CCITT SGXV
Working Party XV/1
Specialists Group on Coding for Visual Telephony

Document #513
June 1989

Source: Japan
Title: Video data buffering
(cf. Section 3.2 of Annex 4 to Document #499R)

## 1. Introduction

As is described in section 7.3 of Document #499R, some additional specification seems necessary to avoid decoder buffer overflow regardless of architecture. This document presents an example of criteria to evaluate several possible specifications concerning data buffering. And this document also presents a new alternative method.

## 2. Evaluation criteria

Several reasonable criteria should be defined to evaluate various possible buffering specifications. The following is major ones discussed in Japan.

1. Assurance of communication between codecs with different architectures; pre-buffering, post-buffering
   This criterion is fundamental. Therefore any specification that does not satisfy this, is not worth considering.
2. Easiness of installation
   Easiness of hardware implementation is desirable.
3. Simplicity of definition
   A simple specification is desirable to avoid misunderstandings. And it will probably need simpler implementation than complicated specifications, and leave feasibility for compact decoders.
4. Coding efficiency
   This criterion includes several sub-criteria.
   - 4-1. Delay time
   - 4-2. Transmission efficiency in terms of bit loss caused by side information and/or filler bits
   - 4-3. Full use of decoder processing capability without under-declaration
   - 4-4. Freedom in coding control
5. Easiness of validation

In addition to the item defined above, a scoring method needs to be defined, which is not described in detail in this document. A sample of scoring table is shown in Annex 1.

## 3. Previous methods and a new method

Two solutions of the problem have been presented in Document #485.

One (or Method 1) defines the permitted limit of deviation from the constant frame reference timing (see Annex 2.)

And the other (or Method 2) defines the permitted limit of delay time from the time that a frame is given to the source coder to the time that PSC of the coded frame is sent to the transmission line (see Annex 3.)

The new method, Method 3, specifies the minimum number of bits per one coded video frame. If the resultant bits are less than the specified amount, filler bits need to be inserted before the next video frame is transmitted. The detail is described in Annex 4.

These methods should be evaluated according to the criteria explained in section 2.

## 4. Conclusion

An example of criteria was presented to evaluate several methods to solve the data buffering problem. And three solutions including one new method were presented. Further study is necessary to choose a method for the final recommendation.

Annex 1 to Document #513

Sample of scoring table

| Method / Score | | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| Criteria | 1 | | | | | |
| | 2 | | | | | |
| | 3 | | | | | |
| | 4 | 1 | | | | |
| | | 2 | | | | |
| | | 3 | | | | |
| | | 4 | | | | |
| | 5 | | | | | |
| Total | | | | | | |

