MULTIMEDIA COMMUNICATIONS GROUP

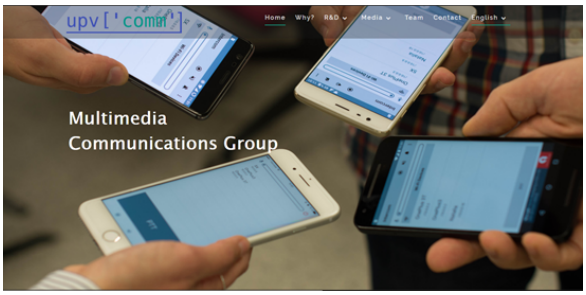
HEAD OF THE GROUP RESEARCH REPORT

Multimedia Communications Group (COMM) started its activities in 2004, and nowadays is composed of a group of 7 researchers, focusing its research lines on multimedia systems and Quality of Experience (QoE). During the last year 2017/2018 the group has continued with its work lines focused on the distribution of multimedia content using protocols like Dynamic Adaptive Streaming over HTTP (DASH); carrying out more in-depth studies into the Internet of Things (IoT) trend; developing new functionalities for multimedia systems based on DRM and cross-layer techniques; and continuing studying new trendy lines such as the integration of protocols for broadcast distribution.

These lines of action have been articulated through the execution of different research and development projects, as well as scientific publications. Among the new projects, we highlight the participation into the European project MAtchUP, in which COMM participates together with the GTAC group and other 27 partners.

In addition, in order to promote the main activities of the group, we have been continuously updating the webpage and we continue being very active in social networks (Facebook, Twitter and Youtube). Also, we have participated actively in initiatives carried out by iTEAM, such as scientific coffees and the first iTEAM Pills Contest, in which COMM was awarded by its video about DASH. Moreover, during the last year the head of the COMM, Juan Carlos Guerri, became a professor.

Following, the main results of the group are summarized, which are accessible through the COMM webpage (www.comm.upv.es).



Home page of the COMM website

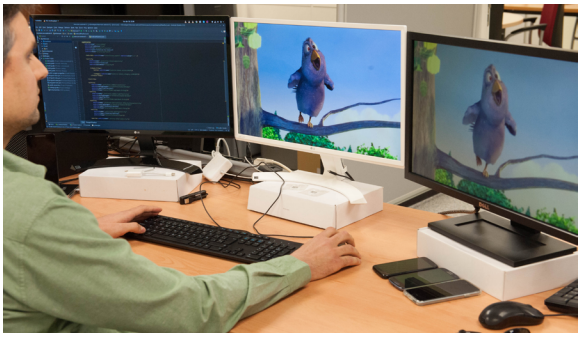
1.- PROJECT ACTIVITIES

The COMM has continued during the last year with its main research lines. Also, new emerging activities have appeared. A short summary of the main advances carried out is presented below:

Adaptive video through MPEG-DASH

One of the main research lines of this year has been the development and analysis of a new algorithm called Look Ahead, which takes into account the information of the size of the forthcoming segments. With our proposal, there is no need to encode videos with constant bitrate because clients will have the tools to choose the best quality that fits in its available bandwidth. To test the algorithm, we have implemented Look Ahead for the ExoPlayer library, the video player behind the YouTube app in the Android platform. Also, the proposed algorithm is compared to relevant algorithms existing in the literature, specifically the Müller and Segment Aware Rate Adaptation (SARA) algorithms as well as to the adaptive algorithm integrated into ExoPlayer. The comparison is carried out by using the most relevant parameters that affect the Quality of Experience in video playback services, that is, the number and duration of stalls, average quality of the video playback and number of representation switches. These parameters can be combined to define a QoE metric.

In this sense, another important research line in this year has been the analysis of metrics that help to calculate the quality perceived by users when consuming video contents. In this regard, we have proposed a new QoE metric based on the PSNR (Peak Signal-to-Noise Ratio) for the evaluation of adaptive bitrate (ABR) algorithms. The different evaluations carried out have proved that this PSNR-based QoE metric results more accurate than other similar metrics proposed in the literature.



