

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,800

Open access books available

122,000

International authors and editors

135M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Digital Videos Broadcasting via Satellite – Challenge on IPTV Distribution

I Made Murwantara, Pujiyanto Yugopuspito,
Arnold Aribowo and Samuel Lukas
*Faculty of Computer Science,
Universitas Pelita Harapan
Indonesia*

1. Introduction

Digital Video Broadcasting via Satellite (DVB-S) is achieving its new order. DVB-S penetration which are reaches a lot of viewer around the world was the evidence. Its capability to deliver high quality digital video primary, with reasonable price was the key success factor. Main factor that made DVB-S technology more mature was the innovation. In recent years, DVB-S is capable to deliver internet traffic. One-way downlink is transmission from satellite to customer location and others media transmission for uplink from customer to the internet. This kind of activities is being done for many years as an inexpensive internet services and as a redundant network link for low speed internet provider.

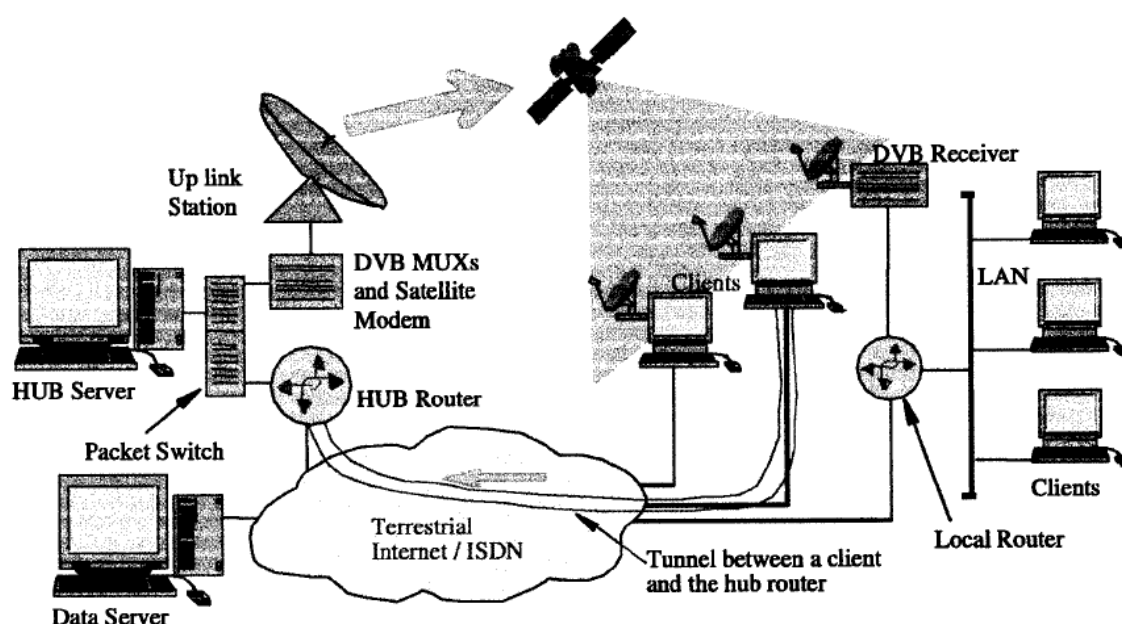


Fig. 1. DVB-S Satellite Network (Nihal 1999)

As the satellite technology increased, two-way satellite communication is served the community everywhere around the globe. The uplink transmission established by L-band

Source: Digital Video, Book edited by: Floriano De Rango,
ISBN 978-953-7619-70-1, pp. 500, February 2010, INTECH, Croatia, downloaded from SCIYO.COM

and the opposite direction served by Ku-Band or C-Band. It have to be established the communication on two different frequency with specific wavelength to prevent signal interference and to meet the International Telecommunication Union (ITU) standard. The transmission reception is considered by the climate and geographical of customer location. For high humidity area, such as Asia, it is wise to use C-Band frequency as its downlink transmission. On the other hand, European countries will be effective to use Ku-Band frequency, otherwise the services can not be delivered on maximal standard.

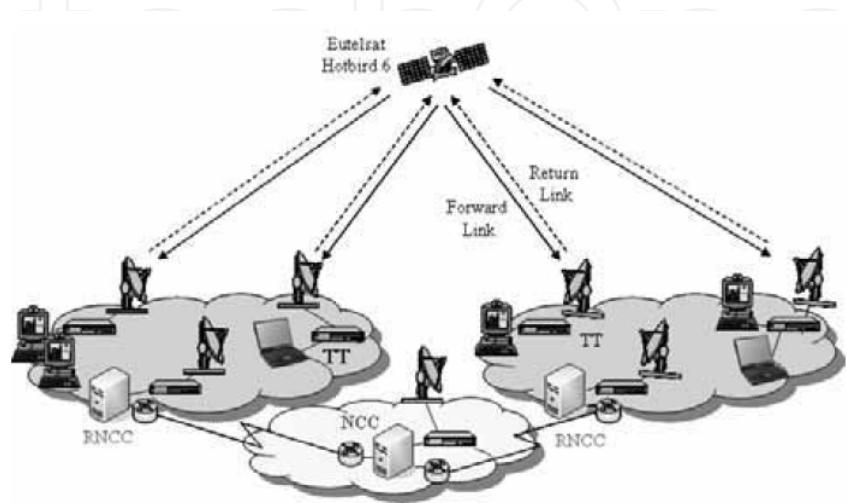


Fig. 2. DVB-RCS Network Architecture (Helmut, rklin et al. 2007)

The Internet Protocol Television (IPTV) is a mechanism of transmitting its information to their customer using internet protocol as media transmission. Because IPTV can be broadcast on the internet protocol, then every media that is capable to communicate using internet protocol is also the media of IPTV distribution. Those are including wired and wireless media. The main interesting part on internet is the development of IP-based broadcasting of “digital” television. This issue bring a lot of investor and technologist to become the pioneer on such technology. And their invention makes a big leap of telecommunication technology, especially how people communicate on low cost (Alberto, Francesco et al. 2006). Delay Timing is also constrain that influence the performance of satellite transmission, exclude the weather condition for specific region.

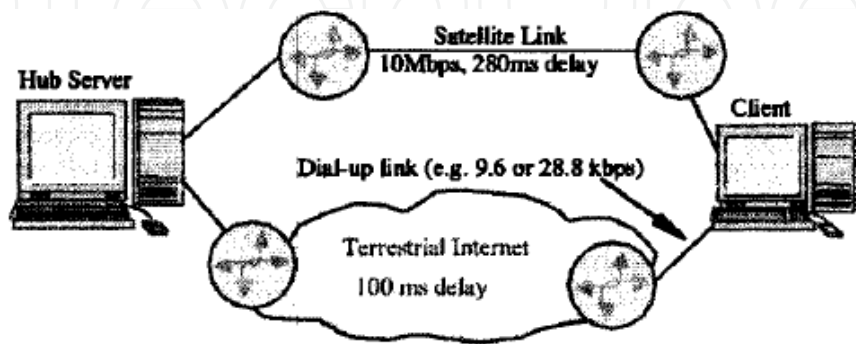


Fig. 3. Satellite Transmission Time Delay(Nihal 1999)

This chapter will be organized as follows. It starts with an overview of IPTV and DVB-S standard and its latest technology in Section 2. In Section 3, the DVB-S technology in relation

to IPTV distribution is explained. Then on Section 4, the challenge of IPTV distribution over DVB-S will be given and Section 5 concludes the chapter.

