Construction of Next Generation Mobile Video On Demand Delivery System Using Broadcast and Communication Integration Environments

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***Abstract*—Watching high quality videos anytime, anywhere is expected because mobile devices become popular. However, if mobile devices try to watch a video at the same time via a wireless network, the concentrated loads to delivery server cause a delay and a stop of playing videos on client devices. Therefore, in this paper, we realize a mobile video on demand delivery system that mobile devices can watch high quality videos continuously by integrated methods of broadcast and communication. We delvelop the prototype system and have practical experiments to evaluate the proposed system.**

I. Introduction

Watching high quality videos anytime, anywhere via a wireless network is expected because mobile devices such as smartphones and tablet computers become popular. However, if mobile devices try to watch a video from its delivery server at the same time, the loads for video delivery are concentrated to the video server and the network around it. The concentration of loads causes a delay and a stop of playing videos on client devices.

Therefore, in this paper, we realize a mobile video on demand delivery system that mobile devices can watch high quality videos continuously in various environments. We realize the delivery methods by integration of broadcast and communication [1]. Even if a huge number of mobile devices request to watch a specific favored video at the same time, the video can be played on the mobile devices in our proposed system immediately without interruption.

II. Broadcast and Communication Integration Environments

In this paper, we assume that mobile devices can receive data by both broadcast and communication. The broadcast in this paper means radio waves such as digital terrestrial broadcasting and one-segment broadcasting. In addition, the broadcast includes network multicast and network broadcast that send data to online devices at the same time. On the other hand, the communication means unicast via Internet or LAN.

Mobile devices send requests of videos to their delivery servers, and the delivery servers send data streams as videos to the mobile devices using both broadcast and communication. The mobile devices play the video receiving pieces of the data stream.

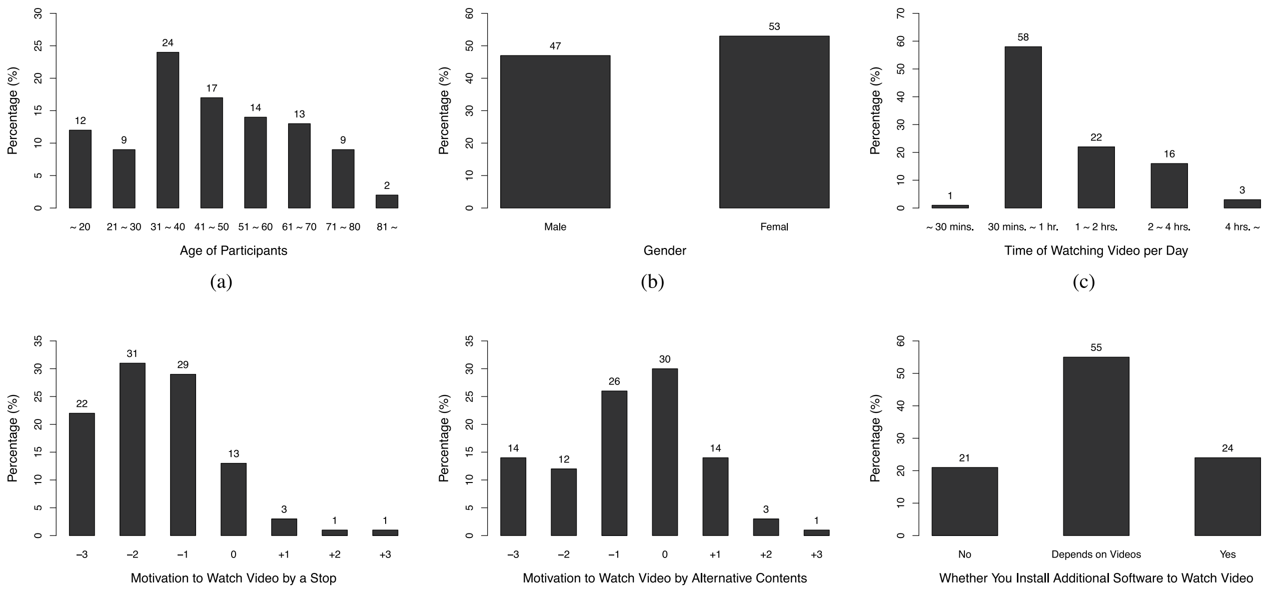
III. Mobile Video On Demand Delivery System Using Broadcast and Communication Integration Environments

