International Journal of Multimedia and Ubiquitous Engineering
Vol.11, No.10 (2016), pp.397-406
http://dx.doi.org/10.14257/ijmue.2016.11.10.37

A Research on Multimedia Traffic Streaming Load Balancing Scheme for IPTV over E2E based Integrated Wireless Access Networks

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Abstract

Multimedia services should be smoothly provided high quality service that satisfies the QoS (Quality of Service), QoE (Quality of Experience) focused on multimedia contents in an HD class and many of selected channels applying Multicast between the backbone and access. But now, there are several problems such as channel delay-time, network bandwidth limit, related traffic distribution control, and so on. So, as providing 2D, 3D multimedia data and using MPEG4 that realizes the optimized effect in a limited Bandwidth to boost safe synchronization and superior efficiency between the present video and network, we suggest an efficient network bandwidth control technique through HIASCR (Hierarchical Intelligent Access Control Router) which is a solution for network bandwidth control technique that may occur when many users access a high-definition service in a HD class at the same time as well as trend of video compression that can decrease cost for high-definition and network efficiency. This technique transmits floating high-definition data to many users depending on number of users and we offer a method to prevent the network load.

Keywords: *Integrated Wireless Access Networks, Multimedia Traffic Streaming, Quality of Experience, IPTV, Bandwidth*

1. Introduction

Recently, IPTV is broadcasting-communication-convergence-service offered in diverse multimedia-services such as Video on Demand, High Media Service, TV broadcasting and Contents. As mentioned, Interactive IPTV over the services become feasible. Interactive Service is able to determine the time and programs for persons who do not want to worry about time, contrary to public TV, satellite, cable TV. Through this interactive IPTV, it gives a figure of T-commerce that combine the advantages with E-commerce and TV. As T-commerce is the word combined Television and Commerce, it can be utilized to search for products and e-commerce like purchasing, payment by TV (Television) and remote control [1].

Also IPTV applies Multicast to backbone and access section reflecting the characteristics of IP media traffic bandwidth and provides 60~80 selected channels and mostly high-definition service of an HD class multimedia contents. These services should smoothly provide QoS and QoE to the users. But, until the present situation, various problems related with channel delay time, network bandwidth limit, traffic decentralized control have been coming up. If there are many users that access at the same time, there can be an overloading of bandwidths when there is a requirement for HD-level of high-definition television service. It causes a defective service. But through HIASCR, we can transfer a high-definition television service

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ISSN: 1975-0080 IJMUE

data and converted data to many users and prevent the overloading of network when transferring to a number of users.

This paper is summarized as follows. The second chapter introduces the IPTV services and technology, media-compression-technology for vision offered on IPTV, IGMP and PIM-SM protocol in connection with IPTV multicast at last. In the third chapter, the suggested efficient IPTV multimedia-transmission-service method based on HIASCR is discussed that is able to control the bandwidth-load of the network. The concluding remarks and future direction of the research are presented in Chapter 4.

2. Related Works and Problem

2.1. Internet Protocol TV (IPTV)

IPTV service is based on wire-wireless that can offer interactive VOD service. Currently, it is based on wire using a Private-Network by SK, KT, and LG companies which refers to IPTV on service now, while wireless-based is the Mobile IPTV where an additional feature of mobility to IPTV service. Figure 1 shows the IPTV multimedia transmission technique based on a regular streaming transmission scheme over IPV6 based Wireless Access Networks.

