International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

# Report ITU-R BT.2249-3

(05/2013)

# Digital broadcasting and multimedia video information systems

BT Series

Broadcasting service (television)

International Telecommunication Union

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REPORT ITU-R BT.2249-3

# Digital broadcasting and multimedia video information systems

(2011-2012-2013)

## Introduction

The term video information systems (VIS)[1] refers to multifunctional interactive systems providing high-quality reproduction of video information on screens of varying sizes in populous locations both in the open (squares, streets, stadiums, etc.) and indoors (halls, shopping centres, subway stations, etc.). Luminescent VIS screens can operate both in daylight and in the dark, in any weather and in different climatic conditions.

VIS thus brings new meaning to the concept of "outdoor television broadcasting", with fragments of conventional TV programmes, programming designed specifically for such presentation, public warning, advertising and, generally speaking, any other services calling for the display of video information for viewing under the aforementioned conditions.

There is now a social demand for progress in the field of digital TV broadcasting, whose role in providing information to society needs to be radically enhanced.

This has given rise to the need for a new global approach to the ongoing development of digital TV broadcasting, characterized by the following features:

– the basis of the approach lies in integration of the various new aspects and components, which have not yet been fully taken into account up to now, in the initial approach to the introduction of digital TV broadcasting (see Fig. 1). They will make a significant contribution to the development of this field and will make the service highly effective from an economic standpoint;

– the results of the research being conducted in these spheres are in many cases already approaching the level of international standardization, generating global support for the new approach;

– in regard to upcoming innovations, a characteristic feature of this approach is the close inter-linkage between the requisite evolution of TV programme content and that of the means of its delivery and display.

The new approach is being put into practice at precisely the right moment in time. Over the next five to ten years, we will, thanks to the progress being made in digital television and radio broadcasting, broadband access (BA), interactivity, enhanced signal transmission in different environments, Internet usage, over-the-top systems (OTT), worldwide broadcast and multimedia roaming, "cloud" technologies, mobile communication and so on, be seeing the biggest leap forward ever in the history of mass informatization.

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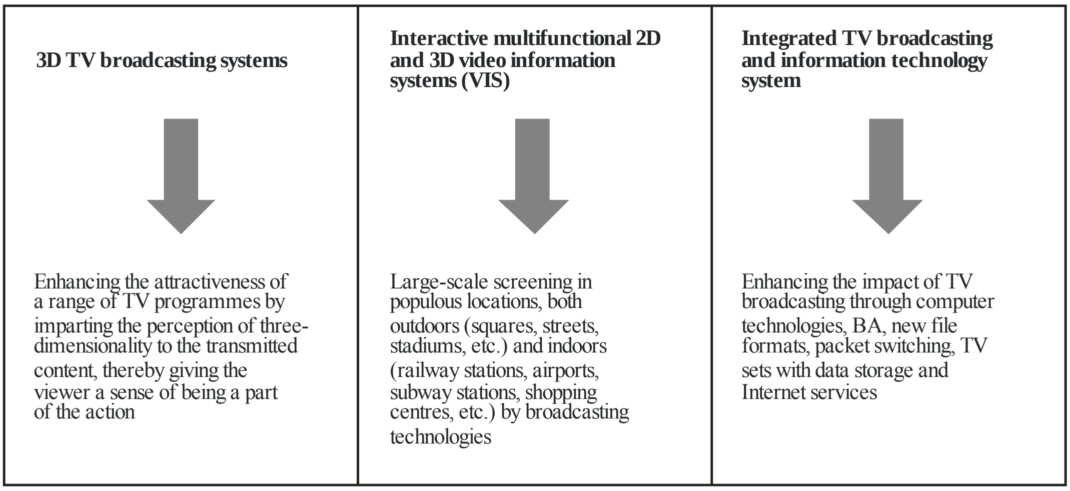
[1] The term VIS (video information system) entered the field of TV metrology in the 1960s as the term applied to the measurement of the quality of TV transmission from the TV camera to the point of monitoring, in which the main source of information as video information. Today, also it is used to denominate the representation of multimedia/audio-visual content (incl. broadcast content) on outdoor flat panel displays.

FIGURE 1

**New aspects and components of digital TV broadcasting**

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3D TV is an important and highly sought-after capability in TV broadcasting. 3D TV technologies that are compatible with 2D systems are examined in Report ITU-R BT.2160 – Features of three-dimensional television (3DTV) video systems for broadcasting. We may look forward to the appearance of 3DTV-NP systems providing the viewer with a number (N) of additional perceptions (P) – for example, touch (tactile sensations), temperature, vibration, and so on.

In this approach, an important role lies with the capability that has come about in the recent years to provide wide-scale public screenings using interactive multifunctional 2D/3D video information systems.

The effectiveness of content development for VIS on the basis of video information obtained from different sources can be considerably enhanced through the use of file data transfer. The study of digital TV broadcasting systems using file transfer has for many years been one of the main areas of activity of ITU-R's Broadcasting Study Group, since major advantages lie in the transition from traditional methods of TV programme signal processing and transmission to their presentation in the form of a stream of media files. Using file-based methods, it is possible to disassociate services from the network and move from the use of time division multiplexing (TDM) for content delivery to IP-based packet switching. This speeds up the search for the required content, enhances its protection and is conducive to the integration of VIS, broadcasting, telecommunication, Internet and other services (Recommendation ITU-R BT.1888 – Basic elements of file-based broadcasting systems).

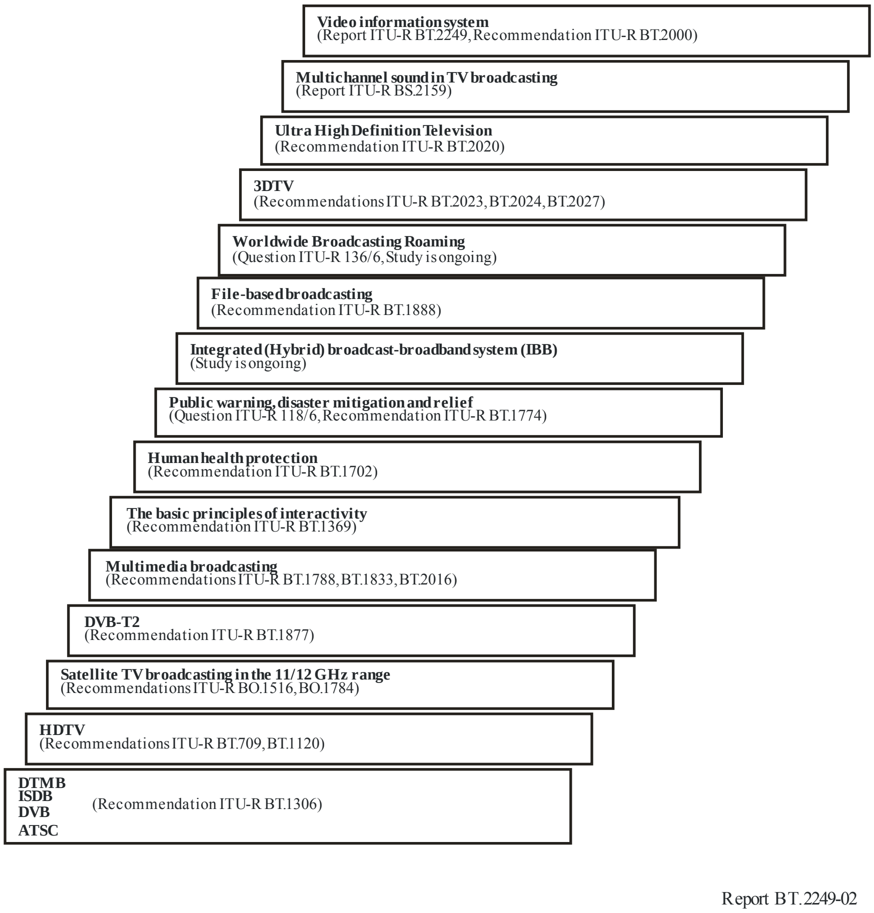
The circumstances have changed in the receiver domain in terms of the mass production of television sets capable of providing many Internet services. In addition to receiving a whole host of TV programmes, they feature, among other things, interactivity, recording of video information and personal programming on the basis of favourite themes. This does not require the use of a computer.

The time has now come when an individual, sitting at home, is able to receive a wealth of video information, while the probability of his or her choosing to watch a particular television transmission or its fragments is diminishing. Innovations associated with the introduction of the concept of worldwide broadcasting and multimedia roaming are appearing. They include "cloud", nano and other technologies. Those technologies will lead to the creation of universal multifunctional receiver terminals.

The activity of ITU-R SG 6 during the last years significantly put forward the implementation of the discussed approach. The results of SG 6 activity on the progress of TV broadcasting technological platform are illustrated in Fig. 2. The inclusion of VIS into the TV broadcasting model, utilization of Internet and mobile communications allowed to formulate the following thesis: multifunctional digital TV broadcasting – anywhere and always, for each and everybody.

FIGURE 2

**The development of multifunctional digital TV broadcasting**




In this regard, it is important to emphasize one of the features of VIS, which is that although a limited number of programmes are produced in multi-screen mode, the specific content and targeted advertising are sure to be viewed by a mass audience. The probability of programmes being viewed on freely accessible VIS displays is very high, since over time these will become virtually ubiquitous, offering attractive high-quality 2D/3D images under all viewing conditions.

As a result, we are seeing a new need for considerable enhancement of the key content of each programme, together with a ripening need to harness the capabilities of outdoor TV.

Looking back in history, we see that the intensive development of the written press and of radio and TV broadcasting in the twentieth century played a positive role in getting people interested in mass information. At the same time, people began to demand constant access to information and adopted a lifestyle including newspaper reading, listening to the radio and television viewing on a daily basis. However, the twenty-first century has ushered in the next stage in information consumption. The accelerating pace of life is compelling the individual not only to keep up with events on the fly, be it in the street, on the subway escalator or in other public places, but also to process large volumes of information at high speed in order to remain abreast of events and take effective decisions. Visual imagery that is convincing, clear and universal helps the viewer to assimilate that information. This explains the growing role of the outdoor screen, it being a known fact that over 80 per cent of people's information intake is visual.

In the past, the high demand for visual information in the populous areas led to the use and ongoing development of traditional, essentially static, means of portraying information, in the form of posters, billboards, indicator panels and so on. Today, these means exist alongside systems using electric-lamp, LED, LCD, GDD and plasma screens set up in public places. However, such solutions are in many cases not capable of reproducing high-resolution/high-quality visual information, particularly as far as moving images are concerned, and this call for new approaches to the effective large-scale provision of public information.

The progress made in recent years in the development and international standardization of high-quality TV imagery has radically changed the environment, opening the way for development and creation of the long-predicted multifunctional interactive public VIS.

The study tasks of ITU-R SG 6 (Broadcasting service) cover broadcasting, including vision, sound, multimedia and data services intended for delivery to the general public (Resolution ITU-R 4-5 – Structure of Radiocommunication Study Group). This includes the production of programmes (including image, sound, multimedia and data) and the contribution of multimedia content signals via communication links between studios, information-gathering facilities (ENG, SNG and others), primary distribution to transmission centres and secondary distribution to consumers for both individual and collective viewing, the international exchange of programmes and quality of service.

In line with the above considerations, the study of VIS falls within the mandate of SG 6 (and its Working Parties). The new VISs enable a broadening of the broadcasting applications sphere from indoor to outdoor − a development of the same order of significance as the transition from black-and-white to colour television, and then to 3D. This new stage in the field of TV broadcasting will see a considerable increase in the viewer population and play a major part in the ongoing development of the information society.

Working Party 6B commenced its studies on VIS in 2008 (Doc. 6B/7, 7 April 2008). Question ITU-R 13/6 – Multimedia and relevant common data format included the study of user requirements in respect of these systems as the initial stage in their international standardization (Doc. 6/45, 22 May 2008).

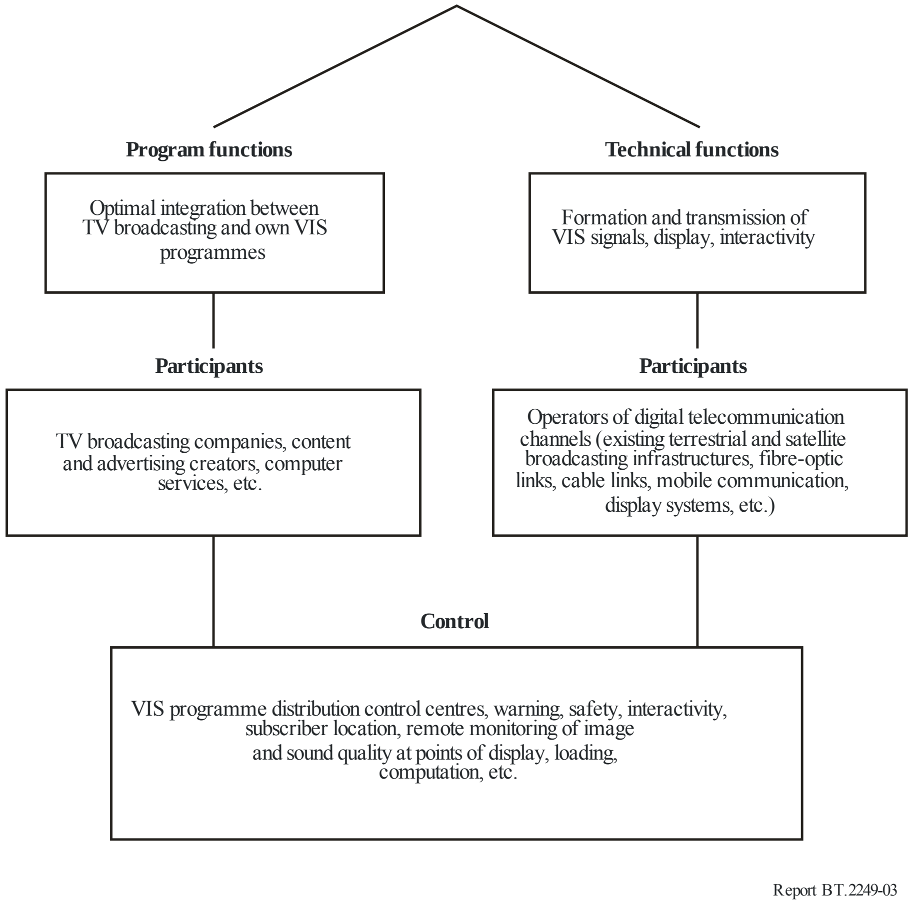
At the meeting of ITU-R SG 6 held in October/November 2008, it was decided to study those requirements within the framework of Question ITU-R 45/6 – Broadcasting of multimedia and data applications (Annex 1; Doc. 6/99, 30 October 2008).

At its 2009 meetings, WP 6B decided to set up a Rapporteur group (rwp6b-rg-4) to study digital multimedia video information systems (VIS) (Annexes 1 and 2). That group developed the present report (Docs. 6B/295 and 6C/514, September 2011).

An integrated model of the functioning of VIS is shown in Fig. 3.

FIGURE 3

**Integrated model of the functioning of interactive video information systems**




The development of modern VISs and their integration with broadcasting within the framework of the model's "programme functions" caused the interest of broadcasting companies as well as content providers, advertising and computer services and Internet concerns, among others. We may anticipate changes in the advertising sphere where the use of domestic and outdoor TV screens is concerned. Telecommunication operators are interested in the "technical functions" and "control" areas, proposing integrated solutions based on display systems, audio accompaniment, interactivity, warning and safety functions and other additional services.

