Standardization of Inter-Destination Media Synchronization

Overview of specification by IETF AVTCORE and ETSI TISPAN

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***Abstract*—Inter-Destination Media Synchronization (IDMS) is a process in which various receivers of the same content are synchronized in their playout. Standardization of an IDMS solution helps to enable interoperability between receivers manufactured by different companies. This paper describes the efforts by ETSI TISPAN and by the IETF AVTCORE working group on standardization of IDMS.**

***Index Terms*—Inter-Destination Media Synchronization, IDMS, standardization, IETF, ETSI**

I. Introduction to IDMS

Inter-destination media synchronization, or IDMS in short hereafter, is about synchronizing the playout of the same content on various different devices. In certain use cases, such synchronization is required for a good user experience, see e.g. [1],[2],[3],[10].

These devices can either be physically close-by or far apart. The latter case is relevant in for example Watching-Apart-Together scenarios, sometimes also referred to as Social TV. In such scenarios, different users watch the same content, each on their own device. But, at the same time, they have some form of communication with each other. This recreates a setting as if you are together watching the same movie or watching the same television program. In such a scenario, delay differences between the playout at the different locations may spoil the user experience. The main example often given here is the shared soccer experience. If one user sees a goal several seconds before the other users, the cheering of the first user will spoil the experience for the other users.

The different devices can also be physically close together. One example of this is if you have multiple televisions inside your home. If your kitchen television is on the same channel as your living room television, and the playout is not synchronized, the audio will mix up and be very disturbing. Other examples here are networked video walls, in which the output of different displays needs to be synchronized, or networked speakers, in which any delay differences may also cause disturbing effects. Also, larger-scale settings such as a stadium or a big airport can be considered physically close together in this respect. In such physically-together scenarios synchronization may be even more important than in the physically separated scenarios, because a single user will readily notice the delay differences that spoil the experience.

II. IDMS standardization

In order to increase the chances of wide-spread adoption of IDMS, and prevent proprietary solutions which only work in (vendor) walled gardens, we (the authors) have been actively contributing to IDMS standardization. Standardization is especially a key issue for IPTV solutions, as it allows interworking of components by different IPTV solution vendors. tandardization can also keep costs down, as vendors can standardize their development and have a large potential market for their products.

We (the authors) have been actively contributing to IDMS standardization for the past years. This standardization started in ETSI TISPAN as part of TISPAN's IPTV release 3 work [6], and is continued in the IETF as part of the AVTCORE Working Group. We have described our work previously in greater detail in e.g. [7-10]. This paper gives an up-to-date overview of the current status. It mainly focusses on the IETF work, as that is the work in progress. A small recap of the ETSI work in this area, which was finished in 2010, is also given in this paper.

III. IETF IDMS standardization

The IETF has adopted the standardization of IDMS as a working-group effort in the AVTCORE working group, see [4] for the current draft. This work started out in 2010 and was based on the work done in ETSI TISPAN (see next section on ETSI TISPAN). The AVTCORE group is responsible for the standardization of the Real-Time Protocol (RTP) and the accompanying RTP Control Protocol (RTCP). RTCP is used for reporting on quality feedback from media receivers to media senders, and is also used to achieve inter-stream synchronization (i.e. lip-sync) if multiple sub-streams are sent separately. RTCP is a suitable protocol for achieving IDMS, considering its current reporting and control mechanisms, and considering it is an extendable protocol.

The IETF solution for IDMS consists of two parts. The main part is the exchange of status information and of synchronization settings. This is implemented using the RTCP

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protocol, and is part of the ongoing media session. The other part is the setup of the synchronization session, which is described in SDP and can be performed using any known session setup protocols that use SDP.

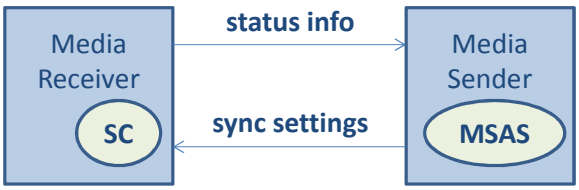

Figure 2 IDMS synchronization between a media receiver containing a Synchronization Client (SC) and a Media Synchronization Application Server (MSAS)

The general concept for IDMS used in the IETF is as follows. Receivers of a media stream report on their status to a central server, normally colocated with the media sender. This central server will calculate the playout differences between the various receivers, and will send IDMS instructions to the various receivers. Accordingly, the receivers will delay their playout (buffer) as needed to achieve synchronization.

The basic setup of IDMS in the IETF solution in is shown figure 1. A media receiver will contain a so-called Synchronization Client (SC) and a media sender will contain a so-called Media Synchronization Application Server (MSAS). The SC will send status reports on RTP media packet arrival times and, optionally, on RTP media packet presentation times to the MSAS. The MSAS will receive such reports from the various SCs that are to be synchronized. It can then determine a reference playout point (e.g. the one of the most delayed SC), and send out synchronization settings to all involved SCs to match with this reference playout point. The RTCP XR report block for IDMS, also called IDMS report, in figure 2 shows the format of the informative status reports sent by SCs. The IDMS report contains the RTP timestamp of a reference packet, its receipt time in its Packet Received NTP timestamp (mandatory) and, optionally, its presentation time in the Packet Presented NTP timestamp.

