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JSTP-IPVB-UC
Use cases and service scenario of IP video broadcast (IPVB) for CATV networks

Summary

In recent years, high-definition video services based on a large bandwidth, such as 4K, 8K, VR, etc., have developed rapidly, and each of them requires a bandwidth exceeding 35 Mbps or even up to 100 Mbps. Accordingly, this leads to the requirement of a huge downlink transmission bandwidth and poses a great challenge to existing broadcast transmission networks.

The recommended IP video broadcast (IPVB) technology can greatly increase the bandwidth of downlink programmes and relieve the bandwidth pressure with low-cost and low-complexity features. It broadcasts IP-based video streams over CATV networks to all subscribers in a downlink direction. In IPVB, IP-based video streams are delivered through multicast channels which are identified by multicast IP addresses and UDP port numbers.

In this document, use cases and a service scenario of IPVB technology are introduced and described.

Note

This is an informative ITU-T publication. Mandatory provisions, such as those found in ITU-T Recommendations, are outside the scope of this publication. This publication should only be referenced bibliographically in ITU-T Recommendations.

Keywords

CATV, HFC, IPVB, IP video, scenario, use cases

Change Log

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1 Scope

This Technical Paper will introduce the use cases and a service scenario of IP video broadcast (IPVB) technology.

2 Use cases and service scenario of IPVB

2.1 IPVB constitutes a one-way optical network

IPVB can independently constitute a one-way IP-based video broadcast system. In this scenario, its system structure is shown in Figure 1.

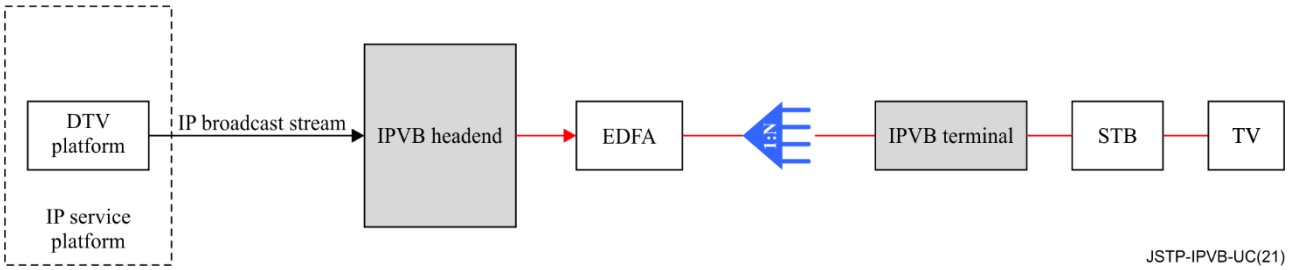

Figure 1 – IPVB constitutes a one-way optical network

While IPVB independently constitutes a broadcast system, the IPVB headend which is just a 10GE switch, receives, converges all the IP broadcast data, and transports them through its downlink optical port according to IEEE802.3ae protocol. An optical amplifier such as an EDFA may amplify the optical signals up to 22 dBm or higher, then the signals are passed the optical splitter and are received by the IPVB terminal. The IPVB terminal will filter the locally requested programmes according to the multicast IP addresses and UDP port numbers, then forward the selected data to the IP set-top box (STB) through Ethernet within the home LAN.

2.2 Adding IPVB to the bidirectional optical network with fibre to home

The typical application scenario of an IPVB system is combined with existing low-cost bidirectional CATV networks (including both HFC and optical networks). The technology scheme based on this typical application has covered more than 1.7 million users in China.

Several use cases and service scenarios of these typical applications will be introduced in the following subclauses.

2.2.1 Application 1: Jishi Media in Jilin province, China

This application system mainly consists of an IP service platform, IPVB headend and IPVB home gateway. In this application, the IPVB headend is a 10GE SDN device, the IPVB home gateway mainly integrates the IPVB terminal, ONU with routing and switching functions, and has GE/FE ports. The architecture diagram of the system is shown in Figure 2.

