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① **SOLICITUD DE**

[X] Patente de Invención [ ] Patente de Modelo de Utilidad

[X] Capítulo I [X] Capítulo II

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⑥ **Título(54)** SISTEMA ROBUSTO DE COMUNICACION DIGITAL ~~Y PLANIMETRIA PARA EL MISMO~~

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10 **ANEXOS**

- [X] Comprobante de pago de la tasa de presentación de la solicitud
- [ ] Documento que acredita la existencia y representación legal cuando el solicitante sea persona jurídica
- [ ] Poderes, si fuere el caso
- [ ] Documento de cesión del inventor al solicitante o a su causante
- [X] Declaraciones
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- [ ] De ser el caso, modificaciones efectuadas a la solicitud internacional
- [ ] Otros

11 **FIGURA CARACTERISTICA**

12 Solicito la Concesión de la patente

NOMBRE **DARIO CARDEÑAS NAVAS**

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(54) Title: MAPPING ARRANGEMENT FOR DIGITAL COMMUNICATION SYSTEM

(57) Abstract: A receiver receives a digital signal. The digital signal contains a frame of robust VSB data and ATSC data, and the digital signal further contains a map. The map contains information indicating a location of the robust VSB data and ATSC data in the frame. A decoder of the receiver decodes the digital signal. A processor of the receiver processes at least one of the robust VSB data and the ATSC data according to the location information contained in the map.

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MAPPING ARRANGEMENT FOR DIGITAL COMMUNICATION SYSTEM

Related Applications

This application claims the benefit of U S Provisional Application No 60/198,014, filed April 18, 2000 and U S Provisional Application No 60/255,476, filed December 13, 2000

Technical Field of the Invention

The present invention relates to the transmission and/or reception of digital data

Background of the Invention

The standard in the United States for the transmission of digital television signals is known as 8 VSB data (ATSC Digital Television Standard A/53) This 8 VSB data has a constellation consisting of eight possible symbol levels In a VSB system, the eight possible symbol levels are all in the same phase In a QAM system, however, the symbols are transmitted in phase quadrature relationship.

The standard referred to above specifies the formatting and modulation of digital video and audio data The transmitted data is in the form of

applications of the present invention is the transmission of auxiliary data in a VSB format with outer encoding for added robustness The auxiliary data transmitted in accordance with the application of the present invention are referred to herein as robust VSB data (RVSB)

Summary of the Invention

In one aspect of the present invention, a method comprises the following receiving a digital signal, wherein the digital signal contains robust VSB data, and wherein the digital signal further contains a map permitting a receiver to process the robust VSB data, wherein the robust VSB data contains a duplicate of the map, and, processing the robust VSB data and the duplicate of the map in response to the map

In another aspect of the present invention, an apparatus comprises a receiver, a decoder, and a processor The receiver receives a digital signal, and the digital signal contains a frame of first and second 8 VSB data. The first and second 8 VSB data have different bit rates The digital

digital signal further contains a map, and the map contains information indicating a location of the first 8 VSB data in the frame The decoder decodes the digital signal The processor discards the second VSB data and processes the first 8 VSB data

In still a further aspect of the present invention, an apparatus comprises a receiver and first and second processors The receiver receives a digital signal, and the digital signal contains a frame of robust VSB data, ATSC data, or both At least the ATSC data has PID numbers associated therewith The digital signal further contains a map, and the map contains information indicating a location of the robust VSB data in the frame The first processor processes the robust VSB data based upon the map The second processor processes the ATSC data based upon PID numbers

Brief Description of the Drawing

These and other features and advantages will become more apparent from a detailed consideration of the invention when taken in conjunction with the drawing in which

Figure 9 shows a robust VSB receiver for receiving the robust VSB data transmitted by the robust VSB transmitter of Figure 7,

Figure 10 shows a circuit for generating the appropriate control signal on the discard control line of Figure 9,

Figure 11 shows yet another robust VSB transmitter for transmitting robust VSB data and ATSC data in accordance with the present invention;

Figure 12 shows an example of four data segments containing 1/2 rate outer coded data that may be transmitted by a robust VSB transmitter according to the present invention;

Figure 13 shows an example of four data segments containing 1/4 rate outer coded data that may be transmitted by a robust VSB transmitter according to the present invention;

Figure 14 shows an example of four data segments containing 3/4 rate outer coded data that may be transmitted by a robust VSB transmitter according to the present invention,

Figure 15 shows the interleavers (I_r) of Figures 1, 9, and 11 in more detail;

accordance with one embodiment of the present invention Figure 2 shows a standard ATSC receiver 12 that receives the ATSC data transmitted by the robust VSB transmitter 10, and Figure 3 shows a robust VSB receiver 14 that receives the robust VSB data transmitted by the robust VSB transmitter 10

The robust VSB transmitter 10 includes a Reed/Solomon encoder 16 that encodes uncoded auxiliary data bytes by adding Reed/Solomon parity bytes to the uncoded auxiliary data bytes The uncoded auxiliary data bytes and the Reed/Solomon parity bytes are interleaved by an interleaver 18 Then, the interleaved uncoded auxiliary data bytes and the Reed/Solomon parity bytes are bitwise encoded by an outer coder 20 using either a convolutional code or other error correcting code The outer coder 20 improves the robustness of the uncoded auxiliary data bytes and the Reed/Solomon parity bytes, converting them to robust data bytes (hereinafter referred to as robust VSB data bytes) and Reed/Solomon parity bytes

The outer coder 20, for example, may be a 1/2 rate coder which produces two output bits for

A standard ATSC receiver, such as the standard ATSC receiver 12 shown in Figure 2, receives and processes the ATSC data and discards the robust VSB data Accordingly, the standard ATSC receiver 12 includes a 2/3 rate inner decoder 34, a deinterleaver 36, and a Reed/Solomon decoder 38, all operating in accordance with the ATSC standard The standard ATSC receiver 12, however, is programmed to decode both the ATSC data and the robust VSB data transport headers (which include the packet identifications or PID's and which have not been coded by the outer coder 20) The standard ATSC receiver 12 reads the PID's of all packets and, at 40, discards those packets having the PID's of robust VSB data The standard ATSC receiver 12 also includes a slice predictor 42 (such as the slice predictor disclosed in U S Patent No 5,923,711) which is responsive to the inner decoded data and which provides an output back to a phase tracker and/or equalizer, as is known in the art

The robust VSB data packets can be received, decoded, and processed by a robust VSB receiver such as the robust VSB receiver 14 shown in

Transactions on Information Theory, May, 1995) This soft decision making operation is more complicated than the widely used Viterbi algorithm, which produces a hard decision output, but the soft decision making operation more fully takes advantage of the coding gain provided by the outer coder 20

The output of the 2/3 rate inner decoder 50 is deinterleaved by a deinterleaver 52 The robust VSB receiver 14 reads the PID's of all packets at the output of the deinterleaver 52 Based upon these PID's, the robust VSB receiver 14 discards those packets at 54 which have the PID's of ATSC data and also discards the transport headers added following the outer coder 20 and the parity bytes added by the Reed/Solomon encoder 28 Thus, the robust VSB receiver 14, at 54, passes only the robust VSB data packets containing the robust VSB data coded by the outer coder 20 The robust VSB data packets are decoded by an outer decoder 56, deinterleaved by a deinterleaver 58 (which is the inverse of the interleaver 18), and Reed/Solomon decoded by a Reed/Solomon decoder 60 in order to

data bytes The uncoded auxiliary data bytes and the Reed/Solomon parity bytes are interleaved by an interleaver 84 Then, the interleaved uncoded auxiliary data bytes and Reed/Solomon parity bytes are bitwise encoded by an outer coder 86 using either a convolutional code or a turbo product code, as discussed above The bitwise output of the outer coder 86 is small block interleaved by a small block interleaver 88 in order to reduce the impact of channel burst errors on the outer decoding The data provided by the small block interleaver 88 may be referred to as Rdata(n o) which stands for normally ordered robust VSB data

One input of a first multiplexer 92 receives ATSC formatted packets each comprising (i) a valid three byte transport header with a PID number for robust VSB data, (ii) 184 placeholder bytes of dummy robust VSB data, and (iii) twenty placeholder bytes for dummy ATSC Reed/Solomon parity data The other input of the first multiplexer 92 receives ATSC formatted dummy packets each comprising 207 bytes of dummy ATSC data These ATSC formatted dummy packets serve as placeholders for

robust VSB data (Rdata(r o)), dummy ATSC Reed/Solomon parity bytes, and dummy ATSC data The reordering of the normally reordered robust VSB data results from the deinterleaving of the deinterleaver 98 and the reordered data may be referred to as reordered robust VSB data

The dummy ATSC Reed/Solomon parity bytes (20 per packet) of the robust VSB packets and the dummy ATSC data packets (207 bytes per packet) are discarded at 100 The remaining robust VSB packets, each including a transport header and reordered robust VSB data, are multiplexed by a second multiplexer 102 with real ATSC data packets each containing 187 bytes of a transport header and ATSC data Either input to the second multiplexer 102 may be selected on a packet by packet basis and is supplied to an ATSC transmitter 104 The selection by the second multiplexer 102 of which input to pass to the ATSC transmitter 104 is based on the robust VSB map to be described hereinafter

The ATSC transmitter 104 typically includes a Reed/Solomon encoder 106, an interleaver 108, and a twelve way 2/3 rate inner encoder 110 all

As shown in Figure 8, a standard ATSC receiver 120 includes a twelve way 2/3 inner decoder 122 which decodes the transmitted data to provide an output data stream comprising normally ordered robust data with interspersed transport headers, ATSC data, and ATSC Reed/Solomon parity bytes located according to the ATSC convolutional byte interleave provided by the interleaver 108 An ATSC deinterleaver 124 restores the transport headers, ATSC data, and ATSC Reed/Solomon parity bytes to their transport "packetized" positions Also, the ATSC deinterleaver 124 converts the normally ordered robust VSB data into reordered robust VSB data This reordered form permits an ATSC Reed/Solomon decoder 126 of the standard ATSC receiver 120 to correctly test parity for the robust VSB data packets The standard ATSC receiver 120 can then read the robust VSB data packet transport headers and gracefully discard the robust VSB data packets at 128 based on their PIDs

As shown in Figure 9, a robust VSB receiver 130 includes a soft output twelve way 2/3 rate inner decoder 132 (A hard output 2/3 decoder

the interleaver 62 is needed in the robust VSB receiver 130 allowing for lower overall feedback delay to the phase tracker and/or equalizer The outer decoded data can be used, for example, by an enhanced slice predictor 142 to generate feedback to the phase tracker and/or equalizer If desired, the feedback may be gated, or the step size of the equalizer gradient algorithm adjusted proportionally to the reliability of the decoded data

The robust VSB data packet payload decoded by the outer decoder 140 is deinterleaved by a deinterleaver 144 (which is the inverse of the interleaver 84) and is Reed/Solomon decoded by a Reed/Solomon decoder 146 (corresponding to the Reed/Solomon encoder 82) in order to reconstruct the original uncoded auxiliary data supplied to the Reed/Solomon encoder 82 of Figure 7

As provided in the ATSC standard, a frame comprises a plurality of segments each containing a predetermined number of bytes The first segment of a frame is a frame sync segment, and the remaining segments in the frame are data segments Although robust VSB data can be transmitted in segments or in

segment, the dummy segment generator 150 sets the transport header and ATSC Reed/Solomon parity bytes to FF The dummy segment generator 150 sets the rest of the bytes of each robust VSB data dummy segment to 00

These dummy segments are fed by the dummy segment generator 150 to an ATSC convolutional byte interleaver 152 whose output is then used to control the discard block 136 which then responds to the FF and 00 codes to correctly discard the reordered ATSC data, the transport headers, and the ATSC Reed/Solomon parity data which are interleaved within the received data stream The discard block 136, thus, passes only the robust VSB data

Figure 11 shows a multiple outer code robust VSB transmitter 160 The robust VSB transmitter 160 operates similarly to the robust VSB transmitter 80 of Figure 7 The robust VSB transmitter 160 has a first Reed/Solomon encoder 162 which encodes first uncoded auxiliary data by adding Reed/Solomon parity bytes to the first uncoded auxiliary data, a second Reed/Solomon encoder 164 which encodes second uncoded auxiliary data by

output of the third outer coder 178 is interleaved by a third small block interleaver 184

The first outer coder 174 is a 1/4 rate coder, the second outer coder 176 is a 1/2 rate coder, and the third outer coder 178 is a 3/4 rate coder, although any other combination of these or other outer coders using different coding rates could be used The data outputs of the first, second, and third small block interleavers 180, 182, and 184 are selected by a multiplexer 186 under control of a select input which determines the order in which the differently outer coded data are inserted into the frame to be transmitted The data at the output of the multiplexer 186 may be referred to as Rdata(n o) which, as before, stands for normally ordered robust VSB data

The top three inputs of a multiplexer 190 receive ATSC format packets each having of a valid three byte transport header with a PID number for robust VSB data, 184 placeholder bytes of dummy robust VSB data, and twenty dummy placeholder bytes for ATSC Reed/Solomon parity data The robust VSB data at the topmost input of the multiplexer 190

multiplexer 190 with the next corresponding normally ordered robust VSB data byte from the multiplexer 186

The output of the data replacer 194 contains normally ordered robust VSB data (which is 1/4 rate coded, 1/2 rate coded, and/or 3/4 rate coded, as appropriate) with interspersed transport headers, dummy ATSC Reed/Solomon parity bytes, and dummy ATSC data packet bytes A convolutional byte deinterleaver 196 (as described in the ATSC Standard) deinterleaves the output of the data replacer 194 to thus effectively "repacketize" the data as packets of transport headers, reordered robust VSB data (1/4, 1/2, and/or 3/4 rate coded), dummy ATSC Reed/Solomon parity bytes, and dummy packets of ATSC data The reordering of the normally ordered robust VSB data results from the deinterleaving of the deinterleaver 196

The dummy ATSC Reed/Solomon parity bytes (20 per packet) and the dummy ATSC data packets (207 bytes per packet) are discarded at 198 in a manner similar to that provided by the discard control line 134 and the discard block 136 of Figure 9 The

output of the interleaver 206 are again normally ordered robust VSB data Also, the interleaver 206 disperses the transport header bytes, the ATSC Reed/Solomon parity bytes, and the ATSC data These data are 2/3 rate coded by the twelve way 2/3 rate inner encoder 208 and are transmitted The transmitted robust VSB data are in normal order, i e , the order provided at the output of the multiplexer 186 This normal data order permits the robust VSB receiver to avoid the delay caused by the deinterleaver 52 and the interleaver 62

As discussed above, an ATSC frame comprises a frame sync segment and a plurality of data segments and, for convenience, robust VSB data are packed into groups of four segments More specifically, Figure 12 shows an example of four data segments that may be used in a frame to transmit robust VSB data that is 1/2 rate coded, Figure 13 shows an example of four data segments that may be used in a frame to transmit robust VSB data that is 1/4 rate coded, and Figure 14 shows an example of four data segments that may be used in a frame to transmit robust VSB data that is 3/4 rate

match However, three complete RVSB Reed-Solomon blocks will pack exactly into four data segments (1 5 bits per symbol) so that, for a 3/4 rate outer code, four segments contain three robust Reed/Solomon encoded blocks

Accordingly, Figures 12, 13, and 14 can be represented by the following table

S	X	Y
1/2	1	2
1/4	1	4
3/4	3	4

where X represents the number of complete robust Reed/Solomon encoded blocks and Y represents the number of frame segments required to contain the corresponding number X of robust Reed/Solomon encoded blocks

However, it should be understood that other coding rates can be used in conjunction with the present invention and, therefore, the above table will change depending upon the particular coding rates that are used

in the ATSC Digital Television Standard A/53 and the Guide to the Use of the ATSC digital Television Standard A/54, except that the B parameter for the robust deinterleaver is 46 instead of 52 and the parameter N is 184 instead of 208

Because a robust VSB Reed/Solomon block comprises 184 bytes, and because an integral number of robust VSB Reed/Solomon blocks are in a data frame, the number of robust VSB data bytes plus robust VSB Reed/Solomon parity bytes in a data frame is always evenly divisible by 46 Therefore, the frame sync segment can be used as a synchronizer for the deinterleavers 58 and 144 (D_r) in the receiver, regardless of the value of G (to be described below) At frame sync, the deinterleaver commutators are forced to the top positions The deinterleavers 58 and 144 are byte wise deinterleavers

Data Mapping

As discussed above, each data frame may contain a mix of robust VSB data segments and ATSC (non-robustly coded) data segments Moreover, the

Each S_c (such as $S_{1/4}$ or $S_{1/2}$ or $S_{3/4}$) is encoded as eighteen symbols (bits) of two level data For all three codes, a total of 3 x 18 = 54 symbols are needed as a definition of the robust VSB map These symbols are inserted into the reserved area near the end of each frame sync segment (just before the twelve precoding bits) For each group of eighteen bits (b_{18} b_1), the last six bits (b_6 b_1) represent the number G of groups of eight segments (8 segments = 2, 4 or 6 robust VSB data packets depending on the outer code) mapped as robust VSB data in the current frame The twelve preceding bits are for comb filter compensation (see the Guide to the Use of the ATSC digital Television Standard A/54) Accordingly, as shown in Figure 18, bits b_6 b_1 represent the number G, bits b_{18} b_{13} are the complement of bits b_6 b_1, and bits b_{12} b_7 can be alternating +1 and -1 (or any other pattern)

Let it be assumed that S = $S_{1/4}$ + $S_{1/2}$ + $S_{3/4}$ Because 312/8 = 39, 0-39 groups of eight segments can be mapped as robust VSB data or 8 VSB

such that, as to RVSB segments, the first 8 x $S_{1/4}$ segments contain the ¼ rate outer coded data, the next 8 x $S_{1/2}$ segments contain the ½ rate outer coded data, and the last 8 x $S_{3/4}$ segments contain the ¾ rate outer coded data However, other robust VSB data segment organizations are possible for these three outer coders or for any number of other types of outer coders

Because this robust VSB map is contained in the frame sync segment, as discussed above, the robust VSB map does not enjoy the same level of coding gain as the robust VSB data However, the robust VSB map may still be reliably acquired by a robust VSB receiver by correlating the robust VSB map over some number of frames Therefore, the robust VSB map should not change too often (for example, not more often than every ~60 frames)

The above mapping method allows a receiver to reliably and simply acquire the robust VSB map by correlation Once a receiver has acquired the map, it is desirable for the receiver to instantly and reliably track changes in the map In order to instantly and reliably track changes in the map, the

number of frames read from a previously received frame If the receiver finds at any time that the definition for an outer code previously acquired by the frame sync correlation does not match the definition for that outer code in the first robust VSB data segment, the receiver should restart its map acquisition process

RVSB Enhanced Slice Prediction and Equalizer Feedback

ATSC 8 VSB receivers make important use of adaptive equalization and phase tracking as explained in the ATSC Digital Television Standard A/53 published by the Advanced Television Systems Committee, in the Guide to the Use of the ATSC Digital Television Standard A/54, also published by the Advanced Television Systems Committee RVSB as described above has features that allow for improvements in adaptive equalization and phase tracking

One such improvement results from feeding back delayed reliable estimates of the input symbol level to the adaptive equalizer and/or phase tracker

at the current time t, the slice predictor of the inner decoder 302 decides a most likely state at time t Then, based on the next possible pair of states, four possible predicted input levels (out of eight) for the next symbol at time t + 1 are selected For example, as shown by the inner decoder trellis in Figure 20, if the most likely state at time t is state one, the next state is ϵ[1 5 2 6] Therefore, the next input level at time t + 1 may be -7, +1 , -3 , or +5 These next input levels correspond to decoded bit pairs 00, 10, 01, and 11, respectively

Similarly, the outer decoder 304 also finds the best path metric for the current time t for the respective trellis A portion of this trellis is shown in Figure 21 for an exemplary outer decoder and may be applied generally to all three outer codes As shown in Figure 21, two possible outer decoder input bit pairs are selected for the time t + 1 based on the next possible pair of states By way of example, the two possible outer decoder input bit pairs may be 11 or 01 The bit pair chosen by the outer decoder 304 is sent to a

already selected by the slice predictor of the inner decoder 302 The outer code can be a convolutional code or other type of error correction code The predictor enhancer 306 is disabled during the periods of time when ATSC data is being received

A feedback enhanced maximum likelihood sequence estimator (MLSE) slice predictor system 320 uses the Viterbi Algorithm and is shown in Figure 22 along with other relevant parts of an RVSB receiver The feedback enhanced MLSE slice predictor system 320 has an inner decoder 322 and an outer decoder 324 which operate similarly to the inner decoder 302 and the outer decoder 304 described above However, instead of using the slice prediction output of the inner decoder 302, an enhanced MLSE module 326 is configured to execute the usual Viterbi Algorithm on the received signal by operating the eight state 2/3 rate code trellis (the same trellis used by the inner decoder 322, including the precoder)

The enhanced MLSE module 326 selects as its next input either (i) the noisy eight level received signal as delayed by a delay module 328 if the next input is a non-RVSB symbol or (ii) the bit

An optional predetermined coded training sequence may be included in a specified portion of the first RVSB segment of a data field This sequence is known in advance by both the transmitter and receiver During the time the decoded training sequence is output from the outer decoder 324, the input to the enhanced MLSE module 326 is switched to a stored version of the decoded training sequence

Certain modifications of the present invention have been discussed above Other modifications will occur to those practicing in the art of the present invention For example, although the standard ATSC receiver 12 and the robust VSB receiver 14 are shown above as separate receivers, the functions of the standard ATSC receiver 12 and the robust VSB receiver 14 can be combined in two data paths of a single receiver capable of decoding both types of data (ATSC data and robust VSB data)

Accordingly, the description of the present invention is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the best mode of carrying out the invention The details may be varied substantially

CLAIMS

1 A method of receiving and processing a digital signal, the method being CHARACTERIZED by the following steps

receiving the digital signal containing a map and first and second N level data, wherein the first and second N level data have the same constellation and different bit rates, wherein the first and second N level data are intermixed in a data frame, and wherein the map contains information indicating a location of at least one of the first and second N level data in the data frame, and,

processing the first and second N level data in accordance with the map

2 The method of claim 1 wherein the received digital signal contains a duplicate of the map

3 The method of claim 2 wherein the data frame comprises an ATSC frame having a frame sync segment and multiple data segments, wherein the map is contained in the frame sync segment, and wherein

8 The method of claim 1 wherein the first N level data comprises first robust 8 VSB data, and wherein the second N level data comprises second robust 8 VSB data

9 The method of claim 1 wherein the first N level data comprises robust 8 VSB data, and wherein the second N level data comprises ATSC data

10 The method of claim 1 further comprising the step of correlating multiple transmissions of the map

11 The method of claim 1 wherein the digital signal further comprises third N level data, wherein the map contains information indicating that the first N level data have been outer coded at a first coding rate, that the second N level data have been outer coded at a second coding rate, and that the third N level data have been outer coded at a third coding rate, wherein the map comprises first, second, and third portions, wherein the first

six unspecified symbols

14 The method of claim 13 wherein the data frame comprises an ATSC frame having a frame sync segment, wherein the frame sync segment contains twelve precoding symbols, and wherein the map is contained in the frame sync segment of the ATSC frame just before the twelve precoding symbols

15 The method of claim 11 wherein the first, second, and third portions each comprise

first symbols designated as G indicating where in the data frame the corresponding first, second, and third N level data can be found,

second symbols designating the complement of G, and,

third unspecified symbols

16 The method of claim 11 wherein the data frame contains m data segments, wherein the first portion of the map comprises a first number from zero to n indicating a first subset of the m data segments containing all of the first N level

19 The method of claim 18 wherein the map comprises a number from zero to n, and wherein n is evenly divisible into m

20 The apparatus of claim 19 wherein n is 39

21 The apparatus of claim 20 wherein, if the map contains the number 39, the m data segments contain only the first N level data

22 The method of claim 1 wherein the processing step comprises the step of discarding the first N level data on the basis of PID numbers

23. The method of claim 1 wherein the processing step comprises the step of discarding the first N level data on the basis of the map

24 The method of claim 1 wherein the processing step comprises the following steps

discarding the first N level data on the basis of PID numbers, and,

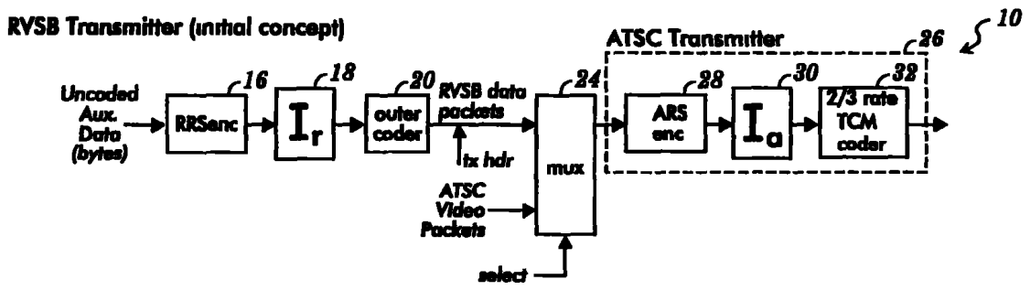

Figure 1

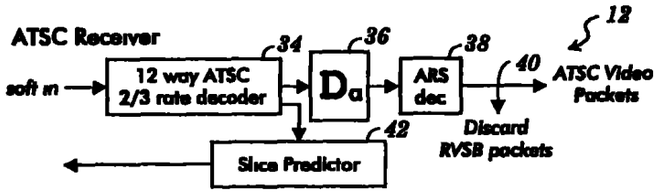

Figure 2

mapper function			
Z2	Z1	Z0	level
0	0	0	-7
0	0	1	-5
0	1	0	-3
0	1	1	-1
1	0	0	+1
1	0	1	+3
1	1	0	+5
1	1	1	+7

Figure 5

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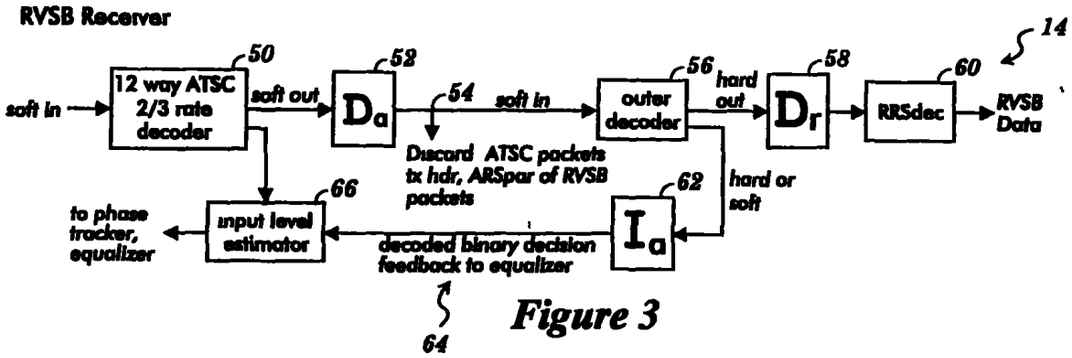

Figure 3

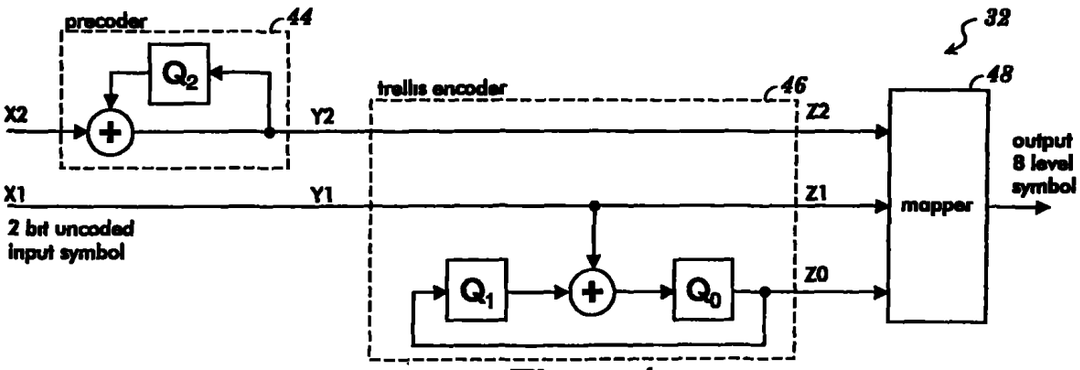

Figure 4

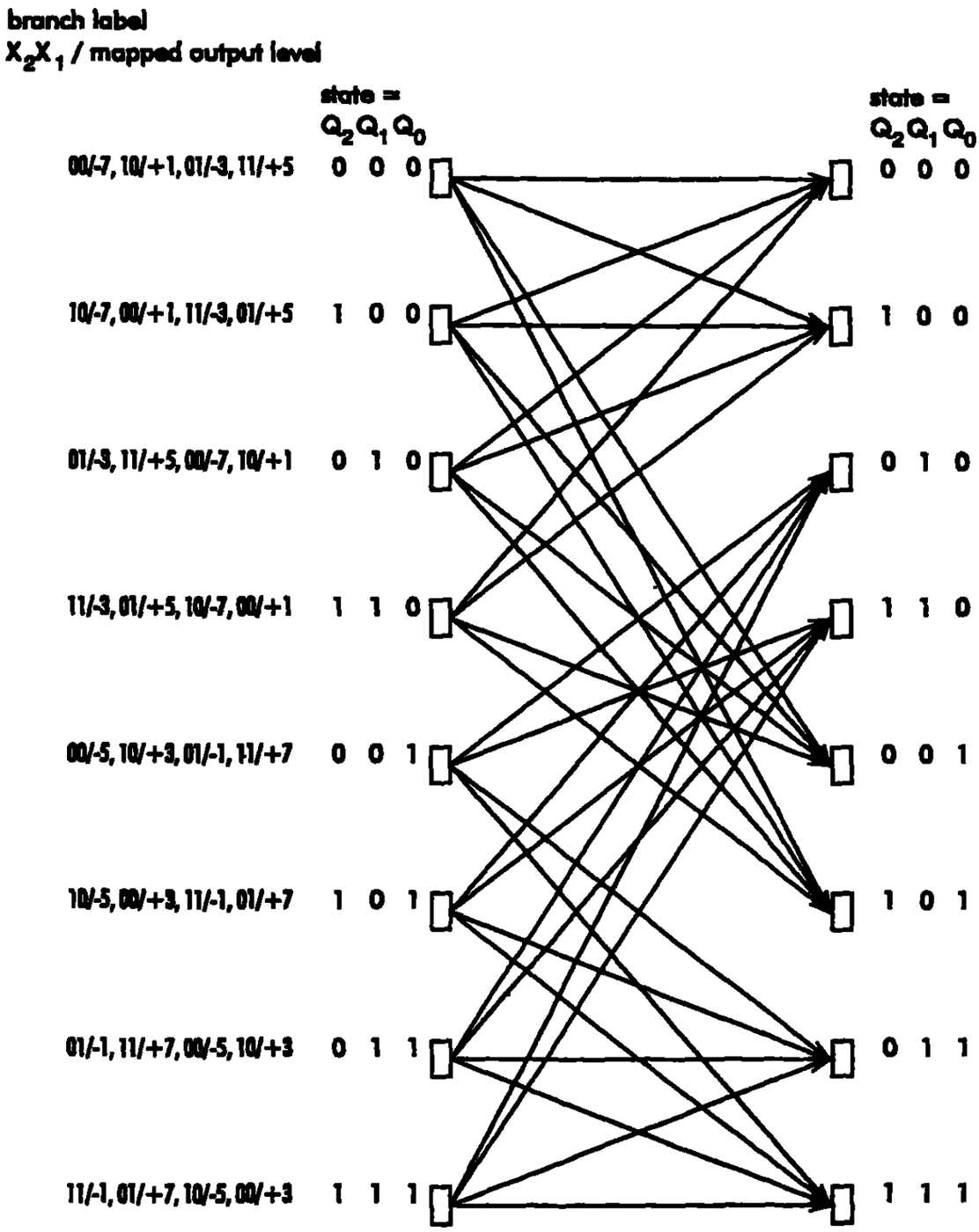
branch label
X_2X_1 / mapped output level
state = $Q_2Q_1Q_0$
state = $Q_2Q_1Q_0$
00/-7, 10/+1, 01/-3, 11/+5
10/-7, 00/+1, 11/-3, 01/+5
01/-3, 11/+5, 00/-7, 10/+1
11/-3, 01/+5, 10/-7, 00/+1
00/-5, 10/+3, 01/-1, 11/+7
10/-5, 00/+3, 11/-1, 01/+7
01/-1, 11/+7, 00/-5, 10/+3
11/-1, 01/+7, 10/-5, 00/+3
0 0 0
1 0 0
0 1 0
1 1 0
0 0 1
1 0 1
0 1 1
1 1 1

Figure 6

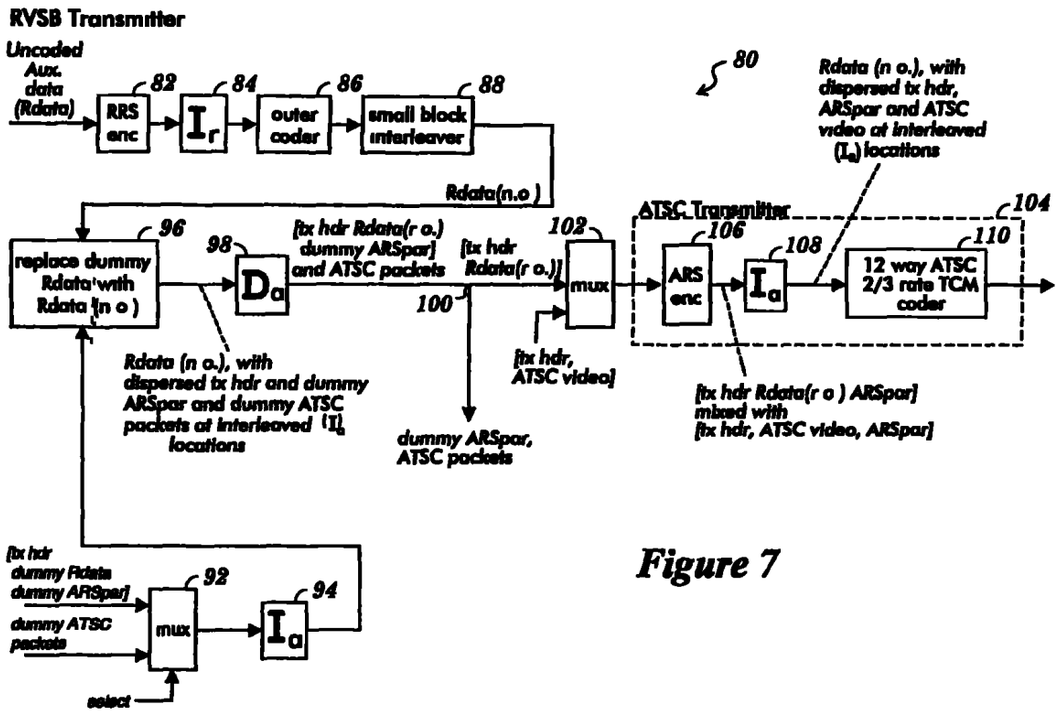
RVSB Transmitter
Uncoded Aux. data (Rdata)
RRS enc
82
I_r
84
outer coder
86
small block interleaver
88
Rdata(n,o)
80
Rdata (n o.), with dispersed tx hdr, ARSpar and ATSC video at interleaved (I_a) locations
ATSC Transmitter
104
replace dummy Rdata with Rdata (n o)
96
98
D_a
[tx hdr Rdata(r o.) dummy ARSpar] and ATSC packets
[tx hdr Rdata(r o.)]
102
mux
100
106
ARS enc
108
I_a
110
12 way ATSC 2/3 rate TCM coder
Rdata (n o.), with dispersed tx hdr and dummy ARSpar and dummy ATSC packets at interleaved (I_a) locations
[tx hdr, ATSC video]
dummy ARSpar, ATSC packets
[tx hdr Rdata(r o) ARSpar] mixed with [tx hdr, ATSC video, ARSpar]
[tx hdr dummy Rdata dummy ARSpar]
92
94
dummy ATSC packets
mux
I_a
select

