

## RECOMMENDATION ITU-R BT.1437\*

**User requirements for digital coding for  
multi-programme television transmission**

(Question ITU-R 43/6)

(2000)

The ITU Radiocommunication Assembly,

*considering*

- a) that in digital broadcasting it is necessary to use the available channel capacity efficiently for a given number of programmes containing different complex contents;
- b) that this may be achieved by multiplexing several programme signals on one channel;
- c) that special methods are required to ensure that the appropriate picture quality is obtained for each programme within the constraints of an overall total bit rate;
- d) that these special methods generally require a control system to regulate the functions of the individual signal encoders and the multiplexer;
- e) that the specification of users' requirements for multi-programme television is essential, including the needs of programme producers, broadcasters and network operators;
- f) that the coding methods should be compatible with those of existing and proposed digital television systems,

*recommends*

that the following user requirements should govern the specification, design and testing of systems for coding for multi-programme transmissions:

## **1 Functional and operational requirements**

### **1.1 Number of programmes**

More than one, maximum is not specified.

### **1.2 Range of variable bit rate**

Because a range of bit rates which can be varied would affect the size of the buffer, the coding-decoding delay and synchronization, it should be restricted to an appropriate range to allow decoding by MPEG-2 compliant decoders.

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\* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2003 in accordance with Resolution ITU-R 44.

### **1.3 Compatibility**

The techniques must allow decoding by an MPEG-2 compliant decoder. The structure of an MPEG data stream has to be taken into account in order to define an appropriate control scheme for multi-programme transmission.

### **1.4 Interoperability**

The techniques should be independent of transmission media and should allow a flexible combination of programmes inside a bouquet.

### **1.5 Flexibility**

Broadcasters or system operators must be able to reassign dynamically the configuration of services such as: the number of multiplexed programmes, the target quality of each programme and the picture format, as required to meet their instantaneous needs.

The technique used must allow decoders to follow such changes without manual intervention by the user. The ability to provide additional data services should be retained.

### **1.6 Extensibility**

Any upgrade to the joint coding technique should be downwards compatible with existing techniques. The use of scalable transmission schemes for graceful degradation and compatible services should not be prevented by introducing the techniques.

### **1.7 Implementation**

Consideration should be given to operating a joint coding scheme when the encoders and multiplexers are at separate locations.

Consideration should be given to a re-multiplexing of primary distribution with secondary distribution in a transmission chain.

## **2 Performance requirement**

### **2.1 Picture quality**

Overall picture quality obtained by the techniques should be superior to that obtained by conventional constant bit rate coding. Because the resultant picture quality of a programme is affected by the complexities of other programmes in addition to its own, it is necessary to restrict the influence to an appropriate level.

### **2.2 Recovery time**

Introduction of the techniques should not increase the recovery time.

### **2.3 Acquisition time**

Introduction of the techniques should not increase the acquisition time.

## **2.4 Relative sound/vision delay**

The relative sound/vision delay should be kept below the level of perceptibility.

## **2.5 Delay**

Coding delay should be close to that for a conventional coder.

## **2.6 Error performance**

Introduction of the techniques should not degrade error performance.

The joint coding for multi-programme transmission, often referred to as statistical multiplexing, is described in Annex 1.

# **Annex 1**

## **Coding for multi-programme transmission**

### **1 Introduction**

In digital broadcasting it is highly desirable to use the available channel capacity in an effective way. In order to achieve this goal several programmes are compressed, multiplexed and transmitted over a single channel. Normally the channel capacity will be divided among these programmes in a pre-determined way, which means that each programme is allocated a fixed bit rate. Due to the fact that the bit rate required to obtain a desired picture quality depends on picture content, a constant bit rate coding leads to large variations of picture quality, and an inefficient use of the channel capacity. This suggests that a variable bit rate compression scheme that allows the channel capacity to be dynamically allocated among programmes would result in improved overall picture quality or bandwidth savings. In order to perform bit allocation across programmes, a control mechanism known as joint coding control has to be introduced. This technique is sometimes referred to as statistical multiplexing, although in conventional statistical multiplexing there is no global control mechanism.

The MPEG-2 encoders available on the market today are designed to support a variable output data rate e.g. for standard definition television (SDTV) material in the range between 2 Mbit/s and 15 Mbit/s. In a multi-programme environment the data rates of several multiplexed programmes can be jointly controlled in such a way that the desired picture quality of each programme is achieved by using a variable bit rate encoding scheme, while maintaining the aggregate bit rate constant at the channel rate.