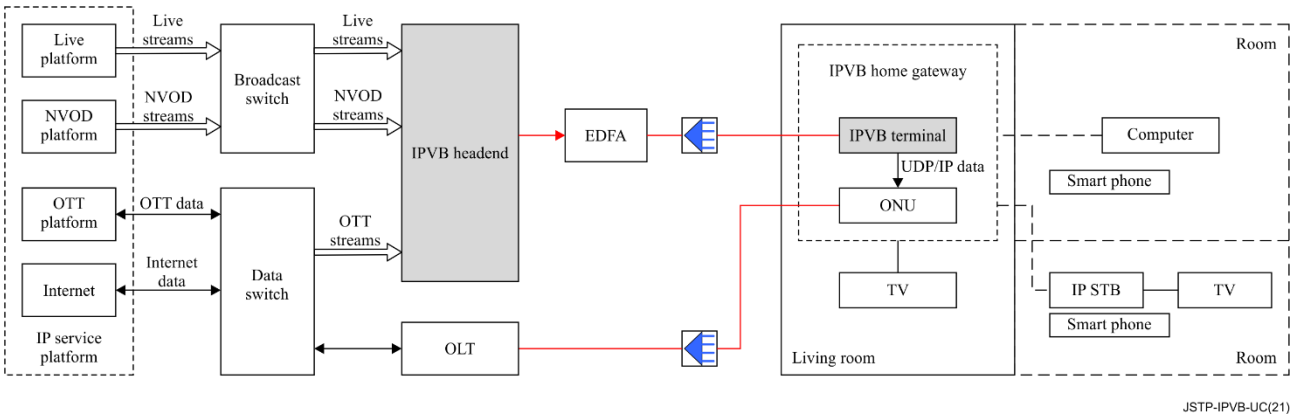

Figure 2 – Architecture diagram of the system, Jishi Media

In this application scenario, the IP broadcast video streams and on-demand OTT video streams are all transmitted in the downlink broadcast channel of IPVB.

The IPVB headend is a 10GE SDN device; it can freely allocate broadcast video transmission bandwidth and on-demand video transmission bandwidth according to needs such as the bandwidth used to transmit broadcast video allocation 3 Gbps, and the bandwidth used to transmit on-demand video allocation 7 Gbps. If the total transmission bandwidth needed is more than 10 Gbps, the broadcast transmission shall be guaranteed based on the principle of broadcast video transmission priority, which is configured in IPVB headend. If the bandwidth used to transmit the on-demand video of an IPVB downlink channel is not enough, the on-demand video can still be transmitted through the original bidirectional channel.

The IPVB headend does the following for video streams transmitted in the IPVB downlink broadcast channel:

1) converges broadcast videos;
2) be a proxy of the video requests from IP boxes to OTT servers;
3) encapsulates OTT down streams to UDP packets, and identifies the different programmes according to the multicast IP addresses and UDP port numbers;
4) transports all IP data out through a 10GE port.

In an IPVB home gateway, the IPVB terminal does the following for video streams transmitted in the IPVB downlink broadcast channel:

1) receives the IP data, filters the locally requested programmes according to the multicast IP addresses and UDP port numbers;
2) unpacks UDP packets of OTT streams as TCP packets;
3) converts the IP addresses of the selected IP data into the IP addresses of the service clients such as IP boxes, and forwards them to the home LAN through an ONU or a home router.

The processes of on-demand services such as OTT services in an IPVB system is shown as follows:

1) After going online, the IPVB headend will broadcast the IP address of a physical port which communicates with an on-demand server and IPVB home gateway periodically in a main channel, namely "the interactive IP address", we call this port of the IPVB headend as "the interactive port". The IPVB home gateway receives the main channel information and extracts "the interactive IP address".
2) The IPVB home gateway interacts with the IPVB headend to obtain the on-demand services address segment which is the IP address segment of on-demand services that need to be transmitted in the IPVB downlink broadcast channel.

3) The user client initiates an on-demand request, then the IPVB home gateway judges whether the destination address of the request packet is in the on-demand services address segment.

