# MOBILE MULTIMEDIA

**Lakshay Gupta[1], Himanshi Lamba[2], Kumar Gaurav[3]**

[1,2,3]*CSE, Dronacharya College Of Engineering (India)*

## ABSTRACT

*Today, we observe the creation of multimedia consumer devices for mobile and home use are increasing. This includes set-top-boxes, game consoles and mobile phones. Although these devices have many things in common still it is accepted widely that they will serve a different purpose. Many companies are trying to define the open application platform for tomorrow's consumer terminals for home use, among others the so-called Multimedia Home Platform(MHP) of the European Digital Video Broadcasting(DVB )project .Meanwhile ,on the cellular end of the multimedia business ,portable appliances like cellular phones ,e-books and PDAs are evolving to multimedia terminals. One of the main obstacle to overcome is bandwidth limitation for both TV and data services. This paper shall summarize some trends and opportunities of mobile multimedia-especially in the DVB and GSM(Global System for Mobile communications) domain, while outlining the different requirements for mobile, home ,and car use of multimedia services.*

***Keywords* -- *Car Multimedia, Digital Video Broadcast Terrestrial (DVB-T), MHP, Mobile Multimedia***

## I INTRODUCTION

Convergence and divergence: Digital convergence is a key term, when talking about Information technology and multimedia. Digital transmission provides an abstraction between service and service delivery, i.e. the same network can deliver different service types and different networks may compete while carrying the same services. Internet technology, especially the World Wide Web constitutes a common platform for content addressing and interpretation. As consumers, we observe convergence through service integration and increasing independence of services and terminals. Example-we may surf the web using our TVset.

On the contrary, we observe a large diversification of user terminals. This observation is exactly addressed with what we call post-computer age or pervasive computing: Computational intelligence will go in all kinds of daily used appliances like pens, vending machines, microwave ovens ,watches ,toys and serve individual people exactly where they are and when they need it.

Many of the services offered will be communication services or at least based on connectivity and thus communication to other devices.

This development offers lots of new opportunities but also challenges and risks. On one hand, all kinds of new services become possible creating demand for new types.

## II. OPPORTUNITIES ANDCHALLENGES IN MOBILEMULTIMEDIA

While a few years ago, the maximum penetration of computers was estimated to about40-50% of all households, we are now f acing a development where every person may own several computing consumer devices. Digital technologies made service, network and terminal provisioning into independent businesses.
The mobile phones have become the most important "personal trusted" device. Today, people use mobile phones as personal address books and calendars. It is difficult to predict, in how far mobile phones will integrate the functionality of today's PDAs ,e-books,etc. What has been learned from the past is that many of the terminal types will survive, same as the computer will not kill the TV and the phone will not make the computer obsolete.

On the other hand, with increasing diversification in devices and software platforms, it will get increasingly difficult to guarantee interoperability of devices and services on all levels. Example- Internet enabled TV sets. Still worse, there is no common application platform for home or for mobile devices Interoperability of different vendor's equipment a big problem as well. This altogether constitutes a major obstacle for content and service providers and consumers to invest in this fragmented and constantly changing market.

Last not least,all mobile communication devices share the same radio frequency bandwidth, which is a limited, scarce resource. Some relief is expected from 3rd Generation (3G) mobile systems like UMTS(Universal Mobile Telecommunication Services)and enhancements of existing systems, like EDGE(Enhanced Data rates for GSM Evolution)and GPRS(General Packet Radio System). However, there are serious doubts that 3G systems will allow attractive, reliable and cost efficient multimedia services in the future due to still existing bandwidth limitation per user and cell. This problem is currently attacked by several means:

Data Broadcast is consuming less bandwidth per user and shall complement personal communications. Short-range radio links like Home R Fand Bluetooth for Point-of-Interest services. Hybrid, asymmetric networks ,which use the scarce bandwidth of cellular system store quest information and download the information through broadcast networks likeDVB-T. Load balancing of data traffic over networks and time. For example, during day time more personal communication bandwidth is provided and less bandwidth for radio and TV services.

## III. THE MULTIMEDIA HOME

As distinct to desktop PCs, Consumer type terminals will support a simpler user interface model and will be optimized for infotainment and e-commerce applications. The catalyst of multimedia services in the home will be digital TV, offering a broad band data pipe into the home. Digital TV is a success, even though in Europe it falls behind expectations raised some years ago. Some of the problems encountered are due to the failure of successfully introducing open standards for common application-and conditional access systems. The result is a rather fragmented European market where proprietary and incompatible systems compete against each other in vertical markets.