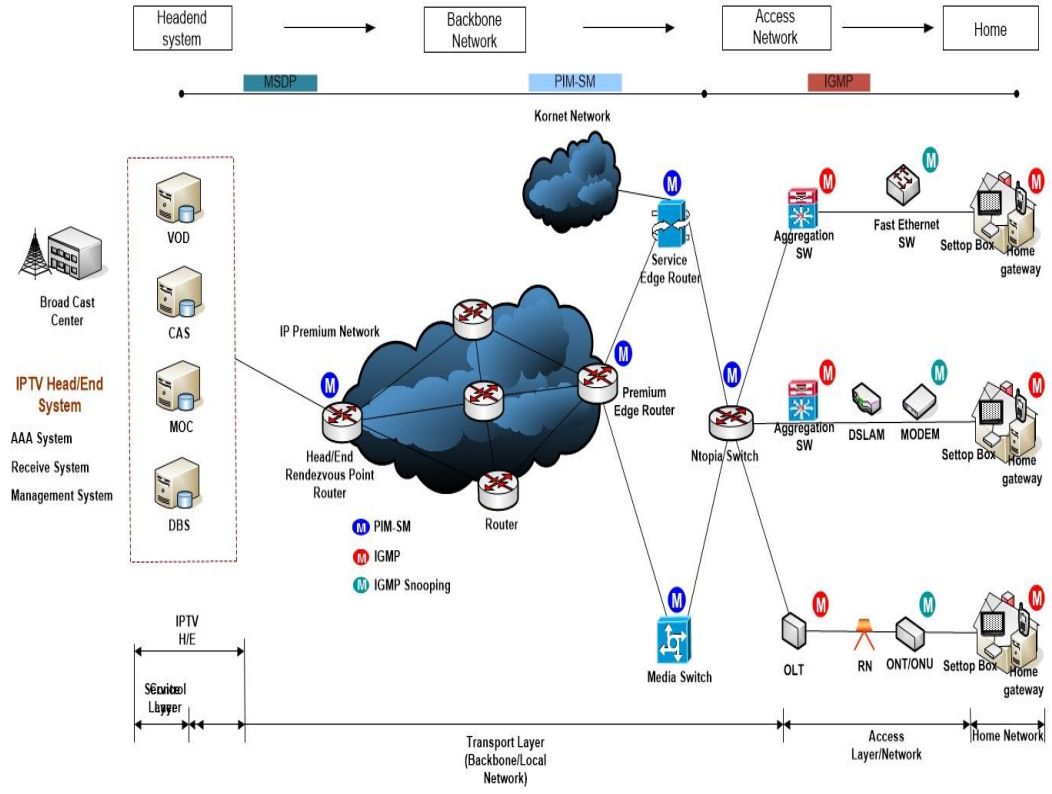

Figure 1. System Architecture of IPTV

Nowadays, in an IPTV service, there are TV Portal web based services with a two-way feature: Firstly, the T-Entertainment; an entertainment service, T-Interactive; information service, T-Commerce; commercial service, and T-Communication; communicational service. Secondly, the participation of Web-based on 2.0 concept, open, and shares services. It is applied to RIA, Web service, UCC contents are applied to IPTV service in various fields. IPTV service will

provides a vast contribution in its entry and its diversity will enable the transmission platform, user services, software and hardware provide a satisfactory service for the users [2].

IPTV is largely composed with a Head-End System, Backbone Network, Access Network, and Homes. Head-End System collects and receives signals in ground wave, which includes broadcasting contents, satellite, etc. It operates on the distribution of broadcasting signals through a Baseband System which does the monitoring through a management system. The authorization of access depends on users or channel with compression multiplexing system, or the protection or encryption of the user contents and reception Log handling [5, 6].

Compress Conditional Access System which provides channel and contents, VOD System, sending video signal, Data Broad System to embody many kinds of two way services, and the signal from a base band with H.264 and make data signals. After multiplex, scrambling, making them an IP and then transfer them.

Backbone Network is a network that passes the processed data. That is, there are Multicasting, QoS technology for the delivery of contents and ensured reliability and efficiency between Head-End and set-top box. Home is transmitted to set-top box of user and possible to use the services of IPTV through a network-equipment called DS-LAM (Digital Subscriber Line Access Multiplexer) of the Access Network.

