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Radio Systems Policy

DISCUSSION PAPER ON THE DEVELOPMENT OF IMPLEMENTATION STRATEGIES FOR THE INTRODUCTION OF ADVANCED TELEVISION SERVICES IN CANADA

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DISCUSSION PAPER

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PUBLIC DISCUSSION PAPER

DEVELOPMENT OF IMPLEMENTATION STRATEGIES FOR THE INTRODUCTION OF ADVANCED TELEVISION SERVICES IN CANADA

1.0 Introduction

Over the past five years, there has been an increase in activity and interest in advanced television systems related to improvements in picture and sound quality. These new services, often referred to as Enhanced Definition Television (ETV or EDTV) or High Definition Television (HTV or HDTV) may require larger transmission bandwidths than the conventional 6 Megahertz channels and will require new strategies for their future implementation in Canada. This discussion paper is primarily intended to solicit views on a number of issues associated with the future implementation of these systems and to propose to introduce an experimental period over the next three years to stimulate industry systems trials and transmission demonstrations.

2.0 Intent

The purpose of this discussion paper is:

(a) to identify the issues associated with the introduction of advanced television systems in Canada;

(b) to introduce an experimental period which will allow transmission demonstrations and systems trials (excluding studio systems);

(c) to identify potential applications and alternative suitable delivery mechanisms for the new technologies;

(d) to identify hardware and software needs of the broadcast industry and likely sources of supply when advanced television systems are implemented;

(e) to obtain more precisely an indication of the timing for the introduction of those applications;

(f) to assess the future need for and extent of radio spectrum necessary for these systems;

(g) to develop a consensus on the technical standards and licensing requirements which may be necessary;

(h) to announce the formation of a consultative committee on advanced broadcast systems;

(i) to obtain public reaction to these new services; and

(j) to assist in the development of an overall Canadian strategy for the future implementation of these systems.

3.0 Television Systems Developments

3.1 Background

The present television system standard used in Canada (525 line NTSC) was established more than thirty years ago. In the last few years some enhancement in camera and display technology as well as adjuncts have been made to the basic NTSC system (such as Teletext services, VBI lines and stereophonic sound) but the basic standard has remained unchanged.

However, far more fundamental changes will take place in the next five to ten years. Developments which have taken place mostly outside North America, particularly in Japan and more recently in Europe, are enabling television systems of considerably improved picture resolution, aspect ratio and sound quality and the elimination of many of the artefacts which limit the picture quality of conventional TV systems especially for large screen displays. Also, these systems will have capabilities to introduce additional non-traditional data services similar to teletext.

Such video services are expected to be offered to the public via non-broadcast media such as VTR's or optical discs. Since the picture quality is expected to be equivalent to that of 35 mm film, use of this technology is expected to augment and in some instances replace traditional film applications such as program production. Furthermore it could be used, in conjunction with video projection, for program distribution to movie theatres via satellite and fibre optic systems. Since broadcasting has always been considered an important aspect of Canada's cultural identity and sovereignty, the Department of Communications is taking this initiative in order to promote a national consensus with respect to the manner of future evolution of television broadcast systems.

3.2 Current Situation

Television systems were originally designed for terrestrial off-air broadcasting. Coaxial cable based cable-TV systems emerged in the 1950s and have expanded over the years to become a prime delivery medium. In more recent times satellite and MMDS systems emerged to augment terrestrial off-air broadcasting. Despite the different transmission media, one basic concept did not change; the NTSC standard was used for the television signal throughout the system from production through distribution to reception.

This situation, however, is about to change, not only for higher definition television systems but also for the present 525-line system.

3.3 International Initiatives

- Japan has defined a new format for television satellite broadcasting based on the NTSC system for the video part and carrying 4 high quality digital sound channels plus an auxiliary data channel on a 5.7 MHz subcarrier. This format is being used for their domestic Broadcasting Satellite Service.

- A family of Multiplexed Analog Component (MAC) systems has been defined in Europe for satellite broadcasting. These systems will permit transmission of enhanced quality television as well as 4 to 8 high quality digital sound channels. Teletext and auxiliary data capability are also included. The D2-MAC system will be used on the German and French broadcasting satellites that are scheduled to be launched in 1987. Measurements are being conducted on the performance of D2-MAC transmitted over cable systems.

