All Together Now: A multi-language and multi-system mobile application to make live performing arts accessible[1]

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ABSTRACT

Stage performances are usually live performances. These days, theatre or opera may be staged anywhere from the traditional seating arrangement to a popular open air representation where actors and audience move in a dynamic open *mise en scène*. In some theatre houses, accessibility to the audio (subtitles) and visual elements of the performances (audio description) has been arranged through the installation of screens on the back of seats, or through the projection of surtitles on a large screen usually located above the stage. In some cases, both practices coexist to show in written form what is being spoken or sung, translated into the vernacular, and audio described to provide a user-friendly representation.

Surtitles, subtitles, audio description, audio subtitling and some other accessible services are being increasingly required by European Directives relating to media content. Yet many barriers still make accessibility an almost utopian ideal. Intelligent mobile phones and the widespread availability of applications may be the way to solve access to live performances, and this is the subject of this paper. The article will first present the many challenges that exist in a live production where synchronous accessibility should be provided. It then presents the system – Universal Access System (UAS) — which has been developed to deliver most accessibility services for live performances via a mobile application.

KEYWORDS

Accessibility, scenic arts, mobile application, live performance, Opera, Theatre.

1. The challenges of live accessibility

All media present accessibility needs, and the practical means and services available differ according to numerous variables. To name three: the content to be made accessible, the formats in which the media is digitised, and the location where the event is taking place. From the user's perspective, there are two very different ways to receive an access service: open and closed. The former is when all users, regardless of their needs, receive an access service, for example the surtitling in an opera house projected at the top of the proscenium (see Figure 1). Access services can also be 'closed,' which is when the service will only be activated at the user's command. Many services can be available concurrently, but the user decides which to access. This is the case for the wide choice of accessible services on offer in Digital TV, Internet Protocol Television (IP TV) and Hybrid Broadcast Broadband TV (HbbTV) with subtitling for the deaf and hard of hearing (SDH) or audio description, or audio subtitles, or sign language[3].

Apart from the challenges posed by making the actual content accessible — the multisemiotic translation of the audio into written form, and of the visual into audio — many issues have to be considered in order to deliver accessible content for all in real time. Drafting a comprehensive and robust taxonomy is an almost impossible task; to move forward and find solutions we have therefore categorised a list of obstacles under four headings: audio and visual channels, time, cost, and technology. These four headings have been taken into consideration when drafting the "Universal Accessible System" (UAS) requirements for making live events accessible.

(a) Audio and visual channels

Both channels, with their semiotic implications, must be represented in a new code in a different system and for different audiences, which can be broadly divided into two groups: sensory- and linguistically-impaired audiences (Oncins *forthcoming*). In the first group two communities can be identified: deaf and hearing-impaired[4] and blind and visually-impaired audiences. A common barrier for deaf and hearing-impaired audiences when attending a stage performance is, for example, when a telephone rings on the stage in a play; not only does what is said by the characters have to be subtitled, but some written annotation is also necessary to inform the audience what can be heard. Likewise, for blind and visually-impaired audiences if, in an operatic production, the lights turn red, blue and white and are reflected onto the background to form the French flag, this visual clue has to be relayed by audio to the visually-impaired patrons (VIPs). On the other hand, in the case of linguistically-impaired audiences, beyond symbolic languages like colour, or lighting (Maszerowska 2012), movement or music (Corral and Lladó 2011), actual languages, such as German, may also become a barrier if used, for example, in a play in Wales. When talking about accessibility, we should also take into consideration the comprehension of different languages and different writing systems. An opera could be being performed in language X (for the purposes of this example, let us say Russian) and need subtitling in language Y (for our example, let us say Danish) to make it accessible to those who do not understand the source language. In this case, with Danish subtitles for Russian opera singing, VIPs will also need audio subtitles to be able to follow the performance. For opera, theatre and film festivals, this solution is a common standard modality: open subtitles which everyone can see. In some film festivals, such as the Locarno International Film Festival in Switzerland, up to three different sets of subtitles are projected for three different languages (English, Italian and German). Hence, creating a system which could offer both written and audio information was the first priority when designing the UAS.

