The Zewall Project: Real-Time Delivering of Events via Portable Devices

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Abstract—**This paper presents an overview of Zewall collaborative project dedicated to proposing an architecture and developing a real-time multimedia streaming application for present day users. This application allows users to film real-time small events (e.g., a local music concert in a village that may not be seen by most of the spectators) and broadcast them 'live' to distant spectators. The technologies like LTE (Long Term Evolution) and HTML-5 (Hyper Text Markup Language 5) are adopted within Zewall project to provide users with high QoS (Quality of Service) and a more dynamic and efficient web interface. We also present each and every aspect of Zewall's architecture along with the description of one of the basic use case and the project outcomes.**

Keywords-live/real-time streaming; user generated content; QoS; LTE.

I. INTRODUCTION

Modern day emergence of real-time video over Internet and recent advancements in network and terminal technologies has provided end-users with new and attractive services at an affordable cost. These novel services have created many opportunities for the service providers to generate more revenue [1]. In this context, our Zewall project [2] aims at developing a diffusion and aggregation service which allows mobile users to film real-time events and broadcast them 'live' to distant users or spectators. These users may not be able to watch a particular event on their television e.g., a local football match happening in a small town, thus via Zewall service such small events can be viewed by several spectators. At the same time, this live broadcasting requires high QoS (Quality of Service) and a simple web interface, therefore we have adopted technologies such as LTE (Long Term Evolution)[1] [3] and HTML5 (Hyper Text Markup Language 5) [4] within Zewall project. Along with rendering access to high quality voice over IP and streaming services, the LTE technology will provide connectivity between the filming persons and the Zewall platform (or server). HTML5, on the other hand, facilitates the playing of multimedia data for spectators over web allowing the addition of new applications to the traditional web pages. This new and promising technology would allow the smartphone users to benefit from the video services (e.g. Zewall), without installing a specific application.

Zewall type service is useful for social media and commercial sites [5] where the stakes in terms of deployment will be particularly important in the coming years, due to the explosion in the use of social networks and the transformation in user behavior provided by the new "smartphones". This explosion is boosted by the influx of users on the Internet (mostly from Asian civilizations [6]) which focus mainly on the image and for whom the 'mobile phone' is the predominant means of communication. Further, the users (especially the youth) are interested in watching the small nearby events in real-time to know what is really happening in their surroundings. These events may not be broadcasted live on TV channels due to less importance or publicity issues. The spectators may also be interested in interacting with the filming persons to understand the things which are unclear to them while watching the video. Thus, the mentioned high proliferation and requirements of users necessities the development of new mobility services in real-time over broadband networks (such as LTE) and the Zewall project is one of the first steps to address this issue.

With the rise of Internet video, some service providers have specialized in the dissemination of personal content on web from a stationary source, such as Ustream, YouTubeDirect, Justin.tv, Livestream, LiveVideo, and Stickam. In general, these solutions allow the aggregation of video streams, however they do not provide filming person's contextual information e.g., their geographical location. On the other hand, there are also some applications such as Bambuser, Qik, Flixwagon, and Kyte [7], which focus on the diffusion of live videos from cellular phones. The filming person can film by subscribing to any of these services and its content will be broadcasted live on a web site. These services use the Flash technology to embed the videos in browsers and link them to the social networks, as a result they are not adaptable to new technologies such as HTML5. Moreover, they do not integrate filming person's contextual information with the video. These services adopt the data-sending rate with respect to the available network bandwidth, therefore the QoS is highly dependent on the network situation (or load).

[1] LTE technology is already been approved in certain countries such as USA and Japan and it is expected to start in France in 2013.

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With Zewall service, we address all the above mentioned limitations in detail. The QoS concern is addressed via LTE technology and the inconvenience caused by Flash technology is handled using HTML5. Furthermore, the algorithms proposed within Zewall allow us to integrate and synchronize the contextual data with the video content.

The rest of the paper is organized as follows. In the next section, a general overview of Zewall is given. In Section III, we present the Zewall architecture. The discussion highlighting various important points of Zewall service, its outcomes and its initial demonstration are provided in Section IV.

II. PROJECT OVERVIEW

This section gives a general overview of Zewall project. There are two basic actors in Zewall: the filming persons and the spectators, both interconnected via Zewall platform. The filming persons transmit the real-time videos to the spectators and these actors can interact with each other (if needed). For simplicity and briefness, we provide a simple use case which clearly explains the core of our project.