Figure 7

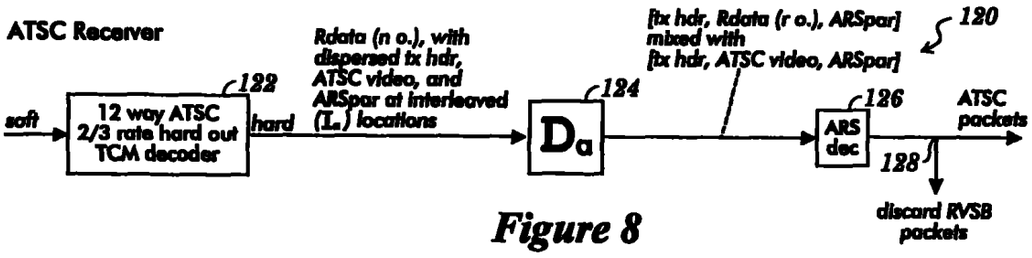

Figure 8

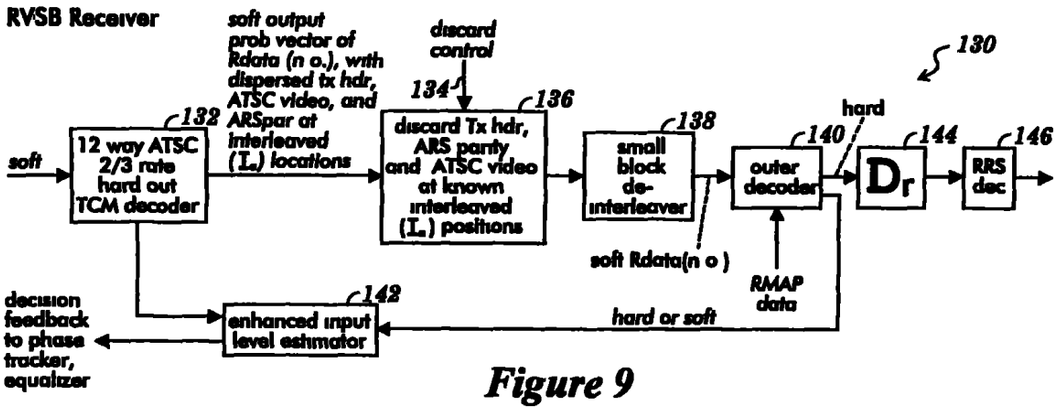

Figure 9

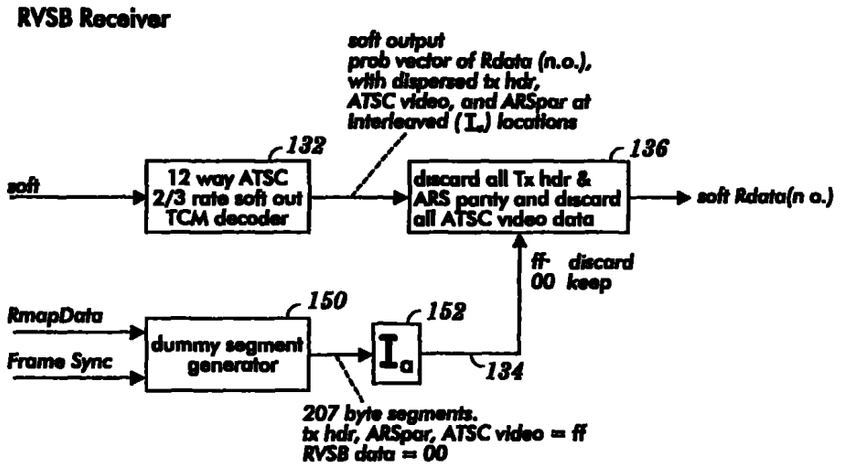

Figure 10

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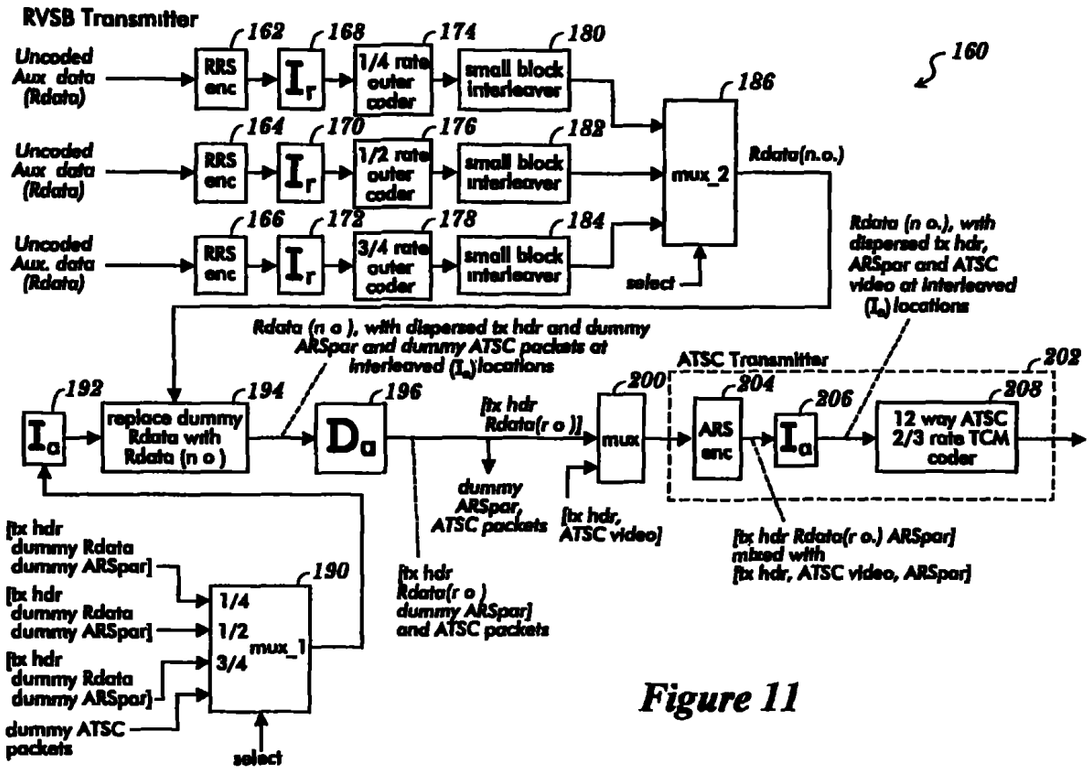

Figure 11

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for 1/2 rate outer code

ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 92 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (576 symbols) 72 bytes payload	RRS parity (160 symbols) 20 bytes	ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 92 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (576 symbols) 72 bytes payload	RRS parity (160 symbols) 20 bytes	ARS parity (80 symbols)
2 bits/symbol	1 bit/symbol		2 bits/symbol

Figure 12

for 1/4 rate outer code

ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 46 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 46 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 46 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (416 symbols) 26 bytes payload	RRS parity (320 symbols) 20 bytes	ARS parity (80 symbols)
2 bits/symbol	0 5 bit/symbol		2 bits/symbol

Figure 13

for 3/4 rate outer code

ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 138 bytes payload			ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 26 bytes payload	20 bytes RRS parity	92 bytes payload	ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 72 bytes payload	20 bytes RRS parity	46 bytes payload	ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 118 bytes payload		20 bytes RRS parity	ARS parity (80 symbols)
2 bits/symbol	1 5 bit/symbol			2 bits/symbol

Figure 14

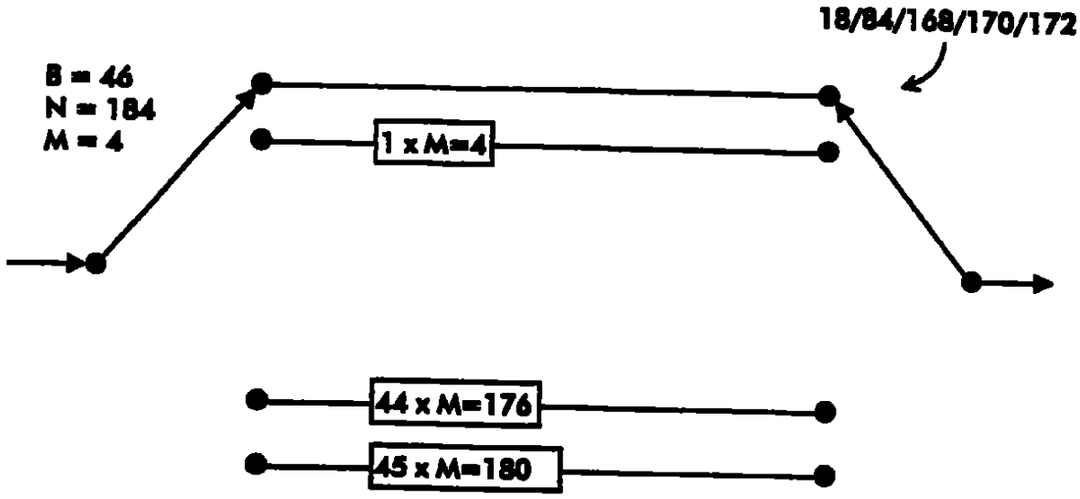

Figure 15

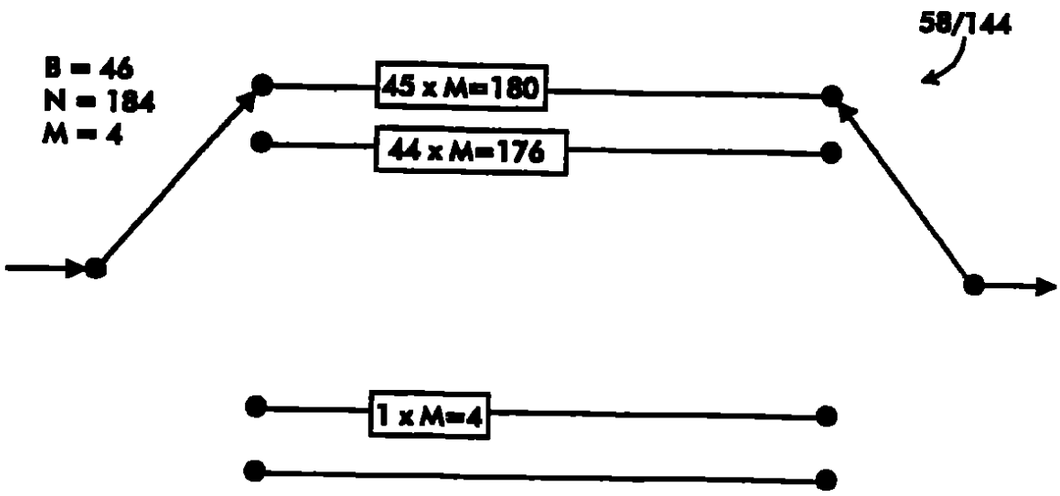

Figure 16

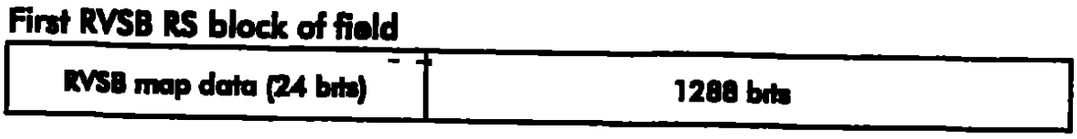

Figure 17

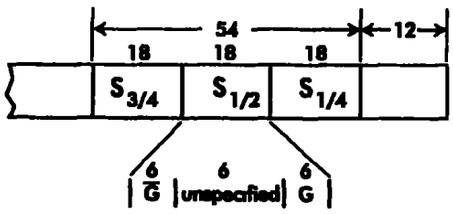

Figure 18

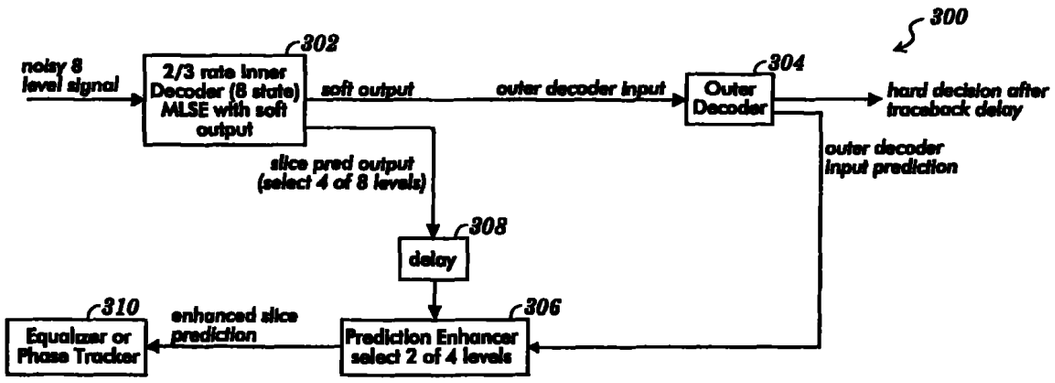

Figure 19

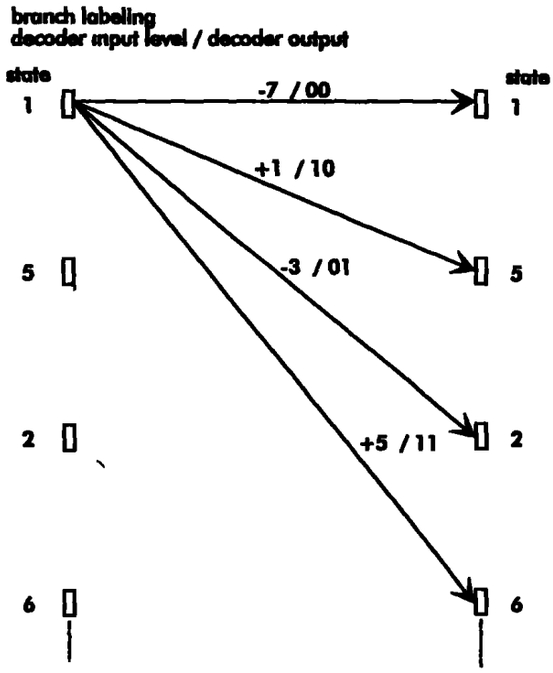

Figure 20

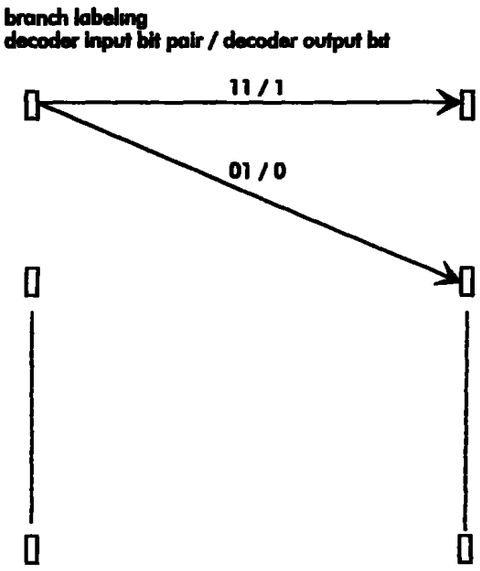

Figure 21

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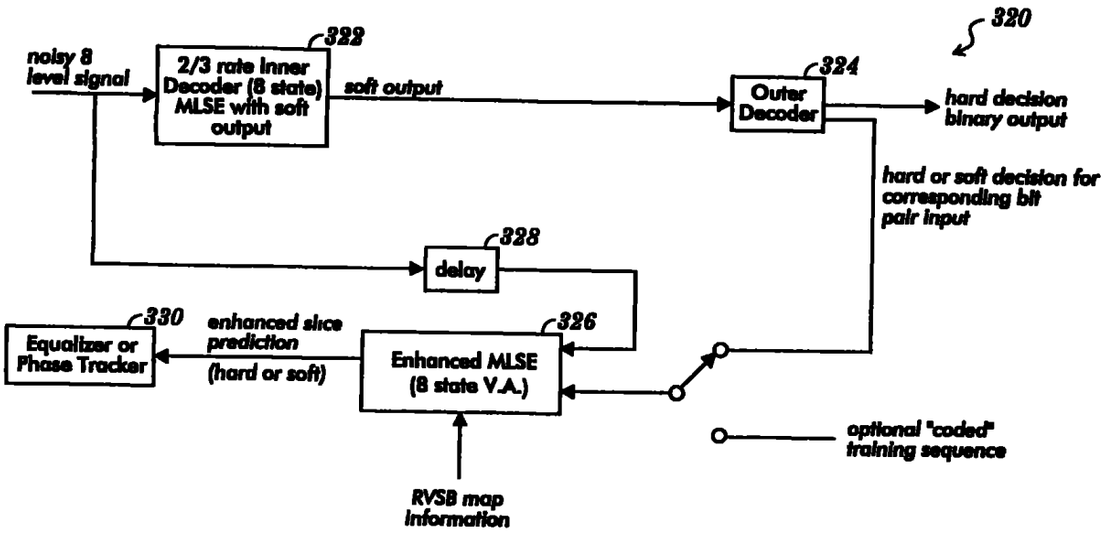

Figure 22

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(84) **Estados Designados** *(regionales)* Patente ARIPO (GH, GM, KE, LS MW, MZ, SD, SL, SZ, TZ, UG, ZW), Patente Euroasiática (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Patente Europea (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), Patente OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG)

Publicado

- *sin informe de búsqueda internacional y se volverá a publicar cuando se reciba ese informe*

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(54) Título **PLANIMETRIA PARA UN SISTEMA DE COMUNICACION DIGITAL**

(57) **Resumen** Un receptor recibe una señal digital La señal digital contiene una trama de datos VSB robustos y de datos ATSC y la señal digital contiene además un mapa El mapa contiene información que indica una localización de los datos VSB robustos y de los datos ATSC dentro de la trama Un decodificador del receptor decodifica la señal digital Un procesador del receptor procesa por lo menos uno de los datos VSB robustos y los datos ATSC de acuerdo con la información de localización contenida en el mapa

PLANIMETRÍA PARA UN SISTEMA DE COMUNICACIÓN DIGITAL

Solicitudes Relacionadas

Esta solicitud reivindica el beneficio para la Solicitud Provisional Norteamericana No 60/198 014, presentada el 18 de abril de 2000 y para la Solicitud Provisional Norteamericana No 60/255 476 presentada el 13 de diciembre de 2000

Campo Técnico del Invento

El presente invento se relaciona con la transmisión y/o recepción de datos digitales

Antecedentes del Invento

El estándar en los Estados Unidos para la transmisión de señales de televisión digital se conoce como datos VSB 8 (Estándar de Televisión Digital ATSC A/53) Estos datos VSB 8 tienen una constelación que consiste de ocho posibles niveles de símbolos En un sistema VSB, los ocho niveles de símbolos posibles están todos en la misma fase En un sistema QAM, sin embargo, los símbolos se transmiten en relación de cuadratura de fase

El estándar arriba mencionado especifica el formateo y modulación de datos de audio y de video digitales Los datos se transmiten en la forma de símbolos con cada símbolo

representando dos bits de datos que son cuadrículas codificadas en tres bits de datos codificados en cuadrícula Cada tres bits de datos codificados en cuadrícula se mapean en un símbolo que tiene un nivel correspondiente a uno de los ocho niveles La codificación e intercalación Reed/Solomon también se suministran para incrementar la robustez de la información transmitida

Los datos auxiliares (diferentes de los datos de video digital o de audio) también pueden transmitirse en un canal de televisión digital Estos datos se formatean y modulan de conformidad con la norma en la misma forma que los datos de video y audio Los receptores fabricados de conformidad con la norma 8 VSB pueden leer identificaciones de paquetes (PIDs) que les permiten diferenciar entre datos de audio, video y datos auxiliares

Sin embargo, mientras que la robustez de las señales de televisión digital transmitidas es suficiente para la recepción de televisión digital, esta robustez puede no ser suficiente para la transmisión de datos auxiliares, particularmente cuando dichos datos sean críticos. De acuerdo con lo anterior, una de las aplicaciones del presente invento es la transmisión de datos auxiliares en un formato VSB con

codificación exterior para mayor robustez Los datos auxiliares transmitidos de acuerdo con la aplicación del presente invento se referirán en este documento como los datos VSB robustos (RVSB)

Resumen del Invento

En un aspecto del presente invento, un método que comprende lo siguiente recibir una señal digital, en la que la señal digital contiene datos VSB robustos, y en donde la señal digital contiene además un mapa que permite a un receptor procesar los datos VSB robustos, en donde dichos datos contienen un duplicado del mapa, y, procesar los datos VSB robustos y el duplicado del mapa en respuesta al mismo

En otro aspecto del presente invento, un aparato que comprende un receptor, un decodificador y un procesador El receptor recibe una señal digital y esta señal contiene una trama de primeros y segundos datos VSB 8 Los primeros y segundos datos VSB 8 tienen distintas tasas de bits La señal digital contiene además un mapa y el mapa contiene información que indica una localización de por lo menos uno de los primeros y segundos datos VSB 8 en la trama El decodificador decodifica la señal digital El procesador

procesa los primeros datos VSB 8 de acuerdo con la información de localización contenida en el mapa

En otro aspecto del presente invento, una señal eléctrica contiene un mapa, los símbolos de los primeros datos, y los símbolos de los segundos datos Los símbolos de los primeros y segundos datos tienen la misma constelación, los símbolos de los primeros y segundos datos tienen diferentes tasas de bits, en donde los símbolos de los primeros y segundos datos están entremezclados en una trama de datos y el mapa contiene información que indica una localización de por lo menos uno de los primeros y segundos datos VSB 8 en la señal eléctrica

En otro aspecto del presente invento, un aparato que comprende un receptor, un decodificador y un procesador El receptor recibe la señal digital y la señal digital contiene una trama de primeros y segundos datos VSB 8 Los primeros y segundos datos VSB 8 tienen la misma constelación y los primeros y segundos datos VSB 8 tienen distintas tasas de bits La señal digital contiene además un mapa y el mapa contiene información que indica una localización de los primeros datos VSB 8 en la trama El decodificador decodifica

la señal digital El procesador descarta los segundos datos VSB y procesa los primeros datos VSB 8

En otro aspecto adicional del presente invento, un aparato que comprende un receptor y un primero y segundo procesadores El receptor recibe una señal digital y la señal digital contiene una trama de datos VSB robustos, datos ATSC, o ambos Por lo menos los datos ATSC tienen números PID asociados con los mismos La señal digital contiene además un mapa y el mapa contiene información que indica una localización de los datos VSB robustos en la trama El primero procesador procesa los datos VSB robustos basándose en el mapa El segundo procesador procesa los datos ATSC basándose en los números PID

Breve Descripción del Dibujo

Estas y otras características y ventajas serán más aparentes a partir de la consideración detallada del invento cuando se tome en su conjunto con el plano en que

La Figura 1 muestra un transmisor VSB robusto para transmisión de datos VSB robustos y datos ATSC de conformidad con el presente invento,

La Figura 2 muestra un receptor estándar ATSC para recibir los datos ATSC transmitidos por el transmisor VSB robusto de la Figura 1,

La Figura 3 muestra un receptor VSB robusto para el recibo de datos VSB robustos transmitidos por el transmisor VSB robusto de la Figura 1,

La Figura 4 muestra el codificador con tasa de 2/3 de tasa de la Figura 1 con detalles adicionales,

La Figura 5 muestra la función de mapeo desempañada por el mapeador de la Figura 4,

La Figura 6 muestra la operación de los decodificadores de tasa 2/3 de las Figuras 2 y 3,

La Figura 7 muestra otro transmisor VSB robusto para transmitir datos VSB robustos y datos ATSC de acuerdo con el presente invento

La Figura 8 muestra un receptor ATSC estándar para recibir los datos ATSC transmitidos por el transmisor VSB robusto de la Figura 7,

La Figura 9 muestra un receptor VSB robusto para recibir los datos VSB robustos transmitidos por el transmisor VSB robusto de la Figura 7,

La Figura 10 muestra un circuito para la generación de la señal de control adecuada en la línea de control de descarte de la Figura 9;

La Figura 11 muestra otro transmisor VSB robusto para la transmisión de datos VSB robustos y de datos ATSC de acuerdo con el presente invento,

La Figura 12 muestra un ejemplo de cuatro segmentos de datos que contienen datos codificados externos de tasa 1/2 que pueden transmitirse por un transmisor VSB robusto de acuerdo con el presente invento,

La Figura 13 muestra un ejemplo de cuatro segmentos de datos que contienen datos codificados externos de tasa 1/4 que pueden transmitirse mediante un transmisor VSB robusto de acuerdo con el presente invento,

La Figura 14 muestra un ejemplo de cuatro segmentos de datos que contienen datos codificados externos de tasa 3/4 que pueden transmitirse mediante un transmisor VSB robusto de conformidad con el presente invento,

La Figura 15 muestra los intercaladores (I_r) de las Figuras 1, 9 y 11 con mayor detalle,

La Figura 16 muestra los desintercaladores (D_r) de las Figuras 3 y 9 con más detalle,

La Figura 17 muestra una estructura de definición de mapa de un primer paquete de datos VSB robustos de una trama,

La Figura 18 muestra una parte del segmento sincronizado de una trama que porta un mapa que indica en qué parte de la trama pueden encontrarse los datos VSB robustos,

La Figura 19 ilustra un predictor mejorado de secciones de acuerdo con una incorporación del presente invento,

La Figura 20 muestra las cuadrículas del decodificador interno de la Figura 19,

La Figura 21 muestra transiciones de estado posibles para el decodificador externo de la Figura 19, y

La Figura 22 ilustra un predictor mejorado de secciones de acuerdo con otra incorporación del presente invento

Descripción Detallada

Transmisión y Recepción de Datos RVSB y ATSC

La Figura 1 muestra un transmisor VSB (10) que transmite tanto datos ATSC como datos VSB robustos de acuerdo con una incorporación del presente invento La Figura 2 muestra un receptor ATSC estándar (12) que recibe los datos ATSC transmitidos por el transmisor VSB robusto (10), y la Figura 3 muestra un receptor VSB robusto (14) que recibe los datos VSB robustos transmitidos por el transmisor VSB robusto (10)

El transmisor VSB robusto (10) incluye un codificador Reed/Solomon (16) que codifica los bytes de datos auxiliares no codificados añadiendo bytes de paridad Reed/Solomon a los bytes de datos auxiliares no codificados Los bytes de datos auxiliares no codificados y los bytes de paridad Reed/Solomon son intercalados por un intercalador (18) Entonces los bytes de datos auxiliares sin codificar intercalados y los bytes de paridad Reed/Solomon se codifican con bits por un codificador externo (20) utilizando ya sea un código convolucional u otro código de corrección de errores El codificador externo (20) mejora la robustez de los bytes de datos auxiliares no codificados y de los bytes de paridad Reed/Solomon, convirtiéndolos en bytes de datos robustos (en

adelante denominados bytes de datos VSB robustos) y en bytes de paridad Reed/Solomon

El codificador externo (20) puede por ejemplo, ser un codificador con una tasa de 1/2 que produzca dos bits de salida por cada bit de entrada, o un codificador, con una tasa de 1/4 que produzca cuatro bits de salida por cada bit de entrada, o un codificador con tasa de 3/4 de tasa que produzca 4 bits de salida por cada tres bits de entrada Otros codificadores podrán utilizarse en lugar de estos

En la salida del codificador externo (20), se adiciona una cabecera de transporte (tx) de tres bytes a cada grupo de 184 datos VSB robustos codificados y bytes Reed/Solomon para formar paquetes de datos VSB robustos Un multiplexor (24) multiplexa estos paquetes de datos VSB robustos con paquetes de datos ATSC (típicamente video y audio) cada uno de los cuales comprende una cabecera de transporte de tres bytes y 184 bytes de datos ATSC Cualquiera de estas entradas al multiplexor (24) puede seleccionarse sobre la base de paquete por paquete y cada entrada seleccionada se suministra a un transmisor ATSC (26) La selección por parte del multiplexor (24) por cuya entrada pasa hacia el transmisor ATSC (26) está basada en un mapa VSB robusto que se describirá más adelante

El transmisor ATSC (26), típicamente incluye un codificador (28) Reed/Solomon, un intercalador (30) y un codificador interno (32) de tasa 2/3, todo lo cual opera de conformidad con la norma ATSC

Un receptor de la norma ATSC, tal como el receptor (12) de la norma ATSC que aparece en la Figura 2, recibe y procesa los datos ATSC y descarta los datos VSB robustos De acuerdo con lo anterior, el receptor de la norma ATSC (12) incluye un decodificador interno de tasa 2/3 (34), un desintercalador (36) y un decodificador Reed/Solomon (38) todos los cuales operan de conformidad con la norma ATSC Sin embargo, el receptor de la norma ATSC (12) está programado para decodificar las cabeceras de transporte de datos VSB robustos y de datos ATSC (lo cual incluye el paquete de identificaciones o PIDs que no han sido codificados por el codificador externo (20)) El receptor de la norma ATSC (12) lee los PIDs de todos los paquetes y en el (40), descarta aquellos paquetes que tengan los PIDs de datos VSB robustos El receptor de la norma ATSC (12) incluye también un predictor de secciones (42) (tal como el predictor de secciones de la Patente Norteamericana No 5 923 711) que responde a los datos decodificados internos y que proporciona

una salida de vuelta al rastreador de fase y/o ecualizador, tal como se conoce en la técnica

Los paquetes de datos VSB robustos pueden recibirse, decodificarse y procesarse por un receptor VSB robusto tal como el receptor VSB robusto (14) que se muestra en la Figura 3 Como se conoce y como se muestra en la Figura 4, el codificador interno de tasa 2/3 (32) del transmisor ATSC (26) incluye un precodificador (44) y un codificador de cuadrículas de cuatro estados (46) En combinación, el precodificador (44) y el codificador de cuadrícula de cuatro estados (46) puede considerarse como un codificador de ocho estados que produce tres bits de salida codificados con cuadrícula (Z0 Z1 Z2) para cada dos bits de entrada (X1 X2) Un mapeador (48) mapea los tres bits de salida codificados con cuadrícula con un símbolo que tiene uno de ocho niveles en la forma en que se indica en la Figura 5 Tal como se conoce bien a partir de la teoría de código convolucional, la operación del precodificador (44) y del codificador de cuadrículas de cuatro estados (46) puede observarse como una cuadrícula cuaternaria (4-ary) de ocho estados.

Por consiguiente, en el receptor VSB robusto (14), un decodificador interno con tasa de 2/3 (50) puede operar en

cualquier cuadrícula cuaternaria (4-ary) de ocho estados que vea al precodificador (44) y al codificador de cuadrícula de cuatro estados (46) del codificador interno con tasa de 2/3 en combinación, tal como se muestra en la Figura 6 para producir una decisión de salida blanda (utilizando por ejemplo, el algoritmo SSA en la forma descrita en la publicación "Detección de Salida Blanda Optima para Canales con Interferencia de Intersímbolo", *Li, Vucetic, y Sato,* IEEE Transacciones sobre la Teoría de la Información, Mayo de 1995) Esta operación de toma de decisiones blandas es más complicada que el algoritmo Viterbi ampliamente utilizado, que produce una salida de decisión dura, pero la operación de toma de decisión blanda aprovecha más ampliamente de ganancia de la codificación provista por el codificador externo (20)

La salida del decodificador interno con tasa de 2/3 (50) se desintercala por un desintercalador (52) El receptor VSB robusto (14) lee los PIDs de todos los paquetes a la salida del desintercalador (52) Con base en estos PIDs el receptor VSB robusto (14) descarta estos paquetes en el (54) que tiene los PIDs de los datos ATSC y también descarta las cabeceras de transporte adicionadas posteriormente al codificador externo (20) y los bytes de paridad adicionados por el codificador Reed/Solomon (28) Así, el receptor VSB robusto

(14), en el (54), pasa únicamente los paquetes de datos VSB robustos que contienen los datos VSB robustos codificados por el codificador externo (20) Los paquetes de datos VSB robustos se decodifican por un decodificador externo (56), se desintercalan por un desintercalador (58) que es el inverso del intercalador (18) y Reed/Solomon se decodifica por un decodificador Reed/Solomon (60) para reconstruir los datos auxiliares no codificados originales provistos al codificador Reed/Solomon (16) de la Figura 1

La salida confiable del decodificador externo (56) (que se puede utilizar en salida blanda o dura) es intercalada por un intercalador (62) (que corresponde al intercalador (30) en un trayecto de retroalimentación (64) con el fin restaurar el ordenamiento de los datos decodificados externos al orden de los datos en el canal Estos datos decodificados externos intercalados pueden por ejemplo utilizarse por un predictor de secciones (66) para crear retroalimentación confiable a un rastreador de fase y/o ecualizador Sin embargo, la demora de la retroalimentación general introducida por el desintercalador (52) y el intercalador (62) en el receptor VSB robusto (14) es generalmente muy larga para proporcionar retroalimentación útil al rastreador de fase y/o al ecualizador

El arreglo que se muestra en las Figuras 7, 8 y 9 evita la demora en la retroalimentación introducida por el desintercalador (52) y el intercalador (62) del receptor VSB robusto (14) La Figura 7 muestra un transmisor VSB robusto (80) en el cual los bytes de datos auxiliares no codificados se codifican por un codificador Reed/Solomon (82) que adiciona bytes de paridad Reed/Solomon a los bytes de datos auxiliares no codificados Los bytes de datos auxiliares no codificados y los bytes de paridad Reed/Solomon son intercalados por un intercalador (84) Entonces, los bytes de datos auxiliares no codificados intercalados y los bytes de paridad Reed/Solomon se codifican en término de bits por un codificador externo (86), utilizando ya sea un código convolucional o un código de producto turbo, en la forma arriba indicada La salida en términos de bits del codificador externo (86) es un pequeño bloque intercalado por un intercalador de bloques pequeño (88) con el fin de reducir el impacto de los errores de las ráfagas del canal en el decodificación externo A los datos provistos por el intercalador de bloques pequeño (88) puede hacerse referencia como Rdatos (n o) que corresponde a los datos VSB robustos ordenados normalmente

Una entrada del primer multiplexor (92) recibe paquetes formateados ATSC cada uno de los cuales comprende (i) una cabecera válida de transporte de tres bytes con un número PID para datos VSB robustos, (ii) 184 bytes que sostienen lugares de datos VSB robustos simulados, y (iii) veinte bytes que sostienen lugares para datos de paridad Reed/Solomon ATSC simulados La otra entrada del primer multiplexor (92) recibe paquetes simulados formateados ATSC, cada uno de los cuales tiene 207 bytes de datos ATSC simulados Estos paquetes simulados formateados ATSC sirven como tenedores de lugares ("placeholders") para los paquetes ATSC reales que se añaden corriente abajo Las entradas del primer multiplexor (92) pueden seleccionarse sobre la base de paquete por paquete y esta selección esta basada en el mapa VSB robusto que se describirá más adelante

Las salida seleccionada del primer multiplexor (92) es intercalada por un intercalador (94) de acuerdo con la Norma ATSC para intercalación convolucional de bytes Un reemplazador de datos (96) recibe tanto la salida del intercalador (94) como la salida del intercalador de bloques pequeños (88) El reemplazador de datos (96) reemplaza cada byte con lugar para tener datos VSB robustos simulados desde el intercalador (94) con los siguientes bytes de datos VSB

robustos normalmente ordenados desde el intercalador de bloques pequeños (88)

La salida del reemplazador de datos (96) contiene datos VSB robustos normalmente ordenados con cabeceras de transporte entremezcladas, bytes de paridad Reed/Solomon ATSC simulados y bytes de paquetes de datos ATSC simulados Un desintercalador (98), que opera de acuerdo con la Norma ATSC para la desintercalación de bytes, desintercala la salida del reemplazador de datos (96) para así "repaquetizar" de forma efectiva los datos como paquetes de cabeceras de transporte, o datos VSB robustos reordenados (Rdata(r o)), o bytes de paridad Reed/Solomon ATSC simulados y datos ATSC simulados El reordenamiento de los datos VSB robustos reordenados normalmente resulta de la desintercalación del desintercalador (98) y a los datos reordenados puede hacerse referencia como datos VSB robustos reordenados

Los bytes de paridad Reed/Solomon ATSC simulados (20 por paquete) de los paquetes VSB robustos y de los paquetes de datos ATSC simulados (207 bytes por paquete) se descargan en (100) Los paquetes VSB robustos restantes, cada uno de los cuales incluye una cabecera de transporte y datos VSB robustos reordenados, son multiplexados por un segundo

multiplexor (102) con paquetes de datos ATSC reales cada uno de los cuales contiene 187 bytes de una cabecera de transporte y datos ATSC Cualquiera de las entradas al segundo multiplexor (102) puede seleccionarse sobre la base de paquete por paquete y se provee a un transmisor ATSC (104) La selección del segundo multiplexor (102) cuya entrada pasa al transmisor ATSC (104) está basada en un mapa VSB robusto que se describirá más adelante

El transmisor ATSC (104) típicamente incluye un codificador Reed/Solomon (106), un intercalador (108) y un codificador interno de tasa 2/3 de doce vías (110) todo lo cual opera de conformidad con la norma ATSC Del codificador Reed/Solomon (106) salen paquetes de cabeceras de transporte, datos VSB robustos reordenados y bytes de paridad Reed/Solomon ATSC multiplexados con paquetes de cabeceras de transporte, datos ATSC y bytes de paridad Reed/Solomon ATSC Los bytes de paridad Reed/Solomon ATSC para los datos VSB robustos se calculan con base en los datos VSB robustos reordenados Además, el intercalador (108) cambia el ordenamiento de los datos VSB robustos de manera que dichos datos en la salida del intercalador (108) vuelvan a ser datos VSB robustos normalmente ordenados También el intercalador (108) dispersa las cabeceras de transporte, los bytes de

paridad Reed/Solomon ATSC y los datos ATSC Estos datos son codificados a una tasa de 2/3 por el codificador interno de tasa 2/3 de doce vías (110) y se transmiten Los datos VSB robustos transmitidos están en el orden normal, v g , el orden provisto a la salida del intercalador de bloques pequeños (88) Este orden normal permite que el receptor VSB robusto evite la demora causada por el desintercalador (52) y por el intercalador (62) del receptor VSB robusto (14)

Tal como se indica en la Figura 8, un receptor de la norma ATSC (120) incluye un decodificador interno 2/3 de doce vías que decodifica los datos transmitidos para proporcionar un flujo de datos de salida que comprenda datos robustos normalmente ordenados con cabeceras intercaladas de transporte, datos ATSC, y bytes de paridad Reed/Solomon ATSC ubicados de acuerdo con la intercalación convolucional de bytes ATSC provista por el intercalador (108) Un desintercalador ATSC (124) restituye las cabeceras de transporte, los datos ATSC y los bytes de paridad Reed/Solomon ATSC hacia sus posiciones "paquetizadas" de transporte También el desintercalador ATSC (124) convierte los datos VSB robustos ordenados normalmente en datos VSB robustos reordenados Esta forma reordenada permite que un decodificador Reed/Solomon ATSC (126) del receptor ATSC

estándar (120) lleve a cabo pruebas correctas de la paridad de los paquetes de datos VSB robustos El receptor ATSC estándar (120) puede entonces leer las cabeceras de transporte de los paquetes de datos VSB robustos y fácilmente descartar los paquetes de datos VSB robustos en (128) con base en sus PIDs

Tal como se indica en la Figura 9, un receptor VSB robusto (130) incluye un decodificador interno de tasa 2/3 de doce vías de salida blanda (132) (Un decodificador de 2/3 de salida dura originaría una pérdida considerable de la ganancia de codificación) La salida del decodificador interno de tasa 2/3 de doce vías de salida blanda (132) incluye datos VSB robustos ordenados de forma normal con datos ATSC reordenados, cabeceras de transporte y símbolos de paridad Reed/Solomon ATSC dispersados dentro de los datos VSB robustos en las ubicaciones indicadas por una línea de control de descarte (134) de la que se hablará más adelante Un bloque de descarte (136), bajo el control de la línea de control de descarte (134), descarta los datos ATSC reordenados, las cabeceras de transporte y los símbolos de paridad Reed/Solomon ATSC

Un desintercalador de bloques pequeños (138) desintercala los datos VSB robustos El desintercalador de bloques pequeños (138) tiene un tiempo de demora relativamente bajo El desintercalador dispersa errores posibles de ráfaga en los datos VSB robustos a la salida del decodificador interno de tasa 2/3 con doce vías de salida blanda (132) Los datos VSB robustos ordenados de forma normal se decodifican en términos de bits por un decodificador externo (140) que también agrupa los datos VSB robustos en bytes La información amplificada le indica al decodificador externo (140) qué tasa de codificación utilizar en los datos provistos al decodificador externo (140) en una entrada de Datos R_{MAP} No se necesita ni el desintercalador (52) ni el intercalador (62) en el receptor VSB robusto (130) permitiendo menos demora en la retroalimentación general hacia el rastreador de fase y/o el ecualizador Los datos decodificados externos pueden ser utilizados, por ejemplo, por un predictor mejorado de secciones (142) para generar retroalimentación al rastreador de fase y/o al ecualizador Si se desea, la retroalimentación puede atravesar por una compuerta o se puede ajustar el algoritmo del gradiente del ecualizador del tamaño del paso proporcionalmente a la confiabilidad de los datos decodificados