The use of loudspeakers is in most cases ineffective on account of the limited public area served and the possibility of transmitting only one accompanying audio channel. Considerable advantages may be derived from individual interactive services accessed via the viewer's standard mobile communication terminal. Such an approach has been made viable on account of the ever more widespread ownership of such terminals (there are now some five billion of them worldwide, for a global population of some 6.7 billion).

A press release issued on 25 May 2010 from the international "Expo 2010" exhibition in Shanghai reported the demonstration of a new VIS with sound accompaniment for the images on the display screens provided in various languages by means of mobile communication terminals.

Video information services for handheld receivers within local areas have been experimentally provided throughout Japan to take advantage of the widespread use of such receivers and features of the system. It would also be effective to combine presentations on large screens and on handheld terminals, where general information was presented to the public on large screens and detailed information that was supplementary was provided to individuals on handheld terminals (see Chapter 3, § 3.2).

It is now obvious that VIS will, in the very near future, usher in a new era of outdoor TV broadcasting. Thanks essentially to a higher quality of reproduction and to the ability to transmit content files (including possible advertisements) to hundreds of thousands of synchronized displays connected to dedicated networks and operating both in daylight and darkness, in any weather and a range of climatic conditions, VIS will replace a large number of conventional advertising posters, indicator panels and electronic facilities not equipped with VIS capabilities.

It is expected to expand the viewer base by setting up large screens at elevated locations, including airborne, with due regard for the requisite safety measures and the parameters essential for the viewing of video information will arising (see Fig. 4). The industry would be well-serviced if the information exchange were standardized.

FIGURE 4

**2D/3D video information systems**

| **1 Using TV screens** | |
|---|---|
| Screens of varying dimensions in static and mobile setups on land | Large screens mounted high up, including airborne and waterborne |
| *Viewing:* in populous locations both indoors and outdoors (halls, shopping centres, stadiums, squares, streets, railway stations, airports, subways, transport stops, pharmacies, etc.)<br><br>*Information:* excerpts from TV programmes, special TV programmes for VIS, advertising, warnings, etc. | *Viewing:* in the area from which the screen is visible (stadiums, squares, streets, embankments, during processions, demonstrations, etc.)<br><br>*Information:* for mass viewing: excerpts from TV programmes (news, sport, etc.), special TV programmes for VIS, advertising, warnings, etc.<br>Viewing: in open areas for large-scale public information in case of emergency situations (disasters, catastrophes, etc.).<br><br>*Information:* as required in such circumstances, with simultaneous safety of infocommunication media. |
| **2 Using virtual images created by such systems** | |

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The notion of the “screen” is now complemented by that of the “virtual screen”, in which technologies are used which create a new type of 3D image in space.

Special TV programmes are already being developed for mobile TV. However, the content for mass viewing of “outdoor” TV broadcasting calls for a different approach, due to the large-area screens seen by viewers who are in motion and looking at the screen from different viewpoints, e.g. from above or below, at any time of day or night, and so on.

Thus, VIS and outdoor TV broadcasting, in meeting a current need, are also setting the seal on the start of a new era in visual information, calling for the development of standards to enable the global interaction of such systems and exchange of their specific content between different types of screen.

The large-scale screenings made possible through the widespread implementation of VIS will be a powerful driving force for the development of a whole range of high-technology sectors and will result in a significant drop in the cost of VIS components.

As we will see later, former ITU-R SG 11 (TV broadcasting), seeing what was coming, already in the early 1990s got down to work on the international standardization of interactivity and of HDTV and EHRI systems, followed at the beginning of the twenty-first century by ITU-R SG 6, with LSDI and UHDTV systems, among others. Virtually all of these areas have seen the development of global recommendations, and the resulting facilities are capable of reproducing the smallest details in images.

For many years, however, for all of the assessment and measurement of TV image quality and studies into the creation of such images, the content of TV programmes and related solutions have been geared towards the reception of TV images within the home, under low-light conditions and only in 2D.

The aims of this Report are therefore:

– to demonstrate the significant demand for VIS, which, given today's time pressures, will be capable of catering to a vast information environment on a scale never before witnessed;

– to point the way to a number of essential innovative studies and create the basis for initiating the international standardization of outdoor TV broadcasting and VIS, complementing traditional household television and moving civilization ahead towards a new stage in its development.

# Chapter 1

## Analysis of existing video information systems for presentation of various types of broadcast and multimedia information, including VIS definition

The term VIS refers to systems for the viewing of video information on screens of varying dimensions in populous locations. The VIS family includes “external television and video”, LSDI (large screen digital imagery), DS (digital signage) systems and so on.

There are also other proposals for the definition of VIS, such as those contained in (Docs. 6/329 and 6/330 of 27 April 2011). The definition and abbreviation for digital broadcasting and multimedia video information system formulated in the final version of this report may, following adoption, be submitted to the SG 6 Rapporteur for vocabulary and terminology.

### 1.1 Background

As is indicated in the introduction to this report, the term VIS refers to systems used in the creation and transmission of TV and multimedia broadcasting content. It also encompasses the equipment used for reproducing content on screens of varying dimensions for viewing by the general public in areas where people congregate. Video information systems therefore fall within the scope of broadcasting services.

There are currently external TV and video systems for viewing of various kinds of essentially multimedia items relating to business, advertising, concerts, shows, sporting and other large-scale events, using screens set up in public places (squares, railway stations, stadiums, streets, parks, airports, shopping and cultural centres, shops, pharmacies, and so on).

These systems, which are based on the use of electric-lamp, light-emitting diode, liquid crystal or gas discharge screens, can be set up outdoors, for example in the street, in squares, etc. They differ from one another in terms of format and image quality, display screen technology and parameters (resolution, brightness, contrast, colour palette, reliability, robustness vis-à-vis external conditions, etc.), viewing situations and other factors.

### 1.2 External TV and video systems

A number of Internet journals publish information on the light screens used in external TV and video systems, where each pixel of the image comprises a cell made up of four colour sources with red, green, dark blue and white filters. The screen resolution is determined by the distance between the lamps, which is normally 0.85 (0.75), 1, 1.15, 1.75 or 2 inches depending on the physical dimensions of the lamps and of the display. Research shows that with a resolution of 120 × 160 pixels, sometimes referred to as “sufficient resolution”, a light screen measuring over 6 × 8 m is able to display images of only standard definition, corresponding to signals produced by the PAL, SECAM and NTSC TV broadcasting systems. This offers far less scope for distinguishing between fine details in the image, especially when viewing from a long distance. Systems using light-emitting diodes or gas discharge screens have the same shortcomings.

External TV and video systems thus have limited resolution and do not allow for high-quality images. This may seriously restrict the use of such systems for the provision of information in public places.

### 1.3 Large-screen digital systems

Large-screen digital imagery (LSDI) systems use HDTV image formats of 3 840 × 2 160 and 7 680 × 4 320 pixels, in line with Recommendation ITU-R BT.1769 – Parameter values for an expanded hierarchy of LSDI image formats for production and international programme exchange.

### 1.4 Digital signage systems

In recent years there has been active development of digital signage systems, used to display different types of video information on screens of varying dimensions in populous locations.

A most simplistic definition of digital signage is that of “remotely managed digital display, typically tied in with sales, marketing and advertising” [Schaeffler J. NAB Executive Technology Briefings. Digital Signage: Software, Networks, Advertising, and Displays. A Primer for Understanding the Business. – Published by NAB-Focal Press. – Copyright © 2008, Elsevier Inc., USA].

It is a centrally and/or remotely controlled and addressable network of typically flat-screen digital displays that deliver targeted content in the form of entertainment, information or advertisement to a designated audience by means of a combination of software and hardware resources. Other common names for Digital Signage include those such as dynamic digital signage, digital out-of-home media network, electronic signage, digital media network, digital advertising network, narrowcasting network and in-store TV network.

Digital signage is not like standard over-the-air broadcast television. Instead, modern-day digital signage typically depends on more than one video, audio or data file getting delivered concurrently to a single screen for concurrent display. Yet, free over-the-air broadcast signals can and do typically become one of many parts of a digital display, whether for digital signage or other purposes. Thus, a typical digital display may involve multiple sets of images that are displayed on the same screen at the same time, and broadcast or multichannel TV content may be part of that.

It follows from the above that digital signage systems are one branch of VIS, and that the functions they perform generally bear no relation to large-scale outdoor TV broadcasting for public viewing.

# Chapter 2

# New VIS with use of broadcast SDTV, HDTV, LSDI and EHRI technologies

## 2.1 Main fields of use

The continuing development and implementation of high-definition television (HDTV) content and equipment, as part of new terrestrial digital television (DTV) services, as well as of cable-TV networks and satellite delivery to home (DBS/DTH) services worldwide, coupled with the possibility to display HDTV and higher definition content on large displays including resolution, high-contrast, and high-brightness digital display systems, enables several applications of VIS.

This digital technology is changing the nature of large audience venues allowing for the presentation of new types of content unavailable until recently to conventional viewers. Sports, concerts, dramas, plays, documentaries, cultural, educational, commercial and industrial events can now are presented to small and large audiences alongside traditionally displayed events. Audiences in many other indoor and outdoor venues can also have access to high quality digital audio and video large screen content. This also permits the owners and operators of large audience venues where large display devices are installed, to better leverage their assets, increase their revenues, by presenting multimedia content, including delivery platforms for broadcast content.

Moreover, VIS may be implemented in digital systems from standard definition to high definition in any type of group audience, from a village hall, local club, university auditoria, schools, church halls, museums, or a sports stadium.

The development of large displays for HDTV and higher resolution, with high brightness, high contrast, is the fundamental technology enabling VIS implementations.

Most of the video information system applications are now broadly defined as digital signage. They include:

– social events;

– cultural events (shows, spectacles, concerts, etc.);

– advertisements;

– forums and exhibitions;

– information public services and *et al*.

### 2.1.1 Collective viewing of TV broadcast programmes

The transition to HDTV programme production for the television networks results in the availability of many potential repurposed HD programmes for collective viewing on large screens. Collective viewing is a field of application for programmes broadcast by satellites to reach specific audiences in specific locations where domestic reception may not offer the same degree of quality or participation. A typical case is represented by the fast growing number of coffee houses, hotels, restaurants, bars etc. particularly in highly frequented tourist locations all over the world, offering to customers collective vision on large screen with LSDI projectors of sport events and/or other TV programmes (movies, serial, etc.) received by satellite. In this case, due to limited number of viewers (in general fewer than 40-50 people) low-cost LSDI projectors are used with screens of medium size.

### 2.1.2 Sporting events

Presently a large number of major sports stadiums are equipped with large screens, using digital TV technology for collective viewing of concurrent events in real-time and/or displaying from different view angles specific moments of the performance.

The 2008 Olympics, held in Beijing and other Chinese cities, were broadcast to the crowds using a digital terrestrial TV broadcasting system conforming to standard GB20600-2006 “Framing structure, channel coding and modulation for digital terrestrial broadcasting system (DTMB)” (ITU-R. China (People's Republic of). Chinese digital terrestrial television broadcasting system // Doc. 6A/287, 3 December 2009). The images were displayed under stationary and mobile conditions on screens of varying dimensions.

Video information systems were also used for the 21st Winter Olympics in Vancouver (Canada). The main facilities were provided by six video information network operators, namely Translink, Pattison Outdoor, CBS Outdoor, Vancouver International Airport, Canada Line and Canada Storyboard.

The **Astral Media Outdoor** company set up six displays, some of them double faced. They measured 3 × 10.2 m and were used for advertising.

A number of screens were set up in Richmond, carrying Media Consortium transmissions, while various screens, both indoor and outdoor, were in operation in Vancouver, likewise showing Media Consortium transmissions. A giant screen was erected in the Convention Centre, where transmission of the Games was interleaved with advertising and promotional clips.

The **Lamar** company equipped the outside of over 25 buses with digital displays measuring 0.65 × 3.15 m. Those buses were on the go for 17 or 18 hours each day, with the displays running the whole time. And each of Vancouver’s 31 electric railway stations, as well as the new Canada Line metro station, were equipped with 46" liquid-crystal displays.

The **Onext Media** company set up some 100 displays in cafes, restaurants, shops, etc., with screens measuring between 32 and 40" and with a 60/40 ratio, the majority of them carrying advertising, while a smaller number carried sports programmes, weather reports, etc.

One of the main technology providers was **Omnivex**, whose software products were used for controlling video information systems at various locations in Vancouver. It set up 180 screens in the Convention Centre.

Omnivex software was also used at Vancouver International Airport, while for the Olympics the city’s TransLink public transport system was equipped with 170 screens in 40 locations. They were connected to the **Lamar** Company’s Commuter Digital Network. The communication infrastructure was set up by Bell.

Another company involved in the deployment of VIS in Vancouver was **Net Display Systems**, whose PADS Solution, which had won a DIGI Award at the Digital Signage Show in New York, was used on the SkyTrain light metro system. With a track length of 49.5 km, SkyTrain is the longest automated light rapid transit system in the world, carrying an annual average of 200 000 daily passengers, equating to more than 74 million passengers per year. Large LCD panels were set up at the stations, interconnected in a network and controlled by means of video information system software.

The **SEEIP** (Station Entrance Emergency Information Panels) project was initiated to bring messaging to passengers before they purchase tickets, with LCD panels located at station entrances informing passengers of any problems that could delay their journey.

On the basis of the PADS Professional software from **Net Display Systems**, iMediaT Digital experts created a network infrastructure on the basis of a send/receive hardware technology carrying high-definition video, audio and RS232 control signals over long distances. Signal transmission was via fibre-optic cable connected between a digital signage player PC and an LCD panel.

The PCs were networked back to a server at the main operations centre which drives the system using the PADS software and SQL server.

**iMediaT Digital** also developed a browser-based interface to assist field operations staff to create or edit alerts and emergency and general information messages. The system enables staff to direct custom messaging to a single screen or any combination of screens throughout the system. During normal operation, the content is designed to inform passengers of SkyTrain rules, interesting facts and other tips. During the Olympics, the screens were used to provide event information and optimize the passenger flow.

The **Screenfeed** company set up broadcasting networks providing access to information on unofficial team placings. This information was constantly updated (in real time) and was supplied to broadcasters free of charge. Access to it was through the Digital Signage Content Store, and involved the use of hardware designed to deliver graphical data on the four teams holding the largest number of medals.

Examples of VIS applications in sporting facilities and events are shown in Figs from 5 to 8.

FIGURE 5

**Olympics. Hockey. Vancouver, 2010**

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FIGURE 6

**Relaying of the world football championship. Hamburg, 2010**


Report BT.2249-06

FIGURE 7

**LED screen at the ANZ Stadium, Sydney**


Report BT.2249-07

FIGURE 8

**Mobile LED screen**

Report BT.2249-08

Large sports scoreboards can be used for displaying not only graphical information or scores but also live images of the event, highlights and replays of key moments, information about the sponsors of the club, stadium, match, competition or tournament, advertising and other video information. Given the size of such events and the huge numbers of people they bring together, such information will be viewed both by the spectators present in the stadium and on television and VIS screens set up in heavily-frequented locations, making it clear that VISs are set to become a highly effective means of outdoor TV broadcasting.

### 2.1.3 Examples of VIS applications for advertisements and information services

Examples of outdoor and indoor applications of VIS are given below. These are examples of potential applications of video information systems for digital video billboards and posters. Billboards or posters placed outdoors would require video displays in which the brightness and colour temperature are automatically adjusted to match the prevailing daylight or night lighting.

FIGURE 9

**Billboard in the main hall of the railway station in Geneva, Switzerland**

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This is a large video display showing short promotional clips, mounted above the access to the escalators in the main passenger hall.

