World Vision 2000
A proposed worldwide forum on the emerging television environment

M.I. Krivocheev
Chairman, ITU-R Study Group 11
Member, ITU-D Telecommunication Development Advisory Board

Beginning with the observation that broadcasting is at a critical point in its development – with the adoption of digital technologies for programme-making and delivery, and increasing competition in all sectors of the industry – the Author states the case for the establishment of a worldwide forum on interactive multimedia television broadcasting.

Known provisionally as "World Vision 2000", the forum would bring together all the major industries claiming a stake in the audiovisual markets of the 3rd millennium. World Vision 2000 would draw back from the situation and ask questions on how convergence can be made to happen, how the new media will shape society, and how to help the world become less of a place with information "haves" and "have nots".

Above all, the forum would be an opportunity for broadcasters, the computer and telecommunications industries, publishers, and others from the developed and developing countries to lay open the fears and promises of digital television and to try to understand the new environment.

1. Broadcasting in the "age of plenty"

Human beings acquire more than 80% of their information through their eyes. Consequently, video and television have become – and will remain in the future – our main source of information. This fact alone is sufficient to highlight the importance to mankind of the medium of television.

Today, television broadcasting is probably the most significant single means of influencing the day-to-day lives of people throughout the world. It is their information and entertainment "superhighway". It can also be a gateway to education.

In brief, broadcasting *matters* to the world.

Original language: English
Manuscript received 17/5/96.

This article is adapted from a paper presented by the Author during the meeting of the Inter-Union Technical Committee, Tunis, May 1996.

In Europe, the number of broadcasters has doubled in the last ten years. In the United States, there are now more than 150 television programme channels covering the greater part of the territory by satellite. Many new broadcasters are offering cable and satellite services; some are providing new terrestrial services. These broadcasters are competing for the same audience and thus, individually, they have less and less possibility to exercise real influence over events in the media world. Collective action by broadcasters is essential.

Broadcasting is important to the developed world, but it is even more important to the developing world. In the poorer areas of the world, there are ten times as many television receivers as there are telephone lines. Globally, television receivers form about two-thirds of the world's communication devices, while telephones form about one-third.

Digital technologies are changing the basic principles of broadcasting. Interactivity is adding important new dimensions to broadcast services. Digital delivery offers the prospect of very economical use of channels through multi-programming, and contributes to greater spectrum efficiency.

In a very real sense, the world is on the verge of a revolution as important as the invention of the printing press. In the digital age of broadcasting, the bye-words will be multi-programming, multimedia and interactivity. The audio-visual market, whether based on broadcasting or on other forms of delivery, is about to move into a vast surplus of delivery resources. In the not-so-distant future, thousands of channels will be available from satellite, cable and terrestrial transmitters. There is the prospect, too, of video-on-demand (VoD) and there is enormous potential for cramming huge quantities of information into new forms of packaged media (tapes, discs, memory cards, etc.).

Since the dawn of broadcasting the model has been a simple one: each broadcaster has a channel, each channel has a single broadcaster. In the digital age, there will be a new actor – the multiplex operator – who may perhaps be neither a programme-maker, nor a broadcaster, nor even a network operator. The multiplex operator will be able to use the tools of digital technology to maximise the number of programmes that can be carried in each television channel.

When paper was scarce and when the written word was a matter for the scribes, an understanding of the written word, the prerogatives of law-making and indulgence in the pleasure of poetry and prose were the preserve of the rich and the learned. When paper ceased to be scarce and, with the technological impetus given by the printing press, the written word began to change the world. So, too, with television. More than the content and the technical quality of programmes, it is the proliferation of multimedia delivery channels which will determine the impact of broadcasting on our society in the future.

Faced with these opportunities for the years ahead, we have a responsibility to ask how the new "age of plenty" will shape our society and shape the broadcast media.

Interactive broadcasting is of particular interest to developing countries because it offers an economical and efficient way to implement many of the information services they need in support of their development programmes. The implementation of interactive services, making use of both the existing infrastructures and those still to be established, will have an impact that goes far beyond simple enhancements to current services. Interactivity in the developing countries will touch upon the most fundamental concepts of the communications infrastructure and of services to the public.

In the planning and implementation of new systems and services, it is necessary to have a clear view of the constraints imposed by the current infrastructures. These constraints impose prudence upon the planners.

In the ITU Radiocommunications Sector (ITU-R), Study Group 11 (Television) has always adopted a global approach to the development of new transmission systems. However, as we move towards the incorporation of interactivity and multimedia components into the broadcasting concept, we find that we, as broadcasters, are not alone. New digital systems are being developed separately in broadcasting, in telecommunications, in computing and in publishing. In this situation, the world badly needs to optimize convergence and to propose new strategies for the up-grading and expansion of television broadcasting services at the beginning of the third millennium. We may note a paradox at this point: the developing countries have the most to gain from optimized convergence – but they have insufficient influence over the development of new technologies.