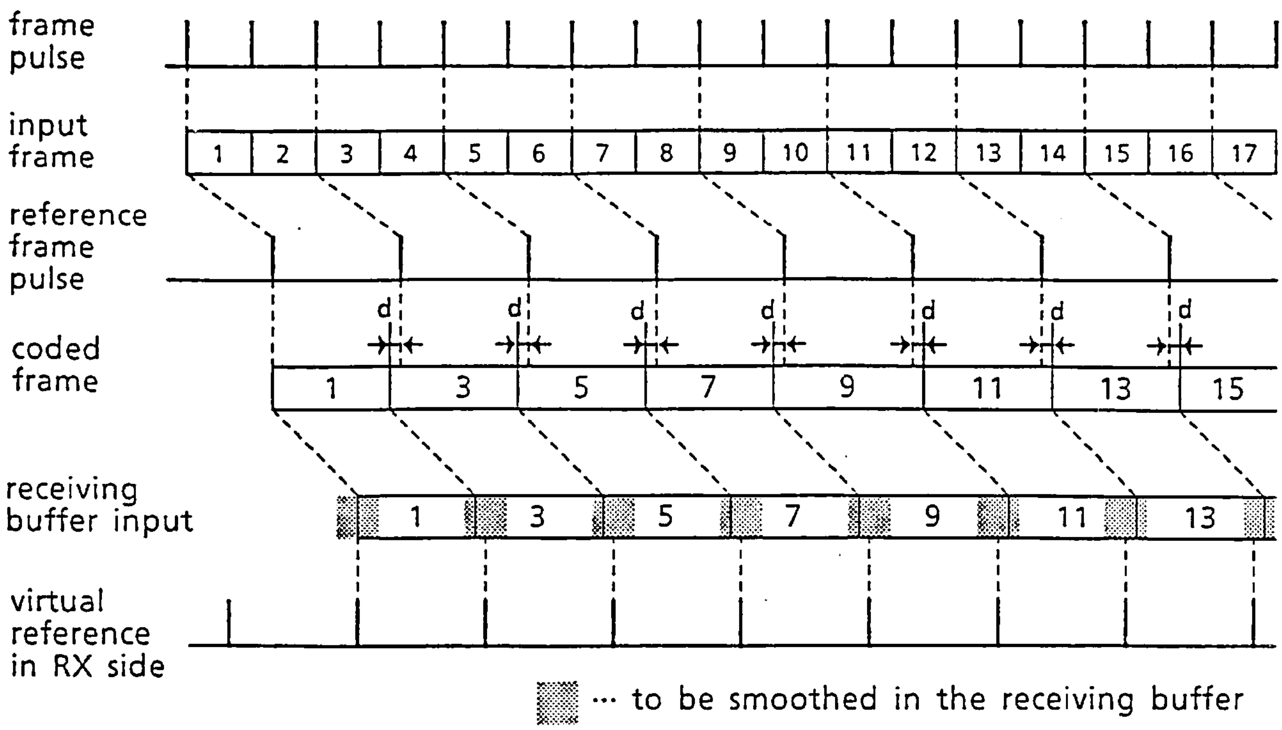


Fig. 1 ordinary case (all d are less than TH)