2.2. Media Compression Technologies

The trend of video-compression is rising with safe synchronization and compression-efficiency with the network at the moment. MPEG-4 is having two things above this. MPEG-4 is a new media-compressing-technology that embodies the best efficiency. Its advantages are the free conversion of digital media, high-efficiency of video/audio, provision of 2D, 3D multimedia data with little bandwidth. MPEG-4 AVC is a more raised compression-efficiency, in other words H.264 compared with MPEG2 is guaranteed compression of over 50% and high-definition. H.264 has some features of highly efficient Encode and tolerance capacity for strong errors. A range of application of H.264 has been extended its diversity range from real-time communication, surveillance-function on Internet/Intranet and Broadcasting System. IPTV also applies the format of H.264 because it includes all techniques of MPEG-4.

As the compression effect has increased, the guarantee of high-definition is ensured due to the network-efficiency for transmission from IPTV to the media. It also uses the H.264 because of the cost. When transferring images of same quality, such as sending an SD-level analogue image, the MPEG-2 can send 8 broadcasts, while HD MPEG-2 can send 2. However, when using the MPEG-4, an SD class can send about 30, while an HD class can roughly send 6 at the same time. This circumstance presents that it is able to use more than 6~30 times in MPEG-4.

Table 1. Kind of Media Compression Technologies

Division	MPEG2	MPEG4	H.246
Purpose	Digital Broadcasting Standard Specification	Object-based Media Transfer	Object-based and High Compression
Availability	End to End Solution Available	End to End Solution Available	End to End Solution Available
Compressibility	SD Quality: 4~6M HD Quality: 19M	SD Quality:3~4M HD Quality: 10M	SD Quality:2~3M HD Quality: 6M
Stability	Stable Commercialization	The Initial Commercialization	The Initial Commercialization Compression and Excellent Compatibility
Incoder/Decoder	S/W, H/W	S/W, H/W	S/W, H/W
Application	Application the Current Broadcasting Industry	-	Application IPTV
Et Cetera	Most Stabilize	-	- Proven Technology as an International Standard Codec - A Low Cost Structure of Competing Operators

Thus, it increases the efficiency of the network and builds a circumstance which can decrease diversity and cost of services. H.265, High Efficiency Video Coding, performing in ITU-T VCEG by an efficient method aims to improve the performance of compression by more than 50% in comparison with H.264 and will complete the standardization by 2010. In this paper, it is expected to watch high-definition television images, save time on changing cording from HD to SD, and effect on the maintenance quality of images to satisfy users QoE.