La carga útil del paquete de datos VSB robusto decodificada por el decodificador externo (140) es desintercalada por un desintercalador (144) (que corresponde al inverso del intercalador (84)) y recibe una decodificación Reed/Solomon por un decodificador Reed/Solomon (146) (que corresponde al codificador Reed/Solomon (82)) para reconstruir los datos auxiliares no codificados originales proporcionados al codificador Reed/Solomon (82) de la Figura 7

Tal como se indica en la norma ATSC, un marco comprende una diversidad de segmentos cada uno de los cuales contiene un número predeterminados de bytes El primer segmento de una trama es un segmento sincronizado de la trama y los segmentos restantes en la trama son segmentos de datos Aunque los datos VSB robustos pueden transmitirse en segmentos o en segmentos parciales, es conveniente transmitir dichos datos en pares de segmentos El mapa VSB robusto discutido arriba indica cuáles pares de segmentos contienen datos VSB robustos para que el bloque de descarte (136) pueda descartar correctamente los datos ATSC reordenados antes de que éstos puedan llegar al decodificador externo (140) Las cabeceras de transporte y los datos de paridad Reed/Solomon ATSC para

todos los todos los segmentos (VSB robustos y ATSC) también pueden descartarse por el bloque de descarte (136)

En la Figura 10 aparece un circuito conceptualmente simple para generar la señal de control adecuada en la línea de control de descarte (134) para controlar esta función de descarte, junto con la porción relevante del receptor VSB robusto (130) El receptor VSB robusto (130) utiliza la información del mapa recibida (el método para transmisión y recepción de esta información de mapa está descrito a continuación) para dar una orden a un generador de segmento simulado (150) de cuándo construir los segmentos de bytes simulados (207) El generador de segmentos simulados (150) también utiliza la señal sincronizada de la trama. Para cada segmento simulado ATSC, el generador de segmentos simulados (150) fija todos los bytes en FF Para cada uno de los segmentos simulados de los datos VSB robustos, el generador de segmentos simulados (150) fija la cabecera de transporte y los bytes de paridad Reed/Solomon en FF El generador de segmentos simulados (150) fija el resto de los bytes de cada segmento simulado de datos VSB robustos en 00

Estos segmentos simulados son alimentados por el generador de segmentos simulados (150) a un intercalador de

bytes convolucional (152) cuya salida es posteriormente utilizada para controlar el bloque de descarte (136) que posteriormente responde a los códigos FF y 00 para descartar correctamente los datos ATSC reordenados, las cabeceras de transporte y los datos de paridad Reed/Solomon ATSC que están intercalados dentro del flujo de datos recibidos El bloque de descarte (136) entonces, pasa únicamente por los datos VSB robustos

La Figura 11 muestra un transmisor VSB robusto con código de salida múltiple (160) El transmisor VSB robusto (160) opera de forma similar al transmisor VSB robusto (80) de la Figura 7 El transmisor VSB robusto (160) tiene el primer codificador Reed/Solomon (162) que codifica los primeros datos auxiliares no codificados añadiendo bytes de paridad Reed/Solomon a los primeros datos auxiliares no codificados, un segundo codificador Reed/Solomon (164) que codifica los segundos datos auxiliares no codificados añadiendo bytes de paridad Reed/Solomon a los segundos datos auxiliares no codificados, y un tercer codificador Reed/Solomon (166) que codifica los terceros bytes de datos auxiliares no codificados añadiendo bytes de paridad Reed/Solomon a dichos terceros datos auxiliares no codificados Los datos auxiliares no codificados, codificados

de primeros como Reed/Solomon, son intercalados por un primer intercalador (168), los segundos datos auxiliares no codificados, codificados como Reed/Solomon, son intercalados por un segundo intercalador (170) y, los terceros datos auxiliares no codificados, codificados como Reed/Solomon, son intercalados por un tercer intercalador (172) Entonces, los primeros datos auxiliares no codificados, codificados como Reed/Solomon intercalados, se codifican en términos de bits por un primer codificador externo (174), los segundos datos auxiliares no codificados, codificados como Reed/Solomon intercalados, se codifican en términos de bits por un segundo codificador externo (176), y los terceros datos auxiliares no codificados, codificados como Reed/Solomon intercalados, se codifican en términos de bits por un tercer decodificador externo (178) La salida en términos de bits del primer codificador externo (174) es intercalada por un primer intercalador de bloques pequeños (180), la salida en términos de bits del segundo codificador externo (176) es intercalada por un segundo intercalador de bloques pequeños (182) y la salida en términos de bits del tercer decodificador externo (178) es intercalada por un tercer intercalador de bloques pequeños (184)

El primer codificador externo (174) es un codificador con tasa de 1/4, el segundo codificador externo (176) es un codificador con tasa de 1/2 y el tercer decodificador externo (178) es un decodificador con tasa de 3/4, aún cuando se puede utilizar cualquier otra combinación de estos u otros codificadores externos que utilicen diferentes tasas de códigos Las salidas de datos del primero, segundo y tercer intercaladores de bloques pequeños (180, 182 y 184) es seleccionada por un multiplexor (186) bajo control de una entrada selecta que determina el orden en que los diferentes datos codificados externos se insertan a la trama para ser transmitidos Los datos a la salida de multiplexor (186) pueden mencionarse como Rdata(n o), los cuales tal como ya se dijo, corresponden a datos VSB robustos normalmente ordenados

Las tres entradas superiores de un multiplexor (190) reciben paquetes de formato ATSC, cada uno de los cuales tiene una cabecera de transporte de tres bytes con un número de PID para datos VSB robustos (184), bytes con sitio para sostener datos VSB robustos simulados y veinte bytes simulados con sitio para sostener datos de paridad Reed/Solomon ATSC Los datos VSB robustos en la entrada de más arriba del multiplexor (190) corresponden a datos

codificados con tasa de 1/4 del primer codificador externo (174), los datos VSB robustos en la siguiente entrada del multiplexor (190) corresponden a datos codificados con tasa de 1/2 del segundo codificador externo (176) y los datos VSB robustos en la siguiente entrada del multiplexor (190) corresponden a datos codificados a una tasa de 1/3 del tercer codificador externo (178) Los datos suministrados por la entrada más baja del multiplexor (190) comprenden paquetes simulados del formato ATSC, cada uno de los cuales tiene 207 bytes de datos ATSC simulados Estos paquetes de datos ATSC simulados sirven como sostenedores para los paquetes de datos ATSC reales que deben adicionarse corriente abajo del multiplexor (190) Las entradas al multiplexor (190) se pueden seleccionar sobre una base de paquete por paquete de acuerdo con la entrada sobre la línea de selección Esta selección está basada en el mapa de datos VSB robusto que se describe más adelante

La salida del multiplexor (190) es intercalada por un intercalador (192) para lograr una intercalación convolucional ATSC correcta Un reemplazador de datos (194) recibe tanto la salida del intercalador (192) como la salida del multiplexor (186) El reemplazador de datos (194) reemplaza cada byte con lugar para tener datos VSB robustos

simulados desde el multiplexor (190) con los siguientes bytes de datos VSB robustos correspondientes ordenados normalmente que provienen del multiplexor (186)

La salida del reemplazador de datos (194) contiene datos VSB robustos normalmente ordenados (codificados a tasas de 1/4, 1/2 y/o 3/4 según sea apropiado) con cabeceras de transporte intercaladas, bytes de paridad Reed/Solomon ATSC simulados, y bytes de paquetes de datos ATSC simulados Un desintercalador de bytes convolucional (196) (en la forma descrita en la Norma ATSC) desintercala la salida del reemplazador de datos (194) para así "repaquetizar" eficazmente los datos como paquetes de cabeceras de transporte, datos VSB robustos reordenados (codificados a tasas de 1/4, 1/2 o 3/4), bytes de paridad Reed/Solomon ATSC simulados y paquetes simulados de datos ATSC El reordenamiento de los datos VSB robustos ordenados normalmente resulta de la desintercalación del desintercalador (196)

Los bytes de paridad Reed/Solomon ATSC simulados (20 por paquete) y los paquetes de datos ATSC simulados (207 bytes por paquete) se descartan en el (198) en una forma similar a aquella provista por la línea de control de descarte (134) y

el bloque de descarte (136) de la Figura 9 Los paquetes VSB robustos restantes, cada uno de los cuales incluye una cabecera de transporte y datos VSB robustos reordenados, son multiplexados por un multiplexor (200) con paquetes de datos ATSC reales, cada uno de los cuales contiene 187 bytes de cabecera de transporte y datos ATSC Cualquier entrada al multiplexor (200) puede seleccionarse sobre una base de paquete por paquete y se suministra a un transmisor ATSC (202) La selección del multiplexor (200) cuya entrada pasará al transmisor ATSC (202) está basada en el mapa VSB robusto que se describirá más adelante

El transmisor ATSC (202) típicamente incluye un codificador Reed/Solomon (204), un intercalador (206) y un codificador interno con tasa de 2/3 de doce vías (208) todo lo cual opera de conformidad con la norma ATSC El codificador Reed/Solomon (204) saca los paquetes de cabeceras de transporte, los datos VSB robustos reordenados y los bytes de paridad Reed/Solomon ATSC multiflexados con paquetes de cabeceras de transporte, datos ATSC, y bytes de paridad Reed/Solomon ATSC Los bytes de paridad Reed/Solomon ATSC para los datos VSB robustos se calculan con base en los datos VSB robustos reordenados Además, el intercalador (206) cambia el ordenamiento de los datos VSB robustos de manera

que dichos datos a la salida del intercalador (206) nuevamente sean datos VSB robustos ordenados de forma normal También el intercalador (206) dispersa los bytes de la cabecera de transporte, los bytes de paridad Reed/Solomon ATSC y los datos ATSC Estos datos son codificados a 2/3 a una tasa de 2/3 por un codificador interno de tasa de 2/3 con doce vías (208) y son transmitidos Los datos VSB robustos transmitidos se encuentran en orden normal, v g , el orden provisto a la salida del multiplexor (186) Este orden normal de datos permite al receptor VSB robusto evadir la demora causada por el desintercalador (52) y por el intercalador (62)

Tal como se discutió arriba, una trama ATSC comprende un segmento sincronizado de trama y una diversidad de segmentos y para conveniencia, los datos VSB robustos se empacan en grupos de cuatro segmentos Más específicamente, la Figura 12 muestra un ejemplo de cuatro segmentos de datos que se puede utilizar en una trama para transmitir datos VSB robustos que están codificados a una tasa de 1/2, la Figura 13 muestra un ejemplo de cuatro segmentos de datos que pueden utilizarse en una trama para transmitir datos VSB robustos que están codificados a una tasa de 1/4 y la Figura 14 muestra un ejemplo de cuatro segmentos de datos que pueden utilizarse en

una trama para transmitir datos VSB robustos que están codificados a una tasa de 3/4. Estos ejemplos representan la trama antes del intercalador (108) y asumen que cada grupo de cuatro segmentos de datos VSB robustos contiene un número integral de bloques codificados Reed/Solomon robustos cada uno de los cuales tiene 184 bytes de largo, de los cuales veinte bytes son bytes de paridad

Para el caso de un código externo con tasa de 1/2, la Figura 12 muestra que el codificador externo saca dos bits por cada bit de entrada. Un paquete de datos VSB robusto se empaca como un bloque Reed/Solomon RVSB hacia un par de segmentos de datos (un bit por símbolo) de manera que, para un código de salida con tasa de 1/2, cuatro segmentos contengan dos bloques codificados Reed/Solomon robustos. Como se indica en la Figura 13, para el caso de códigos externos con tasa de 1/4, el codificador externo saca cuatro bits por cada bit de entrada. Los datos VSB robustos se empacan como un bloque Reed/Solomon RVSB por cada cuatro segmentos de datos (1/2 bit por símbolo) de manera que, para un código externo con tasa de 1/4, cuatro segmentos contengan un bloque codificado Reed/Solomon robusto. Tal como se indica en la Figura 14, para el caso del código externo de tasa de 3/4 el codificador externo saca cuatro bits por cada tres bits de

entrada En este caso, las fronteras de los bytes y símbolos transmitidos no siempre concuerdan Sin embargo, tres bloques completos Reed/Solomon RVSB conformarán un paquete exacto de cuatro segmentos de datos (1 5 bits por símbolo) de manera que, para un código externo con tasa de 3/4, cuatro segmentos contengan tres bloques codificados Reed/Solomon robustos

De acuerdo con lo anterior, las Figuras 12, 13 y 14 pueden representarse por la siguiente tabla

S	X	Y
1/2	1	2
1/4	1	4
3/4	3	4

donde X representa el número de bloques codificados Reed/Solomon robustos completos y Y representa el número de segmentos de trama requeridos para contener el número X correspondiente de bloques codificados Reed/Solomon robustos

Sin embargo, debe entenderse que pueden utilizarse otras tasas de codificación en relación con el presente invento y, por consiguiente, la tabla anterior variará dependiendo de las tasas particulares de codificación que se utilicen

Los intercaladores (18), (84), (168), (170) y (172) se indican con más detalle en la Figura 15 y los

desintercaladores (58) y (144) también se muestran con más detalle en la Figura 16, asumiendo que el bloque codificado Reed/Solomon robusto se elige para que tenga 184 bytes de largo Los intercaladores (18), (84), (168), (170) y (172) son intercaladores convolucionales B = 46, M = 4, N = 184 que intercalan los datos VSB robustos en términos de bytes Este esquema de intercalación es el mismo esquema de intercalación ATSC descrito en la Norma A/53 de Televisión Digital ATSC y en la Guía para Utilizar la Norma A/54 de Televisión Digital ATSC, salvo que el parámetro B para el intercalador robusto es (46) en lugar de (52) y el parámetro N es (184) en lugar de (208) Este intercalador se requiere para que el receptor VSB robusto pueda manejar las largas ráfagas de ruido en el canal aún cuando no se pase por el desintercalador (D_a) ATSC, como se indica en la Figura 9

Tal como se ilustra en la Figura 16, los desintercaladores (58) y (144) son desintercaladores convolucionales B = 46, M = 4, N = 184 que desintercalan los datos VSB robustos en términos de bytes Este esquema de desintercalación también es igual al esquema de desintercalación ATSC descrito en la Norma A/53 de Televisión Digital ATSC y en la Guía para la Utilización de la Norma A/54 de Televisión Digital ATSC, salvo que el parámetro B

para el desintercalador robusto es (46) en lugar (52) y el parámetro N es (184) en lugar de (208)

Teniendo en cuenta que el bloque Reed/Solomon VSB robusto comprende 184 bytes y que un número integral de bloques Reed/Solomon VSB robustos se encuentra en una trama de datos, el número de bytes de datos VSB robustos más el número de bytes de paridad Reed/Solomon VSB robustos en una trama de datos es siempre divisible por 46 Entonces, el segmento sincronizado de trama puede utilizase como un sincronizador para los desintercaladores (58) y (144) (D_r) en el receptor, independientemente del valor de G (que se describe más adelante) En la sincronización de la trama los conmutadores del desintercalador están forzados a las posiciones más altas Los desintercaladores (58) y (144) son desintercaladores en términos de bytes

Mapeo de Datos

Tal como se indicó arriba, cada trama de datos puede contener una mezcla de segmentos de datos VSB robustos y de segmentos de datos ASTC (no codificados robustamente) Además, los datos VSB robustos pueden contener datos codificados con una mezcla de tasas de codificación El receptor VSB robusto (14) o (130) debe tener un mapa VSB

robusto que indica cuáles segmentos son codificados VSB robustos y cuáles códigos externos se utilizan para la codificación VSB robusta de manera que el receptor VSB robusto (14) o (130) puedan correctamente procesar los datos VSB robustos y descartar los datos ATSC Los transmisores VSB robustos (10), (80) y (160) también utilizan el mapa VSB robusto para controlar su correspondiente multiplexión y descartar funciones Este mapa VSB robusto se transmite por un transmisor VSB robusto (10), (80) o (160) al receptor VSB robusto (14) o (130) junto con todos los demás datos en la forma descrita a continuación.

La presencia, número y ubicación de los datos VSB robustos en una trama de datos codificada con un código externo particular se indica por uno o más números S_C que aparecen como datos de dos niveles en el segmento sincronizado de trama de la trama de datos Como ya se sabe, el segmento sincronizado de trama es el primer segmento en una trama Entonces, para los códigos externos descritos arriba (con tasas de 1/4, 1/2 y 3/4), el segmento sincronizado de trama preferiblemente debe contener [$S_{1/4}$, $S_{1/2}$, y $S_{3/4}$] Cada S_C (tal como $S_{1/4}$, $S_{1/2}$, y $S_{3/4}$) se codifica como diez y ocho símbolos (bits) de dos niveles de datos Para todos los tres códigos, un total de 3 x 18 = 54 símbolos se

requieren como una definición del mapa VSB robusto Estos símbolos se insertan al área reservada cerca de la terminación de cada segmento sincronizado de trama (justo antes de los doce bits de precodificación) Para cada grupo de diez y ocho bits (b_{18} b_1), los últimos seis bits (b_6 b_1) representan el número G de grupos de ocho segmentos (8 segmentos = 2, 4 o 6 paquetes de datos VSB robustos dependiendo del código de salida) mapeados como datos VSB robustos en la trama actual. Los doce bits precedentes son para compensación de filtros combinada (ver la Guía para la Utilización de la Norma A/54 de Televisión Digital ATSC) De acuerdo con lo anterior, tal como se indica en la Figura 18, los bits b_6 b_1, representan el número G, los bits b_{18} b_{13} son el complemento de los bits b_6 b_1 y los bits b_{12} b_7 pueden alternarse +1 y -1 (o en cualquier otro patrón)

Asumamos que $S = S_{1/4} + S_{1/2} + S_{3/4}$ Como 312/8 = 39, 0-39 se pueden mapear grupos de ocho segmentos como datos VSB robustos o como 8 datos VSB (datos ATSC) Por consiguiente, cada S_C puede tener un valor de 0 39, siempre que la suma S de los mismos sea $\leq$ 39

Los segmentos de datos VSB robustos preferiblemente se distribuyen en la forma más uniforme posible a lo largo del

la trama de datos Por ejemplo, si S = 1, entonces los siguientes ocho segmentos se mapean como segmentos de datos VSB robustos y todos los otros segmentos se mapean como segmentos de datos ATSC (1), (40), (79), (118), (157), (196), (235) y (274). Si S = 2, entonces los siguientes diez y seis segmentos se mapean como segmentos de datos VSB robustos y todos los demás segmentos se mapean como segmentos de datos ATSC (1), (20), (39), (58), (77), (96), (115), (134), (153), (172), (191), (210), (229), (248), (267) y (286) Estos ejemplos continúan hasta cuando S = 39, en donde toda la trama de datos se mapea como segmentos de datos VSB robustos Para algunos valores de S, el espacio entre pares de segmentos de datos VSB robustos no es perfectamente uniforme Sin embargo, para cualquier valor de S, el espacio se determina de forma anticipada y por consiguiente, es conocido para todos los receptores

Si una trama contiene datos VSB robustos proporcionados por tres codificadores externos que operan a tasas de 1/4, 1/2 y 3/4, entonces los datos de estos tres codificadores externos se pueden dividir en una trama de manera que en cuanto se refiere a los segmentos RVBS, los primeros segmentos 8 x $S_{1/4}$ contengan los datos codificados externos con tasa de 1/4, los siguientes segmentos 8 x $S_{1/2}$ contengan

datos codificados externos con tasa de 1/2 y los últimos segmentos 8 x $S_{3/4}$ contengan datos codificados externos con tasa de 3/4 Sin embargo, son posibles otras organizaciones de segmentos de datos VSB robustos para estos tres codificadores externos o para cualquier número de otro tipo de codificadores externos

Considerando que este mapa VSB robusto está contenido en el segmento sincronizado de trama, tal como se discutió arriba, el mapa VSB robusto no disfruta del mismo nivel de ganancia de codificación que los datos VSB robustos No obstante, el mapa VSB robusto puede todavía adquirirse en forma confiable por un receptor VSB robusto mediante la correlación del mapa VSB robusto sobre algún número de tramas Por consiguiente, el mapa VSB robusto no debe cambiar muy a menudo (por ejemplo, no más a menudo de cada ~60 tramas)

El método de mapeo arriba indicado le permite a un receptor adquirir confiable y simplemente el mapa VSB robusto por correlación Una vez que un receptor ha adquirido el mapa, es deseable que instantáneamente rastree los cambios en el mismo de forma confiable Para rastrear dichos cambios en el mapa de forma instantánea y confiable, la definición del

mapa VSB robusto para cada código externo, excluyendo los bits combinados de compensación, se duplica en el primer bloque codificado Reed/Solomon VSB robusto de la trama Además, existen datos que indican (i) cuándo en el futuro el mapa cambiará y (ii) la definición futura del nuevo mapa El primer paquete de datos VSB robustos de una trama para un codificador externo, por consiguiente, tiene la estructura indicada en la Figura 17, en donde la definición de datos del mapa VSB robusto está dada por lo siguiente ocho bits que designan en mapa actual (únicamente seis de estos bits se utilizan), ocho bits que designan el número de tramas hasta que cambia el mapa (1-125, si es 0, entonces no se esperan cambios), y, ocho bits que designan el siguiente mapa (nuevamente, solo seis de estos bits se utilizan) La porción restante del primer paquete de datos VSB robustos corresponde a datos El primer segmento RVSB en una trama para un codificador externo respectivo tiene el arreglo que se ilustra en la Figura 17

De esta forma, un receptor puede rastrear cambios en el mapa utilizando datos VSB robustos confiables Aún cuando un error de ráfaga destruya un número de tramas, el receptor puede mantener su propio conteo descendiente de las tramas utilizando el número de tramas que se hayan leído a partir de

una trama recibida previamente Si el receptor en cualquier momento encuentra que una definición para un código externo previamente adquirido por la correlación sincronizada de la trama no concuerda con la definición para dicho código externo en el primer segmento de datos VSB robustos, el receptor debe reiniciar su proceso de adquisición del mapa

Predicción Mejorada de Secciones RVSB y Retroalimentación del Ecualizador

Los receptores VSB ATSC 8 hacen uso importante de la ecualización adaptiva y del rastreo de fase en la forma explicada en la Norma A/53 de Televisión Digital ATSC publicada por el Comité de Sistemas Avanzados de Televisión, en la Guía para la Utilización de la Norma A/54 de Televisión Digital ATSC, también publicada por el Comité de Sistemas de Televisión Avanzada El RVSB tal como se describió arriba tiene características que permiten mejoras en la ecualización adaptiva y en el rastreo de la fase

El mejoramiento resulta de la retroalimentación de estimados confiables demorados del nivel de símbolos de entrada al ecualizador adaptivo y/o rastreador de fase con base en una estimación de secuencias a partir de un Algoritmo Viterbi mejorado (Ver "El Algoritmo Viterbi", G D Forney,

Jr , Proc IEEE, vol 61, pp 268-278, marzo de 1873) Este tipo de retroalimentación evita la necesidad de "recodificación", que tiene un problema de inicialización de estado

La Patente Norteamericana No 5 923 711 titulada "Predictor de Secciones para un Receptor de Señal" revela un receptor VSB 8 ATSC que utiliza un predictor de secciones con el fin de proporcionar retroalimentación más confiable al rastreador de fase o al ecualizador adaptivo Esta retroalimentación puede ser aún más confiable con el sistema de predicción de secciones mejorado (300) que se muestra en la Figura 19 El sistema de predicción de secciones mejorado (300) tiene un decodificador interno (302) y un decodificador externo (304) que operan de forma similar a los decodificadores internos y a los decodificadores externos arriba descritos

La salida de predicción de secciones del decodificador interno (302) trabaja en una forma similar a aquella descrita en la Patente Norteamericana 5 923 711 arriba mencionada. Tal como se explicó anteriormente, el decodificador interno (302) se basa en cuadrículas cuaternarias (4-ary) de 8 estados que incluyen un precodificador Con base en la mejor métrica de

trayectoria al tiempo actual t, el predictor de secciones del decodificador interno (302) decide el estado más probable en el tiempo t Entonces, con base en el siguiente par posible de estados, se seleccionan cuatro niveles de entrada predicha posible (entre ocho) para el siguiente símbolo en el tiempo t + 1 Por ejemplo, como se indica en las cuadrículas del decodificador interno en la Figura 20, si el estado más probable en el tiempo t es el estado uno, el siguiente estado será ε[1 5 2 6] Por consiguiente, el siguiente nivel de entrada en el tiempo t + 1 puede ser -7, +1, -3 o +5 Estos niveles de entrada siguientes corresponden a pares de bits decodificados (00), (10), (01) y (11), respectivamente

De forma similar, el decodificador externo (304) también encuentra la mejor métrica de trayectoria para el tiempo actual t para las respectivas cuadrículas Una porción de esta cuadrícula se muestra en la Figura 21 para un decodificador externo ejemplar y se puede aplicar generalmente a todos los tres códigos de salida Tal como se indica en la Figura 21, se seleccionan dos posibles pares de bits de entrada del decodificador externo para el tiempo t + 1 con base en el siguiente par posible de estados A manera de ejemplo, los dos posibles pares de bits de entrada al decodificador externo pueden ser (10) o (01) El par de bits

escogido por el decodificador externo (304) se envía a un mejorador de predicción (306) que selecciona niveles de amplitud +5 o -3 del el grupo de cuatro niveles previamente seleccionado por el predictor de secciones del decodificador interno (302) como la predicción de secciones mejorada para el tiempo t + 1 Considerando que la predicción de secciones del decodificador interno (302) tiene una demora cercana a cero, pero como el decodificador externo (304) solo puede operar sobre el mismo símbolo hasta después de que el decodificador interno (302) haya provisto una salida blanda decodificada, un módulo de demora (308) proporciona un tiempo de mora levemente mayor que el tiempo de demora del rastreo del decodificador interno (302) La predicción de secciones proporcionada por el mejorador de predicción (306) se puede proporcionar como retroalimentación a un ecualizador de rastreo de fase (310)

Con algún tiempo de demora adicional, el decodificador externo (304) puede tomar una decisión dura final y seleccionar un único par de bits de entrada más posible para el tiempo t + 1 Por ejemplo, si se encuentra que 11 es el par de bits de entrada más probable para el decodificador externo (304) según lo determinado por su Algoritmo Viterbi, esta información es enviada por el decodificador externo

(304) al mejorador de predicción (306) que entonces elige +5 de un conjunto de cuatro niveles y pares de bits correspondientes ya seleccionados por el predictor de secciones del decodificador interno (302) El código externo puede ser un código convolucional u otro tipo de código de corrección de error El mejorador de predicción (306) es inhabilitado durante los periodos de tiempo cuando los datos ATSC están siendo recibidos

Una retroalimentación del sistema mejorado de predicción de secciones (320) del estimador de secuencias posibles máximas (MLSE) utiliza un algoritmo Viterbi tal como se muestra en la Figura 22 junto con otras partes relevantes de un receptor RVSB La retroalimentación del sistema mejorado de predicción de secciones MLSE (320) tiene un decodificador interno (322) y un decodificador externo (324) que opera de forma similar al decodificador interno (302) y al decodificador externo (304) arriba descritos Sin embargo, en lugar de utilizar la salida de predicción de secciones del decodificador interno (302), se configura un módulo MLSE mejorado (326) para ejecutar el Algoritmo Viterbi usual sobre la señal recibida mediante la operación de cuadriculas de código con tasa de 2/3 de ocho estados (las mismas

cuadrículas utilizadas por el decodificador interno (322), incluyendo el precodificador)

El módulo MLSE mejorado (326) selecciona su siguiente entrada, bien sea (i) la señal recibida de nivel ocho ruidoso demorada por un módulo de demora (328) si la siguiente entrada es un símbolo no RVSB, o (ii) la salida de decisión de pares de bits del decodificador externo (324) (duro y blando) si la siguiente entrada es un símbolo RVSB El módulo MLSE mejorado (326) realiza esta selección de acuerdo con la información de símbolo por símbolo en el mapa RVSB

El módulo MLSE mejorado (326) saca uno de ocho símbolos posibles como su predicción de secciones, y esta predicción de secciones (decisión de símbolo) es provista por el módulo MLSE mejorado (326) como retroalimentación a un ecualizador o a un rastreador de fase (330)

El módulo MLSE mejorado (326) debería seguir una trayectoria más correcta a través de la cuadrícula de ocho estados que la que sigue el codificador interno (322) porque el módulo MLSE mejorado (326) obtiene entradas más confiables del decodificador externo (324) cuando un símbolo RVSB está disponible

La salida del módulo MLSE mejorado (326) puede ser una decisión de sección dura o de nivel blando También, cualquier indicación de confiabilidad del símbolo del decodificador interno (322) o del decodificador externo (324) se puede utilizar para cambiar el tamaño del paso del algoritmo LMS del ecualizador (Ver la Guía para la Utilización de la Norma A/54 para Televisión Digital ATSC)

Una secuencia opcional de instrucción codificado predeterminado puede incluirse en una porción especificada del primer segmento RVSB de un campo de datos Esta secuencia es conocida por adelantado tanto por el transmisor como por el receptor Durante el tiempo en que la secuencia de instrucción decodificada sale del decodificador externo (324), la entrada al módulo MLSE mejorado (326) se conmuta a una versión almacenado de la secuencia de instrucción decodificada

Algunas modificaciones del presente invento han sido discutidas arriba Otras modificaciones se les ocurrirán a aquellos que practiquen la técnica del presente invento Por ejemplo, aunque el receptor estándar ATSC (12) y el receptor VSB robusto (14) se muestra arriba como receptores separados, las funciones del receptor estándar ATSC (12) y del receptor

VSB robusto (14) pueden combinarse en dos trayectorias de datos de un mismo receptor capaz de decodificar ambos tipos de datos (datos ATSC y datos VSB robustos)

De conformidad con lo anterior, la descripción del presente invento debe interpretarse únicamente de forma ilustrativa solamente y con el propósito de enseñar a aquellos que conocen la técnica la mejor manera de implementar el invento Los detalles pueden variar sustancialmente sin apartarse del espíritu del invento y se reserva el uso exclusivo de todas las modificaciones que estén dentro del alcance de las reivindicaciones anexas

PLANIMETRÍA PARA UN SISTEMA DE COMUNICACIÓN DIGITAL

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REIVINDICACIONES

1 Un método de recibir y procesar una señal digital que se CARACTERIZA por los siguientes pasos

recibir la señal digital que contiene un mapa y unos primeros segundos datos de nivel N, en donde los primeros y segundos datos de nivel N tienen la misma constelación y diferentes tasas de bits, en donde los primeros y segundos datos de nivel N están entremezclados en una trama de datos y en donde el mapa contiene información que indica una localización de por lo menos uno de los primeros y segundos datos de nivel N en la trama de datos, y

procesar los primeros y segundos datos de nivel N de conformidad con el mapa

2 El método de la reivindicación 1 en donde la señal digital recibida contiene un duplicado del mapa

3 El método de la reivindicación 2 en donde la trama de datos comprende una trama ATSC que tiene un segmento sincronizado de trama y múltiples segmentos de datos, en

donde el mapa está contenido en el segmento sincronizado de trama y en donde el duplicado del mapa está contenido en uno de los segmentos de datos

4 El método de las reivindicaciones 1, 2 o 3 en donde la señal digital recibida también contiene datos que indican cuándo cambiará el mapa en el futuro

5 El método de las reivindicaciones 1, 2 o 3 en donde la señal digital recibida también contiene un nuevo mapa que será transmitido en el futuro

6 El método de la reivindicación 5 en donde la señal digital recibida también contiene datos que indican cuándo en el futro se transmitirá el nuevo mapa

7 El método de la reivindicación 1 en donde el mapa contiene información que indica las tasas de codificación de los primeros y segundos datos de nivel N y en donde el paso de procesamiento comprende el paso de decodificar los datos de primero y segundo nivel N basándose en las diferentes tasas de codificación indicadas en el mapa

8 El método de la reivindicación 1 en donde los primeros datos del nivel N comprenden primero datos VSB 8

robustos y en donde los segundos datos de nivel N comprenden segundos datos VSB 8 robustos

9 El método de la reivindicación 1 en donde los primeros datos de nivel N comprenden datos VSB 8 robustos y en donde los datos del segundo nivel N comprenden datos ATSC

10 El método de la reivindicación 1 que comprende además el paso de correlacionar transmisiones múltiples del mapa

11 El método de la reivindicación 1 en donde la señal digital comprende además terceros datos de nivel N, en donde el mapa contiene información que indica que los primeros datos de nivel N han sido codificados externamente a una primera tasa de codificación, que los segundos datos de nivel N han sido codificados externamente a una segunda tasa de codificación y que los terceros datos de nivel N han sido codificados externamente a una tercera tasa de decodificación, en donde el mapa comprende primeras, segundas y terceras porciones, en donde la primera porción indica dónde se pueden encontrar en la trama de datos los primeros datos de nivel N, en donde la segunda porción indica dónde se pueden encontrar en la trama de datos los segundos datos de

nivel N, y en donde la tercera porción dónde se pueden encontrar en la trama de datos los terceros datos de nivel N

12 El método de la reivindicación 11 en donde el mapa comprende cincuenta y cuatro símbolos, en donde la primera porción comprende los primeros diez y ocho de los cincuenta y cuatro símbolos, en donde la segunda porción comprende unos segundos diez y ocho símbolos diferentes de los cincuenta y cuatro símbolos, y en donde la tercera porción comprende unos terceros diez y ocho símbolos diferentes de los cincuenta y cuatro símbolos

13 El método de la reivindicación 12 en donde los primeros, segundos y terceros diez y ocho símbolos comprenden cada uno

seis símbolos designados como G que indican dónde se pueden encontrar en la trama de datos los correspondientes primeros, segundos y terceros datos de nivel N,

seis símbolos que designan y completan la G, y

seis símbolos no especificados

14 El método de la reivindicación 13 en donde la trama de datos comprende una trama ATSC que tiene un segmento sincronizado de trama en donde dicho segmento contiene doce

símbolos precodificados y en donde el mapa está contenido en el segmento sincronizado de trama de la trama ATSC justamente antes de los doce símbolos de precodificación

15 El método de la reivindicación 11 en donde la primera, segunda y tercera porciones comprenden cada una

los primeros símbolos designados como G que indican dónde se pueden encontrar en la trama de datos los correspondientes primeros, segundos y terceros datos de nivel N,

segundos símbolos que designan el complemento de G, y

terceros símbolos no especificados

16 El método de la reivindicación 11 en donde la trama de datos contiene segmentos de datos m, en donde la primer porción del mapa comprende un primer número de cero a n indicando un primer subconjunto de los segmentos de datos m que contienen todos los primeros datos de nivel N, en donde la segunda porción del mapa comprende un segundo número de cero a n que indica un segundo subconjunto de los segmentos de datos m que contienen la totalidad de los segundos datos de nivel N, en donde la tercera porción del mapa comprende un tercer número entre cero y n que indica un tercer subconjunto

de los segmentos de datos m que contiene la totalidad de los terceros de datos de nivel N, en donde el primer número más el segundo número más el tercer número es inferior o igual a n y en donde n se puede dividir sin fracciones en m

17 El método de la reivindicación 1 que comprende además el paso de mantener un conteo relacionado al momento en que el mapa va a cambiar

18 El método de la reivindicación 1 en donde la trama de datos contiene segmentos de datos m, en donde el mapa designa una pluralidad predeterminada de los segmentos de datos, y en donde la totalidad de los primeros datos de nivel N está contenida en segmentos predeterminados

19 El método de la reivindicación 18 en donde el mapa comprende un número de cero a n, en donde n se puede dividir sin fracciones en m

20 El aparato de la reivindicación 19 en donde n es 39

21 El aparato de la reivindicación 20 en donde, si el mapa contiene el número 39, los segmentos de datos m contienen solamente los primeros datos de nivel N.