It is clear that if any serious attempt is made to move towards convergence, each of the main information delivery sectors mentioned above –

broadcasting, telecommunications, computing and publishing – will be at pains to defend its specific interests. Indeed, it should be realised from the outset that no real convergence will be achievable unless each sector is aware not only of the technologies of the others but also of their *raison d'être*, their ambitions, their potential impact on society and their prospects for adaptation to the age of plenty. Before there can be real convergence of technologies, there must be a convergence of mutual understanding between all these parties.

It is perhaps natural that the specialists in each sector will believe that they, and only they, have the breadth of understanding and the experience to know what is best for the others (and, by extension, for the public at large). Nevertheless, each of the potential contributors to the interactive/multimedia/television future has their own reasons for embarking on the adventure. The telecommunications authorities are interested essentially because all signals are potential revenue-earners. The computer industry sees a market for chips and software. Publishers perhaps see future television systems as their saviour, as the printed word declines in popularity. True, the world broadcasting community also has its economic objectives but, in many cases, broadcasters are driven also by their sense of service to the viewer – a form of interested altruism which perhaps entitles them to show the way ahead. On a more practical note, it may be borne in mind that, whereas most broadcasters have embraced telecommunications, computing and publishing for many years, those active in the other sectors mentioned have not yet (with very few exceptions) embraced broadcasting in any real sense of the term.

Table 1
Number of electronic communication devices
– worldwide.

Device	(million)	(%)
Television receivers	1200	59
Telephone lines	645	32
Personal computers	180	9
Total	2025	100

Table 2
Number of electronic communication devices
– developing world.

Device	All users (million)	Domestic users (million)
Television receivers	400	370
Telephone lines	52	25
Personal computers	5	2
Total	457	398

2. Television as a component of the information environment

2.1. The importance of television in a world context

Broadcasting services are the most important mode of information delivery in the world today. They give up-to-date information which is vital to many activities of the public, as individuals, as groups and as entire nations, and they provide coverage via a unique mix of terrestrial and satellite emissions which has left few corners of the globe without coverage.

The figures given in *Table 1*, taken from ITU-D Report 4128 [1], provide an interesting picture of the relative importance, today, of the principal components of the future interactive multimedia infrastructure. Television services are of particular importance. There are about one billion television receivers in the world today and in many developing countries the number of television receivers is several times greater than the number of telephones. Also, despite the forecasts of the promoters of the Internet, the balance of penetration between television and computers remains very heavily in favour of television.

When these data are broken down by country and by level of income, the relative penetration of each sector changes dramatically, as seen in *Table 2* which gives figures for the lower income levels typical of the developing countries.

It can be seen that electronic communication in the poorer regions of the world is critically dependent on television. Whereas the ratio of television receivers to telephone lines is about 2:1 in the higher-income areas of the world, it is nearer 10:1 in the developing countries. This implies that the best approach to the further development of information infrastructures will be quite different in the developing countries, compared to that of the developed world. The developing countries, in particular, will have to make innovative and efficient use of existing television and telecommunications infrastructures to foster national economic and development objectives although, even in the major developed countries, television – and digital television in particular – is being seen increasingly as a critical part of the future pattern of information delivery. More specifically, this implies that if interactivity is accepted as "a good thing", it is of paramount importance that it should be "grafted onto" television systems, these being the most widely-available systems in those developing countries. This combination of

interactivity and television will be a key element in making better use of the current and emerging infrastructure for the efficient and cost-effective delivery of the new information and telematic services that will be major contributors to future progress.

In the planning and implementation of new television systems and services it is, however, necessary to have a clear view of the constraints imposed by the past and current investment in infrastructure. Not only are there many millions of receivers in use – there are also many thousands of broadcasting facilities in operation and these have a long life expectancy. Consequently, it is necessary to be relatively conservative when planning the introduction of new systems and services, while taking maximum advantage of the relevant technical advances. In the analogue world, the choices are relatively limited but, in the emerging digital world, digital standards introduce new challenges, not least in the areas of planning and spectrum management for television broadcasting.

A major achievement of ITU-R Study Group 11 in this respect has been the development of an international strategy for the introduction of new digital television systems, while retaining the existing terrestrial and satellite channels. This has made it possible to focus on a broad range of research, worldwide, on data compression and new transmission methods for digital signals carrying enhanced- and high-definition television, multiprogramme television and stereoscopic television in the conventional 6, 7 and 8-MHz channels (the "6-7-8" concept [2]). This strategy has significant economic impact because it does not impede the continuing introduction of conventional television systems whilst ensuring a low-cost evolutionary transition to future digital television systems.