(b) Time

Synchronicity is a key issue, and perhaps the one which poses the greatest challenge: live or recorded is the key challenge. Synchronicity has a direct implication, and is a much debated topic in relation to subtitling and SDH. Live subtitles produced by re-speaking (Romero-Fresco 2011) and their mode of display and the delay (Romero-Fresco and Martínez Pérez *forthcoming*) are the focus of much discussion by world-wide media access standardisation bodies such as the ITU. It is also a recurrent topic in the popular press, since some errors produce amusing utterances[5]. Aside from technical problems, delivering AD in real time during a stage performance presents the additional challenge of unexpected changes or improvisations. Additionally. in the case of opera the singer might vary the rythm and therefore start singing following a silence (Cabeza i Cáceres 2011: 230). Attempting to devise a system which synchronises the delivery of different media services (SDH and AD) was also a priority.

(c) Cost

Producing, delivering, broadcasting and consuming content has a cost which, in live productions, calls into question the viability of access services. The need to offer AD or SDH for an F1 race or a live football match is often queried. Should the number of expected users be taken into consideration in order to prioritise access services? If media access becomes a legally binding requirement in publicly funded institutions, cost will probably be the priority. When delivering subtitles and AD at a live performance, at least one operator is required for each service. The UAS system was also designed to optimise multimodal delivery of content by a single operator.

d) Technology

This group comprises the many technological solutions which go hand in hand with the different stages in the chain of producing, encrypting, encoding, broadcasting, receiving and delivering content. Explaining how the UAS system was designed to offer one solution which could solve many problems is the aim of this article.

2. What is currently available

Though electronic media may be considered a new development, theatre and opera have been around for centuries. However, only recently has the technology been available to produce and project surtitles — or supertitles/subtitles — in live productions (Burton 2009, Matamala and Orero 2007, Weaver 2010). Whilst subtitles for language accessibility in the cinema have a long history, the first projections of surtitles in opera and theatre were made in the early 1980s (Desblache 2007: 163). More

recently, they have also appeared in festivals. Whilst subtitles or surtitles (as in Figure 1) were projected, nowadays different displays are also available.

Figure 1. Surtitles or supertitles of the performance *Die Zauberflöte* (2012) at the Grand Teatre de Liceu, Barcelona, Spain.

Some opera houses also offer surtitles in different formats, such as the small screens available at the Barcelona opera house, Grand Teatre del Liceu (Figure 2).

Figure 2. Different screens available at the Grand Teatre del Liceu, Barcelona, Spain.

Other services such as AD are a very new development and have not yet become widely established. Live audio subtitling is less common still, and to our knowledge is only offered at the Liceu Opera House in Barcelona as part of the AD service (Orero 2007: 141).

The use of surtitles in the performing arts has increased considerably (Mateo 2007: 137). However, when we searched for standards, a guide of good practice or guidelines on the process of making and delivering surtitles, we found that there is no clear consensus amongst the different

professionals. There are several accessibility solutions, associated with different manufacturers, and the service that theatres and opera houses offer very much depends on their technology and its capacity to deliver. If a theatre does not have the necessary equipment and system in place to deliver AD, a costly investment is required either to replace the existing subtitling system, or to add or rent a new system and equipment with the concomitant rental or maintenance costs.

Since most theatre houses and almost every opera houses have their own system for delivering surtitles, they follow a practically customised process of creating media access services, which sometimes does not coincide with the director's decisions, needs or taste (Udo and Fels 2009, 2010). The surtitler may also disagree with the result, but little can be changed when the available system does not allow for any updating.

New mobile phone technology is ubiquitous and has also entered cinemas and theatres. The displaying of access services is beginning to be available as inhouse technology, such as the iPhone subtitler in Figure 3.

Figure 3. iPhone subtitles.

