Inter-media synchronization for IPTV: A case study for VLC

Lourdes Beloqui Yuste[1], Hugh Melvin[2]
Discipline of Information Technology
NUI Galway
Galway, Ireland
l.beloquiyuste@nuigalway.ie, hugh.melvin@nuigalway.ie

Abstract — *The tight integration and synchronisation of different multimedia facilitates extra features for IP Network delivery TV platforms, such as IPTV allowing it compete with other well established TV delivery systems such as Satellite or aerial TV. This paper presents a case study whereby RSS (Really Simple Syndication) Feeds and Video are tightly synchronised using the media player VLC (VideoLAN Client). In particular it uses the embedded subtitles mechanism to facilitate this and examines two implementation scenarios: synchronisation at client-side or server-side. VLC is used both as a media streamer in the server and as a media player in the client.*

1 INTRODUCTION

Inter-media synchronisation can be employed in an IPTV environment to provide different personalised features for clients. The main video and audio compression standard used for IPTV is MPEG-2 although MPEG-4 slowly is taken over. RSS 2.0 is the main chosen format used by 80% of all RSS Feeds [1].

Inter-media synchronisation is applied to synchronise a TV channel delivered by IPTV, with a logically and temporally related RSS Feed i.e. synchronising is only relevant if the TV program is related to the information stored in the RSS Channel. E.g. a live TV sporting event and a betting company RSS Feed displaying the real-time odds related to it.

2 BACKGROUND

Common inter-media synchronisation challenges include synchronising video with audio or subtitles. Acceptable synch threshold between video and audio (also known as lip-synch) is a rich research area with differing viewpoints but typical values are between 15 and 45 milliseconds [2] with viewers being much more perceptive to audio leading than audio lagging. Inter-media synchronisation between video and subtitles is not as tight, mainly due to the nature of the subtitles as the viewer listens to the audio but has to read the subtitles. Subtitles display in text format the audio information, either in the same language or translated, and the viewer reads the subtitles at his/her own speed. Within the VLC subtitle mechanism, video and subtitles synchronise to the millisecond relative to the start of the video and indicates how long the subtitles should remain on the screen.

2.1 IPTV

IPTV is a system to deliver TV over a private IP Network. It has to compete with traditional TV delivery systems such as Satellite, aerial or cable TV and, on the other hand, Internet TV.

To compete with free Internet TV, which is global and free, it must guarantee QoS over a secured network to compensate for the cost.

To compete with Satellite, aerial or cable TV, IPTV must provide at least the same quality and quantity of services as any other system.

IPTV has advantages over Internet TV because it is delivered multicast, as opposed to unicast delivery used mainly by Internet TV. Multicast streaming has many advantages over unicast such as less bandwidth requirements, less server overload and general reduction on the network routers load. [3]

IPTV's main advantage over traditional systems is the interactivity between the system and the clients, provided by the duplex nature of the underlying IP network.

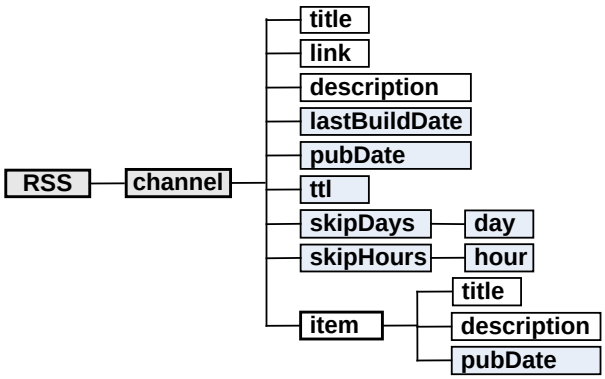

Fig.1: RSS 2.0 Tag structure

1 Member of the Performance Engineering Laboratory (PEL) http://pel.it.nuigalway.ie/
2 Member of Energy Research Centre www.nuigalway.ie/energy and PEL

2.2 RSS

RSS 2.0 is based on XML (Extensible Markup Language). The RSS Feed is stored in a unicode text file which contains the information structured in tags. The file is encapsulated in the <rss version=”2.0”> and <channel> tags. The channel has different tags related to it and can have from one to many items [4].

Some tags are obligatory in a channel, such as <title>, <description> and <link>, and in the items, such as <title> and <description>. Fig.1 shows the compulsory and time related tags in RSS 2.0.