To the extent possible, Study Group 11 has endeavoured to establish *international* standards, this being an important factor for both the developed and the developing countries.

It is not sufficient for new television systems to offer just improved technical characteristics and better image, sound and data quality. They must also provide the consumer with attractive possibilities and services which will stimulate the acquisition of new receivers and related peripheral equipment. Only if customer satisfaction is placed high on the list of priorities will it be possible to recover the cost of developing and implementing the appropriate techniques – and then leave enough profit to make the venture attractive to investors and system operators, too. It is thus necessary to develop a new, extended global approach that would encompass not only the broadcasting technologies, terrestrial and satellite distribution and emission networks of the existing ITU-R global approach but also the new possibilities of consumer equipment of all kinds, including the options for interactivity and multimedia.

This means that standards for the introduction of new television systems which make effective use of the radio spectrum need to be developed by the ITU – in close coordination with the relevant international and regional organizations in broadcasting and other sectors – to ensure that the television interests of broadcasters are harmonized with those of the many non-broadcasting applications.

2.2. The potential of digital television

One of the clear tendencies in television broadcasting is the increase in the number of programmes offered to viewers. In the framework of the existing frequency plans, it is possible to provide three or more programmes of conventional quality within each channel (MPTV 6-7-8 approach), the exact capacity being dependent on whether the channel is terrestrial or satellite. *Table 3* shows some examples of bit-rates per programme channel.

It has been suggested that the present-day plans for the Broadcasting Satellite Service (BSS) in Regions 1 and 3 could accommodate at least ten digital programmes in each of five 27-MHz channels, giving a total of 50 programme services to each country. Such proposals imply the use of programme-dependent bit-rate adaptation, of the kind indicated in *Table 3*. The aim is to ensure that programmes with more spacio-temporal detail (such as fast-moving sports) can be allocated a higher data-rate while less-demanding programmes are allocated lower capacity, with the constraint that viewers should not be aware of changes in capacity allocations occurring while they watch any given programme. Digital technology provides the tools

Programme type	Bit-rate (Mbit/s)
Motion pictures	2.5 – 4
Education programmes	2 – 4
General programmes	3 – 7
Sport	5 – 11
Associated audio	0.064 – 0.256

Table 3
Bit-rate per programme for various types of programme material (examples for standard-definition television, SDTV)

needed to achieve this adaptation, in the form of sophisticated coding and data-compression, new spectrum-efficient modulation schemes and extended statistical multiplexing. Of course, co-ordination of the multiplex is required, and this can be achieved with an appropriate joint coding control scheme.

To exploit the multi-programme television concept to the greatest extent possible, it will be necessary to develop these systems further and, in particular, to carry out the data compression and multiplexing of video data-streams directly at the control centre where all the programme signals are firmly synchronized to a central timing reference. In this way, the vertical blanking intervals of each video signal in the multiplex will be coincident and, together, they represent a valuable resource for the insertion of additional data. The correlation between programme signals from the different studios in a fully-synchronized production centre may also provide additional opportunities for bit-rate reduction, thereby increasing yet further the overall information capacity.

It is to be expected, too, that the continuing research into signal coding algorithms will lead to the development of systems that are better than the present-day MPEG-2 schemes, offering yet a further increase in the number of television programmes or the capacity for information channels and other services. As mentioned previously, the old concept of one channel, one broadcaster, is fast becoming obsolete.

2.3. Computer technologies

The introduction of computer technologies is changing the approach of the manufacturers – whether they are the traditional suppliers of broadcast equipment or newcomers in this field. Computers already permit the processing of images and of image sequences, and the subsequent transfer of assembled programme material via data networks in non-real-time; as processing power and speed increase, there is every reason to suppose that such systems will go “live” as a regular feature of broadcast programmes.

As computers are introduced, the main areas of concern to users should be those relating to the interaction between the television equipment, on the one hand, and the computer equipment on the other hand. Display devices are a specific difficulty, with their significantly different numbers of pixels, line frequencies, image formats and colorimetry. The problem of adapting communications channels for both television and computer data signals has also to be resolved.

The computer industry has discovered that it *can* handle television images although, for the time being, data storage limitations force it to use substantial amounts of bit-rate reduction if it wants to deal with long sequences. Despite this problem, the computer industry is becoming increasingly involved in many aspects of programme production: computer-generated imaging, computer-assisted editing, computerized archive systems, computerized off-line browsers and programme research facilities. They are keen, too, that broadcasters should consider the use of signal networking systems of the kinds used in computing; broadcasters will need to prepare a collective response to this question.