- In North America, the unconstrained access by satellite home receivers to reception of pay-television channels transmitted over satellite led the industry to develop video scrambling systems for secure transmission over the satellites. Two main systems were developed. One (Video Cypher II) is based on an NTSC video format to which two high quality digital sound channels with an auxiliary data channel and an access control data channel are time multiplexed during the unused portions of the video signal. This format is not compatible with NTSC

transmissions and needs to be re-formatted for reception. The second system, developed in Canada, is one of the family of MAC systems (B-MAC). As in the case of the other MAC system, the video signal is transmitted by time multiplexing the compressed luminance/chrominance signals and using line sequential transmission of the chrominance components. Six digitally modulated high quality sound channels, one auxiliary data channel, an access control channel and Teletex can be time multiplexed with the video signal. These two systems are in operation on American satellites. A third system (OAK/Orion) is in operation on Canadian satellites (CANCOM).

- Some European countries are experimenting with an additional subcarrier in the television channel carrying two high quality digital sound channels for television with stereophonic sound, for presently used television systems in Europe.

- NHK, the public broadcaster in Japan has worked since 1971 on the development of a format for high definition television (HDTV). This format for studio production is supported by the US and Canada and was proposed as a world standard at the last CCIR Plenary Meeting in May 1986 but was opposed by several European countries. Meanwhile, it is becoming almost a de-facto standard due to availability of equipment. However, some system parameters still need to be standardized (eg., colorimetry, gamma).

- NHK has developed a tranmission system called MUSE (for Multiple sub-Nyquist Sampling Encoding) that is a very efficient encoding format permitting the satellite broadcasting of HDTV using a single 24/27 MHz channel corresponding to the broadcasting satellite channel bandwith assigned in the 12 GHz plans at RARC-SAT '83 (for Region 2) and WARC-BS '77 (for Regions 1 and 3) respectively. The MUSE encoding technique makes effective use of the human visual system characteristics, in performing the spatial-temporal sub-sampling in order to achieve an approximate 4:1 reduction in signal bandwidth with minimum visual impairments. Experimental transmission of the MUSE signal over the Japanese broadcasting satellite BS-2 commenced in December 1986, and experiments are continuing at present using the follow on BS-2b replacement satellite. Reception of the MUSE signal has been demonstrated utilizing BSS receivers as small as 75 cm. diameter. Japan plans to provide an operational HDTV BSS system using MUSE on the BS-3 commencing in 1989.

- A Japanese manufacturer is developing a video cassette recorder for HDTV using 'MUSE' encoding. If they are successful, this may mean that HDTV will be available to the consumer market in a relatively short term in video cassette form. This could possibly happen before any broadcasting of HDTV is available.

- The Association of Maximum Service Telecasters and the National Association of Broadcasters in the United States tested the MUSE encoding scheme over UHF TV channels in Washington in January-February 1987.

- The Europeans are teaming up through the project EUREKA U95 to develop an HDTV transmission format compatible with their MAC family of systems. Industry is leading the project with the help of different government laboratories and broadcasters. Early demonstration of their system is scheduled for late 1987. Their approach is likely to be based on line doubling of their 625 line systems. The studio production standard will be closely related to the transmission standard.

- Studies are underway in the CCIR to define system parameters for satellite broadcasting of HDTV using the 12 GHz/23 GHz bands. This is being done in preparation for the WARC-ORB (2) in 1988.

- In the United States, the National Association of Broadcasters (NAB), the National Cable Television Association (NCTA), the Electronic Industries Association (EIA), the Society of Motion Picture and Television Engineers (SMPTE) and the Institute of Electrical and Electronic Engineers (IEEE) established the Advanced Television Systems Committee (ATSC) in 1982. It currently has more than 50 member and observer organizations representing all facets of the television and motion picture industry to co-ordinate and develop voluntary technical standards for advanced television systems in the U.S.A.

- SMPTE in the U.S.A., is in the process of defining in detail the various parameters of a television production standard based on the 1125 line 60 Hz frame rate format developed in Japan.