All tags related to time are optional but are obviously required to synchronise the RSS Feed with the video. All of them follow the RFC 822 [5] format. While this format only has seconds’ granularity, our research requires accuracy to milliseconds level. An example of the format can be found in Fig.2.

```
<pubDate>Tue, Oct 2006 06:06:06,000 GMT<pubDate>
```

Fig.2: Example pubDate tag with milliseconds accuracy

2.3 MPEG-2 TRANSPORT STREAM

MPEG-2 Transport Streams are used to stream video content over an IP Network. Transport Stream packets are delivered over the network carrying the MPEG-2 video.

There are two types of timestamps, firstly PCR (Program Clock Reference) and secondly PTS (Presentation Timestamp) and DTS (Decoding Timestamp). The main differences are established in Table 1.

	Bits	Frequency	Location
PCR	42 bits	27MHz	Adaptation Field
PTS	33 bits	90KHz	PES (Packetised Elementary Stream)
DTS	33 bits	90 KHz	PES

Table 1: Comparison between MPEG-2 timestamps

PCR is used to synchronise the encoder and decoder frequencies using a PLL (Phase-Locked Loop) at the decoder.

PTS indicates when a video and its related audio unit must be presented on the TV. DTS indicates when an AAU (Audio Access Unit) and a VAU (Video Access Unit) have to be decoded.

The existence of DTS and PTS is due to the three types of frames that can be found in a video: I-frame (Intra-frame), P-frame (Previous-frame) and B-frame (Bidirectional-frame). In the case of audio PTS always equals DTS and in the case of video that only happens when the VAA is a B-frame [6].

3 PROBLEM

To synchronise a video stream and an RSS Feed two aspects need be taking into account, where and how.

There are two possible places to synchronise, at the client or the server.

If the synchronisation is performed at the server, scalability issues can arise. A large number of clients requesting different TV channels combined with different RSS feeds would not be feasible. On the other hand, by synchronising at the client, server scalability is resolved providing a personalised service at a small increase of the STB (Set-Top Box) overload.

To add the RSS feed to the video image two approaches were taken into account: first to create a 2 stream mosaic with the video on top and the RSS item on the bottom. That involves lots of processing, decoding, creating a new video image combining the two different sources and encoding the final video.

Alternatively, an RSS feed, being a textual data format, has the option of using the subtitles mechanism, which are also text. Most media players have implemented the inter-media synchronisation between subtitles and video and audio as described in the next section

4 DESIGN

The main components in the project are the server and the client. A media player is needed in both of them. VLC [7] is used as a streamer, at the server, and as a decoder, at the client. See the high level diagram in Fig.3.

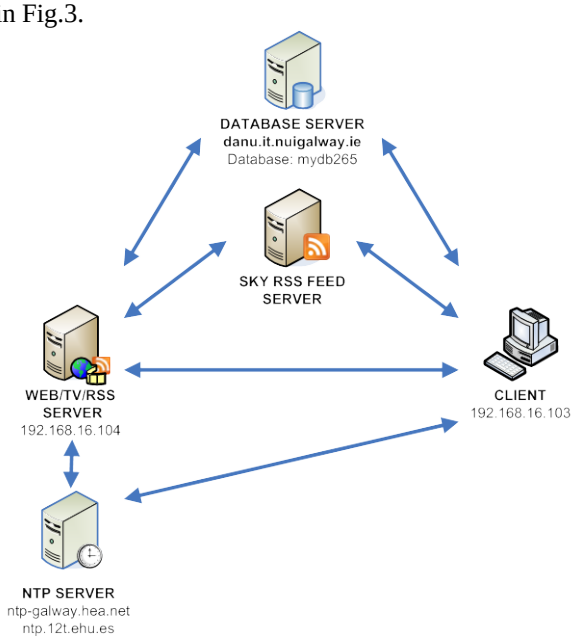

Fig.3: High Level Diagram

The middleware, a JSP (Java Server Pages) user interface, responds to the client's petitions, establishing the parameters for the VLC to stream and to receive the MPEG-2 video file.

There is one external mySql database where all data about the connections is stored: IP address of the client, server, id_TV, id_RSS, date and time of connection.

To perform the synchronisation, all components of the system are connected to the same NTP (Network Time Protocol) Server which guarantees the components are running at the same time within single milliseconds threshold.

The project also allows synchronising with an external RSS Feed with no time related tags. The solution is to add the <pubDate> tags to each item so they can be displayed during the video at a constant rate.