2. Review on DVB-S and IPTV

Digital Video Broadcasting via Satellite (DVB-S) has been served more than a decade. This technology has been emerged as a leading standard to provide video streaming services through the satellite media. Since its introduction, DVB has been used on terrestrial (DVB-T), cable (DVB-C) and satellite (DVB-S) (Helmut, rklin et al. 2007). Those outcomes are the result of demands that communication technology is an unlimited area. DVB Return Channel via Satellite (DVB-RCS) is established as the answer of demand of Internet technology via satellite. DVB-RCS provide a new era of IP relay via satellite. This breakthrough is bringing good news to the internet providers company. It could enlarge the covering area of most providers in the entire world.

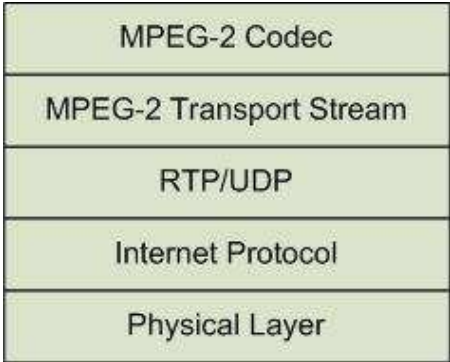


Fig. 4. DVB-IP Protocol Simplified

The development of internet protocol of version 4 (IPv4) for satellite communication had been established since the introduction of DVB-S (Helmut, rklin et al. 2007). Quality of Services (QoS) and packet management are being improved everyday. But the most important achievement is the streaming reliability that fully demanded by customers. In addition, the transformation from IPv4 to IPv6 was on going at satellite network. This challenge has come to DVB protocol to support internet services.

DVB-S systems typically make use of multicast. Multicast communication is predicated on the need to send the same content to multiple destinations simultaneously. Groups or individual who receive the transmission would dynamically change their channel or keep tuned on one favourite channel. Meanwhile the multicast transmission on DVB-S is transmitting hundreds of channel on single frequency. User management on multicast transmission is using the MAC address of the receiver.

The distribution of new technology above DVB-S protocol is a great challenge. How this protocol satisfied their consumer by carrying IPTV on its transmission will be answer on the following pages.

Table 1. shows the DVB specs for Eb/No (energi per bit over noise) required for various modulation and coding rates. An Eb/No of 6-9 dB is desirable. In this satellite design jitter is absent. A set of international standards for digital TV has been developed to follow up on the demand of the digital video quality standard by the DVB Project. It is an industrial consortium with about 300 members and published by a Joint Technical Committee (JTC) of ETSI, CENELEC and European Broadcasting Union (EBU). These are collectively known as

| Coding/Modulation | | Required Eb/No (dB) |
|-------------------|-------|---------------------|
| DVB/QPSK | R 1/2 | 4.5 |
| | R 2/3 | 5.0 |
| | R 3/4 | 5.5 |
| | R 7/8 | 6.4 |
| DVB/8PSK | R 2/3 | 6.9 |
| | R 5/6 | 8.9 |
| Turbo QPSK | R 1/2 | 2.7 |
| | R 5/8 | 3.3 |
| | R 3/4 | 3.9 |
| | R 5/6 | 4.5 |
| | R 7/8 | 4.7 |
| Turbo 8PSK | R 2/3 | 5.4 |
| | R 3/4 | 6.4 |
| | R 5/6 | 7.7 |

Table 1. Link Performance Requirements for Satellite Links Operating with Various Modulation Technologies (Minoli 2008)

Digital Video Broadcast. IPTV using some standards of DVB technology, particularly on satellite links.

Standards of DVB exist for the last decade is defining for the physical layer and data-link layer of a distribution system, as follows:

- Satellite video distribution (DVB-S)
- Cable video distribution (DVB-C)
- Terrestrial television video distribution (DVB-T)
- Terrestrial television for handheld mobile devices (DVB-H)

Distribution systems vary mainly in the modulation schemes used:

- DVB-S uses QPSK.
- DVB-S2 uses QPSK, 8PSK, 16APSK.
- DVB-C (VHF/UHF) uses Quadrature Amplitude Modulation (QAM).
- DVB-T (VHF/UHF) uses 16-QAM or 64-QAM combined with Coded Orthogonal Frequency Division Multiplexing (COFDM).

DVB devices interact with the physical layer via Synchronous Serial Interface or Asynchronous Serial Interface (ASI). All information is transmitted in MPEG-2 transport with some additional constraints.

The DVB is using MPEG2-TS as its transport stream. The MPEG2-TS is mapping the Packet Elementary System (PES) which was produced by MPEG-2 processor. MPEG2-TS are encapsulated in the User Datagram Protocol (UDP) afterwards in IP.

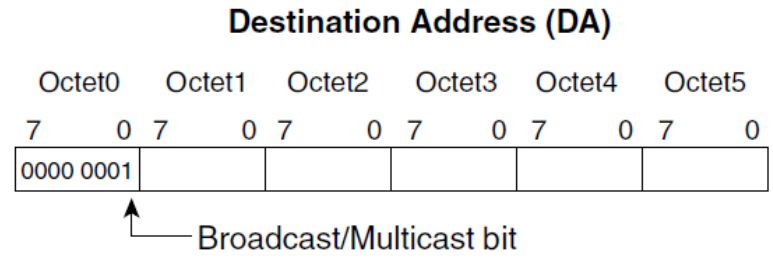


Fig. 5. MAC Address (Minoli 2008)

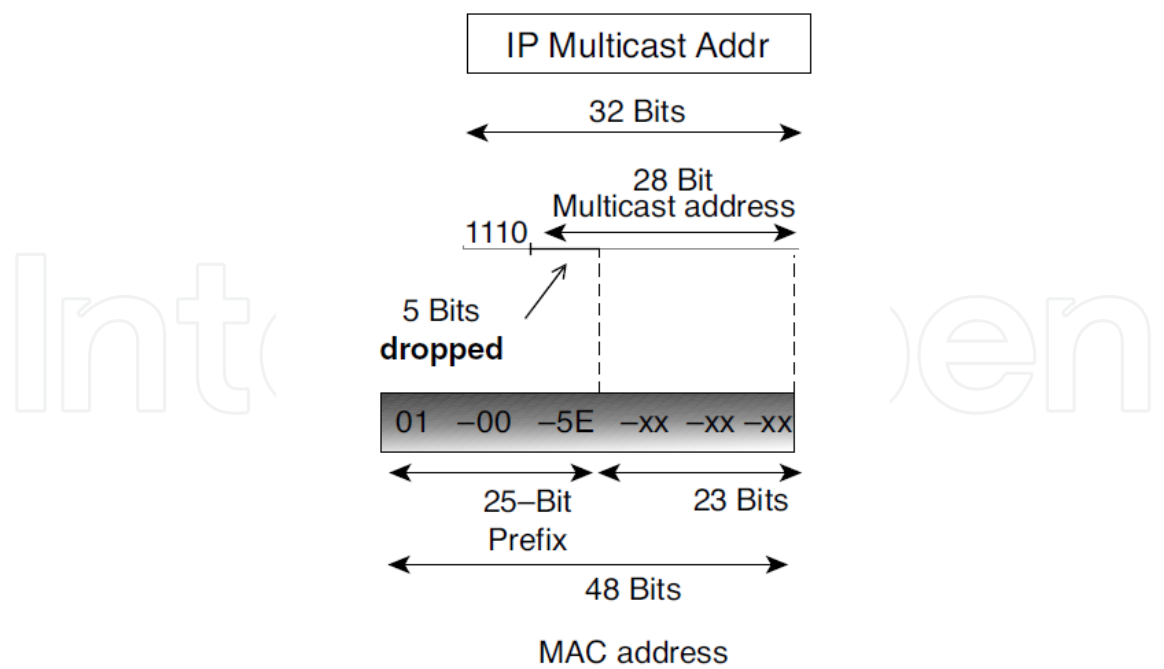


Fig. 6. Scheme of IP Multicast to MAC Address (Minoli 2008)

Each IPTV stream carried a specific Packet Identification Data (PID). PID is used as an identification parameter for specific receiving group. it's have to be exactly the same as setup on the receiver. If this parameter has been setup not properly, then the transmission could not be seen on the screen. Technically it is called the out of tuned condition. DVB-based applications will configure the driver in the receiver to passing up the packet of specified PID. Afterwards, the receiver will extract streams from the TS partially by looking the same PID existed on the packet.

