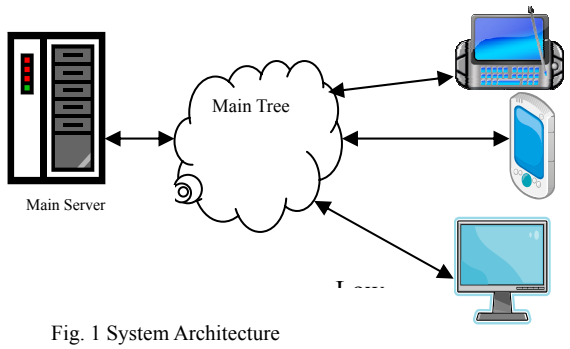

Fig. 1 System Architecture

At OT, peers are more loosely coupled and free to join. They act as a free-rider and have a low quality video access. Although it is free, the OT should find available nodes that are willing to share its upload rate. The decision of accepting a free-rider peer in this tree is placed on each peer. Peers at OT are given low quality video, so they are still able accepting VoD service.

OT may request to several nodes for the enhancement layers. This kind of mechanism, will utilize more of the network, assuming the peers in MT are having unlimited bandwidth subscriptions,, so no peers will be injured by the money-cost. Expected types of peers in OT are mobile devices and peers with low rate of upload. They still can contribute to the system, although not demanded.

III.2. Peer-assisted VoD

Considering our mobile users and peers with low bandwidth rate (upload/download), a mechanism to increase the speed of download video content can use a kind of replication. And utilize idle bandwidth in other peers' connections.

This can be done by sending request from a peer of certain video content to the main server. The server will reply with packets containing the requested contents and list of other peers that may have part of the content too. From the list, the requesting peer can ask for part of content to some nodes in the list.

Meanwhile, the needing peer may also request to near peers in the network, considering the peers may have higher download rate from the main server. If the requested peers are available, then the requesting peer may ask for assistance from it to download next part of the content. This scheme is also assuming the helping peer has bandwidth limit. This kind of scheme is like replication on the edge-severs.

IV. Future work

The mechanisms presented here have not been implemented in real life and in simulation. It will be our future work to be done. We expect of significant improvement of system's performance while increasing the scalability of P2P network.

The experiment will be done in simulated environment using NS2. The fairness will be neglected and focus on optimum contribution of each peers. The two mechanisms of "Free-Rider Supporting System" and the "Peer-assisted VoD" may be implemented separately. But, it is possible too implementing it together in one system.

V. Conclusion

We have proposed a basic mechanism on P2P VoD network management, covering the bandwidth utilization, mobile user consideration, and assisted peers streaming. By this, the mobile users and low bandwidth rate peers will still be able to enjoy good enough quality of VoD service. It is our future work to elaborate our design and verify it by simulation.

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