Target viewers: all passengers and other pedestrians going through the hall.

Approximate billboard size: 6.5 × 3.5 m; aspect ratio: about 16:9, "landscape" oriented.

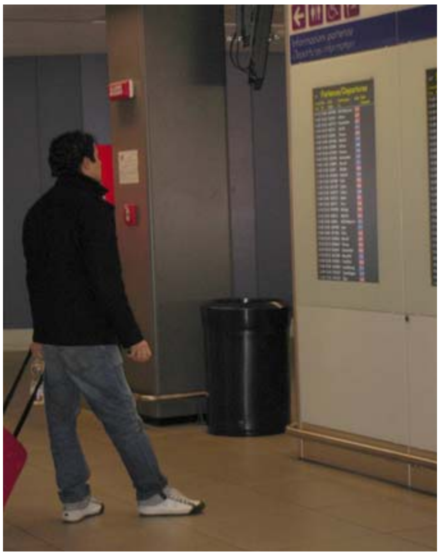
Approximate height of billboard centre above viewers' eye level: 6.5 m.

Approximate vertical viewing angle for a 45° elevation of the billboard centre: 20°.

Digital video system of choice for this vertical viewing angle: 1 920 × 1 080 (Rec. ITU-R BT.709).

FIGURE 10

**Video poster with flight departures in Leonardo da Vinci airport in Rome, Italy**



Report BT.2249-10

Several such digital video posters are installed in departure halls. The photo shows that the typical viewing distance is about 1 m.

Target viewers: airline passengers.

Approximate poster size: 50 × 90 cm., aspect ratio: about 2:1, "portrait" oriented.

Poster height above viewers' eye level: at eye level.

Vertical viewing angle at a viewing distance of 1 metre: 27°.

Digital video system of choice for this vertical viewing angle: 1 920 × 1 080 (Rec. ITU-R BT.709).

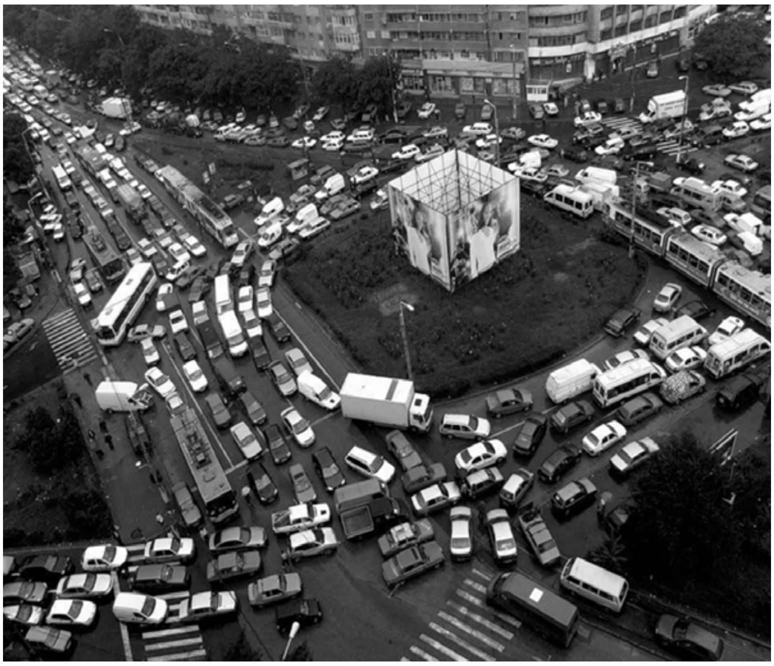
FIGURE 11

**Information display panel at London's Heathrow Airport**

Report BT.2249-11

FIGURE 12

**Roadside information screen**



Report BT.2249-12

FIGURE 13

**Outdoor demonstration screen in Tokyo**


Report BT.2249-13

FIGURE 14

**Display panel for natural disasters notification, Russia**

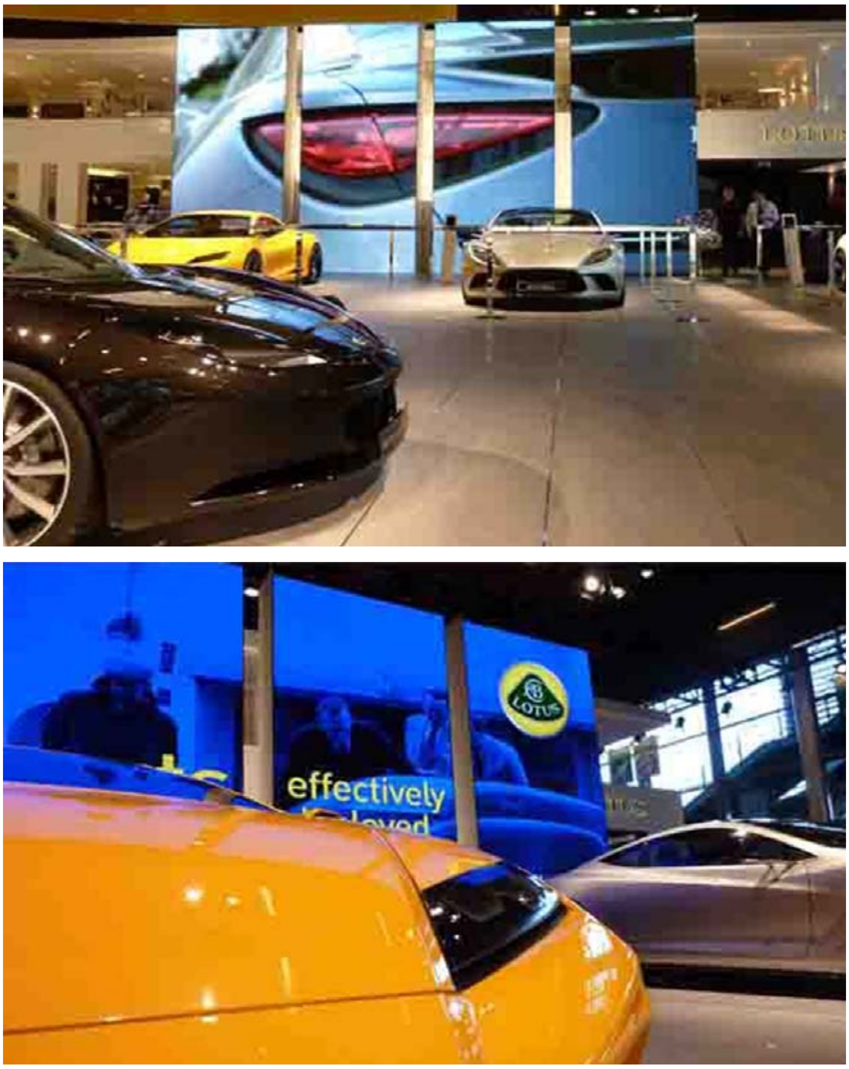

Report BT.2249-14

### 2.1.4 Use of VISs at large-scale public events and festivities

VISs are active "participants" at large-scale public, cultural, commercial and other events, where they serve as a means for displaying different types of video information to audience groups. VISs are also widely used during election campaigns at the federal, regional and local levels. Examples of such use are shown below.

FIGURE 15

**Motor show 2010, Paris**




Report BT.2249-15

FIGURE 16

**Celebration of Town Day 2010, Moscow, Russia**


Report BT.2249-16

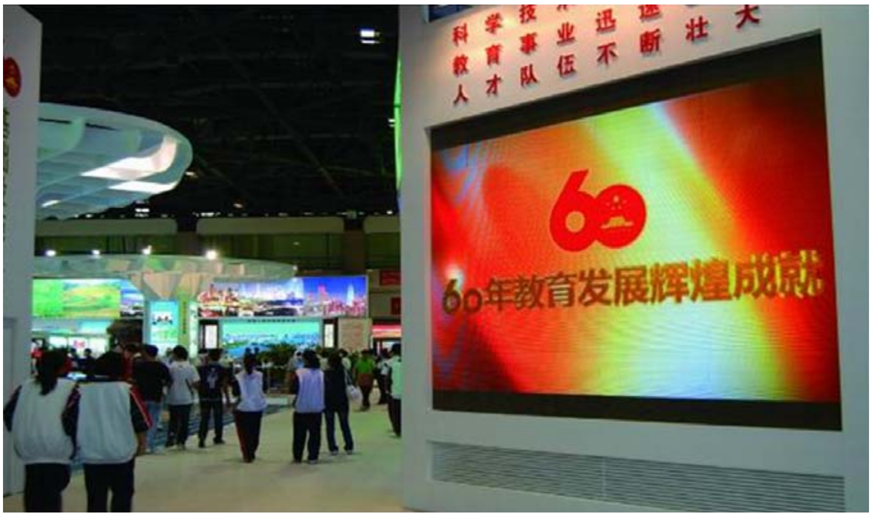
FIGURE 17

**Live broadcast of the wedding of Prince William on an outdoor VIS screen. Times Square, New York, United States, 2011**


Report BT.2249-17

FIGURE 18

**Demonstration screen at the 2010 Expo exhibition, Shanghai, China**




Report BT.2249-18

FIGURE 19

**Freemont street, Las Vegas, United States**


Report BT.2249-19

### 2.1.5 Use of VISs at concerts and shows with large audiences and during television filming

Concert venues are these days equipped with giant VIS screens used for live transmission and for close-up replays of key moments from the event, as well as for conveying information about the organizers and sponsors of the concert or show. It is now hard to imagine a televised event or concert without the presence of a video screen or screen modules as part of the scenographic arrangement. Examples of VIS usage at concerts and shows are given below.

FIGURE 20

**“Nashestvie 2010” rock festival, Emmaus, Russia**


Report BT.2249-20

FIGURE 21

**83rd Oscars ceremony (2010 Oscars), Los Angeles, United States, 7 June 2011**


Report BT.2249-21

FIGURE 22

**Eurovision Song Contest 2011, Düsseldorf, Germany**

Report BT.2249-22

FIGURE 23

**Relaying of opera and ballet in Trafalgar Square, London**

Report BT.2249-23

FIGURE 24

**Giant screen at Keith Richards concert**

Report BT.2249-24

## 2.2 Public warning, disaster mitigation and relief

The use of broadcasting facilities in connection with natural disasters is studied within the framework of Question ITU-R 118/6 – Broadcasting means for public warning, disaster mitigation and relief. Under that Question, ITU-R developed Recommendations ITU-R BT.1774 and ITU-R BO.1774, both entitled "Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief".

In the Recommendations, it is indicated that systems for transmission and reception should include the possibility of forcing suitably equipped and suitably primed receivers (whether switched on or in standby mode) to present programme material for disaster mitigation and relief without intervention from the listener or viewer. Such criteria are directly applicable to video information systems, which constitute components of local, regional, national and international broadcast infrastructures.

On the basis of the results obtained by ITU-R in the course of its studies on the uses of TV and multimedia broadcasting facilities, it appears desirable to provide for the possibility for VIS systems to be automatically switched to a specific video information display mode, with appropriate accompanying audio, to warn the population at large in the event of natural disasters and other emergency situations. Such video information could include details of the situation in the affected areas, guidelines for the population (e.g. escape routes) and other information designed to save lives and mitigate the effects of the disaster.

Public warning could also be provided by means of ad-hoc VIS systems involving the deployment of ground-based transportable screens and screens designed to provide a broader field of vision and be set up at elevated locations, on water, and so on. The use of aircraft is also under study.

In view of the value of VIS systems for providing public information, it would be appropriate to supplement Recommendations ITU-R BT.1774 and ITU-R BO.1774 with specific information regarding their application in the event of natural disasters. This matter should also be drawn to the attention of ITU-T Study Group 2, which is the lead study group on telecommunication for disaster relief/early warning.

# Chapter 3

# TV broadcasting technologies for VIS

## 3.1 Extremely high resolution video system

Advances in information and communication technologies are enabling the development of video information systems (VIS) on the basis of ITU-R's global standards for high-definition television (HDTV), extremely high-resolution imagery (EHRI), ultra high-definition television (UHDTV), mobile and 3D television, and computer facilities. We need to note a number of facts related to the international standardization of such systems in this regard.

Research work is starting on developing a next-generation broadcast system that will extend the technology of HDTV, to provide greater realism and immersion, i.e. a system featuring an extremely high resolution picture of more than 4,000 scanning lines and a three-dimensional (3D) spatial sound of 22.2-multichannels.

The first demonstration models of TV facilities with large and subsequently flat screens for use in darkened rooms or for "outdoor" night-time TV broadcasting in the street were constructed on the basis of the 525- and 625-line standards.

With the first successful compression of digital HDTV signals as early as 1992 (Recommendation ITU-R BT.709) for transmission over standard radio channels (HDTV concepts 6, 7, and 8), the Chairman of CCIR Study Group 11 proposed at a meeting of Task Group 11/4 (Washington, 13-15 October, 1992) that work be continued on enhancing TV image definition and that a start be made on the international standardization of TV systems with a resolution of over 1 000 lines, as selected for HDTV systems (Documents 11F/34 dated 10 November 1994 and 11/76 dated 1 May 1995). This was based on the predicted interest in EHRI for television, sports, computer graphics, medicine, multimedia systems, and various other fields.

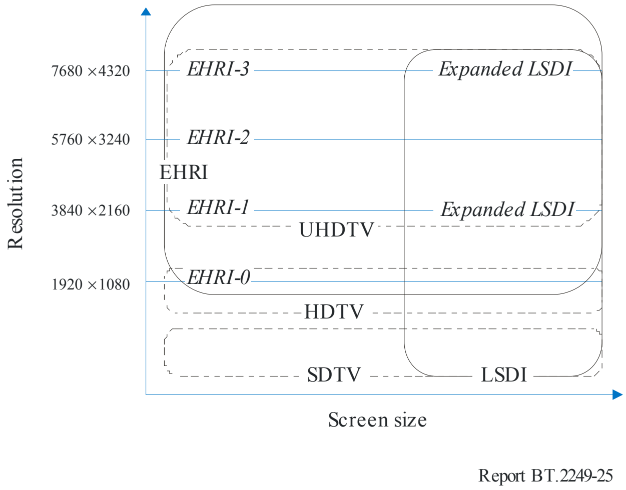
This proposal resulted in global Recommendation ITU-R BT.1201 – Extremely high resolution imagery. Pixel formats of 3 840 × 2 160 and 7 680 × 4 320 were chosen for UHDTV systems on the basis of the progress made in the development of EHRI systems in Japan.

VIS can be implemented on the basis of digital TV systems using LSDI screens with a 16:9 aspect ratio and pixel formats of 3 840 × 2 160 and 7 680 × 4 320 (Recommendation ITU-R BT.1769) for theatres, concert halls, and similar environments with low illumination.

Studies at ITU-R for high resolution imagery include extremely high-resolution imagery (EHRI), an expanded hierarchy of large screen digital imagery (LSDI), and ultra-high definition television (UHDTV). Figure 25 outlines the relationship between EHRI, LSDI, and UHDTV.

FIGURE 25

**Classification of image systems**




The international standards for HDTV, UHDTV, EHRI and LSDI broadcasting systems that are dealt with in this chapter may be used as source materials for the development of ITU-R Recommendations on VIS.

### 3.1.1 Study on extremely high resolution video system

The extremely high resolution image system called super hi-vision is being developed by NHK Science & Technology Research Laboratories in Japan as a future broadcasting system that will give viewers a much greater sensation of reality. The video system has 7 680 × 4 320 pixels and delivers images so real that viewers almost feel they are present at the scene of broadcasting; they may even find themselves trying to touch what is on the screen.