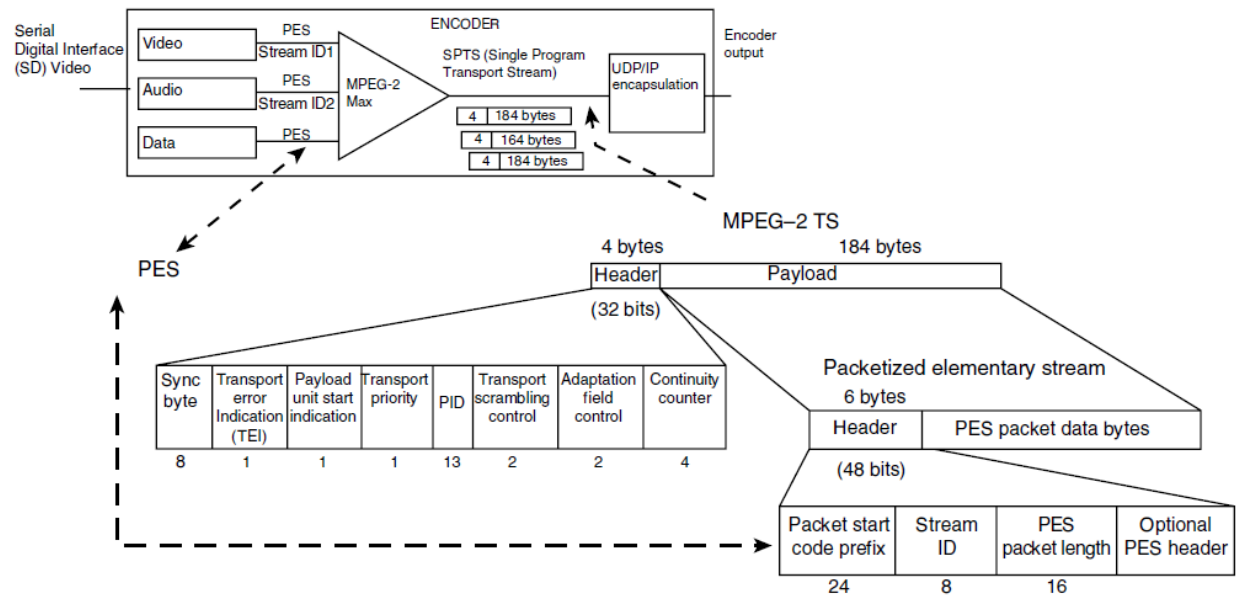


Fig. 7. TS and PES Multiplexing (Minoli 2008)

IPTV stream consist of packets of fixed size, each of which carries a stream-identifying number called PID. These packets are aggregated into an IP packet, the IP packet is

transmitted using multicast methods. Each PID contains specific video, audio or data information.

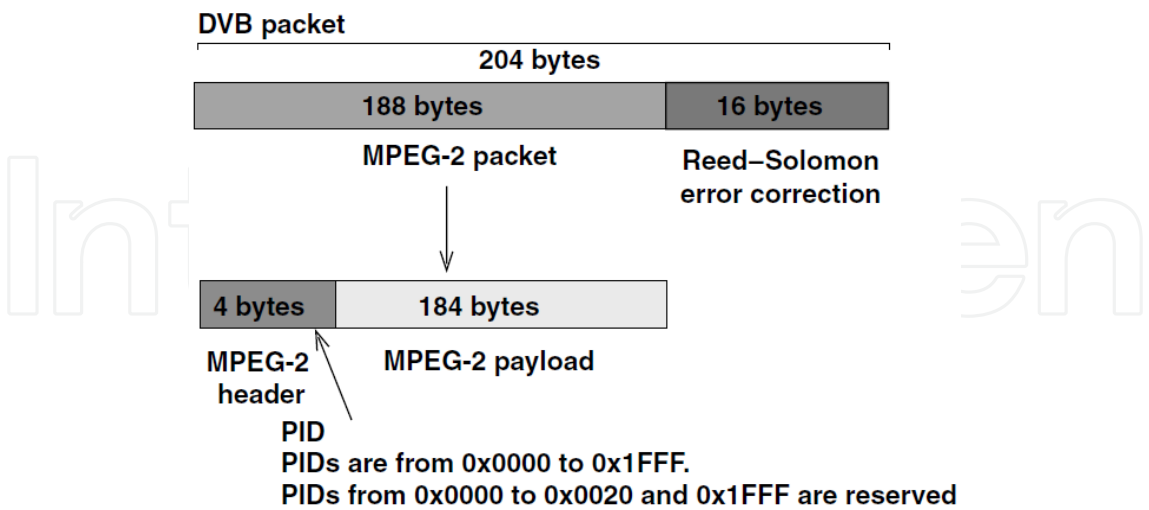


Fig. 8. DVB Packet (Minoli 2008)

For satellite transmission and to remain adequate with existing MPEG-2 technology, TS are encapsulated in Multiprotocol Encapsulation (MPE) and then segmented and placed into TSs via a device called IP Encapsulator (IPE). MPE is used to transmit datagram that exceed the length of the DVB packet size.

IPE handle statistical multiplexing and facilitate coexistence. IPE receivers IP packets from and Ethernet connection and encapsulates packets using MPE and then maps these streams into an MPEG-2 TS. Once the device has encapsulated the data, the IPE forwards the data packets to satellite link.