The existing iPhone subtitling service[6] and its applications show the many possibilities on offer for recorded performances, as is the case with Moviereading[7] (see Figure 4). This is an application for Apple, Android and Samsung smartphones created by an Italian company, which is already available in some Italian film theatres. The application synchronises the subtitles with the audio from the film at any given time through speech recognition. Recently, the audio description function has also been included in this application.

Figure 4. Moviereading.

Not only do all these applications provide media access, but they also offer an important opportunity for testing issues related to reception, user interaction and the quality of the experience, since the split attention between subtitle and film screen is perhaps the biggest deterrent.

Moving from the display of access services to the creation of content to be displayed, an analysis of the market was also undertaken in order to understand what is available and which services manufacturers had yet to cover.

While many subtitling software programmes are currently available, the choice for use in live performances is limited. This is mainly due to the fact that creating subtitles in a pre-determined format has a direct impact on the way they will be broadcast and displayed.

In Table 1 below, we enumerate the most popular software used in theatres and opera houses across Europe and list the many services which are also offered.

Product Name	Description	Multilanguage platform	Speed regulation (fade-in/out)	Close Caption	Supports Audio
Figaro	Mainly used in operas. Displays both open and close captions in seatbacks (wired system) and also on smartphones (wireless system).	Yes	Yes	Yes*	No
Viacom	Used in operas and theatres. Displays both open and close captions only in seatbacks (wired system).	Yes	Yes	Yes	No
Opera Voice	Used in operas, theatres and concerts. Available for Apple and Android (wireless system)	Yes	No	Yes	No
Proscenio Naotek	Used mainly in theatre houses and festivals, only with their own LED screens (open captions) receiving content through a wired network.	No	No	No	No
Supertitles	Used mainly in theatre houses and festivals. Allows content creation and delivery in open caption.	Yes	No	No	No
Airscript	A handset which operates wirelessly mainly used in theatre houses. This system allows the includion of information for the deaf and hearing impaired audience and is also multilanguage.	Yes	No	Yes	No
*Currently only available for Apple.					

Table 1. List of software subtitling programmes.

As is evident in the previous table, there is no commercial software available which integrates both SDH and ADs, and allows for the creation

and sending of AD files to the audience by means of a wireless system. Furthermore, at present, users who wish to receive AD have to resort to either receiving it through headphones using infrared technology or an FM transmitter — the same system for receiving a translation during a conference or meeting — or sitting in specific seats where an audio input jack can be inserted in order to receive the AD through wired facilities (Matamala and Orero 2007). An additional problem is that most of the systems listed in Table 1 require the technical services and support of the manufacturer or are linked to the manufacturer's own devices or services, which increases the costs of making and staging the performance.

At the time of writing this article, and while designing and creating our own system, there is no commercially available solution which can create and deliver AD, SDH and audio subtitles for live performances. It is worth noting that, whilst systems seem to be able to cope with the creation and display of SDH, opera and theatre houses have resorted to generating subtitles, not SDH[8], for all audiences. As Oncins (*forthcoming*) explains, accessibility to live performances has been mainly conceived to break down linguistic barriers through transmitting a foreign language production on stage into another language. However, when dealing with deaf and hearing-impaired audiences, extra linguistic information has to be provided because they depend more fully on the access to non-verbal information.

3. Drafting and editing scripts

When the linear development of access content creation is followed, translation is the very first step. A new text should be adapted from other languages through translation or intralingual translation. In the case of the latter, the many features which characterise SDH should be added. To date, there is no automatic software to translate surtitles, though it is only a matter of time before such a facility exists since there is a European project SUMAT: An Online Service for SUbtitling by MAchine[9] which should aid development in this direction.

As with everything related to AD, this area enjoys less popularity and interest on the part of industry and academia than subtitling. The creation of AD and SDH depends on human production, which has a cost in terms of both time and money.

4. A universal solution to live media access

Since there is no system which is comprehensive in terms of services, languages etc., we decided in 2011 to embark on the creation of a universal system for media access: UAS.