Studies into viewing realism have demonstrated that as the horizontal viewing angle is increased up to around 100°, viewers are increasingly affected by the displayed images. However large the screen, on the other hand, if the scan lines and pixels that make up the screen image can be detected, it becomes difficult for them to enjoy a sense of realism and immersion. Viewers with normal 20/20 vision have the ability of distinguishing between differences in viewing angle of as little as 1/60 of 1°. Thus, to ensure that viewers with normal vision (20/20), who are viewing a screen with a 16:9 aspect ratio, are not able to see the pixel-structure on the screen at a viewing angle of 100°, it is necessary to have approximately 8,000 pixels per horizontal line on a flat screen.

During the meeting of Working Party 6C (October 2011) NHK Corporation (Japan) demonstrated the ultra-high resolution system Super Hi-Vision (UHDTV). Many meeting participants unanimously noted the sense of "being there" in UHDTV pictures and confirmed high quality of the image, although the current 3DTV technology is not used.

When viewed at a distance of less than three times the screen height, 3 840 × 2 160 and 7 680 × 4 320 systems provide viewers with a greater sense of "being there" and greater sense of realness than with the 1 920 × 1 080 system and the 7 680 × 4 320 system performs the best.

Therefore, it is advisable to study in detail the impact of image resolution on depth perception.

Table 1 summarizes the specifications for extremely high resolution video systems on the basis of these kinds of investigations, as specified in Recommendation ITU-R BT.1769 – Parameter values for an expanded hierarchy of LSDI image formats for production and international programme exchange. The image formats, which are defined in relation to the HDTV image format with 1 920 × 1 080 pixels, offer vertical and horizontal pixel resolutions two or four times higher than those of HDTV. The image system is hierarchical, embracing HDTV and these two new formats, with the 4k-line format representing peak resolution. Defining the formats like this enables HDTV technologies and equipment to be used, and allows systems to be efficiently constructed.

TABLE 1

**Specifications for extremely high resolution video systems**

<table>
<tr><th>System</th><th>Spatial resolution<br>(horizontal × vertical)</th><th>Temporal resolution<br>(frame rate, Hz)</th></tr>
<tr><td>2k-line<br>(EHRI-1)</td><td>3 840 × 2 160</td><td rowspan="2">24, 25, 30, 50 and 60</td></tr>
<tr><td>4k-line<br>(EHRI-3)</td><td>7 680 × 4 320</td></tr>
</table>

### 3.1.2 Development of equipment for extremely high resolution video system

*Camera*

A CMOS image sensor was developed that has 33 million pixels and works at a frame rate of 60 Hz. The world's first camera systems that can capture images of 7 680 × 4 320/60/P, and have R/G/B 4:4:4 have been developed by utilizing three sensors.

The latest development is a CMOS image sensor that outputs 7 680 × 4 320 images at 120 fps. An ultra-high definition television camera that operates at 120 Hz is expected to be developed in the near future.

*Projector*

An extremely high resolution projector for the image format of 7 680 × 4 320/60/P combining three 7 680 × 4 320 LCOS panels for RGB has been developed. It has a light power output of 9 000 lumens and a dynamic range of 5 000 to 1. An ultra-high dynamic range projector has also been developed. An extremely wide dynamic range of more than one million to one with light output of 1 200 lumens has been achieved.

*Flat panel display*

A 58-inch, 3 840 × 2 160 PDP with a pixel pitch of 0.33mm, which is the smallest pixel pitch ever in a mid-size PDP panel, has been developed. The previous 103-inch, 3 840 × 2 160 PDP had a pixel pitch of 0.59 mm.

Several LCDs for 3 840 × 2 160/60/P have been reported. The latest development is an 85-inch LCD panel for 7 680 × 4 320/60/P, which is the world's first direct-view display for 8K-UHDTV.

### 3.1.3 Public viewing of extremely high resolution video system

*World Exposition*

House theme pavilion at the 2005 World Exposition Aichi, Japan. During the six months of the Expo, NHK installed a super hi-vision theatre in the global two programmes enchanted 1 560 000 spectators. The programmes were projected onto a 600-inch screen by a projector with 8 000 lumens of light output. The peak luminance on the screen was around 40 cd/m$^2$, which is almost equal to that of a typical movie theatre. To enable visitors to enjoy an acute sense of reality, the theatre was designed so that they could see the screen at a viewing distance ranging from 0.75 H to 2.0 H (H was the height of the screen of 7 m), which corresponded to a horizontal viewing angle of 50-100°.

FIGURE 26

**Theatre at 2005 World Exposition**

Report BT.2249-26

*Museum*

A super hi-vision theatre was constructed in October 2005 at the Kyushu National Museum in Japan. In particular, the museum set up a permanent exhibition room, called Theatre 4 000, to present its valuable artefacts with extremely high resolution imagery. Figure 27 shows the inside of the theatre. The art collections have been placed into digital archives to compile a library of programmes. When digital archives increase substantially in scale in the future at museums and galleries all over the world, such systems should help them considerably in promoting exchanges of collections or cooperative events through global networks.

FIGURE 27

**Theatre at Kyushu National Museum**

Report BT.2249-27

*Music show*

NHK annually broadcasts a popular music show on New Year's Eve from NHK Hall. NHK installed a super hi-vision theatre next to the hall so that more visitors than could physically be accommodated in the hall could enjoy the programme. Singers were filmed with cameras positioned among the seated audience, and visitors to the theatre enjoyed the programme on a large screen as if they were seated in the hall.

FIGURE 28

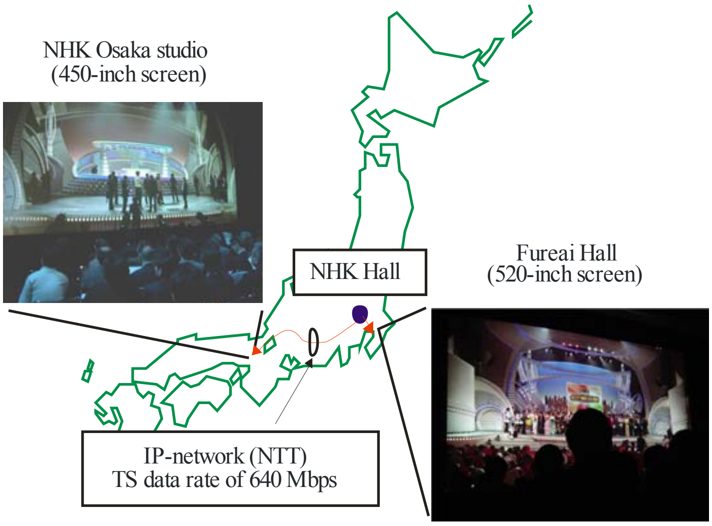
**Public viewing of music show**

Report BT.2249-28

NHK together with NTT (Nippon Telegraph and Telephone Corporation) and NTT Communications Corp. conducted an experiment in December 2006 to perform a super hi-vision broadcast of a live event over a long distance, through an optical IP network link at a verified data rate of 1 Gbit/s. A live programme with the uncompressed 22.2-channel audio of a four-hour musical event was transmitted on New Year's Eve from NHK Hall, which was located next to the NHK Broadcast Center, to a theatre that had been specially setup at the same site. MPEG-2-based encoding equipment was simultaneously used to transmit the signal at a data rate of 640 Mbits/s from Tokyo to Osaka (a distance of approximately 500 km), where the event was enjoyed at a theatre that had been set up in the TV studio of NHK's Osaka broadcasting station.

FIGURE 29

**Simultaneous public viewing of music show**




Report BT.2249-29

*International convention*

International transmissions of super hi-vision were demonstrated at IBC 2008 by the international collaboration group. The transmitted materials were presented on a 275-inch screen in a 50-seat theatre as well as on flat panel displays.

1) Live super hi-vision pictures and sound captured in central London were sent to Amsterdam over an ultra-broadband IP network. Ultra-broadband networks are becoming more widely available, so this demonstration demonstrates the possibility of live super hi-vision content being relayed from virtually anywhere in the future. The 24-Gbit/s super hi-vision video signal was compressed to approximately 600 Mbits/s by using MPEG-2 and multiplexed with uncompressed audio into MPEG-2 TS. The interaction between the MC and reporters in London was also able to be enjoyed.

2) Super hi-vision materials were transmitted via satellite from Turin to Amsterdam. Super hi-vision video was coded with MPEG-4 AVC and 22.2 multichannel sound was coded with AAC. The 140 Mbit/s coded signal was divided into two TS streams and carried over two satellite transponders, using 8PSK 5/6 modulation.

A 33 million pixel full resolution projector and camera for super hi-vision were showcased at IBC 2010. Live outside broadcasting was also conducted using an optic fibre transmission system. Uncompressed super hi-vision video and audio were transmitted live via an optic fibre network to the theatre and presented on a full resolution projector and 22.2 multichannel audio system.

*Conclusion*

There have been many other occasions where the public has viewed super hi-vision around the world. Its success has demonstrated that the combination of extremely high resolution images with multichannel surround sound displayed on a large screen gives the audience the most immersive viewing experience, which is completely different from normal TV viewing.

## 3.2 Video information system for handheld terminals

ITU-R has produced Recommendation ITU-R BT.1833 and Report ITU-R BT.2069 on multimedia broadcasting systems for mobile reception by handheld receivers. The multimedia broadcasting systems will form one type of video information system that provides information toward handheld terminals.

One multimedia broadcasting system is Multimedia System C, a one-segment version of the ISDB-T DTTB system. Integrated receivers with mobile phones have been wide spread in Japan for a broadcasting service called One-Seg. Users of mobile phone with One-Seg receivers are able to watch television as well as associated data services at any time and from anywhere. Broadcasting services connected to the Internet are also available.

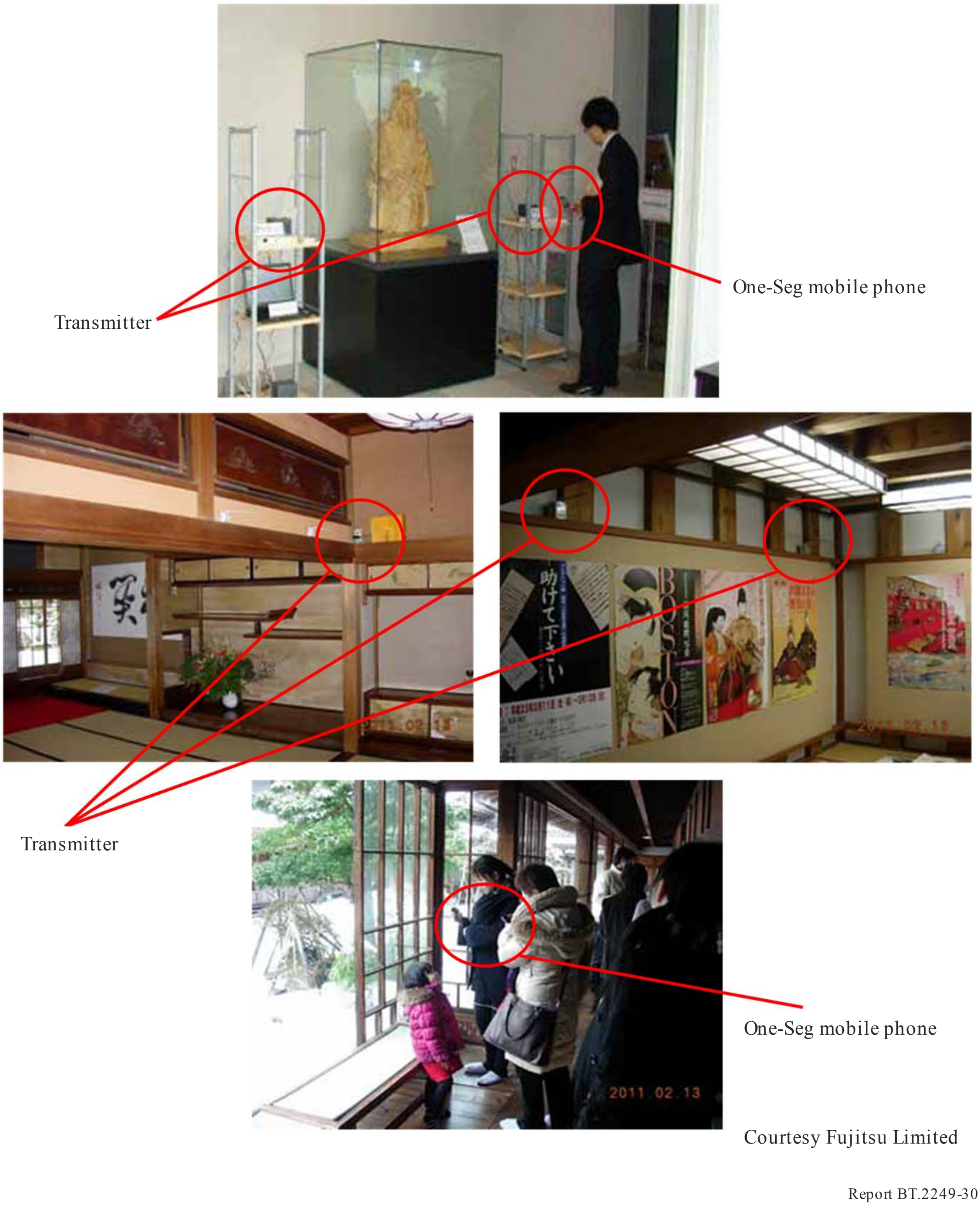
Video information services for handheld receivers within local areas have been experimentally provided throughout Japan to take advantage of the widespread use of handheld receivers and features of the system. These services have employed the same systems and technologies as those in broadcasting but with very low transmitting power to avoid creating harmful interference to existing broadcasting services. The coverage area by one transmitter without a license has normally been within a radius of 2 to 3 m or a radius of up-to 100 m by licensed transmitters. Specific information is provided to guests at local events or local facilities. It would also be effective to combine presentations on large screens and on handheld terminals, where general information was presented to the public on large screens and detailed information that was supplementary was provided to individuals on handheld terminals.

*Museum*

Field trials of video information services were conducted at various museums throughout Japan. While visitors could appreciate art, they could also obtain explanations by using their own mobile phones that functioned as broadcast receivers (see Fig. 30).

FIGURE 30

**Video information service for handheld receivers at museums**



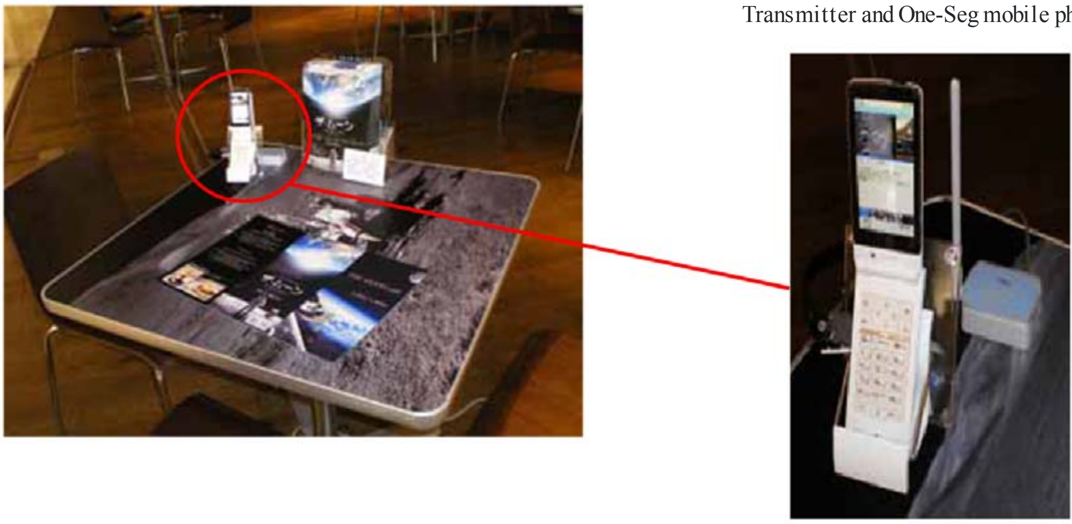
*Restaurant*

A trial was conducted at a restaurant to provide guests with supplementary information on the menu. Guests could watch video of the menu at their tables by using their mobile phones as broadcast receivers.

