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TOWARDS TO MULTIMEDIA ACROSS WIRELESS

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This paper seeks to provide some contributions concerning multimedia across wireless. After short review of the importance of multimedia communication including audio/visual integration, a solution for wireless audio/visual communication is proposed. The second part of the paper deals with universal multimedia access concept over wireless systems. It includes technology overview, as well as the open research questions. Universal multimedia access gives the basic for the future efficient multimedia communications.

K e y w o r d s: multimedia communication, mobile networks, universal multimedia information access

1 INTRODUCTION

Multimedia communication is the field referring to the representation, storage, retrieval and dissemination of machine processable information expressed in multiple media, such as: text, image, graphics, speech, audio, video, animation, handwriting, data files. With high capacity storage devices, powerful and yet economical computer workstation and high speed integrated services digital networks providing a variety of multimedia communication services is becoming not only technical, but also economically feasible. In addition, the broadband integrated services digital network (BISDN) has been given special attention as a next generation communication network infrastructure which will be capable of transmitting full motion pictures and high speed data at 150 and 600 Mbits/s, and voice as well as data [1].

Multimedia best suits the human beings complex perception, communicating behaviors as well as the way of acting. Applications in medicine, education, travel, real estate, banking, insurance, administration and publishing are emerging at a fast pace. These applications are characterized by large multimedia documents that must be communicated within very short delay [2].

Trends towards multimedia communication are represented in Fig. 1.

The new BISDN application system as a result of multimedia processing by workstations can be represented as shown in Fig. 2.

This work seeks to provide multimedia communication model, user and network requirements, as well as brief description of audio/visual integration. In the second part of the paper, we will deal with multimedia across wireless, including audio/visual solution for wireless communications, speech and video transmission using Global System for Mobile (GSM), taking into account wireless multimedia delivery. The final, third part provides universal multimedia information access concept over wireless systems.

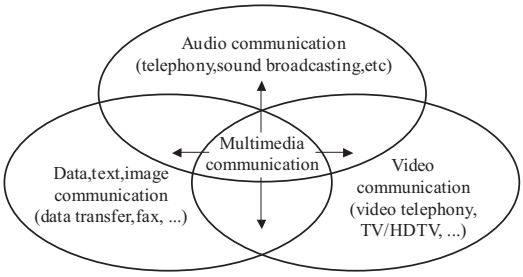

Fig. 1. Trends towards multimedia communication.

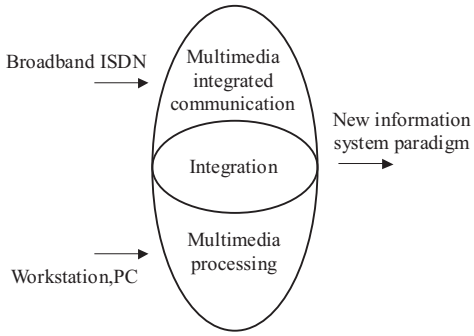

Fig. 2. Integration of multimedia processing and multimedia communication.

2 MULTIMEDIA COMMUNICATION MODEL

The multimedia communication model is strongly influenced by manufacturer- dependent solutions for personal computers and workstations, including application software on the one hand, and by the intelligent network concept on the other. A layered model for future multimedia communication comprises five constituents:

- partitioning of complex information objects into distinct information types for the purpose of easier communication, storing and processing,

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Table 1. Context in which multimedia services can be used

	Local	Remote noninteractive	Remote interactive
Residential	Leisure (TV) The arts Teaching Games ...	Broadcasting	Enhanced telephones Videophones Home shopping Games Remote consultation Video on demand
Mobile	Presentation Demonstration ...	Broadcasting Remote security Monitoring	Project management Contract negotiation ...
Business	Multimedia presentation Training Database consultation ...	Teleinformation Teletraining Telesupervision	Video meeting Videoconferencing Distance learning Project management Remote security Monitoring Remote diagnostic

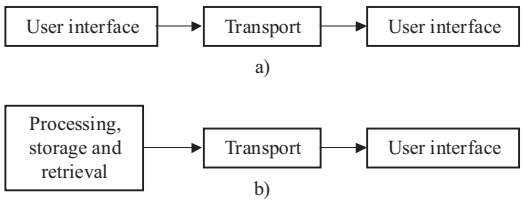

Fig. 3. Elements of multimedia systems: a) person-to-person communications, b) person-to-machine modes.

- standardization of service components per information type, possibly with several levels of quality per information type,
- creation of platforms at two levels: a network service platform, and a multimedia communication platform,
- generic applications for multiple use,
- specific applications: electronic shopping, teletraining and remote maintenance, the multimedia communication platform, as well as including general applications.

There are two key modes in which multimedia systems are used:

- person-to-person communications, and
- person-to-machine communications.