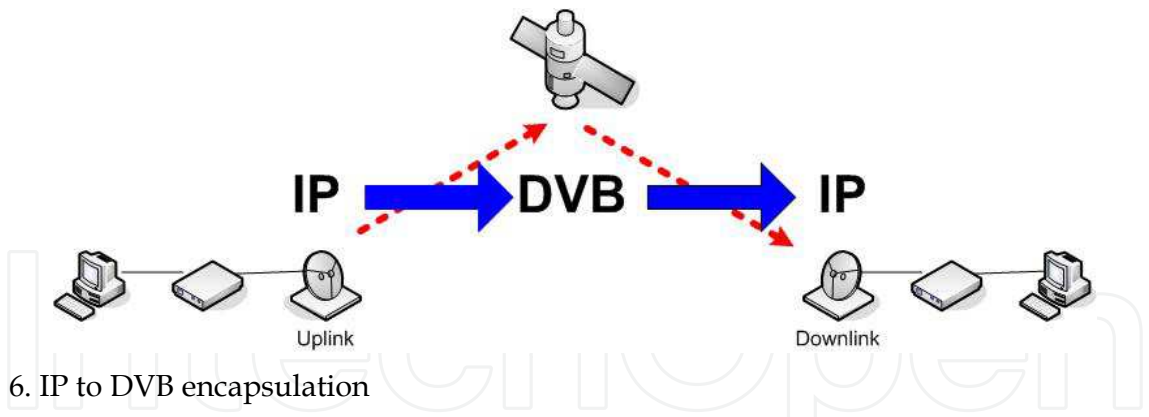


Fig. 6. IP to DVB encapsulation

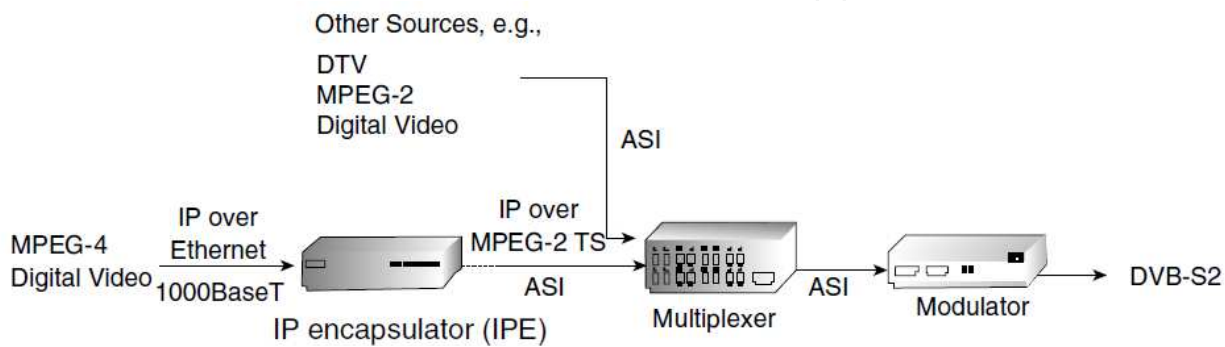


Fig. 7. Encapsulator Function

Data for transmission over the MPEG-2 transport multiplex is passed to an encapsulator that commonly receives Ethernet frames, IP datagram, or other network layer packets. It formats each PDU into a series of TS packets, which sent over a TS logical channel.

3. IPTV distribution on DVB-S

The two basic types of multicast distribution trees provided for IPTV distribution are source trees and shared trees(O'Driscoll 2008). Messages are replicated only where the tree branches. Both trees are loop-free topologies. A source tree is based on the principle of identifying the shortest path through network from source to destination. Due to the fact that source trees identify shortest path, they called shortest path trees (SPT). A new source tree is generally configured when new source servers are added to the IPTV network as can be seen on figure 8. The configuration of a shared three is different to a source tree in the sense that the shared multicast distribution locates the root at a chosen point on the network called a rendezvous point (RP). The RP acts as an intermediate device between IPTV sources and IPTV user. This contrasts with source trees that locate their routes at the source of the IPTV content. The shared tree is shown on figure 9.

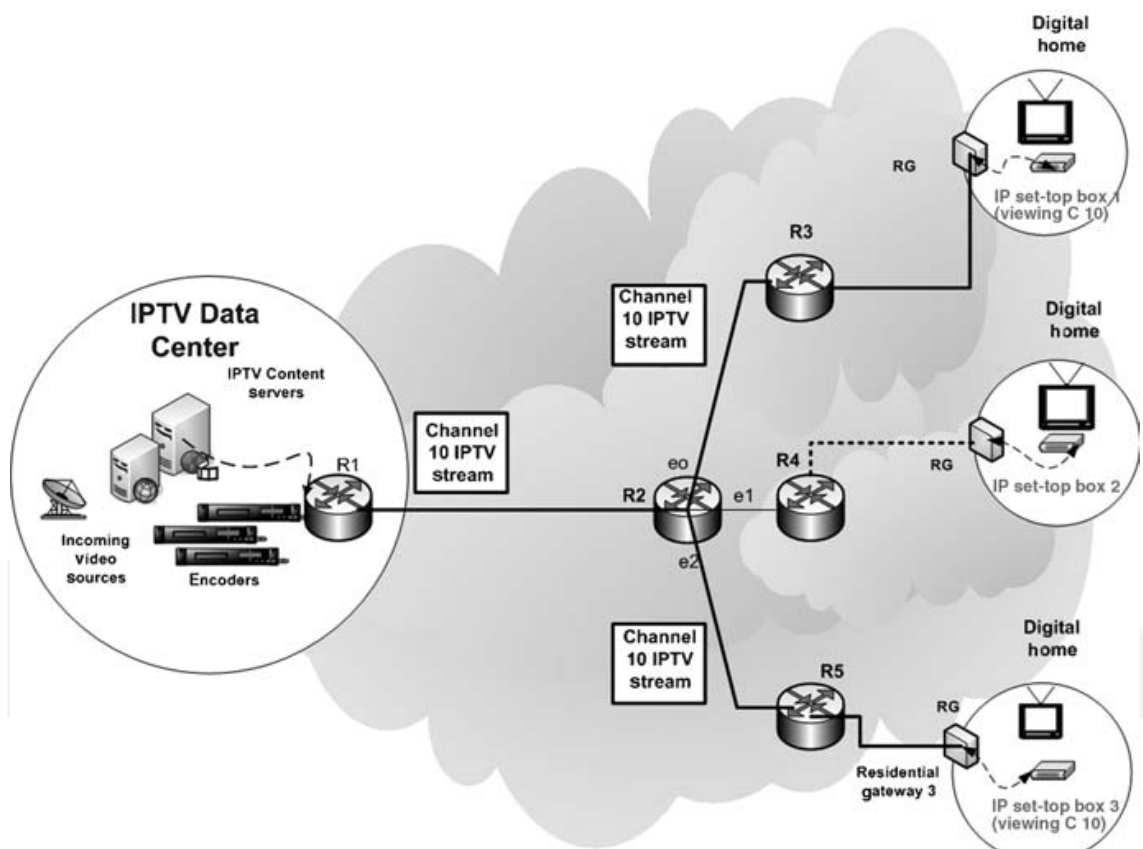


Fig. 8. Source Tree(O'Driscoll 2008)

Distribution of a high resolution stream is not easy to manage and high bandwidth consume. On satellite stream distribution, IPTV could not distribute on effective and efficient manner. Mainly about delay that occur on satellite transmission. To deal with this problem, we propose the cache stream management that provide IPTV streams management on one-way DVB-S environment.