A. Basic use case

The music festival (in a small town) is a popular public event where many visitors may move from one concert to another based on their interest. A simple example is shown in Figure 1. In this Figure, there are many music fans filming and broadcasting live performances to remote viewers within their community via smartphones. The corresponding viewers may be located in the same town, thus showing them a live preview of what is happening in the festival thereby encouraging the viewers to visit the festival. The viewers (or spectators) can also be located in a different city/town, where the videos can be seen via social media based websites such as Zewall platform as depicted in Figure 1. These spectators watching live streams over their smartphones, laptops or any other portable devices, can switch between several videos according to their interest. Moreover, the Zewall service allows the interactivity between the spectators and the filming persons. For example, a spectator can ask a filming person to move to a slightly different location in order to have a distinct view of the live event and so on.

The above scenario can generate revenues for the service providers via advertisements and publicity where the geographic location of filming persons becomes an important factor. For example, during the filming of an event, the filming person may be located close to a restaurant and the live publicity of the restaurant can be negotiated for a respectable price. Another way of revenue generation is by providing filming person with a specific package, allowing her to have a better QoS on the network and thus to offer her community a better retransmission. The availability of the live broadcast with high QoS will ensure further promotion of Zewall platform to other communities.

B. Adopted technologies and methods

LTE: as mentioned before, the streams are broadcasted in real-time from filming persons to spectators requiring the provision of high QoS and data rate in order to avoid any network degradations. Within Zewall, this QoS is assured via the use of LTE technology. Basically, LTE uses OFDMA (Orthogonal Frequency Division Multiple Access) on D-downlink and SC-FDMA (Single Carrier Frequency Division Multiple Access) on uplink providing both the flexibility and higher radio spectrum usage. Compared to the CS (Communication Circuit) which was used for the transfer of voice services, LTE is an all IP (Internet Protocol) network supporting both the multimedia and voice transfers. Unlike 2G and 3G networks, LTE provides service management to avoid network congestion and service degradation. Further, LTE supports bandwidth ranges of 5-20 MHz as well as smaller than 5 MHz (1.4-3 MHz) to add more flexibility. The average latency for LTE is 20ms which may drop below 5ms in ideal network conditions and can jump up to 100ms in worst case scenarios (such as travelling in a train at 350km/h). In addition, it offers a low-cost infrastructure for operators. These and many other adherent features make LTE technology highly suitable for Zewall context. The interested readers can refer to [3][8] for further details on LTE. Furthermore, a platform named as ‘ImaginLab’ is used to test Zewall service over LTE networks. This platform is been developed in France [9].

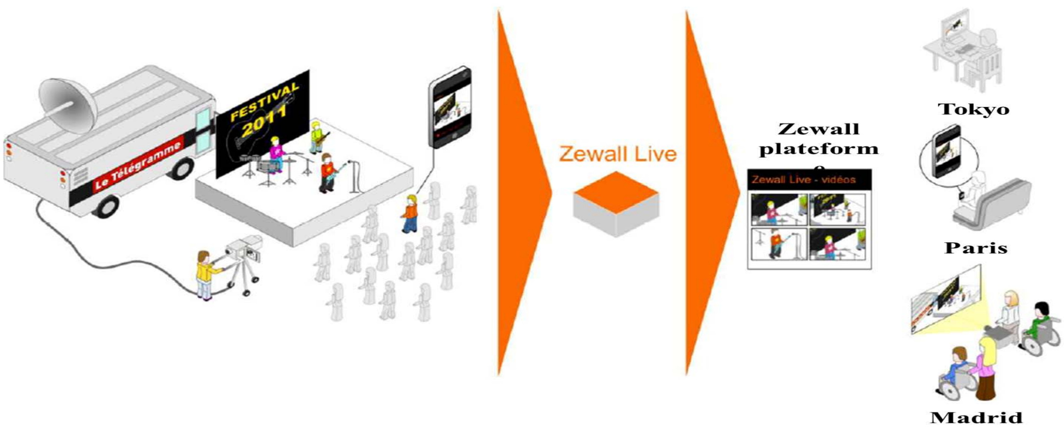

Figure 1. Zewall service: basic use case (Figure done by Orange Labs in the framework of Zewall Project)