The broadcasters’ contacts with the computer industry suggest that, while there may be substantial benefits from computerization, there is a noticeable degree of ignorance of the broadcasters’ overall requirements and objectives. Some computer people worry about technical problems that broadcasters solved long ago and many of them seem not yet to have grasped the challenge represented by the enormous amount of data that will be generated in even a small digital television studio centre every day.

There is an evident need for a more-effective sharing of experience and understanding, for opportunities to discuss ideas and perspectives, and generally to create an environment which favours convergence between the broadcasters and computer industry, and it is to be expected that each party in the process will have at least as much learning to do as the other.

2.4. Data broadcasting

In the general context of the development of digital television systems in the 16:9 aspect ratio, and high-definition systems, an expansion is expected in the associated teletext services.

Digital television in general, and MPTV services in particular, will enjoy large coverage areas and therefore will open new possibilities for the broadcasting of high-speed data-streams, either for general use or for specific subscriber groups. In these circumstances, it is realistic to propose the study of a new concept providing for the transmission of large volumes of data in the same television channel, for multimedia applications. Such data-streams may include addresses associated with interactive on-demand viewing systems, advanced conditional access systems,

etc. Continued studies are also necessary to find new, more-effective methods of embedding data signals within a conventional television signal, bearing in mind that the existing analogue television broadcasting systems, and the corresponding receiving systems (cable networks, receivers, etc.) will continue to develop and improve for many years to come. As mentioned earlier, the broadcasters' objectives may not be purely altruistic; additional data transmission capacity may be a valuable source of revenue. For example, a new service known as "TV inform" has been created in Russia, in addition to the normal teletext service. This is widely distributed in the terrestrial television network and has also given good results in a satellite broadcasting system.

Other adaptations of data broadcasting include still-image broadcasting services. This is an area where new applications are foreseen in a more-integrated broadcasting/computer environment, and there is the possibility, too, of delivering data for stereoscopic display.

2.5. Network planning and introduction strategy

An important problem affecting the introduction of digital terrestrial television broadcasting is frequency planning in the transition period when analogue and digital services simultaneously exist. There are many variants to this problem, dependent on the chosen methods of modulation, the frequency ranges, the strategies adopted for the introduction of new digital networks, etc.

Several such variants of systems, and the co-ordination of the relevant system parameters, are under intensive study at the present time. The new flexible approach to the principles of digital television signal transfer and frequency planning, proposed within ITU-R Study Group 11/3, is just one example of this work. The use of BST-OFDM (band segmented orthogonal frequency division multiplex) modulation is assumed. There is every reason to suppose that this approach will satisfy the various requirements, including restrictions on use of the frequency spectrum, and it is expected that this will be appropriate when including future applications in congested frequency bands.

A potential feature of future digital television broadcast emission systems will be the concept of cellular networks. The cell size could be just a few kilometres radius, using low-power transmitters delivering signals to users in what is known as a multi-channel multiple-address distribution system (MMDS, commonly called a "wireless cable").

Cellular systems can operate in a specially-allocated frequency range, for example above 10 GHz. It has been reported that in a frequency band around 1 GHz it is possible to distribute about 50 analogue programmes with acceptable quality. With digital coding, it is expected that this number could be increased significantly.

The cellular approach offers other potential benefits. The sharing of cellular network infrastructures for broadcast services with those operated by telecommunications and interactive services may reduce the investment burden on all parties, since it would allow new modes of operation and lower costs. However, the rapid development of cellular radio-telephone networks and their great commercial success, have already encouraged some Administrations to propose that frequency bands currently reserved for broadcasting should be handed over to these cellular networks. This is another area where harmonization of different applications should be encouraged, and broadcasters should be stimulated into safeguarding their rights when establishing networks and sharing resources with other telecommunication services. The economic aspects of sharing, including the financial interests of broadcasters and the accounting convenience offered to users of such networks, also need to be addressed.

2.6. Interactivity and multimedia

In recent years a new direction of development has been initiated which is affecting, in a rather complex manner, not only broadcasting but also telecommunications, computer engineering and other areas. The focus of these studies has been multimedia systems.

Multimedia systems are based on the combined use of several technical supports for two-way exchange of information (images, sound, text, etc.) in a user environment based essentially on products of the computer world. These systems bring into play the widest imaginable variety of recording and reproduction devices: television receivers, computer screens, Compact Discs (audio and CD-ROM), electronic musical instruments and many others.

A major component of this new environment is interactive television which will enable television viewers not merely to watch but also to *dialogue* with their information sources. Interactivity in television is not a gadget. It was noted earlier that of today's principal information tools (television,

telephones and computers), television is by far the most prevalent in the homes of the public, especially in those countries which have the most desperate need for better information access. In terms of return on investment, therefore, the addition of interactivity to existing and up-coming television systems is clearly the most effective solution.