2.3. IGMP and PIM-SM

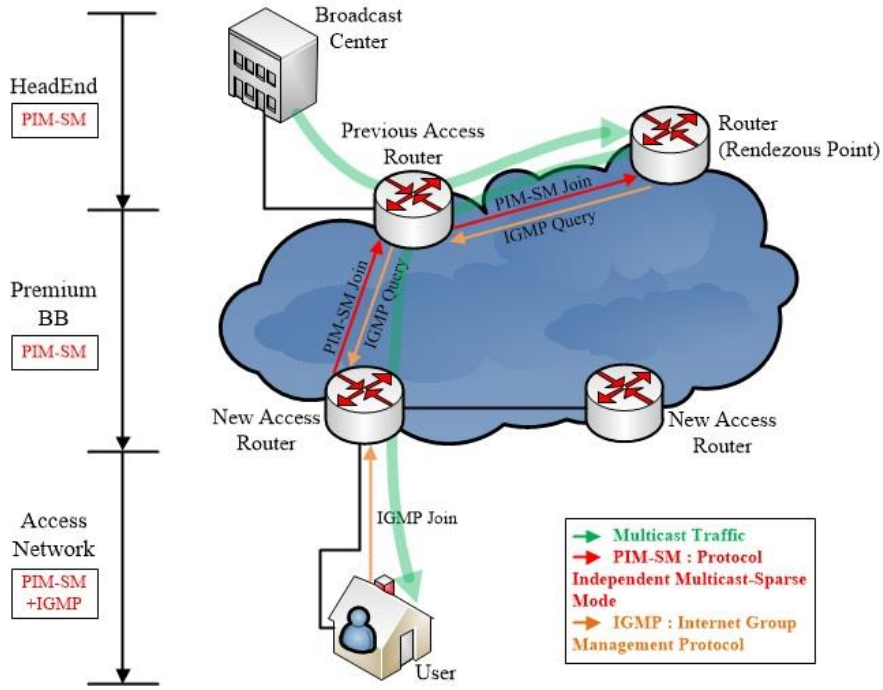

Figure 2. IGMP and PIM-SM

Figure 2 shows the IPTV multicast relationship between IGMP and PIM-SM. IPTV uses a method for multicast-communication that transmit packet to a particular group. Multicast gives less load of traffic or network and can transmit packets passing through the router which is the border of a local network. The protocol that manages the group members of the router refers to IGMP. That is, IGMP in IPTV supports capability that users can do "Leaving" and "Join" to specific groups while moving. PIM-SM is Sparse Mode of Routing PIM which facilitates multicast routing without depending on protocol in huge Network. Like this way, as PIM will be used for Sparse Mode, it will be composed of Tree based on Center to protocol and use it when group members are scattered in all directions. PIM-SM(Shared) applies for acceptance to Router in center or Transmission Host as well as Join and explicit admission is possible [3, 4].

3. Multimedia Traffic Streaming Conversion Scheme for QoE of IPTV over Integrated Wireless Access Networks

In this chapter, the control method of effective network-bandwidth by using new HIASCR that control the service problems that can be caused the network-bandwidth-load when many users are connecting at the same time requires a high-definition service level (HD) without considering the network traffic status. This can cause heavy traffic load and bottleneck which leads to network disconnection. Figure 3 shows the System Architecture of the proposed HIASCR over Wireless/Mobile Networks.