HTML5 and WebRTC: integrating new technologies such as HTML5 and WebRTC (Real Time Communication in Web-browsers) [10] in webpages is one of the main targets of Zewall project. Indeed, multimedia services and interactive communications have recently been available on the web pages only by using proprietary plugins like Flash Player. The deployment of HTML5 technology now allows to standardize these features. It represents the next major revision of HTML used to describe the format of web pages, and brings new tags (e.g., <video> </ video>) for direct reading along with novel attributes (e.g., contenteditable, spellcheck) and APIs (such as data storage, off-line mode, 2D drawing, etc.). An HTML5 application can be accecible on almost all mobile platforms. It allows the users to benefit from an increasing number of features (e.g., GPS and accelerometer). The video broadcasting services like YouTube already use HTML5. Another technology improving the data presentation in web pages is the WebRTC which aims to standardize the infrastructure implemented in web browsers allowing audio and video communications (direct and interactive) between web users. Thus, the use of both HTML5 and WebRTC technologies permits Zewall platform to become more extensive thereby providing spectators with (1) a real execution environment to choose whatever video streams they might prefer to watch and (2) an interface to directly interact with the corresponding filming persons. Data treatment methods: using Zewall service, the filming person can send the contextual data describing its position such as the geographic location and the camera orientation, in parallel with the video stream. This combination of video and contextual data helps spectator to improve its remote involvement in a live event [11]. The information received from the filming person may indeed be precious to the spectator because being closely related to the currently displayed live event, it would be fruitful to have a clear and complete understanding of what is actually happening at the place of event. This understanding is difficult to achieve if the video is broadcasted without contextual data e.g., during a football match, commentary is as important as the game. Moreover, Zewall proposes new methods [11] enabling the treatment of the contextual data and its synchronization with the video streams. It also includes methods for data aggregation enabling to collect, store and publish video content coming from several sources making the simultaneous management of various streams easier for the 'platform administrator'.

III. THE ZEWALL ARCHITECTURE

The Zewall project aims at developing a diffusion and aggregation service which allows spectators to watch live events on their smart devices. For such a dynamic context, our proposed architecture is shown in Figure 2. This figure highlights various important macroscopic components of project and provides an overview of project's technical components (or blocks)[2] as well as the required services.

The architecture depicted in Figure 2 consists of three main actors: filming person's terminal, the server and the client terminal (which can either be a spectator or an administrator). The actors are inter-linked via three control chains (explained below) based on the following processing data types: (1) real-time data: this data should be exchanged periodically between the actors. The examples of such data are the filming person's geo-location and the video stream (or multimedia). (2) Non-real time data: as the name suggests, this data should be exchanged without time constraint and it can be the comments sent to filming persons (e.g. move aside, change angle) and the description of event's program appearing at spectator's portable device (e.g. the music concert will start at 7pm).

A. Real-time chain

The objective of this chain is to ensure the transmission of multimedia flow from the filming person to the spectators via Zewall server. This real-time chain consists of six functional components as shown in Figure 2. The **multimedia** component allows the filming person to capture and transmit video and contextual data to the server. It includes all the functions of encoding, retrieval and contextual data aggregation. At the server side, the **multimedia retrieval** receives the real-time data (from **multimedia**) and performs de-packetization, decoding and synchronization functions. Note that, the reception characteristics such as availability of resources at server and the encoding format are received from the architectural component **real-time (or rt) data monitor** (see below). From **multimedia retrieval**, the flow of data is then transmitted to the **conversion** component. This block performs the processing of received streams in the form of transcoding, resizing and/or content modification. Then the data is transmitted to two components i.e., the **emission** and the **storage**. The former is used to send flows requested by the spectator and the latter allows the server to store the received data in order to use it later. At the spectator side, **multimedia display** block assures the reception and displaying of real-time data streams.

B. Control chain

The objective of this chain is to manage real-time data and control its transmission and reception. It consists of two functional components. The **multimedia control** 'located within filming person's terminal' sends control information (as per starting, pausing, termination, synchronization) to **multimedia** component as well as negotiating the diffusion characteristics of the filming person (such as the encoding format and the information of session initialization, pausing and termination) with the **rt data monitor** block at the server side. This latter manages the multimedia streams received from the spectators, receives the instructions (e.g., to terminate the flow of data) from the **administrator interface** (see below) and sends the instructions to the **multimedia retrieval** block.

C. Non real-time chain

This chain is to ensure the persistence and control of non-real time data and it consists of six functional components. The **filming person interface** allows the filming persons

[2] By a technical component, we mean an architectural element, providing interface between two main actors (e.g., the spectator and the server).