In Europe, the DVB project tries to push open specifications and standards for application platforms. Example-TAM (Technical Aspects of the Multimedia Home Platform) grouping DVB is one of these bodies. TAM focuses on the specification of a j ava based application platform called "Multimedia Home Platform".

MHP's concept builds on Java applications that are downloaded via the broadcast stream(e.g.PSTN).These applications have controlled access to the system resources through dedicated Java AP is (Application Programmers Interface)A security model distinguishes between trusted and distrusted applications ,where the latter have only access to a limited set of resources.

All in all, MHP defines three profiles, where the higher profiles contain additions to the lower profiles:

Enhanced Broadcasting: Downloading of Java applications through the broadcast channel. Example-electronic program guide, display of program associated data, news ticker,etc. Interactive Broadcasting: An interaction channel is added (e.g. via modem) and Internet connectivity isused as a communication channel for the applications.eg-HTML profile. Internet Access: This is basically the interactive broadcast profile plus "a real web browser" that shall render most of the existing web pages. This profile is not yet defined.

A different approach is taken by the"Advanced Television Enhancement Forum(ATVEF)"[3] ,where the software platform consists of an Internet browser, which receives HTML/JavaScript content being cached in memory. This content is then timely synchronized with TV broadcast by so called"triggers".This platform has the advantage that web content can be rendered, thus bridging the gap between Internets and broadcast. Consumer devices are usually controlled via remote controls rather than key boards and pointers. Moreover, browsers typically do not give total control over the graphical service rendering

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## IV. CANDIDATE MOBILE COMMUNICATION SYSTEMS

A key element to enable mobile multimedia services is a wireless broad band communication channel.Most multimedia services demand for highly asymmetric channels. Digital TV standards offer high data rates for data broadcasting.The following standards will be in use in several parts of the world:

1. DVB-T mainly in Europe

2. ISDB-T (Terrestrial Integrated Services Digital Broadcasting)mainly in Japan

3. ATSC (Advanced Television Systems Committee) Mainly in the USA

DVB standard was developed to replace the analogTV system.The key features are high band width efficiency, undisturbed reception, better picture quality and the capability to broadcast data services. Orthogonal. Frequency Division Multiplexing (OFDM) is used in Digital Audio Broadcasting (DAB) as well,but with a 10 time slower bandwidth(1.5Mb/s).It is ideal for amulti-path environment with changing channel conditions like in mobile environment Services. . To increase the communication efficiency packet-switched systems (GPRS, UMTS) are preferable for back channel purposes.

Since DVB-T can handle long echoes it is possible to use it in single frequency networks. This reduces the number of frequencies needed to provide a wide area with the same TV/data services. DVB-T operates extremely robust even under very unfavorable conditions. .

While other solutions for broad band mobile data reception exist, DVB-T is the solution selected for Europe and many other DVB-T adopters all over the world. While DVB-T pilot projects currently run all over the world,DVB-T is in commercial operation in U.K ,Sweden and so on in Spain.

ISDB-T [12 ]Is the Japanese digital TV standardands based on OFDM as well. Different modulation schemes are used as compared to DVB-T.(DQPSK (Differential Quadrature Phase Shift Keying) instead of QPSK(Quadrature Phase Shift Keying))results in a better bandwidth efficiency.

The US standard ATSC uses a single side band system. The ATSC standard cannot be usedfor mobile reception at all.It has high bandwidth efficiency, hence it is well suited for High DefinitionTelevision (HDTV).

Enhanced second –generation cellular phone technologies (eg.GPRS) and third-generation(3G) technology (UMTS [14][16]) will offer packet-switched data services with quite high data rates compared to 2G cellular systems. GPRS increases the data rate for packet-switched services. UMTS supports both packet-switched and circuit-switched data services.For pedestrians the data rate will be upto 384kb/s.The maximum bit rates drop dramatically once the number of users per cell increases. Hence GPRS and UMTS cannot replace the digital

## V. DRIVERS OF MOBILE MULTIMEDIA

In fact, there is more about mobile multimedia than simply creating a wireless home terminal .Law forces some national broadcasters to provide nation wide TV coverage. They are interested in digital TV, because,it strongly reduces their transmission costs per channel.They improve the attractiveness of terrestrial reception which was decreased strongly due to the introduction of cable and satellite services.

