Design of Service Architecture for Hierarchical UHD Broadcasting over Heterogeneous Networks

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Abstract. The video resolution among broadcasting contents is particularly becoming high toward Ultra High Definition (UHD). Due to its massive size, however, UHD contents cannot be delivered over the existing broadcasting system. To solve this problem, we have considered two aspects: techniques of video codec and transmission. In this paper, we propose service architecture for delivering UHD contents encoded hierarchically over heterogeneous networks. They can be divided into two parts and at the sending entity and then transmitted the part of High Definition (HD) content over the broadcasting network and the rest over the communication network. At the receiving entity, they can be merged into the original contents. The proposed architecture is based on Internet Protocol (IP) in order to be compatible with packet-switched networks.

Keywords: digital broadcasting, scalable video coding, MMT

1   Introduction

In recent years, the technology relative to digital broadcasting is evolving rapidly. Contents are becoming reality such as 3D and Ultra High Definition (UHD) and devices for playing various media contents are launched, however, broadcasting technologies are not sufficiently prepared to transmit these services yet. It is difficult that high-quality contents are delivered via the current broadcasting networks as well. Therefore, it is necessary that realistic video contents are encoded high-efficiently and transmitted stably [1].

According to developing technologies of mobile networks such as 3GPP and LTE, the consumption of contents over the wireless networks is increasing. Considering the trend of mobile content consumption, service provider wants to product contents formatted as IP packet in order to reduce the cost of production. To satisfy these requirements, transport protocols are suggested such as MPEG Media Transport.

In this paper, we design the service architecture based on MMT. It enables user in various receiving environments to be provided adaptive ultra-high-quality contents. Additionally, video contents are encoded hierarchically because display devices have different resolutions and environments.

2 Overview of MPEG Media Transport

The MMT is technologies for transporting coded media data over heterogeneous packet-switched networks including IP networks and digital broadcasting networks. It includes three functional areas: Media Processing Unit (MPU) format, signaling messages and delivery protocol[2].

The MPU format based on the ISO based Media File Format (ISOBMFF) defines the logical structure of media content, the Package and the format of the data units for encapsulating the encoded data. The delivery functional area defines an application layer transport protocol and a payload format. It has more features than conventional application layer transport protocols for delivering multimedia data such as multiplexing, support of mixed streaming and download delivery in a single packet flow. The signaling message functional area manages delivery and consumption of media data and defines formats of signaling messages.

3 Hierarchical UHD Broadcasting Services over Heterogeneous Networks

We propose hierarchical UHD broadcasting services over packet-switched networks and digital broadcasting networks. The ultra-high quality media data is encoded hierarchically via the scalable coding techniques, and then divided into two or three parts[3]. Each part is transmitted over different networks. The main part is delivered over digital broadcasting networks to users who have a mobile device and a fixed device displaying up to the high-quality contents such as 2K and 4K. The other part for ultra-high-quality contents is delivered over IP networks when users connect the return channel and request. For this service, the signaling information is sent over digital broadcasting networks in advance.

The service architecture is shown in Fig. 1. The main data via broadcasting networks and additional data over IP networks should combine to make one original media content in case ultra-high-quality is required.
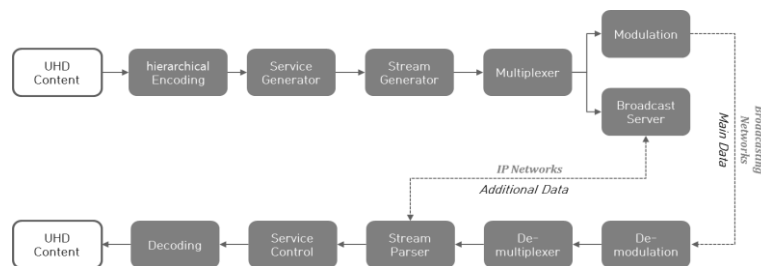

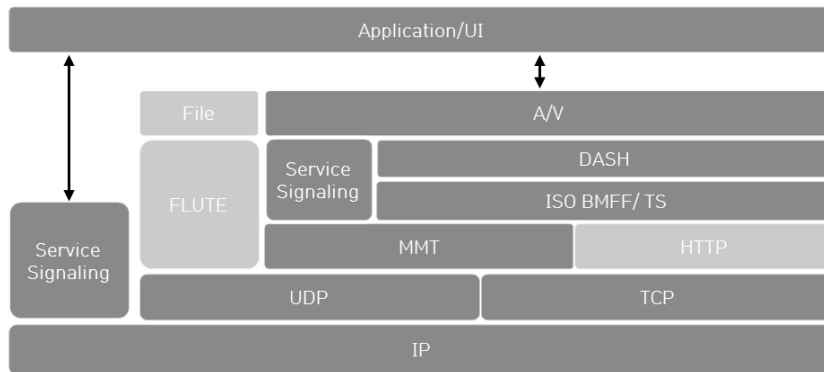
Fig. 1. The design of the service architecture

Fig. 2. The service of protocol stack

The service of protocol stack is defined in Fig. 2. The service signaling information is delivered with encapsulating as IP packet in order to notice the existence of additional data for ultra-high-quality content. Therefore, it is parsed before media data.

The video and audio data can be delivered over HTTP in order to be compatible with Internet or over MMT for broadcasting networks after they are encapsulated by ISO BMFF or TS[4].

Fig. 3. depicts a sequence diagram about users who have only mobile devices. The sending contents are hierarchical UHD contents composed of main and high-quality contents. The mobile device can detect the signal of hierarchical contents, but it does not receive high-quality content. As a result, mobile devices extract main contents and display only.

The digital broadcasting network needs technologies of error corrections because it has many problems to transmit the data such as transmission errors and low bandwidth. Therefore we adapt Forward Error Correction (FEC) method to the proposed system. Before the received contents are displayed, corrupted data are corrected the original.
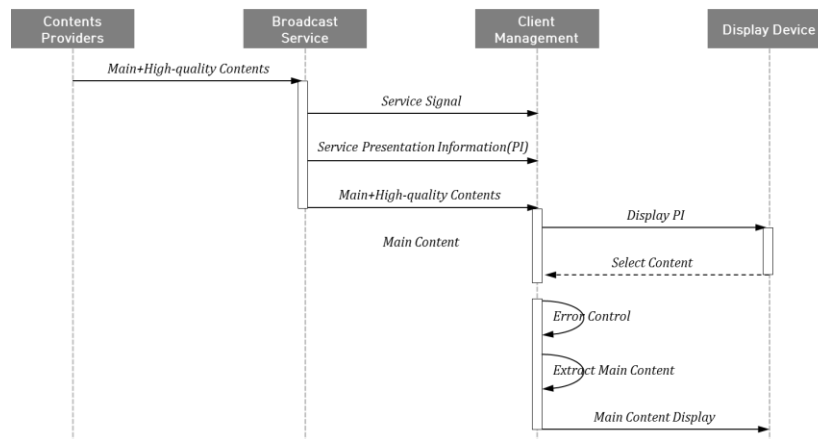

Fig. 3. The service of protocol stack

4   Conclusions

We proposed the service architecture for delivering UHD contents encoded hierarchically over heterogeneous networks. It was based on MMT which includes technologies for the transport and delivery of coded media data for multimedia services over packet-switched networks and digital broadcasting networks. To improve the transmission efficiency of UHD content, one content is encoded hierarchically, divided into main, high-quality and ultra-high-quality and then transmitted over the broadcasting network and the communication network. Users can be provided a proper content according to their reception environments.

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