FIGURE 31

**Video information service for handheld receivers at restaurant**

Transmitter and One-Seg mobile phone



Courtesy Fujitsu Limited

Report BT.2249-31

*Local service*

A number of trials have been or are being conducted throughout Japan to evaluate the potential of video information services on handheld terminals within local areas such as airports, shopping malls, underground malls, schools, stadiums, town halls, within the framework of utilizing white space. Trials of video information services at evacuation centres are also being conducted to support refugees during disasters.

# Chapter 4

# Integration of VIS with TV broadcasting and other information services

## 4.1 New approach to the content of outdoor TV broadcasting having regard to the technological features of large-screen VIS

Given that VIS are designed to display various kinds of broadcasting and multimedia video information with audio accompaniment, we need to study ways and means of ensuring the optimum integration of such systems with broadcasting and other information services, taking into account the specific nature of VIS content, particularly where systems to be used in the street and other outdoor settings are concerned.

Image viewing on large outdoor VIS screens is different from home viewing inasmuch as the viewers may be either stationary or in motion – sometimes at high speed, for instance in a moving vehicle – relative to the screen. Other key considerations are the varying brightness of the ambient background at different times of the day and night and the changing distance between the moving viewer and the screen. The need to ensure comfortable viewing conditions that take account of these and other factors calls for a new approach to the content for outdoor TV broadcasting having regard to the technological specificities of large outdoor VIS screens.

An important consideration when formulating programming policy for outdoor TV broadcasting is the need to catch the attention of the information consumers, i.e. the majority of people in the city or community in question. The emotional impact of TV images seen in the street by people on the move is very different from that experienced by viewers sitting quietly at home. Grabbing the attention of moving persons calls for special programming, including so-called "attention frames" between TV fragments. Sequences should ideally last from 20 to 30 seconds and be rich in snappy emotional content – for example, short, highly topical news items from the political, social, cultural and sporting spheres, delivered without commentary, as well as "star frames". These frames, in the form of short mini-stories based, for instance, on popular TV shows help to catch viewers' attention for long enough to ensure that they go on to watch the subsequent video content, including possible advertisements, viewed more favourably under these circumstances than when they interrupt one's home TV viewing. It should be noted that special programmes recently created for mobile TV broadcasting do not meet the objectives of outdoor VIS.

It can thus be seen that VIS and the outdoor TV broadcasting currently taking shape not only respond to the challenges of our time but also testify to a new era of information viewing while opening up the way towards a new type of content.

What will be the impact of the new VIS, and why can we now consider the new age in the development of the screen arts, with TV broadcasting in pride of place, to be upon us? Traditionally, watching TV at home takes place in a darkened space of limited dimensions, whereas outdoor TV broadcasting regularly takes place in the open. This fact imposes special requirements on the producers – directors, camera operators, actors, technical operatives – of new screen stories in regard to image perception. In addition, large outdoor VIS screens call for a special kind of subject-matter and a specific approach to the presentation of information. The screen must be installed such as to be visible from all angles and, most importantly, from afar. The image, including any captioning or other graphic elements, must be discernable over a considerable distance. It should therefore be presented as close-up fragments, unlike TV programmes for home viewing, which, in addition to close-ups, will contain medium-sized and small subjects.

It is to be noted that a viewer looking at a home normally remains in one position, but is unlikely to do so in an outdoor situation. The vertical and horizontal image viewing angles change, as does the brightness of the ambient background. These factors have to be taken into account when preparing sequences for VIS, so that the composed "picture" is perceived as a whole without any distortion. The audio accompaniment also has to be harmoniously integrated into the VIS sequence.

The shape of large outdoor screens is an important consideration. The current preference is for flat screens. However, round, concave, spherical and other forms of screen are now making their appearance. The most attractive type of screen for mass audiences is a large one – possibly round and even revolving – set up in the centre of a city square. Such features make for a considerable increase in audience numbers since the screen is visible from all angles. To increase those numbers still further, consideration is being given to the possibility of setting up outdoor screens on high ground, as well as of raising them by means of aircraft, subject to safety measures and the requisite parameters for the viewing of video information.

In some cases, large screens can be used in split-screen mode, simultaneously displaying different TV sequences.

### 4.2 Integration of outdoor VIS with 3D TV broadcasting

One of the basic requirements where VIS systems are concerned is that they permit "glasses-free" viewing of different types of broadcasting and multimedia video information on the same screen, having regard to the above-mentioned special characteristics of VIS content. This is made possible through the integration and compatibility of VIS with various video services, including 3D TV broadcasting systems that are compatible with 2D broadcasting.

3D TV technologies that are compatible with 2D systems are considered in an ITU-R report on the subject (Report ITU-R BT.2160 – Features of three-dimensional television (3DTV) video systems for broadcasting). The report proposes hierarchical levels of system compatibility characterizing the features of the image as displayed using existing 2D or specialized 3D TV facilities.

Information on progress made in the development of 3D TV technology can be found in the papers of the Workshop on Three-dimensional television broadcasting, organized by ITU, EBU and SMPTE [Toward worldwide standards for first and second generation 3D TV // Workshop on Three-dimensional television broadcasting, EBU, Geneva, 30 April 2009].

The future study should concentrate on specific issues pertaining to outdoor 3D TV for VIS.

### 4.3 Extension of the use of ITU-R Recommendations for LSDI applications to a subset of VIS applications

The ITU Terminology Database defines LSDI as "a family of digital imagery systems applicable to programmes such as dramas, plays, sporting events, concerts, cultural events, etc., from capture to large screen presentation in high resolution quality in appropriately equipped theatres, halls and other venues."

The area of application of LSDI is thus limited to HDTV applications relevant to television programmes intended for large screen presentation.

Documents (6/330, 6A/482, 6B/268, 6C/447, 27 April 2011) note the following definition for VIS:

"VIS is a multifunctional interactive system displaying video information with high quality on screens of various sizes in places for viewing both in open areas (squares, streets, stadiums and other) and in large premises (halls, shopping centres, underground stations and the like)".

The definition of VIS thus covers interactive systems (supposedly including systems that support local interactivity), high quality video information systems (supposedly including HDTV), and viewing in open areas and also in large closed premises.

Hence, there is a degree of overlap among LSDI applications and some VIS applications; LSDI applications may be considered as the subset of those VIS applications that are based on local interactivity and on HDTV digital imagery for presentation of programme material.

ITU-R has issued a consistent number of Recommendations relevant to LSDI, which may be extended to cover VIS applications.

Such an extension would lead to desirable commonality of specifications and implementation approaches, where appropriate, among LSDI applications and some VIS applications, and it would also formally recognize the potential for that subset of VIS applications to also use a number of ITU-T Recommendations in the J-series, which ITU-T SG 9 has issued for the delivery of LSDI application by means different from broadcasting (e.g. cable-casting, web-casting, etc.).

A draft new Recommendation has been prepared, intended to extend the applicability of Recommendations that have been issued for LSDI applications, to their use for VIS applications.

## 4.4 VIS safety

### 4.4.1 Information safety

Content safety is of particular importance for VIS systems in view of their use for the provision of public information in heavily-frequented locations. The utmost attention should be paid to ensuring that information and the underlying infrastructure (communication channels, power supply systems and so on) are protected from man-made (intentional) influences which may inflict damage on all participants in the information relationship. To this end, cryptographic solutions, information backup, uninterruptible power supply systems and so on may be used.

It would be appropriate to supplement Recommendation ITU-R BT.1852 – Conditional-access systems for digital broadcasting with information safety methods for VIS with large outdoor screens.

To help the development of international Recommendations for effective content safety of VIS, it was proposed to collaborate with ITU-T SG 17 as the leading Study Group on telecommunication security, on studies of those systems.

### 4.4.2 Screen safety

Issues of information and functional safety with respect to VIS screens can be resolved by developing safety mechanisms to guard against information substitution within the display units, so as to avoid disturbances and the showing of unauthorized video sequences. Measures should likewise be taken to prevent breakdowns and mechanical damage to displays.

## 4.5 Audio accompaniment for VIS services

### 4.5.1 Audio accompaniment using loudspeakers

Systems providing sound accompaniment for VIS video content are characterized by the following features:

– Provision of audio content over large, heavily-frequented areas (open spaces), with the sound sources at a considerable distance from one another (with poorly-located loudspeakers liable to produce a disturbing echo, both in the open and in large indoor spaces).
– Sound-wave propagation under outdoor conditions depends to a large extent on climatic factors and atmospheric conditions (dust concentration, mist or fog, etc.).
– Open spaces are always subject to different forms of acoustic noise and interference.

We may draw a distinction between concentrated, area-based, distributed and narrow-beam sound systems, the application of which will depend on the particular characteristics of any given VIS.

*Concentrated sound systems*

Such systems are centralized and use powerful loudspeakers located at various points around the area to be served, according to its configuration. Where there is a high level of acoustic noise (streets, squares, etc.), it may be necessary to use horn loudspeakers, characterized by a high sound pressure and narrow directivity for a relatively small range of reproducible frequencies. Such sound systems are most suitable for use in open spaces, with one or more loudspeakers set up at a single spot. According to the configuration of the space in question, they may either be stacked one above the other, thereby boosting the system's directivity and range, or arranged in a semi-circle so as to reach a far broader area.

Horn loudspeakers provide a fairly low quality of sound. In enclosed areas with a low noise level it is therefore better to use sound systems offering a broad range of reproducible frequencies. In most cases, for example, one loudspeaker will suffice for a room up to 12 m wide. In wider rooms it will be desirable to have two or four loudspeakers, in which case they should be positioned such that their acoustic axes are parallel to one another.

*Area-based systems*

Area-based (decentralized) sound systems may be divided into linear and spatial systems.

Linear area-based systems should be used to deliver audio within extensive but narrow spaces such as streets. It is to be noted that such systems entail a fairly high risk of echo on account of the sound-wave propagation difference between adjacent loudspeakers. An echo may originate in the direct vicinity of the loudspeaker, since it is here that the sound-wave propagation difference is greatest. In such cases, sound-wave propagation difference is to be understood as meaning overlapping between the sound received from a loudspeaker by a listener standing very close to it and the sound being emitted by an adjacent loudspeaker. For this reason, care should be taken when designing such systems to disperse the sound delivery areas and plan those areas that will not be served. Such systems are actually made up of a number of single-site systems, each serving its own area.

When similar systems are used to provide street audio by means of column loudspeakers (sound systems set up in open spaces), barely any echo is heard. This is achieved by employing a large number of column loudspeakers having a lower sound pressure than horn speakers. It is also to be noted that this solution will result in a far less uneven sound distribution than if horn speakers were used for the same street.

Spatial area-based systems are used for large areas deemed unsuited to the use of single-site sound systems. Such systems may comprise semi-circular grouped sets of horn speakers or column speakers, and provide sufficiently even sound coverage for both outdoor spaces and large indoor areas.

*Distributed systems*

Distributed sound systems are suitable for indoor audio delivery. They can be divided into linear and surface systems. Linear systems are used for long, narrow rooms, in which case the speaker arrangement is referred to as a chain. According to the configuration of any such room, it may receive sound from one or two chains of audio systems that are either wall mounted or mounted on suspended ceilings. The main system parameters are the height of the speaker chain fixture above the surface to which the sound is to be delivered, the distance between adjacent speakers and unevenness of sound delivery.

Surface systems are best used in large rooms with the speakers set out in a lattice arrangement.

*Narrow-beam systems*

Narrow-beam sound systems are suitable for indoor and outdoor audio delivery.

They are widely used for audio delivery at exhibitions, museums and showrooms. The sound beam can be directed towards a specific area while at other areas the sound will be unheard.

This technology creates a high-density narrow beam of sound that can be steered with the same precision as light beam. A diameter of sound beam can be from 2 to 200 meters. Uniform sounding in case of 2 meters beam diameter will be provided by two adjacent sound emitters horizontally spaced by about 2 meters (http://www.holosonics.com/brochure/Audio_Spotlight-Brochure.pdf).

Distributed sound delivery to open spaces such as mass public events can be reached using sound reflectors and diffusers.

### 4.5.2 Personalized audio accompaniment

The audio accompaniment for VIS content that we looked at in the preceding subsection has the following main shortcomings:

– Possible occurrence of echo and cross-interference between adjacent speakers.

– Dependency of sound-wave propagation in open-air spaces on climatic factors and atmospheric conditions (dust levels, mist/fog, humidity, etc.).

– External acoustic interference, and so on.

All of this has a considerable influence on the evenness and distinctness of the audio accompaniment experienced in the target area, in addition to which audiences may find it annoying, for example, to have to hear a succession of different languages.

The above shortcomings can to a large extent be eliminated by providing audiences with a customized interactive audio experience via standard mobile terminals. The ever-increasing ownership of such terminals (there are now some five billion of them worldwide, for a global population of 6.7 billion) makes such an approach altogether realistic.

During the international “Expo 2010” exhibition in Shanghai, the Russian pavilion featured a new multi-image VIS screen which enables the subscriber to select a given screen and the language for the audio accompaniment. All of this is set up interactively by the subscriber with the aid of a menu that is transmitted to his or her standard mobile terminal.

# Chapter 5

# Assessing the quality of VIS video services

## 5.1 Viewing images on VIS screens

Comfortable viewing of TV and multimedia on VIS screens with different sizes is possible at an optimum distance between a viewer and a screen and the optimum horizontal viewing angle in accordance with Recommendation ITU-R BT.1845.

According to this Recommendation, the optimal horizontal viewing angle refers to the angle at which the image appears at the optimal viewing distance, when two contiguous pixels subtend an angle of 1 arc-min at the viewer's eye.

The optimal viewing distance and the optimal horizontal viewing angle in image heights (H) are shown in Table 2.