The network operators want to increase the sale of network bandwidth, by enabling new types of services with new network technologies. In many countries a close cooperation between the broadcast and cellular network operators has been established. Service and content providers see the opportunity to advertise and sell their services, thus increasing the total usage of their services. Car manufacturer improves the cars' Man• Machine Interface (MMI) by using enhanced input/output devices. An open application platform allows upgrading of multimedia equipment during the life cycle of a car.

Mobile terminal manufacturers serve individual persons instead of households; there are more individuals than households the market. Furthermore, there is a large potential for use and fashion-based diversification and innovation of terminals. Car terminal manufacturers currently suffer from vertical markets due to high customization. An open application platform would help them to reduce development time and costs. People, finally, spend more than 10% of their lifetime traveling, either for business or leisure, while they want to stay connected in every respect. This is proven by the current sales figure for mobile phones. Important aspects for car drivers are-security and travel assistance.They desire to use the same services in the car to which they are used to at home and in the office which is only possible with an open application platform.

Technology drives mobile multimedia with new means to communicate,cache, process, and display multimedia content:

1.*Connectivity:*New means to communicate.It enables new services.

2.*Memory and persistent storage:* Evolving memory technology allows caching of more content and offline processing.For example, audio/video content and whole web-sites maybe downloaded in background and consumed offline.

3.*Processing:* More processing resources with less power consumption allow rendering of more complex multimedia content.

4.*Display:* Visualizing multimedia content demands fo r cheap high-resolution display that comply to "mobile"requirements.

## VI. NEW SERVICES AND OPORTUNITIES

Mobile communication technology opens up new business And service opportunities.The first idea is to deliver. Existing services to the mobile user.E ven existing service may create a new user experience,if consumed in an environment.E.g. a car race on a portable TV while being physically at the race.

The mobile environment adds a new dimension to the information channel and that is location, e.g. services and information that can adapt to the location of the consumer.Mobile users seek new forms of

*information related to traveling*. These"location aware" services provide information being adapted to the current location Of the user.

off- board navigation uses up-to-date information concerning new roads, road construction, traffic, weather conditions ,but also local tourist information, like e.g point of interest(POI),the nearest gas station, hotels,restaurants,etc..GPS equipped phones are even commercially available.

Mobile phones are *personal* and *trusted* devices suited for personalized services. These services range from personalized information to so-called mobile-commerce ("m-commerce") applications.

Figure shows a partitioning into general services that are being designed for mobile usage, which either acts locally(upperpart) or they need a network connection (lower part).

In the following ,some emerging service types will be discussed,focusing on car systems.

Location-aware services: Cellular based positioning techniques like GPS mobile terminals will be able to determine the current position. Professional services like *fleettracldng* and *fleet management* are examples of such services ,which are realized by sending periodically the car's position to a service center, usinga cellular data link or Short Message Service(SMS).

Some service providers already today offer *local traffic information, route guidance* and *off-board navigation.* Route guidance means that the driver is informed selectively about relevant traffic jams around the current position of the car .Similarly,the drive rmay be informed about the traffic situation along a specified route. With *off• board navigation* ,the service provider guides the driver to the destination by sending him turn-by-turn driving instructions through the mobile communication network. Key drivers for the telematics market are-safety and security.These are not necessarily multimedia services,but they require positioning. These services require the highest level of reliability for the terminals to guarantee the functionality of the terminal even in case of accidents or breakdown. This can be achieved by means of very reliable and also redundant communication modules.

In case of emergency, the in-car system initiates automatically a S OS call and sends the current position of the car to the service provider .The SOS call can also be initiated manually, in case of less fatal accidents or breakdown events. It is desired to include data indicating the status of the care lectronics and sensors and send them to the service provider for remote car diagnosis.This feature could be extended for anti-theft. In case of the ft, the car can be located using a remote car-tracking system.

Another purpose of car terminalsis to provide in-car services, i.e.to provide a common user interface to all units and functions inside the car.The car includes several units and devices likee.g. radio, air-conditioner, electronically adjustable outside mirrors, etc ,which have their own knobs, controls and displays.Mostof these devices are produced by different companies with even different UI styles.A

multimedia terminal could act as a common user interface for all in-car electronics.Integration of new devices could easily be carried out by updating the UI related software of the terminal.