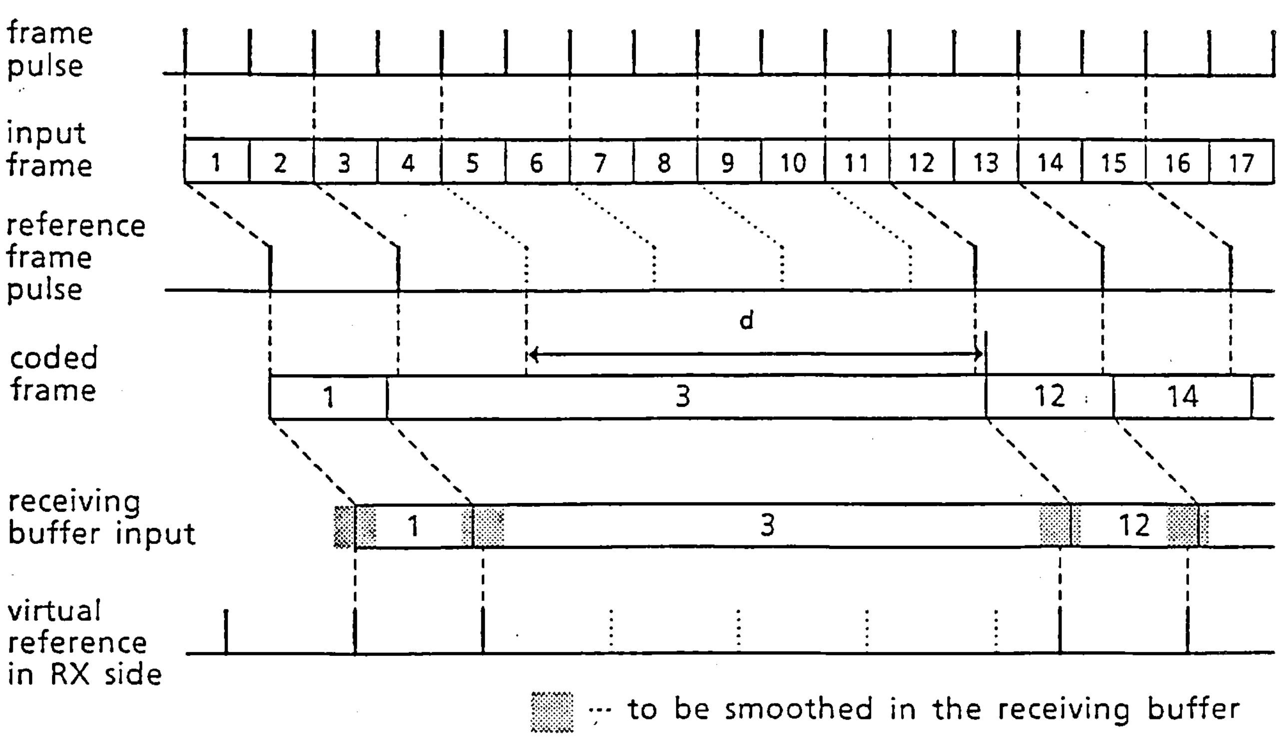


Fig. 2 case of overflow (d is more than TH in frame 3)

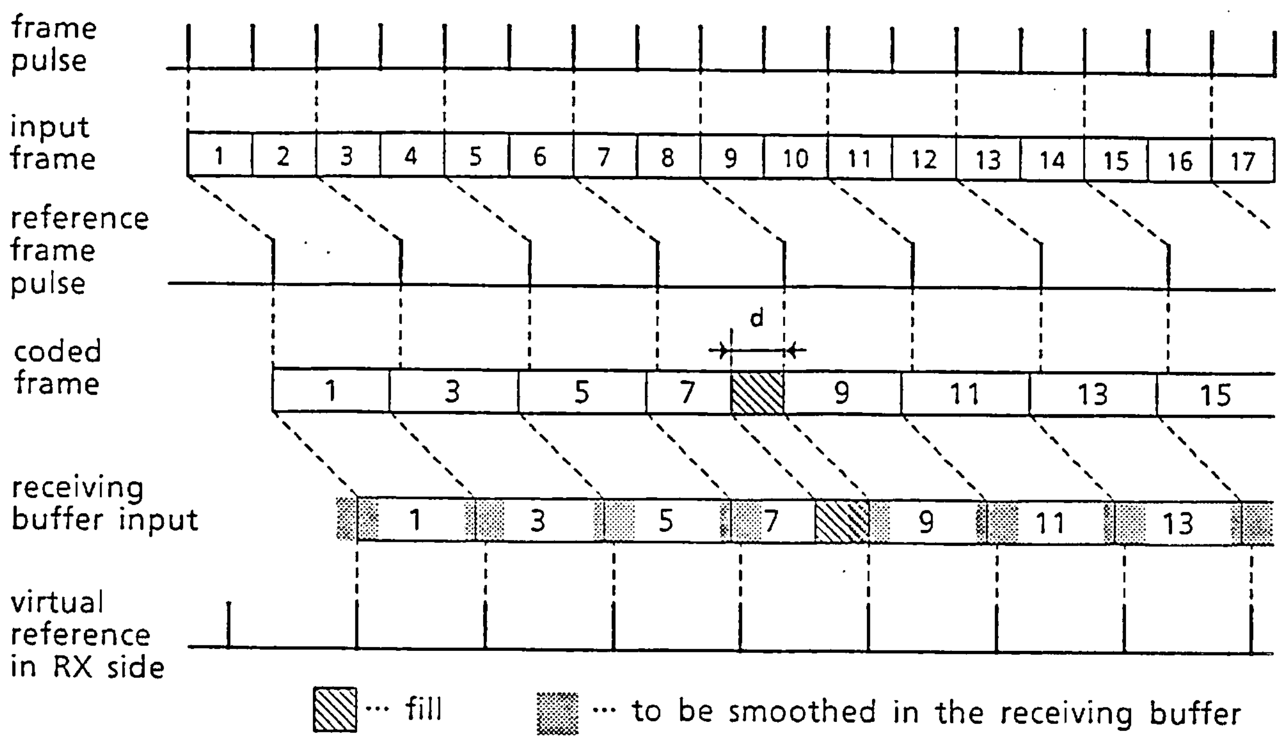


Fig. 3 case of underflow ( d is more than TH between frame 7 and 9 )