The system has been designed to offer the following access services:

1. Subtitling: multilanguage subtitling and SDH.
2. Audio description: multilanguage AD.
3. Spoken subtitles: through speech synthesis: subtitles --> voiced subtitles.
4. Automatic AD: through speech synthesis: AD text --> voice to create AD in an automatic mode.
5. Delivery of spoken subtitles and the whole performance or AD through VoIP for those who use hearing aids.
6. Emergency pack: which adds a pre-recorded sign language for some emergency messages to all these previous services, since sign language is usually delivered live, and the interpreter may not have access to the message. The emergency will also activate the vibration mode on the mobile phone to alert deaf users to the incoming information.

The interface designed by our team has the following features for creating content (Figure 5):

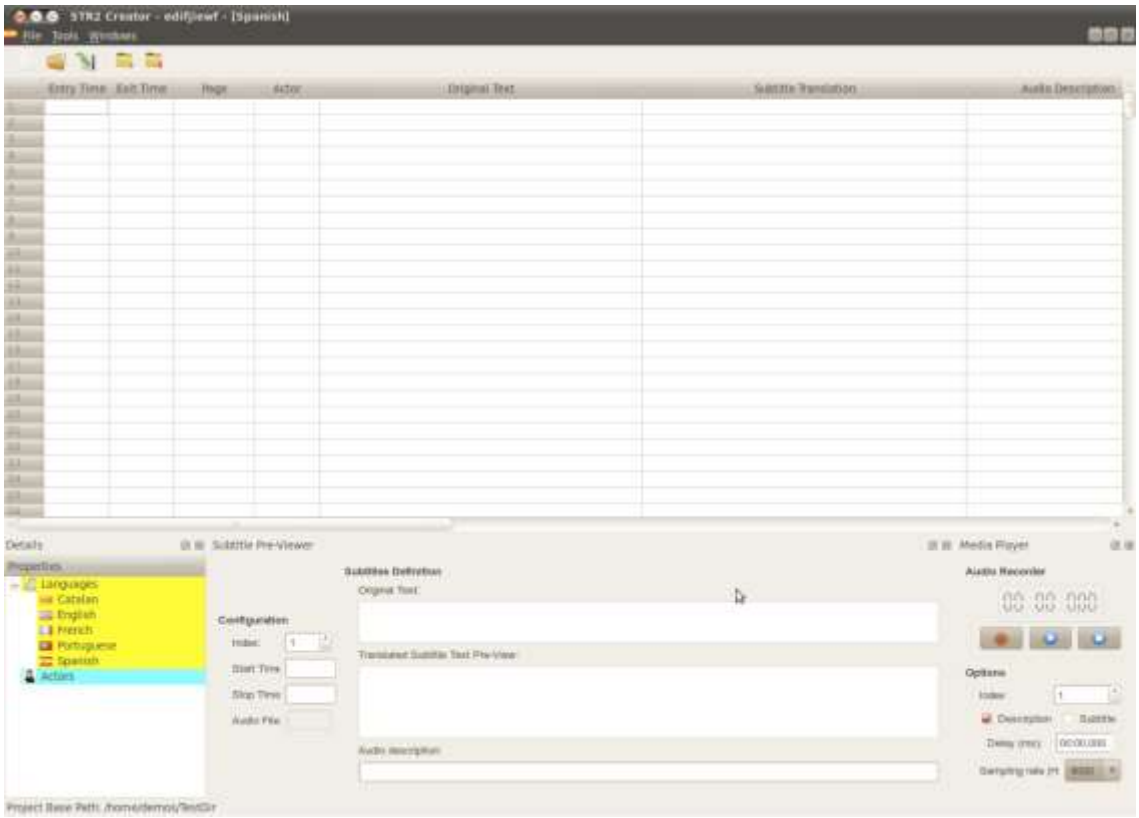

Figure 5. System interface for editing text.

The page has been divided in two main horizontal areas. The top resembles an Excel document displaying five columns: page, author, original text, subtitle, and audio description.