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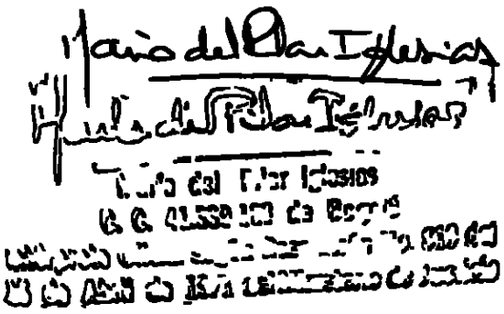
22 El método de la reivindicación 1 en donde el paso de procesamiento comprende el paso de descartar los primeros datos de nivel N sobre la base de números PID

23 El método de la reivindicación 1 en donde el paso de procesamiento contiene el paso de descartar los primeros datos de nivel N sobre la base del mapa

24 El método de la reivindicación 1 en donde el paso de procesamiento comprende los siguientes pasos

descartar los primeros datos de nivel N sobre la base de los números PID, y

descartar los segundos datos de nivel N sobre la base del mapa



CLAIMS

1 A method of receiving and processing a electrical signal, the method being CHARACTERIZED by the following steps

receiving an electrical signal containing symbols representing first and second N level data, wherein each of the symbols representing the first N level data correspond to a first number of data bits, wherein each of the symbols representing the second N level data correspond to a second number of data bits, wherein the first and second numbers of data bits are unequal, and wherein the first and second N level data have the same constellation, and,

discarding one of the first and second N level data

2 The method of claim 1 wherein the first N level data comprises robust 8 VSB data, and wherein the second N level data comprises ATSC data

3 The method of claim 1 wherein the first N level data comprises first robust 8 VSB data, and wherein the second N level data comprises second robust 8 VSB data

4 The method of claim 1 wherein the received electrical signal contains a data frame comprising a plurality of ATSC data segments, wherein the data frame contains the first and second N level data, wherein the data frame further contains third N level data, wherein the first, second, and third N level data have the same constellation and different bit rates, wherein one complete Reed/Solomon block of the first N level data is packed into two complete ATSC data segments, wherein one complete Reed/Solomon block of the second N level data is packed into four complete ATSC data segments, and wherein three complete Reed/Solomon blocks of the third N level data are packed into four complete ATSC data segments

5 The method of claim 1 wherein the discarding step comprises the following steps

inner decoding the received electrical signal to recover the first and second N level data,

discarding the recovered first N level data, and,

outer decoding the second N level data

6 The method of claim 5 wherein the step of discarding the recovered first N level data comprises the step of discarding the recovered first N level data on the basis of a map

7 The method of claim 1 wherein the first N level data comprises normally ordered robust VSB data, wherein the second N level data comprises reordered ATSC data, and wherein the discarding step comprises the step of discarding the ATSC data

8 The method of claim 1 wherein the first N level data comprises normally ordered robust VSB data, wherein the second N level data comprises reordered ATSC data, and wherein the discarding step comprises the step of discarding the robust VSB data

9 The method of claims 7 or 8 wherein the discarding step further comprises the step of discarding transport headers and Reed/Solomon parity data

10 The method of claim 8 wherein the step of discarding the robust VSB data comprises the step of discarding the robust VSB data based upon PID numbers

11 The method of claim 1 wherein the discarding step comprises the step of discarding the one of the first and second N level data based upon a user selection

12 The method of claim 1 wherein the first N level data comprises outer coded first N level data, wherein the received electrical signal includes an ATSC frame having a plurality of ATSC segments, and wherein the ATSC segments comprises

a non-outer coded ATSC transport header,

non-outer coded ATSC Reed/Solomon parity data, and,

the outer coded first N level data

13 The method of claim 12 wherein the discarding step comprises the step of deinterleaving the received electrical signal such that the outer coded first N level data occurs between the non-outer coded ATSC transport header and the non-outer coded ATSC Reed/Solomon parity data in each of the ATSC segments

14 The method of claim 12 wherein the discarding step comprises the step of deinterleaving the received electrical signal such that the outer coded first N level data are packed into Reed/Solomon blocks each containing the first N level data and Reed/Solomon parity data, wherein K complete Reed/Solomon blocks are packed into L complete ATSC segments, wherein K is an odd integer ≤ 3, and wherein L is an even integer ≤ 4

15 The method of claim 1 wherein the received electrical signal contains a map, wherein the first and second N level data are intermixed in a data frame, wherein the map contains information indicating a location of at least one of the first and second N level data in the data frame, and wherein the one of the first and second N level data is discarded in accordance with the map

16 The method of claim 15 wherein the received electrical signal contains a duplicate of the map

17 The method of claim 16 wherein the data frame comprises an ATSC frame having a frame sync segment and multiple data segments, wherein the map is contained in the frame sync segment, and wherein the duplicate of the map is contained in one of the data segments

18 The method of claims 15, 16, or 17 wherein the received electrical signal also contains data indicating when in the future the map will change

19 The method of claims 15, 16, or 17 wherein the received electrical signal also contains a new map to be transmitted in the future

20 The method of claim 19 wherein the received electrical signal also contains data indicating when in the future the new map will be transmitted

21 The method of claim 15 wherein the map contains information indicating the coding rates of the first and second N level data so that the first and second N level data can be decoded based upon the different coding rates indicated by the map

22 The method of claim 15 wherein the first N level data comprises first robust 8 VSB data, and wherein the second N level data comprises second robust 8 VSB data

23 The method of claim 15 wherein the first N level data comprises robust 8 VSB data, and wherein the second N level data comprises ATSC data

24 The method of claim 15 further comprising the step of correlating multiple transmissions of the map

25 The method of claim 15 wherein the electrical signal further comprises symbols representing

third N level data, wherein each of the symbols representing the third N level data correspond to a third number of data bits, wherein the first, second, and third numbers of data bits are unequal, wherein the map contains information indicating that the first N level data have been outer coded at a first coding rate, that the second N level data have been outer coded at a second coding rate, and that the third N level data have been outer coded at a third coding rate, and wherein the map indicates where in the data frame the first, second, and third N level data can be found

26 The method of claim 25 wherein the map comprises a first eighteen symbols, a second different eighteen symbols, and a third different eighteen symbols, and wherein the first, second, and third eighteen symbols each comprise

six symbols designated as G indicating where in the data frame the corresponding first, second, and third N level data can be found,

six symbols designating the complement of G, and,

six unspecified symbols

27 The method of claim 26 wherein the data frame comprises an ATSC frame having a frame sync

segment, wherein the frame sync segment contains twelve precoding symbols, and wherein the map is contained in the frame sync segment of the ATSC frame just before the twelve precoding symbols

28 The method of claim 25 wherein the data frame contains m data segments, wherein the first portion of the map comprises a first number from zero to n indicating a first subset of the m data segments containing all of the first N level data, wherein the second portion of the map comprises a second number from zero to n indicating a second subset of the m data segments containing all of the second N level data, wherein the third portion of the map comprises a third number from zero to n indicating a third subset of the m data segments containing all of the third N level data, wherein the first number plus the second number plus the third number is less than or equal to n, and wherein n is evenly divisible into m

29 The method of claim 15 further comprising the step of maintaining a count related to when the map will change

30 The method of claim 15 wherein the data frame contains m data segments, wherein the map comprises

a number from zero to n, and wherein n is evenly divisible into m

31 The apparatus of claim 30 wherein n is 39

32 The apparatus of claim 31 wherein, if the map contains the number 39, the m data segments contain only the first N level data

33 The method of claim 15 wherein the processing step comprises the step of discarding the first N level data on the basis of PID numbers

34 The method of claim 15 wherein the processing step comprises the step of discarding the first N level data on the basis of the map

35 The method of claim 15 wherein the processing step comprises the following steps

discarding the first N level data on the basis of PID numbers, and,

discarding the second N level data on the basis of the map

36 A method for transmitting a digital signal comprising

providing first and second streams of digital data,

reordering the digital data of the first stream of digital data in accordance with a first interleave to provide a third stream of digital data, and,

reordering the digital data of the second and third streams of digital data in accordance with a second interleave comprising an inverse of the first interleave to provide a time multiplexed output comprising the second stream of digital data reordered according to the second interleave and the third stream of digital data reordered to reflect the order of the first stream of digital data

37 The method of claim 36 wherein the digital data in the first stream of digital data are robust VSB data, and wherein the digital data in the second stream of digital data are ATSC data

38 The method of claim 36 wherein the reordering of the digital data of the first stream of digital data comprises

providing dummy first stream digital data,

replacing the dummy first stream digital data with digital data of the first stream of digital data, and,

reordering the digital data of the first stream of digital data in accordance with the first interleave

39 The method of claim 36 wherein the reordering of the digital data of the first stream of digital data comprises

providing dummy first stream digital data and dummy second stream digital data,

replacing the dummy first stream digital data with digital data of the first stream of digital data,

reordering the digital data of the first stream of digital data and the dummy second stream digital data in accordance with the first interleave to provide the third stream of digital data, and,

wherein the reordering of the digital data of the second and third streams of digital data comprises

replacing the reordered dummy second stream digital data in the third stream of digital data with digital data of the second stream of digital data, and,

reordering the digital data of the second and third streams of digital data in accordance with the second interleave

40 The method of claim 36 wherein the data of the first stream of digital data are robust VSB data, wherein the reordering of the digital data of the first stream of digital data comprises

providing a source of dummy VSB data and dummy ATSC data,

replacing the dummy VSB data with the robust VSB data, and,

reordering the robust VSB data and the dummy ATSC data in accordance with the first interleave to provide the third stream of digital data, and,

wherein the reordering of the digital data of the second and third streams of digital data comprises

replacing the dummy ATSC data in the third stream with real ATSC data, and,

reordering the robust VSB data and the real ATSC data in accordance with the second interleave

41 The method of claim 40 wherein the replacing of the dummy ATSC data in the third stream with real ATSC data comprises

discarding the dummy ATSC data, and,

multiplexing the robust VSB data and the real ATSC data

REIVINDICACIONES

1 Un método de recibir y procesar una señal eléctrica, método éste que se CARACTERIZA por los siguientes pasos

recibir una señal eléctrica que contiene símbolos que representan primeros y segundos datos de nivel N, en donde cada uno de los símbolos que representa los primeros datos del nivel N corresponde a un primer número de bits de datos, en donde cada uno de los símbolos que representa los segundos datos de nivel N corresponde a un segundo número de bits de datos, en donde los primeros y segundos números de los bits de datos no son iguales y en donde los primeros y segundos datos de nivel N tienen la misma constelación, y

descartar uno de los primeros y segundos datos de nivel N

2 El método de la reivindicación 1 en donde los primeros datos de nivel N comprenden datos robustos de 8 VSB y en donde los segundos datos de nivel N comprenden datos de ATSC

3 El método de la reivindicación 1 en donde los primeros datos de nivel N comprenden los primeros datos

robustos de 8 VSB, y en donde los segundos datos de nivel N comprenden los segundos datos robustos de 8 VSB

4 El método de la reivindicación 1 en donde la señal eléctrica recibida contiene una trama de datos que comprende una pluralidad de segmentos de datos ATSC, en donde la trama de datos contiene los primeros y segundos datos de nivel N, en donde la trama de datos contiene además terceros datos de nivel N, en donde los primeros, segundos y terceros datos de nivel N tienen la misma constelación y diferentes tasas de bits, en donde un bloque completo Reed/Solomon de los primeros datos de nivel N está empacado en dos segmentos de datos completos ATSC, en donde un bloque completo Reed/Solomon de los segundos datos de nivel N está empacado en cuatro segmentos completos de datos ATSC, y en donde tres bloques completos Reed/Solomon de los terceros datos de nivel N están empacados en cuatro segmentos completos de datos ATSC

5 El método de la reivindicación 1 en donde el paso de descarte comprende los siguientes pasos

decodificar internamente la señal eléctrica recibida para recuperar los primeros y segundos datos de nivel N,

descartar los primeros datos recuperados de nivel N, y

decodificar externamente los segundos datos de nivel N

6 El método de la reivindicación 5 en donde el paso de descartar los primeros datos recuperados de nivel N comprende el paso de descartar los primeros datos recuperados de nivel N sobre la base de un mapa

7 El método de la reivindicación 1 en donde los primeros datos de nivel N comprenden datos VSB robustos normalmente ordenados, en donde los segundos datos de nivel N comprenden datos ATSC reordenados y en donde el paso de descarte comprende el descarte de datos ATSC

8 El método de la reivindicación 1 en donde los primeros datos de nivel N comprenden datos VSB robustos normalmente ordenados, en donde los segundos datos del nivel N comprenden datos ATSC reordenados y en donde el paso de descarte comprende el paso de descartar los datos VSB robustos

9 El método de las reivindicaciones 7 u 8 en donde el paso de descarte comprende además el paso de descartar cabeceras de transporte y datos de paridad Reed/Solomon

10 El método de la reivindicación 8 en donde el paso de descartar los datos VSB robustos comprende el paso de descartar los datos VSB robustos basados en los números PID

11 El método de la reivindicación 1 en donde el paso de descartar comprende el paso de descartar el uno de los primeros y segundos datos de nivel N basándose en una selección del usuario

12 El método de la reivindicación 1 en donde los primeros datos de nivel N comprenden los primeros datos de nivel N codificados externamente, en donde la señal eléctrica recibida incluye una trama ATSC que tiene una pluralidad de segmentos ATSC y en donde los segmentos ATSC comprenden

una cabecera de transporte ATSC codificada no externa,

datos de paridad codificados no externos ATSC Reed/Solomon, y

los primeros datos de nivel N codificados externamente

13 El método de la reivindicación 12 en donde el paso de descarte comprende el paso de desintercalar la señal

eléctrica recibida de manera que los primeros datos de nivel N codificados externamente ocurran entre la cabecera de transporte ATSC codificada no externa y los datos de paridad Reed/Solomon ATSC codificados no externos en cada uno de los segmentos de ATSC

14 El método de la reivindicación 12 en donde el paso de descarte comprende el paso de desintercalar la señal eléctrica recibida de manera que los primeros datos de nivel N codificados externamente estén empacados en bloques Reed/Solomon que contengan cada uno los primeros datos de nivel N y los datos de paridad Reed/Solomon, en donde bloques completos K Reed/Solomon se empacan en segmentos L completos ATSC, en donde K es un número entero impar $\leq$ 3, y en donde L es un número entero par $\leq$ 4

15 El método de la reivindicación 1 en donde la señal eléctrica recibida contiene un mapa, en donde los datos de primero y segundo nivel N están entremezclados en una trama de datos, en donde el mapa contiene información que indica una localización de por lo menos uno de los primeros y segundos datos de nivel uno en la trama de datos, y en donde el uno de los primeros y segundos datos de nivel N se descarta de conformidad con el mapa

16 El método de la reivindicación 15 en donde la señal eléctrica recibida contiene un duplicado del mapa

17 El método de la reivindicación 16 en donde la trama de datos comprende una trama ATSC que tiene un segmento sincronizado de trama y múltiples segmentos de datos, en donde el mapa está contenido en el segmento de trama sincronizado, y en donde el duplicado del mapa está contenido en uno de los segmentos de datos

18 El método de las reivindicaciones 15, 16 o 17 en donde la señal eléctrica recibida también contiene datos que indican cuándo cambiará en el futuro el mapa

19 El método de las reivindicaciones 15, 16 o 17 en donde la señal eléctrica recibida también contiene un nuevo mapa para ser transmitido en el futuro

20 El método de la reivindicación 19 en donde la señal eléctrica recibida también contiene datos que indican cuándo en el futuro se transmitirá el nuevo mapa

21 El método de la reivindicación 15 en donde el mapa contiene información que indica las tasas de codificación de los primeros y segundos datos de nivel N de manera que ambos

puedan ser decodificados basándose en las diferentes tasas de codificación indicadas por el mapa

22 El método de la reivindicación 15 en donde los primeros datos de nivel N comprenden primeros datos 8 VSB robustos y en donde los segundos datos de nivel N comprenden segundos datos robustos 8 VSB.

23 El método de la reivindicación 15 en donde los primeros datos de nivel N comprenden datos robustos 8 VSB y en donde los segundos datos de nivel N comprenden datos ATSC

24 El método de la reivindicación 15 que comprende además el paso de correlacionar transmisiones múltiples del mapa

25 El método de la reivindicación 15 en donde la señal eléctrica comprende además símbolos que representan terceros datos de nivel N, en donde cada uno de los símbolos que representan los terceros datos de nivel N corresponden a un tercer número de bits de datos en donde los primeros, segundos y terceros números de bits de datos no son iguales, en donde el mapa contiene información que indica que los primeros datos de nivel N han sido codificados externamente a una primera rata de codificación, que los segundos datos de

nivel N han sido codificados externamente a una segunda tasa de codificación, y que los terceros datos de nivel N han sido codificados externamente a una tercera tasa de codificación, y en donde el mapa indica dónde se pueden encontrar en la trama de datos los primeros, segundos y terceros datos de nivel N

26 El método de la reivindicación 25 en donde el mapa comprende unos primeros diez y ocho símbolos, unos segundos diez y ocho símbolos diferentes, y unos terceros diez y ocho símbolos diferentes, en donde los primeros, segundos y terceros diez y ocho símbolos comprenden cada uno

seis símbolos designados como G que indican dónde se pueden encontrar en la trama de datos los correspondientes primeros, segundos y terceros datos de nivel N,

seis símbolos que designan el complemento de G, y

seis símbolos no especificados

27 El método de la reivindicación 26 en donde la trama de datos comprende una trama ATSC que tiene un segmento de trama sincronizado, en donde dicho segmento contiene doce símbolos de precodificación y en donde el mapa está contenido

en el segmento de trama sincronizado de la trama ATSC justamente antes de los doce símbolos de precodificación

28 El método de la reivindicación 25 en donde la trama de datos contiene segmentos de datos m, en donde la primera porción del mapa comprende un primer número de cero a n que indica un primer subconjunto de los segmentos de datos m que contiene la totalidad de los primeros datos de nivel N, en donde la segunda porción del mapa comprende un segundo número de cero a n que indica un segundo subconjunto de los segmentos de datos m que contiene la totalidad de los segundos datos de nivel N, en donde la tercera porción del mapa comprende un tercer número de cero a n que indica un tercer subconjunto de los segmentos de datos m que contiene la totalidad de los datos del tercer nivel N, en donde el primer número más el segundo número más el tercer número es inferior o igual a n, y en donde n se puede dividir por m sin que queden fracciones

29 El método de la reivindicación 15 que comprende además el paso de mantener un conteo que se relaciona con el momento en que el mapa va a cambiar

30 El método de la reivindicación 15 en donde la trama de datos contiene segmentos de datos m, en donde el mapa

comprende un número de cero a n y en donde n se puede dividir por m sin que queden fracciones

31 El aparato de la reivindicación 30 en donde n es 39

32 El aparato de la reivindicación 31 en donde, si el mapa contiene el número 39, los segmentos de datos m contienen solamente los primeros datos de nivel N

33 El método de la reivindicación 15 en donde el paso de procesamiento comprende el paso de descartar los primeros datos de nivel N sobre la base de números PID

34 El método de la reivindicación 15 en donde el paso del proceso comprende el paso de descartar los primeros datos de nivel N sobre la base del mapa

35 El método de la reivindicación 15 en donde el paso del proceso comprende los siguientes pasos

descartar los primeros datos de nivel N sobre la base de los números PID, y

descartar los segundos datos de nivel N sobre la base del mapa

36 Un método para transmitir una señal digital que comprende

proporcionar un primero y segundo flujo de datos digitales,

reordenar los datos digitales del primer flujo de datos digitales de conformidad con una primera intercalación para proporcionar un tercer flujo de datos digitales, y

reordenar los datos digitales del segundo y tercer flujo de datos digitales de conformidad con una segunda intercalación que comprende un inverso de la primera intercalación para proporcionar una salida de tiempo multiplexada que comprende el segundo flujo de datos digitales reordenados conforme a la segunda intercalación y el tercer flujo de datos digitales reordenados para reflejar el orden del primer flujo de datos digitales

37 El método de la reivindicación 36 en donde los datos digitales del primer flujo de datos digitales son datos VSB robustos y en donde los datos digitales del segundo flujo de datos digitales son datos ATSC

38 El método de la reivindicación 36 en donde la reordenación de los datos digitales del primer flujo de datos digitales comprende

proporcionar datos digitales simulados del primer flujo,

reemplazar los datos digitales simulados del primer flujo por datos digitales del primer flujo de datos digitales, y

reordenar los datos digitales del primer flujo de datos digitales de conformidad con la primera intercalación

39 El método de la reivindicación 36 en donde la reordenación de los datos digitales del primer flujo de datos digitales comprende

proporcionar un primer flujo de datos digitales simulados y un segundo flujo de datos digitales simulados,

reemplazar el primer flujo de datos digitales simulados por los datos digitales del primer flujo de datos digitales,

reordenar los datos digitales del primer flujo de datos digitales y el segundo flujo de datos digitales *simulados* de conformidad con la primera intercalación para proporcionar el tercer flujo de datos digitales, y

en donde la reordenación de los datos digitales del segundo y tercer flujo de datos digitales comprende

reemplazar el segundo flujo de datos digitales simulados reordenados en el tercer flujo de datos digitales por datos digitales del segundo flujo de datos digitales, y

reordenar los datos digitales del segundo y tercer flujo de datos digitales de conformidad con la segunda intercalación

40 El método de la reivindicación 36 en donde los datos del primer flujo de datos digitales son datos VSB robustos, en donde la reordenación de los datos digitales del primer grupo de datos digitales comprende

proporcionar una fuente de datos VSB simulados y datos ATSC simulados,

reemplazar los datos VSB simulados con los datos VSB robustos, y

reordenar los datos VSB robustos y los datos ATSC simulados de conformidad con la primera intercalación para proporcionar un tercer flujo de datos digitales, y

en donde la reordenación de los datos digitales del segundo y tercer flujo de datos digitales comprende

reemplazar los datos ATSC simulados del tercer flujo por datos ATSC reales, y

reordenar los datos VSB robustos y los datos ATSC reales de conformidad con la segunda intercalación

41 El método de la reivindicación 40 en donde el reemplazo de los datos ATSC simulados en el tercer flujo por datos ATSC reales comprende

descartar los datos ATSC simulados, y

multiplexar los datos VSB robustos y los datos ATSC reales

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Intérprete Oficial según Resolución No. 819 del
15 de Abril de 1971 del Ministerio de Justicia

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Industria y Com rcio

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***** C O N S I G N A C I O N *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No PAGO	FECHA PGO	Vr PAGO
[redacted] CARDENAS Y CARDENAS P I	CONSIGNACION	BANCO POPULAR	050-00110-6	3163918	08/10/2002	2,951,000 00

***** C O N C E P T O *****

CANT	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-01 SOLICITUDES	1 TRAMITES DE SOL DE PATENTE DE IN	378,000 00
		TOTAL : $	378,000 00

SON: TRESCIENTOS SETENTA Y OCHO MIL PESOS

[redacted]

RESPO[redacted]LE _____

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PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty

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International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* 29471/36995

Box No. I TITLE OF INVENTION
MAPPING ARRANGEMENT FOR DIGITAL COMMUNICATION SYSTEM

Box No. II APPLICANT

Name and address: *(Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*
ZENITH ELECTRONICS CORPORATION
2000 Millbrook Drive
Lincolnshire Illinois 60069
United States of America

☐ This person is also inventor

Telephone No.
847/941-8018

Facsimile No.
847/941-8003

Teleprinter No.

State *(that is, country)* of nationality
US

State *(that is, country)* of residence
US

This person is applicant for the purposes of: ☒ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*
FIMOFF, Mark
1020 Concord Lane
Hoffman Estates, Illinois 60195
United States of America

This person is:
☐ applicant only
☐ applicant and inventor
☒ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE, OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country.)*
JOIKE, Trevor B.
MARSHALL O'TOOLE, GERSTEIN MURRAY & BORUN
6300 Sears Tower
233 S Wacker Drive
Chicago, Illinois 60606
United States of America

Telephone No.
312/474-6300

Facsimile No.
312/474-0448

Teleprinter No.

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*

Regional Patent

☒ **AP** ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ **EA** Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian

☒ **EP** European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA** OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)*

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*

☒	AE United Arab Emirates	☒	LC Saint Lucia
☒	AG Antigua and Barbuda	☒	LK Sri Lanka
☒	AL Albania	☒	LR Liberia
☒	AM Armenia	☒	LS Lesotho
☒	AT Austria	☒	LT Lithuania
☒	AU Australia	☒	LU Luxembourg
☒	AZ Azerbaijan	☒	LV Latvia
☒	BA Bosnia and Herzegovina	☒	MA Morocco
☒	BB Barbados	☒	MD Republic of Moldova
☒	BG Bulgaria	☒	MG Madagascar
☒	BR Brazil	☒	MK The former Yugoslav Republic of Macedonia
☒	BY Belarus	☒	MN Mongolia
☒	BZ Belize	☒	MW Malawi
☒	CA Canada	☒	MX Mexico
☒	CH and LI Switzerland and Liechtenstein	☒	MZ Mozambique
☒	CN China	☒	NO Norway
☒	CR Costa Rica	☒	NZ New Zealand
☒	CU Cuba	☒	PL Poland
☒	CZ Czech Republic	☒	PT Portugal
☒	DE Germany	☒	RO Romania
☒	DK Denmark	☒	RU Russian Federation
☒	DM Dominica	☒	SD Sudan
☒	DZ Algeria	☒	SE Sweden
☒	EE Estonia	☒	SG Singapore
☒	ES Spain	☒	SI Slovenia
☒	FI Finland	☒	SK Slovakia
☒	GB United Kingdom	☒	SL Sierra Leone
☒	GD Grenada	☒	TJ Tajikistan
☒	GE Georgia	☒	TM Turkmenistan
☒	GH Ghana	☒	TR Turkey
☒	GM Gambia	☒	TT Trinidad and Tobago
☒	HR Croatia	☒	TZ United Republic of Tanzania
☒	HU Hungary	☒	UA Ukraine
☒	ID Indonesia	☒	UG Uganda
☒	IL Israel	☐	US United States of America
☒	IN India	☒	UZ Uzbekistan
☒	IS Iceland	☒	VN Viet Nam
☒	JP Japan	☒	YU Yugoslavia
☒	KE Kenya	☒	ZA South Africa
☒	KG Kyrgyzstan	☒	ZW Zimbabwe
☒	KP Democratic People's Republic of Korea		
☒	KR Republic of Korea		Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet.
☒	KZ Kazakhstan	☒	CO Colombia

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fee) must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application country	regional application * regional Office	international application receiving Office
item (1) 18 April 2000 (18.04.00)	60/198 014	US		
item (2) 13 December 2000 (13.12.00)	60/255,476	US		
item (3) 13 March 2001 (13.03.01)	Unassigned	US		

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s) 1, 2 & 3

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen, the two-letter code may be used)*

ISA/EP

Request to use results of earlier search, reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority).*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST· LANGUAGE OF FILING

This international application contains the following number of sheets.	
request	3
description (excluding sequence listing part)	46
claims	8
abstract	1
drawings	12
sequence listing part of description	
Total number of sheets	70

This international application is accompanied by the item(s) marked below·

1 ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3 ☒ copy of general power of attorney; reference number if any·
4. ☐ statement explaining lack of signature
5 ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7 ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9 ☒ other *(specify)* postcard

Figure of the drawings which should accompany the abstract:

Language of filing of the international application. English

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

By Trevor B Jolley

For receiving Office use only

1 Date of actual receipt of the purported international application.		2 Drawings. ☐ received ☐ not received
3 Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application		
4. Date of timely receipt of the required corrections under PCT Article 11(2)		
5 International Searching Authority (if two or more are competent): ISA/	6 ☐ Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only

Date of receipt of the record copy by the International Bureau.

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This sheet is not part of and does not count as a sheet of the international application.

PCT

FEE CALCULATI N SHEET

Annex to the Request

For receiving Office use only

International application No.

Date stamp of the receiving Office

Applicant's or agent's file reference: 29471/36895

Applicant: ZENITH ELECTRONICS CORPORATION

CALCULATION OF PRESCRIBED FEES

1 TRANSMITTAL FEE — 240.00 T

2. SEARCH FEE — 848.00 S

International search to be carried out by: EP

(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3 INTERNATIONAL FEE

Basic Fee

The international application contains 79 sheets.

first 30 sheets — 382.00 b1

40 remaining sheets x $8.00 additional amount = 360.00 b2

Add amounts entered at b1 and b2 and enter total at B — 742.00 B

Designation Fees

The international application contains 87 designations.

6 number of designation fees payable *(maximum 6)* x 82.00 amount of designation fee = 492.00 D

Add amounts entered at B and D and enter total at I — 1,234.00 I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the

4. FEE FOR PRIORITY DOCUMENT *(If applicable)* — P

5 TOTAL FEES PAYABLE

Add amounts entered at T, S, I and P and enter total in the TOTAL box — 2,320.00 TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ authorization to charge deposit account (see below)	☐ bank draft	☐ coupons
☒ cheque	☐ cash	☐ other *(specify)*
☐ postal money order	☐ revenue stamps	

DEPOSIT ACCOUNT AUTHORIZATION *(this mode of payment may not be available at all receiving Offices)*

The RO/ US ☐ is hereby authorized to charge the total fees indicated above to my deposit account.

☒ *(this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit)* is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☒ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

Deposit Account No.	Date *(day/month/year)*	Signature
13-2855	27/03/01	

PATENT COOPERATION TREATY

General Appointment of Agent

The undersigned applicant appoints

Trevor B Jorke
MARSHALL, O'TOOLE, GERSTEIN,
MURRAY & BORUN
6300 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6402
United States of America
(312) 474-6300

as agent, to act on its behalf before the competent International Authorities in connection with any and all international applications filed by it and of which it is the sole applicant

Date October 13, 1997

Zenith Electronics Corporation
a Delaware corporation
1000 Milwaukee Avenue
Glenview, Illinois 60025
U S A

By _____
Name Richard F Vitkus
Title Secretary

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To

TREVOR B JOIKE
MARSHALL O TOOLE GERSTEIN MURRAY & BORUN
6300 SEARS TOWER 233 S WACKER DRIVE
CHICAGO IL 60606

PCT

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20 5(c))

Date of mailing (day/month/year)	24 APR 2001
Applicant's or agent's file reference: 29471/36995	IMPORTANT NOTIFICATION

International application No	International filing date (day/month/year)	Priority date (day/month/year)
PCT/US01/09733	27 MAR 01	18 APR 00

Applicant: ZENITH ELECTRONICS CORPORATION

Title of the invention: MAPPING ARRANGEMENT FOR DIGITAL COMMUNICATION SYSTEM

1 The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above

2 The applicant is further notified that the record copy of the international application.

[X] was transmitted to the International Bureau on 24 APR 2001

[ ] has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*

[ ] because the necessary national security clearance has not yet been obtained.

[ ] because (*reason to be specified*):

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22 1(c)).

3 FOREIGN TRANSMITTAL LICENSE INFORMATION Completed by

[ ] Additional license for foreign transmittal not required This subject matter is covered by a license already granted on the equivalent U.S. national application. Refer to that license for information concerning its scope.

[ ] License for foreign transmittal not required 37 CFR 5 11(a)(1) or 37 CFR 5 11(a)(2). However a license may be required for additional subject matter See 37 CFR 5 15(b).

[X] Foreign transmittal license granted. 35 U.S C 184, 37 CFR 5 11 on April 2001 (date)

[X] 37 CFR 5 15(a) [ ] 37 CFR 5 15(b)

Name and mailing address of the receiving Office Assistant Commissioner for Patents Box PCT Washington, D C 20231 Attn RO/US Facsimile No.	Authorized officer PCT Operations - IAPD Team 1 305-3747 (703) 305-3230 (FAX) Telephone No

Form PCT/RO/105 (July 1992)

/33

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To

TREVOR B JOIKE
MARSHALL O TOOLE GERSTEIN MURRAY & BORUN
6300 SEARS TOWER 233 S WACKER DRIVE
CHICAGO IL 60606

PCT

NOTIFICATION CONCERNING PAYMENT OF PRESCRIBED FEES

(PCT Rules 14, 15 and 16 and Administrative Instructions, Sections 304(a) and (b) and 323(b))

Date of mailing (day/month/year)	24 APR 2001
Applicant's or agent's file reference: 29471/36995	PAYMENT DUE: See item 3 for time limits

International application No	International filing date/Date of receipt (day/month/year)	Priority date (day/month/year)
PCT/US01/09733	27 MAR 01	18 APR 00

Applicant: ZENITH ELECTRONICS CORPORATION

1 The applicant is hereby notified that this receiving Office has received

☒ the payment of all the prescribed fees, and ☐ an overpayment, which will be refunded in due course

☐ no or insufficient payment of the prescribed fees and the applicant is hereby invited to pay the balance due, as summarized under item 2, within the time limit(s) indicated under item 3

2 Fees and payment calculation:

Total fees payable	-	Amount paid	=	Balance
_____		_____		_____

☐ The details of the calculation are given in the Annex.

3 Time limit(s) for payment and amount(s) payable (Rules 14.1, 15.4 and 16.1(f)):

☐ within ONE MONTH from the date of receipt of the international application (for the transmittal fee (if any), the search fee, the basic fee and the designation fee). The amount payable for each fee is the amount applicable on the date of receipt of the international application.

☐ within ONE YEAR from the priority date (only for the designation fee and only if this time limit expires later than the above time limit)
—If the designation fee is paid within one month from the date of receipt of the international application, the amount payable is the amount applicable on that date of receipt.
—If the designation fee is paid within one year from the priority date but later than one month from the date of receipt of the international application, the amount payable is the amount applicable on the date of payment. The receiving Office should be consulted for the applicable amount.

☐ within 16 MONTHS from the priority date (only for the fee for priority document). The applicant's attention is drawn to the fact that the request made by the applicant under Rule 17.1(b) will be considered not to have been made unless the fee is paid within that time limit.

4 Additional observations (if necessary):

☐ The search copy will not be transmitted to the International Searching Authority until the search fee is paid (therefore the start of the international search will be delayed)(Rule 23.1(a) and (b))

Name and mailing address of the receiving Office: Assistant Commissioner for Patents, Box PCT, Washington, D.C. 20231 Attn: RO/US	Authorized officer: Cynthia Fridie, PCT Operations - IAPD Team 1
Facsimile No.	Telephone No. (703) 305-3230 (FAX)

Form PCT/RO/102 (January 1999)

v

PATENT COOPERATION TREATY

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From the RECEIVING OFFICE

To

TREVOR B JOIKE
MARSHALL O TOOLE GERSTEIN MURRAY & BORUN
6300 SEARS TOWER 233 S WACKER DRIVE
CHICAGO IL 60606

PCT

INVITATION TO CORRECT DEFECTS IN THE INTERNATIONAL APPLICATION

(PCT Articles 3(4)(i) and 14(1) and Rule 26)

Applicant s or agent s file reference: 29471/36995	Date of mailing (day/month/year): 24 APR 2001
International application No: PCT/US01/09733	REPLY DUE within ONE MONTH from the above date of mailing
Applicant: ZENITH ELECTRONICS CORPORATION	International filing date (day/month/year): 27 MAR 01

DOCKETED 5/24/01

1 [X] The applicant is hereby invited within the time limit indicated above to correct, in the international application as filed, the defects specified on the attached

- [X] Annex A
- [ ] Annex B1 *(text matter of the international application as filed)*
- [ ] Annex C1 *(drawings of the international application as filed)*

2 [ ] The applicant is hereby invited, within the time limit indicated above, to correct, in the translation of the international application furnished under Rule 12 3, the defects specified on the attached

- [ ] Annex A
- [ ] Annex B2 *(text matter of the translation of the international application)*
- [ ] Annex C2 *(drawings of the translation of the international application)*

Additional observations (if necessary):

HOW TO CORRECT THE DEFECTS?

Correction must be submitted by filing a replacement sheet embodying the correction and a letter accompanying the replacement sheet, which shall draw attention to the difference between the replaced sheet and the replacement sheet. A correction may be stated in a letter only if it is of such a nature that it can be transferred from the letter to the record copy without adversely affecting the clarity and direct reproducibility of the sheet onto which the correction is to be transferred (Rule 26.4).

ATTENTION

Failure to correct the defects will result in the international application being considered withdrawn by this receiving Office (see Rule 26.5 for further details).

A copy of this invitation and any attachments has been sent to the International Bureau

[X] and the International Searching Authority

Name and mailing address of the receiving Office: Assistant Commissioner for Patents, Box PCT, Washington, D C 20231, Attn: RO/US	Authorized officer: Tamara Fridie, PCT Operations - IAU Team 1, (703) 305-3747
Facsimile No	Telephone No.

Form PCT/RO/106 (July 1998)

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ANNEX A TO FORM PCT/RO/106

International application No.
PCT/US01/09733

The receiving Office has found the following defects in the international application as filed:

1 As to signature* of the international application (Rules 4.15 and 90.4), the request

a. ☐ is not signed.

b. ☐ is not signed by all applicants.

c. ☐ is not accompanied by the statement referred to in the check list in Box No. VIII of the request explaining the lack of the signature of an applicant for the designation of the United States of America.

d. ☒ is signed by what appears to be an agent/common representative but

☐ the international application is not accompanied by a power of attorney appointing him.

☐ the power of attorney accompanying the international application was not signed by all the applicants.

☒ other (*specify*):
THE ADDRESS RECORDED ON THE POWER OF ATTORNEY FOR THE APPLICANT ZENITH ELECTRONICS CORPORATION IS NOT THE SAME AS THE ADDRESS RECORDED ON THE REQUEST PLEASE CLARIFY

* All applicants must sign, including inventors if they are also applicants (e.g. where the United States of America is designated).

2. As to indications concerning the applicant, the request (Rules 4.4 and 4.5):

a. ☐ does not properly indicate the applicant's name (*specify*):

b. ☐ does not indicate the applicant's address.

c. ☐ does not properly indicate the applicant's address (*specify*):

d. ☐ does not indicate the applicant's nationality

e. ☐ does not indicate the applicant's residence.

f ☐ other (*specify*):

3. As to the language of certain elements of the international application, other than the description and claims (Rules 12.1(c) and 26.3*ter(a) and (c)*)

a. ☐ the request is not in a language which is both a language accepted by this receiving Office and a language of publication, which is (are):

b. ☐ the text matter of the drawings is not in the language in which the international application is to be published, which is.

c. ☐ the abstract is not in the language in which the international application is to be published, which is:

4. The title of the invention:

a. ☐ is not indicated in Box No. I of the request (Rule 4.1(a)).

b. ☐ is not indicated at the top of the first sheet of the description (Rule 5.1(a)).

c. ☐ as appearing in Box No. I of the request is not identical with the title heading the description (Rule 5.1(a)).

5. As to the abstract (Rule 8):

☐ the international application does not contain an abstract.

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

136

To

TREVOR B JOIKE
MARSHALL O TOOLE GERSTEIN MURRAY & BORUN
6300 SEARS TOWER 233 S WACKER DRIVE
CHICAGO IL 60606

PCT

NOTIFICATION REGARDING CERTAIN CORRECTIONS MADE *EX OFFICIO*

(PCT Administrative Instructions, Section 327)

Applicant's or agent's file reference: 29471/36995	Date of mailing (day/month/year): 24 APR 2001
International application No: PCT/US01/09733	REPLY DUE: NONE. However see paragraph 3 below
Applicant: ZENITH ELECTRONICS CORPORATION	International filing date (day/month/year): 27 MAR 01

1 The applicant is hereby notified that this receiving Office has corrected formal defects in the international application *ex officio* as shown on the attached copy of:

- [X] the request, sheet No 3
- [ ] the description, sheet No.
- [ ] the claims, sheet No
- [ ] the drawings sheet No.
- [ ] other *(specify)*

2 If the applicant agrees with these corrections, no further action is required in this regard.

3 In case of disagreement with these corrections, the applicant should promptly inform this receiving Office accordingly

Name and mailing address of the receiving Office: Assistant Commissioner for Patents, Box PCT, Washington, D C 20231, Attn: EO/US	Authorized officer: -3T Operations - IAP D Team 1 (703) 305-3747 (703) 305-3230 (FAX)
Facsimile No.	Telephone No.

Form PCT/RO/146 (July 1992)

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Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application country	regional application * regional Office	international application receiving Office
item (1) 18 April 2000 (18.04.00)	60/198,014	US		
item (2) 13 December 2000 (13.12.00)	60/255,478	US		
item (3) 13 March 2001 (13.03.01)	09/804,237 Unassigned	US		

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): 1, 2 & 3

* *Where the earlier application is an ARIPO application, it is necessary to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen, the two-letter code may be used).*

ISA/EP

Request to use results of earlier search; reference to that search *(If an earlier search has been carried out by or requested from the International Searching Authority).*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:	
request	3
description (excluding sequence listing part)	48
claims	8
abstract	1
drawings	12
sequence listing part of description	
Total number of sheets	70

This international application is accompanied by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☒ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☒ other *(specify)*: postcard

Figure of the drawings which should accompany the abstract: -

Language of filing of the international application: English

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

By Trigve B. Johnsen

(2703.01)

For receiving Office use only

1. Date of actual receipt of the purported international application: JC14 Rec'd PCT/PTO 27 MAR 2001		2. Drawings: ☐ received. ☐ not received.
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application.		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA/	6. ☐ Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only

Date of receipt of the record copy by the International Bureau.