So, what will interactivity offer? For viewers, interactivity permits a number of additional services. For broadcasters and other information providers it is the means by which services can be more-closely tailored to the real needs of their customers. For example, interactive television can be the basis of:

– interactive educational programmes and distance learning;

– video-on-demand (VoD);

– dialogue with viewers (for example, allowing viewers to give their opinion on a programme while it is on the air);

– programme ratings (audience research);

– interrogation of the population (consumer research, etc.);

– participation in game shows, quizzes, etc. from the viewers' homes;

– tele-medecine, tele-shopping – indeed, tele-"almost anything that needs a return channel"!

The demand for these or other interactive television services will depend on many factors. It will be especially important in the developing countries where remote education is a priority and learning is of great social importance. In view of the aspirations of the various layers of the population to increase their level of culture and education, there is every reason to believe that educational television based on interactive systems will be popular. The first international pilot project on the application of interactive television broadcasting for learning and remote education was developed by the ITU and UNESCO in 1995, and in 1996 it will be put into practice in Morocco and in India.

Other forms of interactive services are also being developed, on the basis of cable television networks, or integrated with computer data networks (e.g. the Internet, the DAVIC proposals). Underestimation of the vital necessity of a fast transition to interactivity in broadcasting will have serious consequences including, in particular, a significant reduction in the viewing audience and a decrease of the commercial impact of programmes and advertising. As other services start adding value in the form of interactivity, value will be seen to be lost in broadcasting if interactivity is not added there, too. There will inevitably be a tendency, for example, for advertisers to drift towards interactive services which are able to provide a full service including processing of a viewer's immediate commitment to purchase via the return channel.

Taking account of the wide range of interactive services that can be envisaged, there is scope for the implementation of a new approach to the harmonious development of systems and services in the interests of the consumers through wide integration and unification of methods and resources. An overall approach permits increased efficiency of services at both national and worldwide level.

We have noted earlier that the "age of plenty" will be characterized by a proliferation of media channels offering, in general, a quality of television picture not unlike that achieved today with analogue systems. But that is not to say that systems offering improved quality can be – or should be – ignored. Broadcasters have clearly understood this point, and considerable efforts continue to be made to improve the existing broadcasting systems: PALplus, enhanced SECAM and enhanced NTSC are just a few examples. The transfer of multimedia signals, and in particular of image signals from high and super-high resolution computer systems, will demand that broadcasters provide a substantial improvement of technical quality for the delivery of audiovisual and other information. New demands will be made on broadcasting facilities. This implies the need for standardization of technologies for the transfer and distribution of signals, for example to permit interfacing between broadcasting and computer networks.

One of the most difficult problems arising from the development of interactive television services will be the organization of the huge number of narrowband digital return channels giving viewers access to the programme sources and to additional information. The Author has previously proposed the study of a global approach to interactive television involving the mobilisation and convergence of all available means of communication. This global approach would require the development of complex inter-working between interactive television broadcasting, mobile communication networks using terrestrial and satellite channels, cable television networks, telephone networks and also

a new option in the form of dedicated wireless return channels [2].

While developing such systems, due account must be taken of the fact that in the developed countries and in densely-populated areas elsewhere, television programme delivery is largely achieved using (coaxial) cable networks and terrestrial broadcasting networks. The coaxial cables and fibre-optic lines of CATV networks, which have built-in two-way transmission capability, allow the organization of return channels, at least as far as the head-end facilities, without particular difficulty. In this case, the return channels could be based on a variety of technologies including telephone lines, various forms of satellite systems, mobile communication systems including new forms of wireless telephony, and radio transmitters integrated in television receivers.

In the developing countries, and in regions with low population density, terrestrial transmitters and satellite delivery of programmes are more prevalent, in association with individual television receiving installations. In these circumstances there may be limitations on the development of telephone and mobile communication channels, and it may be assumed that the creation of interactive television systems will be oriented more towards the use of wireless return channels, including satellite systems.

It is clear, then, that the mass introduction of interactive television services will generate new requirements for existing and future communications facilities. The scale of this development must not be under-estimated. It may be assumed that the introduction of interactive television will increase, at least by an order of magnitude, the traffic that has to be carried in systems carrying the return channels. There is a considerable risk that interactive services will overload the return channel capacity and no doubt service providers and broadcasters will, initially, have to take steps to tailor the demand for return channel capacity to suit the resources available. The opportunities for the further development and expansion of these systems in the early years of the 21st century are huge, with forecasts that there will soon be about 200 million mobile communication transceivers and about 2 billion television receivers in use worldwide.