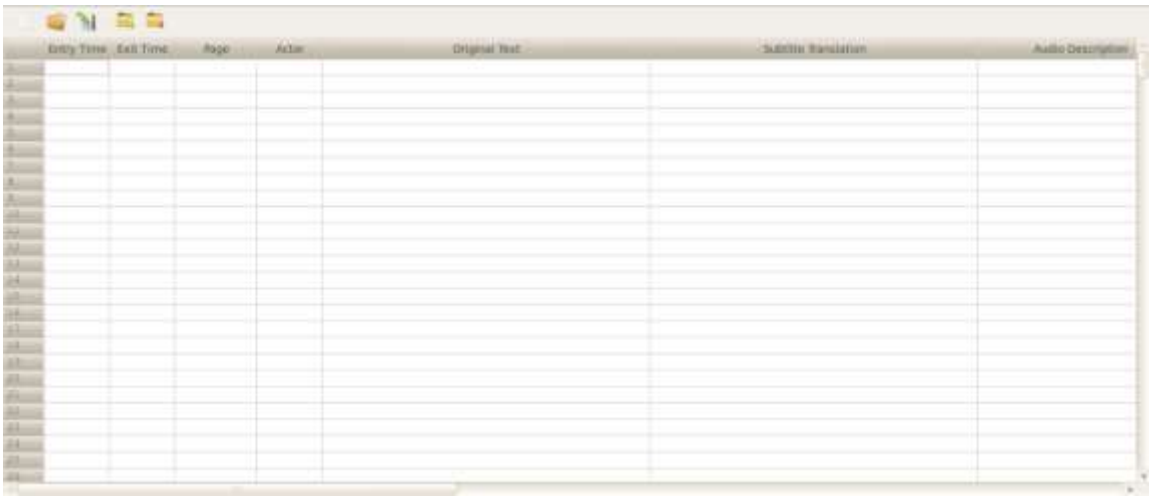

Figure 6. The top part of the interface.

The functions to create the text for the columns can be found in the lower part of the screen; in the bottom left corner there is a window dealing with two functions: languages and character identification.

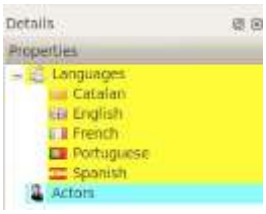

Figure 7. Section of the interface for language and character identification.

The UAS system will store as many language files as required, with the possibility of choosing different language writing systems, such as Japanese. Here we can also pair characters with the subtitle colour which is identified when projected, as shown below in Figure 8, where two characters are speaking to each other and are individually identified by either white or yellow.

Figure 8. Character identification by colour in subtitles.

The centre of the lower part of the screen is used to create three different services: the original language subtitle in the first window, its translation in the second window and the AD in the third.

Figure 9. Section of the interface for creating texts.

It is important to understand that, even if a Shakespeare play is being represented, the original canonic text is adapted for subtitles, and hence subtitles are created for the source subtitles and their many possible translations.

With regard to AD, the UAS system has been designed to create a dependency of the AD text on the subtitles. This does not mean AD is created without taking dialogue into consideration; this 'dependency' has been created for delivery purposes only. AD content is created and recorded in the same way as it is traditionally done for live performances. This is perhaps one of the most interesting developments of the UAS. The concept which inspired this dependency is that AD is usually never delivered when meaningful audio can be heard; in short, the AD is complementary to the subtitles. When entering the venue the patron will select subtitling, audio subtitling or AD. This fact allows the use of a single product to provide accessibility services to both audiences: deaf and hard-of-hearing and blind and visually impaired. To achieve this aim, we have automated the delivery of AD. At the end of certain subtitles, there will be a period of silence — a time void of dialogue — allowing the AD to be delivered. In other words, certain subtitles are tagged to deliver the previously prepared AD. This fact facilitates the task of the system operator, allowing him/her to use SDH as a point of reference while providing also AD.

Once the texts are ready, they are stored in cloud format or on the PC which will later be used to deliver the scripts.