TABLE 2

**Optimal horizontal viewing angle and optimal viewing distance in image heights (H) for various digital image systems**

| Image system ($h \times v$) | Reference | Aspect ratio ($a : b$) | Pixel aspect ratio ($r$) | Optimal horizontal viewing angle ($\theta$) | Optimal viewing distance ($d$) |
|---|---|---|---|---|---|
| 720 × 485 | Rec. ITU-R BT.601 | 4:3 | 0.89 | 11° | 7 *H* |
| 640 × 480 | VGA | 4:3 | 1 | 11° | 7 *H* |
| 720 × 576 | Rec. ITU-R BT.601 | 4:3 | 1.07 | 13° | 6 *H* |
| 1 024 × 768 | XGA | 4:3 | 1 | 17° | 4.5*H* |
| 1 280 × 720 | Rec. ITU-R BT.1543<br>Rec. ITU-R BT.1847 | 16:9 | 1 | 21° | 4.8 *H* |
| 1 400 × 1 050 | SXGA+ | 4:3 | 1 | 23° | 3.3 *H* |
| 1 920 × 1 080 | Rec. ITU-R BT.709 | 16:9 | 1 | 31° | 3.2 *H* |
| 3 840 × 2 160 | Rec. ITU-R BT.1769 | 16:9 | 1 | 58° | 1.6 *H* |
| 7 680 × 4 320 | Rec. ITU-R BT.1769 | 16:9 | 1 | 96° | 0.8 *H* |

## 5.2 Subjective assessment of the quality of images on the "indoor" VIS screens

The following Recommendations should be used for subjective assessments of VIS images:

1) Recommendation ITU-R BT.500 – Methodology for the subjective assessment of the quality of television pictures

2) Recommendation ITU-R BT.710 – Subjective assessment methods for image quality in high-definition television

3) Recommendation ITU-R BT.802 – Test pictures and sequences for subjective assessments of digital codecs conveying signals produced according to Recommendation ITU-R BT.601

4) Recommendation ITU-R BT.1128 – Subjective assessment of conventional television systems

5) Recommendation ITU-R BT.1129 – Subjective assessment of standard definition digital television (SDTV) systems

6) Recommendation ITU-R BT.1210 – Test materials to be used in assessment of picture quality

7) Recommendation ITU-R BT.1438 – Subjective assessment of stereoscopic television pictures

8) Recommendation ITU-R BT.1663 – Expert viewing methods to assess the quality of systems for the digital display of large screen digital imagery in theatres

9) Recommendation ITU-R BT.1702 – Guidance for the reduction of photosensitive epileptic seizures caused by television

10) Recommendation ITU-R BT.1729 – Common 16:9 or 4:3 aspect ratio digital television reference test pattern

11) Recommendation ITU-R BT.1788 – Methodology for the subjective assessment of video quality in multimedia applications

12) Recommendation ITU-R BT.1845 – Guidelines on metrics to be used when tailoring television programmes to broadcasting applications at various image quality levels, display sizes and aspect ratios.

## 5.3 Objective measurement of VIS image quality

Possible use of the following key Recommendations should be taken into account in the objective measurement of TV and multimedia image quality on VIS display screens:

1) Recommendation ITU-R BT.1885 – Objective perceptual video quality measurement techniques for standard definition digital broadcast television in the presence of a reduced bandwidth reference

2) Recommendation ITU-R BT.1908 – Objective video quality measurement techniques for broadcasting applications using HDTV in the presence of a reduced reference signal.

## 5.4 Future work

The list below provides an indication of some entities within and outside ITU that have expertise relevant to the assessment of VIS video service quality and which could cooperate with ITU-R Working Party 6B in this area of studies within ITU-R Study Group 6.

**ITU bodies**

ITU-R Working Party 6C

ITU-T Study Group 9

ITU-T Study Group 12

ITU-T Study Group 16

ITU-T Study Group 17

**Some other international or regional standardizing bodies and forums**

SMPTE – Society of Motion Picture and Television Engineers

ARIB – Association of Radio Industries and Businesses

ATSC – Advanced Television Systems Committee

ETSI – European Telecommunications Standards Institute

IEC – International Electrotechnical Commission

ISO – International Organization for Standardization

ISO/IEC JTC1/SC29/WG11 (MPEG) – Moving Picture Experts Group

**International or regional unions and associations of broadcasters**

WBU-TC – Technical Committee of the World Broadcasting Unions

Regional unions and associations of broadcasters (ABU, ASBU, CBU, EBU, IAB, NABA, OTI, URTNA)

Cooperation with these organizations could result in the development of international standards and Recommendations on the quality of VIS video services.

# Chapter 6

# VIS displays

## 6.1 General requirements for VIS displays

As things stand, VIS displays generally take the form of information panels optimized for the presentation of textual and graphical information. Unsatisfactory results are thus obtained when such displays are used for presenting high-grade images or multimedia video information, including HDTV. The reasons for this are as follows:

– low physical resolution of the screen;

– limited dynamic range for changes in brightness and contrast ratio;

– narrow colour triangle (locus) and small variety of shades;

– inadequate response speed resulting in a lower-quality image when seeking to reproduce the naturalness of dynamic objects in motion;

– the autonomous nature of displays makes it impossible to associate several displays in a uniform information network;

– lack of feedback to the video programme preparation centre means that remote operators are unable to monitor the presence and quality of the image on the screen.

Another important reason for the efficiency shortcomings of existing VIS displays is their inability to adapt the image brightness and contrast to outdoor light conditions, which can change hundreds of times in the course of one day. Displays with optimum brightness for midday will therefore be excessively bright in the morning and evening and in overcast conditions. Such over brightness causes eye fatigue, making the viewing of video information less comfortable. Another negative factor is the unnecessarily high power consumption in low outdoor light conditions, which, given the projected huge uptake of VIS, is liable to represent an undue burden on the environment.

Depending on the way in which they are to be used, VIS can be divided into two main groups, namely indoor and outdoor.

Outdoor displays have to be highly stable and resistant to climatic and mechanical factors. Such VIS must remain serviceable under all possible weather conditions in the region in question. In the case, for example, of Russia and countries with similar climatic conditions, the outside temperature can vary between –50 and +50°C.

Indoor and outdoor VIS displays differ in terms of pixel size and brightness range. As a rule, indoor displays have a pixel size not exceeding 8 mm and a brightness of up to 1 000 cd/m$^2$, making plasma (PDP) displays the preferred option. Outdoor displays, on the other hand, generally have a pixel size exceeding 8 mm and a brightness of 10 000 cd/m$^2$, making LED screens the preferred choice.

Practically all modern VIS displays are made up of a number of video display modules combined into a composite unit, making it essential to have very high synchronicity between the individual modules, as well as identical brightness, contrast and colour characteristics. In addition, the VIS video module control circuit must accommodate the real-time formation of video signals for each video module from any source connected to its input, with automatic scaling of image scanning formats to bring them into conformity with the module's physical resolution parameters. The electronic circuitry of a VIS must enable the smooth and natural representation of subjects in motion without loss of information.

### 6.1.1 Requirements related to ambient lighting

It is common viewing experience that the same image will appear too bright when viewed under soft ambient lighting, or it will appear too dim when viewed under bright ambient lighting.

Similarly, the same image will appear too "cold" when viewed under "warm" ambient lighting (at a low color temperature) or it will appear too "warm" when viewed under "cold" ambient lighting (at a high color temperature).

Broadly speaking, a video image will best visually "merge" in the ambient in which it is displayed, when its color temperature roughly matches the color temperature of the ambient lighting and when its peak-white brightness roughly matches the brightness of whites in the ambient. Indeed, the image peak brightness needs to somewhat exceed the ambient peak brightness if the displayed VIS message is intended to catch the attention of casual viewers.

The level and color temperature of ambient lighting (if the ambient lighting has a continuous spectrum) can be readily measured by mounting a simple tri-stimulus photometer in the vicinity of the VIS display. Based on the photometer readings, it is then possible for the VIS display to automatically adjust its white level and color temperature within its allowed ranges, to the level and color temperature of the ambient lighting. If this feature is considered important for the envisaged display applications, then the display should include the necessary image processing power.

### 6.1.2 Requirements related to weatherproofing and thermal control

A requirement of all displays intended for outdoor VIS presentations is that they should be designed to operate in all kinds of weather, including under mist, rain, snow and hail. Consequently the display should be adequately weatherproofed. This imposes special care in the design of its covers and ventilation slots, if any.

Displays intended for outdoor VIS presentation should also have an adequate thermal control in order to be capable to operate even in full sunlight on hot days, taking into account that, when the display is placed in full sunlight, its image brightness needs to be increased to somewhat compensate for the high level of ambient lighting and this increases the heat generated within the display itself.

### 6.1.3 Requirements for high quality VIS displays

In view of the above, high-quality displays for VIS must meet the following requirements:

1) Types and formats of displayed signals

– VIS must reproduce SDTV, HDTV, UHDTV and EHRI images with interlaced or non-interlaced raster from sources connected to the VIS inputs, as well as multimedia images, without loss of information from these signals. The latter requirement is met where the physical resolution (pixel matrix) of the VIS display equals or exceeds the resolution of the input video signal. In this case, the VIS display's scaling circuitry should up-convert the input signal. If, on the other hand, the resolution of the input signal is higher than the physical resolution of the screen, the signal will need to be down-converted with minimum information loss.

– The physical resolution of a VIS must not be below that of Full HDTV (1 080 × 1 920 pixels) with the capability of displaying a 1 080p high-definition signal. As the high-speed communication infrastructure continues to develop, and with the emergence of high-resolution video content and ongoing advances in display technology, the requirements in regard to VIS display resolution can be increased to the levels of UHDTV and EHRI, and thereafter possibly to the level of glasses-free 3D TV for public viewing.

– VIS must accommodate the playback of digital video signals with a capacity not less than an 8 bit brightness signal for black-and-white images and 24 bit representation of colour signals. In the future, it will be possible to raise these requirements to 12 and 36 bits, respectively.

– VIS screens can have a 4:3 format (recommended for displaying SDTV signals) or a 16:9 format (recommended for HDTV, EHRI and UHDTV).

– The diagonal screen size may be from 2 to 10 m for indoor VIS, and over 10 m for outdoor VIS. The horizontal screen size for a 4:3 TV format may be 3 × 4 m, 6 × 8 m, 9 × 12 m, 12 × 16 m, etc.

**Screen dimensions and image viewing distance on a VIS screen**

The key criteria for calculating the potential number of viewers of a VIS display during large-scale events are visual resolution and image viewing distance.

Table 3 illustrates the relationship between the linear dimensions of the display screen and the effective image perception distance.

TABLE 3

**Correlation between linear dimensions and area of effective perception of the information (www.screens.ru)**

| Linear dimensions of electronic screen (height above ground) | Minimum distance | Optimum distance for graphics and video | Optimum distance for textual information |
|---|---|---|---|
| 3 × 4 m (>3 m) | 5 m | 10-30 m | 10-20 m |
| 4 × 6 m or 5 × 7.5 m (>4 or 5 m) | 5 m | 10-50 m | 10-30 m |
| 6 × 8 m (>5 or 7 m) | 10 m | 20-70 m | 20-50 m |
| 9 × 12 m (>6 or 9 m) | 10 m | 20-200 m | 20-100 m |
| 12 × 16 m (>6 or 12 m) | 15 m | 40-300 m | 40-200 m |

This table gives only a general idea, since the parameters it presents depend on the specific location of the screen and size of the pixels. What it does show is that the greater the linear dimensions, the greater the distance and area of information perception (both text and video), and hence the greater the potential size of the venue served by the display.

Pixel size is likewise an important consideration, as is the distance between the centres of the colour dots forming the full-colour image. The criteria for choice of pixel size depend on the way in which the VIS is to be used. Table 4 shows the relationship between pixel size and the viewing distance at which two adjacent pixels can be distinguished. The resolution of the human eye (for 100 % vision) is assumed to be one angular minute.

TABLE 4

**Relationship between pixel size and the viewing distance**

| Pixel size (mm) | Viewing distance at which adjacent pixels can be distinguished (m) |
|---|---|
| 1 | 3.6 |
| 2 | 7.2 |
| 4 | 14.4 |
| 8 | 28.8 |
| 10 | 36 |
| 16 | 57.6 |
| 32 | 115.2 |

For dynamic video images, the minimum distance for “comfortable” viewing decreases by half.

2) Requirements for VIS display modules

– Image brightness and contrast. These characteristics are of particular importance if it is planned to use an electronic screen/display during daylight hours and it is impossible to prevent direct sunlight from falling onto it. This calls for use of a system with a screen brightness not less than 10 000 cd/m$^2$. If, on the other hand, the screen does not face direct sunlight (being installed, for example, on the porch of a building with the building protecting it from the sun), a brightness of 5 000 cd/m$^2$ may be sufficient.

It is important to choose the brightness parameters of the video modules according to the manner in which the VIS is to be used. For standard premises (showrooms, industrial exhibitions, etc.), indoor panels with a brightness of 1 000 cd/m$^2$ are used in order to surpass other light sources by a factor of three. Higher levels of brightness will result in viewing discomfort in premises with soft lighting (theater foyers, art galleries, etc.), where a brightness rating of 300 cd/m$^2$ is recommended. For open-air use, outdoor panels with a wide range of brightness variation are used. To ensure good image contrast, video modules must have an antiglare surface and not reflect sunlight into the viewing area. For night-time viewing, the comfortable brightness value is around 300 cd/m$^2$.

Table 5 shows recommended brightness values for VIS displays:

TABLE 5

**Recommended brightness values for VIS displays**

| Type of display | Brightness range |
|---|---|
| Outdoor | 300-10 000 cd/m$^2$ |
| Indoor | 200-1 000 cd/m$^2$ |

For optimum viewing conditions, an outdoor VIS should include an adaptive brightness and contrast capability that responds to changes in the ambient light level and average image brightness.

– The speed at which the signals are processed in the VIS’s digital signal processor (DSP) and its video modules must be sufficient to ensure the representation of natural movement without any visible artefacts. For these reasons, it is preferable to use formats with progressive raster.

– Care should be taken to ensure that images can be viewed from a wide range of angles in the vertical and horizontal planes without appreciable changes in brightness and contrast. The choice of viewing angle for a VIS display determines the manner in which it can be used. For an indoor VIS, the maximal viewing angles usually lie between ±70° in the horizontal plane and from 0° to 45° in the vertical plane. A wider viewing angle in the horizontal plane is inadvisable owing to significant geometric distortion of the image and complete loss of perception quality. Viewing of the image at angles greater than 45° in the vertical plane causes physical discomfort to the viewer, since a VIS screen is mounted as high up as practicable and viewing it from above is in most cases impossible. For outdoor use, the same or a smaller viewing angle is recommended, since a greater angle generally requires use of an antiglare coating on the VIS panel, which in turn increases the power consumption. For optimum viewing, it is recommended that panels be set up at an inclination from the vertical.
– Nowhere in the viewing area must images on a VIS screen present visible geometric or other distortions, including jagged edges on diagonal lines.
– To improve image quality in VIS, it is recommended that use be made of the picture enhancement methods that are widely and effectively used in modern TV sets, namely:
  – enhancement of the image's grey tones (grey scale);
  – colour correction;
  – algorithms to enhance the on-screen portrayal of movement.

3) Requirements for VIS displays consisting of several modules

For display screens comprising several modules, the following additional requirements apply:

– In each module, the brightness, contrast and colour rendition parameters must be identical.
– No visible seams between video modules.
– The DSP must distribute the source image signals to the video modules without any information loss.

4) Additional requirements for VIS

– High reliability, including built-in self-diagnostics with automatic transmission of fault data to the control centre.
– Where the distance between remote control centres and VIS displays is great, it is advisable to use remote monitoring and control of the system parameters and image quality. Use of wired or wireless television cameras for direct monitoring of the on-screen image is preferable.
– High resistance to destruction (anti-vandal protection), including a built-in system for automatic transmission of attempted damage or theft alerts.
– Ability to link VIS displays into information systems for simultaneous presentation of images, including for the purpose of providing public information in emergency situations.
– Interactive information exchanges between viewers and the control centre by means of suitably-enabled mobile terminals.
– Direct broadcast capability for sporting, cultural and other large-scale events.

The main parameters for VIS displays are shown in Table 6. In many cases, the parameters for indoor and outdoor displays are the same. However, the difference between the two types of display in terms of viewing conditions is that outdoor screens are viewed from far greater distances than indoor displays. Accordingly, the requirements for the resolution (i.e. minimum pixel size) of indoor displays, which are viewed from shorter distances, are generally more exacting than for outdoor displays. At the same time, the requirements for brightness range, spectral composition of outdoor illumination and colorimetry for outdoor displays are considerably higher than for indoor displays; and the requirements for the size of the brightness and chromaticity adaptation range are generally higher for outdoor than for indoor displays. Finally, the requirements in regard to stability vis-à-vis external influences (including climatic) are more exacting for outdoor displays.