Yet another area which should be examined carefully by broadcasters is the effective interfacing of traffic in these diverse return-channel networks and the associated data-handling systems. After all, there is little point in encouraging viewers to participate if you, as a broadcaster or service provider, cannot listen properly!

There will be much to think about, too, in the "software" domain, notably in connection with the development of common standards for multimedia broadcasting and other data services, associated hardware devices (hard disks, high-speed processors, etc.), the production of low-cost multimedia products and the development of appropriate software for the production of appealing programmes. Standard interfaces will be needed, also, both for programme makers (to facilitate training and enhance productivity) and the end-user (to facilitate their use of new interactive products). If there is any doubt regarding the needed for standard interfaces, it will be sufficient to consider what might have been the level of public acceptance of the World Wide Web without a limited number of specially-designed, easy-to-use browsers.

It may be noted that ITU-R Working Party 11C has prepared a first draft new Recommendation on interactive television, which features a three-tier classification of interactive services:

– *local interactivity* which does not have a return channel to the source of the service;
– *simple interactivity* which has a one-way return channel;
– *full interactivity* which has a two-way return channel.

In a locally-interactive system, the broadcast programme is downloaded onto the viewer's computer hard disk from which it can be accessed interactively in a manner similar to a CD-ROM.

A further classification has been proposed, which relates data-rates to potential applications:

– *low data-rate*, implying a data-rate of about 150 bit/s (or even less) for simple return commands and simple error correction;
– *medium data-rate*, implying a data-rate of about 6 to 7 kbit/s for more-complex applications and instructions, including the requirement for more-sophisticated protection for security and error-protection coding;
– *high data-rate*, implying a data-rate of about 64 kbit/s for more-demanding applications.

This overview of interactive television, seen from the perspective of the global approach, shows that interactive systems will be characterized by the mobilization of a wide range of resources for the effective and economic provision of return channels. Some conclusions may be drawn at this point.

Interactive systems will find wide application in sound and television broadcasting, and in other sectors of the information industry including multimedia. These systems will have a special role to play in education, for example in the UNESCO programmes in favour of the developing countries.

To satisfy the demand for return channels for interactive television and sound broadcasting networks, several billion return channels will be needed to link viewers and listeners back to the programme sources and to other information providers. The scale of resources implied by such channels is far in excess of those currently available – or even forecast – for conventional duplex telephone channels, whether wired (PSTN) or wireless (mobile terrestrial, satellite radio services, etc.). It follows that major studies and research programmes are needed, aimed at an essentially new strategy for the development of broadcasting and telecommunications infrastructures at both national and international levels.

In both broadcasting and in telecommunications, interactivity implies a modification of the traditional models:

– Until now, broadcasting has been (with the exception of the occasional "phone-in" programme) a simplex activity. It will become a duplex operation.

– The telecommunications industry has long been accustomed to duplex operation, but with an approximate balance of information flow in each direction. That balance will be upset and return channels will come to *dominate* the future telecommunications infrastructure – in the process becoming a force that promotes the expansion of the broadcasting and telecommunications infrastructures.

Inevitably, new problems will have to be addressed in the area of traffic management, not only as a consequence of the increase in overall information flow, but also as a result of the diversity of return-channel technologies that must be envisaged.

The mobility of recipients of information, and their need to obtain interactive access to services from any point on the Earth, will place heavy demands on radiocommunication channels, even if the use of wired telephony and cable distribution networks is maximized. New frequency bands will have to be allocated and exploited; new and more-efficient ways to use radio channels will have to be developed, taking account of the specific characteristics of return channels for interactive systems.

Complementing the vast programme of work for the creation of the necessary infrastructures and information-handling systems, there is a major need for studies in the general area of man-machine interfaces, with the emphasis on making interactive services easy and convenient to use. Interactive services will be used only if they are accessible. Accessibility is measured not only in terms of availability of a channel but also in terms of its acceptability. Acceptability, in turn, is dependent on numerous rather fluid concepts: language, culture, education, social heritage and many others.

At first sight, such a vision of interactive television might seem unrealistic. But this is not a fantasy world; it is not utopia. Let us remember what certain voices were telling us just a few years ago when we launched the idea of high-definition television. The critics said HDTV could not be done, or that no-one wanted it. Now they see that it can be done (even in existing television channels!), and that it will be done to an ever-increasing extent in the coming years. So, too, for interactive television. It *can* be done – it *will* happen.

2.7. Stereoscopic television and high-resolution imagery

Current improvements in coding, error-protection and modulation techniques allow new television systems to include the option of stereoscopy within the present-day bandwidth limitations (the 6-7-8-S approach). The degree of correlation between the left and right hand images is generally so great that the additional data capacity needed to convey the stereoscopic difference signal is quite modest.

