21GHz 대역 스케일러블 위성방송 시스템 구현

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A Scalable Satellite Broadcasting System in 21GHz Band

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Abstract - A scalable satellite broadcasting system is designed to guarantee quality of multimedia service cooperatively utilizing both Ku Band and Ka band. In the system, video streams are separated into a base layer and an enhancement layer, and are transmitted over the two channels, Ku Band and Ka band, respectively. A basic quality of service using the base layer stream can be provided even when the enhancement layer stream over Ka band channel is unavailable by rain attenuation. A rain fall model is simulated using Barlett-Lewis Pulse model and is used in the operation test of the implemented sacalable satellite broadcasting system.

1. INTRODUCTION

This paper proposes a satellite broadcasting system for high quality multimedia service in the 21 GHz Ka band. In the Ka band frequency, the satellite can be applied to meet the increasing demand for high quality multimedia service in virtue of a wider available bandwidth than Ku band. However, it seems quite probable that high attenuation by rain in the Ka band causes a degradation of service quality or an outage of service [1]. In order to broadcast in the Ka band, it is necessary to develop a transmission technology which can overcome the satellite signal attenuation by rain.

In this paper a scalable broadcasting system is designed to cope with the problem of the outage of link in the Ka band by rain attenuation. The proposed system divides video streams, encoding with Scalable Video Coding (SVC), into a base and an enhancement layer streams. The streams are transmitted separately by Ku band channel and Ka band channel, respectively. Even when the link of the Ka band channel is broken by heavy rain, the terminal can maintain a multimedia service of basic quality using the base layer stream from the Ka band channel. In addition, the scalable broadcasting system compatibly provides both high and normal quality services for normal quality service subscribers.

2. SUBJECT

2.1 SCALABLE VIDEO CODING

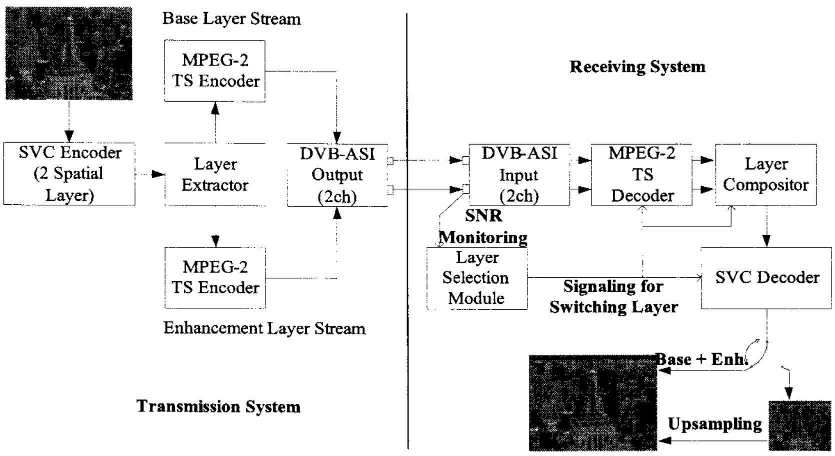
SVC enables the video stream to have scalability with temporal or spatial resolutions or qualities for transmitting and decoding of only partial bit streams [2]. SVC, is extension of H.264/AVC standard, jointly has been developed by ISO/IEC MPEG and the ITU-T in the framework of the Joint Video Team (JVT). A SVC stream consists ofone base layer stream to be compatible with H.264/AVC and additional enhancement layer streams to enhance video quality. The SVC provides temporal, spatial and quality scalability by decoding subsets of the bit stream. Temporal scalability and spatial scalability make the stream have various picture size or frame rate, respectively. The sub-stream with quality scalability has different signal to noise ratio (SNR).

2.2 SCALABLE SATELLITE BROADCASTING SYSTEM

The scalable satellite broadcasting system is proposed to provide high quality multimedia service in the 21 GHz. The structure of the proposed system model is shown in Fig. 1.

Layer extractor divides a SVC stream containing two layers of spatial scalability into two streams, which are the base and enhancement layer stream. Each stream is packetized to MPEG-2 Transport Stream (TS). Base and Enhancement layer streams are transmitted over Ku and Ka channel.