TABLE 6

**The main parameters for VIS displays**

| Types of display | | |
|---|---|---|
| **Display parameters for VIS** | **For indoor use** | **For outdoor use** |
| Input signal<br>• TV<br>• PC | <br>NTSC/PAL/SECAM<br>VGA, XGA, SXGA/UXGA | <br>NTSC/PAL/SECAM<br>VGA, XGA, SXGA/UXGA |
| Display image format | 4:3 (SDTV)<br>16:9 (recommended for HDTV, EHRI and UHDTV) | 4:3 (SDTV)<br>16:9 (recommended for HDTV, EHRI and UHDTV) |
| Physical screen resolution (in pixels)<br>a) reference level<br>b) high level | <br>1 920 × 1 080 @ 50/60/24 Hz (2K)<br>3 840 × 2 160 (4K) | <br>640 × 480 @ 50/60 Hz<br>1 920×1 080 @ 50/60/24 Hz (2K) |
| VIS displays must render SDTV and HDTV video or multimedia signals with non-interlaced or interlaced raster with the following capacity:<br>• For a black and white image<br>• For a colour image<br>• Recommended | <br>8 bit<br>24 bit<br>36 bit | <br>13 (8+5) bit *<br>24 + 5 bit*<br>24 + 7 bit* |
| Brightness (cd/m²)<br>• Daytime<br>• Night-time | <br>1 000<br>200 | <br>10 000<br>300 |
| Image viewing angle (vertical/horizontal) for direct viewing of display<br>• For displays with direct frontal viewing<br>• For displays suspended high up | <br>160/160<br>120/60 | <br>160/160<br>120/60 |
| Image colour temperature ** | From 3 000 to 9 000°K | From 3 000 to 9 000°K |
| Working temperature range<br>Min:<br>Recommended: | <br>From –5 to +50°C | <br>From –40 to +50°C<br>From –50 to +50°C |
| Humidity % | 10-80% | 0-98% |

TABLE 6 (*fin*)

**The main parameters for VIS displays**

| Types of display | | |
|---|---|---|
| **Display parameters for VIS** | **For indoor use** | **For outdoor use** |
| Power supply | 100-240 V AC<br>50 or 60 Hz | 100-240 V AC,<br>50 or 60 Hz<br>*or*<br>Three-phase 3*220/380 V AC,<br>50 or 60 Hz |
| Lifetime | >50 000 hours | >50 000 hours |

* Plus 5 bits for brightness regulation ("black level") in "day/night" modes (with the addition of a further 2 bits recommended for gamma correction).

** Depending on the lighting characteristics (brightness and spectral composition of the ambient light).

For example, in accordance with Russian Federation Standard GOST R 52870-2007 "Means for displaying information for collective viewing. Requirements for the visual display of information and measurement methods", the optimum viewing distance $r_{\text{view}}$ is determined by the distance L between the screen's radiating elements and the theoretical angular discrimination of eyesight ψ (where pupil diameter (d) = $3 \cdot 10^{-3}$ m and the wavelength corresponding to the maximum value for the eye's spectral sensitivity (λ) = 555 nm = $0.555 \cdot 10^{-6}$ m) and may be expressed by the following formula:

$$l = \psi \cdot r_{\text{view}},\ \psi = (1.22\ \lambda)/d, r_{\text{view}} ld/(1,22\ \lambda),$$

where $r_{\text{view}}$ is the shortest distance from screen to viewer at which the individual screen elements (pixels) will be indistinguishable. The value of $r_{\text{view}}$ is determined by means of the expression:

$$r_{view} = \frac{l \cdot 3}{1.22 \cdot 0.555 \cdot 10^{-3}} = l \cdot \frac{3}{0.677} \cdot 10^3 = \ell \cdot 4.43 \cdot 10^3 \text{mm}$$

For example, if L = 10 mm, then $r_{\text{view}} = 10 \times 4.43 \times 10^3$ mm = 44.3 m.

The above information may be used as reference data for development of an ITU-R Report, and there after also for recommendations on requirements in respect of VIS displays.

## 6.2 Main types of screen for VIS displays. Requirements for display screens

### 6.2.1 Review of screen technologies for VIS displays

(http://www.ekranua.com/ru/; http://www.incotex.com)

The following main VIS display technologies are currently in use:

– panels based on gas-discharge (plasma) modules;

– monolithic plasma display panels (PDP) (screen size up to 1.5 m);

– displays based on projection modules;

– LED screens for outdoor use;

– LED screens for indoor use, with smaller pixels (3-6 mm).

Some of these displays can be used only for alphanumeric information (e.g. plasma modules).

**Plasma display panels (PDP)**

In terms of their brightness, resolution, contrast, size and screen depth parameters, PDPs based on single-unit (comprising a single video module) plasma panels successfully compete with projection systems with screen sizes ranging from 1 to 1.5 m. In this size range, composite screens made up of plasma modules are not normally used on account of the thickness of the side sections in which the driver units are housed. However, with the recent appearance of display modules with a gap width of 3 mm and thinner, the use of composite displays comprising four video modules is becoming increasingly common.

The flat plasma screen market currently features models with an aspect ratio of 16:9 and resolution of 1 365 × 768 pixels. The lifetime of a plasma screen is in the order of 25 000 hours.

Among the disadvantages of single unit (monolithic) plasma panels are the following:

– limited diagonal screen size – around 1.5 m for mass production models;
– cannot be used in composite screens on account of the significant width of the side sections (30-100 mm);
– complexity of servicing and repair (on expiry of lifetime all panels have to be fully replaced);
– actual operational lifetime relatively short at around 25 000 hours;
– relatively narrow operational temperature range (0 to 40°C) is relatively narrow.

Monolithic PDPs are designed primarily for use in airports, railway stations, supermarkets, exhibition halls, and concert halls.

**Rear-projection monitors (video modules)**

For the display of high-resolution information (UXGA –1 600 ×1 200 pixels and higher), rear-projection monitors with a diagonal screen of 5 m and SXGA or UXGA resolution may be used. A video projection module comprises a projector, a reflecting mirror and a rear-projection screen (moveable as determined by the magnification ratio).

The disadvantages of such information display systems include the following:

– large depth (0.7-1.5 m) for a screen diagonal of 1.7-5 m;
– low image brightness (around 300 cd/m$^2$), although adequate for indoor use;
– low image contrast (around 500:1);
– limited lifetime of the powerful light sources (backlights) used in such systems (some 2 000 hours – less than half a year of continuous operation).

**Multi-component (composite) screens comprising several rear-projection video modules (video wall)**

– Where the need is for high-quality, high-resolution images and graphical information over viewing systems (including geographic information systems, situation rooms, etc.), wide use is made of multi-component (composite) screens comprising several rear-projection video modules. The information may be displayed either over the entire surface of the composite screen or in “multi-window” mode (where the “windows” can be of any size and the information displayed in any part of the screen). The screen-to-screen gap is 1 to 3 mm.
– Where each XGA module has a resolution of 1 024 × 768 pixels and the number of modules is nine (in a 3 × 3 configuration), the overall screen resolution is 3 072 × 2 304 pixels. Such resolution coupled with an adequate brightness level cannot be achieved by using a single rear-projection monitor. The lifetime of lamps used in projectors

for composite rear-projection screens is around 8 000 hours (approximately one year of continuous operation).

– The disadvantages of information management and display setups using multi-component screens include the following:
  - low image brightness (around 300 cd/m$^2$);
  - low image contrast (around 500:1);
  - large unit depth: 800-900 mm plus an area behind the screen to allow for maintenance.

**VIS displays based on LED technologies**

Full-colour LED screens with pixel size 3 to 40 mm are designed to display full-colour dynamic images in all existing standards. There are both indoor and outdoor versions.

LED screens are notable for their brightness, long lifetime and high-quality images. Since LEDs introduced a higher level of brightness to the market, full-colour LED screens have all but entirely supplanted the lamp screens that preceded them, since they are far more reliable and long-lived, have a higher image quality and resolution and consume less energy per pixel.

At the functional level, an LED screen comprises a metal supporting structure into which the LED modules are mounted. A module comprises its housing, on the front surface of which are mounted the light-emitting arrays made up of LEDs. The controller and power supply unit are located within the housing.

According to pixel size (from 12 to 35 mm), in such a design the number of pixels per module can vary from 16 × 16 to 64 × 64 pixels (depending on the particular model), with the size of the module itself varying from 0.4 to 1.5 m.

Where the image resolution requirements are not high, the number of pixels can be in the region of 100 × 100 per m$^2$ of screen surface.

***LED screens for outdoor use***

LED screens for dynamic outdoor advertising and the display of alphanumeric information can also be used for showing "live" video, making them suitable for direct transmissions featuring large-scale events and festivities. The wide range of operating temperatures (–40 to +50°C) means that such screens can be used for outdoor video information display systems in virtually any climatic zone. The lifetime of LEDs (up to and exceeding 50 000 h), their low power consumption per pixel, coupled with the appearance on the market of LED screens with small pixel sizes (based on SMD LEDs of 3 to 6 mm for surface mounting on the panel) enables such screens to be used in outdoor conditions.

***LED screens with small pixel size for indoor use***

The appearance of LEDs for surface mounting (three LEDs per cluster) has enabled the construction of small, high-resolution video screens for indoor use (concert and sports halls, TV studios, railway stations and airports, situation rooms, exhibitions, conferences, and so on).

LED modules with pixel sizes from 3 to 6 mm are used mainly for indoor displays and provide a comfortable information viewing experience even at a distance of 2 to 5 m. Such modules can in principle be combined to form LED screens of any size and configuration, which can be operated in ambient temperatures from –20 to +50°C.

### 6.2.2 Trends in the ongoing evolution of displays for VIS

1) Broadening the dynamic range of the brightness signal

Where indoor displays are concerned, the surrounding light intensity will vary between 200 and 1 000 cd/$m^2$. To compensate for these changes, the resolution of the input signal 8 bits/colour (24 bits), the minimum has to be increased to 12 bits (2 bits for brightness control and 2 bits for gamma correction).

In the case of outdoor VIS displays, the brightness variation range extends from 300 to 10 000 cd/$m^2$ ("day/night" mode), making it necessary to increase the bit capacity of the input signal to 15 bits (5 bits for brightness control and 2 bits for gamma correction). Where LED screens are concerned, moreover, additional bits are required for correcting brightness scatter in pixels and modules.

2) Developing a new generation of LEDs on the basis of advances made in the field of nanotechnology and PDPs with calibrated brightness and colour characteristic values

Enhancing VIS image quality calls for more exacting requirements with respect to the active components of VIS screens, which will have to accommodate a broader colour range corresponding to x.v.Colour technology.

3) To eliminate image artefacts, wide use has to be made of preprocessing (precorrection) of image signals, which involves speeding up of the front-end processing of the video signal in DSPs and VIS modules, as well as in image signal transmission networks.

4) For displays operating in real-time mode, it is essential to minimize the image and audio delay, for example when showing sporting events on VIS screens. Where several VISs are used simultaneously, the asynchronicity between them must be minimal and at most no more than a few frames. For this reason, satisfactory results cannot be achieved through the use of standard compression algorithms of the MPEG-2, MPEG-4 / H.264 variety, since here the delay could amount to several tens of frames. A more effective solution is to use intraframe compression algorithms of the MJPEG type, where the delay can in theory be brought down to one single frame. The very best parameters are achieved through the direct transmission of video signals without digital compression, but this calls for high-speed data transmission links (transmission of an HDTV signal in accordance with Standard 292M SMPTE requires a bit rate of 1.485 Gbit/s).

5) The central DSP for processing the images in an outdoor VIS must provide for adaptive variation of the image brightness and colour temperature according to the brightness of the ambient light (direct sunlight, diffused light, nighttime). With this, the brightness of a VIS screen may change 30 or more times. Furthermore, to ensure comfortable viewing, the colour temperature of the image should, depending on the brightness and spectrum of the outdoor light, be adaptable within the range 3 000 to 9 000°K. To this end, the VIS processor must have light sensors whose signals are used for adaptively controlling the display parameters.

6) The pixel dimensions on a VIS screen depend on the video content being displayed. For example, most advertisements have a low resolution in the order of 320 × 288 pixels, since the creators of such content expect it to be viewed on low-quality displays. Such information can be shown on displays with a pixel size of 8 to 16 mm. SDTV image signals require displays with a pixel size of 6 to 8 mm (depending on the screen size and viewing distance). For their part, HDTV, EHRI and UHDTV image signals call for the development of a new generation of VIS screens with a pixel size smaller than 3 to 4 mm. This has become possible since the appearance of new, high-performance LEDs consuming less energy and with a high light flux, manufactured using nanotechnology.

On the basis of the foregoing, the following questions need to be considered:

a) What requirements should be laid down for the processing of signals in outdoor VIS displays to ensure adaptive image brightness and colour temperature variation in accordance with outdoor lighting?

b) What requirements should be laid down for preprocessing of the video signal in a VIS display and for the processing of video data streams in communication lines?

c) What requirements should be laid down in regard to displays for the new generation of VIS which will ultimately accommodate a broader colour range and support x.v.Colour technology?

d) What should be the optimum image viewing angles for the different types of indoor and outdoor VIS?

# Chapter 7

# Operational aspects

## 7.1 General

The similarity between VIS and digital broadcasting system chains makes it possible, for VIS monitoring, to use an approach that is similar to the approach specified in Recommendation ITU-R BT.1790 – Requirements for monitoring of broadcasting chains during operation.

Monitoring is carried out using objective control techniques and measurements while the system is in operation, i.e. it is carried out by equipment rather than by a human operator. The monitoring task is subdivided into monitoring the status of the physical signals and monitoring the perceived quality of the audiovisual content.

The main general requirements in regard to status and quality control for VIS may include the following:

– capability of in-service monitoring;
– applicability to the video formats in use such as SDTV, HDTV, UHDTV, EHRI, computer graphics formats, etc.;
– applicability to the numbers of video and audio channels in use;
– applicability to the transmission bit rates in use;
– applicability to different signal processing such as standards conversion and aspect ratio conversion;
– applicability to different sources of degradation (e.g. transmission errors, unlocked clock, improper original signals, malfunctioning of transmission links and equipment);
– applicability to different programme contents;
– applicability to the system configurations in use;
– traceability of the causes of malfunction, failure and degradation;
– availability of precise information for switching to a reserve system from the monitoring result.

## 7.2 Monitoring the status of VIS signals

Status monitoring consists in checking the signals in the VIS chain for conformity with standards or technical requirements while the system is operational. It allows for objective evaluation of the status and functioning of the facilities and transmission links used in the VIS chain.

The following main requirements may be cited in regard to status monitoring for VIS:

– ability to judge whether the signal including RF characteristics conforms to its specification;
– ability to detect any errors in the signal;
– ability to monitor the functioning status of equipment including malfunctions;
– ability to detect errors and malfunctions precisely in a short time (preferably in real-time);
– ability to monitor each component and equipment in the VIS chain;
– applicability to bit streams (e.g. MPEG-TS) and RF signals, in addition to baseband video and audio signals;
– ability to detect errors which cannot be detected by humans (e.g. occasional bit error).

## 7.3 Quality control of VIS services

Quality control consists in objective checking of the conformity of VIS programme content and the components thereof (TV and computer images, audio, alphanumeric information, etc.) with the required quality levels according to the image scanning formats used, viewing characteristics in outdoor and indoor conditions, dimensions and height of the screen support and other factors.