TRANSMITTAL LETTER TO THE UNITED STATES RECEIVING OFFICE

Date	March 27 2001
International Application	PCT/US01/09733
Attorney Docket No.	2947/3865

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I. *Certification under 37 CFR 1 10 (if applicable)*

EK667824482US	March 27 2001
Express Mail mailing number	Date of Deposit

I hereby certify that the application/correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1 10 on the date indicated above and is addressed to Assistant Commissioner for Patents, Washington, D.C 20231

Laura Frasher	Laura Frasher
Signature of person mailing correspondence	Typed or printed name of person mailing correspondence

II. ☒ New International Application

TITLE	MAPPING ARRANGEMENT FOR DIGITAL COMMUNICATION SYSTEM	Earliest priority date (Day/Month/Year): 18.04.00

SCREENING DISCLOSURE INFORMATION In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmittal should and could be granted and for other purposes, the following information is supplied. (Note: check as many boxes as apply):

A. ☐ The invention disclosed was not made in the United States.

B. ☐ There is no prior U S. application relating to this invention.

C. ☒ The following prior U S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. *(NOTE: priority to these applications may or may not be claimed on form PCT/RO/101 (Request) and this listing does not constitute a claim for priority).*

application no.	60/198,014 & 60/255,476	filed on	18.04.00 & 13.12.00
application no.	unassigned	filed on	13.03.01

D. ☒ The present international application ☒ is identical ☐ contains less subject matter than that found in the prior U.S. application(s) identified in paragraph C. unassigned serial no , filed 3/13/01

E. ☒ The present international application ☒ contains additional subject matter not found in the prior U.S. application(s) identified in paragraph C. above. The additional subject matter is found on pages various and ☒ DOES NOT ALTER ☐ MIGHT BE CONSIDERED TO ALTER the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 CFR 5.1 See 37 CFR 5.15 provisionals

III. ☐ A Response to an Invitation from the RO/US. The following document(s) is (are) enclosed:

A. ☐ A Request for An Extension of Time to File a Response

B. ☐ A Power of Attorney (General or Regular)

C. ☐ Replacement pages:

pages		of the request (PCT/RO/101)	pages		of the figures
pages		of the description	pages		of the abstract
pages		of the claims			

D. ☐ Submission of Priority Documents

Priority document		Priority document	

E. ☐ Fees as specified on attached Fee Calculation sheet form PCT/RO/101 annex

IV ☐ A Request for Rectification under PCT 91 ☐ A Petition ☐ A Sequence Listing Diskette

V ☐ Other (please specify):

The person signing this form is the:		
	☐ Applicant	Trevor B. Jolin
	☒ Attorney/Agent (Reg. No.) 28,842	Typed name of signer
	☐ Common Representative	

PTO-1382 (Rev. 4-1993) (Modified) U.S. Department of Commerce: Patent and Trademark Office

~~138~~ 139

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE (RO/US)

In the matter of	)
	)
International Pat. Appl No. PCT/US01/09733	)
	)
International Filing Date 27 March 2001	)
	)
Title **Mapping Arrangement for Digital Communication System**	)
	)
Applicant: **Zenith Electronics Corporation**	)
	)
Attorney Docket No. 29471/36995	)

Response to Invitation to Correct Defects

Commissioner of Patents
Box PCT
Washington, D C 20231

This paper is in response to the Invitation to Correct Defects dated April 24, 2001

Officer Fridie has identified a discrepancy in Applicant's address identified in the general power of attorney and Applicant's address identified in the Request. Zenith Electronics Corporation recently moved to 2000 Millbrook Drive, Lincolnshire, Illinois 60069 The address identified in the Request is Applicant's current address

Should the Examining Attorney have any additional questions, she is urged to contact the undersigned at the indicated number

Respectfully submitted,

Trevor B Jolke
Reg. No 25,542
MARSHALL, O'TOOLE, GERSTEIN
MURRAY & BORUN
Attorney for Applicant
6300 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6402
(312) 474-6300

Dated May 21, 2001

TD

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PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
TREVOR B JOIKE
MARSHALL O'TOOLE GERSTEIN MURRAY & BORUN
6300 SEARS TOWER; 233 S WACKER DRIVE
CHICAGO IL 60606

PCT

COMMUNICATION IN CASES FOR WHICH NO OTHER FORM IS APPLICABLE

Applicant s or agent s file reference: 29471/36995	Date of mailing (day/month/year): 20 JUN 2001
International application No.: PCT/US01/09733	REPLY DUE: See paragraph 1 below
Applicant: ZENITH ELECTRONICS CORPORATION	International filing date (day/month/year): 27 MAR 01

1 ☐ REPLY DUE within _____ months/days from the above date of mailing

☐ NO REPLY DUE, however see below _____

☒ IMPORTANT COMMUNICATION

☐ INFORMATION ONLY

2. COMMUNICATION
THE RECEIVING OFFICE ACKNOWLEDGE THE RECEIPT OF A RESPONSE TO INVITATION TO CORRECT DEFECTS DATED 17 MAY 2001 HOWEVER THE ADDRESS RECORDED ON THE REQUEST FOR ZENITH ELECTRONICS CORPORATION MUST BE THE SAME AS THE ADDRESS RECORDED ON THE POWER OF ATTORNEY THE PCT/RO/108 REMAIN OUTSTANDING

Name and mailing address of the receiving Office Assistant Commissioner for Patent Box PCT Washington, D.C 20231 Attn RO/US Facsimile No. 703-305-3230	Authorized officer Barbara Fridie BF Telephone No. 703-305-3747

Form PCT/RO/132 (July 1992)

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE (RO/US)

In the matter of	)
	)
International Pat. Appl No PCT/US01/09733	)
	)
International Filing Date 27 March 2001	)
	)
Title **Mapping Arrangement for Digital Communication System**	)
	)
Applicant: **Zenith Electronics Corporation**	)
	)
Attorney Docket No. 29471/36995	)

Response to Invitation to Correct Defects

Commissioner of Patents
Box PCT
Washington, D C. 20231

This paper is in response to the Invitation to Correct Defects dated April 24, 2001

Officer Fridie has identified a discrepancy in Applicant s address identified in the general power of attorney and Applicant's address identified in the Request. Zenith Electronics Corporation recently moved to 2000 Millbrook Drive, Lincolnshire, Illinois 60069 The address identified in the Request is Applicant's current address

Should the Examining Attorney have any additional questions, she is urged to contact the undersigned at the indicated number

Respectfully submitted,

Trevor B Jones
Reg. No 25,542
MARSHALL, O'TOOLE, GERSTEIN
MURRAY & BORUN
Attorney for Applicant
6300 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6402
(312) 474-6300

Dated May 21, 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE (RO/US)

In the matter of

International Pat. Appl No PCT/US01/09733

International Filing Date 27 March 2001

Title **MAPPING ARRANGEMENT FOR DIGITAL COMMUNICATION SYSTEM**

Applicant
Zenith Electronics Corporation

Attorney Docket No
29471/36995

CERTIFICATE OF MAILING BY EXPRESS MAIL
"EXPRESS MAIL" mailing label
No EK657823592US
Date of Deposit July 19 2001

I hereby certify that this paper and the documents referred to herein as enclosed herewith are being deposited with the United States Postal Service "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C F.R. §1 10 on the date indicated above and are addressed to Box PCT Assistant Commissioner for Patents, Washington, D C 20231

Richard Zimmermann

Response to Communication

Commissioner of Patents
Box PCT
Washington, D C 20231
ATTN Barbara Fridie

Fax 703/305-3230

This paper is in response to the Communication dated 20 June 2001

Enclosed is a general appointment of agent from Zenith Electronics Corporation in the undersigned s favor The applicant s address identified in the power of attorney corresponds with the address identified in the Request

Should the Examining Attorney have any additional questions, she is urged to contact the undersigned at the indicated number

Respectfully submitted,

Trevor B Jolke
Reg. No 25,542
MARSHALL, O'TOOLE, GERSTEIN
MURRAY & BORUN
Attorney for Applicant
6300 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6402
(312) 474-6300

Dated July 19 2001

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PCT

GENERAL POWER OF ATTORNEY

(for several international applications filed under the Patent Cooperation Treaty)

(PCT Rule 90 5)

The undersigned person(s):
(Family name followed by given name for a full legal entity, full official designation. The address must include postal code and name of country.)

ZENITH ELECTRONICS CORPORATION
2000 Millbrook Drive
Lincolnshire Illinois 60069
United States of America

hereby appoint(s) the following person as. ☒ agent ☐ common representative

Name and address
(Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country.)

JOIKE, Trevor B. and HEPPERMANN Roger A.
MARSHALL, O'TOOLE, GERSTEIN MURRAY & BORUN
6300 Sears Tower
233 S Wacker Drive
Chicago, Illinois 60606
United States of America

to represent the undersigned before

☒ all the competent International Authorities

☐ the International Searching Authority only

☐ the International Preliminary Examining Authority only

in connection with any and all international applications filed by the undersigned with the following Office

United States Patent and Trademark Office as receiving Office

and to make or receive payments on behalf of the undersigned.

Signature(s) *(where there are several persons, each of them must sign, next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading this power)*

By _____
Name: Jack Kail
Title: Assistant Secretary

Date: June 15, 2001

The demand must be filed directly with the competent International Preliminary Examining Authority or if two or more Authorities are with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line

IPEA/ EP

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty

The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION

Applicant's or agent's file reference: 29471/36995

International application No.	International filing date *(day/month/year)*	(Earliest) Priority date *(day/month/year)*
PCT/US01/09733	27 March 2001 (27.03.01)	18 April 2000 (18.04.00)

Title of invention: MAPPING ARRANGEMENT FOR DIGITAL COMMUNICATION SYSTEM

Box No. II APPLICANT(S)

Name and address *(Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country.)*

ZENITH ELECTRONICS CORPORATION
2000 Millbrook Drive
Lincolnshire Illinois 60069
United States of America

Telephone No.: 847/941-8018

Facsimile No.: 847/941-8003

Teleprinter No.:

Applicant's registration No. with the Office:

State *(that is, country)* of nationality	State *(that is, country)* of residence
US	US

Name and address: *(Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is country)* of nationality	State *(that is, country)* of residence

Name and address: *(Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality	State *(that is, country)* of residence

☐ Further applicants are indicated on a continuation sheet.

Box No. III AGENT OR COMMON REPRESENTATIVE, OR ADDRESS FOR CORRESPONDENCE

The following person is ☒ agent ☐ common representative

and ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.

☐ is hereby appointed and any earlier appointment of (an) agent(s) /common representative is hereby revoked.

☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority in addition to the agent(s)/common representative appointed earlier

Name and address: *(Family name followed by given name for a legal entity, full official The address must include postal code and name of country.)*

JOIKE Trevor B
MARSHALL, GERSTEIN & BORUN
6300 Sears Tower
233 S Wacker Drive
Chicago, Illinois 60606
United States of America

Telephone No
312/474-6300

Facsimile No.
312/474-0448

Teleprinter No.

Agent's registration No. with the Office

☐ Address for correspondence. Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments.*

1 The applicant wishes the international preliminary examination to start on the basis of:

☒ the international application as originally filed.

the description
☐ as originally filed
☐ as amended under Article 34

the claims
☐ as originally filed
☐ as amended under Article 19 (together with any accompanying statement)
☐ as amended under Article 34

the drawings
☐ as originally filed
☐ as amended under Article 34

2. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3 ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69 1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

☒ which is the language in which the international application was filed.

☐ which is the language of a translation furnished for the purposes of international search.

☐ which is the language of publication of the international application.

☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

International application No PCT/US01/09733 146

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination		For International Preliminary Examining Authority use only: received	not received
1 translation of international application	sheets	☐	☐
2 amendments under Article 34	sheets	☐	☐
3 copy (or where required, translation) of amendments under Article 19	sheets	☐	☐
4 copy (or where required, translation) of statement under Article 19	sheets	☐	☐
5 letter	sheets	☐	☐
6. other *(specify)*	sheets	☐	☐

The demand is also accompanied by the item(s) marked below

1 ☒ fee calculation sheet
2. ☐ original separate power of attorney
3 ☐ original general power of attorney
4 ☐ copy of general power of attorney; reference number if any
5 ☐ statement explaining lack of signature
6. ☐ sequence listing in computer readable form
7 ☐ other *(specify)*

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

By Trevor B Jolley Date 05 Oct 2001

For International Preliminary Examining Authority use only

1 Date of actual receipt of DEMAND

2 Adjusted date of receipt of demand due to CORRECTIONS under Rule 60 1(b)

3 ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply ☐ The applicant has been informed accordingly

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5

5 ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:
JOIKE, Trevor B
MARSHALL, GERSTEIN & BORUN
6300 Sears Tower
233 S Wacker Drive
Chicago, Illinois 60606
ETATS-UNIS D'AMERIQUE

NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(e) and 61 1(b), first sentence and Administrative Instructions, Section 601(a))

Date of mailing *(day/month/year)*	16. 10. 01
Applicant's or agent's file reference: 29471/36995	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 01/ 09733	27/03/2001	18/04/2000

Applicant

ZENITH ELECTRONICS CORPORATION

1 The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application.

05/10/2001

2 This date of receipt is:

- [X] the actual date of receipt of the demand by this Authority (Rule 61 1(b)).
- [ ] the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- [ ] the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404) received the required corrections.

3 [ ] ATTENTION: That date of receipt is AFTER the expiration of 19 months from the priority date. Consequently the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

[ ] *(If applicable)* This notification confirms the information given by telephone, facsimile transmission or in person on.

4 Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx. 523656 epmu d Fax. (+49-89) 2399-4465	AIMAIE MURILLO J Tel (+49-89) 2399-8059

Form PCT/IPEA/402 (July 1998) P20452 (11/10/2001)

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CHAPTER II 148

PCT

FEE CALCULATION SHEET

Annex to the Demand

International application No.	PCT/US01/09733
Applicant's or agent's file reference	29471/36985

For International Preliminary Examining Authority use only

Date stamp of the IPEA

Applicant
ZENITH ELECTRONICS CORPORATION

CALCULATION OF PRESCRIBED FEES

1 Preliminary examination fee	2,998.20	P
2. Handling fee *(Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.)*	287.61	H
3 Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box ..	3,285.80	TOTAL

MODE OF PAYMENT

- [x] authorization to charge deposit account with the IPEA (see below)
- [ ] cash
- [ ] cheque
- [ ] revenue stamps
- [ ] postal money order
- [ ] coupons
- [ ] bank draft
- [ ] other *(specify)*

AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT
(This mode of payment may not be available at all IPEAs)

IPEA/ EP

- [x] Authorization to charge the total fees indicated above.
- [x] *(This check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)* Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.

Deposit Account No. 26300287

Date. 05 Oct 2001

Name: Trevor B. Jolke

Signature: Trevor B. Jolke

PATENT COOPERATI N TREATY

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From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:
JOIKE, Trevor B
MARSHALL, GERSTEIN & BORUN
6300 Sears Tower
233 S Wacker Drive
Chicago, Illinois 60606
ETATS-UNIS D'AMERIQUE

RECEIVED
0 4 2002
SCHIFF HARDIN & WAITE
PATENT OFFICE

WRITTEN OPINION
(PCT Rule 66)

Date of mailing *(day/month/year)*	24/01/2002
Applicant's or agent's file reference: 29471/36995	REPLY DUE: within 1 / 00 months/days from the above date of mailing

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 01/ 09733	27/03/2001	18/04/2000

International Patent Classification (IPC) or both national classification and IPC
H04N7/24

Applicant
ZENITH ELECTRONICS CORPORATION

1 This written opinion is the first drawn up by this International Preliminary Examining Authority

2. This opinion contains indications relating to the following items:

- I [X] Basis of the opinion
- II [ ] Priority
- III [X] Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV [ ] Lack of unity of invention
- V [X] Reasoned statement under Rule 66.2(a)(ii) with regard to novelty inventive step or industrial applicability; citations and explanations supporting such statement
- VI [ ] Certain documents cited
- VII [ ] Certain defects in the international application
- VIII [ ] Certain observations on the international application

3 The applicant is hereby invited to reply to this opinion.

When? See the time limit indicated above. The applicant may before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3
For the form and the language of the amendments, see Rules 66.8 and 66.9

Also For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4bis
For an informal communication with the examiner see Rule 66.6

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is 18/08/2002

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel (+49-89) 2399-0 Tx. 523656 epmu d Fax: (+49-89) 2399-4465	Examiner Formalities officer (incl. extension of time limits) Tel. (+49-89) 2399 2828

Form PCT/IPEA/408 (cover sheet) (July 1998)

I **Basis of the opinion**

1 The basis of this written opinion is the application as originally filed

III **Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

2 The question of whether the claimed invention appears to be novel, to involve an inventive step, or to be industrially applicable has not been and will not be the subject of the international preliminary examination (Article 34 (4) (a) (i) (ii) PCT, see also international search report) in respect of

2 1 Applications having an unnecessary plurality of independent claims (generally not more than 1 independent claim in the same category is necessary, Article 6 PCT),

2 2 unsearched subject-matter (Article 17 (2) (a), Rule 66 1 (e) PCT), e g

2.2 1 claimed subject-matter under Rule 39 1 PCT,

2 2 2 applications where the description, the claims, or the drawings fail to comply with the prescribed requirements to such an extent that no meaningful search could have been carried out,

2 3 claimed subject-matter under Rule 67 1 PCT

V **Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability**

3 To the extent that the international preliminary examination has been carried out (see item III above), the following is pointed out

In light of the documents cited in the international search report, it is considered that the invention as claimed in at least one of the independant claims does not appear to meet the criteria mentioned in Article 33 (1) PCT, i e does not appear to be novel and/or to involve an inventive step

4 If amendments are filed, the Applicant must comply with the requirements of Rule 66 8 PCT and indicate the basis in the originally filed application of the amendments made (Article 34 (2) (b) PCT) otherwise these amendments will not be taken into consideration for the establishment of international preliminary examination
The attention of the applicant is drawn to the fact that if the application contains an unjustified plurality of independent claims no examination of any of the claims will be carried out

SCHIFF HARDIN & WAITE
A Partnership Including Professional Corporations

6600 Sears Tower Chicago, Illinois 60606-6473
Telephone (312) 258-5500 Facsimile (312) 258-5700

Chicago
Washington
New York
Merrillville
Dublin

February 11, 2002

VIA TELEFAX

European Patent Office /IPEA
Erhardtstrasse 27
D-80331 Muenchen
Germany

RE PCT International Application No PCT/US01/09733
Zenith Electronics Corporation
Our Ref No FP01,0518WO (formerly 29471/36995)

Dear Ladies and Gentlemen

The Examiner in the above captioned application has refused to exam the application, citing several PCT Articles and Rules Applicant requests clarification for the reasons given below

First, the examiner asserted that there are too many independent claims, citing Article 6 Article 6 essentially states that the claims shall define the invention, shall be clear and concise, and shall be fully supported by the description Because there is only one independent claim in each application, because the claims define the invention, because the claims are clear and concise, and because the claims are fully supported by the description, applicant has compiled with this article

Second, the examiner asserts that the subject matter is unsearched, citing PCT Article 17(2)(a) and Rule 66 1(e) Article 17(2)(a) essentially provides that, if the examination authority considers that (I) the application relates to subject matter which the searching authority is not required to search and decides not to search or (II) the description, drawings, or claims cannot support a meaningful search, then no search will be established Neither of these sections applies since applicant has already received a search report Rule 66 1(e) states that claims relating to subject for which no international search report has been established need not be examined However, an international search report has been issued

Third, the examiner asserts that there is claimed subject matter under PCT Rule 39 1 This rule essentially provides that a search need not be conducted if the subject matter of the application relates to (i) scientific or mathematical theories, (ii) plants or animals, (iii) methods of doing business, (iv) medical treatments, (v) mere presentations of information, or (vi) computer programs Again, none of these sections apply since applicant has already received an international search report Also, it is hard to see how the items listed in this rule apply to the claims

Fourth, the examiner essentially repeats a portion of Article 17(2)(a) which has been discussed above

Fifth, the examiner asserts that there is claimed subject matter under PCT Rule 67 1 This rule is not very different from PCT Rule 39 1, which has been discussed above

Accordingly, applicant has difficulty in understanding the Written Opinion mailed January 24, 2002 and asks for a clarification

Sincerely,

FOR THE FIRM
Trevor B Jolke

TBJ/edr

PATENT COOPERATION TREATY

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
JOIKE, Trevor B
MARSHALL, GERSTEIN & BORUN
6300 Sears Tower
233 S Wacker Drive
Chicago, Illinois 60606
ETATS-UNIS D'AMERIQUE

RECEIVED
MARSHALL GERSTEIN

PCT

WRITTEN OPINION

(PCT Rule 66)

Date of mailing (day/month/year)	05.03.2002
Applicant's or agent's file reference: 29471/36995	REPLY DUE: within 3 month(s) from the above date of mailing

International application No.	International filing date (day/month/year)	Priority date (day/month/year)
PCT/US01/09733	27/03/2001	18/04/2000

International Patent Classification (IPC) or both national classification and IPC
H04N7/24

Applicant
ZENITH ELECTRONICS CORPORATION

1 This written opinion is the second drawn up by this International Preliminary Examining Authority

2. This opinion contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain document cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

3. The applicant is hereby invited to reply to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments see Rule 66.4 bis.
For an informal communication with the examiner see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 18/09/2002.

Name and mailing address of the international preliminary examining authority:	Authorized officer / Examiner
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Schneiderlin, J Formalities officer (incl. extension of time limits) Schalinatus, D Telephone No. +49 89 2399 8342

Form PCT/IPEA/408 (cover sheet) (January 1994)

WRITTEN OPINION International application No. PCT/US01/09733

I. Basis of the opinion

1 With regard to the elements of the international application (Replacement *sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*):

Description, pages

1-46 as published

Claims, No.:

1-24 as published

Drawings, sheets.

1/12-12/12 as published

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item

These elements were available or furnished to this Authority in the following language. , which is

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23 1(b))
- ☐ the language of publication of the international application (under Rule 48.3(b))
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3)

3 With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing

- ☐ contained in the international application in written form
- ☐ filed together with the international application in computer readable form
- ☐ furnished subsequently to this Authority in written form
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of

- ☐ the description, pages
- ☐ the claims, Nos.

☐ the drawings, sheets

5 ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c))

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement

1 Statement

Novelty (N)	Claims	1
Inventive step (IS)	Claims	
Industrial applicability (IA)	Claims	

2. Citations and explanations
see separate sheet

WRITTEN OPINION
SEPARATE SHEET

International application No PCT/US01/09733

To section IV:

Reference is made to the following documents

D1 US-A-5 966 120 (SHEN PAUL ET AL) 12 October 1999 (1999-10-12)

D2. WO 98 51111 A (KONINKL PHILIPS ELECTRONICS NV ,PHILIPS SVENSKA AB (SE)) 12 November 1998 (1998-11-12)

The document D1 discloses (the references in parentheses applying to this document) a system for transmitting (see figure 1) and receiving/processing a distribution data stream (I e digital signal), the distribution data stream containing a map (see col 4 ll 29-33 the map contains information indicating a location of at least one of the video or auxiliary data in the data frame) and video (i.e first) and auxiliary (second) data intermixed in a data frame using the MPEG specification The video and auxiliary data have the same constellation (because only one and the same type of modulation is used to transmit them since they are sent through the same distribution data stream) The video and auxiliary data have different bit rates since the video has variable bit rate (see abstract)

f course in the receiver the video and auxiliary data are processed (see fig 4) in accordance with the map

The subject-matter of claim 1 is therefore not new

A similar objection could be based on D2.

Independent claim 1 is not in the two-part form, but uses the word "characterized by" therefore this word should be removed from the claim or the features known in combination from the prior art (document D1) be placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features be included in the characterising part (Rule 6 3(b)(ii) PCT)

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6 2(b) PCT This applies to both the preamble and characterising portion

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 October 2001 (25 10 2001)

PCT

(10) International Publication Number
WO 01/78494 A3

(51) International Patent Classification[7] H04N 7/24
H04L 1/00

(21) International Application Number PCT/US01/09733

(22) International Filing Date 27 March 2001 (27 03 2001)

(25) Filing Language English

(26) Publication Language English

(30) Priority Data
60/198,014 18 April 2000 (18 04 2000) US
60/255,476 13 December 2000 (13 12 2000) US
09/804,231 13 March 2001 (13 03 2001) US

(71) Applicant ZENITH ELECTRONICS CORPORATION [US/US] 2000 Millbrook Drive Lincolnshire IL 60069 (US)

(72) Inventor FIMOFF Mark 1020 Concord Lane Hoffman Estates IL 60195 (US).

(74) Agent JOHE Trevor B Marshall O Toole Gerstein Murray & Borun 6300 Sears Tower 233 S Wacker Drive Chicago IL 60606 (US).

(81) Designated States (national) AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW

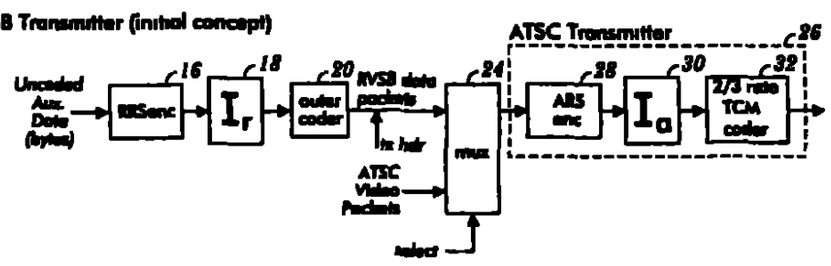
(84) Designated States (regional) ARIPO patent (GH GM KE LS MW MZ SD SL SZ TZ UG ZW) Eurasian patent (AM AZ BY KG KZ MD RU TJ TM) European patent (AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR) OAPI patent (BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG)

Published
— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report
24 January 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette

(54) Title MAPPING METHOD FOR VSB AND ATSC IN A RECEIVER



(57) Abstract A receiver receives a digital signal The digital signal contains a frame of robust VSB data and ATSC data and the digital signal further contains a map The map contains information indicating a location of the robust VSB data and ATSC data in the frame A decoder of the receiver decodes the digital signal A processor of the receiver processes at least one of the robust VSB data and the ATSC data according to the location information contained in the map

WO 01/78494 A3

INTERNATI NAL SEARCH REPORT

Ir tional Applica o
PCT/US 01/09733

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A CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/24 H04L1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal WPI Data, PAJ, INSPEC, COMPENDEX

C DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication where appropriate of the relevant passages	Relevant to claim No.
X	US 5 966 120 A (SHEN PAUL ET AL) 12 October 1999 (1999-10-12) column 3 line 34 - line 44 column 4, line 22 -column 5 line 8 column 7, line 53 -column 8, line 4 column 8, line 37 - line 49 claim 12	1,7,18, 22-24
A		2-6, 8-17, 19-21

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

Special categories of cited documents

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure use exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

& document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 2001	13/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office P B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Tx 31 651 epo nl, Fax (+31-70) 340-3016	Reilly, D

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No PCT/US 01/09733

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5966120	A	12-10-1999	AU	7724996 A	11-06-1997
			EP	0862836 A1	09-09-1998
			JP	2000500632 T	18-01-2000
			WO	9719560 A1	29-05-1997
WO 9851111	A	12-11-1998	EP	0935903 A1	18-08-1999
			WO	9851111 A1	12-11-1998
			JP	2000513899 T	17-10-2000

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44 1)

To
MARSHALL, O'TOOLE, GERSTEIN,
MURRAY & BORUN
Attn Joike, Trevor B
6300 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606
UNITED STATES OF AMERICA

	Date of mailing (day/month/year) 13/11/2001
Applicant's or agent's file reference 29471/36995	FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US 01/09733	International filing date (day/month/year) 27/03/2001
Applicant ZENITH ELECTRONICS CORPORATION	

1 [X] The applicant is hereby notified that the International Search Report has been established and is transmitted herewith

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes to amend the claims of the International Application (see Rule 46)

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34 chemin des Colombettes
1211 Geneva 20 Switzerland
Fascimile No (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2 [ ] The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith

3. [ ] With regard to the protest against payment of (an) additional fee(s) under Rule 40.2 the applicant is notified that.

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made

4 Further action(s) The applicant is reminded of the following:

Shortly after 18 months from the priority date the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication a notice of withdrawal of the international application or of the priority claim must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively before the completion of the technical preparations for international publication

Within 19 months from the priority date a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later)

Within 20 months from the priority date the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office P.B 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel (+31-70) 340-2040, Tx 31 651 epo nl Fax (+31-70) 340-3016	Carina Bergstr^m

Form PCT/ISA/220 (July 1998)

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19 The Notes are based on the requirements of the Patent Cooperation Treaty the Regulations and the Administrative Instructions under that Treaty In case of discrepancy between these Notes and those requirements, the latter are applicable For more detailed information see also the PCT Applicant's Guide a publication of WIPO

In these Notes, "Article" Rule and "Section" refer to the provisions of the PCT the PCT Regulations and the PCT Administrative Instructions respectively

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has after having received the international search report, one opportunity to amend the claims of the international application It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore it should be emphasized that provisional protection is available in some States only

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority The description and drawings may only be amended under Article 34 before the International Examining Authority

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41

When? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later It should be noted, however that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46 1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below

How? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter

The letter will not be published with the international application and the amended claims It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English, if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped),whether

(i) the claim is unchanged;

(ii) the claim is cancelled;

(iii) the claim is new

(iv) the claim replaces one or more claims as filed,

(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter

1 [Where originally there were 48 claims and after amendment of some claims there are 51]
"Claims 1 to 29, 31, 32 34, 35 37 to 48 replaced by amended claims bearing the same numbers, claims 30 33 and 36 unchanged, new claims 49 to 51 added."

2. [Where originally there were 15 claims and after amendment of all claims there are 11]
"Claims 1 to 15 replaced by amended claims 1 to 11 "

3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]
"Claims 1 to 6 and 14 unchanged, claims 7 to 13 cancelled, new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15 16 and 17 added; all other claims unchanged.

4. [Where various kinds of amendments are made]
"Claims 1 10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14, claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief not exceeding 500 words if in English or if translated into English

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable item 5 below
29471/36995		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 01/09733	27/03/2001	18/04/2000

Applicant

ZENITH ELECTRONICS CORPORATION

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18 A copy is being transmitted to the International Bureau

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1 **Basis of the report**

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed unless otherwise indicated under this item

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b))

b With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing

[ ] contained in the international application in written form

[ ] filed together with the international application in computer readable form

[ ] furnished subsequently to this Authority in written form

[ ] furnished subsequently to this Authority in computer readble form

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2 [ ] Certain claims were found unsearchable (See Box I)

3. [ ] Unity of invention is lacking (see Box II)

4 With regard to the title,

[ ] the text is approved as submitted by the applicant.

[X] the text has been established by this Authority to read as follows

MAPPING METHOD FOR VSB AND ATSC IN A RECEIVER

5. With regard to the abstract,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established according to Rule 38.2(b) by this Authority as it appears in Box III The applicant may within one month from the date of mailing of this international search report, submit comments to this Authority

6 The figure of the drawings to be published with the abstract is Figure No 1

[ ] as suggested by the applicant.

[X] because the applicant failed to suggest a figure

[ ] because this figure better characterizes the invention

[ ] None of the figures.

Form PCT/ISA/210 (first sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/09733

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/24 H04L1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 966 120 A (SHEN PAUL ET AL) 12 October 1999 (1999-10-12) column 3, line 34 - line 44 column 4, line 22 -column 5, line 8 column 7, line 53 -column 8, line 4 column 8, line 37 - line 49 claim 12	1,7,18, 22-24
A		2-6, 8-17, 19-21

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents

A document defining the general state of the art which is not considered to be of particular relevance
E earlier document but published on or after the international filing date
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
& document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 2001	13/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Reilly, D

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 01/09733 165

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate of the relevant passages	Relevant to claim No.
X	WO 98 51111 A (KONINKL PHILIPS ELECTRONICS NV ,PHILIPS SVENSKA AB (SE)) 12 November 1998 (1998-11-12) abstract page 4, line 20 - line 27 page 5, line 24 -page 6, line 14 page 6, line 31 -page 7, line 3 page 9, line 28 -page 10, line 8 claims 3,8	1,7,18
A		2-6, 8-17, 19-24

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No PCT/US 01/09733

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5966120 A	12-10-1999	AU 7724996 A	11-06-1997
		EP 0862836 A1	09-09-1998
		JP 2000500632 T	18-01-2000
		WO 9719560 A1	29-05-1997
WO 9851111 A	12-11-1998	EP 0935903 A1	18-08-1999
		WO 9851111 A1	12-11-1998
		JP 2000513899 T	17-10-2000

US005966120A

United States Patent [19]

Arazi et al

[11] Patent Number 5,966,120

[45] Date of Patent Oct. 12, 1999

[54] METHOD AND APPARATUS FOR COMBINING AND DISTRIBUTING DATA WITH PRE-FORMATTED REAL-TIME VIDEO

[75] Inventors: Efraim Arazi, Adam S. Tom, Paul Shen, all of San Francisco; Edward A. Krause, El Cerrito, all of Calif.

[73] Assignee: Imedia Corporation, San Francisco, Calif.

[21] Appl. No.: 08/561,010

[22] Filed: Nov. 21, 1995

[51] Int. Cl.[6] H04N 7/12

[52] U.S. Cl. 345/327; 348/12; 348/473; 370/505

[58] Field of Search 348/7, 12, 13, 348/385, 387, 386, 389, 420, 423, 462, 473, 489, 455/4.2, 5.1, 6.1; 370/477, 505, 506, 521, 523, 528; 375/363; 345/327; H04N 7/12

[56] References Cited

U.S. PATENT DOCUMENTS

4,755,993	7/1988	Grover	370/110.1
5,168,353	12/1992	Walker et al.	358/86
5,267,334	11/1993	Normille et al.	382/56
5,305,113	4/1994	Iwamura et al.	358/312
5,315,584	5/1994	Savary et al.	370/18
5,319,707	6/1994	Wasilewski et al.	380/14
5,359,601	10/1994	Wasilewski et al.	370/73
5,386,213	1/1995	Haupt et al.	341/67
5,400,401	3/1995	Wasilewski et al.	380/9
5,418,782	5/1995	Wasilewski	370/73
5,420,640	5/1995	Munch et al.	348/525
5,420,866	5/1995	Wasilewski	370/110.1
5,448,568	9/1995	Delpuch et al.	372/94.2
5,452,006	9/1995	Auld	348/390
5,461,619	10/1995	Citta et al.	370/83
5,493,339	2/1996	Birch et al.	348/461
5,506,904	4/1996	Sheldrick et al.	380/23
5,519,780	5/1996	Woo et al.	348/467
5,583,562	12/1996	Birch et al.	348/12
5,612,742	3/1997	Krause et al.	348/385
5,650,825	7/1997	Naimpally et al.	348/465
5,757,416	5/1998	Birch et al.	348/6
5,793,410	8/1998	Rao	348/7

FOREIGN PATENT DOCUMENTS

0 517 464 A1	12/1992	European Pat. Off.	H04N 7/00
0 692 914 A2	1/1996	European Pat. Off.	H04N 7/52
WO 94/30014	12/1994	WIPO	H04N 7/13
WO 95/15647	6/1995	WIPO	H04N 7/025

OTHER PUBLICATIONS

U. Riemann, "Der MPEG-2-Standard Generische Codierung für Bewegtbilder und zugehöriger Audio-Information—Multiplex-Spezifikation für die flexible Übertragung digitaler Datenströme (Teil52)," Fernseh- und Kino-Technik, vol. 48, No. 10, pp. 545-553 (Oct. 1994) XP000468290

Aravind, Rangarajan et al., Image and Video Coding Standards, *AT&T Technical Journal*, Jan./Feb. 1993, pp. 67-91

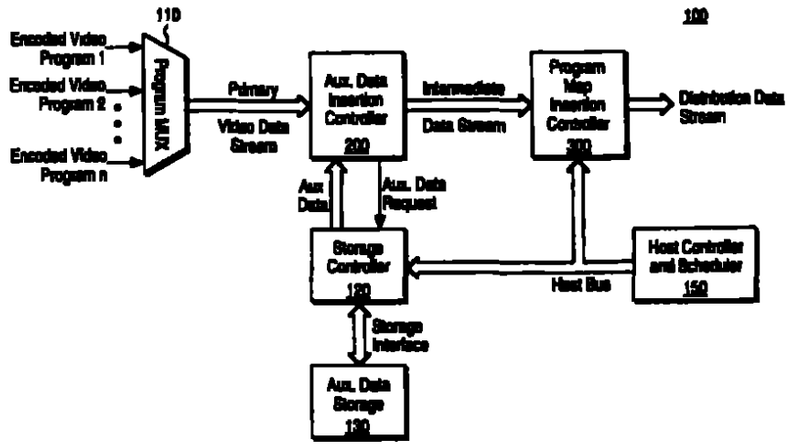
Primary Examiner—Nathan Flynn

Attorney, Agent or Firm—McCutchen, Doyle, Brown & Enersen, LLP

[57] ABSTRACT

A system for providing efficient constant bit rate distribution of variable bit-rate encoded video programs while facilitating the distribution of encoded video programs along with Auxiliary Data of a general character to one or more receivers. At a particular receiver a customized augmented video program is created by inserting selected portions of the Auxiliary Data into a selected encoded video program. The encoded video portion of the augmented video program can be transmitted, decoded and displayed in real time while the Auxiliary Data need not be transmitted in real time but can be stored locally at the receiver for real time presentation at a later time. Real time presentation might include insertion into the video program while non real-time presentation might include insertion into non-video applications separate from the video program.