Both of these modes have a lot of commonality as well as some differences. For example, in the person-to-person mode, user interface provides the mechanisms for all users to interact with each other and a transport layer (teleconferencing, videophones, distance learning, shared workspace scenarios). The user interface creates the multimedia signal and allows users to interact with the multimedia signal. The transport layer preserves the quality of the multimedia signals, so that all users receive what they perceive to be high-quality signals at each user location [3].

On the other side, in the person- to-machine mode, there is again a user interface for interacting with the machine, along with a transport layer moving the multimedia signal from the storage location to the user, as well as mechanism for storage and retrieval of multimedia signals that are either created by the user, or requested by the user (creation and access on business meeting notes, access broadcast video and document archives from digital library or other repositories). The storage and retrieval involve browsing and searching to find existing multimedia data. Also, storage and archiving in order to move user created multimedia data to the appropriate place for access by others.

A number of key requirements are common to the new multimedia services, like instant availability, real-time information transfer, service always on- line, users should be able to access their services from any terminal (mobile point of delivery). Multimedia applications have several requirements with respect to the service offered to them by the communication system. These requirements depend on the type of the application and on its usage scenario which influences the criticality of the demands [4].

3 USER AND NETWORK REQUIREMENTS

From a user's point of view, the most important requirements of multimedia communications are:

- fast preparation and presentation of the different types of interest, taking into account the capabilities of available terminals and services,
- dynamic control of multimedia applications with respect to connection interactions and quality of demand combined with user-friendly human/machine interfaces,

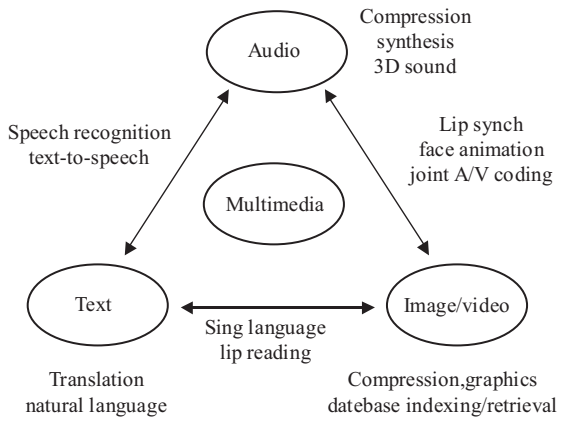

Fig. 4. Media interaction.

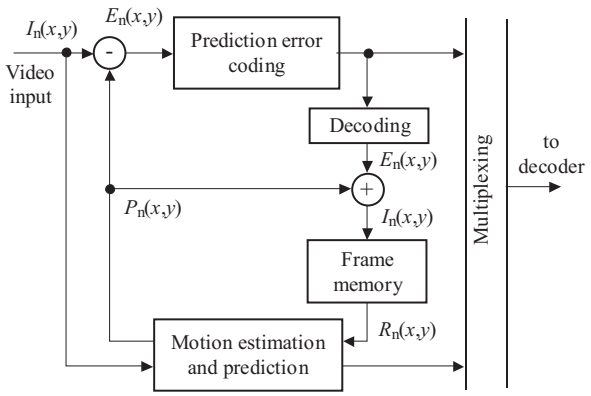

Fig. 5. Block diagram of the mobile video encoder.

- intelligent support of users, taking into consideration there individual capabilities, and standardization.

From network point of view, the most important requirements of multimedia communications are:

- high speed and changing bitrates,
- several virtual connections over the same access,
- synchronization of different information types,
- suitable standardized services and supplementary service supporting multimedia applications.

Context in which multimedia services can be used is presented in Table 1.

Service usage conditions can be defined by their use, place independence and degree of urgency. The requirements of applications regarding the communications services can be defined into traffic and functional requirements.

The traffic requirements include transmission bandwidth delay and reliability. They depend on the use kind, number and quality of the data streams. The requirements concerning traffic can be satisfied by the use of resource management mechanisms. The functional requirements are multicast transmission and the ability to define coordinated sets of unidirectional streams. A key requirement is that same high quality network services should exist when building integrating networking platforms for voice, data and multimedia services.

4 AUDIO/VISUAL INTEGRATION

A recent trend in multimedia research is to integrate audio and visual processing in order to exploit such interaction. We also exploit the interaction among different types. Using speech recognition technology, one can analyze speech waveforms to discover the spoken text. From the sentence of text, a talking head audio/visual sequence can be generated using computer graphics to animate a facial model. Also, text-to-speech synthesis to provide synthetic acoustic speech can be used. From the point of view audio/visual integration, topics which are in research progress include: automatic lip reading, speech driven face animation, speech assisted lip synchronization, facial-feature tracking, audio/visual mapping bimodal person verification and joint audio/video coding.

Media interaction is shown in Fig. 4.

