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A Study on Efficient Join Mechanism Using Streaming-Service-Time in Mobile P2P Environment

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Abstract. In keeping with the recent development of mobile-related industries, users require higher quality media service based on high-performance terminal devices and intellectual networks. In addition, P2P technology, which reduces the burden on a server and distributes roles unlike the existing client/server model, is attracting attention in mobile areas as well. This paper looks into the network mechanism where a new node is added into the mobile streaming system, and suggests an efficient join technique for mobile nodes of limited resources and battery capacity. This method takes into account the wait time of peers, and suggests a technique for peer-to-peer selection, in which the parent node's choice of a join node is based on remaining download time. As a result, an improved system can be constructed which reduces the rate of churning and provides more robust and resilient topology.

Keywords: peer-to-peer, mobile P2P service model, mobile streaming system, P2P topology, churning

1 Introduction

The popularization of diverse mobile devices and many networks has created an environment of high-speed data transmission for the current mobile users.

In 2013, Korea saw a rise in the rate of smart mobile devices (smart phone and pad) ownership compared to the previous year(63.7%→71.6%), whereas the rate of computer ownership per household declined for the first time since 2005(82.3%→80.6%)[1]. From these findings, it can be seen that a future shift from normal PCs to mobile devices in the network terminal device market is inevitable.

On the other hand, P2P (peer-to-peer), which was known to the world with the advent of Napster, is technology that enables one-to-one data sharing between PCs even without an intermediary server[2]. This technology resulted in leveling up desktop PCs from clients to servers, and changed situation so that users can play roles ranging from simple consumers to producers unlike the client/server model.

Consequently, P2P technology is attracting attention as technology that enables rapid access to frequently used objects by reducing burdens on the server and distributing roles. In fact, it is expected that operators of CDN(Content Delivery

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Network) and mobile clouds will provide more excellent services under the circumstances where P2P technology is grafted to result in efficient and cost-saving networks.

And yet, a differentiated peer selection technique is required that can provide optimum streaming services while minimizing the energy consumption of the whole system as well as prevent free riding[3], an endemic problem of P2P and consider energy performance as in users' batteries.[4]

2 Peer Management for Mobile P2P Service Model

In the mobile P2P service, heterogeneous devices join through diverse access networks, and thus it is necessary to perform efficient management in consideration of the service areas and characteristics of peers. That is, in the case of mobile peers, they vary in the performance of bandwidths according to access networks, and have limited features according to the playback time of media, the performance of buffer, network interfaces, software platforms, the reproduction performance of devices, and the mobility of mobile devices. Methods for enhancing the accuracy of geographical locations for mobile peers have been suggested using GPS information, RTT and TTL [5].

Also, the phenomenon of peers' joining and leaving in the P2P system is called churning [6]; and in case of frequent churning, a decrease in system performance may result, and the proper quality of streaming cannot be guaranteed [7]. Particularly, for mobile P2P service limited in resources and performance, this problem proves to be a more sensitive factor. In addition, there is the problem of batteries due to the limitations of physical resources in mobile terminal devices. If energy is also considered when peers of high contribution within the system are first given free patching and are allocated to the source node during streaming service delivery, stable service can be provided, control signals due to re-peering caused by battery discharge can be reduced, and the overall energy can be saved through reducing control request messages that are consecutively generated within the system [8]. Mobile system saving-related apps, which quit or temporarily suspend unimportant background apps so as to extend battery life, have been popular recently. In this context, file sharing may fall into the wait state temporarily as a user halts a P2P-related app.

Therefore, a separate strategy is needed to complement problems caused by the insufficient resources of mobile devices and to exchange contents effectively. Moreover, bottlenecks between peers occur due to the characteristics of P2P users, because selfish peers are only interested in downlink bandwidths and avoid sharing their own resources [5], and thus a decline in the performance of the overall system is a problem that must be solved.

3 RDT(Remaining Download Time) System

The previous study suggested a strategy of mobile P2P transmission for effective mobile service in the mobile P2P network environment, and a priority caching

strategy for it [4]. This paper used the concepts of BO (bandwidth-ordered) tree, TO (time-ordered) tree, and RO (relay-join) tree so as to enhance transmission efficiency when new nodes join. Further, the method did not rely on the parent node alone for shared contents, but distributed them to child nodes in order and improved the performance of the overall system.

The system proposed in this paper employs the method of peering around bandwidths of upper nodes and nodes having much remaining download time so as to maintain the existing topology and reduce the rate of churning. (But this study assumes that all batteries have the same capacity condition.)

Newly joining nodes start streaming service in earnest after a series of processes for exchanging buffer map information regularly through a P2P network agent so as to choose the most optimum parent node. For this, the agent uses the uploading/downloading information, IP address, and PID of every node.

As shown in Figure 1, a joining node requests resource allocation from a P2P network to which it belongs. At this time, the join node delivers its required bandwidth $bW_{join}(t)$, and the resource allocation agent selects a node having a bandwidth suitable to the request of the join node as well as the longest remaining download time, and maintains the optimum resource allocation so as to make the most of shared downlink bandwidths. Expression 1 shows the method of selecting the most suitable parent node CN_i, and definitions of the variables in the expression are described in Table 1.

$$CN_i \in \{ \{ BW_{join} \le BW_i, \ for\ all \ \ i \} \cap \{ MAX(RDT_i) \ \ for\ all \ \ i \} \} \quad \textbf{(1)}$$