In our delivery system, we propose the following methods;

- Stream merger
  If mobile devices try to watch a video from its delivery server at the same time, the loads for video delivery are concentrated to the video server and the network around it. Therefore, we propose a method that delivers common data among clients by multicast. The common data are delivered as merged streams.
- Alternative contents
  Delivery servers in our proposed system send alternative contents such as a lightweight video, pictures and texts to keep motivation to watch videos under bad network conditions. The delivery servers send the alternative contents to clients first when the delivery servers receive requests of videos from clients. If the network condition gets worse, the clients show the alternative contents to those users to avoid a stop or a delay of videos. We must consider the alternative contents to not cause discomfort of users.
- Adaptive multi rate
  The rate of battery consumption on clients is influenced by the frame rate of playing videos. Therefore, we propose a method to change the frame rate of playing videos adaptively based on the remaining battery level. The clients can watch videos for a longer time with adaptive quality of videos by our proposed method.

IV. Implementation

We develop server software and a client application to construct a video delivery system. The server software is installed to a Windows PC to delivery videos on demand. Figure 1 shows a configuration screen of the server software.



(a) (b) (c)

(d) (e) (f)

Fig. 2: Answers of participants

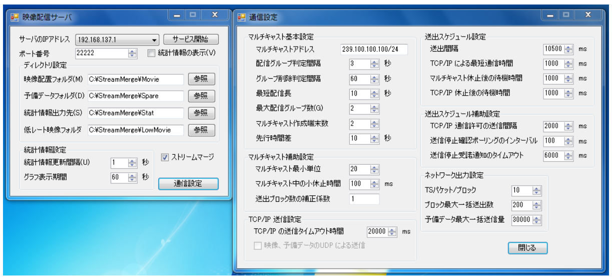


Fig. 1: Configuration of server (in Japanese)

The client application is installed to Android devices to request video delivery and watch the delivered videos. The server and clients in the constructed system are on the same LAN. The clients request the server to delivery video via LAN.

We have two practical experiments using the constructed system. The first experiment is on October 25th and 26th, 2014, in Tokyo, Japan. Another experiment is on November 22th, Okayama, Japan. Table I shows the environment of the experiment in Okayama.

In these experiments, we give participants questions and collect answers after they finish watching a video with the constructed system. The questions are about watching videos and subjective performance of the constructed system. By the mentioned two experiments, the total number of the gained answers is about 230. Figure 2 shows answers of participants in the experiments. Figure 2 (d) and (e) shows the level of motivation change to watch the video after a stop or viewing alternative contents.

About the subjective performance of the constructed system, although seven devices watched the video at the same time in the experiment of Okayama, all devices did not have a stop or delay to watch the video.

TABLE I: Experiment Environment in Okayama

Video delivery server

OS	Microsoft Windows 7 Professional SP1
CPU	2.50 GHz dual-core
Main memory	4 GB
Ethernet	1000BASE-T

Wireless LAN

Access point	Buffalo WAPM-AG300N
Standard	IEEE 802.11b/g/n (2.4 GHz band)
Multicast rate	24 Mbps
Additional antenna	Buffalo WLE-HG-SEC

Client examples

Google Nexus 7 (2013, Android 4.3)
Sony Xperia C (C2305, Android 4.2.2)

Video data (PR video of Okayama)

Container format	MPEG2-TS
Video coding format	H.264
Audio coding format	AAC
Bit rate	1 Mbps
Frame size	1280×720

V. Conclusion

In this paper, we realized a mobile video on demand delivery system that mobile devices can watch high quality videos continuously by integrated methods of broadcast and communication. We delveloped the prototype system and had practical experiments to evaluate the proposed system.

Acknowledgment

This research was partly supported by the Strategic Information and Communications R&D Promotion Programme (SCOPE) of the Ministry of Internal Affairs and Communications.

References

[1] Y. Gotoh, T. Yoshihisa, H. Taniguchi, and M. Kanazawa, "A method to reduce interruption time for streaming delivery of broadcast and communications integration environments," in *Proc. of the 4th International Workshop on Intelligent, Mobile and Internet Services in Ubiquitous Computing (IMIS 2010)*, Feb. 2010, pp. 784–789.