Test for the evaluation of the Quality of Experience

Adaptive streaming for 3D video

During this year, different tests were performed to evaluate the behavior of an adaptive streaming system over HTTP and how it affects the quality of 3D video. For this purpose, different channels of transmission with variable bandwidth have been emulated using the NetEm tool, which allows to modify and restrict the server output bandwidth (also the delay or packet loss).

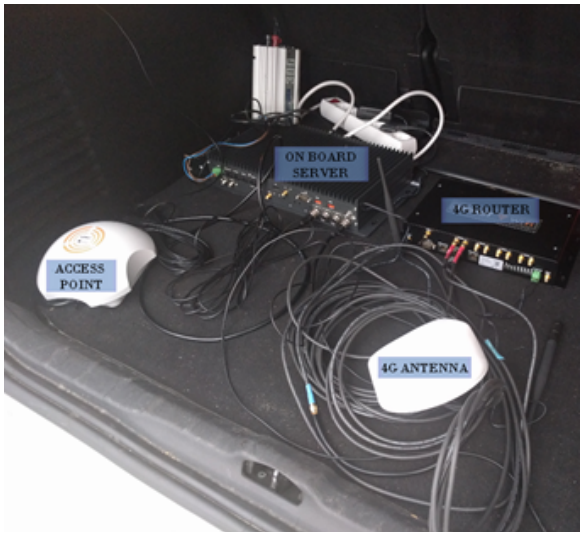
Understanding that objective evaluation techniques may not be sufficient to characterize a 3D video transmission system, in this year the work has focused on the design and implementation of subjective tests that allow assessing the performance of coding systems and 3D adaptive streaming video. The subjective tests also allow to validate the comparison between encoders (which was carried out previously) using objective quality parameters such as PSNR and Structural Similarity (SSIM). Currently, different subjective tests are being carried out. Also, we are working on a proposal that allows to establish automatically a relationship between the objective parameters of Quality of Service (QoS) and the QoE in adaptive 3D video streaming systems.

Video streaming over mobile wireless ad hoc networks

During this year we have kept on analysing and testing new routing algorithms in order to improve the QoE of the users. These routing algorithms work in a cross-layer manner, meaning that they can obtain relevant parameters from network and transport layers and take advantage of them in order to improve the quality of video flows. This is achieved by means of the adaptation of the video bitrate, either using scalable video coding or simply pre-encoded variants of the same video. In this line, we have started studying the MPEG SAND (Server and Network Assisted DASH) technology, which offers standardization messages and protocols in order to improve the user experience in the streaming service and to better use the bandwidth.

TV content transmission in mobility

This year we have implemented and evaluated a multimedia transmission system that sends TV/radio contents to vehicles in mobility. The system has mainly two blocks, one on the cloud and another on the mobile vehicle. On the cloud, a DVB (Digital Video Broadcasting) receiver obtains the TV/radio signal and prepares the contents to be sent through 4G. Specifically, contents are transcoded and packetized using the DASH standard. Vehicles in mobility use their 4G connectivity to receive the flows transmitted by the cloud. The key element of the system is an on-board proxy that manages the received flows and offers them to the final users in the vehicle. The proxy contains a buffer that helps reduce the number of interruptions caused by handover effects and lack of coverage.



Assembly of the TV content transmission in mobility over 4G system in a car

Internet of Things

During this year, the group has deepened in the field of Internet of Things, specifically in Smart Cities. The National Smart Cities Plan, within the Digital Agenda for Spain, is committed to helping local Spanish entities in the transformation processes towards smart urban areas. To this purpose, it is necessary the use of a package of tools designed to facilitate the transformation process as well as a catalog of ICT solutions. In this line of solutions we find FIWARE, an open software platform promoted by the European Union for the development and deployment of IoT services.

In our research group, during this year we have studied the components that allow the acquisition, the processing, the storage and the distribution of data within the framework of FIWARE, with the purpose of creating a pilot platform based on the FIWARE standards. This will allow the students of the IoT Classroom to develop their applications and simulate a connected city. In addition, this platform is useful for the research group to specialize in the integration of different devices to the platform, in the publication of open data and indicators, etc. In short, to be able to work as IoT integrators.