- The EIA in the U.S.A. has formed a Broadcast Television Systems Committee to study the evolution of HDTV in the ~~Home~~ home. As a first step they are preparing a questionnaire for soliciting opinions from the industry.

- In Japan in September 1985, the Broadcasting Technology Association (BTA) was established by broadcasters and manufacturers of broadcasting equipment to develop broadcasting technology and to promote and contribute to the realization of new broadcasting services.

- In February 1987 in the United States, the Association of Maximum Service Telecasters, the National Association of Broadcasters, the Association of Independent Television Stations and 55 other broadcast organizations and companies filed a petition for notice of inquiry with the FCC, requesting the Commission to undertake an inquiry into the issues arising from the introduction of high-definition television.

3.4 Canadian Initiatives

- In 1982 and 1985 the Department of Communications, in collaboration with the Canadian Broadcasting Corporation and the National Film Board, sponsored two Colloquia on High Definition Television and a third Colloquium with additional support from Telesat Canada will be held in October 1987 where latest developments in advanced television systems will be discussed.

- In 1985, the Department of Communications commissioned a major study on future television technologies and their impact on Canada. A report entitled 'An Assessment of Current and Future Television Technology and its Impact on Canada' was issued.

- The Canadian Cable Television Association undertook studies under the title 'Project 90' to assess the evolution of cable television services and the impact of technological change.

- In 1987, a contract commissioned by DOC was completed concerning a process to develop a broadcasting equipment industry research strategy. The strategy will be a collaborative effort among broadcasters, suppliers, governments and university laboratories.

- In June 1987, the Department of Communications initiated a proposal ~~proposed~~ that organizations interested in broadcasting form an Advanced Broadcast Systems Committee to guide the orderly evolution of future broadcast systems in Canada. This committee is now in the early stages of activity.

4.0 Systems and Standards

An important characteristic of present television systems is the use of a single signal standard from production through to display. In North America this is the well known NTSC standard. However, in order to facilitate international program exchange and improve picture quality to viewers, standards and signal formats for production, distribution and display are beginning to differ from each other even for present television services. For example, production is moving from an analog format to a digital component format (although this process may include a number of incremental steps), transmission may be based on multiplexed analog components rather than a composite signal format, and in the receiver, sequential rather than interlaced scanning may be used for display. In future television systems, signal formats may exhibit even a larger variety, in order to optimize and adapt to particular transmission media or applications.

Progressive stages are foreseen by some parties in the evolution of television systems from the present systems to future High Definition Television Systems. These stages are defined by CCIR as **Enhanced Television and Extended Definition Television** (CCIR Document 11/1006-E, 10th December 1985).

According to CCIR, **Enhanced Television** designates a number of improvements applicable to current 525/60 and 625/50 television systems either with unchanged or with new emission standards.

The term **Extended Definition Television** implies new systems that are based upon 525/60 or 625/50 scanning, but providing a wider aspect ratio and increased resolution.

Ultimately it is foreseen, that **High Definition Television** systems will employ more than 525/60 or 625/50 scanning lines to achieve higher resolution and a wider aspect ratio. The number of scanning lines will likely be above 1,000; especially if interlace scanning is employed, and the aspect ratio is expected to be 16:9.

While production, distribution and display may each use different signal formats and standards, there obviously have to exist links between these standards in order to provide broadcast services. It may also be desirable, that some degree of compatibility exists between higher quality television signal formats and lower quality signal formats.

Table I, from CCIR Document 11/1006-E of 10th December 1985 (See Annex A), identifies in its 'boxes' the basic elements of present and possible future television systems. The boxes of a same line correspond to standards of different quality levels. Conversion between production standards is envisaged according to operational requirements. Television services use different paths going from production to display; paths in the vertical direction represent the most straight forward way of implementing one service, nevertheless, oblique paths are usable if required. As an example, a signal produced in analogue components (box 2) may feed a composite signal distribution network (box 5) and decoded for display in a conventional form (box 9). On the other side the same production signal may feed a multiplexed-analogue-components signal distribution network (box 6) and could in turn feed either a conventional (MAC receiver/decoder) RGB display (box 10) or an improved display using scanning-up-conversion (box 11).

