INTRODUCTION TO THE SPECIAL ISSUE ON DIGITAL TELEVISION

by T.J.B. SWANENBURG

Philips Research Laboratories, Prof. Holstlaan 4, 5656 AA Eindhoven, The Netherlands

Up until recently, all through the history of mankind, the hearth has been the source of heat and of prepared food and as such the centre around which a house was built and the family gathered. In the last three decades television has changed society to an extent that this is no longer true. In the civilized world the hearth has been replaced by a distributed source of heat, the position of the family is no longer unique and heat and prepared food no longer determine the house centre. The television set is more often than not in the dominant position now, it is the window to the outside world and television watching consumes a substantial amount of the time one is free to spend.

The invention of the art of printing was highly instrumental in the change of society, around half a millennium ago, when the large-scale distribution of written information undermined the authority of traditional institutions and people's attitudes to them. The worldwide introduction of television and its continuous expansion generated a similar change, with larger impact because of the easier access of the intellectual content due to the visual support. The weaker dependence on the written language contributed to the interconnection of large sections of mankind, up to then unknown to each other, and often therefore made enemies more easily. Whether all of the effects of television are to be judged as positive and desirable, could be subject to discussion and largely represents a personal attitude, but the facts are undeniable.

Apart from the social impact the facility of television is important for industrial and economic reasons. The hardware content demands an elaborated infrastructure for signal delivery and both at the transmitter and receiver ends technology is available at a level of complexity of which the most daring forecaster could not have dreamed. At the receiver end this is available for a price allowing it to be within everybody's reach.

For a long time the television transmission chain has been considered as a technically underused facility which, to begin with for economic reasons, is in need of further applications. Like all technical products television shows a continuous improvement in lifetime and performance, generally taking advantage of
developments elsewhere in science and technology. That television should take advantage of developments in that other branch of electronics, computer technology, is evident. For years it has been a source of deep embarrassment to the electronics industry that these two are still living apart. They have much in common but what kept them apart is that television is based on analogue and computers on digital technology. How these two have met and in the last few years have come closer together and are now on the verge of merging is the subject of this special issue of the *Philips Journal of Research* on Digital Television.

The driving force behind the introduction of digital television is that once the path has been paved for the distribution of digital signals for television, the same channels and technology can be used for providing new services. These new services are expected to give the new digital infrastructure a firm economic basis. In all papers collected in this issue, aspects of these new services will be referred to in detail as will the arguments for the technical solutions presented.

In Digital Television everything is digital apart from the TV set. For a long time it has been thought impossible to digitize the video signal without demanding a forbiddingly high bandwidth for transmission. This problem has been solved by determining in the sequence of scenes what is redundant and what is irrelevant to the viewer. Then the digitized signal can be compressed by leaving out what cannot be seen and transmitting only once what a sequence of scenes have in common. The high quality of the received pictures is achieved by the appropriate source coding allowing error correction. The mathematical techniques applied are explained by Challapali and Nocture and a more advanced technique, based upon a constant instead of a variable bit-rate, by Keesman. Once this problem has been solved it is of vital importance that for all aspects standards are developed and accepted worldwide by the technical community. Due to the economic interests such standards have been or are being reached at a rate which could be an example for any international co-operation. The MPEG-2 source coding standard forms the basis for further digital system standards, specifications for interfaces and protocols. Stienstra discusses two pre-standardization projects which allow even faster development of digital system standards for the new market opportunities created by MPEG-2: in Europe the Digital Video Broadcasting project and on a global scale the Digital Audio–Video Council. The transmission channels available are terrestrial broadcasting, cable distribution and satellite transmission: the signal requirements and solutions regarding coding and modulation are discussed in detail by de Bot and Daffara, by Ghosh and by Rysdale, de Bot and Hulyalkar, respectively. In order to stimulate the delivery of digital video services to the homes of consumers the National Information Infrastructure has been conceived covering the USA as a network of networks. This and the services supplied are described by Balakrishnan,
Introduction