5. System architecture

The system designed has an architecture comprising three elements (see Figure 9): a content server, a Wi-Fi network and mobile Internet devices (MID).

The content server stores the files containing subtitles, SDH or AD in as many languages as necessary, including in languages with different

alphabets. It allows the operator to start a new session and to launch files containing content accordingly. It is also possible to launch advertising material during breaks.

The server, using the Wi-Fi network, distributes content to the MIDs around the theatre. The MIDs must have installed an application specially developed to interact with the content server. At the beginning of the performance, users choose from a list of available languages and services. The choice of language is for both the application interface and for the content.

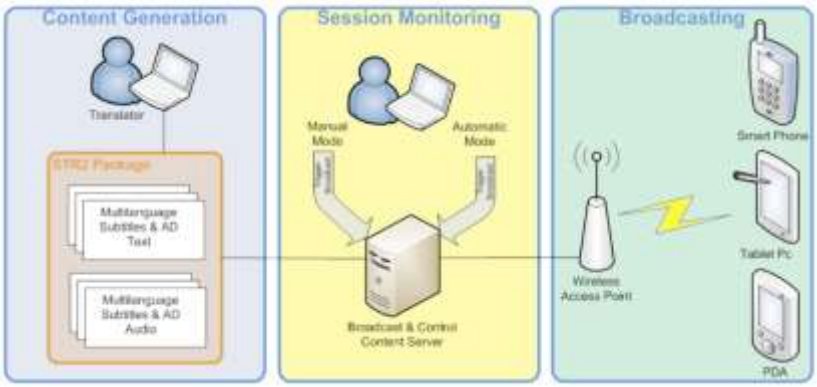

Figure 10. System architecture.

The system has been designed to allow access content to be displayed in any operating system, such as on Android, iOS and in any existing screen format, such as Smartphones, Tablets or iPads, with Internet connectivity.

6. Data storage

The content generated by the application for each language is then stored in an XML format file, with a well-defined structure. Each file contains all the subtitling and audio description information (both written and spoken) presented in the language tables (Figure 4).

Finally, the application compresses, packages and exports all these pieces of content into a single file for ease of handling by the operator. This approach means that it is faster and easier to set up the real-time broadcasting service, avoiding possible errors due to missing or misplaced files.

7. Real time delivery of services

Once all the files have been stored, and the performance begins, one operator manages all the services. This has been achieved through cueing AD to subtitle time codes.

Given the fact that each performance is different, 'real-life' accessibility services will always be exposed to unexpected changes, thereby leading to surprises even if the professional involved has attended rehearsals or previews or has received a recorded DVD of the stage performance. As Griesel (2009: 123) points out: "In the real translation situation when the performance is shown on stage, the source text can change. There might be improvisations and the translator has to react spontaneously as in an interpreting situation." This means that it is impossible to know, with any level of accuracy, the exact length of any silence gap for AD[10]. Thus, even if a real person were to deliver the AD, the same state of uncertainty regarding the silence span will exist. Taking this into consideration, the possibility of linking AD files to the end of subtitles offers the possibility of optimising delivery, allowing several access services to coexist with just a single operator present.

While AD and subtitles or surtitles are standard services, speech technologies also allow for automatic delivery of spoken subtitles. Such services should be offered for two important reasons. The first is that visually impaired patrons (VIPs) and those with low reading proficiency have the opportunity to listen to subtitles. The second is to avoid the split attention of the user, since having simultaneously to read from a handheld mobile application and look up at the stage may cause fatigue.

Since technology allows for sound to be delivered through VoIP to those with hearing aids via Wi-Fi, this service — which falls under the category of audio subtitling — has also been included.

Finally, the emergency service comprises a finite group of messages, for example "Fire in the theatre. Please evacuate" or "The car with the registration no. XYZ should be removed from the fire exit." Messages are also sent using haptic communication through the vibration of the mobile device. This additional system of communication has been introduced particularly for deaf and hearing-impaired audiences, who usually communicate through sign language. These emergency messages are previously agreed with the management of the venue and will be delivered independently from the access files created for the performance. Delivery is both through written subtitles, and also in sign language, through the use of avatars, which are animations in the form of artificial 2D or 3D characters.