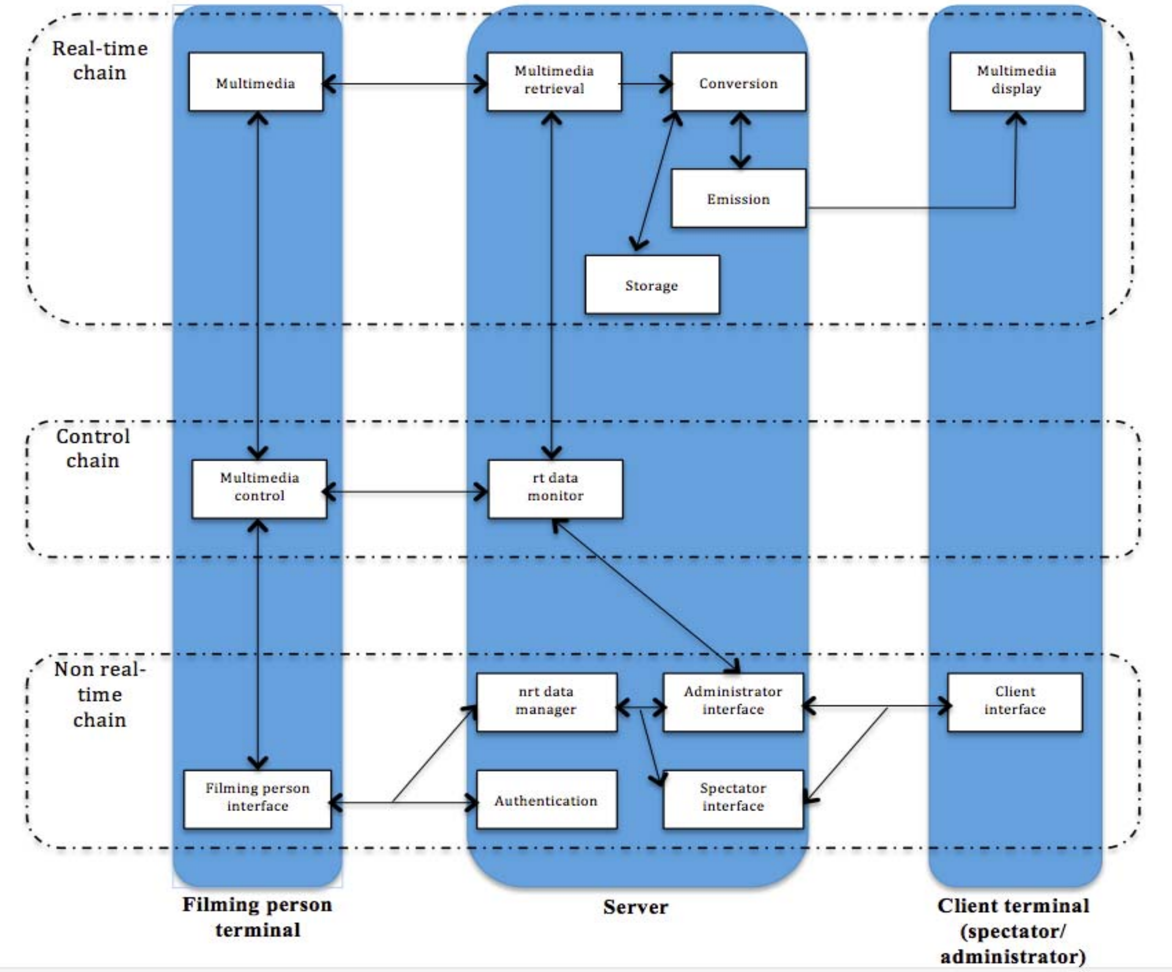

Figure 2. Zewall general architecture

identify themselves via login and password in order to access the Zewall platform (by connecting with the **authentication** block). It then receives the information from Zewall server's **non-real time (or nrt) data manager** block in the form of 'the description of live event's program'. **nrt data manager** receives instructions (e.g., ask the filming person to change its angle) from the **administrator interface** and the **spectator interface**. Both these interfaces receive their instructions from the **client interface**. They are also responsible for sending the non-real time information (i.e., the program of live event) to the **client interface** when a spectator connects to the Zewall platform. Further, the **administrator interface** has the ability to modify non-real time data e.g., it can make changes to the program by updating its timings and adding new sub-programs. It also sends instructions to the **rt data monitor** to start/stop the data flow.