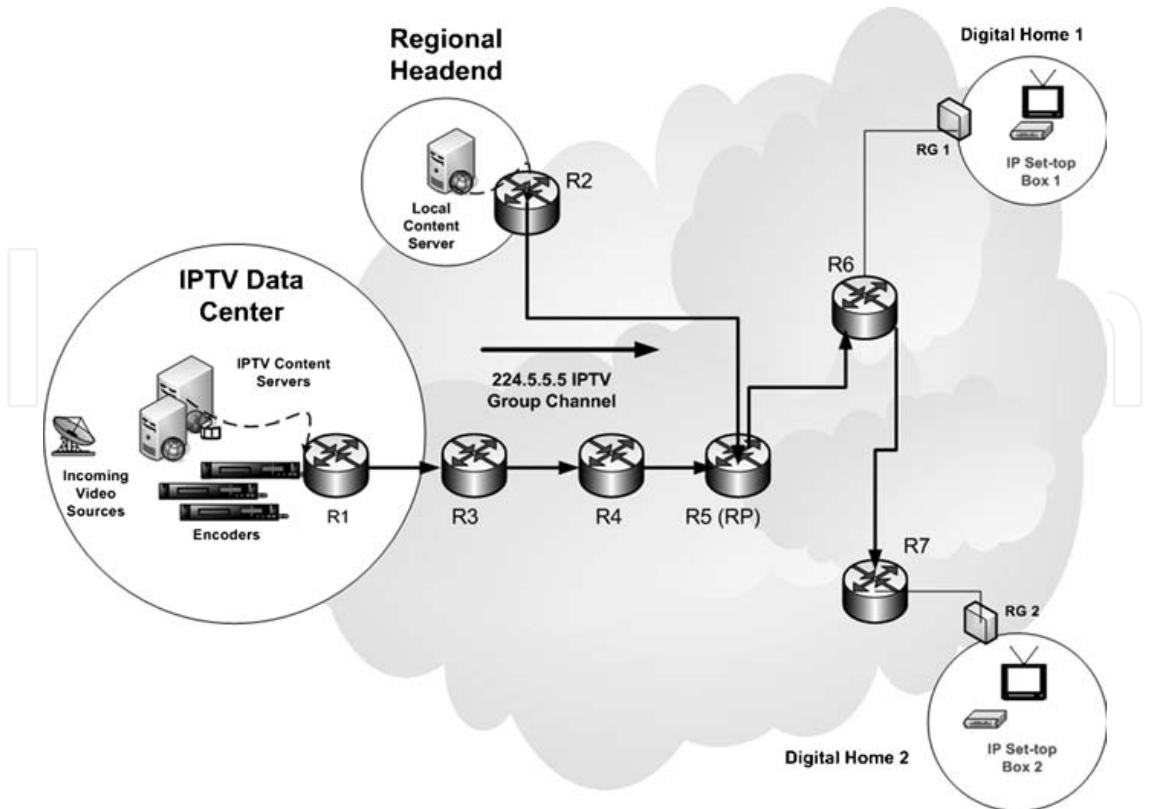


Fig. 9. Shared Tree(O’Driscoll 2008)

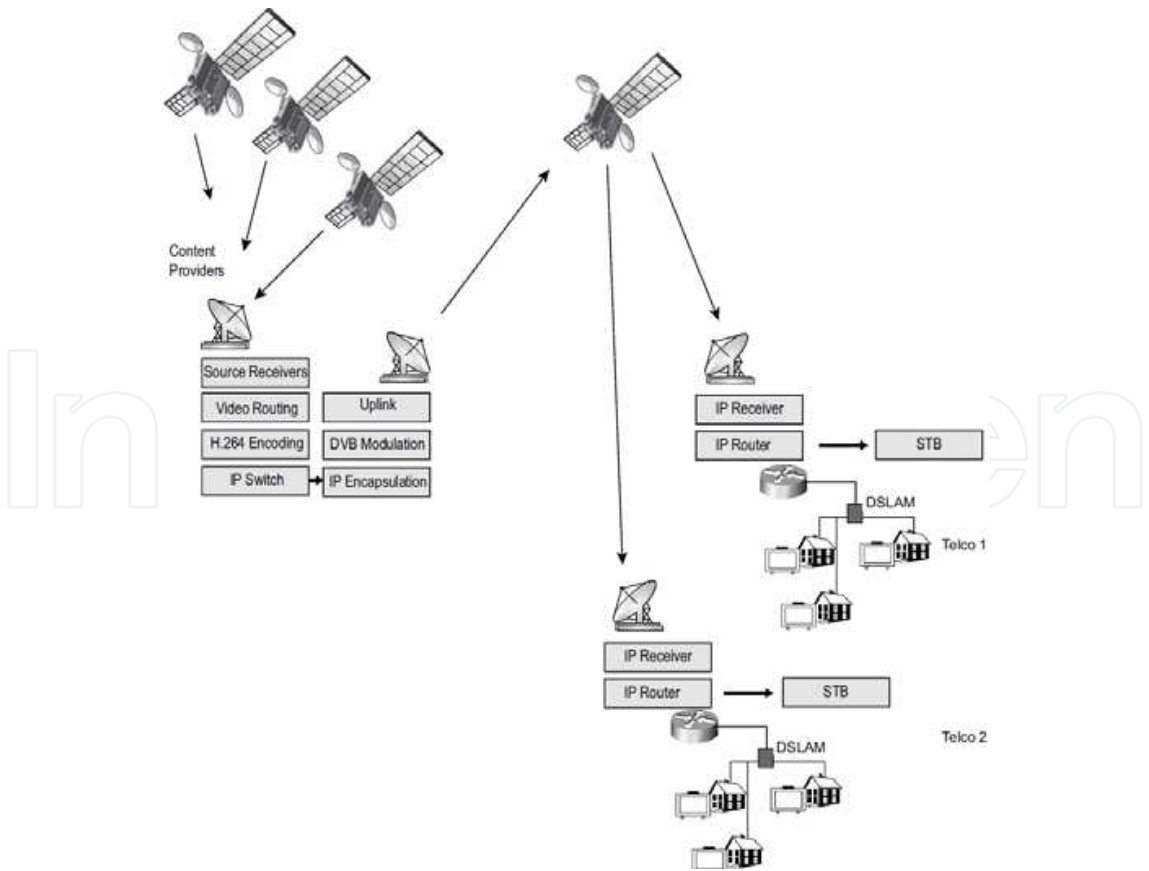


Fig. 10. Single Source IPTV (Minoli 2008)

Cache Stream Management (CSM) is an IPTV cache stream system. CSM do not utilize the network performance overall. Indeed, it is a simple solution for IPTV distribution over DVB-S. The CSM consists of grid computing facility which is doing request analyzes, and then makes a schedule for each request specifically to the cache manager.

In this chapter, IPTV distribution is only cover single source downlink via satellite and uplink via local network. The local network capacity is considered fulfil the request signalling to the IPTV provider, besides cost for stream uplink via satellite is very expensive.

| Application | Design Concern | | | | | | | Current Technology | Future Technology |
|------------------------|----------------|----------------------|------------------|--------------|---------------|----------|------------------|-------------------------|------------------------|
| | Low Bitrate | Multiformal Decoders | Right Management | High Quality | Random Access | Low Cost | Error Robustness | | |
| Internet Streaming | ■ | ■ | ■ | | | | | WMV9, MPEG-4, Quicktime | |
| Digital terrestrial TV | | | | ■ | | | ■ | MPEG-2 | MPEG-2, H.264, AVS 1.0 |
| Satellite TV | ■ | | | ■ | | | ■ | MPEG-2 | H.264 HP |
| IPTV | ■ | | ■ | ■ | | | ■ | MPEG-2, MPEG-4 | MPEG-4 |

Table 1. Compression Characteristics

Gotta(Alberto, Francesco et al. 2006), shows the output of their experiment on figure 9 using a single channel transmission delay via satellite. Their experiment was using a multi frame which is made of 8 frames, each containing 6 time slots. Every time slot is composed by 8 cells (MPEG-2 packets).

The response to an offered traffic impulse is a throughput transient with amplitude R_{min} lasting for T_a , followed by a throughput transient with amplitude $R + R_{min}$ ending at T_t , after which the throughput is equal to the offered traffic. All the following results are valid for $R > R_{min}$.

The duration of the throughput transient T_t depends on the impulse amplitude. In fact, the moment the source starts sending packets at rate R , the service rate allocated to the TT is R_{min} , meaning that the queue at the TT fills up at a rate $R - R_{min}$. After an allocation delay of T_a , the scheduler assigns the bandwidth $R + R_{min}$ and the queue empties at a rate R_{min} (that is, the difference between the output and the input rates). The queue length reaches its maximum $T_a(R - R_{min})$ after a time equal to the allocation delay T_a . Since the total duration T_t of the transient is the sum of the allocation delay and the time required to empty the queue.

$$T_t = T_a + T_a \frac{R - R_{min}}{R_{min}} = T_a \frac{R}{R_{min}} \tag{1}$$

Bottom graphs in Fig. 8 show results for the one-way delay. The peak amplitudes during the transient weakly depend on transmission rates. Indeed, the maximum queuing delay T_d is given by the ratio between the maximum queue size and the offered traffic rate where τ is the satellite system latency.

$$T_d = \tau + (1 - \frac{R_{min}}{R}) \tag{2}$$

Gotta’s et. al. experiment results emphasize the delay that could not be avoided on satellite transmission. Their result shows the need of CSM to be implemented on IPTV distribution via satellite.