26 Claims, 6 Drawing Sheets



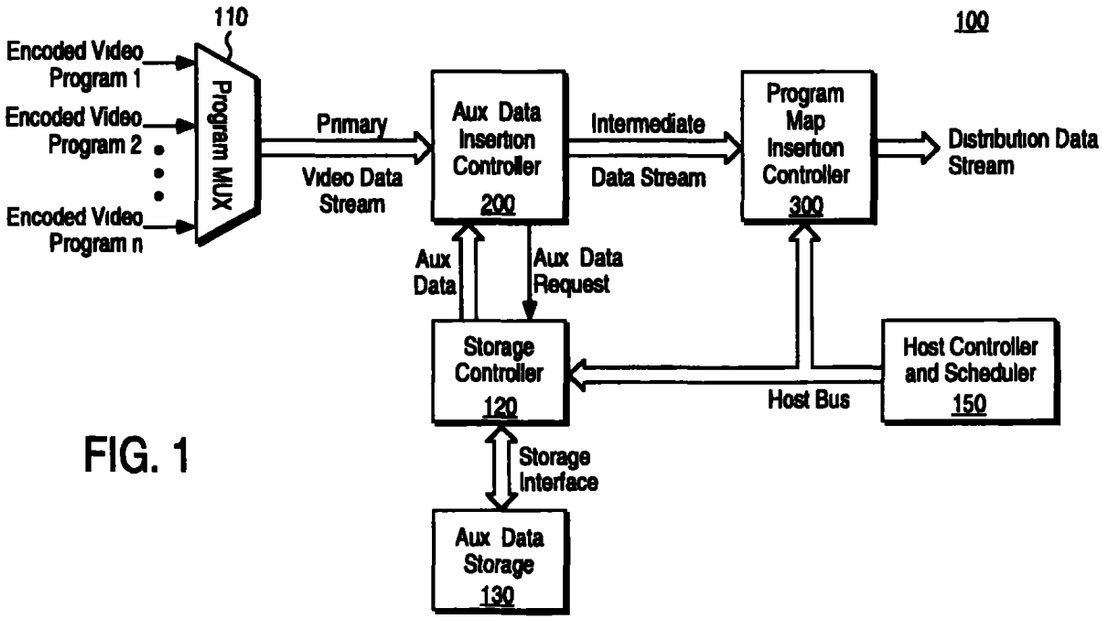
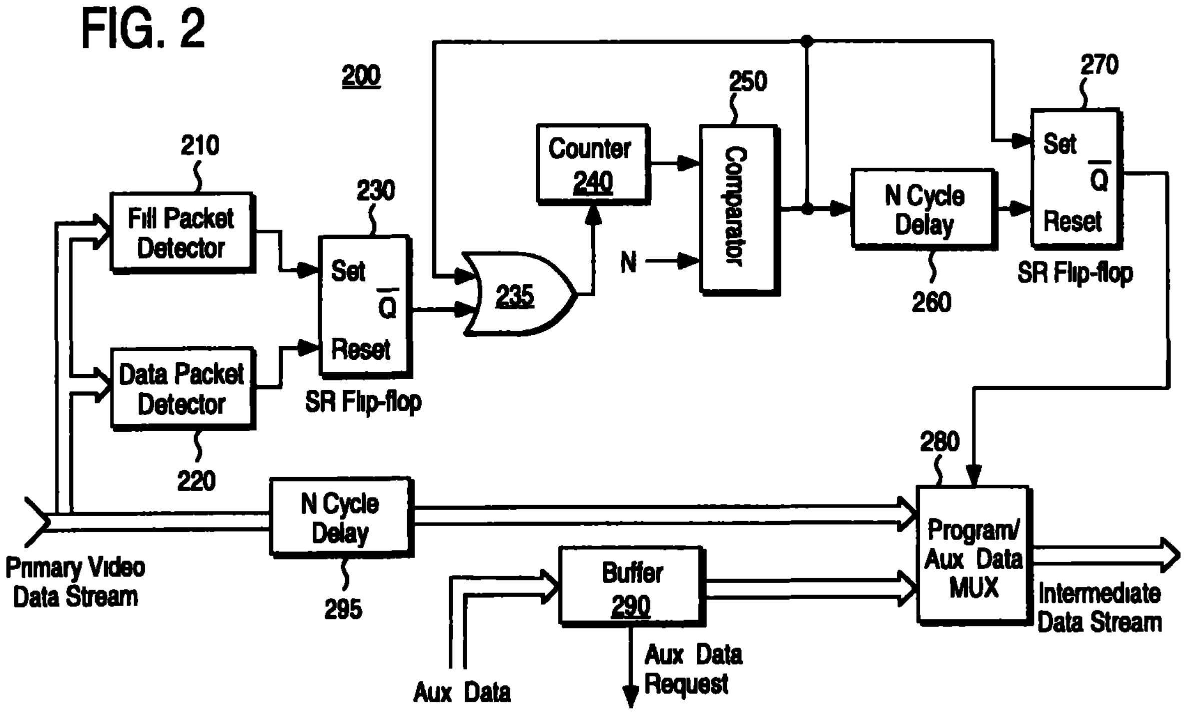

110
100
Encoded Video Program 1
Encoded Video Program 2
Encoded Video Program n
Program MUX
Primary Video Data Stream
Aux Data Insertion Controller 200
Intermediate Data Stream
Program Map Insertion Controller 300
Distribution Data Stream
Aux Data
Aux Data Request
Storage Controller 120
Host Controller and Scheduler 150
Host Bus
Storage Interface
Aux Data Storage 130

FIG. 1

FIG. 2


200
210
Fill Packet Detector
Data Packet Detector
220
230
Set
Q
Reset
SR Flip-flop
235
Counter 240
250
Comparator
N
N Cycle Delay
260
270
Set
Q
Reset
SR Flip-flop
280
Program/ Aux Data MUX
Intermediate Data Stream
Primary Video Data Stream
N Cycle Delay
295
Buffer 290
Aux Data
Aux Data Request

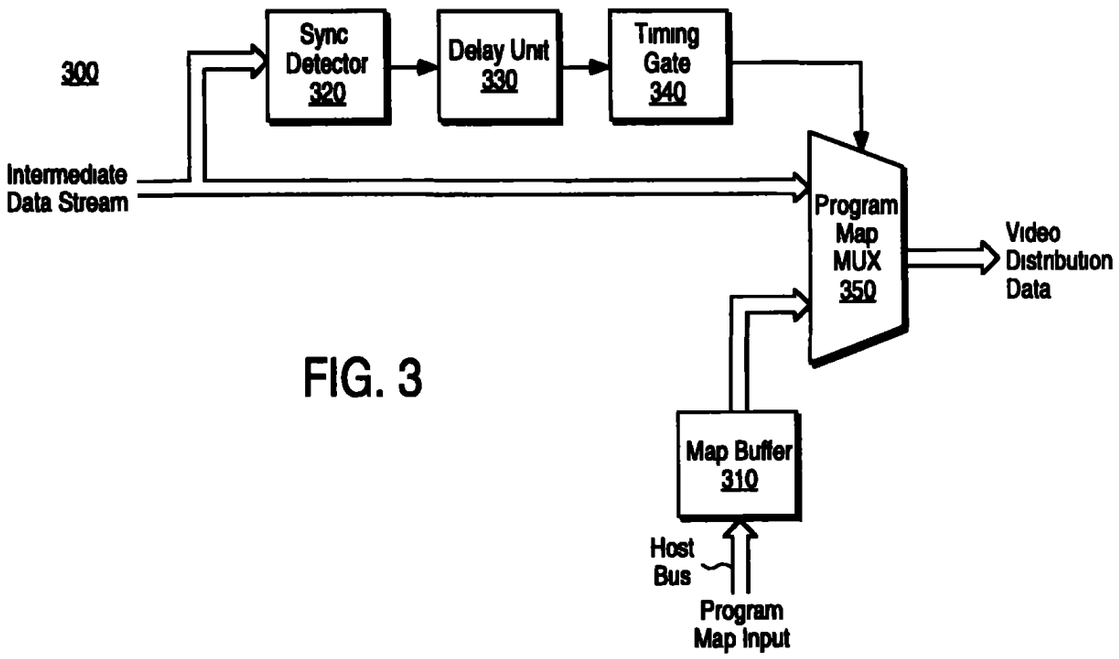

300
Sync Detector 320
Delay Unit 330
Timing Gate 340
Intermediate Data Stream
Program Map MUX 350
Video Distribution Data
Map Buffer 310
Host Bus
Program Map Input

FIG. 3

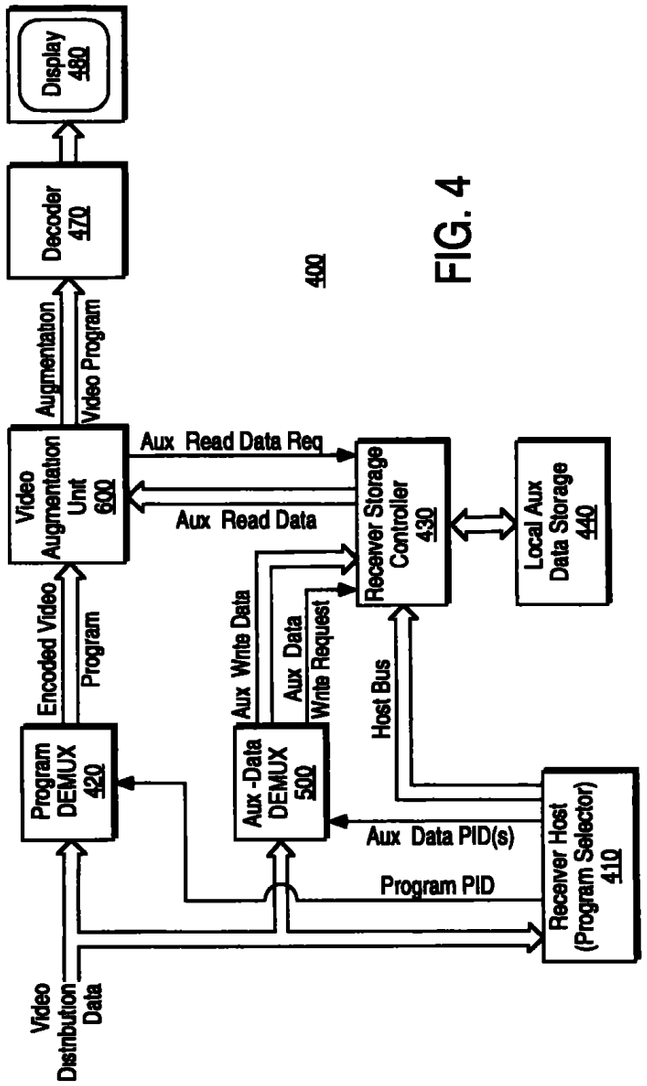

Display 490
Decoder 470
Augmentation
Video Program
Video Augmentation Unit 600
Aux Read Data Req
Aux Read Data
Receiver Storage Controller 430
Local Aux Data Storage 440
Encoded Video
Program
Aux Write Data
Aux Data Write Request
Host Bus
Program DEMUX 420
Aux -Data DEMUX 500
Aux Data PID(s)
Program PID
Receiver Host (Program Selector) 410
Video Distribution Data
400

FIG. 4

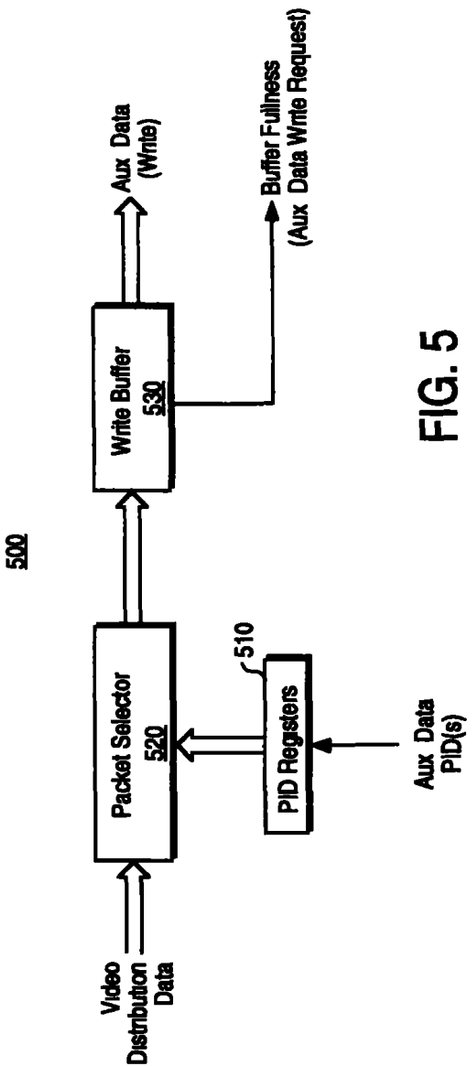

500
Video Distribution Data
Packet Selector 520
510
PID Registers
Aux Data PID(s)
Write Buffer 530
Aux Data (Write)
Buffer Fullness (Aux Data Write Request)

FIG. 5

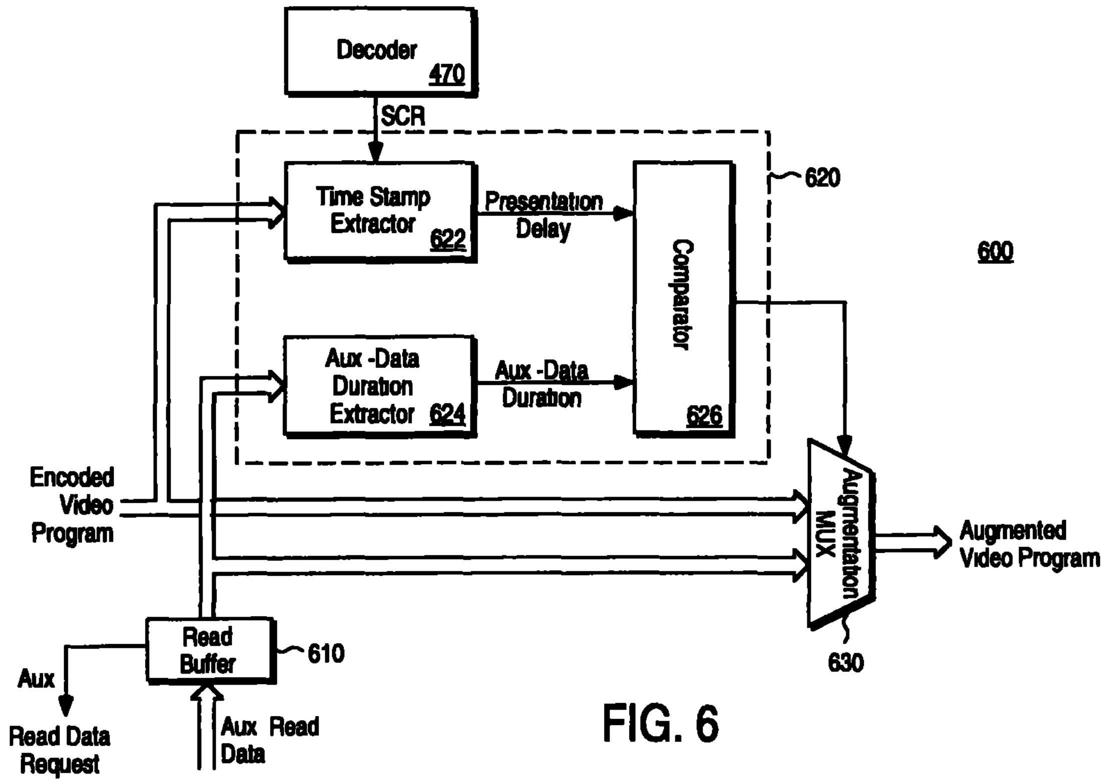

600
Decoder 470
SCR
620
Time Stamp Extractor 622
Presentation Delay
Comparator 626
Aux -Data Duration Extractor 624
Aux -Data Duration
Encoded Video Program
Augmentation MUX
Augmented Video Program
630
Read Buffer
610
Aux Read Data Request
Aux Read Data

FIG. 6

METHOD AND APPARATUS FOR COMBINING AND DISTRIBUTING DATA WITH PRE-FORMATTED REAL-TIME VIDEO

BACKGROUND OF THE INVENTION

1 Field of the Invention

The present invention relates to the distribution and reception of compressed video information More particularly the invention relates to providing constant bit rate distribution of variable bit rate-encoded video programs while facilitating the distribution of auxiliary data of a general character to one or more receivers and to receiving the distributed video information and creating a customized video program for presentation at each individual receiver

2 Background

The present invention relates to the encoding formatting, distribution and reception of compressed video programs Video programs are often encoded using a particular video compression technique known as variable bit rate (VBR) encoding. VBR encoding can be used to overcome the well known problem of most video compression encoders wherein the image quality tends to vary as a function of image complexity Typically a video program will contain a variety of scenes. Many of these scenes are lacking in motion or detail and are therefore easily compressed However other scenes containing complex details may be more difficult to compress, particularly when moving in a complex or random manner Therefore unless the available bandwidth is very high the perceived quality of the decompressed and reconstructed images will tend to vary from one scene to the next This problem becomes more serious as the available bandwidth is reduced until eventually the video becomes unacceptable often because of just a few problem scenes.

VBR encoding overcomes this problem by allocating more bits to those scenes which are difficult to compress and fewer bits to those scenes which are more easily compressed In this way the decompressed and reconstructed images can be made to appear consistently uniform and therefore superior to the reconstructed images derived from a constant bit-rate (CBR) encoder adjusted for the same average rate of compression As a result it is possible to compress a video program more efficiently by using the VBR encoding technique This increases the number and variety of programs or program streams that can be delivered over a fixed-bandwidth communication channel reduces the storage capacity requirements at the head end or other site where the program library is maintained and reduces the storage capacity requirements at the head end or other site where the program streams are to be distributed over a fixed-bandwidth communication channel

The disadvantage of the VBR encoding technique is that it presents certain problems when manipulating or editing the compressed bit-streams In particular it becomes difficult to efficiently utilize a fixed-bandwidth communication channel since the variable bit-rate stream may at times exceed the capacity of the channel, while at other times, it may utilize only a fraction of the available channel capacity As would be clear to one in the art the possibility of exceeding the capacity of the channel is also a problem with non-VBR encoded data

One known technique that is used to alleviate this problem is to buffer the compressed bit-stream at the transmission end of the communication channel in order to convert the variable rate stream to a constant rate stream In such a case it is also necessary to buffer the signal received at the other end of the channel in order to recover the variable rate stream that is necessary for proper timing of the reconstructed video images. Unfortunately, the required amount of buffering required to convert a variable rate input to a constant rate output would be prohibitively expensive and would introduce long delays into the distribution system Moreover existing video compression standards such as the MPLG standard specify limits on the amount of buffering required for conforming decoders. Therefore it is important that the received bit-streams be decodable without exceeding these limits.

Another prior art technique that can be used to reduce the inefficiency of distributing VBR encoded (and non VBR encoded) programs over a fixed-bandwidth channel combines a plurality of program streams into a single multiplex Although each additional program stream will increase the overall data rate of the multiplex, the average per-stream variance compared to the variance of the original individual streams will tend to decrease in approximate proportion to the number of streams, assuming approximate statistical independence among them Therefore if the nominal rate that can be accommodated by the channel is significantly greater than the average rate of a single program stream then the channel utilization can be significantly improved This technique is known in the art as statistical multiplexing.

When using buffering, one prior art method of assuring that buffer overflow does not occur is to provide feedback between the buffer and the encoder When the buffer approaches a full state a buffer fullness signal from the buffer informs the encoder to reduce the bit rate so that the buffer does not overflow When the buffer has more room the feedback signal from the buffer to the encoder enables the encoder to increase the bit rate in order to maintain image quality Such feedback is particularly effective when combined with statistical multiplexing. In such a case, a single buffer may be at the output of the multiplexer and feedback from that buffer is to all the encoders of the programs being multiplexed Because the multiplexing reduces effective per-stream data rate variance in general less buffering would be required to convert the multiplex to a fixed bit rate stream than if each individual encoder included a VBR-to-constant bit-rate buffer

The combination of buffering with statistical multiplexing with feedback for conveying encoded (particularly VBR encoded) program streams over fixed-bandwidth channels, can be effective but generally may not be sufficient when efficient utilization of the entire channel is important

In addition, there are often situations where no feedback is possible between the output buffer of the multiplexer and the individual encoders. One such situation occurs when multiplexing previously encoded data streams. Another occurs when the encoders are located in an area physically remote from the multiplexer Both these situations are referred to herein as remote encoding, indicating that encoding and multiplexing are remote in time location, or otherwise, so that no feedback is possible from the multiplexer to the encoders of the program streams to be multiplexed

In many applications a library of auxiliary data, which exists independently of the encoded video data, may need to be selectively distributed to the same set of receivers that receive video programs, or to a different set of receivers connected to the same distribution network The auxiliary data may be of any general type, including additional encoded video data Suitable examples of independent

libraries of auxiliary data are storage systems containing advertisements, promotional features or previews, news and other information content, or, data for computer-related applications. Such auxiliary data may be either compressed or uncompressed. They may be selectively directed to certain individual receivers or to certain pre-defined subsets of the entire receiver population. Such pre-defined subsets may vary over time in response to certain information that is known, gathered or inferred by arbitrary means. For example, one subset of receivers may subscribe to a service that provides local news, while a second possibly overlapping, subset of receivers may choose to receive one of many different categories of advertisements.

Methods for addressing arbitrary subsets of the receiver population are easily implemented within the MPEG 2 standard ISO/IEC 13818 (hereinafter called "MPEG"). Each component of an MPEG-compatible data multiplex is assigned an unique program identification number (PID). For example, a first video program included in the multiplex may be comprised of one video stream and two audio streams, and these components may be identified by PID values of 1, 2 and 3 respectively. Similarly, a second video program included in the same multiplex, may be comprised of one video stream, four audio streams, and one teletext data stream, and these components may be assigned PID values of 4 through 9, respectively. If ten additional streams are to be extracted from an independent library and included in the data multiplex, then these appended streams could be assigned PID values of 10 through 19, respectively. In this way, all audio, video, or data stream components of all programs contained within a multiplex would be assigned unique PID's, regardless of whether the programs originate from an independent library or otherwise.

MPEG's system layer specification also includes provisions for embedding tables or program maps within the bit-stream to identify the different programs contained within the multiplex and to establish a correspondence between these programs and the PIDs associated with their audio, video or data components. In addition, different types of programs can be classified into groups, and each such group can be assigned a unique identifier. These unique identifiers can be included in the embedded program tables, with one or more identifiers assigned to each program.

SUMMARY OF THE INVENTION

It is an object of the invention to provide for efficient real time distribution of one or more variable bit-rate programs to one or more receivers. In cases where a plurality of programs are multiplexed together and distributed simultaneously, it is possible, in the context of the present invention, for one or more of these programs to be encoded at a constant bit rate. Typically, each variable bit rate or constant bit rate program will consist of a video stream component, one or more audio stream components, and possibly one or more data stream components. Each of these real time distributed programs are hereinafter referred to as primary programs.

It is another object of the invention to selectively distribute auxiliary data of a general character to one or more receivers. The auxiliary data is distributed in non-real time using any available channel capacity and is stored locally at the selected receivers for real-time presentation at a later time.

In accordance with the foregoing, one aspect of the invention comprises a method and apparatus for efficient CBR distribution of primary programs, along with auxiliary data of a general character to one or more receivers. A primary data stream, comprising at least one VBR program and possibly one or more CBR programs, is converted to a CBR data stream by inserting auxiliary data where fill packets would have otherwise been used to create a CBR data stream.

Typically, the auxiliary data may be differentiated from the primary programs in that the auxiliary data need not be distributed in real time. By doing away with the requirement for real time or near real time distribution of at least a portion of the program multiplex, it becomes easier to efficiently utilize the available channel bandwidth. Once the real-time component of the multiplex has been formed using prior art techniques, the remaining channel bandwidth can be used to accommodate the non-real time component. In this way, it becomes possible to attain 100% channel utilization as long as there exists some non real time data in the queue awaiting distribution. Thus, the CBR distribution data stream is created, and data transmission capacity is increased, by the insertion of auxiliary data in space that would otherwise be wasted.

In an exemplary embodiment of this aspect of the invention, the primary programs and the auxiliary data are each assumed to be divided into segments or packets. The next packet of auxiliary data is inserted inbetween the packets of the primary programs whenever the distribution channel is idle for a time interval that is at least as long as the time interval needed to transmit the next packet of auxiliary data. In addition, MPEG-compliant program map data illustrating the location of each of the primary program or auxiliary data stream components in the multiplexed data stream are inserted into the data stream for use at the receiver. Such program maps are described in §2.4.4 of the MPEG system layer documentation, ISO/IEC 13818-1.

In connection with the foregoing, another aspect of the invention comprises a method and apparatus for receiving the CBR distribution data stream at a particular receiver and combining a selected primary program with selected auxiliary data to create a customized augmented program for that particular receiver. The receiver is configured with sufficient local storage to buffer the selected auxiliary data until they are needed for insertion into the selected primary program or for other presentation at a later time.

In an exemplary embodiment of this aspect of the invention, a receiver program selector receives the distribution data stream and uses a program map embedded therein to direct program and auxiliary data multiplexers (MUXes) to extract a selected primary program and selected portions of the auxiliary data stream, respectively. A video augmentation unit then inserts the selected auxiliary data into the primary program stream to create an augmented primary program which is supplied for decoding and viewing. In the typical case the auxiliary data comprises short program segments including both video and audio data.

In this way individual receivers which include some form of local storage could be programmed to receive certain program segments or certain types of program segments at any time of the day. For example, all new car advertisements could be classified together and assigned a unique group identification number. If such advertisements are periodically extracted from an auxiliary data library and combined with the multiplexed primary programs prior to distribution, then the program map embedded in the distribution data stream would be updated to reflect such additions. A receiver that has been programmed to receive all advertisements pertaining to new automobiles, and which is monitoring, the

received bit stream could detect such an advertisement by matching the relevant group classification number in the embedded program table with an internal list representative of the types of programs which it has been programmed to receive. The PIDs corresponding to any associated audio video or data streams comprising the advertisement, could then be extracted from the distribution data stream and copied to local storage for viewing at a later time.

In an alternative embodiment of the invention the selected auxiliary data need not be combined with a primary program but can be maintained separately for independent presentation as in the case of non-video data. For example the new car advertising, mentioned above could take the form of brochures to be printed on a receiver's printer or an interactive computer demo to be displayed on his computer.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features and advantages of the present invention will be apparent from the following detailed description, in which:

FIG. 1 illustrates a system for generating a constant bit rate Distribution Data Stream comprising a Primary Video Data Stream and an Auxiliary Data Stream where the Primary Video Data Stream includes a plurality of multiplexed variable bit rate encoded Video Programs, and the Auxiliary Data Stream contains other information.

FIG. 2 illustrates an Auxiliary Data Insertion System for creating an Intermediate Data Stream by inserting the Auxiliary Data Stream into the Primary Video Data Stream in accordance with the fullness of the Primary Video Data Stream.

FIG. 3 illustrates a Program Map Insertion System for embedding program map information into the Intermediate Data Stream to create a Video Distribution Data Stream.

FIG. 4 illustrates a system for receiving a constant bit rate Video Distribution Data Stream, extracting a selected Primary Encoded Video Program and the Auxiliary Data Stream, and associating selected portions of the Auxiliary Data Stream with the selected Primary Encoded Video Program to create an Augmented Video Data Stream for decoding and display at a receiver.

FIG. 5 illustrates an Auxiliary Data Demultiplexer in accordance with the system of FIG. 4, for extracting the Auxiliary Data Stream from the Video Distribution Data Stream.

FIG. 6 illustrates an Augmentation Unit, in accordance with the system of FIG. 4, for creating the Augmented Video Data Stream by inserting selected portions of the Auxiliary Data Stream into the selected Primary Encoded Video Program.

DETAILED DESCRIPTION OF THE INVENTION

A method and apparatus are disclosed for use in a distribution system wherein augmented program streams are envisioned. The augmented program streams may include both video and audio data and other auxiliary data that is not real-time dependent. Although the present invention is described predominantly in terms of the transmission and storage of video and audio information encoded in accordance with the MPEG format, the concepts and methods are broad enough to encompass distribution systems using other data compression techniques. Throughout this detailed description, numerous details are specified such as program types and data stream organizations, in order to provide a thorough understanding of the present invention. To one skilled in the art however it will be understood that the present invention may be practiced without such specific details. In other instances, well-known control structures and encoder/decoder circuits have not been shown in detail in order not to obscure the present invention. Particularly many functions are described to be carried out by various components within a compressed video distribution system. Those of ordinary skill in the art once the functionality to be carried out by such circuits is described will be able to implement the necessary components without undue experimentation.

Referring now to FIG. 1 there is shown one embodiment of a system for combining real time data with auxiliary data to produce a constant bit rate (CBR) data stream for efficient distribution. For example the real time data may be variable bit rate (VBR) encoded video programs and the auxiliary data may be any other form of data e.g. teletext advertising, or other encoded video. Thus, the CBR data stream is augmented to carry Auxiliary Data in the portion of the Primary Video Data Stream that would otherwise be wasted. The Encoded Video Programs (e.g. MPEG video) are received in real time from n different sources and combined by the Program Multiplexer (MUX) 110 into a single Primary Video Data Stream. In this example the output of the Program MUX 110 is provided at a CBR matched to the CBR video distribution channel. The Program MUX 110 ensures this CBR by inserting fill packets into the Primary Video Data Stream whenever its data rate would otherwise be less than that of the video distribution channel. The design of such a multiplexer is well known to those skilled in the art for example in the context of MPEG-compatible encoders where the fill packets are known as "stuffing bits."

In some applications it may also be necessary to ensure that the output data rate does not exceed the data rate of the video distribution channel. The fill packets, which typically serve as delay buffers without conveying useful information may be replaced with Auxiliary Data that do not require real time distribution. The Auxiliary Data are extracted from the Distribution Auxiliary Data Storage 130 by the Distribution Storage Controller 120 and combined with the Primary Video Data Stream by the Auxiliary Data Insertion Controller 200.

FIG. 2 illustrates Auxiliary Data Insertion Controller 200 in greater detail. The Primary Video Data Stream is sent to a Fill Packet Detector 210 and a Data Packet Detector 220, which provide active enable outputs upon detection of fill packets and data packets, respectively. The outputs of Fill Packet Detector 210 and Data Packet Detector 220 are sent to the set and reset terminals respectively of SR Flip Flop 230, which provides an inverted output of logical 1 output when the Primary Video Data Stream consists of a data packet and a logical 0 when the Primary Video Data Stream consists of a fill packet. In alternative embodiments of the present invention, those of ordinary skill in the art will recognize that other designs may reverse the polarities of the various signals described above and in the following.

The output of Flip Flop 230 is sent to OR logic 235 together with an output of Comparator 250. As will be described below the output of Comparator 250 is a logical 1 when the fill packet length is sufficiently long to allow replacement of fill packet data by Auxiliary Data. Thus, initially, before a fill packet is detected, the output of OR logic 235 is a logical 1 which resets the output of Counter 240 to zero, and since 0 is less than N the assumed size of all packets of auxiliary data the output of Comparator 250

is a logical 0. Then when a fill packet is first detected by Fill Packet Detector 210, it will set the SR Flip Flop 230 thereby causing the inverted output of the SR Flip Flop to become a logical 0. Next the output of OR gate 235 will change from logical 1 to logical 0, since both of its inputs are now 0, and this will cancel the reset of Counter 240 thereby enabling it to begin counting. The counter will continue incrementing until one of two conditions occur. The first condition is satisfied if Data Packet Detector 220 detects a next data packet causing SR Flip Flop 230 to reset thereby causing OR gate 235 to output a logical 1 thereby causing Counter 240 to reset to 0. The second condition is satisfied if the output of Counter 240 becomes equal to N. This causes Comparator 250 to output a logical 1 to SR Flip Flop 270 to direct Program/Auxiliary Data MUX 280 to replace the fill packet with Auxiliary Data. If the duration of the fill packet is at least N cycles, then at least one Auxiliary Data packet can be inserted into the bit stream (assuming that all Auxiliary Data packets are N cycles in duration). That is, the purpose of the Flip Flop 270 is to measure a fixed time interval of exactly N cycles and to output a replace packet enable signal during this time interval for signaling the Program/Auxiliary Data MUX 280 to select data from the Auxiliary Data Storage 130 (via Buffer 290) instead of the Primary Video Data Stream. The multiplexing of Auxiliary Data continues for N cycles, at which time an entire Auxiliary Data packet has been inserted and the Flip Flop 270 is reset via N-Cycle Delay Counter 260, to indicate completed multiplexing of an N-cycle Auxiliary Data packet and to suspend further multiplexing at Program/Auxiliary Data Multiplexer 280. The logical 1 output of Comparator 250 is also sent through OR logic 235 to reset Counter 240, which in turn causes the output of Comparator 250 to return to a logical 0 state thereby enabling Counter 240 to begin measuring the duration of the next fill packet interval. Although Flip Flop 270 and Counter 240 are reset upon the occurrence of an N-cycle fill packet interval it will be readily appreciated that the above-described counting and multiplexing process will continue to multiplex Auxiliary Data into the Primary Video Data Stream until a data packet is detected in the Primary Video Data Stream by Data Packet Detector 220.

The Auxiliary Data (from the Distribution Auxiliary Data Storage 130 via Distribution Storage Controller 120 of FIG 1) are accumulated using a Buffer 290 to ensure that the Auxiliary Data are always available when needed. The Auxiliary Data Request Signal (sent from the Auxiliary Data Insertion Controller 200 to the Distribution Storage Controller 120 in FIG 1) is reflective of the amount of data in the Buffer 290, and is used to signal the Distribution Storage Controller 120 when additional Auxiliary Data are required to prevent the Buffer 290 from underflowing.

The operation of both the Distribution Storage Controller 120 and the Program Map Insertion Unit 300 can be controlled by the Host Controller and Scheduler 150, as shown in FIG 3. In this example the program map is generated by the Host Controller 150 and inserted into a Program Map Buffer 310 located in the Program Map Insertion Unit 300. The Program Map Insertion Unit 300 parses the bit stream and inserts the program map data from the Program Map Buffer 310 at the appropriate time. An insertion command would be provided to Program Map Multiplexer 350 upon detection of an appropriate signal at a Synchronization Detector 320 after an optional delay via Delay Unit 330, and would continue for a predetermined interval specified by Timing Gate 340. The particular choice of synchronization delay and timing signals will depend on the particular encoding standard being used and are well known to those skilled in the art. For example, in the MPEG specification these signals are defined in §2.4.4 of the MPEG System Layer Documentation, ISO/IEC 13818-1.

FIG 4 shows a system for receiving a Video Distribution Data Stream extracting a selected Primary Encoded Video Program and the Auxiliary Data Stream and inserting selected portions of the Auxiliary Data Stream into the Encoded Video Program to create a customized Augmented Video Program for display at the receiver. As an example the system may be used for inserting narrowcast (targeted) advertising into the Video Program. That is, the Auxiliary Data would be comprised of encoded video and audio data and would be used for delayed insertion into the Encoded Video Program. As another example, the Auxiliary Data could be related to but physically independent of the Encoded Video Program. For example, the Auxiliary Data could be promotional coupons transmitted to the recipient's printer for goods or services related to the theme of the Encoded Video Program. In general, any type of Auxiliary Data can be handled at the receiver provided it is appropriately identified within the Video Distribution Data Stream.

In the described embodiment, all data streams are MPEG compatible. Each component of an MPEG-compatible data stream is assigned an unique program identification number (PID). For example a first Encoded Video Program may be comprised of one video stream and two audio streams, and these components may be identified by PID values of 1, 2, and 3 respectively. Similarly a second video program may be comprised of one video stream, four audio streams, and one teletext data stream and these components may be assigned PID values of 4 through 9 respectively. If ten Auxiliary Data packets are combined with the Encoded Video Programs, then these appended streams could be assigned PID values of 10 through 19 respectively. In this way all components contained within a data stream are assigned unique PIDs.

MPEG includes provisions for embedding tables or program maps (see the MPEG system layer documentation ISO/IEC 13818-1) within a data stream to identify different programs within the data stream and to establish a correspondence between these programs and the PID's associated with their various components. In addition different types of programs can be classified into groups, and each such group can be assigned a unique identifier. These unique identifiers can be included in the embedded program maps, with one or more identifiers assigned to each program. In this way individual receivers which include some form of local storage can be programmed to receive certain programs or certain types of programs at any time of the day.

For example at the distribution end all new car advertisements could be classified together and assigned a unique group identification number. If the advertisements are periodically added to the Auxiliary Data Stream and combined with the Primary Data Stream for distribution then a program map embedded in the Distribution Data Stream would be updated to reflect this addition. A receiver that has been programmed (either locally or remotely) to receive all advertisements pertaining to new automobiles, would monitor the Distribution Data Stream and detect the appropriate advertisement by matching the relevant group classification number in the embedded program map with an internal list representative of the types of programs which it has been programmed to receive. The appropriate packets (identified by their PIDs) corresponding to the Auxiliary Data comprising the advertisement would then be extracted from the Distribution Data Stream and copied to local storage for access at a later time (as opposed to on the fly).

In a narrowcasting analogy to conventional broadcast television a Video Program might be free to a viewer with distribution costs covered by advertising to be inserted into commercial intervals encoded into the Video Program Or the receiver could access the advertisement independently of the Video Program perhaps on a different device (e g an advertisement in the form of a computer demo or a coupon to be printed on a printer). The form of the Auxiliary Data is irrelevant as long as it can be encoded with appropriate PIDs and program map information

The Receiving System 400 works as follows. Program Selector 410 parses the received Video Distribution Data Stream and extracts the program map. Based on the Program map and any direct or indirect input from the user or remotely generated control signals, Primary Encoded Video Program PID values are provided to the Program DEMUX 420, which extracts the desired Primary Encoded Video Program from the Distribution Data Stream Similarly Auxiliary Data PID values are provided to the Auxiliary Data DEMUX 500 which extracts selected portions of the Auxiliary Data (hereafter called Local Auxiliary Data) to be transferred to Local Auxiliary Data Storage 440 via Receiver Storage Controller 430 for access at a later time

FIG 5 shows that Auxiliary Data DEMUX 500 includes a Write Buffer 530 in order to simplify the interface with the Receiver Storage Controller 430. The Write Buffer 530 is important for situations when the Receiver Storage Controller 430 is unable to accept the Local Auxiliary Data in real time (as they are being provided from the Distribution Data Stream) As Write Buffer 530 is filled it sends an Auxiliary Data Write Request to signal the Receiver Storage Controller 430 that accumulated Local Auxiliary Data are ready to be transferred to Local Auxiliary Data Storage 440.

In the exemplary embodiment of the invention the Auxiliary Data also comprise video data As shown in FIG 4, the Local Auxiliary Data remain in Local Auxiliary Data Storage 440 until they are ready to be combined with a Primary Encoded Video Program The Primary Encoded Video Program is selected from the Video Distribution Data Stream by a Program DEMUX 420 and passed to a Video Augmentation Unit 600 for combination with the Auxiliary Data from the Local Auxiliary Data Storage 440 to produce an Augmented Video Program The Augmented Video Program is passed to a Decoder 470 for decoding and then to a Display 480 for viewing.