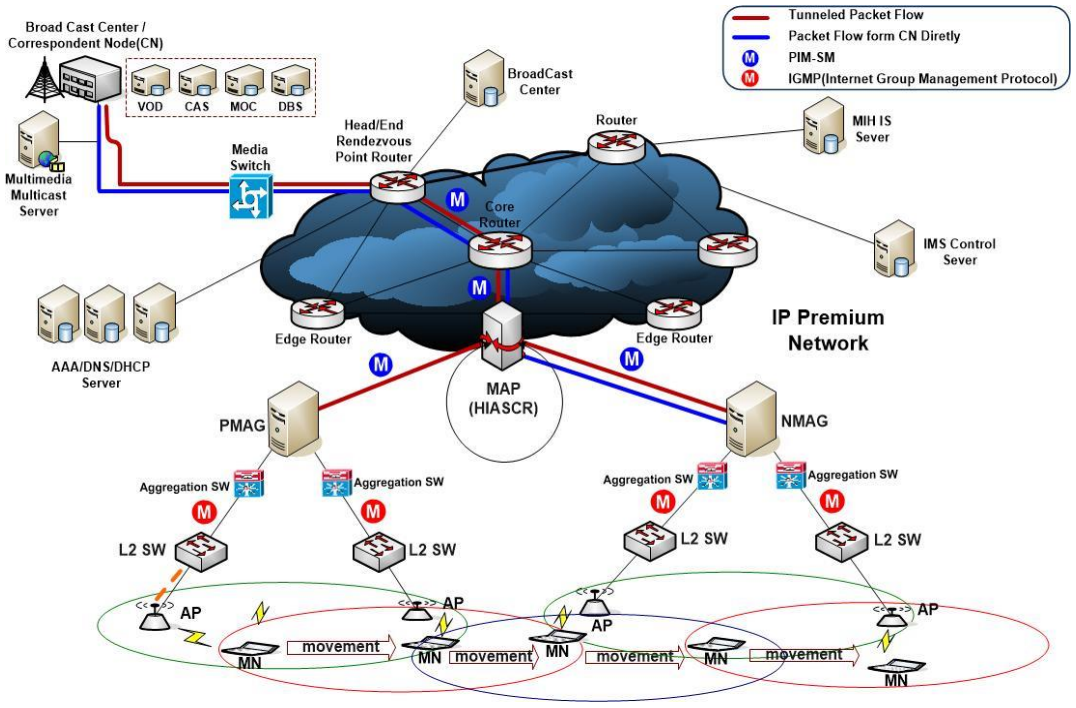

Figure 3. System Architecture of Proposed HIASCR over Wireless/Mobile Networks

3.1. Hierarchical Intelligent Access Streaming Control Router (HIASCR)

The present data identifies the regular network bandwidth, which is transmitting through the newly suggested HIASCR and collects the network bandwidth information and then sends the collected data to module. The network bandwidth is evaluated if it reaches the threshold and accordingly takes an appropriate measure.

It passes the PIM-SM protocol through an aggregation SW, evaluates the subcritical network bandwidth through the signal process in HIASCR and sends information. It arrives at ISTB (Improved Set top Box), mobile device MI (Mobile Interface) module and manages and evaluates packet through periodic BIB (Bandwidth Information Broadcasting) signal which can include mobility information and sent to the viewers.

The following are the assumptions for the suggested technique in this paper. Figure 4 shows the structure of HIASCR system and the related ISTB, mobile device structure. HIASCR recognizes the information of net bandwidth and save it in BCM.

■ HIASCR decides the current status between wire and wireless/mobile environment. That is, HIASCR maintain two important modules for wired system and wireless/mobile system.

■ HIASCR is connected with the Premium Edge Router and Rendezvous Point Router as Mesh-up structure.

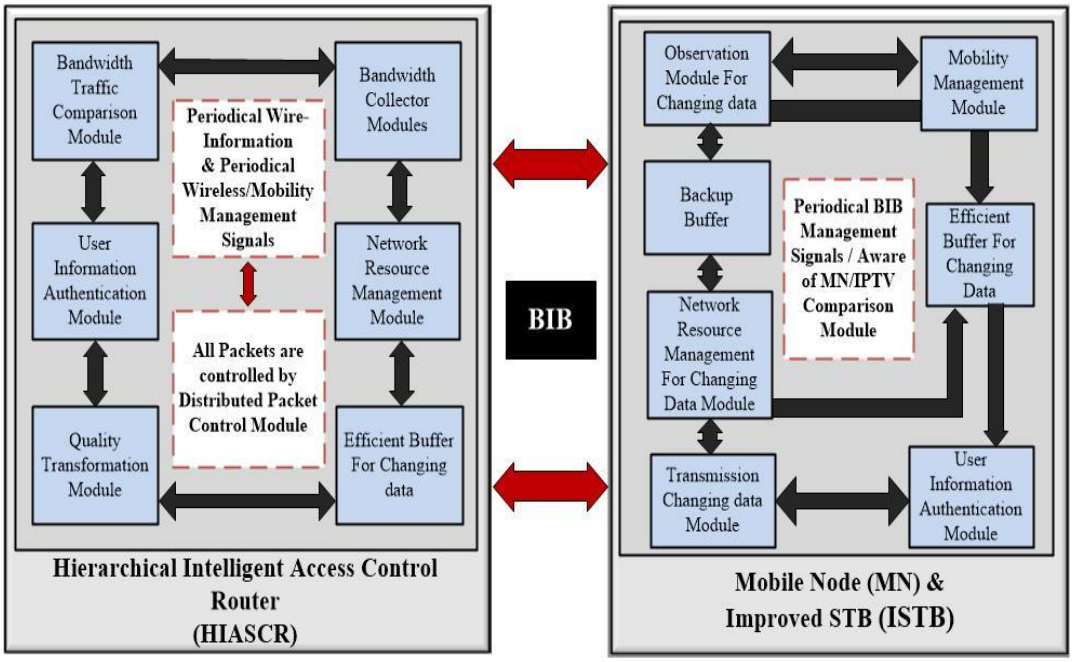

Figure 4. HIASCR System Structure and ISTB System Structure

If wired system was selected, HIASCR performs the sequence below (Option 1):

■ If HIASCR's status is wire environment, HIASCR start with the IGMP protocol and the proposed scheme (Option 1). If not, mobile device starts the Hierarchical mobility management protocol which can support seamless streaming transmission during handover (Option 2).

