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SATELLITE-BROADCASTING SYSTEMS OF ISDB (INTEGRATED SERVICES DIGITAL BROADCASTING)

(Questions ITU-R 101/10 and ITU-R 101/11)

(1990-1994)

1. Introduction

The progress of digital technology such as multimedia and digital television has made the general public more and more accustomed to high-quality, reliable and easy-to-use consumer digital devices. This, as a matter of course, has likewise prompted consumers to seek the advantages inherent in the digitalization of broadcasting. Integrated services digital broadcasting (ISDB) enables the transmission of various kinds of information, digitally encoded and systematically integrated in a single digital broadcasting channel.

This Report discusses the basic concept and technical considerations of the ISDB system.

2. Concept of ISDB system

In the ISDB system, many kinds of information such as video, audio, teletext, still pictures, facsimile, computer software and even HDTV, from different origination sources, are digitally encoded, systematically integrated, and transmitted by a single digital broadcasting channel. Digitalization in the ISDB system not only makes possible high-quality transmission but also allows greater flexibility and efficiency in operation. It also makes possible the provision of multimedia services, and simplifies both information selection and access for the user.

It could become possible at some point in the future to incorporate into ISDB almost all kinds of broadcasting services now or under development.

3. Basic functions

It is desirable for ISDB to realize the following functions:

1) Flexibility
   - Many kinds of signals, from high-speed video signals to low-speed data signals, and the combination of them should be able to be multiplexed on the same transmission channel.
   - Various service signals which have a wide variety of transmission rates should be able to be transmitted.
   - Organization of service should be able to be arranged freely.
   - Signals should be able to be multiplexed based on their priorities.
   - The grade of service quality should be able to be selected for each receiver.

2) Extensibility
   - New services should be able to be introduced easily in the future.
   - New broadcasters should be able to take part in the broadcasting business easily.
3) Inter-operability
   - Transcoding among various digital broadcasting systems should be able to be done with ease.
   - Interconnection with other systems such as the communication system, package media, or computer system should be able to be easily established.
   - The multiplex method should be applied to a variety of transmission channels with widely-spread transmission capacity.
4) Emission characteristics
   - Efficient emission should be realized.
   - Good emission quality, such as robustness against channel errors, should be obtained.
   - Stable synchronization should be regenerated.
   - Recovery time should be short after interruption.
   - Signals should be transmitted with minimum delay.
5) Reception
   - Programmes should be able to be easily selectable.
   - Services should be able to be multiplexed and demultiplexed easily.
   - Signal components should be able to be displayed synchronously with each other.
   - Links among services or signal components should be able to be established.
   - Waiting time after selecting channel should be able to be decreased.
   - Common receiver should be able to be realized for all transmission media.
6) Conditional access
   - A wide range of applications requiring conditional access should be able to be introduced.
7) Other requirements
   - Operational costs for broadcasters should be reduced.
   - The receiver circuitry should be made simple and low-cost.

4. Technical considerations

4.1 Emission aspects

Use of a direct broadcasting satellite is considered an effective medium for ISDB. The service requires a wide bandwidth channel and at present almost all of the terrestrial broadcasting frequencies are in use in some areas. Broadcasting satellites would also more effectively serve ISDB's goal of economically providing consistent high-quality, reliable services over broad geographical areas.

4.2 Framework of ISDB transport system

In order to meet the functions mentioned in § 3, it is appropriate that the service transport methods for ISDB have the following functions:

1) multiplexing a variety of digitized video or audio signals and various kinds of data so that the signals are transmitted on a single channel and are received separately at the receiver;
2) optionally, error correction coding for the signals transmitted on various kinds of channels, so that they can be received correctly under various receiving conditions, such as severe noise or interference;
3) modulating the digital signals, which are integrated into a single bit-stream including the error correcting codes, by means of the multiplexing methods, using appropriate modulation and emission methods based on the characteristics of each transmission channel;
4) introducing conditional access systems which can be applied to each of the various kinds of digital signals, using appropriate conditional access systems;
5) data access method for the transport method mentioned above which enables easy reception of the desired service or programme at the receiving side.

4.3 Service multiplex methods

There are basically two service multiplex methods: structured transmission and packet transmission.

i) Structured transmission method

In the structured transmission method, data corresponding to each service are located in fixed positions in the transmission frame. This method has the following characteristics:

- it allows for optimum transmission of each service, assigning it to an appropriate frame area and position according to the required transmission rate;
- the desired data can be easily separated, because data can be identified based on their position in the frame;
- transmission efficiency is high if the transmission rate of each service is constant;
- it has poor extensibility, because it is difficult to accommodate new services once the system has been specified.

ii) Packet transmission method

A packet consists of a header and data field for each particular service. The header indicates data attributes. In the packet transmission method, the packet is located arbitrarily in the transmission frame. This method has the following characteristics:

- various services can be specified with a common transmission protocol and handled in the same manner;
- it requires data separation processing to select the desired packets from all transmitted packets;
- transmission efficiency is high, because it allows for optimum transmission of variable bit rate services, thus compensating for the somewhat higher overhead due to the presence of packet headers;
- new services can be easily added, which means that it provides high extensibility and flexibility.

For obtaining robustness against transmission error, the transmitted data should be constructed within the transmission frame which has periodicity. The frame should have a frame synchronization code which has sufficient length for regenerating synchronization quickly and reliably. The depth of interleaving, the method of randomizing transmission signals, and the schemes for error correction should be determined based on the requirements for each system and the transmission channel characteristics.

4.4 Information identification function

ISDB makes it possible to integrate and transmit a large variety of services.

Such features underscore the importance of identification and index capabilities. These would enable the user easily to receive, select, use directly, or store automatically and retrieve the required information.

4.5 Other aspects

Other aspects are also expected to be studied and combined in an optimum manner to develop ISDB. These would include:

- source coding;
- channel coding;
- digital modulation;
- conditional access; and
- the concept of a universal receiver.

5. Conclusion

ISDB is expected to be able to include various services such as multimedia, multichannel television and HDTV. A practical, well-organized model should be studied for implementing future broadcasting systems.