Reliable multicast transmission over communication networks

We have continued studying a protocol named ROUTE (Real-Time Object Delivery over Unidirectional Transport), which is considered the evolution of FLUTE (File Delivery over

Unidirectional Transport), a highly studied protocol by part of the research group. The ATSC (Advanced Television Systems Committee) published in 2016 a new candidate standard which proposes the jointly use of ROUTE and DASH. ROUTE, apart from the functionalities of the FLUTE protocol (such as multicast transmission of files), allows to provide video streaming services in multicast.

1.1.- ONGOING PROJECTS

Name of the project: Desarrollo de nueva plataforma de entretenimiento multimedia para entornos náuticos (CDTI TIC-20170102)

Summary of the project: The overall objective of the project is the definition and implementation of a new platform capable of supporting and providing real-time content distribution services and Internet access in an environment of high user density and high mobility, taking into account the complexity of the reception and signal transmission in maritime environments, in which there are usually connectivity problems so Internet access is only possible by satellite. The project started in July 2017. Since then, COMM has been responsible for the design of the architecture and the specifications. Also, COMM has implemented a DRM (Digital Rights Management) offline module that allows to play video contents without the need of having a permanent connectivity to Internet. Moreover, COMM has developed a system for the improvement of the Quality of Experience of users based on the transmission of video contents.

Funding entity: Ministerio de Economía, Industria y Competitividad. CDTI (Centro para el Desarrollo Tecnológico Industrial)

Name of the project: MAtchUP: MAximizing the UPscaling and replication potential of high level urban transformation strategies (774477, Call H2020-SCC-2017)

Webpage of the project: http://www.matchup-project.eu

Summary of the project: The project aims at strengthening the planning processes for urban transformation, consolidating the benefits of deploying large scale demonstration projects of innovative technologies in the energy, mobility and ICT sectors, by means of substantially improved models for replication and upscaling, based on impacts evaluation, and ensuring the bankability of the solutions by means of innovative business models, which lead to achieve real deployment further than the pilots carried out in the lighthouse cities. With this, it is sought a high penetration of the validated technologies in those cities less prepared to adopt very innovative solutions and formalize it in a standard commitment, accompanied by capacity building strategies, to guarantee at least medium term implementation. The project started in October 2017, with an expected duration of five years. COMM focuses on actions related to ICT. During this year, the detailed design of the interventions to be implemented in Valencia is being prepared. The design includes technical descriptions, financial plans (including the structure of business models of each individual action), social strategies and citizens' engagement.

Funding entity: European Union's Horizon 2020 Research and Innovation Programme

Meeting of the MAtchUP project in Antalya (Turkey)

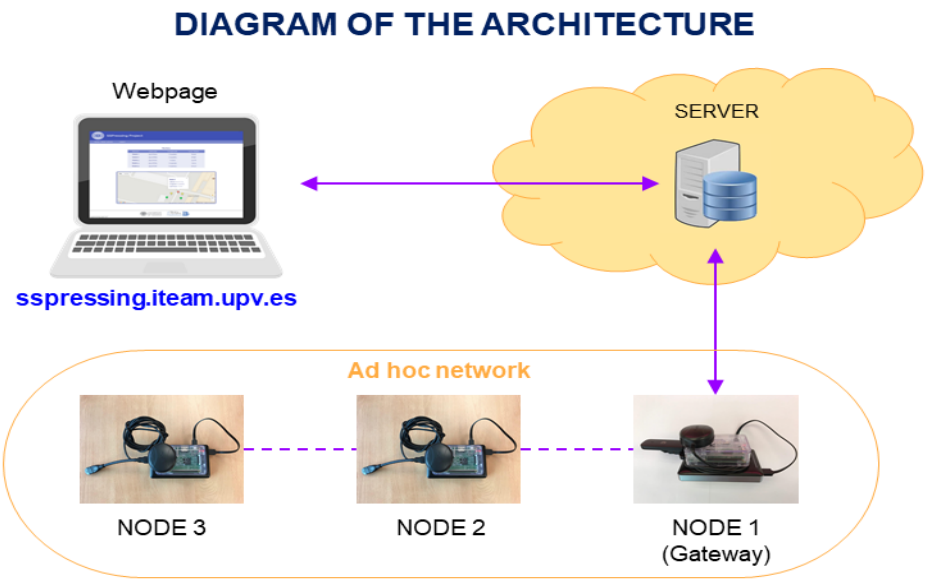
Name of the project: SSPressing - Smart Sound Processing for the digital living (TEC2015-67387-C4-4-R)