As it can be seen, media are categorized into three major classes: textual information, audio including speech and music, image and video. The goal of speech recognition is to enable a machine literally to be able to transcribe spoken inputs into individual words. Another set of applications of speech recognition technology is the so-called spoken language understanding systems, where the user is unconstrained in terms of what can be spoken. A good example of utilizing audio/visual interaction for human speech communication is lip reading, also referred to as speech reading. Lip synchronization is one of the most important issues in videotelephony and videoconferencing. The improvement in multimedia interaction can be obtained by using joint audio/video processing compared to the situation where audio and video are processed independently [5].

5 MULTIMEDIA ACROSS WIRELESS

Wireless in multimedia communications requires medium-to-high bitrate channels (64 kb/s to 2 Mb/s per user). Broadband wireless networks that support bitrates in access of 2 Mb/s per radio channel are necessary. Multiple users or sessions could share each radio channel. We have to address the following key issues, i.e. how to increase the capacity of wireless channels, how to provide quality of service (QoS) in a cost-effective way, and how to combine the wireless channel impairments. Audio, video and graphics need to be compressed before transport across a bandwidth constrained wireless channel. Scalable compression schemes that offer graceful degradation with loss of data have become popular. Even with scalable and multiple description-based service coding schemes, there will still be lost data on wireless systems [6].

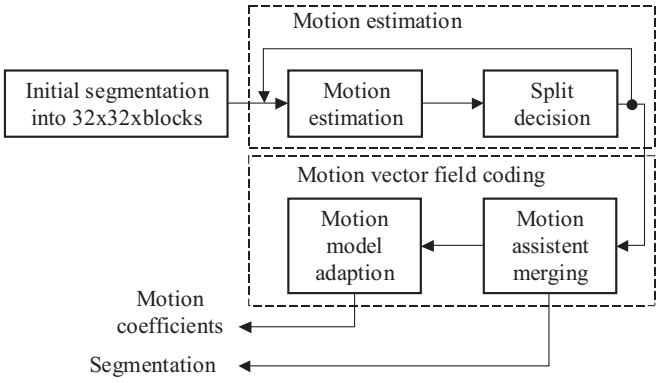

Fig. 6. Block diagram of the mobile video motion field estimation and encoding.

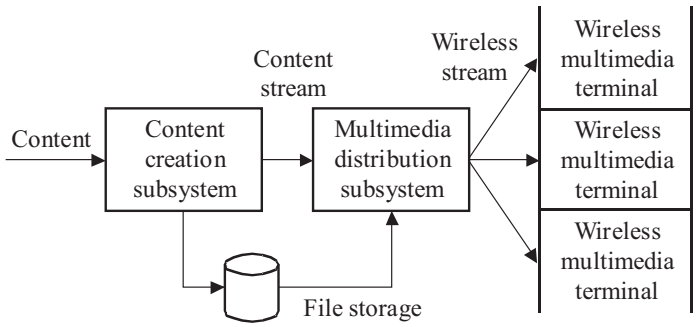

Fig. 7. Wireless multimedia network system.

5.1 Audio/visual solution for wireless communications

In the area of wireless audio, the focus has been on the development of speech coding solutions for codeless systems, cellular telephony services and emerging personal communication services. In particular, compressed image and video signals can experience severe degradation, if transmitted across error- prone channels. This is due to the use of variable length coding (VLC) in compressed bitstream, as well as due to the development of prediction-based coding needed for eliminating both spatial and temporal redundancies in the original signal. Also, channel errors affecting a VLC could result in a loss of synchronization at the decoder.

Using Global System for Mobile (GSM) at least two clear trends can be seen, i.e. the basic speech service is developing with enhancement in quality/ capacity performance, and the available data rates are increasing making live video transmission and multimedia realistic.

5.2 Speech transmission in GSM

There are two different standardization items concerning speech transmission in GSM: the enhanced full rate (EFR) codecs and the adaptive multirate (AMR) codecs. The EFR codec uses a 12.2 kb/s rate for speech coding and 10.6 kb/s for error protection adding up to the GSM full rate channel total of 22.8 kb/s. It provides wire line quality for the most typical error conditions, and for background and mobile-to-mobile calls. The algorithmic delay of the codec is 20 ms, while the computational complexity is within 1.5 to 20 millions of instructions per second.

The AMR codec would operate in full rate (22.8 kb/s) and half rate 11.4 kb/s channels using multiple bitrates and adapting the source coding and channel coding bitrates according to the estimated quality of the radio channel.

5.3 Video across GSM

In general, the mobile video coder has same operating principles as most other compressed video coders.