■ HIASCR defines periodically the BIB message to ISTB. This message includes electronic bandwidth information, current network conditions, traffic information, and *etc*.

■ HIASCR consists of BCM (Bandwidth Collector Module) to collect network bandwidth information and BTCM (Bandwidth Transmission Comparison Module) that compares whether or not the network bandwidth has reached the threshold through the data collected from BCM. Also, it does the Decryption for data through UIM (User Information Authentication Module) that gives a user authentication.

■ HIASCR is essentially probable due to the efficient network resource management, that is, multiple network support through UMA (Unlicensed Mobile Access) service in the NRMM(Network Resource Management Module).

■ If the network bandwidth reaches the subcritical in BTCM, QTM (Quality Transformation Module) changes the pictures from HD-level to SD-level. Changed data goes into the Efficient Buffer.

■ ISTB is able to periodically predict the change of data through received BIB in Observation Module. When data is changed by this, ISTB can prepare reception of changed data in advance.

■ HIASCR defines CBI (Changing Bandwidth Information) message for transmission to ISTB final network bandwidth information.

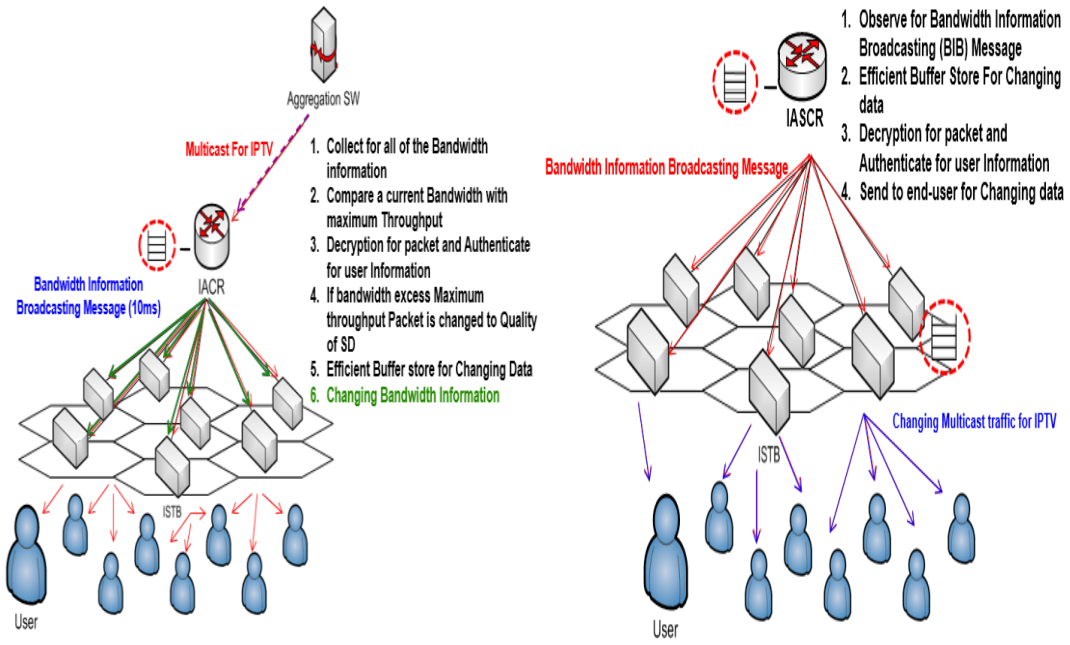

Figure 5. Multicast Signaling Flow and HIASCR Procedure

If wireless/mobile system, HIASCR performs the sequence below (Option 2):

■ If HIASCR's status is wireless environment, the mobile device starts the mobility management protocol such as hierarchical mobility management protocol (HMIPv6) which can support seamless streaming transmission during handover.