IV. DISCUSSION AND PROJECT OUTCOMES

In this section, at first, we present the possible advantages of Zewall type service along with the novelties it brings to the users. Here are some of the points:

- Usage of real-time streaming, data aggregation and interactivity: unlike traditional web sites, the live video displaying of Zewall would attract a large amount of population interested in the closely localized regions. The aggregation of videos and contextual data is another important feature of Zewall service. Zewall also provides the possibility of having a real-time interactivity between spectators and filming persons, encouraging more and more people to use this service.
- Different use cases: another advantage of Zewall is its usage under different scenarios e.g., a local musical concert, a regional football match not broadcasted live on TV, etc. In addition, the spectators have the flexibility of viewing an event with several angles.
- Possibility of earning revenue via publicity: as already mentioned, Zewall is characterized as 'free for end-users' service, however it can generate revenue for the service providers via small level advertisements (referring to the example presented in Section II.A).
- Possibility of using standard solutions instead of proprietary ones: the detailed architecture of Zewall was designed by taking in account the standard

solutions/technologies available for the transmission of multimedia streams. By combining the benefits of LTE and HTML5, Zewall can be considered as an important service to be used in the near future over users personal handheld and smart devices.

- Compliance with regulatory filming and distribution rights: measuring the legal impact of real time video (creation, collaboration, dissemination, promotion, compensation, responsibility) is important to ensure that the rights and the obligations of each stakeholder are respected. We should also examine the legal issues concerning the Zewall project. Indeed, the tools which are available to broadcast and consume in real-time or communicate while broadcasting must abide by the existing legal rules. Those dealing with the access to contents, the right to one's image, the copyright and the management of personal data.

Project Outcomes

The Zewall service has already been tested on a small level as shown in Figure 3. This figure is taken in a room with limited equipment. Clearly, the video is been captured via an LTE enabled smartphone and broadcasted on a laptop and a television screen on real-time. Moreover, to implement Zewall at big commercial levels, two scenarios are envisaged:

1. **First** (mid-project) demonstration of Zewall was carried out in 'Brest[3]' during the famous sailing boat festival (tonners de Brest 2012). The 20^{th} anniversary of this event was celebrated in July 2012 making it ideal to perform the real-time implementation of Zewall project. This demonstration was conducted with a limited number of filming persons (i.e., 6) over an LTE network based platform known as 'ImaginLab'[4] (as already introduced in Section II.B). During 9 days, up to 82 hours of video were broadcasted to general public on open screens and Zewall website [12]. These videos were also shown to a specified number of spectators by providing them with the LTE-enabled smartphones. While broadcasting, we noticed that the average video duration was 426 seconds (with a maximum duration of 3976 seconds) and the average bitrate was 227 kbps (with a maximum value of 1779,3 kbps). This demonstration shows the efficiency and the robustness of Zewall architecture. However it was pointed out that the limited batteries of smartphones allow us to cover only an event with a small duration.

2. **Second** (and final) demonstration will be carried out at the end of 2013 by examining the pros and cons of Brest 2012 and performing architectural evolutions necessary to make Zewall a common service, available to the general public. The environment will be more open (like a football match) with many filming persons. This time, the spectators would be able to access the service on their own smart devices at any region they are located in. Moreover, our Zewall service will be built under the legal framework on which the collaboration between amateurs and professionals is based (such as what type of contract? What kind of compensation?) and the responsibility of various stakeholders (amateurs, editors, hosts).

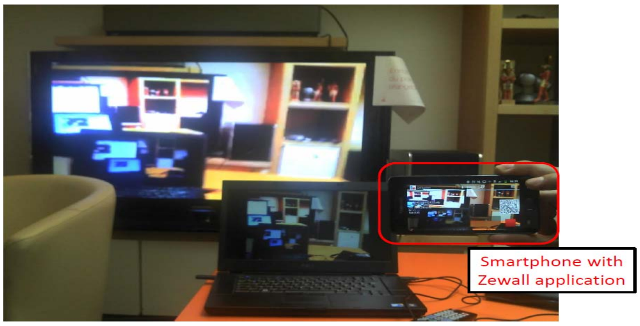

Figure 3. A small level demonstration of Zewall

V. PARTNERS

The partners of Zewall project are: France Telecom-Orange Labs (leader), Telecom Bretagne (academic), Le Télégramme, Nexcom, Niji, Saooti, ST Ericsson.

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[12] http://brest2012.zewall.eu/.

[3] Brest is a city in the Bretagne region of France.
[4] Imaginlab is a platform developed to test and implement future network applications and services. For details refer to [9].