FIG 6 shows a Video Augmentation Unit 600 comprising an Insertion Detector 620, a Read Buffer 610 and an Augmentation Multiplexer 630 The Insertion Detector 620 interrogates the Encoded Video Program for opportunities to insert Local Auxiliary Data, and signals the Augmentation Multiplexer 630 accordingly The Local Auxiliary Data are accumulated using a Read Buffer 610 to ensure that the Local Auxiliary Data are always available when needed As the Read Buffer 610 empties, it sends an Auxiliary Read Data Request signal to signal the Receiver Storage Controller 430 that additional Local Auxiliary Data are required to prevent the Read Buffer 610 from underflowing.

In one embodiment Insertion Detector 620 is configured for use in MPEG-compliant systems where the Local Auxiliary Data are automatically inserted whenever Presentation Delays of sufficient duration are encountered in the Encoded Video Program stream being received from the Program DEMUX 420. Such Presentation Delays can be determined by Time Stamp Extractor 622 by subtracting the current time (the Source Clock Reference or SCR from the Decoder 470) from the specified display time (the Presentation Time Stamp or PTS) of the next segment of the Encoded Video Program and adjusting the result to account for the current delay due to decoder buffering Comparator 626 compares the Presentation Delay with the duration of the next Local Auxiliary Data segment to be read from local storage as determined in Auxiliary Data Duration Extractor 624 If the Presentation Delay exceeds the duration of the Local Auxiliary Data segment then the Local Auxiliary Data segment is selected by the Augmentation MUX 630

In a preferred embodiment of the invention, special signals could be inserted into the Encoded Video Program prior to distribution in order to mark the appropriate points for Local Auxiliary Data insertion In that case, Insertion Detector 620 would merely read the special signals directly from the Encoded Video Program without needing to compare Presentation Delays and Auxiliary Data Durations as discussed above In that case Insertion Detector 620 could be a single unit (rather than the trio of elements 622 624 and 626) because it would only have to monitor the Encoded Video Program for the special signals and signal the Augmentation MUX 630 each time a special signal is detected

However as mentioned previously the Augmented Video Program need not be solely of video type but may contain computer programs, information to be sent to a printer or any other non-video data Therefore in another alternative embodiment of the invention the non-video portion of the Augmented Video Program could be diverted to other Access Devices (not shown in the figure) connected either in parallel with or downstream of the Decoder 470. Such an embodiment might be useful where the receiver is not the end user but a intermediate service provider Thus, even when the Local Auxiliary Data are of non video type and do not need to be inserted into the Augmented Video Program it may be convenient to transmit only a single data stream to the end user

Conversely in yet another alternative embodiment of the invention, the Local Auxiliary Data would be directly sent to other Access Devices without an Augmented Video Program ever being made This could be achieved by eliminating Video Augmentation Unit 600 and passing the Local Auxiliary Data directly to the other Access Devices In addition since many applications do not require real-time presentation of the data, no local storage devices may be needed and in such cases, Receiver Storage Controller 430 and Local Auxiliary Data Storage 440 could also be omitted

The forgoing illustrates that while the present invention has been disclosed with respect to certain particular embodiments, the invention is not limited to these embodiments and various modifications and changes thereto may be effected without departing from the spirit and scope of the invention.

What is claimed is.

1 A method of modifying a primary data stream wherein the primary data stream comprises one or more variable bit rate programs, and wherein the primary data stream further comprises fill data said method comprising

receiving the primary data stream

detecting fill data in the primary data stream,

inserting an auxiliary data stream in place of the fill data and

adding location data for the programs and for the auxiliary data,

to form a modified data stream for distribution to a plurality of receivers configured for individually extracting selected portions of the modified data stream in accordance with the location data

2 A method of forming a modified data stream for distribution to a plurality of receivers, comprising the steps of

statistically multiplexing a plurality of encoded video programs,

monitoring the statistically multiplexed encoded video programs for the occurrence of a fill packet,

maintaining a buffer of auxiliary data segments,

replacing the fill packet with at least one segment of the auxiliary data stream from the buffer if the segment is smaller than the size of the fill packet

adding location data for the encoded video programs and for the auxiliary data

to form a modified data stream for distribution to a plurality of receivers configured for individually extracting selected portions of the modified data stream in accordance with the location data

3 The method of claim 2 wherein the step of adding the location data comprises

monitoring the intermediate data stream for a synchronization signal

determining an allowable location data duration and

inserting at least a portion of the location data during the location data duration

4. The method of claim 3 wherein the modified data stream is encoded in a manner compatible with the MPEG standard

5. A method of creating a receiver-specific customized display stream for an individual receiver from a modified data stream sent to a plurality of receivers, comprising the steps of

receiving a modified data stream at a receiver the modified data stream comprising

a statistically multiplexed portion comprising one or more encoded video programs, and

an auxiliary data portion comprising auxiliary data inserted in place of fill data,

determining location data from the modified data stream

selecting an encoded video program from the statistically multiplexed portion of the modified data stream in accordance with a first predetermined characteristic of the receiver and the location data,

selecting local auxiliary data from the auxiliary data portion of the modified data stream in accordance with a second predetermined characteristic of the receiver and the location data

storing the local auxiliary data and

associating the encoded video program and the local auxiliary data to form a receiver-specific augmented video program for decoding and display

6 A method of creating a receiver-specific customized display stream for an individual receiver from a modified data stream sent to a plurality of receivers, comprising the steps of

receiving a modified data stream at a receiver

determining location data from the modified data stream

selecting an encoded video program in accordance with a first predetermined characteristic of the receiver and the location data,

selecting local auxiliary data from the modified data stream in accordance with a second predetermined characteristic of the receiver and the location data

storing the local auxiliary data, and

associating the encoded video program and the local auxiliary data to form a receiver-specific augmented video program for decoding and display

wherein the step of selecting the local auxiliary data from the modified data stream includes temporarily accumulating the selected auxiliary data in a buffer and writing data from the buffer to a local auxiliary data storage in accordance with a fullness indication of the buffer

7 A method of creating a receiver-specific customized display stream for an individual receiver from a modified data stream sent to a plurality of receivers, comprising the steps of

receiving a modified data stream at a receiver

determining location data from the modified data stream

selecting an encoded video program in accordance with a first predetermined characteristic of the receiver and the location data,

selecting local auxiliary data from the modified data stream in accordance with a second predetermined characteristic of the receiver and the location data

storing the local auxiliary data and

associating the encoded video program and the local auxiliary data to form a receiver-specific augmented video program for decoding and display

wherein the step of associating the encoded video program and the local auxiliary data includes,

monitoring the encoded video program for at least one insertion interval,

maintaining a buffer of local auxiliary data segments, and

inserting at least one segment of the local auxiliary data into the insertion interval if the segment is smaller than the insertion interval.

8. The method of claim 7 wherein the insertion interval is determined in accordance with the MPEG standard

9 The method of claim 8 wherein the monitoring the encoded video program for the insertion interval includes the steps of

determining a presentation interval as a difference between a presentation time stamp and a system clock reference

determining a duration of a segment of the local auxiliary data, and

providing an insertion enable signal when the presentation interval is larger than the duration of the local auxiliary data segment

10 The method of claim 5 wherein the step of associating the encoded video program and the local auxiliary data comprises creating a data stream including a first part of video type to be provided to a video display device and a second part of non-video type to be provided to a non-video device

11 A method of creating a customized video program for a viewer comprising the steps of

statistically multiplexing a plurality of encoded video programs,

adding an auxiliary data stream to form an intermediate data stream,

adding location data for the encoded video programs and for the auxiliary data to form a modified data stream for distribution to a plurality of receivers,

receiving the modified data stream at a specific receiver

determining the location data from the modified data stream

selecting one of the encoded video programs in accordance with a first predetermined characteristic of the receiver and the location data

selecting local auxiliary data from the modified data stream in accordance with a second predetermined characteristic of the receiver and the location data storing the local auxiliary data

associating the encoded video program and the stored local auxiliary data to form a customized program and

providing the customized program to a viewer for decoding and display

12 A system for forming a constant bit rate modified data stream for distribution to a plurality of receivers, comprising

a program multiplexer for statistically multiplexing a plurality of encoded video programs to the modified data stream

a data insertion controller coupled to receive a multiplexed program stream from the program multiplexer and for inserting auxiliary data therein to yield a modified data stream, and

a program map insertion controller coupled to receive the modified data stream for adding location data for the encoded video programs and for the auxiliary data to the modified data stream

13 The system of claim 12 wherein the data insertion controller comprises.

a first detector for providing an insertion signal upon detecting fill packet intervals of a minimum duration within a primary video data stream incorporating the statistically multiplexed encoded video programs;

a first buffer for holding portions of the auxiliary data, and

first multiplexing logic, connected to the first detector and the first buffer for inserting at least one segment of the auxiliary data into the primary video data stream

14. The system of claim 13 wherein the program map insertion controller comprises.

a synchronization detector coupled to receive the modified data stream for detecting a synchronization signal therein

a timing device connected to communicate with the synchronization detector for providing a control signal during a predetermined interval after detection of the synchronization signal

a second buffer for holding at least a portion of the location data, and

second multiplexing logic, responsive to the timing device and to the second buffer for multiplexing the buffered location data and the received data stream

15 The system of claim 14 configured to be compatible with the MPEG standard.

16 A system for creating a customized display stream for an individual receiver from a modified data stream sent to a plurality of receivers, comprising.

a program selector coupled to receive a modified data stream for determining location data therefrom the modified data stream comprising

a statistically multiplexed portion comprising one or more encoded video programs, and

an auxiliary data portion comprising auxiliary data inserted in place of fill data,

first demultiplexing logic for selecting an encoded video program from the statistically multiplexed portion of the modified data stream responsive to an identifier from the program selector and the location data,

second demultiplexing logic for selecting local auxiliary data from the auxiliary data portion of the modified data stream responsive to a second identifier from the program selector and the location data

a storage device for storing the local auxiliary data from the second demultiplexing logic and

an augmentation unit for associating the encoded video program and the stored local auxiliary data to form a receiver-specific augmented video program for decoding and display

17 A system for creating a customized display stream for an individual receiver from a modified data stream sent to a plurality of receivers, comprising

a program selector coupled to receive a modified data stream for determining location data therefrom

first demultiplexing logic for selecting an encoded video program from the modified data stream responsive to an identifier from the program selector and the location data,

second demultiplexing logic for selecting local auxiliary data from the modified data stream responsive to a second identifier from the program selector and the location data,

a storage device for storing the local auxiliary data from the second demultiplexing logic; and

an augmentation unit for associating the encoded video program and the stored local auxiliary data to form a receiver-specific augmented video program for decoding and display

wherein the second demultiplexing logic for selecting local auxiliary data from the modified data stream includes.

a packet selector connected to the processor for selecting local auxiliary data from the modified data stream in accordance with the location data, and

a first buffer connected to the packet selector for temporarily accumulating the selected local auxiliary data and connected to deliver the selected local auxiliary data to the storage device in accordance with a fullness indication of the buffer

18 The system of claim 17 wherein the augmentation unit for associating the encoded video program and the local auxiliary data comprises.

a second buffer for holding at least a portion of the local auxiliary data,

an insertion detector for determining an opportunity to insert a segment of the local auxiliary data into the encoded video program, and

augmentation multiplexing logic for inserting the segment of the local auxiliary data into the insertion interval in accordance with a command from the insertion detector

19 The system of claim 18 configured to be compatible with the MPEG standard.

20 The system of claim 19 wherein the insertion detector includes.

a first extractor for determining a presentation interval as a difference between a presentation time stamp and a system clock reference

a second extractor for determining a duration of a segment of the local auxiliary data and

comparing logic connected to the first and second extractors, for providing the insertion command to the augmentation multiplexing logic when the presentation interval is larger than the duration of the local auxiliary data segment

21 The system of claim 16 wherein the augmentation unit outputs a data stream including a first part of video type to be provided to a video display device and a second part of non-video type to be provided to a non-video device

22 A system for creating a customized video program for a viewer comprising

a multiplexer for statistically multiplexing a plurality of encoded video programs,

a first controller for adding auxiliary data to the output of the multiplexer

a second controller for adding location data for the encoded video programs and for the auxiliary data to the output of the first controller thereby forming a modified data stream

a distribution channel for distributing the modified data stream to at least one receiver

a processor for determining location data from the distributed modified data stream

a first demultiplexer for selecting an encoded video program from the modified data stream in accordance with a first predetermined characteristic of the processor and the location data

a second demultiplexer for selecting local auxiliary data from the modified data stream in accordance with a second predetermined characteristic of the processor and the location data

a storage device for storing the local auxiliary data from the second demultiplexer and

an augmentation unit for associating the encoded video program and the stored local auxiliary data to form a receiver-specific augmented video program for decoding and display

23 A method of forming a modified data stream for distribution to a plurality of receivers, comprising the steps of

statistically multiplexing a plurality of encoded video programs to form a primary data stream wherein, to occupy a constant bit rate data channel, additional data must be added to said primary data stream at one or more locations, said one or more locations comprising a fill portion

inserting an auxiliary data stream to form an intermediate data stream said auxiliary data stream inserted in said fill portion and

adding location data for the encoded video programs and for the auxiliary data to form a modified data stream for distribution to a plurality of receivers capable of individually extracting selected portions of the modified data stream in accordance with the location data

24 A method of forming a modified data stream for distribution to a plurality of receivers comprising the steps of

statistically multiplexing a plurality of encoded video programs.

monitoring the statistically multiplexed encoded video programs for the occurrence of a fill packet

maintaining a buffer of auxiliary data segments,

replacing the fill packet with at least one segment of the auxiliary data stream from the buffer if the segment is smaller than the size of the fill packet and

adding location data for the encoded video programs and for the auxiliary data to form a modified data stream for distribution to a plurality of receivers configured for individually extracting selected portions of the modified data stream in accordance with the location data

25 A system for forming a modified data stream for distribution to a plurality of receivers, comprising.

a program multiplexer for statistically multiplexing a plurality of encoded video programs to the modified data stream

a data insertion controller coupled to receive a multiplexed program stream from the program multiplexer and for inserting auxiliary data therein to yield the modified data stream and

a program map insertion controller coupled to receive the modified data stream for adding location data for the encoded video programs and for the auxiliary data to the modified data stream

26 The system of claim 25 wherein the data insertion controller comprises

a first detector for providing an insertion signal upon detecting fill packet intervals of a minimum duration within a primary video data stream incorporating the statistically multiplexed encoded video programs,

a first buffer for holding portions of the auxiliary data and

first multiplexing logic connected to the first detector and the first buffer for inserting at least one segment of the auxiliary data into the primary video data stream

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO 5,966,120

DATED October 12 1999

INVENTOR(S) Efraim Arazi et al

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below

Column 10, line 55, after "rate" insert --encoded video--

Column 11, line 9, after "data" insert --stream--

Column 11, line 12, after "packet" insert --, to form an intermediate data stream--

Signed and Sealed this

Fifth Day of December, 2000

Attest

Attesting Officer

Q. TODD DICKINSON

Director of Patents and Trademarks

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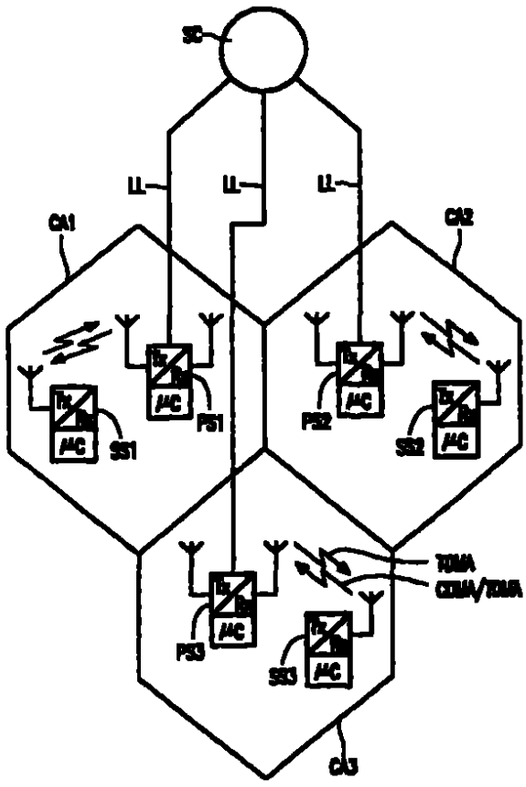
(54) Title. LINK QUALITY DEPENDENT MODULATION SCHEME

(57) Abstract

A flexible two–way telecommunications system comprises a plurality of geographically distributed primary stations (PS1 to PS3) whose coverage areas (CA1 to CA3) define contiguous cells Secondary stations (SS1 to SS3) are capable of roaming between and within the coverage areas of the primary stations. Downlink communications from the primary stations comprise TDMA transmission and uplink transmissions from the secondary stations comprise CDMA/TDMA transmissions. Data packets transmitted on the downlink are modulated to suit the quality of the link between the primary station and the addressed secondary station. A header applied to the downlink transmission includes information about the location of the respective data packets relative to a reference point and the modulation scheme applied to each data packet.



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DESCRIPTION

LINK QUALITY DEPENDENT MODULATION SCHEME

Technical Field

The present invention relates to a flexible two-way telecommunication system, particularly, but not exclusively, to a cellular radio system such as a Universal Mobile Telephone System (UMTS)

Background Art

A radio interface for UMTS is still at the conceptual stage but system designers are now beginning to specify a number of requirements, for example the ability to support a wide range of bit rates (8kbps - 2 Mbps) with high spectral efficiency are two of the most important Other aspects which will have to be addressed are the flexible deployment of base-stations with the minimum of frequency planning, and the need to support real time services

The radio interface should provide sufficient frequency diversity to mitigate the effects of multi-path propagation Time diversity could be used but this is not very effective for stationary or slow moving terminals Antenna diversity may also be employed, particularly at base stations

Possible techniques include frequency hopping or broadband modulation In the latter case a single broadband carrier would require the use of an equaliser at the receiver Direct Sequence Spread Spectrum or Multi-Carrier Modulation could also be applied, requiring a Rake receiver or FFT demodulator respectively

Norihiko Morinaga et al in an article entitled "New Concepts and Technologies for Achieving Highly Reliable and High-Capacity Multimedia Wireless Communications Systems" IEEE Communications Magazine, January 1997, pages 34 to 40, discuss the requirement for a highly reliable and a high capacity digital system for use as the third or fourth generation of mobile cellular telecommunications In particular the merits of system design concepts

and techniques for achieving highly reliable and high-capacity multimedia wireless communications using time division multiple access (TDMA) and code division multiple access (CDMA) systems are discussed With respect to TDMA, this article proposes that a TDMA - based adaptive modulation with dynamic channel assignment is effective to achieve a high capacity microcellular system The authors remark that broad bandwidth CDMA presents problems of severe interchip interference and of synchronisation at the receiver As a consequence they examine slow frequency and OFDM (orthogonal frequency division multiplex) spread spectrum systems and remark that they will be a candidate for high rate transmissions in submillimetre - or millimetre - wave transmissions Multicarrier CDMA systems are also considered but the conclusion was reached that single carrier CDMA systems were preferable *This article does not disclose how a flexible system using* TDMA and CDMA techniques may be implemented

Disclosure of Invention

An object of the present invention is to optimise the method of transmission of a signal to the conditions surrounding the receiving environment.

According to one aspect of the present invention there is provided a method of transmitting a signal between a primary station and a secondary station, each said station comprising transceiving means and control means, at least the control means of the primary station being capable of determining the quality of a signal received on an uplink, characterised by modulating a signal to be transmitted on a downlink and by selecting the characteristics of the transmission in response to information concerning the quality of the uplink and/or downlink

According to another aspect of the present invention there is provided a two-way telecommunications system comprising a primary station and at least one secondary station comprising transceiving means, the primary station comprising transmitting means for transmitting signals on a downlink, receiving

means for receiving signals transmitted by the transceiving means of the secondary station on an uplink and control means, said control means including means for determining the quality of a signal received by the receiving means from the uplink and means for modulating a signal to be transmitted on the downlink, said modulating means selecting the characteristics of the uplink and/or downlink transmission in response to information obtained concerning the quality of the uplink and/or downlink

Other factors which may be taken into account when selecting the said characteristics include application requirements such as bit rate, bit error rate (BER) and end-to-end delay

Brief Description of Drawings

The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein

Figure 1 is a block schematic diagram of two-way telecommunications system,

Figure 2 illustrates an example of a downlink frame structure,

Figure 3 illustrates an example of an uplink frame structure,

Figure 4 illustrates an example of the downlink header structure,

Figure 5 illustrates an example of a downlink packet data burst structure,

Figure 6 illustrates an example of a downlink real-time data burst structure,

Figure 7 is a block schematic diagram of a transmitter which can be used in a primary and a secondary station, and

Figure 8 is a block schematic diagram of a receiver which can be used in a primary and a secondary station

In the drawings corresponding features have been indicated with the same reference numbers

Mode for Carrying Out the Invention

Figure 1 illustrates a cellular radio system which operates in accordance

with a flexible protocol which is able to support efficiently a wide range of multimedia applications with different bit rates in a wide range of operating conditions on the air interface

The illustrated system comprises a system controller SC which is coupled by say landlines LL to respective primary stations PS1, PS2 and PS3 The primary stations PS1, PS2, PS3 comprise transceivers and microcontrollers, the transmitter of each of which transceivers defines its own coverage area CA1, CA2 and CA3 which for convenience is shown as hexagonal In order to allow flexible deployment of the primary stations it is desirable to be able to re-use the same carrier frequency in immediately adjacent coverage areas or cells Mobile, for example portable, secondary stations SS1, SS2 and SS3 comprising transceivers and microcontrollers are able to roam between and within the coverage areas CA1, CA2 and CA3

Transmissions on a down-link from a primary station are in the form of a broadband TDMA downlink transmission, the transmitted modulation and coding being selected according to the interference environment at the secondary station being addressed In the case of uplink transmissions from the secondary stations SS1 and SS3 they may comprise CDMA and TDMA transmissions

In order to provide flexibility, the broadband TDMA downlink comprises different modulation and coding schemes, nominally of the same bandwidth, but without the constraint of fixed time slots within a time frame A frame header is used to indicate the location of data intended for each user within the frames In the case of an uplink transmission, a framing structure is used and the frame is partitioned between CDMA and TDMA sections and in order to allocate secondary stations to parts of the uplink frame, this allocation is indicated in the downlink information

Time Division Duplex (TDD) and Frequency Division Duplex (FDD) are both possible In TDD, the durations of uplink and downlink frames could be different Further the frame duration might not need to be fixed precisely, but could vary around some nominal value (cf IEEE 1394 standard)

In order to maximise data throughput, transmissions to secondary stations which are close to a primary station use a high order modulation but for secondary stations operating under very poor signal-to-noise conditions, such as may occur near the boundary of a cell, low bit rate orthogonal coding may be used The C/N (Carrier to Noise) requirements for some known modulation schemes with AWGN are tabulated below In the table Eb/No indicates energy per bit divided by noise density and Bps/Hz indicates bits per second divided by frequency

Modulation	Eb/No(dB)	Bps/Hz	C/N(dB)
64-QAM	18	6	26
16-QAM	13	4	19
4-QAM/4-PSK	9	2	12
2-PSK	9	1	9
8-FSK	8	0 75	7
16-FSK	7	0 5	4
32-FSK	6 5	0 31	1 5
64-FSK	6	0 19	-1
128-FSK	6	0 11	-3 5
2-PSK,spread by 9	9	0 11	-0 5

The results assume coherent detection and could be improved using channel coding in combination with a selected modulation scheme

Figure 2 illustrates an example of a TDMA frame structure suitable for use on the downlink transmission from a primary station The frame structure comprises a plurality of frames, each being of the same duration, for example 5ms which is a good compromise between efficiency and transmission delay The downlink frame comprises a sync sequence S indicating the start of the frame, a header H, followed by one or more data bursts DB1 to DB4 and possibly a null transmission NT until the start of the next frame The format of each data burst (e g modulation and coding, training sequences, data

organisation) is flexible The header H contains an indication of the formats and timing of each data burst together with some information on the location of users data within the data bursts The allocation of user data to data bursts is negotiated between the primary station and the secondary station Training sequences TS may be embedded in the data bursts to enable the secondary station to estimate the channel characteristics The distribution of training sequences within the frame need not necessarily be uniform and could be adaptive to the velocity of a secondary station A rapidly moving secondary station will experience faster changes in the channel and consequently need more rapid updating of the channel impulse response Slow moving mobiles, particularly at long range, may be able to use several training sequences to get a better estimate of channel impulse response For optimum efficiency the data bursts are contiguous Also the sync sequence S could be used as a training sequence

The requirements of the header are to enable the mobile to efficiently locate its data within the frame while minimising the transmission overhead Some example header formats are detailed later

Since the format of the header H is flexible, both traffic and signalling channels can be easily mapped into the same physical radio channels

A data burst for each secondary station is transmitted within a particular designated time interval with a modulation scheme and power level such that the required number of bits are sent within the frame duration and can be reliably received by the secondary station (considering the prevailing interference environment)

For example, signals intended for secondary stations close to the primary station (experiencing low co-channel interference from adjacent cells) could use a high order modulation (e g 16-QAM), while for those further away QPSK might be appropriate For secondary stations at the cell boundary experiencing significant co-channel interference a robust modulation of low bandwidth efficiency might be necessary (e g 128-FSK)

The header H is used to indicate the location within the frame of data

intended for particular users It could also indicate the quantity of data and modulation scheme In a downlink scenario the allocation of data within the frame can be completely flexible

As an example, for mobile radio applications, the bandwidth of the transmission from a primary station could be around 1 5 MHz, with a frame duration of around 5ms A wider bandwidth would offer greater benefits from frequency diversity, but the processing requirements of the secondary station's receiver would be correspondingly greater In order to simplify dynamic channel allocation, it is desirable that the modulation bandwidth is kept constant, but this is not essential

As a general principle it would be desirable to minimise the peak transmitted power level to minimise interference to other users So, given the required quantity of data to be sent and the interference levels at each secondary station, the aim is to select a modulation and bit rate for each secondary station such that the transmission occupies the whole frame duration with a uniform minimum power level (or at least a close approximation to this condition) As an example, if just a single low bit-rate user was being served by the primary station this condition would be met by selecting a low order modulation scheme and transmitting for the entire duration of the frame

When selecting a modulation scheme (including multicarrier and spread spectrum) account must be taken of constraints imposed by for example channel characteristics, transmitter and receiver processing power, transmitter linearity and adjacent channel emissions The modulation scheme and transmission power can vary dynamically from user to user and from frame to frame If conventional spreading techniques are used, then more than one user may be supported in the same time-slot

Since some of the information in the header H will be required by distant secondary stations it will need to be robustly transmitted, with significant redundancy A solution which reduces the total redundancy is to partition the header blocks with differing levels of coding (or modulation) Two partitions are probably sufficient, where modulation schemes are referred to in one of the

partitions (but not both) It may be desirable for the header H to include a length indicator and some error detection, such as CRC

Figure 3 illustrates an example of an uplink frame structure An exclusively TDMA structure is possible, but not considered practical for uplink transmissions because for high efficiency the secondary stations would be required to achieve high timing accuracy A CDMA approach has the desirable feature that efficient variable rate communication is possible In addition the receiver complexity, which could be considerable if multi-user detection is used, is located at the primary station However, for very high bit rates and correspondingly large packet sizes, better performance (with lower complexity) may be obtained by using part of the frame in a TDMA mode

Figure 3 shows a split of resources in the uplink frame structure between CDMA section 8 and TDMA section 9 More particularly the duration of the uplink frame is the same as the downlink frame, say 5ms The frame commences with a guard space GS and is followed by the CDMA section 8 Three data bursts DB10, DB11, DB12 are included in the frame and are separated from each other and the CDMA section 8 by guard spaces GS A null transmission section NT may be included to complete the frame The precise allocation can be indicated in the downlink, for example in the frame header or via control channels Likewise timing can be derived from the downlink.

The format of the uplink bursts must be agreed by secondary station and the primary station during call set up This signalling could be carried out using the CDMA section 8 The division between the CDMA and the TDMA sections 8,9 may be determined dynamically in which case the downlink header will contain an indication of the location of the division The TDMA section 9 is composed of data bursts DB10, DB11, DB12 from three users as indicated by the different hatching patterns Each of the data bursts DB10, DB11 and DB12 may include at least one training sequence TS located intermediate the start and finish of the data burst The number of training sequences allocated per packet is determined by the need to be able to track channel changes Power

control is applied to the CDMA section 8 of the uplink transmission and may be applied to the transmission of the data bursts DB10 DB11,DB12 in order to minimise adjacent channel interference In the event of the frame not being filled completely by data bursts, a null transmission NT is made to complete the frame

Similar principles can be used in sending data packets on the uplink as are used on the downlink but some additional features are necessary

Variable bit-rate real time services, where access to the channel is needed without prior reservation, can be efficiently supported by CDMA techniques, and section 8 of the frame is allocated to use of this access mechanism Multicarrier CDMA could also be appropriate One requirement may be to use sufficient bandwidth to obtain the benefits of frequency diversity However, primary stations may also be able to exploit antenna diversity Low bit-rate non-real time services may also be allocated to this portion of the frame, since the overheads associated with packet transmission (training sequence and guard space) may be significant.

High bit-rate packets can be more efficiently transmitted by TDMA, particularly if the secondary station is close to the primary station Therefore section 9 of the frame is allocated to use of this access mechanism In this case guard spaces GS are provided in front of the CDMA section 8 and between the section 8, data bursts DB10, DB11 and DB12 and, if present, the null transmission NT in order to make allowance for timing errors by the secondary stations The duration of the guard space GS may be adaptive, depending on the size of the coverage area Permission to transmit a data burst at a given time may be granted by the primary station

The timing of the uplink frame can be derived from the downlink sync sequence S Timing advance may be desirable in large cells

An example of a downlink header structure will now be described with reference to Figure 4 The header structure comprises 6 concatenated fields 10 to 20, each field serves for indicating field sizes 10, that is, the sizes of the fields 12,14,16 and 20, number of bursts 12, number of addresses 14 in a

frame, number of addresses in each burst 16, the addresses in each burst 18 and the timing offset of each burst 20, respectively The appended frame is organised such that data packets using the same modulation/coding scheme are transmitted together in the same data burst By the field 18 listing the destination addresses for the packets in each burst (for convenience in the order in which they are transmitted) and the field 20 giving the timing offset of the start of each data burst, a user can determine if there is a relevant data packet in the frame, and in which data burst it is located

The allocation of Temporary Addresses and agreement on Burst Formats can be established at Registration or Call Set Up, or changed by signalling

Parameter Description	Units	Designation	Number of Bits
Size of Temporary Address Field	Bits	STAF	4
Size of Number of Bursts Field	Bits	SNBF	3
Size of Number of Packets Field	Bits	SNPF	4
Size of Timing Offset Field	Bits	STOF	4
Number of Bursts	Number	NB	SNBF
Number of Temporary Addresses with Data Packets in Current Frame	Number	NTA	STAF
List of Number of Temporary Addresses with Data Packets in each Burst	List of numbers		NB*SNPF
List of Temporary Addresses with Data Packets in each Burst	List of addresses		NTA*STAF
Timing Offset of each Burst	List of Offsets		NB*STOF

The sizes of all the fields are adjustable over wide limits to allow the greatest possible degree of flexibility

If some typical figures are taken as an example, for a frame duration of

5ms with a nominal throughput capability of 1Mbps, then the frame will consist of a maximum of 5000 bits If the number of Temporary Addresses is 200, then STAF = 8 If the minimum packet size is 3 bytes, then the maximum number of packets is about 200 and SNPF = 8 If the timing resolution is specified as 1 part in 4096 then STOF = 12 If the Number of Bursts is 6, then SNBF = 3

Taking a typical case of 20 data packets in a frame, this means that the total number of bits in the header is 4+3+4+4+3+8+(6*8)+(20*8)+(6*12) = 306 bits which is an overhead of about 6% The overhead due to the header is thus about 2 bytes per packet

A Burst Identifier is implicitly assigned to each data burst, and they are transmitted in ascending order Not all bursts need to be transmitted An untransmitted burst will have no Temporary Address assigned to it in the header

Further simplification is possible For example the Number of Temporary Addresses with Data Packets in the Current Frame could be deduced by summation of the number of packets in each data burst

The allocation of burst format to each burst (e g modulation, coding, structure) can be dynamic The details could be communicated to a mobile on registration, at call set up or by signalling

It is probably desirable to standardise the formats of some burst (e g for broadcast channels)

In some applications it may be desirable to allocate the same burst format to more than one data burst

The structure of downlink data bursts is flexible Therefore any format could be defined, subject to the system bandwidth constraints Two possibilities optimised for non-real time packet transmission and very low rate variable real-time transmission, respectively, will now be considered

The data burst structure shown in Figure 5 comprises 5 concatenated fields commencing with a training sequence 22 and followed by field sizes 24, number of packets 26, packet sizes 28 and the packets 30 themselves The

following table gives an example of implementing a packet data burst

Parameter Description	Units	Designation	Number of Bits
Training Sequence	Bits	TS	40
Size of Number of Packets Field	Bits	SMPF	4
Size of Packet Size Field	Bits	SPSF	4
Number of Packets	Number	NP	SNPF
List of Packet Sizes (in bytes)	List		NP*SPSF
Packets	Data		up to $NP*2^{SPSF}*8$

This packet format could be used when only one training sequence is required It also assumes that all the relevant destination addresses are given in the Frame Header The length of the training sequence given here is only illustrative

Let us assume that the data burst contains 5 packets of average size 20 bytes and maximum size 50 bytes Then SNPF = 3, SPSF = 6, NP = 5 and the overhead (without training sequence) is 4+4+3+(5*6) = 45 bits which, given the size of packet data of 5*20*8 = 800 bits, represents an overhead of about 6%, or about 1 byte per packet

For low bit rate speech, with a bit rate of 8 kbps, the typical packet size would be 5 bytes The overhead considering both frame header and burst structure is about 3 bytes per packet (or 60%)

Figure 6 illustrates an example of a downlink real-time data burst structure which commences with a training sequence 32 which is followed by field sizes 34, size of address map 36, the address map 38 and the data bytes 40 The following table gives an example of implementing a downlink real-time

data burst structure

Parameter Description	Units	Designation	Number of Bits
Training Sequence	Bits	TS	40
Size of Number of Bytes Field	Bits	SNBF	4
Size of Address Map	Bits	SAM	SNBF
Address Map	Bit Map		SAM
Data Bytes	Data		up to SAM*8

This burst is designed to be efficient for circuit switched (connection oriented) low bit rate real time traffic which may also have variable bit rate and variable occupancy The data from several users is multiplexed in the packet. To save space in the frame header, only one Temporary Address is assigned to be used by all the users On call set up the user is informed of the relevant Temporary Address and assigned one or more bytes in the burst, each designated by a location in the Address Map To deal with variable bit rates, bytes are only transmitted in the frame when there is data from the signal source In this case the corresponding bit in the Address Map is set Otherwise the bit in the Address Map is not set and that byte is not transmitted The user can thus identify whether relevant data is present by examining their allocated locations in the Address Map

As an example, it will be assumed that there are 40 users which have each been assigned 6 bytes of capacity in the burst, but the signal source is only 50% active With a frame duration of 5ms this corresponds to an active bit rate of 9600 bps, which may be appropriate for low rate speech services Then SNBF=8, SAM = 240 which is an overhead (without training sequence) of 4+8+240 = 252 bits The average packet will contain 960 bits, so the overhead represents about 26% of the data throughput The efficiency could

be improved significantly by changing the granularity of the capacity allocation to match the signal source (e g to 3 bytes instead of 1 byte)

For fixed rate low bit rate services the Address Map would not be required and as a consequence the efficiency could be higher

Figures 7 and 8 are block schematic diagrams of a transmitter, receiver and controller as embodied in a primary station The secondary station could be similar but omit those features relating to handling inputs from, and outputs to, a multiplicity of users For convenience of description, the transmitter and receiver have been shown separately However, in reality certain parts, such as controller 42 and frequency generators (not shown separately), will be common and identified by the same reference number

Referring to Figure 7, different users or different applications run by one user U1,U2,U3 to Un are coupled to a buffer 44 The users U1 to Un provide digital outputs Outputs of the buffer 44 are coupled to multiplexer 46 Information concerning the user data is relayed to the controller 42 by a line 48 An output from the multiplexer 46 is coupled to a frame/data burst building stage 50 which also receives inputs from a sync source 52 and a header generator 54 The frame/data burst is supplied to a channel coding stage 56 for encoding If it is decided that the channel coded signal should be interleaved then this is done in an interleaving stage 58 The signal is then modulated in a modulator 60 The modulation scheme(s) used on the signal(s) is determined by the controller 42 which on an input 62 from the receiver (Figure 8) receives estimates of the channel quality to each of the respective addressees of signals Stage 64 is a signal spreading stage whose use is optional The modulated signal is converted into an analogue signal in a digital to analogue converter 66 and is passed to a transmitter 68 Although not shown, the block representing the transmitter 68 includes a master oscillator and mixer for frequency up-conversion and a power amplifier

The broken lines represent control lines from the controller 42 to the stages 46,50,52,54,56,58,60,64 and 68, respectively

The receiver shown in Figure 8 comprises a receiving stage 70, which

includes amplifiers, local oscillator, mixer and filters (not shown), coupled to an analogue to digital converter 72 The digitised output is supplied to a buffer 74, a sync signal detector 76 and to a RSSI stage 78 An output of the buffer 74 is supplied to another buffer 80 and to a header decoding stage 83 The outputs of the sync signal detector 76 and the header decoding stage 83 are coupled to the controller 42 which recovers the information in the header and uses it in controlling various stages of the receiver If the received signal is a CDMA signal then it is de-spread in a de-spreading stage 82 A demodulator 84 demodulates a signal on its input using a modulation scheme selected by the controller 42 in response to data in the header The demodulator 84 provides outputs to a channel quality estimating stage 86 and an optional de-interleaving stage 88

Any error correction/detection of the demodulated signal is carried out in error correction/detection stage 90 which supplies an output to a demultiplexer 92 to which are connected the users or different applications of one user U1 to Un The error correction/detection stage 90 also provides an output to the stage 86 and an error indication to the medium access control (MAC) layer