Car multimedia terminals have to provide car drivers with appropriate user interface extensions for a secure interaction with the system while driving. Most of the mobile multimedia services are already available for home terminals. Many of the requirements for home terminals apply to mobile terminals as well ,like the limited number of keys ,easy and safe use, lower resolution of the displays etc.. But car-terminals have to meet additional important requirements: Any interaction with the car system should not distract the driver.For security reasons visual presentation of information to the driver should be avoided. The Man-Machine interface has to be adapted for the driver's needs. A common solution for this is to integrate speech recognition (SR) and text-to• speech (TTS) systems. Thus, the information could be presented to the driver by means of TTS and the driver can operate the system safely while driving using speech recognition systems.

The two main challenges for in-car voice IO. Speech recognition noise is very difficult in ambient. Reliable results have only been achieved either with speaker dependant recognition, or with speaker independent method.

The latest standardization activities for wireless applications likeWAP (wireless application protocol)will provide ubiquitous access to Internet information servers.

WAP has been designed taking into account the bandwidth constraints in mobile networks.

WAP is an open independent network platform. Even though it is also device independent the initial focus is on mobile phones .WAP services are coded in WML(Wireless Markup Language)Client side scripting is possible through WML script. WAP servers can be implemented by means of HTTP (Hypertext Transport Protocol) servers plus a WAP gateway, transcoding the content. Typical applications include *text based query services (flight schedules), e-commerce, banking etc.*

Bluetooth Is an industry standard for short range wireless communication and networking.BT is a cost efficient technology that can be integrated in virtually any electronic device. Forecasts say that in a few years timeBT will not only be part of every PC and mobile phone, but also integrated into cameras, vending machines, household appliances etc.BT will be used to integrate the functionality and services of handheld devices and smart phones without any mechanical installation effort.Bluetooth Is an ideal means for wireless in-car communication.

Multi-modal means:

1. Different terminals can communicate information seamlessly. The content can be transferred between a large range of terminals.

2. Several input and output modalities (audio, video and tactile) can be used to deliver a similar content.example- an email text message.can be displayed on a BT-screen.

The combination of ad hoc networking and multi-modality opens a new vision for multimedia services.For example,in-car terminal could log into the BT host server of a gas station and download some *point-of-interestinformation*ofthe localareaaroundthestation. Any BTdevice can *export its user interface* to a BT enabled mobile phone(e.g.usingWML) and allow the user to interact with this device.

The success of the mobile multimedia business depends strongly on the cooperation of all service chain members.

## VII.TERMINAL TYPES AND THEIR REQUIREMENTS COMPARED

Both mobile and home terminals move towards multimedia,even though they come from different directions .Multimedia home terminals evolve from TVs while **car terminals** evolve from car phones and navigation systems. Another constraint is that mobile wideband communication systems do not yet exist. Manycar manufacturers like to see multimedia to develop in the following steps:

1. Narrow band security ,telematics and interactive services (e.g. WAP) complement mobile car phones and navigation.

2.Car computers will provide a uniform and consistent user interface to all electronic car equipment.Such appliances would be controlled via a high-speed optical bus, like MOST (MediaOriented Systems Transport)

3. Once reasonable coverage of mobile data and audio/video broadcast gets available, digital television ,interactive services and Internet will make their wayi into t he car.

Compared to home and portable devices,car terminals have some very special requirements:

Voice recognition and text-to-speech are needed as user interface extensions.

Telematics, navigation and security services need to access to a positioning system.

The last point suggests that there are some commonalties in the home and car environment. In both cases TV and radio broadcast service scan be decently delivered.Both environments impose limitation on the user-input device,even though there are less compelling reasons to use voiceI /Ointhe home.

MHP and other home platforms have to bere• assessed with respect to car requirements.There shall be support for application life cycles that do not depend on the currently selected TV service.The car is a very dynamic environment ,and the car platform shall be able to consistently handle external events like incoming calls, car system alerts, etc. Control has to be passed between applications withoutuser interaction.The platform shall support simultaneous execution of multiple applications from different sources. You may wish to use entertainment and navigation services at same time.

With regard to portable terminals, we believe that there will be both the **handheld**"personal trusted device", and **portable** devices .Due to their small displays and the limited bandwidth mobile phones are used to render shortclips.

With larger screens,better sound, and equipped with mass storage,portable devices are more suited for real entertainment. For this purpose these devices are equipped with a digitalTVandcellularreceiver.These devices will support the same application platformas digital TVreceivers.As with mobile phones,power consumption, battery lifetime and weight are the technical challenges to improve consumers' acceptance.

The World Wide Web is the fastest growing service market and is currently almost entirely dedicated to Personal Computers. There will be more devices connecting to the Internet, which have been equipped with different types of user interfaces depending on their concrete usage. This calls for device• independent services.There are several options for the service provider to cope with this problem:

Create content that renders well on all platforms using style sheets.Style sheets can control the rendering from high-resolution displays down to voice rendering.Style sheets are not consistently supported across browsers.