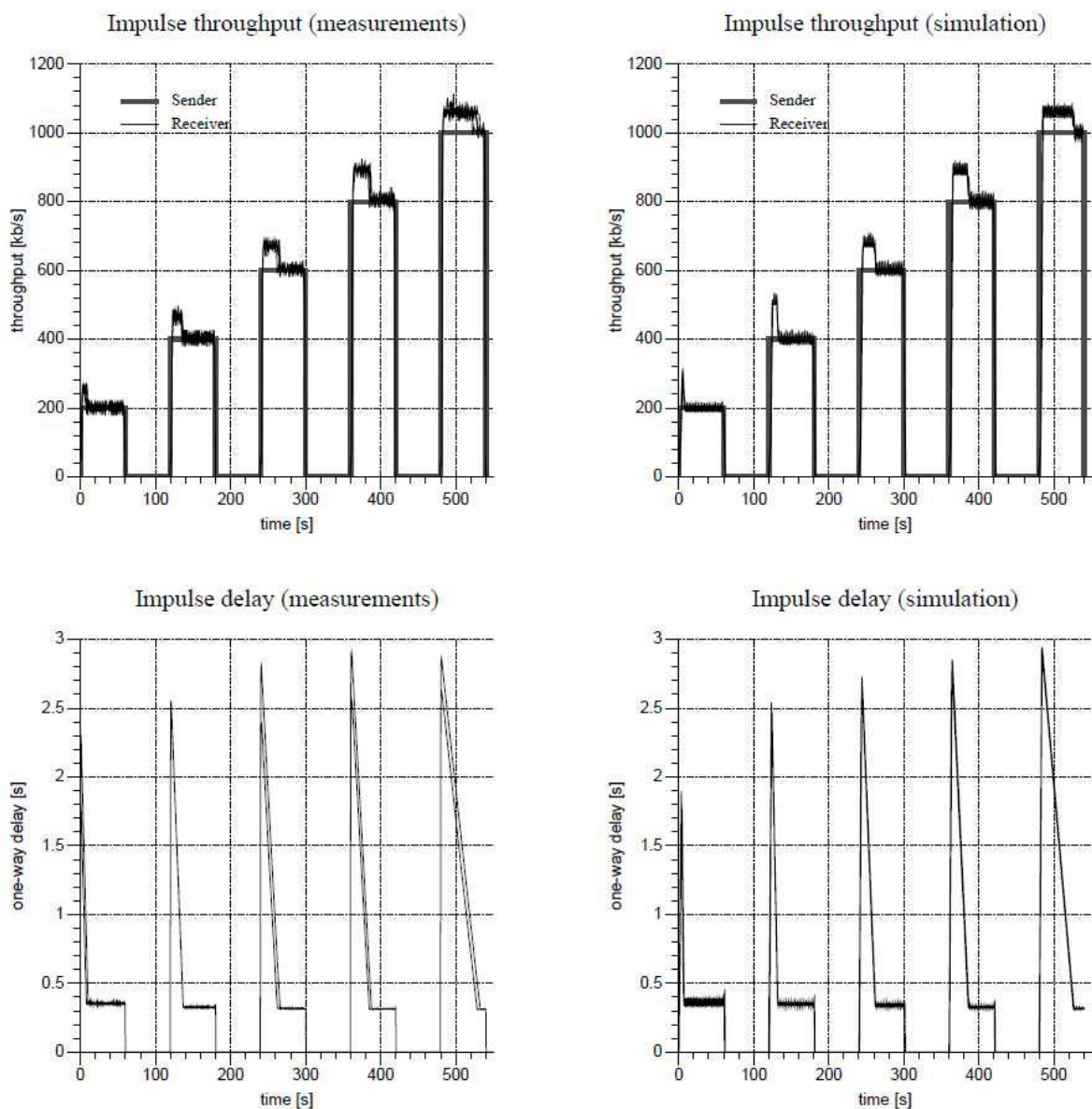


Fig. 11. Throughput and one-way delay (Alberto, Francesco et al. 2006)

4. Challenge on IPTV distribution

Problems on satellite transmission are always about compression and delay. As compression playing a big role on device manufacturing and transmission standard, its existence must comply on DVB organizational standard. While delay, it is can not be anticipated on current satellite technology.

And we proposed CSM as a framework that is projected to overcome such problem. On Cache Stream Management, its system is separated into three critical sections. First section is Request Manager (RM), this RM must ensure that every incoming request are served. Each

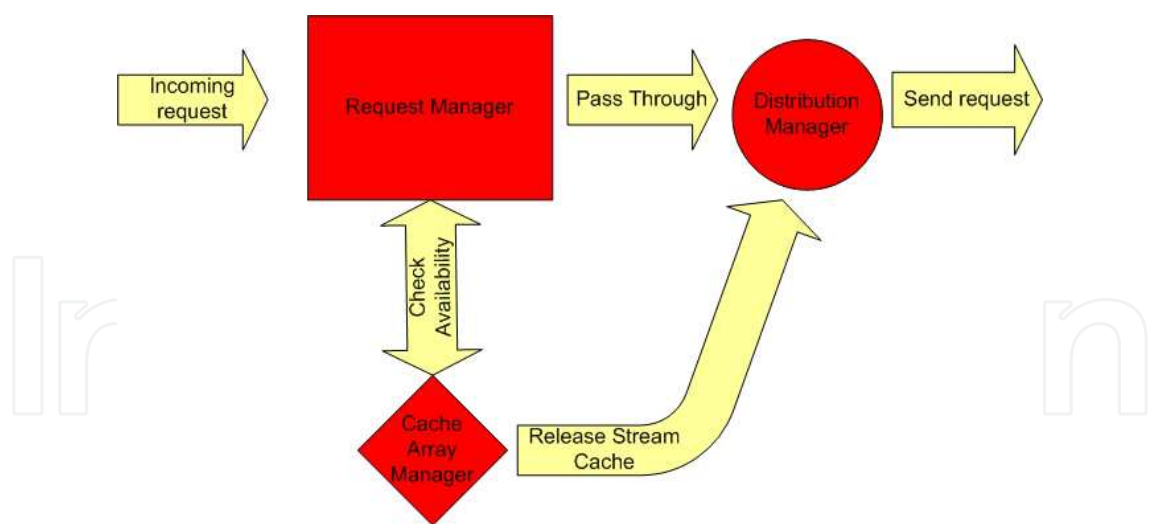


Fig. 12. Cache Stream Management

request in particular will be check to the availability on Cache Array Manager (CAM), if the request is match then the content will be delivered based on the cache source. If it is not, then distribution manager will retrieved the data from source. For real time events (i.e. sports), CAM will act as a validation content to user that want to replay the events. In particular, CSM is not useful if the main backbone is a terrestrial or cable network because the aim of CSM is to support remote area with low upstream network capacity. This happen based on the capability of those both technologies to deliver a multicast session without significant delay. But to the satellite technology, cache system is playing a vital role on stream delivery.