At this point in time no agreements have been reached at the international level on signal format standards for production, distribution and display for most of the proposed new television systems, in particular for High Definition Television. However, many proposals from various countries are now being submitted to CCIR and other national and regional standards organizations reflecting those countries needs and industrial strategies. It is therefore necessary for Canada to also make its views and requirements known, so that new television systems may be influenced toward Canada's future broadcast service needs.

5.0 Proposed Frequency Bands and Sharing

Based on the expected interest in this area and the need to identify specific frequency bands where these future services could potentially be accommodated, the Department reviewed a number of bands which would likely be candidates for this type of service. As a result of this review, the Department intends to introduce a period of experimentation in the following frequency bands:

I. Below 1 GHz

(a) 470-806 MHz Band

Broadcasting is Primary

Up to two channels may be used where available for demonstration purposes in limited geographic areas of Canada.

II. 1-10 GHz

(a) 2500-2686 MHz

Fixed and Broadcasting Services share the band on a Primary basis with the Fixed-Satellite and Broadcasting-Satellite services.
Up to 3-4 adjacent channels may be used where available for demonstration purposes in limited geographic areas of Canada.

III. Above 10 GHz

(a) 11.7-12.2 GHz

Fixed-Satellite is Primary in this band.

(b) 12.2-12.7 GHz

Fixed, Mobile-except Aeronautical Mobile, Broadcasting and Broadcasting-Satellite Service are Primary in this band.
Existing and future terrestrial services are not to cause harmful interference to broadcasting satellites.
Channelization and other technical parameters would be based to the greatest extent possible on Appendix 30 of the Radio Regulations.

(c) 22.5-23.0 GHz

Fixed, Mobile, Inter-Satellite and Broadcasting-Satellite Service are Primary in this band.

Future applications for experimentation in other bands would be considered and would be evaluated on a case-by-case basis; applicants, however, would have to demonstrate why the specific above noted bands are not suitable for their experimental purposes.

Experiments/demonstrations may be terrestrial (radio/cable) or by satellite. The Department would be interested in views on delivery alternatives.

6.0 Proposed Licensing Conditions

The conditions noted below apply to experimental programs commenced before March 31, 1990. No new experimental programs will be authorized beyond that date.

During this experimental period and dependent upon the responses received from this notice, the Department may conclude that specific frequency bands could be designated for this type of use. If this is the case, the Department will proceed to further public consultation on the spectrum policy and licensing requirements which would apply.

For the experimental period, the following conditions will apply:

(a) Experimental licences will be issued for a maximum period of one year. They can, however, be renewed to permit the completion and evaluation of an experimental program. It would be the Department's intention to authorize experimental projects on such a basis for up to but not longer than 3 years.

(b) Licences will be issued for a specific geographic location only (coordinates to be specified in the application).

(c) Use of the assigned frequencies shall be confined within a geographically limited area.

(d) Receivers used in the demonstration or experiment will not be marketed to the general public.

(e) Experimenters should bear in mind that operation of the system is on an experimental basis only and does not confer any right of continued tenure for the frequencies assigned or any future right to continuation of the experiment/ demonstration.

(f) The licensee will be requested to provide to the Department an annual report on the technical and operational performance of the system and of "user/public reaction." (It is anticipated that as a part of the demonstration, a number of viewing locations will be established in public places throughout a city.)

It is recommended that applicants contact the Director-General, Broadcasting Regulation Branch in Ottawa regarding the terms and conditions of experimental certification in these bands.

7.0 Technical Guidelines

As there is great diversity possible in experimentation, no specific criteria are given here. The system operators and the Department will determine what guidelines/technical requirements must be satisfied.

