Foreword

MEDIA STREAMING, MOBILE DEVICES AND RELATED SERVICES

The media streaming and the mobile devices are two research and development areas that are in constant change. The link between them is the mobile and wireless networks that are used to communicate the mobile devices naturally. The combination of mobile devices and media streaming leads to very interesting mobile multimedia services and new business models.

In Spanish starting a sentence with the expression "Three words …" means the writer wants to present only the main ideas and starting points to readers that allow them to seek more information. In this sense we have titled our first sections starting by this Spanish expression. The objective is to write a short foreword about the things the reader can find in this book.

"THREE WORDS" ABOUT MEDIA STREAMING

Streaming. It is difficult to understand technical concept for novice researchers and under-graduate students. *Media Streaming*. It is a difficult to understand technique that is not always understood in their precise sense. Let us write "three words" about this.

Streaming is related to the theoretic concept of System Theory named *overlapping* of concurrent atomic actions. An atomic action is the one that starts, executes and finishes with no interruption of other action. That is, it is observable and is the one that occurs in a given interval of time. Concurrent atomic actions can occur in different parts of a system at the same time and independently. For example, one shop assistant is shelling tomatoes (action one) while another one is reading the bill of a buyer (action two). The system is the shop where the shop assistants are and a person outside the shop can see these two concurrent actions. The overlapping means the instants of time when the actions start (execute and finish) is not the same. But after their starting instant of time there is an interval of time when they can be simultaneously observed. It is easy to realize that a network of devices is a system in which these overlapping occur for every instance of time. Readers interested in full understanding of Streaming technique can read several works. As an example we mention the following: For instance, Rodriguez and Campelo (2003) hid the memory latency in front of the processor speed, Chan and Wong (2005) overlapped actions in the Job-Shop Scheduling problem, Kang and Zhou (2007) hid the latency of Web page's objects communication, Padmanabhan and Lily (2009) hid the latency of communication among parallel processors and Sharanya and Matthew (2009) efficiently used bandwidth in wireless sensor networks.

Now is the turn to explain Media Streaming. In few words, Media streaming is the application of Streaming technique to *Streams*. But what is a Stream? Brownlee and Claffy (2002) defined a Stream as an "individual *Internet Protocol* (*IP*) session between ports on pairs of hosts". English dictionary defines Stream as "*narrow river*". Informally, Stream can be defined as a set of data packets that flow in the path between an origin node and a final node (extreme to extreme). The overlapping of communication actions (in the links) and processing actions (in the intermediate devices) is clear and natural. Thus, *Media Streaming* is the overlapping of the processing of the information pieces in the hosts (terminals) and the communication of their associated streams in the network. Austerberry (2005) presented an understandable introduction to the typical architecture of video and audio streaming system. Rao and Bojkovic (2006) did a high quality review of media streaming, discussed a very interesting wide vision of current research topics in media streaming and presented different network architectures, protocols, coding and *Quality of Service* (*QoS*) mechanisms. Media Streaming is the key technique to implement multimedia services in actual networks.

Several indicators have shown that video streaming is well implanted in Information Society: First Erman and Gerber (2009) showed that the usage of the *HiperText Transfer Protocol* (*HTTP*) to distribute multimedia content exhibited an 83% annualized growth rate. Second, recent statistics showed streaming traffic surpasses *Peer-to-Peer* (*P2P*) traffic in Internet. Third, streaming was the key technique to implement multimedia services on broadband Internet (Esaki & Sunahara, 2008). Lastly, a *Publish*/*Subscribe* architecture of Internet is proposed by Katsaros and Fotiou (2009). Furthermore, video streaming has had important consequences in Enterprise 2.0 (Tuten 2008). These consequences have forced video streaming to meet some technical and QoS requirements (Xipeng, 2008). Zhu et al. (2011) have recently edited a book on media streaming.

The future of multimedia services is linked to streaming technique. Moreover, the implementation of streaming technique in wireless networks is challenging. This book contributes to this research topic reviewing and presenting research and telco companies' works.

OTHER "THREE WORDS" ABOUT MOBILE DEVICES

Wireless communications and mobile devices are also well implanted technologies in Information Society (Pagani, 2005). Currently, mobile manufacturers offer high-end mobile telephones with on chip *Wireless Network Interface Cards* (*WNIC*) like Bluetooth, *Wireless Fidelity* (*WiFi*), *Global Positioning System* (*GPS*) and *Third Generation* (*3G*) Wireless networks. Mobile operators have improved their networks to facilitate the access to *Video on Demand* (*VoD*) servers (Qadeer & Ahmad, 2009). Their objectives have been to stay competitive, to offer better and more cost-efficient provisioning of old services as well as new services (Dahlman & Parkval, 2007), and to satisfy the user requirements (Pagani & Schipani, 2005). Savo (2006) identified some general challenges that must be taken on to satisfy those user requirements. On the one hand, the dynamic adaptation of the wireless channel and *Medium Access Control (MAC)* protocol to the number of active users in a wireless *Access Point* (*AP*). On the other hand, the design of routing algorithms, transport protocols, security procedures and mobility management. Apostolopoulos and Trott (2005) remarked that the efficient implementation of wireless video streaming service presents some important differences as compared to other services. Verkasalo (2009) studied the access pattern of European users to multimedia services and concluded that video streaming technique implementation in mobile networks, in the years to come, must be improved to provide a good user experience.