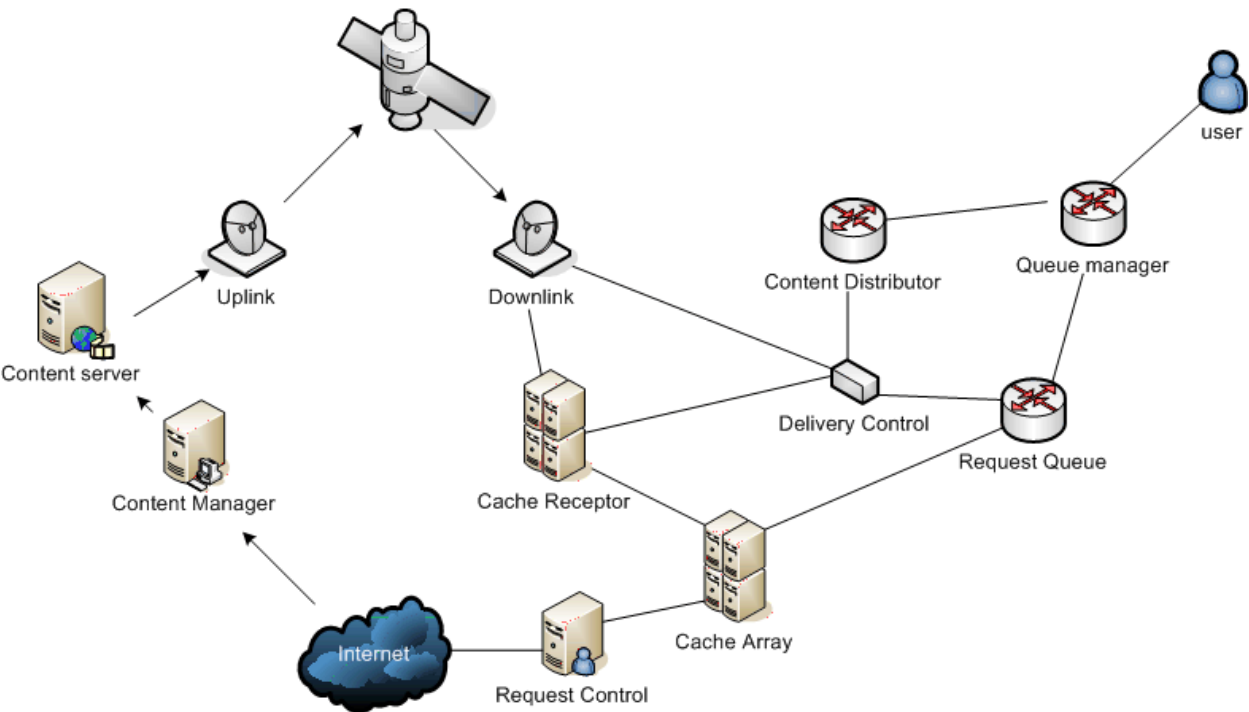


Fig. 13. Cache Stream Management Implementation.

In CSM implementation, incoming content is managed by Cache Receptor. The Cache Receptor is acting like a grid computing storage system. It will store every incoming content

and waiting for an instruction from the Delivery Control. If there is no request then the content will be record as there are no content send to the Delivery Control.

Cache Array is a control request manager. It will checking for a request whether it is exist on the cache request or not, if it is exit then the Cache Receptor will send that request via delivery control. On IPTV this request is a channel. The Cache Array keeps updating its content information database by Cache Receptor. Its operation supported by Request Queue that is triggering the Delivery Control to pass the request.

Particularly, every channel request would not delay interfere other channel. The Content Distributor which is functioning as a distributor mechanism manager will arrange the allocation bandwidth. It will manage the change of the channel that is requesting by end user. If a specific channel is highly demand by user then the Content Distributor will allocate that particular channel with higher bandwidth and priority. In fact, the Queue Manager is the front end sensor for each decision made by the system in relation to channel statistics.

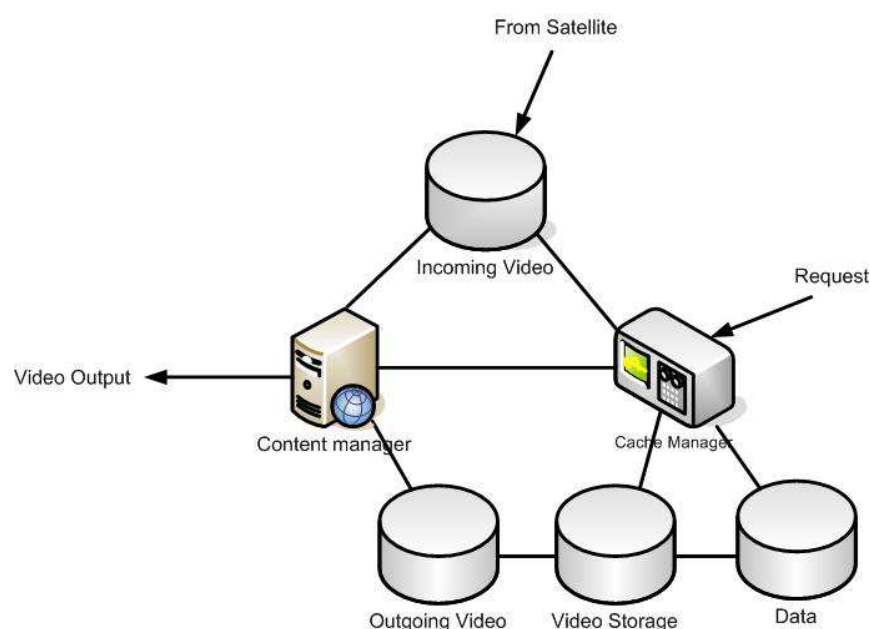


Fig. 14. Cache Receptor and Cache Array

In detail of Cache Array and Cache Receptor can be seen on figure 14. The Cache Array in this configuration is working as the Cache Manager, it manage the incoming request by updating the Content Manager to release every available channel by checking its availability to Data (Database Storage).

Incoming content stream from satellite is collected by a content storage. For short time, the content will be send to the user via the Content Manager if it is tagged live streaming by cache manager and will keep stream until the Cache Manager inform the Content Manager to stop. If a stop signal is given to the Content Manager by the Cache Manager, then that particular channel will be saved on video storage. On this state the Content Manager will retrieve all its content from storage array that represent by Outgoing Video, Video Storage and Data.

IPTV is delivering television stream via IP and each channel have to be served on real-time system in accordance to its critical mission. Channels were served by Content Manager which is not different to grid front manager function. Each channel is delivered on real-time

basis. To handle this condition the Content Manager can not working on a single queue mechanism. It must be managed into array system which will be effectively transfers channels on it services.