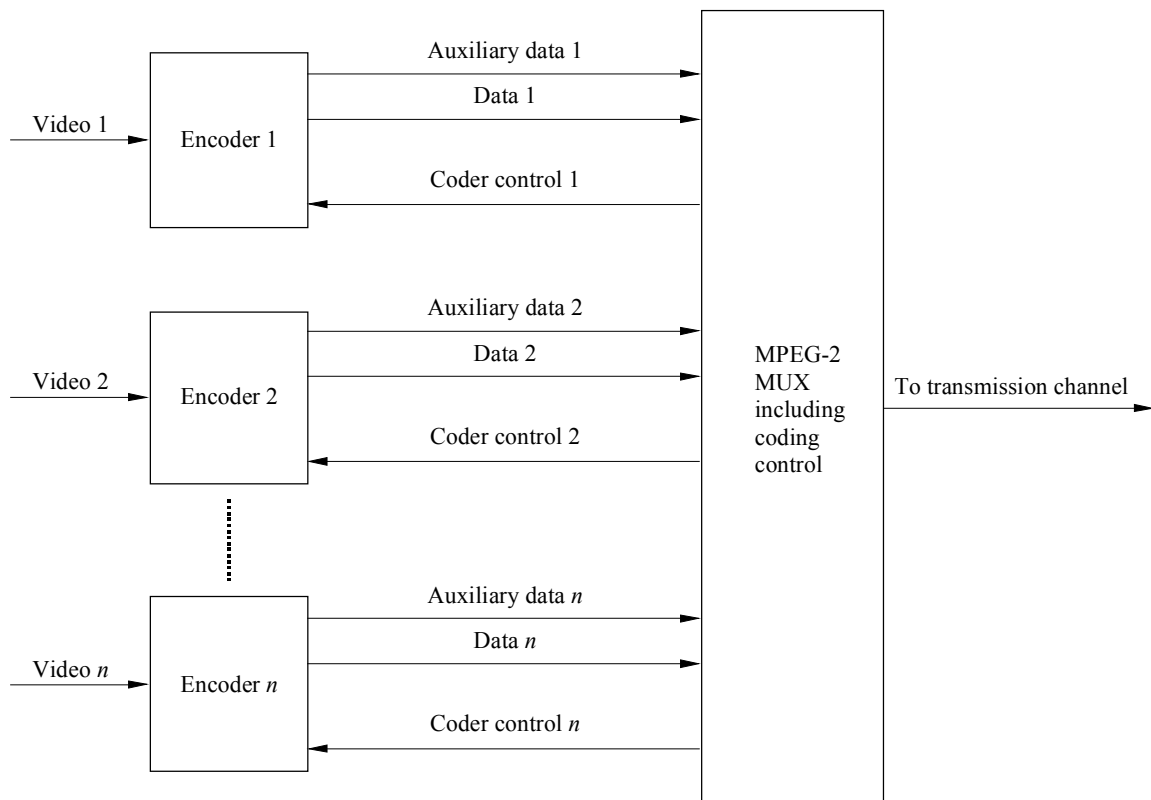
### **2 A joint coding control scheme**

Under the assumption that the programmes to be encoded use an MPEG-2 encoding scheme, the encoders already produce a variable output data rate that is smoothed in the output buffer of the system if a transmission over a fixed rate channel is desired. Instead of controlling the bit rate for each individual programme, a joint coding control scheme provides a variable bit rate for each programme under the assumption that the total bit rate of the system is constant and is in the optimum case equivalent to the channel capacity. In order to control the total bit rate, the joint coding control mechanism adjusts the appropriate encoding parameters in such a way that the more

complex programmes will be allocated more bits than the less complex programmes. This scheme reduces the fluctuations of the picture quality within programmes and among the programmes transmitted in the same channel. Alternatively, the same picture quality can be achieved at a lower average bit rate per channel.

This coding control scheme needs a bidirectional link between the encoders and the channel multiplexer. An example of such a control scheme is shown in Fig. 1.

FIGURE 1  
Schematic for a joint coding control system



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Another example could have the coding control in a master encoder controlling other encoders at the same location, thus avoiding a control link from the channel multiplexer to the encoders. However, this necessitates links between encoders.