Last years have seen an explosion of wireless mobile devices available in the market. All of them are allowed to communicate using the above wireless technologies. Among the recent devices are: e-readers, video consoles, intelligent cars, intelligent cameras, ultra small portable computers and the smart phones. The evolution in the hardware of smart phones (also other mobile widgets) include high performance processors, memory and codec support. Several companies have launched their own version of the desktops operating systems for these devices (*Windows Phone, iOS, Linux* (*Android*)). The success of these operating systems is high and is the responsible of selling a big amount of devices in the last year. *Android* devices (netbooks, smart phones and tablets) have a high volume market. This heterogeneity in the implementation of mobile devices has provoked a problem with the design of multiplatform software (the iOS versions of software must be adapted to Android devices). This heterogeneity also influences the design and implementation of streaming protocols appropriated for these devices. Main companies that dominate the market with their proprietary versions of Streaming servers (*Windows Media Server* (generally included in the *Windows Server* operating system), the *RealNetworks Media Server*, the *Darwin Streaming Server* (*Apple*) and the *Adobe Flash Media Server* (Sanders, 2008)), have serious competitors: free software and open source projects like *VideoLAN* and *Openflash*. Also the above heterogeneity is a problem for the implementation of a standard protocol for streaming. Traditional version, *Real Time Streaming Protocol* (*RTSP*) (and its variation *Real Time Multimedia Protocol* (*RTMP*)), have a serious competitor: the *HiperText Transfer Protocol* (*HTTP*) that is adapted to issue the streaming to mobile devices. An additional remark is that the success of media streaming is due in part to the increase usage of Internet videos and well known Web sites. That could provoke the massive use of adapted versions of HTTP in the next recent future.

This book contributes to this state of the art presenting some works in this direction in order to analyze the challenges and solutions of several authors.

MOBILE MULTIMEDIA SERVICES

Some recent works include improved mechanisms for mobile multimedia services. We will briefly comment on some of them.

Frossard and Martin (2008) presented multiple paths routing algorithms to take advantage of the structure and organization of the network to efficiently deliver video packets from the VoD Server. Buyya and Pathan (2008) argued in favor of proxy caching, *Content Distribution Network* (*CDN*) and *P2P* paradigms to alleviate two bottlenecks: the VoD Server scheduling and load balancing. Bruneo and Iellamo (2009) argued that Grid Technology reports better results than CDN and P2P. Man-Fung and Chan (2007) considered mobile telephones to access a broadcast TV Server using 3G. These mobile telephones re-sent the TV signal to other mobile telephones using ad hoc WiFi or Bluetooth WNIC. But they neither considered the power consumption nor possible service disruptions in the ad hoc network. Shorfuzzaman and Eskicioglu (2009) analyzed efficient multicast of video streaming for heterogeneous devices (portable computers and Personal Digital Assistants (PDA)) using in-network trans-coding in the network edges and network processors in the routers' WNIC. But current and upcoming high-end mobile telephones and portable computers have powerful processing hardware to efficiently implement transcoding. Bolla and Mangialardi (2009) proposed the adaptation of *Real Time Streaming Protocol* (*RTSP*) to solve access problems of nomadic users. For instance, if the mobile device of the nomadic user changes its IP address, the VoD Server will terminate the streaming session, thus the mobile device starts a new session from scratch with its new IP address.

At the beginning of the twenty-first century the three dominant multimedia services were on line learning (Kurbel, 2003), telemedicine (Murthy & Krishnamurthy, 2004) and m-commerce (Ghinea & Angelides, 2004). Ten years later there is a constellation of services based on video streaming. Examples of very recent research efforts are mobile interactive *Television* (*TV*), wireless video sensors, multiparty audio conferencing (Zhang & Mao, 2008), multicast mobile services in 3G (Rümmler & Gluhak, 2009) and others reviewed in Section 6.9 of (Sauter, 2009). The following is a brief description of recent services:

- *Mobile e-learning*. Learning administrative tools like *moodle* and others more specialized: *e-aula*, *Claroline* and *Manhattan* allow VoD from mobile telephones. Some universities expose the lessons of their star professors in *youtube*. Learning enhanced by technology (Cycon & Schmidt, 2009) is named *Mobile learning* or *seamless learning* or *ubiquitous learning* (Druin, 2009). It allows students to collaborate, on learning topics and tasks, in any time and place using video based dialogs.
- *Media streaming in e-commerce*. Information transmission of digital goods and decision-making (video meeting, real-time surveillance, information services …) can be improved by video streaming technique as indicated by Hou and Xia (2008).
- *Video and music sharing applications*. A user of a *Mobile Social Network* (*MSN*) interacts with each other exclusively using a mobile telephone (Dong & Song, 2009). Silva and Salgado (2006) explained that a *WirelessSpontaneous Network* (WSN) allows the members of MSN to share music and video when they physically meet. Examples of MSN are *JuiceCaster* and *MocoSpace*. A step ahead is the demonstration that a mobile user can cooperate using a WSN to form cooperative groups (Grob & Kuhn, 2009).
- *Podcasting, vodcasting and broadcatching*. A mobile streaming Client can download an audio stored file (*podcast*) or a video stored file (*vodcast*) using a Web interface and *Really Simple Syndication* (*RSS*). Less common for mobile telephones (also MP3 or MP4 gadgets) is to use RSS and P2P technology (*Broadcatching*) to download music or video stored files.
- *Mobile P2P TV and Mobile Interactive TV*. Mobile telephones use 3G or WiFi to access the Internet P2P mobile TV service (Bruns, 2009). But this service is not exempt of inefficiencies (Wu & Li, 2009). The *Justin.tv* and *current.tv* companies follow the *youtube* model. The *Mobile Streaming Live Broadcasting Service* (*Mobile Interactive TV*) is still in its infancy; however some initiatives have appeared recently. For instance, the *Qik*, *Kyte*, *Upstream.tv* and *FlixWagon* enterprises implement a *publish*/*view* model of mobile video. It exhibits very short times between the publication and the viewing (quasi-interactive service).
- *Multimedia Collaborative Web Servers Applications*. Yankelovich and Horan (2009) thought *Voice Over IP* (*VoIP*) and video streaming should augment the quality of the cooperation among users of a Collaborative Web Server Applications. Current high-end mobile telephones use such applications naturally.
- *Universal Plug and Play Media Server*. Examples of this kind of Server are *TVMOBiLi*, *FreeNAS* and *FUPPES*. Moreover, there is a galaxy of free media servers adapted to specific home gadgets and gaming devices. An additional requirement is they must be *Digital Living Network Alliance (DLNA)* compliant. The mobile telephone can act as a *Control Point* (Client) for these media servers. For instance, *Windows Mobile*, *Symbian*, *iPhone* and *Android* have compatible clients for some of these servers.

Foreseeable niches for streaming technique based multimedia services could be wireless gaming, medical tele-care, on line learning and home networking (Dixit & Prasad, 2008; Panton, 2008).

"THREE FINAL WORDS" ABOUT TECHNOLOGY INNOVATION SYSTEMS

Sometimes the word innovation is confusing. We have heard people confusing innovation and research on one hand and innovation and creativity on the other hand. But innovation is not research and also innovation is not creativity.

Let us write some things about innovation and its relation with research and creativity.

Creativity is the motor of Research. That is, a researcher could be involved in the solution of a particular challenge during long time. That researcher could consult a lot of solutions and understand them perfectly. Probably, they could be put into practice. But a new solution needs necessary the researcher has certain grade of creativity. Without creativity no new solution can arise. The process the researcher has done is named Research. That it, the researcher discovered a problem (sometimes the discovery also needs creativity), then the researcher studies its importance and solutions and finally he/she will present the best solution. It is important to remark that usually, the researcher seeks for the best solution (in Basic Research, the amount of time employed in finding the best solution is not the critical factor to have success in the research process). A lot of research results are written and never will be implemented and transferred to the technological market. Innovation means that exactly. Innovation is the process by which the research results are implemented in the Industry.

The development of an Innovation system in technological industries is very important. That is, a well-tuned innovation system could allow a particular company to improve its product and gain a competitive advantage (over other companies). That is the reason why a lot of big companies have their own research and innovation departments. In those departments there are experts in research and expert in innovation (a better option is to involve all the employees in innovation as important and famous enterprises do currently). An innovation system does not seek for the best improvement of products: it seeks economic productivity. It has a certain amount of time to put the improved product in the Market. We think it is very important to review research works done in the University or research centers but also to present works from the Industry. We think this because the well-tuned research (University) and innovation (Industry) will produce the best for the Information Society in which we are living.

After reading the above paragraphs, the reader perhaps could understand better why we have included in this book some works from the Industry and other works from research center (located at universities mainly). In our case it is important to understand both types of works in order to generate new multimedia services and mobile devices.

Alvaro Suarez Sarmiento
University of Las Palmas de Gran, Spain

Elsa Macias Lopez
University of Las Palmas de Gran, Spain

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