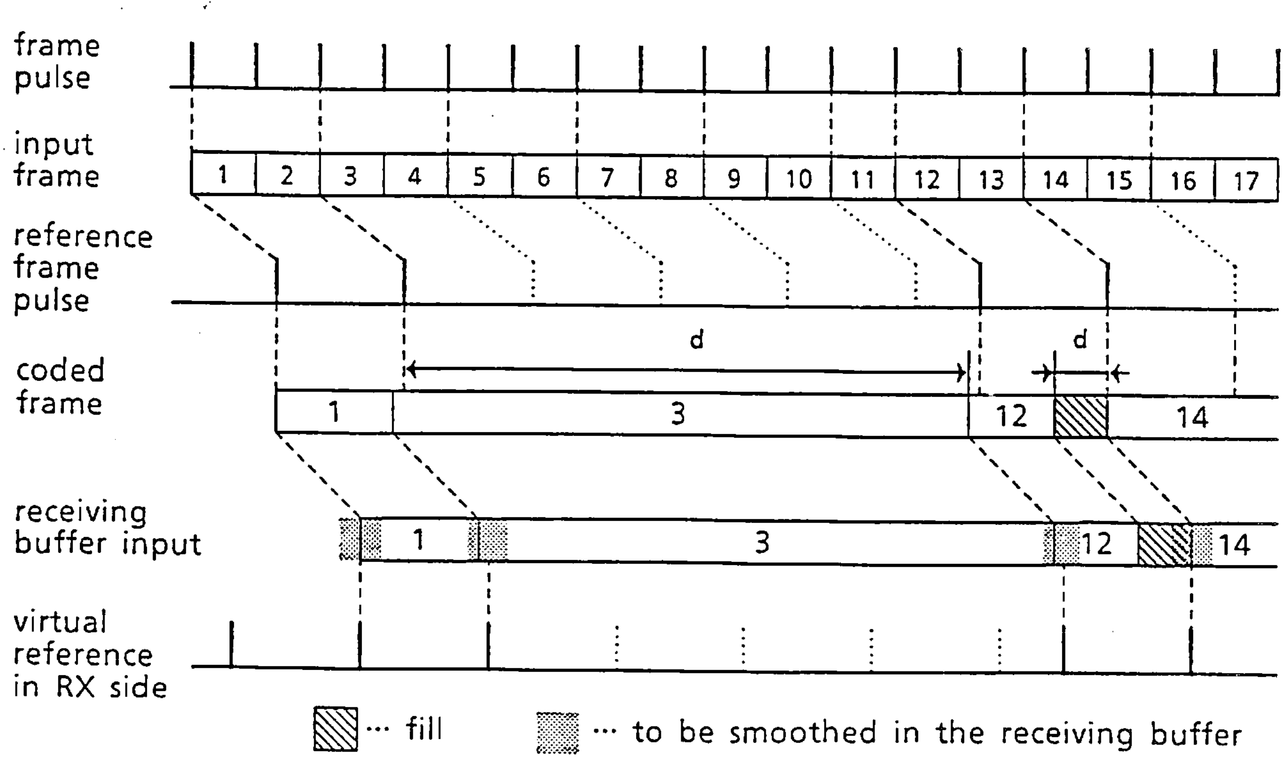


Fig. 4 case of bad control ( underflow follows overflow )

Annex 2 to Document # 485

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March, 1989

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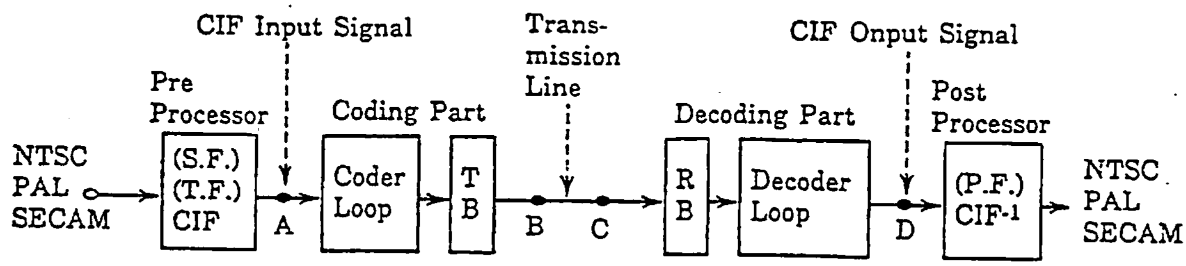