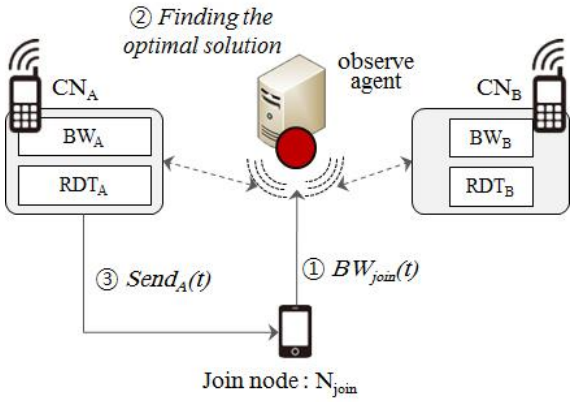

Fig 1. The proposed system model

Table 1. Notation and variable definitions

Notation	Definition
N_{join}	the new node to join the network
CN_i	the candidate node to be chosen as a parent node
BW_{join}	required bandwidth of N_{join}
BW_i	available bandwidth of candidate Node A and B
RDT_i	remaining download time of candidate Node A and B
$Send_i$	actual sending bandwidth

4 Performance Evaluation

To experiment the proposed system model, a mesh-based P2P streaming system was implemented on ns-2 (ns version 2.26) [9], and the topology was created using GT-ITM [10].

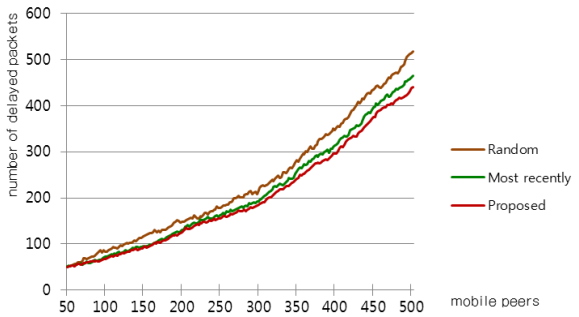

Fig 2. Number of delayed packets

Further, as for the experimental arguments, using different numbers of peers, 100, 200, 300, 400 and 500, three methods were compared, i.e., the peer selection method to which the mechanism proposed by this paper is applied, the general model of RTT-based random peer selection, and the model of allocation to the most recent peer. The length of media streaming was 600s, the mean data speed of the source node was 412 Kbps, and the buffer length of a peer was assumed to be 60s.

As shown in Figure 2, the technique of random-based allocation is a method of unconditional allocation without regard to the current state of a child node, and shows high packet delay rates. Also, as for the method of the most recent-based allocation, it is similar to the method proposed, but has the increased amount of waiting packets compared to the method proposed. This is because limitations in resources held by peers in the mobile P2P service cause frequently the wait state in the service. The results of the experiment show that the method proposed by us improved performance max 15% compared to the random-based method, and max 5% compared to the most-recent method. The method proposed examines bandwidths and remaining download time, and thus reduces the phenomenon of churning to the utmost compared to the two previous methods, and improves the overall system.

5 Conclusion

This paper looked into matters required to be considered for mobile P2P networking and mobile streaming service. And it suggested a method for selecting peers that improves the performance of the overall system and takes into account a mechanism centering around bandwidths and the remaining download time.

Further, using important considerations for peer selection that were obtained from the research model and the experiment, it conducted the comparative evaluation of

several mechanisms, and showed that P2P streaming performance can be improved by raising the max use rate of resources within a system

Users demand higher quality media service, on the basis of high-performance terminal devices and intellectual networks. Also, diverse technologies for the stabilization of service quality and the minimization of costs required for it are under study. In this context, when designing a service system in the future in keeping with the revitalization of mobile P2P streaming service, research on stable services is required in consideration of the method of additional resource optimization, the energy saving effects of a system, and the differentiation of user services.

Reference

1. "Internet Use Survey in Korea", Ministry of Science, ICT & Future Planning (http://www.msip.go.kr), KOREA, Dec, 2013.
2. Hongyong Huang, Haiyan Wu, Guozheng Wang, "Study of Distributed P2P Information Sharing System", IITA 2009. Third International Symposium on, pp. 300-303, 2009.
3. A. Bharambe, C. Herley, and V. Padmanabhan, "Analyzing and Improving BitTorrent Performance", TR, MSR-TR-2005-03, Microsoft Research, 2005.
4. Chang Hee Kim, Sung Uk Choi, "Efficient Service Scheduling in Mobile P2P-based Video-on-Demanding Streaming", Advanced Science and Technology Letters, Vol.43(HCI 2013), pp. 84-88, 2013.
5. Ana Paula Couto da Silva et al., "Chunk Distribution in Mesh-Based Large-Scale P2P Streaming Systems: A Fluid Approach", IEEE Trans PDS, Vol. 22, No. 3, Mar, pp. 451-462, 2011.
6. Cui, Y., Cao, Y., Dai, L., Xue, Y., "Optimizing p2p streaming throughput under peer churning. In", Vanderbilt University Institute of Software Integrated Systems Technical Report ISIS-08-905, 2007.
7. Garroppo Rosario G, Giordano Stefano, Spagna Stella, Niccolini Saverio, Seedorf Jan, "Topology control strategies on P2P live video streaming service with peer churning", Computer Communications Vol. 35, No. 6, pp. 759-770, 2011.
8. S. Lim, S. W. Lee, B. Lee, and S. Lee, "Power-aware optimal checkpoint intervals for mobile consumer devices", IEEE Trans Consumer Electron, Vol. 57, No. 4, pp. 1637-1645, Nov, 2011.
9. Network Simulator, NS-2. http://www.isi.edu/nsnam/ns/
10. E. W. Zegura, : GT-ITM: Georgia Tech Internetwork Topology Mode.