Studies of auto-stereoscopic displays, which do not require the viewers to wear glasses, are under way in several countries. In the context of multimedia interactive television services, studies will need to be undertaken to determine the number of source and display channels needed for effective auto-stereoscopic systems, and the appropriate methods for matrixing these channels for transmission.

Looking perhaps a little further ahead, consideration must also be given to ways in which images of the kinds generated by computer imaging systems can be conveyed effectively in multimedia broadcasting channels. A first draft new Recommendation on extremely high-resolution imagery (HRI), prepared within ITU-R Study Group 11,

gives an interesting insight of the challenges that lie ahead in this area. The data-processing, storage and transmission demands relating to 16:9 images, having resolutions of 7680 pixels horizontally and 4320 pixels vertically, make today's Pentium processors, 1 Gbyte hard disks and DVB transmission systems look like mere play-things.

2.8. Multi-lingual broadcasting

As it is now possible to convert textual information into audio signals and to translate texts and speech automatically from one language to another, studies may be contemplated on fundamentally new concepts of multilingual sound associated with television broadcasting. Multilingual broadcasting is important as an aid to the breaking down of language barriers in all regions of the world, and for international programme exchange, and it generally helps to make broadcasting more effective.

As these technologies develop further, it will become possible to use computers to translate the original sound of a television programme into the languages of the viewers in any given region. Initially, in view of the probable high cost of such facilities, the computer could be installed at the transmitter serving the region, or at the head-end of the local cable network; when the costs have reduced sufficiently, individual translation units could be built into receivers for individual use.

Taking a rather expansive view of what new language-engineering technologies might do in broadcasting, it might be a good idea to use automatic translation systems, coupled with speech recognition and analysis devices, to run operations in telecommunications and broadcasting networks. After all, in a true interactive multimedia broadcasting system, is there any reason why a user – who might be illiterate – should have to type his VoD request into a keyboard? No, let him speak into the telephone, in his own language, and call up the VoD answering machine at the cable head-end and instruct it to play the nine o'clock news again at a quarter-to-ten.

As an option for the more-immediate future, an entirely new service for blind people might be offered in which the textual content of television – teletext, subtitles, etc. – could be processed by a computer unit equipped with a suitable form of electro-mechanical interface, operating on the basis of the Braille alphabet, for example. Such a service would give a whole new dimension to the concept of "television for the blind".

Here again, it is clear that coordinated research is necessary, involving the computer industry, experts in the field of languages and, of course, broadcasters.

3. Who needs a World Forum?

There is an old proverb: "Any road is the right road if you don't know where you are going". Technology is creating a new environment and changing the world order. But broadcasters do not have to be tossed by the winds, or leave their fate to chance. They can – and should – control the situation, and a World Forum could be just the means to help them to do so.

The broadcast landscape is now characterized by significantly greater competition and by the frag-

Professor Dr. Mark I. Krivocheev *is an academician and is Head of a Scientific Department concerned with Television in the Radio Research Institute (NIIR) in Moscow.*

In 1946, Professor Krivocheev designed a scanning unit which, for the first time, achieved the display of a new standard 625-line television raster. On 3 September 1948, he made history by pressing the button which inaugurated the world's first 625-line television transmission. In 1951, the first frequency plan for television stations in the former USSR was prepared by Professor Krivocheev. He is the originator, or co-originator, of more than 90 inventions and patents in television technology and his books and papers have been published in many countries.

Professor Krivocheev has been a participant and leader in international television studies in the framework of the ITU since 1948, serving as Vice-Chairman of Study Group 11 from 1970 and Chairman since 1974. Since 1995, he has been a Member of the ITU-D Telecommunication Development Advisory Board (TDAB). His contributions have been widely recognised by national and international bodies. He has received government awards in his own country, has been decorated "Chevalier de l'Ordre National du Merite" in France and has received the "Gold Medal of the Order of Merit" from Poland, among other distictions. He holds Honorary Membership of the A.S. Popov Society, the IEEE, the Institute of Television Engineers of Japan (ITEJ) and the Fernseh- und Kinotechnischen Gesellschaft (FKTG). He is an Honorary Fellow of the British Kinematograph, Sound and Television Society (BKSTS), and is a Fellow of the SMPTE and of the Chinese Institute of Electronics (CIE).

mentation of larger broadcasters into small entities. There is an ever-diminishing number of broadcasting organizations whose size and resources permit them to participate in international matters such as standardization. The few will be carrying a much larger load and the many will benefit from their work at little or no expense.