4) If the packet does not belong to the address segment, it will be forwarded according to standard Ethernet protocol without special treatment; if it belongs to the address segment, the packet is regarded as an on-demand service packet and processed as follows:

   a) The IPVB home gateway sends a message to the IPVB headend requesting the multicast IP address and port number, and listens for this multicast IP address and port number continuously.

   b) If the IPVB home gateway does not receive the needed multicast IP address and port number, it will forward the request packet according to the standard Ethernet protocol without special treatment; if it receives the needed multicast IP address and port number, it will do the operations in step c and d.

   c) Encapsulate the whole request packet into the data part of the UDP packet; the source address of the UDP packet header is the IPVB home gateway address, and the destination address is "the interactive IP address" of IPVB headend.

   d) The new UDP packet is sent to the interactive port of the IPVB headend.

5) After the IPVB headend received the new UDP packet, it will remove the UDP packet header, revert it to the previous on-demand request packet, replace the source address with the interactive IP address of the IPVB headend, and forward it to the on-demand services server.

6) After the on-demand services server receives the on-demand request packet and processes it in a normal way, the reply packet and subsequent service packets are sent to the interactive port of the IPVB headend through the standard Ethernet network.

7) After the IPVB headend received the downstream video packets, it will conduct the following processing:

   a) Replace the destination IP and MAC addresses in the downstream video packets with the source IP and MAC addresses of the first original request packet.

   b) On the basis of the previous packet, the UDP header is added, and the destination IP address and port number adopts the assigned multicast IP address and port number.

   c) Send the reconstructed packet to the IPVB home gateway through the IPVB downlink broadcast channel.

8) After the IPVB home gateway has received the downstream video data on the corresponding multicast IP address and port number, it will remove the UDP header of the received packet to restore a complete IP packet, and send it to the user client of the original request.

9) The packet received by the user client is the on-demand service packet, it is played in the normal way. The whole on-demand service process is completed.

This application scheme provides 25 sets of 4K programmes, 305 sets of HD programmes, 118 sets of SD programmes, 180 sets of time shift and back to see programmes, 300 sets of NVOD exclusive programmes, and many industry exclusive channel programmes. It greatly improves user satisfaction and experience.

This application scheme had already covered more than 1.3 million users by the end of 2018. 65% of these users opened a broadband service, and more than 95% of these users opened bidirectional on-demand services. The numbers of CATV network users increased 12%.

All these numbers can prove that this scheme is effective.

2.2.2 Application 2: Guangxi Radio & TV network in Guangxi province, China

This application system mainly consists of an IP service platform, IPVB headend and IPVB STB. In this application, the IPVB headend is a 10GE SDN device, and the IPVB STB mainly integrates the IPVB terminal, PON ONU and WIFI router. The architecture diagram of the system is shown in Figure 3.

