

The invention relates to a method for the digital transmission of communications or recording and reproduction of communications.

During the transmission and/or recording and reproduction of signals, the packing density is often subjected to temporal fluctuations. This may apply both to processed signals as well as to those which have been processed by a source encoder for the reduction of irrelevancy and redundancy. Designing the transmission path or the recording medium for the maximum packing density is technically complicated and uneconomic. Through a limitation of the transmission or recording capacity to an average packing density by compression and subsequent expansion in the time domain i.e. by using different word lengths of the data segments in dependence on the packing density, the problem arises of distinguishing the different length data segments again after the transmission or recording. This recognition is particularly difficult when interference has removed the recognition criteria. The case may then arise that even after the interference has died out, a proper recognition of the subsequent data segments is prevented.

A method for the digital transmission of communications using variable code word lengths in which blocks of constant length are generated with sync pulses and filled with fill characters is described in "Electronics and Communications in Japan", Vol 59-A, No 5, p 51 - 60.

The object of the invention is to improve a method for the digital transmission of communications or the recording and reproduction of communications such that the influences of interference on the recognition of the data segments is substantially reduced but without thereby having to artificially increase the bit rate.

This object is achieved in a method in accordance with the first part of claim 1 by the features mentioned in the characterising part. Claim 10 includes a device in accordance with the invention.

The invention combines the means for the compression and expansion of the data segments in the time domain with a fixed time frame and ensures that blocks whose capacity has not been exhausted by the data segments assigned to it, are filled by other data segments and so are better utilised. Thus, on the one hand, the completeness of the data is guaranteed and on the other hand, due to the time frame, it is possible to recognise the data segments by the assignment to the blocks. The influence

of interference is thus limited to the direct consequences of the alteration of the individual items of data and of itself, can no longer be disadvantageously effective on the subsequent recognition of the data segments. This is all due to the fixed time frame of the blocks of constant word lengths.

In a further development of the invention, a plurality of blocks can be combined into a frame and within this frame, the data segments, as regards the sum of their word lengths, are made equal to the sum of the word lengths of the blocks, before the filling of the blocks. This equality may consist in an increase or reduction of the original word lengths of the data segments. What is important however, is that the sum of the word lengths of the data segments is at most equal to the sum of the word lengths of the blocks in order that the word lengths of the blocks which are available may be optimally utilised and so that no important information gets lost. A regular reduction of the irrelevancy or a coarsening of the information is not to be considered here as a loss of essential pieces of information. Equality of the sum of the word lengths of the data segments with the sum of the word lengths of the blocks is also to be considered as occurring when the sum of the word lengths of the data segments is somewhat smaller than the sum of the word lengths of the blocks i.e. if not all the blocks have been filled with portions of data segments. This is frequently the case in practice, since an exact filling would considerably increase the co-ordination time and the result would bear no relation to the effort expended.

The invention further relates to a device for the digital transmission of communications and/or recording and reproduction of communications in accordance with the first part of claim 10.

As regards this, its object is to improve a device of the type hereinbefore described such that the influences of interference on the recognisability of the data segments is substantially reduced.

This object is achieved in a device in accordance with the first part of claim 10 by the features mentioned in the characterising part.

Developments and advantageous embodiments of the invention are apparent from the claims 2 - 9, the subsequent description and the drawing which illustrates one embodiment of the invention.

In the drawing, there is shown in:

Fig. 1 a block circuit diagram of the invention,

Fig. 2 illustrations of the data flow in time, at selected positions of the circuit illustrated in Fig. 1.

The block circuit diagram includes, in the direction of data flow, a coder 1, a multiplexer 2, a first storage group 3 and a second storage group 4 which is switchable alternatively to the latter, a demultiplexer 5, a transmission path or a record carrier 6, a first decoder 7, a second multiplexer 8, a third storage group 9, a fourth storage group 10 which is switchable alternatively to the latter, a second demultiplexer 11, a second decoder 12 as well as a first control circuit 13 and a second control circuit 14.

The data fed to the coder 1 may be e.g. video signals which are obtained by conversion by means of an analogue to digital converter. In so far as particular parts of the picture from which data words are formed, are given here, this data has a fixed word length including a data segment end signal but it exhibits a different packing density. For the video signal, this is functionally related to the fine structure of the picture.