The situation is now very critical. Broadcasters who are able truly to influence technology are fewer and fewer in number. The phenomenon of convergence of the computer industry, telecommunications, publishing and broadcasting calls for action by broadcasters if they are to preserve a stake in the media world.

We can, for example, look to a future world where interactive multimedia is a major element in education. But will this be dominated by broadcasters' interests – or by other interests? Broadcasters with a strong commitment to the concept of service to the public will no doubt have a clear response to this question. But, whatever their philosophy or their mandate, *all* broadcasters need their own vision of where they fit into the future multimedia environment, and they will have to make sure their voices are heard.

A new strategy forum spanning the computer industry, broadcasting and the other members of the future world multimedia community would provide the opportunity for cross-fertilization of ideas and perspectives and would help to create the environment needed for the promotion of new approaches to convergence.

While it is true that there are already several regional groupings in the broadcasting sector, such as the DVB Project in Europe and the Grand Alliance in the United States, these are essentially concerned with the development and promotion of specific media delivery systems. Broadcasters do not have any forum which stretches across the delivery media.

A collective voice is always stronger than an individual voice and the establishment of a world media forum, lead by broadcasters, will allow that voice to be heard.

Existing forums such as NAB, ITVS, IBC and ISTB are very much concerned with the presentation of technologies – in particular those which are aimed at the developed world. They have little interest in the problems of global convergence. The World Forum would bring together experts in the relevant technologies, of course, but also experts in the planning, implementation and operation of broadcasting and information infrastructures.

Major subjects to be covered include:

- technologies available for digital broadcasting over the various media supports (terrestrial, satellite, cable, PSTN);
- convergence of broadcasting, telecommunications, computing, interactivity and multimedia;
- strategies for the development of information infrastructures and services based on these and alternative technologies;
- effective planning for the use of the limited spectrum and financial resources available;
- implementation strategies and alternatives;
- inter-operability with other networks;
- integration of existing infrastructures;
- the range of services appropriate for such infrastructures: educational, social, administrative, transactional, entertainment;
- systems and equipment for interactive broadcasting delivery and reception;
- examples and case histories of recent applications.

It is envisaged that the Forum would encourage the presentation of papers by experts from around the world, workshop sessions to define and develop the key issues from all perspectives, informal presentations and poster sessions on specific issues in which experts and delegates can explore subjects in depth, and demonstrations of relevant technologies.

Before the World Forum can begin its work, it will be necessary to examine the options for potential membership, and the agenda. The bringing together of experts from the industries involved in multimedia broadcasting will in itself provide valuable contact at the working level, but there is a need for discussion at a higher level, too. Here, it is important to ensure contacts involving people who can represent the broadcasters' strategic planning interests, as a means of ensuring that the systems are endorsed (at least in principle) at as early a stage as possible by the people who will be expected to implement them and use them.

The proposed World Forum responds uniquely to the newly-perceived need for the opening of a dialogue involving the developed and the developing countries, and the researchers and industrial interests in all related fields, with a view to the establishment of the requirements for the im-

plementation of digital broadcasting systems which incorporate interactivity and multimedia elements in the context of world-wide social development.

Acknowledgements

The Author is grateful to all those who have participated creatively in the many discussions leading to the preparation of the proposal for the World Forum: Dr. G.T. Waters (Director, EBU Technical Department and Secretary, EBU Technical Committee), Mr. Om P. Khushu (ABU, Chairman, Inter-Union Technical Committee), Mr. D. Wood (Head of New Technology, EBU), Mr. K.P. Davies (CBC), Mr. G. Dupont (UNESCO) and Mr. A. Jones (BBC).

Within the ITU, special acknowledgements go to Mr. R. Jones (Director, Bureau of Radiocommunications, Mr. A. Laouyane (Director, Telecommunication Development Bureau), Dr. G. Rossi (Head of Study Group, Department A) and Mr. P. Kantchev (Counsellor, Telecommunication Development Bureau), for their valuable and efficient support. The Author also expresses special thanks to Mr. H. Yushkiavitshus (UNESCO) for his outstanding contribution to the development of television and his contribution to the joint ITU/UNESCO work in the field of interactive television and its application in the developing countries.

Editorial note

The proposal outlined in this article was presented by the Author to the meeting of the Inter-Union Technical Committee (IUTC) in Tunis in May 1996. The IUTC recognised the merits of the proposal and agreed to set up a small group, led by Dr. G.T. Waters, to examine how the ideas could be implemented in practice. The matter will be examined again at the next meeting of the IUTC.

Bibliography

[1] ITU-D Report 4128: **World Telecommunication Development Report.**

[2] Krivocheev, M.I.: **A Global Approach to studies in television broadcasting**. EBU Technical Review, No. 259 (Spring 1994), pp. 24-46.