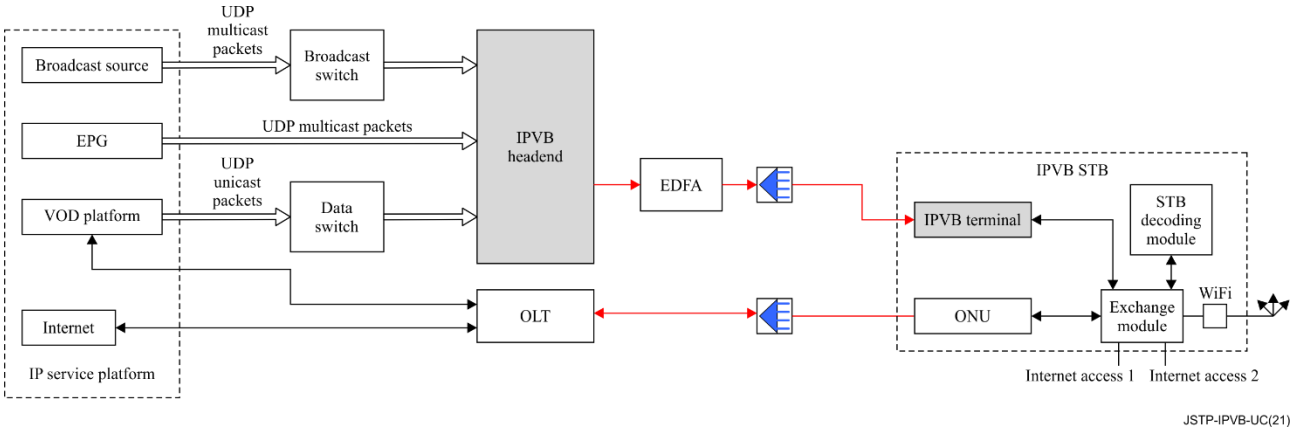

Figure 3 – Architecture diagram of the system, Guangxi Radio and TV network

In this application scenario, the IP broadcast video streams and on-demand VOD video streams are all transmitted in the downlink broadcast channel of IPVB. The IPVB headend is a 10GE SDN device, which does the following:

1) converges broadcast videos;
2) converts the unicast IP addresses of VOD down streams into multicast IP addresses, and identifies the different programmes according to the multicast IP addresses and UDP port numbers;
3) transports all IP data out through a 10GE port.

In the IPVB STB, the IPVB terminal does the following:

1) receives the IP data, filters the locally requested programmes according to the multicast IP addresses and UDP port numbers;
2) converts the IP addresses of the selected IP data into the IP addresses of the service clients such as IP boxes, and forwards them to the home LAN through an ONU or a home router.

This system scheme had already covered more than 0.4 million users by the end of 2018.

2.3 Adding IPVB to HFC network with cable to home

Based on taking the HINOC network in HFC networks as an example, there is an application scheme for IPVB combined with HINOC that has been designed. This application system mainly consists of an IP service platform, IPVB headend, IPVB-HINOC-corridor gateway and HINOC modem. Within this equipment, the IPVB-HINOC-corridor gateway mainly integrates the IPVB terminal, ONU with routing and switching functions, and HINOC bridge. The architecture diagram of this scheme is shown in Figure 4.

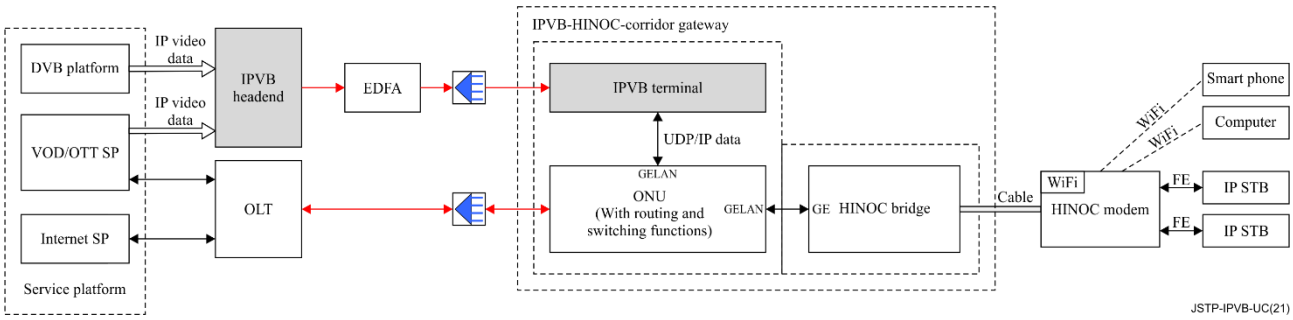

Figure 4 – Architecture diagram of this scheme, IPVB combined with HINOC

In this application system, the IP video streams are all transmitted in the downlink broadcast channel of IPVB. In the IPVB-HINOC-corridor gateway, the IPVB terminal module receives the IP video data, filters the locally requested programmes according to the multicast IP addresses and UDP port numbers, converts the IP addresses and port numbers of the selected IP data into the IP addresses of the service clients, then transmits this IP video data to the ONU module through the GE port. After that, the HINOC bridge module processes and modulates the IP data to coaxial RF signals, then transmits them to the HINOC modem located in users' homes through cable.