Effective Synchronisation of Hybrid Broadcast and Broadband TV

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***Abstract*—Watching a sport event via an IPTV channel and choosing a broadcast radio station as a play-out audio stream is the scenario discussed in this paper. Hybrid Broadcast and Broadband TV (hbbTV) provides an excellent platform to combine multimedia delivered via both systems. By following the recommendations in this paper, a synchronized play-out of multiple media streams delivered via the hbbTV system can be achieved.**

I. Introduction

The future is moving towards the unification of TV delivery systems within one single TV receiver as described by Hybrid Broadcast and Broadband TV (hbbTV) [1]. Each TV delivery system, broadcast and broadband, due to its own characteristics, provides different features which, unified at the client-side, can develop into new services. Broadcast TV technologies include satellite, terrestrial and cable, whereas broadband access is used by IPTV and webTV.

The services provided by hbbTV can be improved via the combined play-out of an IPTV video delivery with a broadcast radio channel, which is of particular interest to sports viewers. In other words, a viewer selects a sports event on an IPTV channel and then decides on the commentary, depending on the language and style of that commentary.

A key point is to provide a synchronised play-out of video and audio streams. This allows IPTV companies to offer this possibility to their subscribed clients [2] and allows those broadcast companies to be differentiated from other free TV delivery systems. Fig. 1 illustrates this possibility based on the Network Time Protocol (NTP) [3], which in this paper is establish a way to distribute time in DVB to enable synch between media delivered via DVB and IP Networks.

Depending on which form of delivery is used, other protocols are also required. Using MP2T [4], as the core packetization system, facilitates synchronisation between media streams delivered via both technologies. Broadcast systems are transmitted via Digital Video Broadcast (DVB) standards. Special relevance is given to the DVB standard for audio/video coding used in broadcasting applications based on MP2T [5]. TV channels transmitted via IPTV also use the MP2T packetization and, although not obligatory for the transport of the media delivery, the use of the Real-Time Protocol (RTP) [6] is recommended to add extra reliability.

The paper now considers multimedia synchronisation before passing on to the proposed solution.

II. Multimedia Synchronisation

The main considerations associated with media synchronization are as follows:

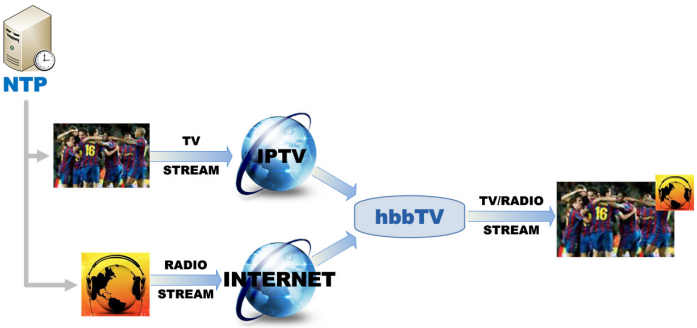

Fig. 1. Framework prototype to synch IPTV channel with Internet Radio via NTP synchronised sources to perform audio substitution at client-side

1) Different standards used: The delivery of video over IPTV uses MP2T as a transport media container usually transported via RTP for previously mentioned reasons. Different DVB standards also use MP2T as a media container facilitating synchronisation between media streams from different media delivery platforms.

2) Initial clock synchronisation of DVB source and the IPTV server: To synchronise at the receiver media delivered from different sources via different platforms requires all sources to be synchronised to the same wall-clock time.

3) Continuous play-out timestamps: Once the initial synchronisation moment is executed both media streams must continue to be synchronised. Due to clock skew between the different source clocks and network jitter and network delay in IPTV, sources that are synchronised at the start of a media session will progressively lose synch.

III. Proposed Solution

A. Time alignment IPTV Server and DVB Source

Synchronisation at source is required to ensure that both streams can be relatively synchronised to the required degree to the same wall-clock time. This can be achieved by NTP, GPS, or Precision Time Protocol (PTP) depending on the circumstances.

B. Delivery Initial wall-clock relationship timestamps

The relationship between the timestamps and the wall-clock time they relate to, in the two different sources, needs to be established. The delivery of a connection between the initial timestamp with the NTP clock over IP networks is performed via the Real-Time Control Protocol (RTCP), a companion protocol of RTP, which provides the RTP timestamp, related to the MP2T payload timestamps, and their related NTP times.

