Measurement System for Playout Delay of TV Signals

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ABSTRACT
TV signals are carried towards end-users using different (broadcast) technologies and by different providers. This is causing differences in the playout timing of the TV signal at different locations and devices. Authors have developed a measurement system for measuring the relative playout delay of a TV output. This measurement system consists of an application running on Android and a back-end system, and uses the Gracenote fingerprinting platform.

Author Keywords
TV; broadcast; media synchronization; delay; Android

ACM Classification Keywords
H.5.1 [**Multimedia Information Systems**]: Video, Broadcasting

BACKGROUND

The following scenario might sound familiar: imagine you are watching an exciting soccer match, such as a world cup game. The team you are supporting is in ball possession and is setting up an attack when you suddenly hear loud cheering noises coming from your neighbors. A little later you see where this cheering came from: a goal was scored. This is an example often given to illustrate a playout difference. A playout difference is the difference in delay between the displaying of a certain piece of content on different TV systems, possibly using different techniques or obtaining content from different content providers. These playout differences have been shown to be noticeable or annoying, even for differences as small as just 1 second [1].

A playout difference is not just annoying when watching football, there are other applications where playout differences cause problems. Examples of this are applications that involve real time content or user interaction through television. Sources such as [2] and [3] report or expect an increase in the use of these kind of advanced television services.

Knowledge of playout differences is essential for the design of such services. An example where this is essential is a second screen application for live TV quizzes that require live viewer interaction. Knowing the playout delays make it possible for service developers to account for this in their design. It will also be interesting to know if there is delay dispersion for geographically different locations or different moments in time.

Thinking one step ahead, knowing or being able to quickly measure these delays area step in the direction of a possible synchronization of TV broadcast chains, see e.g. [4].

Authors have developed a measurement system for playout delay of TV signals. This paper describes that system, and proposes a demonstration of the system. Further background on the system can be found in [5].

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MEASUREMENT SYSTEM

To measure the playout delay of a TV broadcast, we use a technique called audio fingerprinting. Audio fingerprinting techniques make use of so-called fingerprints that digitally summarize the content of audio. These fingerprints are then matched against a previously calculated (or in case of live TV fingerprinting a real-time calculated) set of reference fingerprints in a fingerprint database. Our system makes use of the freely available live TV fingerprinting platform "Entourage" provided by the company Gracenote [6]. This TV fingerprinting platform provides real-time recording and fingerprinting of live TV channels done by Gracenote. This acts as the reference that we use for comparing a locally (i.e. a normal TV) recorded fingerprint (and the corresponding starting moment in time) with. The platform of choice is Android, which allows for performing easy measurements, not only by ourselves but also by people that are not familiar with our measurement system. More specifically, an Android device records audio from a TV through its internal microphone, calculates an audio fingerprint and compares this with the mentioned reference. The playout difference is then calculated as the difference in time between the recording of both audio fingerprints.

Furthermore, our measurement application allows for input of metadata such as the broadcaster name, channel name, TV technology, TV quality (HD/SD) and location. A measurement of the playout difference combined with this manually entered metadata is submitted to a back-end database server on which the measurements are stored.

To accurately compare the moment the fingerprint is recorded on the smartphone with the moment the fingerprint is recorded on the reference, both sources need

to have an accurate notion of time. To accomplish this, the smartphone obtains a timestamp by querying an NTP server.

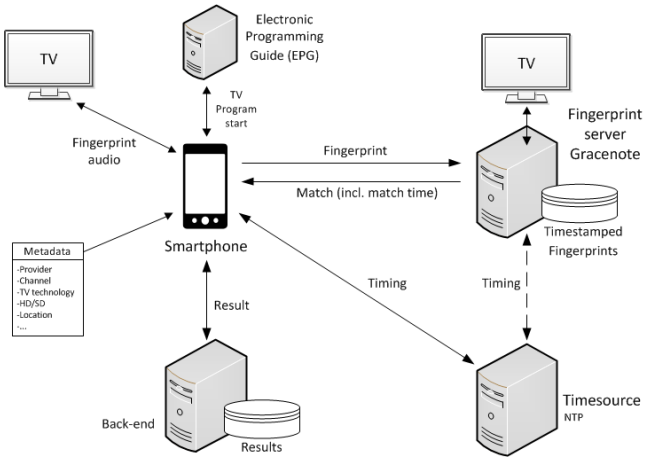

Figure 1: Architecture of the measurement system

An architectural overview of the system can be found in Figure 1. The smartphone application acts as the center of communication between the mentioned components. The smartphone application records sound from a TV, queries the NTP server for a timestamp and starts creating a fingerprint right at this moment. Next, the created fingerprint is submitted to the reference server of Gracenote which compares the fingerprint with its database of live, continuously created fingerprints of its own TV source. If a match is found, the time offset (relative to the start of matching TV program) is returned to the smartphone.

Next, the smartphone queries the EPG server to determine the absolute moment in time the fingerprint was recorded on the reference. The moment of local fingerprint recording and the moment of reference fingerprint recording are compared against each other to obtain the playout difference. Finally, combined with manually entered metadata, the playout difference measurement is submitted to a back-end database, storing the results.

DEMONSTRATION

Our measurement system can be demonstrated using any Android device and any media device playing one of the supported TV channels BBC1, BBC2 or TV5. The Android device will capture the audio of the TV channel using an audio cable, calculate the fingerprints and determine the relative playout delay. This process normally takes a number of minutes. A single fingerprint measurement takes some tens of seconds, and one application measurement consists of eight fingerprinting measurements. Multiple fingerprinting measurements are done to deal with outliers encountered in the Gracenote fingerprinting platform results.

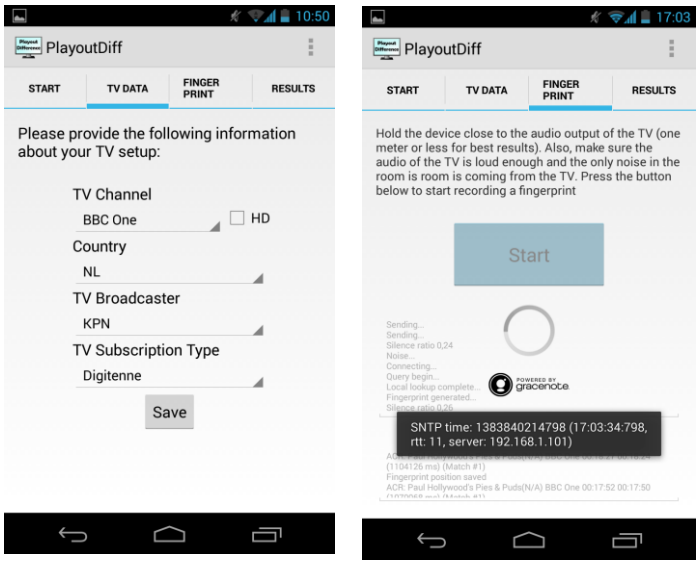

Figure 2 Two screenshots of our measurement application. The left one shows the metadata, supplied by the user of the application. The right one shows fingerprinting in progress.

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