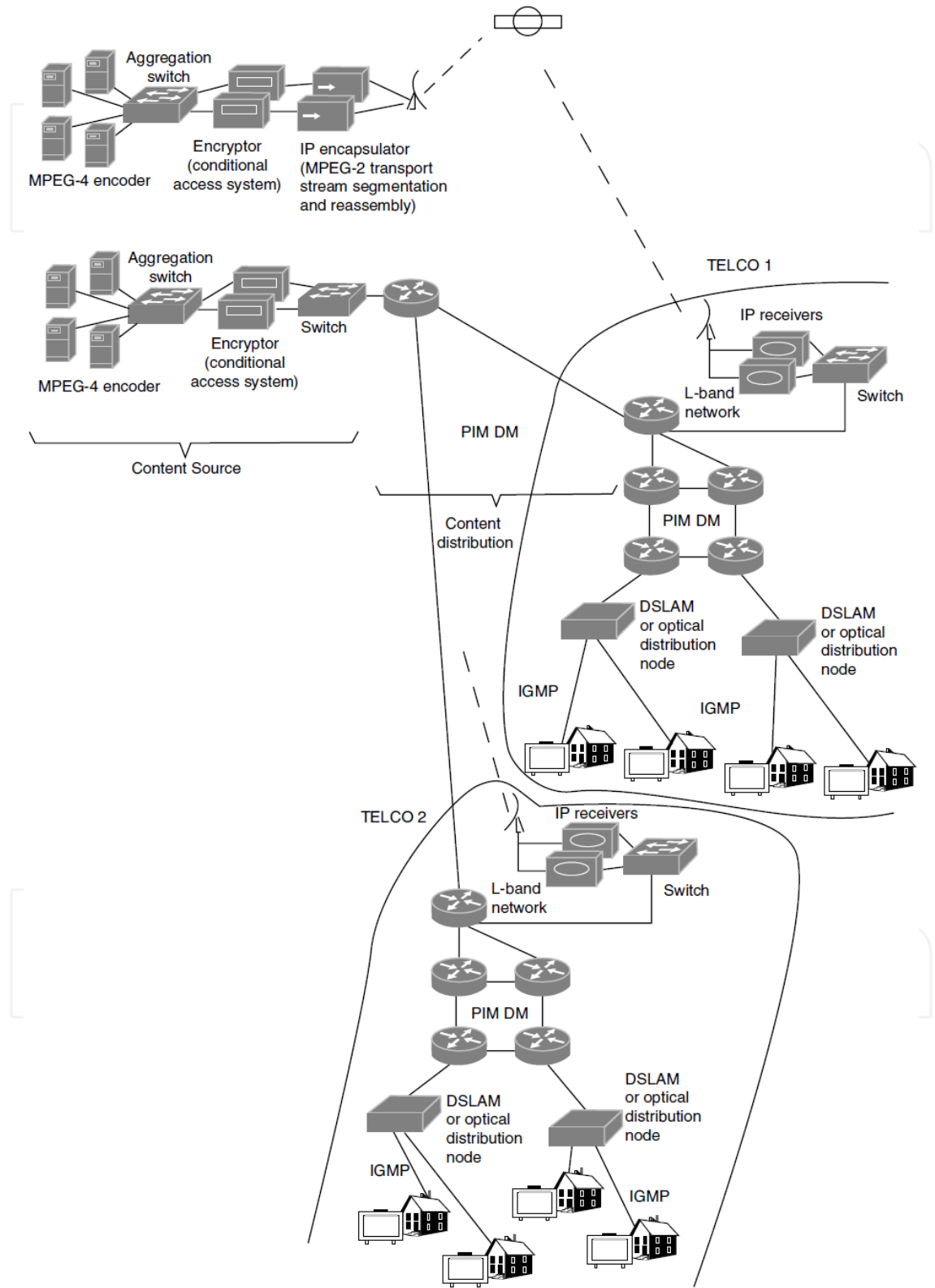


Fig. 15. IPTV Multicast Implementation(Minoli 2008)

The incoming content, content delivery and caching are working on a dense system. Implementation of CSM can be seen on figure 15. The CSM exact position is between the switch and first router on satellite content reception. Each user would be request via local network whether the contents are ready on the cache system. If it is not available then the request will be passed through the router. The router will contact the IPTV head operation channel system to send their specific request channel via satellite.

5. Conclusion

In this chapter, we already propose our design of Cache Stream Manager as a solution to IPTV distribution technology via one-way satellite communication. The main protocol distribution is DVB-S. The Cache management is the main agenda which was resonance by this chapter. This mechanism supported by grid technology would produce a great pleasure for IPTV operator. In particular, IPTV operators which would like to make wider of its services on low cost. The cost is always the bigger barrier for IPTV operator to spread their services to some remotes area.

One-way DVB-S is discussed as a protocol and mechanism to send IPTV services. Channel request and user interaction were manage through local internet. The user interaction and request is not necessary to use high speed internet, because the schedule is only xml data which is updated every time user receiving the video services. It was sending under the video signal. And user interaction will be sends to request control that manage every request if the demand is not exist on the cache array.

6. References

- Alberto, G., P. Francesco, et al. (2006). Simulating dynamic bandwidth allocation on satellite links. Proceeding from the 2006 workshop on ns-2: the IP network simulator. Pisa, Italy, ACM.
- Fatih, A., W. David, et al. (2001). "Adaptive rate control and QoS provisioning in direct broadcast satellite networks." *Wirel. Netw.* 7(3): 269-281.
- Frank, K., B. Torben, et al. (2005). A Synthesizable IP Core for DVB-S2 LDPC Code Decoding. Proceedings of the conference on Design, Automation and Test in Europe - Volume 3, IEEE Computer Society.
- Helmut, B., rklin, et al. (2007). "DVB: from broadcasting to ip delivery." *SIGCOMM Comput. Commun. Rev.* 37(1): 65-67.
- Hyoung Jin, Y., P. Jang Woong, et al. (2008). Data-aided algorithm based frequency synchronizer for DVB-S2. Proceedings of the 2nd international conference on Ubiquitous information management and communication. Suwon, Korea, ACM.
- Minoli, D. (2008). IP multicast with applications to IPTV and mobile DVB. Canada, John Wiley & Sons, Inc.
- Nihal, K. G. S. (1999). "Return link optimization for internet service provision using DVB-S networks." *SIGCOMM Comput. Commun. Rev.* 29(3): 4-13.
- O'Driscoll, G. (2008). NEXT GENERATION IPTV SERVICES AND TECHNOLOGIES. New Jersey, WILEY-INTERSCIENCE, JOHN WILEY & SONS, INC., PUBLICATION.
- Xu, N., S. Li, et al. (2005). The design and implementation of a DVB receiving chip with PCI interface. Proceedings of the 2005 conference on Asia South Pacific design automation. Shanghai, China, ACM.



Digital Video

Edited by Floriano De Rango

ISBN 978-953-7619-70-1

Hard cover, 500 pages

Publisher InTech

Published online 01, February, 2010

Published in print edition February, 2010

This book tries to address different aspects and issues related to video and multimedia distribution over the heterogeneous environment considering broadband satellite networks and general wireless systems where wireless communications and conditions can pose serious problems to the efficient and reliable delivery of content. Specific chapters of the book relate to different research topics covering the architectural aspects of the most famous DVB standard (DVB-T, DVB-S/S2, DVB-H etc.), the protocol aspects and the transmission techniques making use of MIMO, hierarchical modulation and lossy compression. In addition, research issues related to the application layer and to the content semantic, organization and research on the web have also been addressed in order to give a complete view of the problems. The network technologies used in the book are mainly broadband wireless and satellite networks. The book can be read by intermediate students, researchers, engineers or people with some knowledge or specialization in network topics.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

I Made Murwantara, Pujianto Yugopuspito, Arnold Aribowo and Samuel Lukas (2010). Digital Videos Broadcasting via Satellite – Challenge on IPTV Distribution, Digital Video, Floriano De Rango (Ed.), ISBN: 978-953-7619-70-1, InTech, Available from: <http://www.intechopen.com/books/digital-video/digital-videos-broadcasting-via-satellite-challenge-on-iptv-distribution>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2010 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike-3.0 License](https://creativecommons.org/licenses/by-nc-sa/3.0/), which permits use, distribution and reproduction for non-commercial purposes, provided the original is properly cited and derivative works building on this content are distributed under the same license.

IntechOpen

IntechOpen