The coder 1 is a source coder which reduces the redundant and irrelevant portions of the supplied data. This may be effected for example with the aid of a discrete cosine transformation whose output signal is subsequently weighted whereby inessential spectral coefficients are separated from the essential ones. Data segments of variable word lengths then appear at the output of the coder 1. A data segment end signal is also present in these data segments.

By means of the first multiplexer 2 which simultaneously includes a counter for the number of bits of the word length corresponding to a block, the data of a data segment is initially read into the first storage group 3. The number of storage positions corresponding to the word length of a block is reserved for each block in this storage group. If the storage positions are not or just completely utilised, then, for this block, one maintains the allocation to the storage group 3. In the other case, the remainder in excess of the word length of a block is written into the second storage group 4. In a similar manner, the next data segment is then allocated to and stored in a further block.

For the video signal, a data segment may consist for example of a square of 8 x 8 picture elements. A coded block of this data segment would thus occupy 64 bits. Expediently, all the picture

segments of a complete picture are combined into one frame and all the blocks pertaining to a frame are stored in the storage group 3 together with the data segments whose word lengths have exceeded the word length of a block in the storage group 4. Thereafter, beginning with the first block, the blocks are emitted via the multiplexer 5 onto the transmission path 6 or to the record carrier and, in those cases in which the available word length is smaller than the maximum possible, are filled up with the excess portions of the data segments by switching over to the second storage group 4. The result is thus a sequence of blocks which all or nearly all comprise the maximum possible word lengths and thereby contain all the portions of a plurality of data segments. In the last blocks, it could nevertheless happen, that the blocks can no longer be quite filled with portions of the data segments. In this case, empty positions are inserted. The appropriate control is effected by the control circuit 13 which co-ordinates the time sequence. The circuit may be realised in hardware using discrete components as well as by a computer with the assistance of the internal memory of the computer.

After the transmission or the storage, the data interlaced in the blocks reaches the first decoder 7 which analyzes the blocks for the data segment end signal. The first part of the block is then read into the third storage group 9 by means of the second multiplexer 8 until the data segment end signal appears. Thereafter, the multiplexer 8 switches over to the fourth storage group 10 into which the remaining portion is read. Subsequently, the next block is initially again read into the third storage group 9. There are now present again in the storage group 9, blocks which respectively comprise just one data segment. In so far as this data segment has an equal word length or a smaller word length than the block, the data segment is complete. In this case, the complete data segment is switched to the second decoder 12 by the second demultiplexer 11. In the other case, i.e. when the data segment located in the storage group 9 is still incomplete, it is completed with the remaining portions in that, after the end of the incomplete data segment, there is a switching over from the storage group 9 to the storage group 10 by means of the demultiplexer 11.

Data segments of variable word length are then present again at the input of the second decoder 12. The decoder 12 is the complement of the coder 1 so that a data stream appears at its output which again corresponds to the input data stream of the coder 1.

For the explanation of the data flow, reference will now be made to Fig. 2. The illustration is limited here to three data segments having different packing densities. The data segments before the coding in the coder 1 or after the decoding in the decoder 12 are referenced by capital letters A, B, C. This is reproduced diagrammatically in the fields 14 and 23. In contrast thereto, the coded signals are represented by small letters. In accordance with the meaning of the code, the letters also have indices. The index 1 stands for a dc component, the index 2 for the largest spectral coefficient, the index 3 for secondary spectral coefficients and the index 4 for a data segment end signal. In the example illustrated, the data segment end signal is already present for the segment marking of the non coded data. For the coded data, the dc component as well as the most important coefficient and, if necessary, a discriminating signal for the length of the data segment which is not provided with particular reference signs, occupy a fixed area. The word length determined by the secondary coefficients is the only variable.

The packing density of the data segment is so distributed that in segment A, a small, in segment B, an average and in segment C, a high packing density prevails. This is illustrated in field 15 by the different word lengths of the data segment having the index 3. A signal stream corresponding to this field appears at the output of the coder 1. Field 16 depicts the occupation of the storage positions in the storage group 3 and field 17 that in the storage group 4. From field 16, it can be seen that three blocks of equal word length are allocated to the data segments. The first block is not completely filled with the data segment a, the second block is just filled with the data segment b, the third block cannot completely accept the data segment c. The surplus portion is therefore located in the storage group 4.