Basile, Cugnini and Shen. For the next generation of North American broadcast television and high-data rate transmission on cable TV systems several competing solutions were available. The transmission system selected on the basis of laboratory trials and finally field-tested is described by Bryan, Ghosh and Hulyalkar. At the transmitter end, the signal is compressed and a real-time encoder operating according to the MPEG-2 standard and available on the market now is described by Nocture and Brouste. At the receiver end the signal is decoded, to be accepted by the conventional TV set, by what is now commonly known as a Set-top box. This dedicated computer should be available at a price equal to or less than that of a TV set. Akiwumi-Assani and Vlot present details of a multimedia computer hardware and software architecture close to realization and representative of the current offering of Philips Digital Video Communication Systems for application in telephone cable and satellite networks that provide services to the home. Rath and Wendorf enlarge upon further development of a modular designed Set-top box, including a real-time operating system with extensive multimedia support and stress the vital importance of the Set-top box advanced control software for flexibility. A working system of a server for 100 streams of 2 Mbit/s each for video-on-demand based on a disk array technology, interacting with a Set-top box based on CD-i, is described by Eggenhuisen and van Loo. A version supporting higher bit-rates per stream is being developed for MPEG-2 encoded material. The Set-top box which is connected to the digital TV plug, converts the digital signal into ordinary video: it would be desirable to record the digital data stream directly and replay it later. This and other applications like interactive games, teleshopping, telebanking, video-on-demand, require a sophisticated interface. Bloks selects the IEEE-1394 high speed digital serial bus as very well suited for this purpose. It is in the interest of the broadcaster, but also of the subscriber that pay-TV programmes are made available. Clear TV signal is scrambled and it can only be descrambled by a chip inside the Set-top box, if authorized to do so. Nowadays various schemes for such conditional access are on the market but they are fully incompatible. Van Schooneveld discusses the various proposals for standardization and the difficulties in coming to a decision. Once the digital transmission systems have been made available, the new multimedia applications demand huge volumes of information to be made accessible, for professional applications as well as for entertainment, by a retrieval system. Text can be characterized by the semantic content, but images, video and audio each demand different, new, partly still unsolved, representation models, discussed by Abdel-Mottaleb, Wu and Dimitrova. Similarly customers are to be informed on the programmes, preview data should be made available and programme changes are to be communicated. Rosengren presents details of an on-screen Electronic Programme Guide, indispensable for a few hundred channels, and describes how
this can be implemented in the Set-top box.

The transmission chain for multimedia transmission is available nowadays to a sufficiently large extent. Secondly it is fully within the capabilities of the electronics industry to upgrade the actual TV set in the short term to a multimedia terminal. However, before doing so the characteristics of the transmission and of the facilities have to be agreed upon and standardized over as large a part of the world as possible. This stage has not yet been fully reached: the papers in this issue describe the possibilities and options chosen. It is also within the capabilities of the electronic community to solve this shortly.

A more serious problem is that all papers necessarily enlarge upon the technical means to an end but that the extent and the precise shape of this end are still fairly obscure. Roughly six areas of interest can be distinguished where multimedia can be applied: entertainment, communication, shopping, learning, working and home-management. Up to now, watching television has been an entertainment offered virtually free of charge with extremely cheap, high-quality and long lasting equipment. A daily newspaper is much more expensive. Compared to what is spent on cars bought, maintained and run, or on active and passive sport, the multimedia industry is working on the wrong side: the consumer is not used to spending money on television. Multimedia will offer a more sophisticated form of television entertainment at a higher price: the material offered and the facility of a personal choice should induce the customer to pay for it. Philips is active in multimedia software through Polygram and co-operation with large publishing houses is unavoidable. Communication with video facilities probably presents a market, given the direct success of the fax-telephone facility. Shopping could be an attractive application if combined with sophisticated interactive ordering and display techniques supported with credit facilities. Learning and working in general demand low bandwidth, and it is hard to imagine what the large bandwidth available for multimedia could add. For home management two trends in society could be helpful: the increased criminal environment and the ageing population. Security survey is an interesting application and applied on a larger scale demands the bandwidth offered. For the ageing population which is less mobile and more vulnerable, the wired facilities may be useful. Monitoring certainly is one of them.

Philips Research hopes that the readers of this Special Issue enjoy the papers presented and share the confidence Philips has in applying electronics to the benefit of society. The main difficulty, however, has been noted earlier:

"For the gods perceive things in the future, ordinary people things in the present, but the wise perceive things about to happen."

Philostratos (A.D.200), Life of Apollonius of Tyana, viii, 7.