If an RTCP packet is sent by the source at the beginning of the media session the relationship is established and sent to the receiver. The periodicity of RTCP packets sent can vary depending on the application.

Although DVB systems also use MP2T to transport media streams they do not use RTP or RTCP and, thus, another method is needed. DVB systems use delivery of Service Information (SI) tables [7] to send the receivers necessary information for correct media delivery and to provide fast zapping time. The tables related to time are the Time and Date Table (TDT) and the Time Offset Table (TOT). The TDT provides Coordinated Universal Time (UTC) time to receivers whereas the TOT sends information about the local time offset. The field concerned is the *UTC_time* (40 bits). The transmission of TDT and TOT tables is at least every 30 seconds [8].

We propose to send the relationship between MP2T timestamps from the related program with the wall-clock time using the Event Information Table (EIT). The EIT transmits, among other information, the *transport_stream_ID*, *event_ID*, *start_time* (40 bits) and *duration* (24 bits). We propose to add an extra field indicating the timestamps of the initial PTS event, in our case the sport event transmitted, called *PTS_timestamp* (33 bits), as in the MP2T.

C. MP2T Encapsulation

Both broadband and broadcast systems, use as a core media container MP2T. MP2T has two timestamps: Presentation Timestamps (PTS) and Decoding Timestamp (DTS), which indicate the time to perform their function. The synchronisation between an encoder and a decoder's clock is performed via the clock references. In MP2T DTS and PTS are found in the Packetized Elementary Stream (PES) Header and PCR in the Adaptation Field. The PCR transmission frequency can't exceed 100ms, although DVB recommends a 40 ms frequency [9], while timestamps frequency transmission varies depending on frames types and frame decoding requirements. [4]

D. Scenario proposed

The user's behaviour is usually to select the TV channel and then select the audio. In our scenario, a user selects the IPTV channel over which the sports event is being transmitted and then selects a broadcast radio for the audio.

From the video we have, via RTP/RTCP, the wall-clock time relationship with video and when a user selects the broadcast radio we need to establish the same relationship for the audio stream, which the new field within the EIT will provide. Both media streams will be delivered via MP2T.

The TV/Radio synch is performed in a Media Sync module where the input streams, the radio audio broadcast stream and TV broadband stream, will be synched and delivered within a single MP2T stream where audio packets' substitution would have been applied within the Media Sync module. The runtime environment module at the hbbTV would perform the play-out of the already synchronised TV/Radio MP2T. Fig. 2 depicts the architecture and components [1] of an hbbTV terminal.

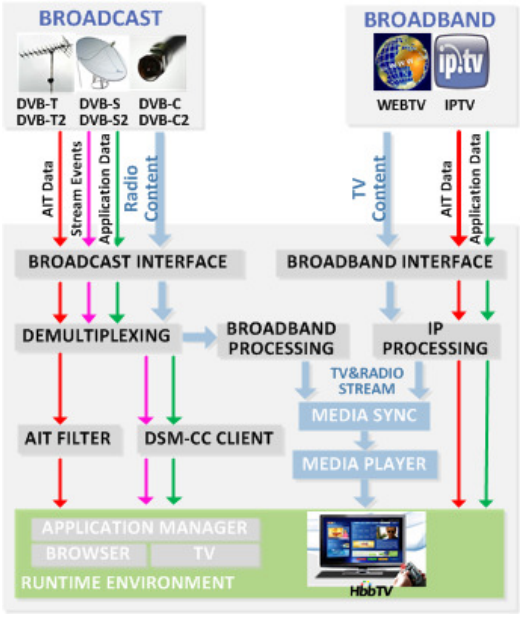

Fig. 2. Framework hybrid broadcast (audio Radio channel) and broadband (video IPTV channel) with Media Sync Module included

Our proposed solution includes the addition of the Media Sync module located between the media processing and the media player.

IV. Conclusion

We have proposed to convey the relationship between wall-clock time and the PTS timestamp via an added field in the EIT called *PTS_timestamp*. Further work involves testing the viability of adding an extra field into the EIT table and comparing it to other options such as sending the information in a special table at the beginning of event transmission.

Acknowledgement

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