Field 18 illustrates the data stream beyond the demultiplexer 5. As is apparent from the drawing, the free area in the first block has been filled with the remaining portion of the data segment c. This data stream can now be transmitted and/or stored and read out in the illustrated time sequence. It is illustrated in field 19 how the data segment end signals are evaluated by the first decoder 7 for the control of the multiplexer 8. The multiplexer 8 is controlled by the decoder 7 such that blocks of equal length are read into the storage group 9 as is shown in the field 20 and that surplus portions of the data segments are read into the storage group 10 as is illustrated by field 21. Field 20 now corresponds to the field 16 while field 21 corresponds to the field 17. Subsequently, there follows an allocation of the data to data segments of different lengths as is shown in field 22. This illustration corresponds to field 15. After passing through the second decoder 12, the output signal, as it is illustrated in field 14, is received in field 23 whereby the signal processing is completed.

## Claims

1. Method for the digital transmission of communications or recording and reproduction of communications in which first data segments (A, B, C) having variable word lengths are converted into second data segments (a, b, c) having constant block lengths wherein fill characters are inserted if necessary and wherein the second data segments are separated by end signals (a4, b4, c4), characterised in that, for the production of the second data segments, a respective block of constant word length is initially allocated to the first data segments and that subsequently the blocks whose data segments (a1 - a4) exhibit a shorter word length than that of the blocks are filled with the remaining portions (c3) including the end signal (c4) of such first data segments which have a greater word length than the blocks, and that after the transmission or for the reproduction, the data segments are reconstituted from the blocks into their corresponding original word lengths.

2. Method in accordance with claim 1, characterised in that, a plurality of blocks are combined into a frame and that within this frame the sum of the word lengths of the first data segments is made equal to the sum of the word lengths of the blocks, before the filling of the blocks.

3. Method in accordance with claim 2, characterised in that, the sum of the word lengths of the first data segments is made equal by weighting relevant to the information.

4. Method in accordance with claim 2, characterised in that, the sum of the word lengths of the first data segments is made equal by quantisation weighting.

5. Method in accordance with one or more of the claims 2 to 4, characterised in that, essential portions of the first data segments are allocated unaltered to special regions of the blocks and that less essential portions are weighted and distributed as necessary to other blocks.

6. Method in accordance with claim 5, in which the data are digital video signals which are processed by a source encoder using a transformation transferring into the spectral region, characterised in that, essential portions of the first data segments are formed by the dc component and a maximum spectral coefficient and the variable portions by subordinate spectral coefficients.



7. Method in accordance with claim 6, characterised in that, essential portions are formed additionally by a control signal for the representation of the size of the first data segments.

8. Method in accordance with one or more of the claims 5 to 7, characterised in that, selected portions of the first data segments are protected, in particular against transmission and recording errors, by protection signals.

9. Method in accordance with claim 8, characterised in that, the selected portions of the data segments is a dc component and/or a value and/or an address of a spectral coefficient.

10. Device for the digital transmission of communications or recording and reproduction of communications in which first data segments (A, B, C) having variable word lengths are converted into second data segments (a, b, c) having constant block lengths by means of a circuit arrangement, wherein fill characters are inserted if necessary and wherein the second data segments are separated by end signals (a4, b4, c4), characterised by, a counter arranged on the source side of a transmission path (6) or a record carrier and having a multiplexer (2) splitting the signal path into a first storage group (3) and a second storage group (4), a first demultiplexer (5) combining the storage groups (3, 4), by a decoder (7) arranged on the sink side of the transmission path (6) or of the record carrier, a subsequent second multiplexer (8) connected thereto which splits the signal path into a third storage group (9) and a fourth storage group (10), a second demultiplexer (11) combining the third and fourth storage groups (9, 10), as well as by a control circuit (13) on the source side and a control circuit (14) on the sink side, by a first control circuit (13) which initially assigns the incoming data segments to the first storage group (3) and which controls the first demultiplexer (5) in such a way that the remaining portions including the end signals are added to the data segments of not filled stores of the first storage group, and by a second control circuit (14) which controls the third and fourth storage groups and the second demultiplexer (11) in order to reconstitute the data segments in accordance with their original word lengths.