8. Reception

The patron can download the application, together with the emergency files, onto their smartphone beforehand or once seated in the theatre. The system has been created with the possibility of offering a carousel of promotions and advertisements, and also information regarding the theatre or opera production, which may be the first screen the user sees in real time. Once the language and services have been chosen, the

operator delivers the services, avoiding the need to synchronise each individual service, since only one file is delivered.

A black background has been chosen for the screen, and the default colour of the subtitles is orange rather than white. This is to avoid excessive luminosity to maximise readability, and battery performance. However, the system may also deliver colour-coded subtitles if files have been created in this mode.

The following additional features of the system, of particular interest to the professional, should be considered:

- It supports all major subtitle formats such as SubRip (.srt), SubViewer 1 and 2 (.sub), SubStation Alpha (.ssa/.ass) and MicroDVD.
- Matroska (.mkv) subtitles, like .ssa/.ass and .srt, are automatically converted to soft subtitle tracks when imported.
- Subtitles are synced in real-time using the time offset stepper.
- It allows automatic and manual metadata tagging.
- Character identification using colour can be created manually or automatically.
- It facilitates audio subtitling from text to speech language synthesis.
- It permits audio description either from existing mp3 files or created through speech-to-text speech synthesis
- It contains an emergency suite with messages in all formats and also with sign language avatars.
- It has offline versions including video with subtitles and audio descriptions.

9. Conclusions

This article has presented a new system for creating and delivering media access content in different modalities: subtitling, audio description and audio subtitling. The system supports many different languages and alphabets, and has been developed taking into account existing systems and their capabilities. It is hoped that, with an all-inclusive system, the cost of delivery can be kept to a minimum, with one operator delivering all content in a synchronic fashion. While the system is not currently commercially available, it is fully operational in the cinema at Universitat Autònoma de Barcelona (Spain) where five films were programmed and delivered in the academic year 2011/12 and one play in 2012/2013. The system takes into consideration the four categories of obstacles to providing live access services, and could be a viable solution to real-time media access.

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Notes

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[2] This work has been carried out within the scope of the doctoral program in Ambient Intelligence and Accessibility offered in the Centre for Ambient Intelligence and Accessibility of Catalonia (CAiAC), Department of Translation and Interpreting at the Universitat Autònoma de Barcelona.

[3] This paper has been written in Europe, and follows EU terminology for Access Services, as opposed to US or Canadian terminology, such as: caption, closed caption, spoken captions, and video description.

[4] Due to the fact that the deaf and hearing impaired community is of a very heterogeneous nature, the purpose of this project is to provide a multiplatform tool which allows different types of subtitles which are adapted to the different end user needs, including the needs of deaf audiences whose mother tongue is sign language.

[5] For further references see the article "Reading the news" available on the BBC website quoted under the "Websites" section of the present paper.

[6] For further references see the article website "Watch movies with subtitles on the iPhone" quoted under the "Websites" section of the present paper.
[7] For further references see the project website "Moviereading" quoted under the "Websites" section of the present paper.
[8] Arnáiz Uzquiza (2012: 109) in her classification of parameters for the SDH (subtitles for deaf-and-hard of hearing) introduces the category "extralinguistic information" referring to the representation of all non-verbal sound information provided in the audiovisual text. In this category she provides the following parameters: character identification, paralinguistic information, sound effects and music. In the case of opera, the dimension of music would be excluded, because it represents an inherent element of the performance. But in the case of stage performances all four parameters should be considered with in the process of the surtitles.
[9] For further references see the project website "SUMAT: An Online Service for SUbtitling by MAchine Translation" quoted under the "Websites" section of the present paper.
[10] Throughout the period when we have been offering AD at Liceo Opera House in Barcelona, we can safely say that no two performances have been the same in elapsed time.