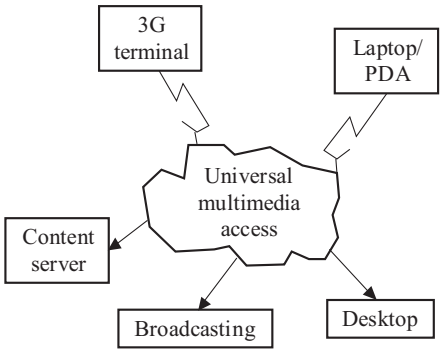

Fig. 8. The universal multimedia access concept.

An example of block diagram of the mobile video encoder is shown in Fig. 5, while block diagram of the mobile video motion vector field estimation and encoding is shown in Fig. 6. As it can be seen, it consists of two blocks: motion estimation and motion vector field coding. Split decision is joint to motion estimation, while motion vector field coding block has got motion assisted merging and motion model adaptation. Motion assisted merging is responsible for segmentation, while motion model adaptation is responsible for motion coefficients.

Real time video across cellular phones requires error resilience enhancement both to the system level and video codec.

5.4 Wireless multimedia delivery

New mobile services could include the delivery of news, whether stock and sports updates to mobile users. Streaming multimedia (SMM) application, includes both on-demand and live streaming using voice and video as the primary media types [6]. The components of SMM include: content creation subsystem, multimedia distribution subsystem and wireless multimedia terminals. Fig. 7 shows wireless multimedia network system.

Content creation subsystem generates content, which is distributed to users by multimedia (MM) distribution servers and displayed by wireless terminals [7]. The job of multimedia distribution server is to stream live or stored content to wireless MM terminals. It can also manipulate or repurpose content. The role of wireless multimedia terminal is to receive streamed multimedia content from the multimedia distribution server and displayed to the user. The content may be either live or on the demand.

6 UNIVERSAL MULTIMEDIA INFORMATION ACCESS OVER WIRELESS SYSTEMS

Universal multimedia access (UMA) deals with the delivery of images, video, audio and multimedia content under different network conditions, user and publisher preferences and capabilities of terminal devices. A major motivation behind UMA is to enable terminals with the limited communication; processing, storage and display capabilities to access reach multimedia content. UMA will enable users to access to future services independently on their choice of access technology, terminal equipment and usage preferences. Furthermore, 3G mobile management systems will perform effectively with the quality of service and authentication, authorization and accounting (AAA) of the end-to-end network to verify the users identities and rights, as well as to insure the QoS requirements providing a seamless end-to- end service to the user.

6.1 Universal multimedia information access concept

Universal multimedia access concept is multidisciplinary, involving multimedia signal processing, digital communications, radio systems and telematics. This concept covers the universal access to multimedia information through the complete system and is shown in Fig. 8.

Network operators and service will be able to tailor content from original servers with possibly widely varying characteristics and different network access communication links. To enable full exploitation of the envisaged smart content, new or modified protocols are required.

Existing protocol mechanisms are available wherein mapping can be determined between applications the user terminal devices, and network requirements.

ITU H.323 protocol provides a foundation for multimedia communication across Internet Protocol (IP) — based networks. It is designed to run on top of common network architectures. Namely, it encompasses terminals, gateways and multipoint control units.

The Session Initiation Protocol (SIP) developed by Internet Engineering Task Force (IETF) is an application layer control signaling protocol for creating, modifying and terminating multimedia sessions. The mapping and negotiation is usually established during connection setup and remains through the life of a connection. SIP provides the capability to change the parameters of an existing session. The performance depends on stochastic, dynamic variations of channel characteristics: errors, delay, jitter and network congestion.

Currently, two signaling protocols for Internet telephony and multimedia conference exist: H.323 and SIP. SIP is more appropriate protocol for multimedia call control over wide area network (WAN) then H.323, since SIP is a lightweight, transparent, independent and text-based protocol. Also, SIP is well suited to provide interoperability not only between clients and gateways, but also among other emerging protocols.

New or modified protocols are essential and necessary to first establish and then mapped the various requirement between the user, terminal equipment, the communication network access bandwidth and other limitations. The protocol is required to monitor the channel conditions; such an adequate and acceptable level of service is maintained through the life of the session.

7 CONCLUSION

The actual problem of multimedia across wireless is presented. The emphasis is on audio/visual solution for wireless communications including speech and video across GSM. Solutions for the mobile video encoder and mobile video motion vector field estimation are proposed. In the second part of the paper, universal multimedia access as the basic for the future or efficient multimedia communications is shown. Under the given scenario, the protocol using 3G Code Division Multiple Accesses can be recommended in order to support the corresponding connectivity. Some research questions remain open, like:

- tailoring QoS to individual multimedia content sources and usage requirements,
- human interface factors, as user requirements and usage references need to be addressed,
- the process of capturing a particular user's preferences and requirements,
- the knowledge of whether a user has a preference for a certain modality of the multimedia content has a strong bearing on the choice of media conversion.

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