Fig. 1 Outline Block Diagram of the Codec

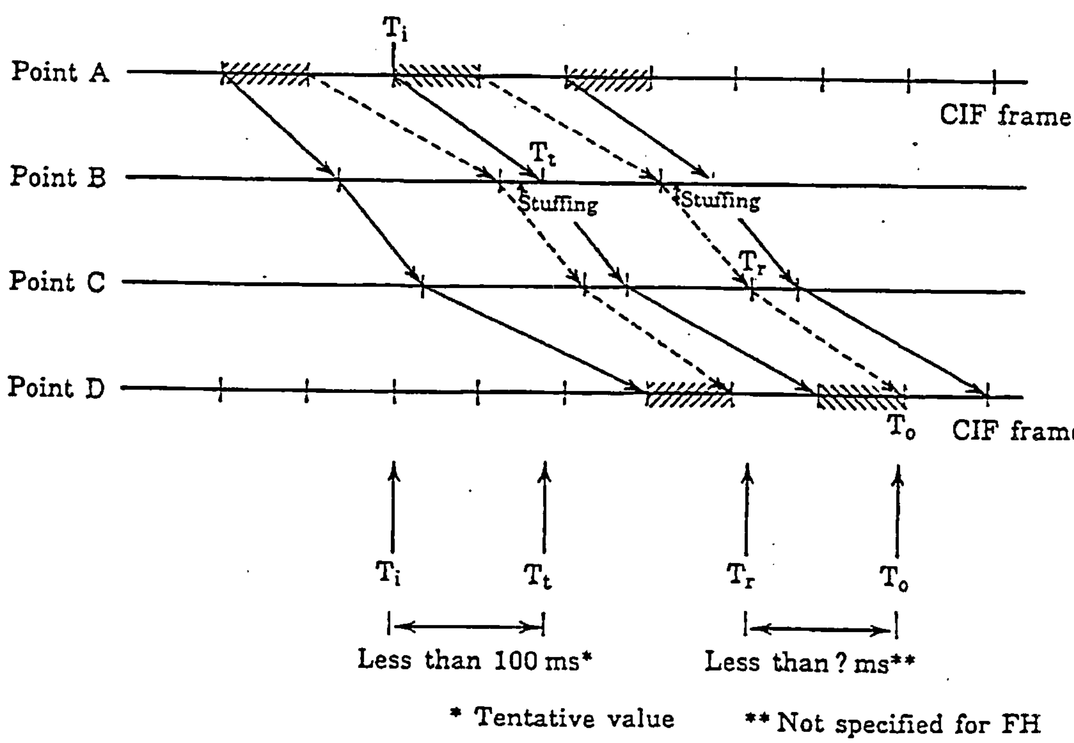



Fig. 2 Time Relations

Annex 4 to Document #513

## 1. Introduction

According to the current specification of FH, the number of non-coded frames (denoted by **t**, from 0 to 3) is negotiated before a communication starts. The video input rate to a coder is restricted by **t** and time interval between frames are stretched (see Fig. 1 in Annex 5.) But **t** cannot directly stretch the interval of PSCs on a transmission line (see Fig. 1.) Therefore data of several video frames can be transmitted while a decoder can process one video frame (see Fig. 2 (a).) This may cause decoder buffer overflow or large delay time.

This Annex presents a method to limit the rate of video frames on transmission line less than or equal to the negotiated value by defining a minimum number of bits per coded frame.

## 2. Definition of the minimum number of bits

The maximum coded video frame rate **F** is calculated as

$$\mathbf{F} = 30 / (\mathbf{t} + 1)$$

A new parameter **p** (=**F**/**R**) is introduced to show the maximum decoding power, where **R** denotes the number of video frames that the decoder can process within a second (see Fig. 3 in Annex 5; Note that R over 30 is permissible.) And **p** is also negotiated with **t**.