8.0 Related Documents

- SP-Gen - General Information Related to Spectrum Utilization and Radio System Policies.
- Broadcast Procedures and Rules.
- SP 302.5 - Spectrum Utilization Policy for the Fixed, Radiolocation and Broadcasting Services in the Band 2500-2686 MHz.
- SP 312.7 - Spectrum Utilization Policy for the Fixed Service and Fixed-Satellite Service in the Band 12.7-13.25 GHz.
- SP 320.2 - Spectrum Utilization Policy for the Fixed Service and Fixed-Satellite Service in the Band 20.2-23.6 GHz.
- RSP 113 - Radio Standard Procedure - Application Procedure for Planned Radio Stations above 890 MHz in the Terrestrial Fixed Service.
- Appendix 30/30A of the ITU Radio Regulations
- Various Recommendations and Reports of CCIR Study Groups 10 and 11.

9.0 Questions for Public Comment

With the overall intent of this discussion paper in mind, the Department would like interested parties to provide information and comments in response to the following questions:

9.1 Potential Impact of Advanced Television Systems on Marketability and Competitiveness

(a) What impact will the implementation of advanced television systems in Canada and other countries have on the competitiveness of Canadian industry in general and your organization in particular, in the near term (0-5 years) and in the longer term (6-12 years)?

(b) How do you see these systems being financed and how will they be introduced (for example will they be introduced as non-broadcast services through VCR's and optical discs, or as large screen projection systems for use in movie-theatres for live transmission of special events such as sports, opera performances, etc., or as discretionary services via cable systems, or as private institutional systems for large corporations, etc)?

(c) What issues, if any, affecting your organization will have to be resolved before the introduction of these services (for example regulatory, spectrum, ownership rules and policies, competition, technical, etc)?

(d) What assistance, if any, should be provided by government to the broadcast equipment supply industry?

9.2 Services/Applications

(a) What types of new services or applications do you foresee as a result of higher quality television systems (for example a new and specialized type of broadcast service, new movie theatres showing video projections instead of film, teleconferencing, telemedicine, tele-education, etc)?

(b) Who do you expect will use these new services (for example as a new broadcast service, would it be the traditional broadcasters, the cable system operators or satellite system operators, etc; or in the case of telemedicine, would it be hospitals, doctors, provincial health care authorities, or the general public, etc)?

9.3 Requirements for National Standards

(a) How important do you think it would be to have a single world-wide television standard for production?

(b) Do you think that a single world-wide distribution and broadcasting standard is required, or would a common North American standard be sufficient?

(c) How important do you think it would be to have a common standard for new television systems for different delivery media such as terrestrial off-air, cable and satellite? Would some form of converter in the users home be acceptable?

(d) Do you think that any compatibility between new television systems and the present NTSC system is required?

(e) If you think that compatibility is required, what ought the extent of compatibility be (for example should any higher quality television signal be directly receivable by existing NTSC receivers without any converter (While such signal formats are feasible they also would

perpetrate certain impairments in the picture which are inherent in the NTSC signal format such as cross-colour and cross-luminance distortion), or would it suffice that the signal format of any advanced television system can be converted to NTSC format by a low-cost converter (for example by choosing line and frame rates that are compatible with the NTSC format, but transmitting the signal in time multiplexed component format rather than a composite signal? Multiplexed Analog Component (MAC) systems are examples of such systems.

(f) The Department of Communications has established a national Advanced Broadcast Systems Committee to provide direction to support advanced television services. Would your organizations be interested to actively participate in the work of an Advanced Broadcast Systems Committee?

9.4 Implementation Strategies

(a) When advanced television systems are introduced, do you expect and prefer an evolutionary and gradual enhancement of the existing systems or a sharp transition from today's systems to truly High Definition TV systems?

(b) As a broadcast service, do you expect that advanced television systems will be introduced as an additional service or will replace existing television services?

(c) Where and when would you expect these systems to be introduced first in Canada?

9.5 System Delivery

(a) What type of delivery mechanism do you expect to be used for these systems?

(b) Do you foresee the necessity for terrestrial off-air broadcasting?

(c) What restrictions (policy, technical, etc.), if any, should be applied to the method of delivery of services?

10.0 Procedural Matters

The Department invites written comments from all interested parties on the introduction of advanced television services in Canada. Specific details are requested on the types of uses, suitability of frequency bands, bandwidth, power, standards, protection criteria, regulatory aspects and delivery alternatives.

Any other comments deemed pertinent to the implementation of advanced television systems in Canada would also be welcomed.