Webpage of the project:

http://sspressing.upv.es

Summary of the project: The project performs systems for analysis and synthesis of environments and sound scenes in an "intelligent" and computationally efficient way through network acoustic nodes. Specifically, the following objectives/developments are addressed: conformation of interactive virtual sound environments with distributed multinode control systems, creation of interactive virtual sound scenes and analysis of sound scenes for detection, location and classification of events and scenes, and development of systems to aid hearing and improve intelligibility. In the second year of the project, regarding the management of the communication network, the functionality of the ad-hoc network has been improved. Specifically, now sensors are able to record audio, doing the feature extraction and transmitting this value to the server throughout the ad hoc network. The server then receives the feature extraction from the sensors and runs the classifier, showing the classification results for each interval of time and sensor at the project webpage: https://sspressing.iteam.upv.es.

Funding entity: Ministerio de Economía, Industria y Competitividad (Programa Estatal de I+D+i orientada a los Retos de la Sociedad)



2.- RESEARCH RESULTS

2.1.- FEATURED PUBLICATIONS

- *Distributed sensor network for noise monitoring in industrial environment with Raspberry Pi.* N. Blasco, M. de Diego, R. Belda, I. de Fez, P. Arce, F. J. Martínez-Zaldívar, A. González, and J. C. Guerri, in Proc. of the Int. Conf. on Intelligent Systems and Applications (INTELLI-IAP), Nice (France), Jul. 2017, pp. 51-55.

Monitoring the noise in working places is essential to protect the health of workers. Two main factors must be taken into account, and thus controlled, when considering noise exposition during the working hours: level of perceived noise and time exposed to that noise level. In industrial environments, these factors represent a high priority due to the quantity of equipment inside the factory. We present a low cost system to measure and monitor noise conditions in an industrial environment. The proposed solution is based on ad hoc wireless probes and a server in the cloud, which acts as a centralized data sink. The proposed system helps to detect critical levels of noise for workers sending warning messages to predefined contacts by means of a text message or email when hazardous situations occur.

- *Evaluación de un sistema DASH para el streaming de vídeo 3D.* P. Guzmán, P. Arce, and J. C. Guerri, in Proc. of Jornadas de Ingeniería Telemática (JITEL), Valencia (Spain), Sep. 2017, pp. 224-228.

With the consumption of high definition content that becomes the main trend, we can once again observe an increase in the consumption of 3D content. This has made the topics related to content production, coding, transmission, Quality of Service (QoS) and Quality of Experience (QoE) perceived by users of 3D video distribution systems a subject of research with numerous contributions in recent years. As part of this work, a comparison of the performance of the most popular video coding standards H.264, H.265 and their corresponding extensions for 3D video has been made in the first place. On the other hand, an experimental evaluation of the video quality received in an HTTP adaptive streaming (DASH) 3D video scene has been carried out.

- *Look Ahead: A DASH Adaptation Algorithm.* R. Belda, I. de Fez, P. Arce, J. C. Guerri, presented at the IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, Valencia, Spain, Jun. 2018.

This paper proposes a video quality adaptation algorithm based on the Dynamic Adaptive Streaming over HTTP (DASH) standard for on-demand video services. When a video is encoded with constant quality, the resulting bitstream has variable bitrate due to the inherent nature of the video encoding process. The proposed algorithm, called Look Ahead, takes into account this bitrate variability in order to calculate, on the fly, the appropriate quality level that minimizes the number of interruptions during the playback. Moreover, the Look Ahead algorithm has been implemented and integrated into ExoPlayer v2. The proposed algorithm is compared to the Müller and Segment Aware Rate Adaptation (SARA) algorithms as well as to the adaptive algorithm integrated into ExoPlayer. The comparison reflects that Look Ahead outperforms the Müller, SARA and the ExoPlayer adaptive algorithms in terms of number and duration of video playback stalls, with hardly decreasing the average video quality.