For example, when a decoder can process 12 frames per second, it will send 2 as **t** to limit the maximum number of transmitted frames to 10. But in the new method, **F**=10, **R**=12, and **p**=**F**/**R**=10/12, and this value is transmitted to the encoder to utilize full decoding power.

The minimum number of bits, **bm**, is defined as

$$\mathbf{bm} = \mathbf{p} * \mathbf{r} / \mathbf{F}$$

where **r** denotes the video transmission bit rate (bits/s). And if the number of bits generated by one video frame coding is less than **bm**, filler bits are inserted as is shown in Fig. 2 (b) in Annex 5.

This method is equivalent to negotiate **R**.

## 3. How to insert filler bits

Two methods are possible to insert filler bits under current FH specification.

The first is to use **stuffing bit pattern** (0000 0001 111), and the second is to use **error correcting frame** with Fill Indicator bit set to 0.

## 4. Features of new method

The new method has following features.

- Transmitted video frame rate never exceeds the decoding power. And communications without decoder buffer overflow are assured regardless of architecture.
- Only methods already in FH specification are used to insert filler bits.
- The specification is simple and easy to install.
- Wide range of freedom is left on delay time control, coding frame rate, and so on.
- Bit loss may occur by inserting filler bits to satisfy the minimum number of bits. But this situation may be avoidable by coding control.

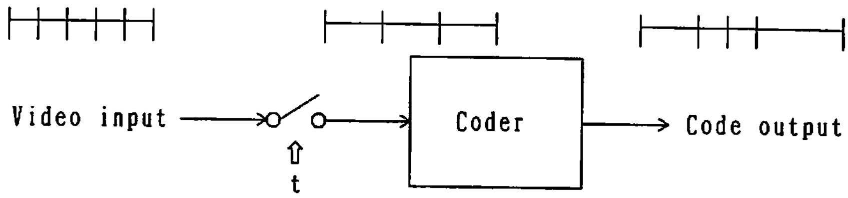
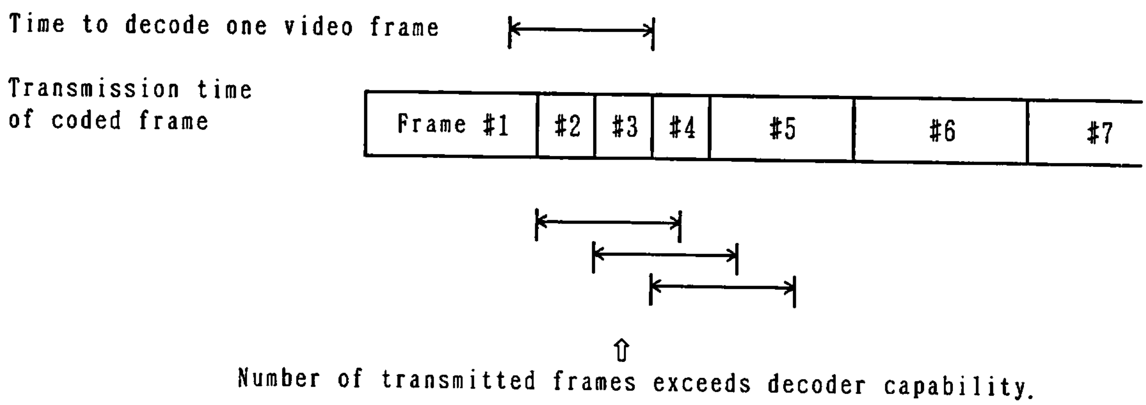
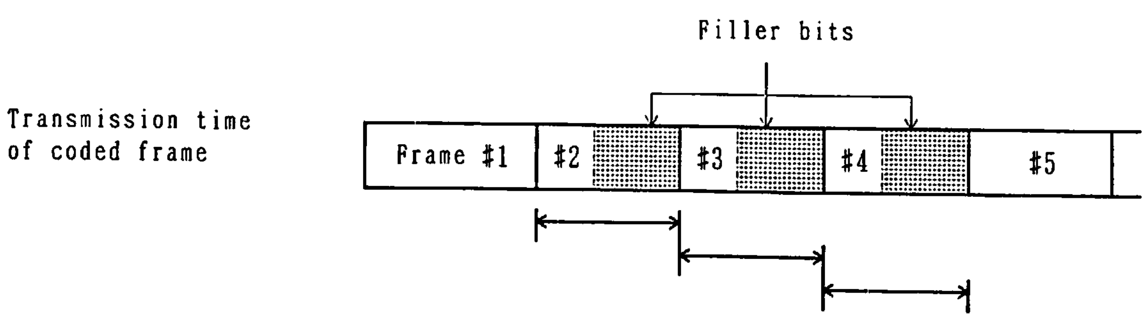