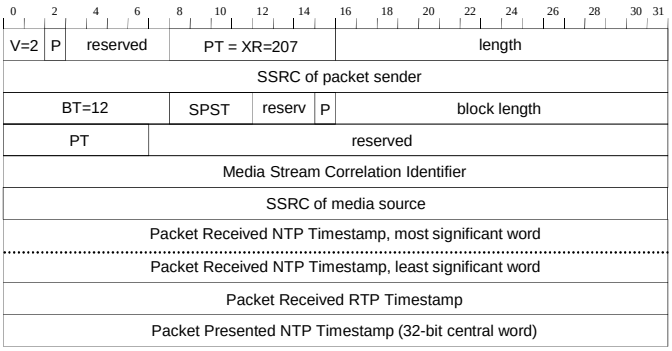

Figure 1 RTCP XR Report Block for IDMS, containing fields for reporting RTP packet arrival time and presentation time

The settings instructions sent by the MSAS have a similar format, but use a newly defined IDMS Settings packet type (see [4]). The main difference with the status report block is that the IDMS settings packet uses a 64 bit presentation timestamp that allows for a higher level of granularity in those applications requiring stringent sync accuracy.

To enable establishment of IDMS sessions, the IETF solution also specifies two SDP parameters for signaling the use of the IDMS reports and setting packets. These SDP parameters can be used in any session-control protocol, such as SIP or RTSP, to enable IDMS for that media session. Part of the SDP parameter for the XR report block is a so-called SyncGroupId. This SyncGroupId identifies the synchronization group with which to synchronize, i.e. this is comparable to a conference-ID for participating in a conference call. This field is contained as the media stream correlation identifier in the status report block. This allows an MSAS to correlate a status report to its proper synchronization group, thus enabling independent IDMS processes for different logical groups of SCs .

Discussions within the AVTCORE working group on the accuracy of NTP implementations also lead to another Internet Draft (ID) on clock source signaling [5]. Most solutions for IDMS rely on all receivers having synchronized clocks. For clock synchronization, NTP is a much used protocol. But, in practice, clock synchronization relying on NTP is not always accurate. The protocol itself is quite reliable, but clients depend on their server to be accurate. NTP servers are not always accurate, most likely because of faulty implementations.

The ID on clock sources defines new SDP attributes with which SCs can signal which clock synchronization mechanisms are available to it. This is an extensible list which currently supports NTP, PTP, GPS and Galileo. Not only the mechanism can be communicated, also the clock source, for example an NTP server address, is included. This allows various SCsto choose the same clock source, to guarantee synchronized clocks. Also, SCscan indicate how reliable their clock is by indicating how often they synchronize their clock, and what the last time was that they did synchronize it.

IV. ETSI IDMS STANDARDIZATION

The work within the IETF is largely based on the specification of IDMS by ETSI TISPAN. TISPANs IPTV release 3 contains a large number of new IPTV features for its IPTV specifications [6]. One of these features is the ability to perform IDMS. ETSI specifies a functional architecture and the reference points between the functions, in this case the Sync reference point between the MSAS and the SC, as shown in figure 3. The MSAS is specifically defined as a separate function, whilst the SC is specified as either part of a receiver or as part of the transport layer, also explained in [7].

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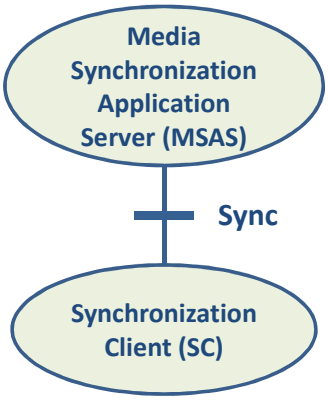

Figure 3 ETSI TISPAN Sync reference point between an MSAS and an SC

ETSI has specified the initial XR report block (as shown in figure 2) and its associated SDP parameter, as now contained in the (newer) IETF specifications. For sending IDMS settings, the ETSI specifications also use the XR report block, but differentiating by using another value for the Synchronization Packet Sender Type (SPST) parameter.

ETSI also did initial work on synchronizing the same content but in different formats, i.e. in case of some users receiving an SD stream and some users receiving an HD stream. We (the authors) intend to continue this initial work also within the IETF AVTCORE group.

V. Future work

We plan to continue our standardization work on the RTCP-based IDMS solution within the IETF. There are several issues in achieving a flexible, accurate and scalable IDMS solution that we are working on.

A first issue is that achieving synchronization may take some time. This is especially noticeable when a synchronization session has just started, or when new members join an existing synchronization session. Novel feedback reporting mechanisms will be needed to enable faster reaction to dynamic events in an IDMS session (start-up delays, out of sync situations, latecomer accommodation, etc.).

Furthermore, an IPTV environment is a large-scale Single-Source Multicast (SSM) setting. For IDMS, certain issues arise. Either all viewers of a certain program need to be synchronized, or only groups of viewers watching the program together or multiple televisions in the same location need to be synchronized. Also, different viewers can receive different versions of the content in different RTP streams, e.g. some receive an SD-quality stream and others an HD-quality stream. Thus, IDMS needs to be achieved for multiple versions of the same content in different media streams. Furthermore, additional (unicast) feedback aggregation mechanisms will be needed to enable scalable IDMS solutions.

Besides, we are currently looking into an HTTP adaptive streaming-compatible IDMS solution. MPEG-DASH seems a primary candidate for this, as it is the only standardized version of HTTP adaptive streaming. We are not currently involved in MPEG standardization, but with the growing importance of HTTP-based streaming solutions, we feel that we need to look into this.

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