## VIII. IMPLEMENTATION CONSIDERATIONS ON MOBILE TERMINALS

One of the most critical factors of wireless terminal design is the energy management. A wireless terminal needs a "virtually"wireless energy source.There are two fundamental ways to increase the Use gateways to convert arbitrary content into a format that renders well on the particular platform. Unfortunately, the development of such gateways is verydifficult and conversion of arbitraryWebPages fo rmobile phone may even be i mpossible operating time of wireless terminals:reduction of power consumption or increasing energy density of the battery.

Mobile wireless terminals have four f unctional blocks:display, processing module,communication module,andpower management block.The three first ones are power consumers of the device and the last one is the energy source.

Multimedia devices are purposed for content and media rich services.This kind of device needs agraphical display of relatively high resolution.Selection of the display is critical with respect to power consumption. For TV applications, VGA resolution is almost sufficient.
Most of today's Web content is made for SVGA and higher resolution.There are several possible display technologies like Field emission displays(FED),Active Matrix LCDs (AMLCD)(reflective or with backlight)or head mount displays (HMD's which are usually implemented using AMLCD technology).

Power consumption of AMLCD light modulating elements is not large.Reflective colors AMLCDs are coming from several vendors.HMDs bring a new dimension in to the game of power consumption of displays.Power consumption is lower compared toany other alternative.

Intelligent mobile devices need calculation power for content decoding and applications which depends upon the architecture, the processor and the peripheral components. Almost all leading Internet browsers run wellon x86 platform .The battery energy density is normally expressed either on volume metric energy densityor gravity metric energy density.

There are three parameters ,which can be used when segmenting wireless communication devices. These are cell size ,mobility factor and communication speed.For example, current cellular phones operate on macro and micro cells with high mobility.. GPRS is generally a very low power block. This is mainly due to system design issues: the interface is ON only when needed.

## IX. SOME ACTIVITIES AND PLAYERS IN MOBILE MULTIMEDIA

There appliances are several activities trying to establish standards for multimedia. The standardization bodies for car multimedia systems recognized the need for a multimedia distribution channel in the car.To meet the demands of compatibility for the appliances fromdifferent manufacturers,acommon open API is needed. Several manufacturers have already demonstrated some multimedia solutions for the car ,but they are all based on proprietary platforms.

The *IDB forum* specifies a low speed and a high speed bus system for vehicles.The IDB specification is open and uses existing standards if possible.

The *MOST consortium* specifies the networking of car appliances from physical to application layer. It allows upto 22Mb/s bus transfer rate and allows to connect different devices.

Both **Motivate** (Mobile Television and Innovative Receivers) and **Memo** (Multimedia Environment for Mobiles) have been EUprojects [5].While Motivate dealt with mobile reception of DVB-T signals, Memo's target was to provide network structures for hybrid mobile network access, using DAB andDVB-T.

**MCP** (Multimedia Car Platform) is a new EU project that has just started. MCP will define an open application platform for mobile multimedia applications and services. The MCP consortium consists of CE manufacturers, carmakers, service providers and Network operators. The MCP project emphasizes on the openness of the platform to enable horizontal markets.

The **Bluetooth** Special Interest Group is specifying and promoting the Bluetooth standard. This consortium, originally consisting of Ericsson, IBM, Intel, Nokia and Toshiba, has now been joined by almost 1200 Companies. The Bluetooth standard is available for free.

The **WAP** standard, Is an open standard defined by the WAP forum, offers an efficient way to interact via a markup and scripting language over a cellular network connection to enable new kinds of services.

There are **DVB-T trials** for mobile reception ongoing in several countries (e.g. Germany, Singapore, Finland, Sweden,USA).

## X. CONCLUSIONS

Next generation mobile phones will be the ubiquitous companion of the mobile information society. However,Creation of services that render well on these different platforms, Efficient usage of bandwidth. The first two points are a matter of careful standardization of scalable content and application environments. For the latter point, it is felt that data broadcast and digital TV are important factors to efficiently deliver broadband services.

At the same time new service opportunities open up that really differ from existing services just being consumed in amobile environment. In general, location awareness adds a new dimension to all kinds of existing services.

The technology for mobile services and mobile consumer devices is available today.The success of these services will finally depend on convincing business models and the harmonization and interoperability of services and devices.

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