Fig. 1

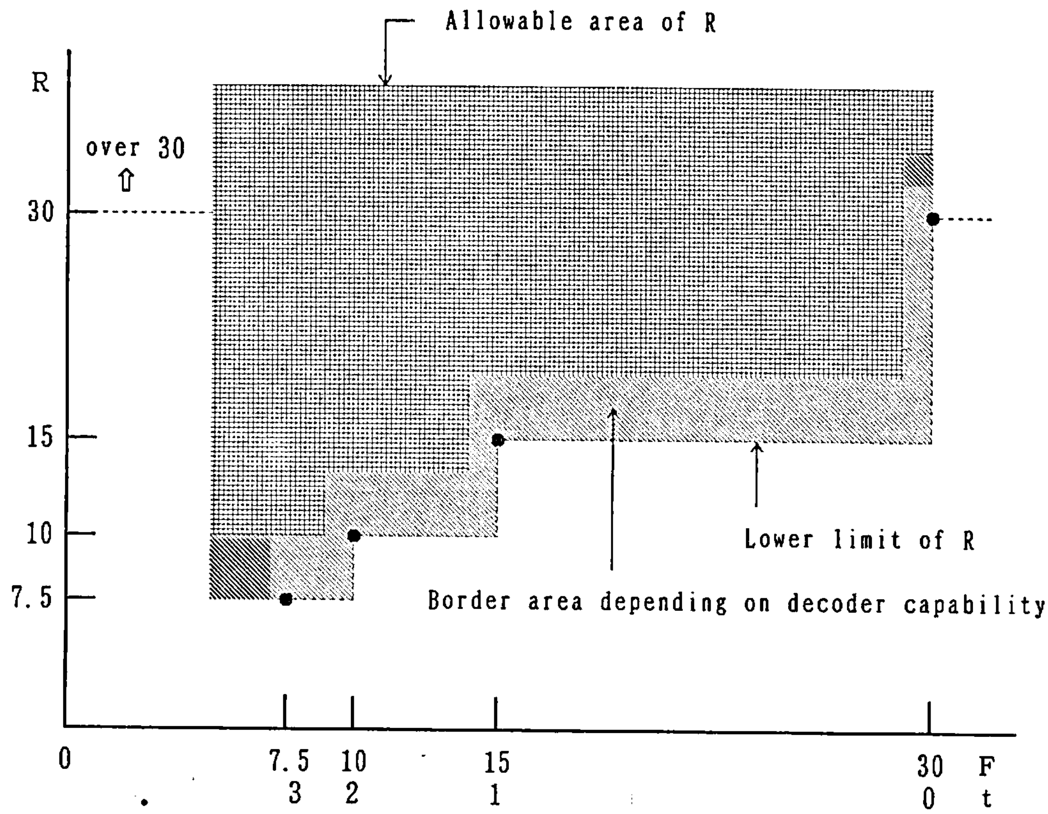



(a) Without minimum bit regulation




(b) With minimum bit regulation

Fig. 2



Allowable area of R
R
over 30
30
15
10
7.5
Lower limit of R
Border area depending on decoder capability
0
7.5
3
10
2
15
1
30
0
F
t


Fig. 3