■ HIASCR defines periodically a BIB message to MN. At this time, HIASCR change the BIB message I-flag from "0" to "1". That is, when I-flag set to "0", BIB message act as wire signaling. If I-flag is set to "1", then the BIB message acts as wireless message. This message includes electronic bandwidth information, current network conditions, traffic information and etc. To support route optimization, BIB buffer can store the periodic RA message which can reduce the random waiting time.

■ If HIASCR become the mobility anchor point (MAP) for treat efficient IPTV transmission during handover.

■ The MN (Mobile Node) sends a router solicitation (RS) message to NMAG to receive router advertisement (RA) message which can include the prefix of AR and MAP. By using RA message the MN makes LCoA and RCoA.

■ MN sent RBU(Regional Binding Update) to MAP. The MAP update own binding cache.

■ After finishing the HMIPv6 mobility handover protocols, HIASCR start acting as in the proposed system. That is, HIASCR perform the proposed IGMP procedure.

■ When a mobile node moves to a neighboring local domain area, performing HIASCR status is not changing. MN starts to make new LCoA and perform address confirmation. At this time, MN send just a local binding update message to NMAG which include new LCoA.

■ However if MN moves to a regional domain area, performing HIASCR procedure would be stop. And the mobile node has to make both new LCoA and

RCoA. At this time, MN sends a binding update message to HA which includes LCoA and RCoA.

■ When mobile device move to local domain area, HIASCR status is not changing. However if mobile device move to regional domain area, the mobile device have to make new LCoA and RCoA. Also, at the same time, MN has to send IGMP message to new MAP to register.

Figure 5 shows the proposed HIASCR-system multicast signaling flow and HIASCR procedure. On the base of saved information, HIASCR renews the information of net bandwidth periodically and if it reaches to subcritical, BTCM calculates the available bandwidth and decides to how many users it can transfer IPTV data. After that UIM confirms user's information and performs Decryption about data. The information calculated by BTCM goes to QTM and QTM changes the level of images from HD to SD. And then in Efficient Buffer, Decrypted data is Encrypted and saved.

3.2. Improved Mobile device and Set-top-box (ISTB)

Unlike an existing mobile device and STB, MN and ISBT added an observation module, mobility module and integrated switching module. So, we can predict network bandwidth through regular BIB message. Also when network reaches to threshold, we can efficiently treat changed data by prediction. BIB message also act as L2 signaling message which can support seamless mobility management. That is, when use this IPTV service over mobile IPv6 environment, BIB message include stored L2 information which can reduce handover latency.

Considering the net bandwidth, new users are added in HIASCR. It calculates the net bandwidth for the multicast group in advance, handles requested service, and transfers it to ISTB periodically as BIB message.

If the net bandwidth reaches to subcritical, ISTB notices users that because of the subcritical status of the net bandwidth they can adjust the quality of image by messages. When ACR sends CBI message finally, we report users that the quality of images were changed up to the net bandwidth.

4. Conclusion

We have suggested a method for network bandwidth utilization considering the efficient network bandwidth management of IPTV services in this paper. The network bandwidth utilization based on the suggested HIASCR cannot just transmit high-definition data only to a few users, but, it is possible to transmit to a large number of users through high-definition and converted data depending on the number of users and it also can prevent network load. Also, this scheme is expected to provide a seamless data transmission between the mobile node and the corresponding node when a handover takes place without data black-out.

Acknowledgments

This paper has been supported by the 2016 Hannam University Research Fund.

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