The following main requirements may be cited in regard to quality control:

– ability to evaluate quantitatively the perceptual quality;

– ability to perform systematically an objective quality assessment with a precision close to subjective quality assessment by humans;

– ability to perform perceptual quality assessment using only bit streams (e.g. TS);

– ability to perform perceptual quality assessment using only the signals concerned (i.e. non-reference methods);

– ability to evaluate an overall audiovisual quality (e.g. A/V relative timing);

– ability to detect the occurrence point of quality degradation;

– ability to perform perceptual quality assessment using only baseband signals;

– repeatability (i.e. evaluation result should not be affected by the successive signals);

– ability to evaluate quality in a short time or instantaneously.

## 7.4 Requirements in regard to control and measurement equipment

General requirements in regard to control and measurement equipment for VIS may include the following:

– the monitoring method should not disturb the monitored signals;

– simultaneous measurement of multiple signals or channels in use;

– easy maintenance;

– ability to log the assessment results for later use;

– compatibility among different manufacturers, including the log format (i.e. a standard format needs to be provided);

– extendability to more monitored signals and items when required;

– easy selection of displayed items among multiple items to be monitored;

– user-friendly display of the status and errors;

– real-time and continuous usability.

In some cases, moreover, additional requirements may be called for to cater for the particular characteristics of specific VIS and their operational features.

## 7.5 ITU-R Recommendations in the field of VIS

Methodologies need to be developed for the operation and monitoring of VIS chains on the basis of existing ITU Recommendations and standards of other international organizations, which may be adapted as necessary to accommodate the particular characteristics of VIS.

The operational aspects of VIS applications can be based on the following ITU-R Recommendations:

1) Recommendation ITU-R BS.1387 – Method for objective measurements of perceived audio quality

   This Recommendation could usefully be supplemented with new provisions relating to the progress made in audio technologies since 2001 and setting out the technical requirements with respect to audio information characteristics for VIS.

2) Recommendation ITU-R BT.1204 – Measuring methods for digital video equipment with analogue input/output

   New provisions could be added to this Recommendation, relating to measuring methods in HDTV, UHDTV, EHRI and multimedia applications (VIS).

3) Recommendation ITU-R BT.1683 – Objective perceptual video quality measurement techniques for standard definition digital broadcast television in the presence of a full reference

   It would be useful to reflect the progress since made in the methodology for evaluating image quality, having regard to different viewing conditions, different image formats and other VIS-related aspects.

4) Recommendation ITU-R BT.1720 – Quality of service ranking and measurement methods for digital video broadcasting services delivered over broadband Internet protocol networks

   It would be useful to illustrate the manner in which this Recommendation could be applied to all types/levels of VIS service.

5) Recommendation ITU-R BT.1359 – Relative timing of sound and vision for broadcasting

   The need for studies on the timing of image and audio signals for different types of VIS system should be reflected.

6) Recommendation ITU-R BT.1729 – Common 16 × 9/4 × 3 aspect ratio digital television reference test pattern

   It would be useful to supplement the recommended test patterns with elements that would enable their use in the various VIS applications.

7) Recommendation ITU-R BT.1691 – Adaptive image quality control in digital television systems

   This Recommendation could usefully be supplemented with provisions relating to the operational aspects of adaptive image quality control in the context of VIS systems.

8) Recommendation ITU-R BT.1692 – Optimization of the quality of colour reproduction in digital television

   This Recommendation could usefully be supplemented with provisions relating to optimization of the quality of colour reproduction in the use of outdoor and indoor VIS.

**Conclusion**

In the not-too-distant future, VISs will come to be one of the predominant means of delivering video information within population centres, above all in heavily-frequented locations. The pictures will be created by TV and computer systems. The content will be delivered to the screens by means of terrestrial and satellite radio channels, an extensive network of digital communication channels, the Internet and other infocommunication media.

Within the framework of this historic reform, a prominent part will be played by broadcasters, as leaders in this promising area. For it is they, with their creative potential and technical facilities, that will be supplying the ever more sophisticated TV programmes and variety of content that VIS networks are able to accommodate. The participation of broadcasters in the introductory phase of outside TV broadcasting will serve not only to radically enhance their role and significance in the information society, but also to favour a fundamental expansion of the range of services on offer with considerable economic support. VIS development is likewise of interest to numerous telecommunication services for whom it represents an opportunity to secure appreciable gains in traffic volumes.

The international standardization of VISs based on the application of SDTV, HDTV, LSDI, EHRI and UHDTV digital TV broadcasting technologies, coupled with computer facilities, will make for unification (or at least harmonization) of the methods used in the preparation, transmission and display of content, and for the creation of a single global network of such systems, integrating broadcasting, multimedia and other information services.

The definition that has been formulated for VISs describes them as multifunctional interactive systems intended for the preparation and transmission of TV content and multimedia broadcasting and fragments thereof, as well as of more specialized content, including advertising, alerts and so on, with the images being viewable both indoors and outdoors in heavily-frequented locations (streets, squares, parks, railway and subway stations, airports, trade and cultural centres, bus and tram stops, etc.). The integrated model for VIS operation is founded on a new global approach to the development of TV broadcasting and takes account of the system’s programme and technical functions and main participants in their implementation.

The means for assessing and measuring the quality of TV pictures, the techniques used in the production of those pictures and in the preparation of TV broadcasting content, as well as other developments in this area, have for all these years been geared solely towards the reception of TV transmissions with two-dimensional (2D) pictures under domestic conditions with low levels of lighting. It is for this reason that we now have a new line of studies focusing on the integration within VISs of 2D/3D TV broadcasting services and other information services, with the possibility of viewing 2D and 3D images both indoors and outdoors on screens of varying dimensions and under different ambient conditions of brightness.

In view of the similarity between VIS and broadcasting systems, and in the interests of accelerating and broadening the studies of those systems, the study of VIS aspects has been included in existing Questions on digital TV broadcasting that are highly relevant to VIS, including those relating to user requirements, 3DTV broadcasting, high-definition images, picture quality assessment and so on.

In this regard, the following ITU-R Questions have been revised:

– Question ITU-R 128/6 – Digital three-dimensional (3D) TV broadcasting (Doc. 6/263, 22 October 2010);

– Question ITU-R 40/6 – Extremely high-resolution imagery (Doc. 6/267, 25 October 2010);

– Question ITU-R 126/6 – Recommended operating practices to tailor television programme material to broadcasting applications at various image quality levels, display sizes and aspect ratio (Doc. 6/253, 21 May 2010);
– Question ITU-R 45/6 – Broadcasting of multimedia and data applications (Annex 2 to Doc. 6B/243, 19 November 2010);
– Question ITU-R 44/6 – Objective picture quality parameters and associated measurement and monitoring methods for digital television images (Doc. 6/371, 13 June 2011);
– Question ITU-R 102/6 – Methodologies for subjective assessment of audio and video quality (Doc. 6/371, 13 June 2011).

A number of ITU-R Questions not requiring revision, and which can be used in the study of VIS, have been identified. This considerably broadens the scope of the studies and pre-establishes the need for the preparation of contributions containing proposals on standardization of the main aspects of VISs. Such Questions include the following:

– Question ITU-R 16/6 – Digital interactive broadcasting;
– Question ITU-R 49/6 – Conditional-access broadcasting systems;
– Question ITU-R 88/6 – Subjective assessment of stereoscopic television pictures;
– Question ITU-R 95/6 – Use of computer technology in television broadcasting applications;
– Question ITU-R 96/6 – User requirements in the area of media asset management and transfer protocols for television programme production, recording and archiving;
– Question ITU-R 100/6 – Television and multimedia images quality levels;
– Question ITU-R 109/6 – In-service monitoring of perceived audiovisual quality for broadcasting and distribution networks;
– Question ITU-R 111/6 – Technical methods for the protection of privacy of end-users in interactive broadcasting systems (television, sound and data);
– Question ITU-R 112/6 – Guidelines on functionalities of facilities based on the use of digital servers in broadcast programme recording, archiving and playout;
– Question ITU-R 113/6 – Delivery of interactive information to and from large screen digital imagery venues through broadcasting systems;
– Question ITU-R 118/6 – Broadcasting means for public warning, disaster mitigation and relief;
– Question ITU-R 122/6 – Objective perceptual audio quality measurement methods;
– Question ITU-R 123/6 – Approaches in programme production intended to improve the perceived image quality of broadcast digital SDTV and HDTV programmes, a. o.

ITU-R SG 6 is currently discussing proposals relating to a draft new Recommendation focusing on the overlap of LSDI and VIS applications and to a draft revision of Question ITU-R 15/6, as well as working documents on revision of Recommendations ITU-R BT.1691 – Adaptive image quality control in digital television systems and ITU-R BT.1692 – Optimization of the quality of colour reproduction in digital television.

Proposals have been made with respect to liaison in the study of VIS with ITU-T SG 9, ITU-T SG 12, ITU-T SG 16 and ITU-T SG 17. A statement was received in reply from ITU-T SG 9 on liaison with WP 6B, referring to the development of recommendations on the transmission of signals in TV broadcasting systems with high-resolution video which may be of interest for the study of VIS. A response liaison statement was also received from ITU-T SG 17 on collaboration with WP 6B on the VIS security.

The Report may be conducive to the organization of new studies with ITU-R SG 6 on issues associated with the study group's new field of activity in liaison with ITU-T SGs 9, 12, 16 and 17, as a basis for studies, the development of recommendations and other aspects of the international standardization of broadcasting and multimedia VISs.

Proposals still remain to be developed on the following important aspects of broadcasting and multimedia VISs:

– User requirements in regard to VIS and elements of the system path, including picture viewing at different horizontal and vertical screen viewing angles, automatic adaptation of picture parameters on outdoor screens to changes in ambient lighting during the day and at different times of the year, variations in climatic and other external influences, and so on.

– Information security in VISs.

– Subjective and objective assessment of picture quality on VIS screens.

The study of VIS by ITU-R SG 6 should preferably be carried out with reference to the work of the Global Broadband Commission established in May 2010 by ITU and UNESCO (ITU Press Release, Geneva, 10 May 2010 – ITU and UNESCO announce top-level global Broadband Commission. Leading names from industry, UN agencies and civil society to work on strategies to harness the transformational power of broadband and accelerate progress towards the MDGs, http://www.broadbandcommission.org/media/pressrelease_10may2010.pdf).

The increasingly widespread presence of screens in society may lead to a radical increase in demand for broadband links and end up being one of the key outcomes of the group's studies in all areas of its work.

VIS standardization should be pursued under the auspices of ITU-R SG 6 with the participation of other international organizations specializing in the provision of information services to society. This will enable the elaboration of global standards that will serve to guide VIS development in different countries.

# Annex 1

## Establishment of a Rapporteur Group on digital multimedia video informational systems

Source: Annex 9 to Document 6B/106

Working Party 6B (SWG 6B-2) considered Document 6B/102 contributed by the Russian Federation. The document shows an urgent necessity to study all the aspects and user requirements for digital multimedia video informational systems.

The study of the user requirements for digital multimedia video informational systems (VIS) on the basis of high definition television (HDTV), large screen digital imagery (LSDI) and extremely high resolution imagery (EHRI) is included in Question ITU-R 45-1/6 – Broadcasting of multimedia and data applications.

These requirements can include a variety of the video information, displayed on the screen for collective viewing of various kinds of the broadcasting multimedia and information for business, advertising, concerts, shows, sport, cultural mass activity, etc. with screens installed in multicrowded places (squares, railway stations, stadiums, streets, parks, airports trade and cultural centers, shops, drugstores, etc.) provided with the help of VIS integrated in digital TV broadcasting. It is important to also have comfortable viewing of the image on the screen of the VIS display, contribution, distribution and management of content signals and other VIS aspects.

Also of high importance for VIS is Question ITU-R 126/6 – Recommended operating practices to tailor television programme material to broadcasting applications at various image quality levels display sizes and aspect ratios.

For the consolidation of the international efforts in this area and to accelerate the standardization process, it is proposed to establish a Rapporteur Group on digital multimedia video informational systems as well as to appoint the chairman of the group.

**Terms of reference of the Rapporteur Group**

– Study of VIS integration in digital TV broadcasting, methods for maintaining comfortable viewing of the images on screens of displays, interactivity, technologies of contribution, distribution, and management for secured content delivery and other aspects of digital multimedia video informational systems.

– The analysis of existing digital multimedia video informational systems and preparing a brief progress report of existing and prospective technologies and devices, which can be suitable for these systems.

– Preparation of working materials for the development of ITU-R Recommendations on digital multimedia video informational systems.

The basis for the work of the Rapporteur Group are the Recommendations ITU-R BT.709 – Parameter values for the HDTV standards for production and international programme exchange (Part II), ITU-R BT.1201 – Extremely high resolution imagery, ITU-R BT.1769 – Parameter values for an expanded hierarchy of LSDI image formats for production and international programme exchange, ITU-R BT.601 – Studio encoding parameters of digital television for standard 4:3 and wide screen 16:9 aspect ratios, and ITU-R BT.1845 – Guidelines on metrics to be used when tailoring television programmes to broadcasting applications at various image quality levels display sizes and aspect ratios.

The work progress might be reflected in a report to be submitted to the next meetings of Working Parties 6B and 6C.

**Working procedures:**

– The Rapporteur Group should work in accordance with § 2.14 of Resolution ITU-R 1-5.

– The work will be supported with a mailing list (e-mail reflector) [to be prepared by the Secretariat].

**Chairman of the Rapporteur Group**

The Rapporteur Group is led by:

Professor Krivocheev (Russian Federation)
E-mail: intcoop@minsvyaz.ru
as an Acting Chairman

All interested participants are encouraged to join the e-mail reflector.

# Annex 2

## Continuation of the Rapporteur Group on digital multimedia video information systems

Source: Annex 9 to Document 6B/163

Working Party 6B received an excellent Report, Doc. 6B/133, from the acting Rapporteur Group Chairman Professor Krivocheev. This Report has a lot of important information on digital multimedia video information systems (VIS) and proposals for revising three Questions: ITU-R 45-2/6, ITU-R 126/6 and ITU-R 131/6.

In order to continue the Rapporteur Group, WP 6B requested Professor Krivocheev to serve as the Chairman of the group and he kindly accepted the request.

**Terms of reference of the Rapporteur Group**

– Study of VIS integration in digital TV broadcasting, methods for maintaining comfortable viewing of the images on screens of displays, interactivity, technologies of contribution, distribution, and management for secured content delivery and other aspects of digital multimedia video information systems.
– The analysis of existing digital multimedia video information systems and preparing a brief progress report of existing and prospective technologies and devices, which can be suitable for these systems.
– Preparation of working materials for the development of ITU-R Recommendations on digital multimedia video information systems.

The basis for the work of the Rapporteur Group are the Recommendations ITU-R BT.709 – Parameter values for the HDTV standards for production and international programme exchange (Part II), ITU-R BT.1201 – Extremely high resolution imagery, ITU-R BT.1769 – Parameter values for an expanded hierarchy of LSDI image formats for production and international programme exchange, ITU-R BT.601 – Studio encoding parameters of digital television for standard 4:3 and wide screen 16:9 aspect ratios, and ITU-R BT.1845 – Guidelines on metrics to be used when tailoring television programmes to broadcasting applications at various image quality levels display sizes and aspect ratios.

The work progress might be reflected in a report to be submitted to the next meetings of Working Parties 6B and 6C.

**Working procedures**

– The Rapporteur Group should work in accordance with § 2.14 of Resolution ITU-R 1-5.
– The work will be supported with a mailing list (e-mail reflector)

**Chairman of the Rapporteur Group**

The Rapporteur Group is led by:

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All interested participants are encouraged to join the e-mail reflector.