Submissions should be addressed to the Director General, Telecommunications Policy Branch, Department of Communications, 300 Slater Street, Ottawa, Ontario, K1A 0C8 and to ensure consideration, must be postmarked on or before December 1, 1987 or received by other means by the same date. All representations must cite the Canada Gazette Part I Notice publication date, title and the Notice reference number.

Take note that all written comments received in response to this Notice will be made available for viewing by the public during normal business hours at the Department of Communications Library, 300 Slater Street, Ottawa, for a period of one year from the close of comments and at the Regional Offices of the Department at Moncton, Montreal, Toronto, Winnipeg and Vancouver for a period of six months from the close of comments.

Also take note that approximately two weeks after the close of the comment period, copies of all written comments received in response to this notice will be made available to the public. Copies may be obtained, by mail order or over-the-counter, from Kwik-Kopy Printing, 300 Slater Street, Ottawa, K1P 6A6. Reasonable costs of duplication will be charged.

ANNEX A

TABLE I – A tentative classification of TV standards: arrows indicate the main paths of interest

Field of application of baseband standards	Systems based on conventional scanning structures (625/50 or 525/60 2:1 interlaced)		Systems based on higher resolution scanning structures and wider aspect ratio	
Production of television programmes	PAL/SECAM NTSC (Rep. 624) 1	Analogue Y, R-Y, B-Y components (Rep. [AB/11]) Digital Y, C_R, C_B components (Rec. 601) 2	625/50 and 525/60 related extended-definition television (Rep. [AB/11]) 3	HDTV production (Rep. 801) 4
Distribution of television programmes (transmission and emission)	PAL/SECAM NTSC (Rep. 624) 5	Time-compressed and multiplexed analogue Y, R-Y, B-Y components (MAC) (Reps. [AB/11], [AA/10-11], [AB/10-11]) 6	Extended-definition television distribution 7	HDTV distribution 8
Display of broadcast programmes	R, G, B components (decoded from composite) 9	R, G, B components (derived from Y, R-Y, B-Y) 10	Up-converted R, G, B components 11	HDTV R, G, B components 12

DEPARTMENT OF COMMUNICATIONS

RADIO ACT

NOTICE NO. DGTP-009-87/TRS-019-87

Development of Implementation Strategies for the Introduction of Advanced Television Services in Canada

Over the past few years, research and development activity has led to the potential for improvements in television picture quality with the result that there is great interest by the broadcasting industry concerning the manner in which these improved services may ultimately be delivered to the general public. These new services require substantial further consideration in the areas of standards, spectrum requirements, compatibility with conventional TV and methods for distribution to viewers.

To assist the Department in the development of future decisions and strategies for the eventual implementation of these advanced television services, and to demonstrate to the public what the future of these services may provide, it is the intent of the Department to:

1) identify issues associated with the introduction of these systems;

2) introduce an experimental period over the next three years to permit transmission demonstrations and allow systems trials;

3) assess the future need for and extent of radio spectrum necessary for these systems;

4) identify potential applications and alternative suitable delivery mechanisms for the new technologies;

5) identify hardware and software needs of the broadcast industry and likely sources of supply when advanced television systems are implemented;

6) develop a consensus on the technical standards and licensing requirements which may be necessary;

7) obtain public reaction to these new services;

8) announce the formation of a consultative committee on advanced broadcast systems.

Further details are available in the companion discussion paper which also specifies proposed trial frequency bands and other conditions pertinent to any applications for experiments and demonstration systems.

Copies of the discussion paper are available from Information Services, Department of Communications, 300 Slater Street, Ottawa, Ontario K1A 0C8, or from the Department's regional offices in Moncton, Montreal, Toronto, Winnipeg and Vancouver.

The Department invites written comments from all interested parties on the introduction of advanced television services in Canada. Specific details are requested on the types of uses, suitability of frequency bands, bandwidth, power, standards, protection criteria, regulatory aspects and delivery alternatives.

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Dated at Ottawa this 16 day of July, 1987.

G.R. Begley
Director General
Broadcasting Regulation Branch

for V. Hill
Director General
Telecommunications Policy Branch