5 IMPLEMENTATION

In our VLC IPTV test-bed, two approaches have successfully been implemented and are currently being analysed. Firstly, where RSS feeds are streamed separately and they are embedded within the VLC client (Set-Top Box). Secondly, where the TV and RSS feeds are merged in the server and then streamed to the client.

MPEG-2 video format was chosen, being the main format for IPTV video streaming. VLC recognises different subtitle formats including SubRip. This format was selected due to its 1 millisecond's accuracy and some html text format [8]. An example of SubRip subtitles format can be found in Fig. 4.

```
1
00:00:06,000-->00:00:12,000
<p><font color="#00ffff">Fri, 2 Oct 2009 15:39:32
UTC</font></p>
<p>Pakistan Routs 'Cancer' Of Taliban Fighters</p>

2
00:00:16,000-->00:00:22,000
<p><font color="#00ffff">Fri, 2 Oct 2009 15:39:42
UTC</font></p>
<p>Rogue Bull Gores Runner To Death In Spain</p>
```

Fig. 4: Example SubRip subtitles

For VLC to display a subtitle file related to a video, both are stored locally, all that is needed is for both files to be located in the same folder and to share the same name with the corresponding extension, .mpeg for video and .srt for a subtitles file.

5.1 Client-side alignment

VLC in client-side alignment works as follows: the server(s) stream(s) the TV file encoded with MPEG-2 and RSS feeds independently. RSS is converted to subtitle format. The client, subtitles are embedded within MPEG-2. See Fig. 5. In this case the inter-media synchronisation is performed at the decoder in the client by VLC.

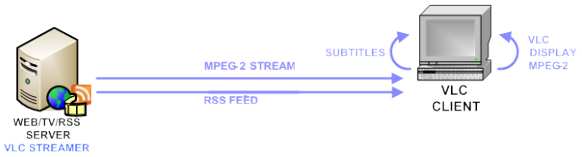

Fig. 5: VLC client-side alignment.

5.2 Server-side alignment

VLC in the server-side alignment works as follows: RSS feeds are converted to subtitle format, the server transcodes the MPEG-2 video with the subtitles file, both being stored in the server, and then streams it to the client. See Fig. 6. In this case the inter-media synchronisation between subtitles and MPEG-2 is performed at the server when it is transcoded before streaming.

Fig. 6: VLC Server-side alignment

6 CONCLUSIONS

Initial results suggest that the way RSS/subtitles is handled (Client v Server) differs between client/server implementation which affects the end quality of the video. This is presumably due to the processing steps which are quite different i.e. streaming the video and then aligning it with the RSS (via subtitles) (client implementation) or embedding the RSS/subtitles within the video in the server and then streaming it to the client. This is currently been investigated further.

Other major issues to be considered and investigated in future work include the broader impacts of differing client/server implementation. These include server processing requirement, bandwidth requirement, and potential for multicasting and STB functionality/cost.

In summary, this paper describes how the VLC media player is used to showcase inter-media synchroni-

sation of logically and temporally related RSS and Video Feeds. Details are provided about VLC streaming combined with video transcoding and inter-media synchronisation between video and subtitles and how this affects the TV/RSS synchronisation project.

Acknowledgments

This research is done within the Performance Engineering Laboratory (PEL) group at NUI Galway. PEL is a widely distributed research group based principally at University College Dublin and Dublin City University with links to other research institutes including NUI Galway.

The support of SolanoTech, an IPTV company based in Athlone, Ireland is also acknowledged www.solanotech.com.

References

[1] Wittenbrink, H. *RSS and Atom*. Packt Publishing Ltd, 2005.

[2] "ATSC Implementation Subcommittee Finding: Relative Timing of Sound and Vision for Broadcast Operations", Doc. ID-191, 26 June, 2003.

[3] Williamson, B. *Developing IP Multicast Networks*. Cisco Press, 2000.

[4] RSS 2.0 at Harvard Law. RSS 2.0 Specification. http://cyber.law.harvard.edu/rss/rss.html

[5] RFC 822. Standard for the format of arpa internet text messages. www.ietf.org/rfc/rfc0822.txt

[6] International Standard ISO/IEC 13818-1. Generic coding of Moving Pictures and Associated audio: Systems.

[7] VideoLAN Client Software, Open Source Code. www.videolan.org.

[8] Annodex. Open Standards for annotation and indexing networked media. http://www.annodex.net/node/8