Layer compositor reconstructs the SVC video data from the streams received by Ku and Ka channel. It should be required to synchronize between layer streams. The layer selection module determines whether the decoder uses enhancement layer stream by monitoring of SNR for the Ka channel. If the received SNR is lower than the link margin, the layer selection module sends a signal to maintain service of basic quality by removing the enhancement layer stream. In this case, the result of decoding



<Fig. 1> The proposed scalable satellite broadcasting system.

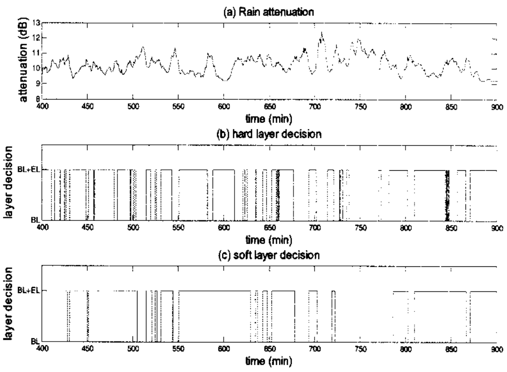
with base layer is upsampled to resize the resolution.

2.3 TEST RESULTS

The characteristics of the test streams are summarized in Table 1. Two different resolutions, i.e., CIF and 4CIFare used in the test of the scalable transmission system. The results of the hard and soft layer switching algorithms are comparatively shown in Fig. 2. The dead zone of 0.3 dB difference in the soft switching reduces the switching times significantly down to 15% compared with the switching times of the hard decision. The rain fall model is designed using Barlett-Lewis Pulse model, where the model is constructed with Poisson processes for storm, rain, cell, and depth and their combined exponential models for lifetime and intensity[5]. In Fig.3, the scalable video outputs are illustrated, confirming the operation of the implemented satellite transmission system.

<TABLE 1> Characteristics of the test stream (CITY)

	Base Layer	Enhace Layer
Bit-rate	1Mbps	2Mbps
Resolution	CIF	4CIF
Frame rate	30fps	30fps
Stream format	MPEG-2 TS (Video, Audio)	MPEG-2 TS (Video)



<Fig. 2> The results of the layer switching algorithms.

3. CONCLUSION

This paper proposes a collaborative transmission of high definition TV utilizing both Ka and Ku bands. A scalable video transmission system is designed and its prototype is implemented usingSVC for a base and an enhanced layer streams. The performance of the scalable satellite broadcasting system is tested with the rain falll model designed using the Barlett-Lewis Pulse model. The soft switching algorithm proposed in this paper improves the switching characteristics significantly. It reduces switching by less than 15%, eliminating the short transition of less than few minuites only with the allowance of 0.3dB dead zone, consequently improving for the smoother quality of service even in heavy raining situation.

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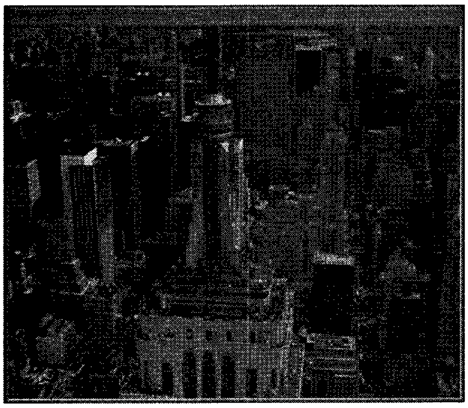
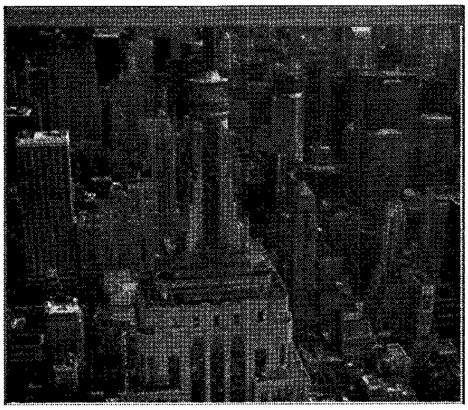


(a) Decoding with base and enhancement layers.



(b) Upsampling after decoding with only base layer.

<Fig. 3> Test results of the scalable satellite broadcasting system.

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