The stage 86 uses the outputs from the RSSI stage 78, the demodulator 84 and the error correction/detection stage 90 to make an estimate of the channel quality and to supply this estimate on the line 62 coupled to the controller 42 of the transmitter (Figure 7)

On the basis of the information given in the header, power saving can be practised by the transceiver In use the controller 42 can energise the receiver to receive the sync signal and header in each frame and if it determines that there are no data bursts for it, various stages of the receiver can be de-energised or put into a sleep mode Additionally by analysing the information in the header, the controller 42 may determine that say the third one of five data bursts in the frame is addressed to it and in consequence it de-energises or puts into a sleep mode various stages of the receiver for substantially the durations of the first ,second, fourth and fifth data bursts In

another variant applicable to a low rate data user/application, the primary station and an addressed secondary station can arrange for data to be transmitted every 1 in N frames, where N is an integer, so that the receiver can sleep for the intervening (N-1) frames

Other features of implementing the system in accordance with the present invention are

The same frame structure can be used in both time division duplex (TDD) and frequency division duplex (FDD) modes Timing can be derived from the downlink sync sequence In the case of TDD the partitioning between uplink and downlink could be variable

In typical operating environments with frequency selective fading, a wide bandwidth is desirable in order to obtain the benefits of frequency diversity Possible solutions are single broadband carrier with equalisation at the receiver, multi-carrier modulation (MCM), direct sequence spread spectrum (DSSS) These have the advantage of reducing the need for time domain interleaving Slow frequency hopping is another option, but this is likely to imply significant interleaving delay

Using a single carrier approach, a carrier spacing of the order of 1 6 MHz would be viable If MCM techniques are adopted then the effective bandwidth would be much wider

The frequency re-use distance should be chosen to maximise spectral efficiency One possible solution for the downlink might be to use DSSS techniques with re-use in adjacent cells (cluster size = 1) Another approach is to accept the possible loss in capacity due to a larger re-use distance, in order to obtain higher throughput from a single carrier

The system capacity can be increased by adapting the modulation scheme to the channel conditions For example, high order modulations (e g 16-QAM) could be used on the downlink for transmission to secondary stations near the primary station, where C/I is relatively good Similarly, robust modulation (e g BPSK) and coding schemes can be used to reach mobiles near the edge of the cell where C/I is poor

If interleaving is required, then data bursts can be defined where the interleaving depth can in principle be any combination of the following

- within a burst,
- over more than one burst in a frame,
- over more than one frame

For flexible deployment dynamic channel allocation (DCA) is desirable

Two different handover types are considered

Intra-cell (to a different downlink burst, or from CDMA to TDMA sections in uplink) This is straightforward, and a downlink handover may not even need any signalling between mobile and base-station, since the change can be indicated in the frame header

Inter-cell (to a different carrier frequency, or possibly the same one if spreading is used) A mechanism is proposed below for inter-cell handover, which does not require two transmitters or receivers When a secondary station is in a situation where an inter-cell handover is likely transmissions (on both uplink and downlink) are limited to alternate frames This would simplify monitoring signals from other primary stations without the need for two receivers It would also allow communication to be established with two base stations at once (allowing "soft handover")

Furthermore, if the calls where a handover is expected (i e with secondary stations near the cell boundary, and therefore using a low order robust modulation) are placed on a downlink transmission burst closely following the header in time, then handovers can be carried out between unsynchronised primary stations, since the probability of overlap between required parts of the downlink frames are minimised Distance from secondary to primary station can be determined (at least in a relative way) if both transmitted and receiver power levels are known The proposed uplink frame also supports this handover feature

Power control can be applied in both the uplink and downlink In the uplink, the power of the secondary station should be adjusted to achieve sufficient C/I at the primary station In the downlink, the choice of modulation

scheme, burst format and power level can be made to minimise interference to other users, while still achieving a good quality connection A uniform power level throughout the frame is a reasonable objective here

On the downlink data for low bit rate users is allocated close to the header so that their receivers only need to power-up once

Dynamic Channel Allocation DCA can be applied, particularly to ease handover problems for roaming secondary stations at cell boundaries To allow a secondary station at a cell boundary to distinguish signals from different primary stations, it will be desirable to use different orthogonal codes This could be achieved by use of different spreading codes Allocation on a random basis may be sufficient A secondary station may be able to detect codes used by a neighbouring primary station and request the use of a different one

When setting-up a cell, the secondary station will need to inform the primary station of its current radio environment (i e interference levels in possible channels, velocity-if known) The primary station will also need to know the path loss to the secondary station, which might be inferred from received level on the up-link if the transmit power is known There will also need to be an agreement between the secondary station and primary station on their respective capabilities (e g bit rate, modulation, coding) Such information may be pre-stored in the system controller SC (Figure 1)

The data for a particular user could be identified by time in relation to the start or finish of the header Sync sequences might help, for example if they are regularly spaced Some sync/address data might be included in the user data to allow for small timing errors

Control and signalling information may be placed in the header, or in separate time slots

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the design, manufacture and use of telecommunications systems and component parts thereof and which may be used instead of or in addition to features already described herein

Industrial Applicability

Universal Mobile Telephone System and other cellular telephone systems

CLAIMS

1 A method of transmitting a signal between a primary station and a secondary station each said station comprising transceiving means and control means, at least the control means of the primary station being capable of determining the quality of a signal received on an uplink, characterised by modulating a signal to be transmitted on a downlink and by selecting the characteristics of the transmission in response to information concerning the quality of the uplink and/or downlink

2 A method as claimed in Claim 1, characterised by further selecting the said characteristics on the basis of at least one of bit rate, bit error rate and end-to-end delay

3 A method as claimed in Claim 1 or 2, characterised in that downlink transmission comprise time frames and in that each time frame includes a header having indicia indicating the transmission characteristics and timing of each data burst in the time frame

4 A method as claimed in Claim 1, 2 or 3, characterised in that downlink transmissions are TDMA.

5 A method as claimed in any one of Claims 1 to 4, characterised in that uplink transmissions are CDMA and/or TDMA

6 A two-way telecommunications system comprising a primary station and at least one secondary station comprising transceiving means, the primary station comprising transmitting means for transmitting signals on a downlink, receiving means for receiving signals transmitted by the transceiving means of the secondary station on an uplink and control means, said control means including means for determining the quality of a signal received by the

receiving means from the uplink and means for modulating a signal to be transmitted on the downlink, said modulating means selecting the characteristics of the uplink and/or downlink transmission in response to information obtained concerning the quality of the uplink and/or downlink

7 A system as claimed in Claim 6, characterised in that the primary station transmits downlink signals in accordance with a TDMA format comprising a succession of time frames each including a frame header

8 A system as claimed in Claim 7, characterised in that the frame header includes indicia indicating the location of data bursts intended for one or more of the secondary stations

9 A system as claimed in Claim 8, characterised in that the frame header includes indicia indicating the format and timing of each data burst

10 A system as claimed in Claim 8 or 9, characterised in that training sequences are embedded in the data bursts

11 A system as claimed in any one of Claims 7 to 10, characterised in that the at least one secondary station effects power saving by adopting a sleep mode whenever the secondary station determines that data bursts are directed to other secondary stations

12 A system as claimed in any one of Claims 7 to 11, characterised in that the time frames are of a substantially fixed duration

13 A system as claimed in anyone of Claims 6 to 12, characterised in that the modulating means applies a high order modulation scheme to signals to be transmitted to secondary stations relatively close to the primary station and low bit rate orthogonal codes when transmitting signals to relatively

distant secondary stations

14 A system as claimed in any one of Claims 6 to 13, characterised in that traffic data is transmitted on the downlink with a modulation scheme and power level determined to ensure reliable receipt by a secondary station

15 A system as claimed in any one of Claims 6 to 14, characterised in that uplink signals are transmitted as CDMA signals

16 A system as claimed in any one of Claims 6 to 15, characterised in that uplink signals are transmitted in accordance with a TDMA format

17 A system as claimed in Claim 16, characterised in that TDMA uplink signals comprise at least two data bursts and in that a guard space is provided between adjacent data bursts

18 A system as claimed in Claim 16 or 17, characterised in that TDMA uplink signals comprise data bursts, and in that each data bursts comprises at least one training sequence

19 A system as claimed in Claim 16, 17 or 18, characterised in that TDMA uplink signals comprise data packets, and in that the bit rates of at least two of the data packets are different

20 A system as claimed in any one of Claims 6 to 19, characterised in that timing for uplink signals is derived from the downlink signals

21 A system as claimed in any one of Claims 6 to 20, characterised in that the system is a cellular system comprising a plurality of cells, each cell having a primary station defining a respective coverage area

22 A system as claimed in Claim 21, characterised in that primary stations have means for handing over secondary station participating in a call from one cell to another cell

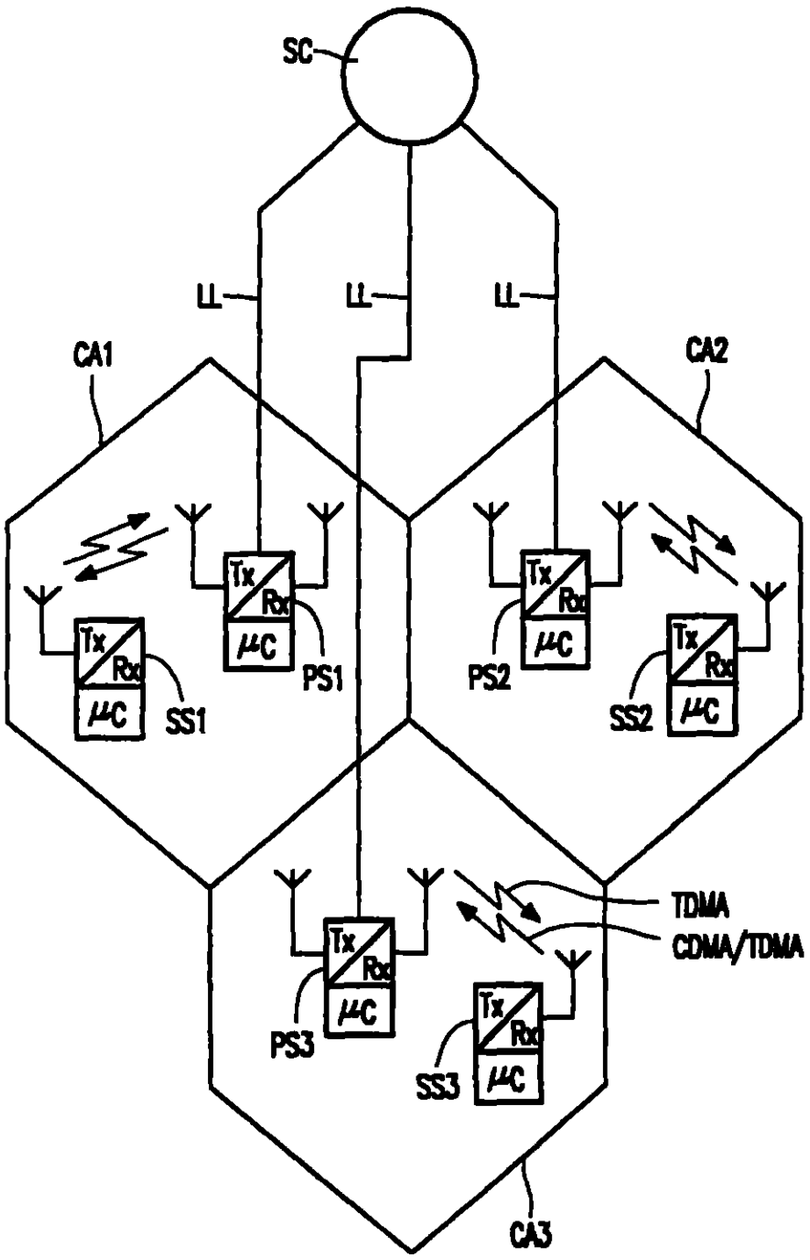
SC
LL
LL
LL
CA1
CA2
CA3
Tx
Rx
μC
PS1
SS1
PS2
SS2
PS3
SS3
TDMA
CDMA/TDMA

FIG. 1

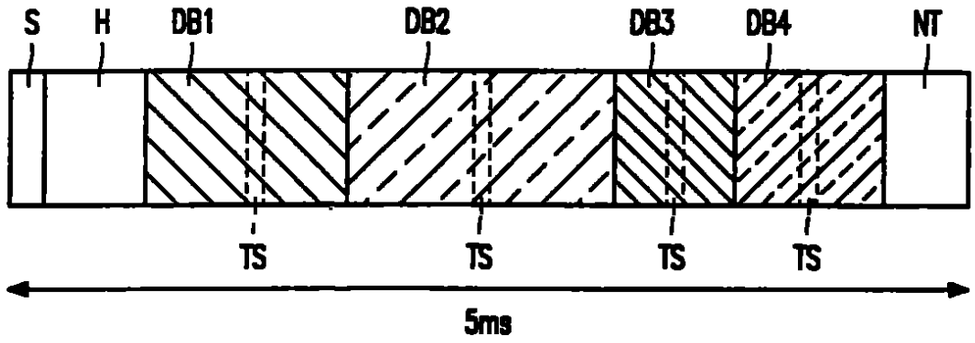

FIG. 2

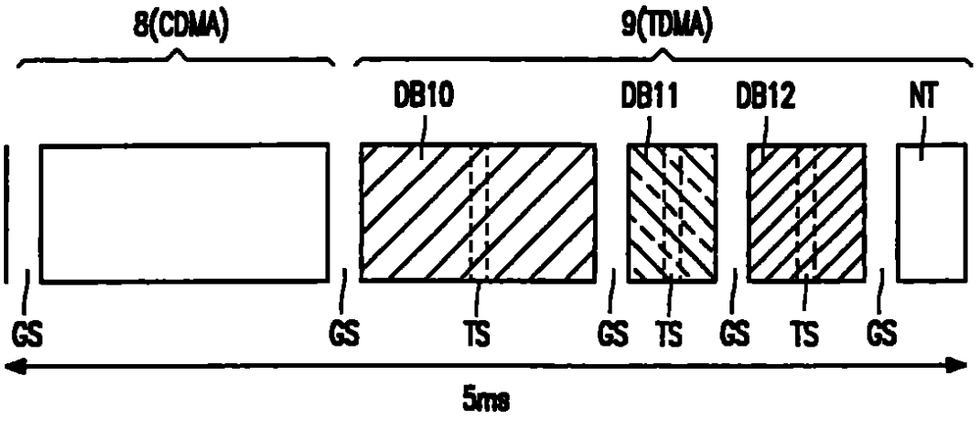

FIG. 3

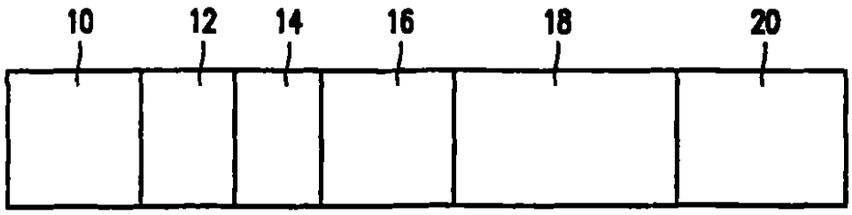

FIG. 4

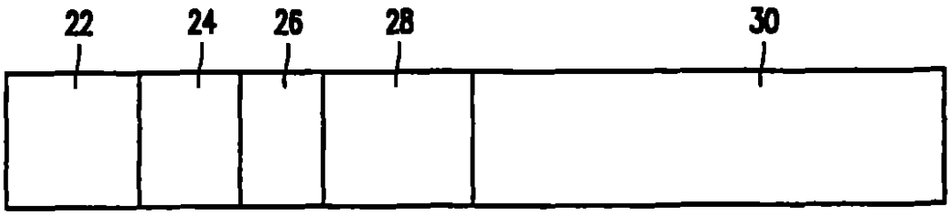

FIG. 5

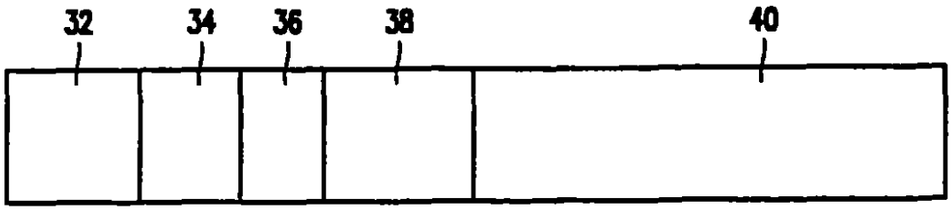

FIG. 6

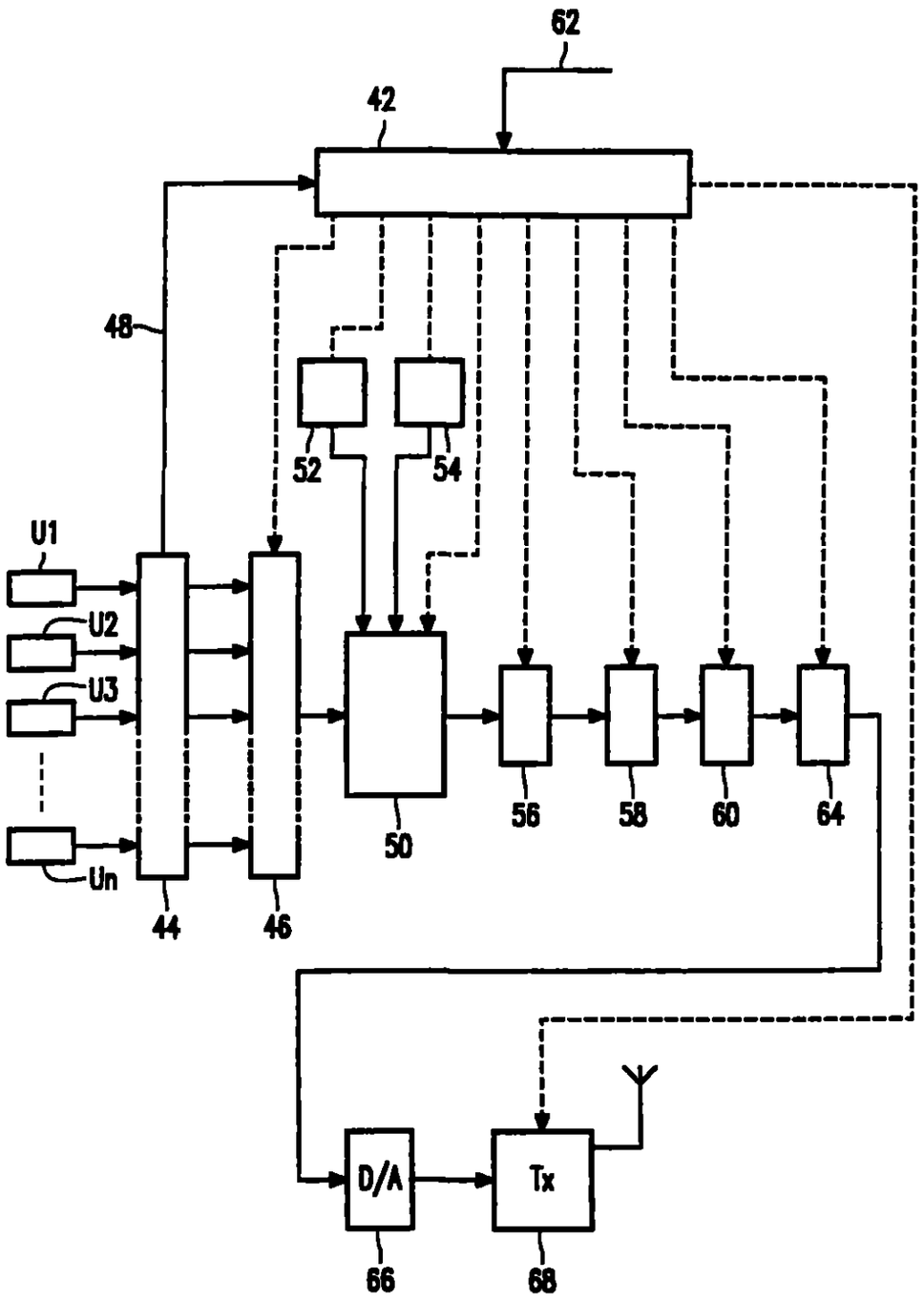

FIG. 7

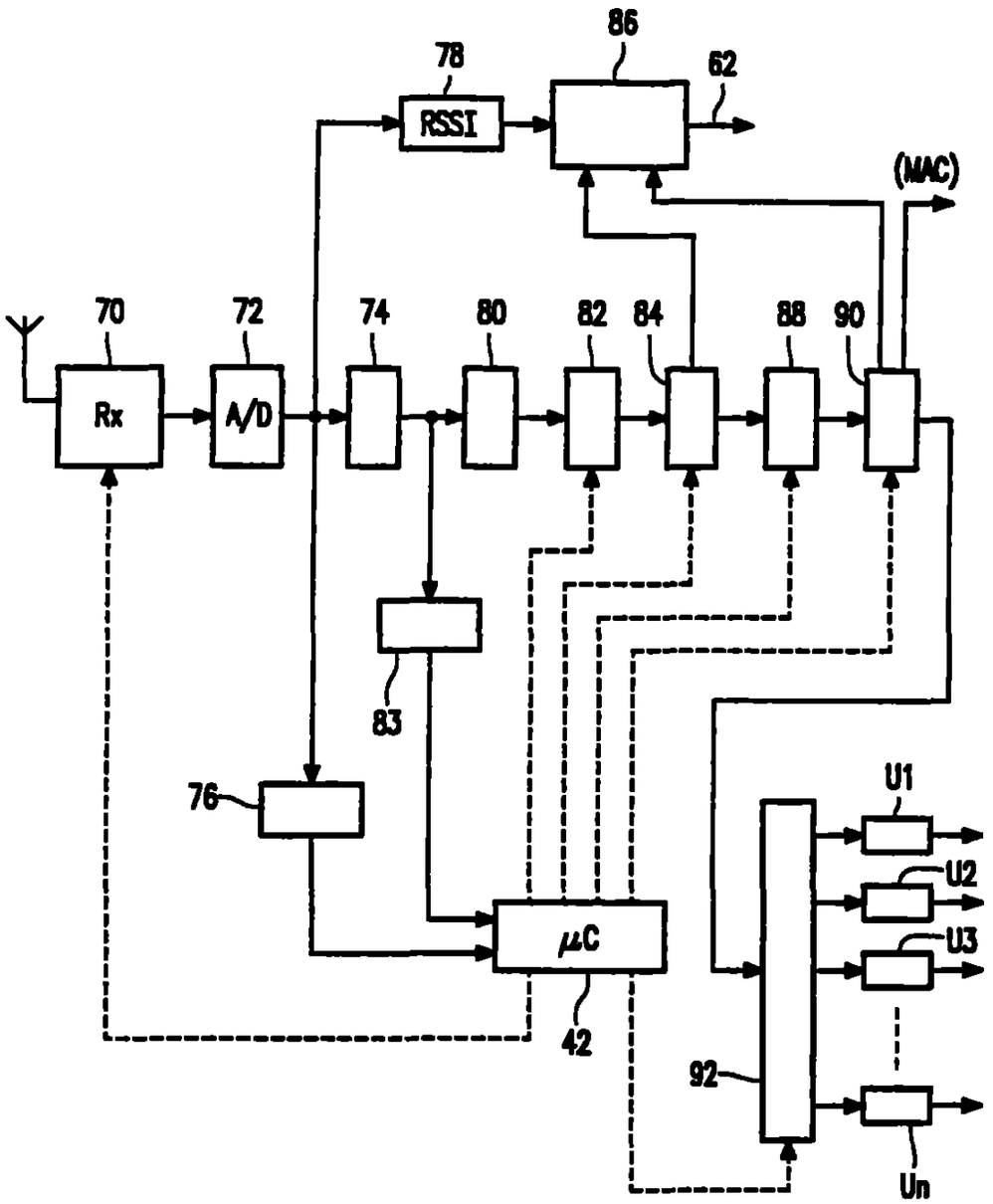
86
78
62
RSSI
(MAC)
70
72
74
80
82
84
88
90
Rx
A/D
83
76
U1
U2
U3
μC
42
92
Un

FIG. 8

INTERNATIONAL SEARCH REPORT

Information on patent family members

27/07/98

International application No
PCT/IB 98/00338

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0713300 A1	22/05/96	GB 2295295 A	22/05/96
		GB 9423400 D	00/00/00
EP 0472511 A2	26/02/92	SE 0472511 T3	
		AT 150606 T	15/04/97
		AU 642760 B	28/10/93
		AU 8261991 A	27/02/92
		CA 2049712 A	24/02/92
		DE 69125227 D,T	03/07/97
		DK 472511 T	22/09/97
		ES 2101736 T	16/07/97
		GR 3022879 T	30/06/97
		HK 100397 A	08/08/97
		JP 4234232 A	21/08/92
		NZ 239283 A	27/09/94
		US 5327576 A	05/07/94
WO 9526613 A2	05/10/95	AU 1952795 A	17/10/95
		CN 1144591 A	05/03/97
		EP 0752190 A	08/01/97
		FI 941333 A	23/09/95
		JP 9510846 T	28/10/97
GB 2313254 A	19/11/97	GB 9610315 D	00/00/00
		WO 9744968 A	27/11/97
EP 0353759 A2	07/02/90	AU 632055 B	17/12/92
		AU 3927889 A	08/02/90
		CA 1316218 A	13/04/93
		GB 2223914 A,B	18/04/90
		US 4910794 A	20/03/90
		US 5070536 A	03/12/91
		US 5483676 A	09/01/96
		US 5673031 A	30/09/97

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To

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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71 1)

Date of mailing (day/month/year)	04 07.2002
Applicant's or agent's file reference: 29471/36995	IMPORTANT NOTIFICATION

International application No	International filing date (day/month/year)	Priority date (day/month/year)
PCT/US01/09733	27/03/2001	18/04/2000

Applicant
ZENITH ELECTRONICS CORPORATION

1 The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application

2 A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices

3 Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices

4 **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301)

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned

For further details on the applicable time limits and requirements of the elected Offices see Volume II of the PCT Applicant's Guide

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Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
29471/36995		
International application No	International filing date (day/month/year)	Priority date (day/month/year)
PCT/US01/09733	27/03/2001	18/04/2000
International Patent Classification (IPC) or national classification and IPC H04N7/24		
Applicant ZENITH ELECTRONICS CORPORATION		

1 This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES I e sheets of the description claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70 16 and Section 607 of the Administrative Instructions under the PCT)

These annexes consist of a total of sheets

3. This report contains indications relating to the following items.

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty Inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability citations and explanations suporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
05/10/2001	04.07.2002
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel +49 89 2399 0 Tx. 523656 epmu d Fax +49 89 2399 4465	Authorized officer Schneiderlin, J Telephone No. +49 89 2399 7400

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No PCT/US01/09733

I Basis of the report

1 With regard to the elements of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70 16 and 70 17))*:
Description, pages

1-46 as published

Claims, No.

1-24 as published

Drawings, sheets

1/12 12/12 as published

2 With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item

These elements were available or furnished to this Authority in the following language which is

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23 1(b))
- ☐ the language of publication of the international application (under Rule 48 3(b))
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55 3)

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing

- ☐ contained in the international application in written form
- ☐ filed together with the international application in computer readable form
- ☐ furnished subsequently to this Authority in written form
- ☐ furnished subsequently to this Authority in computer readable form
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. The amendments have resulted in the cancellation of

- ☐ the description, pages.
- ☐ the claims, Nos

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No PCT/US01/09733

☐ the drawings, sheets

5 ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70 2(c))

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6 Additional observations, if necessary

V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement

1 Statement

Novelty (N)	Yes.	Claims	
	No	Claims	1-24
Inventive step (IS)	Yes	Claims	
	No	Claims	1-24
Industrial applicability (IA)	Yes.	Claims	1-24
	No	Claims	

2 Citations and explanations
see separate sheet

INTERNATIONAL PRELIMINARY EXAMINATION REPORT - SEPARATE SHEET International application No PCT/US01/09733

To section IV.

Reference is made to the following documents

D1 US-A-5 966 120 (SHEN PAUL ET AL) 12 October 1999 (1999-10-12)

D2 WO 98 51111 A (KONINKL PHILIPS ELECTRONICS NV PHILIPS SVENSKA AB (SE)) 12 November 1998 (1998-11-12)

The document D1 discloses (the references in parentheses applying to this document) a system for transmitting (see figure 1) and receiving/processing a distribution data stream (i e digital signal), the distribution data stream containing a map (see col 4 ll 29-33 the map contains information indicating a location of at least one of the video or auxiliary data in the data frame) and video (i e first) and auxiliary (second) data intermixed in a data frame using the MPEG specification The video and auxiliary data have the same constellation (because only one and the same type of modulation is used to transmit them since they are sent through the same distribution data stream) The video and auxiliary data have different bit rates since the video has variable bit rate (see abstract)
Of course in the receiver the video and auxiliary data are processed (see fig 4) in accordance with the map
The subject-matter of claim 1 is therefore not new
A similar objection could be based on D2

As far as they have been understood, none of the dependent claims appear to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and inventive step

Independent claim 1 uses the word "characterized by", but is not in the two-part form the features known in combination from the prior art (document D1) should have been placed in the preamble (Rule 6 3(b)(i) PCT) and the remaining features be included in the characterising part (Rule 6 3(b)(ii) PCT)

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6 2(b) PCT This applies to both the preamble and characterising portion

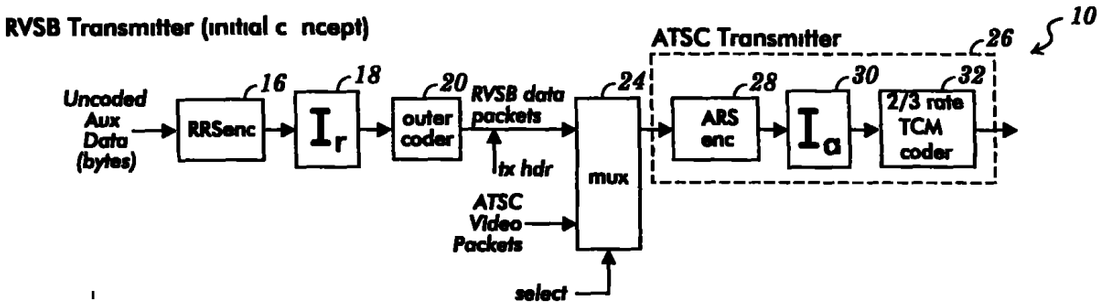

Figure 1

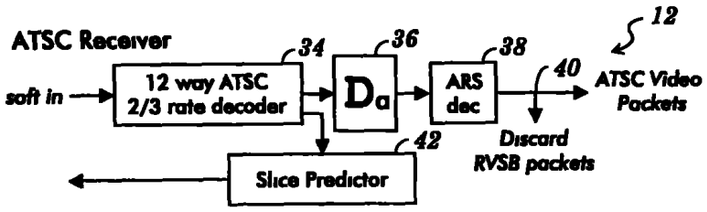

Figure 2

mapper function			
Z2	Z1	Z0	level
0	0	0	-7
0	0	1	-5
0	1	0	-3
0	1	1	-1
1	0	0	+1
1	0	1	+3
1	1	0	+5
1	1	1	+7

Figure 5

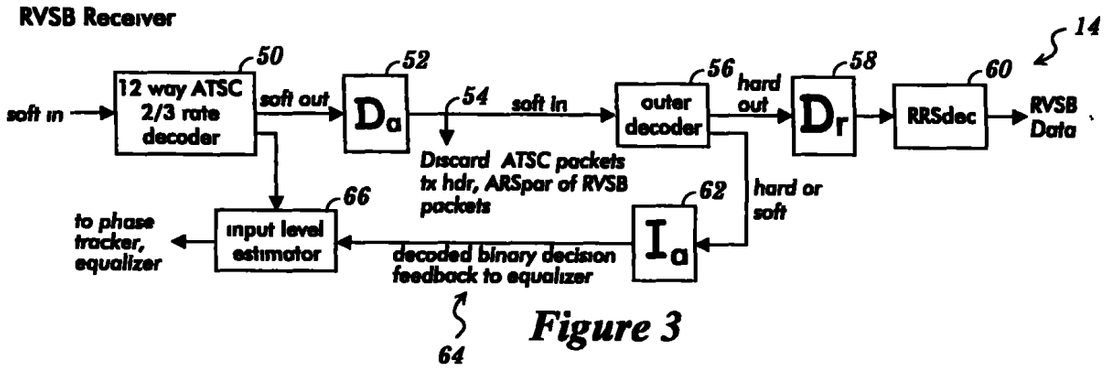

Figure 3

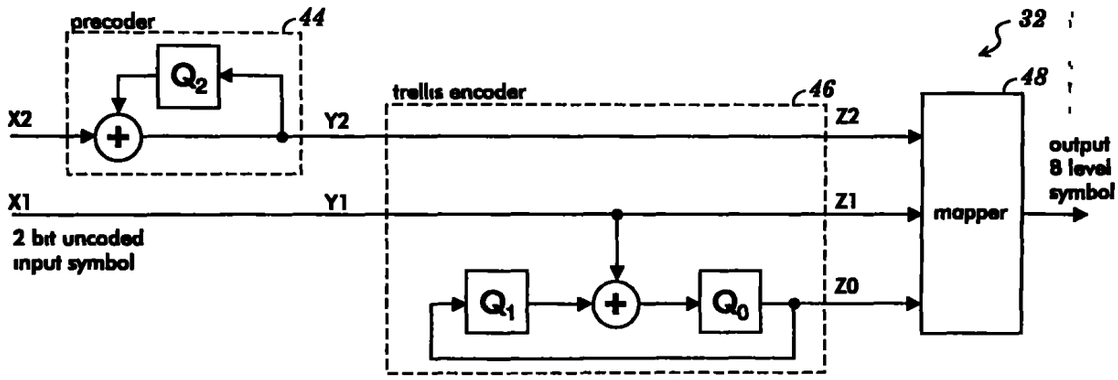

Figure 4

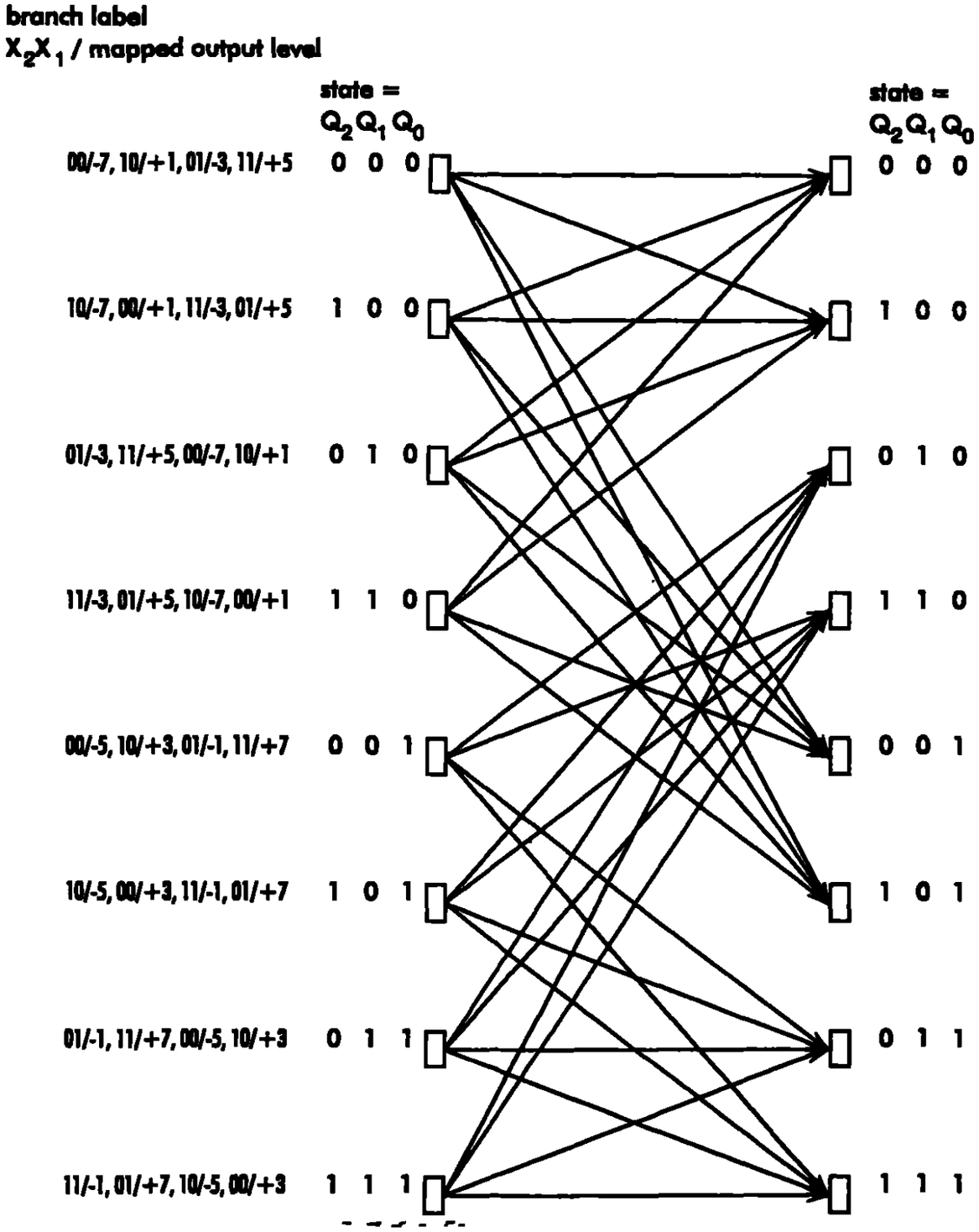
branch label
X_2X_1 / mapped output level
state = $Q_2Q_1Q_0$
state = $Q_2Q_1Q_0$
00/-7, 10/+1, 01/-3, 11/+5
10/-7, 00/+1, 11/-3, 01/+5
01/-3, 11/+5, 00/-7, 10/+1
11/-3, 01/+5, 10/-7, 00/+1
00/-5, 10/+3, 01/-1, 11/+7
10/-5, 00/+3, 11/-1, 01/+7
01/-1, 11/+7, 00/-5, 10/+3
11/-1, 01/+7, 10/-5, 00/+3
0 0 0
1 0 0
0 1 0
1 1 0
0 0 1
1 0 1
0 1 1
1 1 1
0 0 0
1 0 0
0 1 0
1 1 0
0 0 1
1 0 1
0 1 1
1 1 1

Figure 6

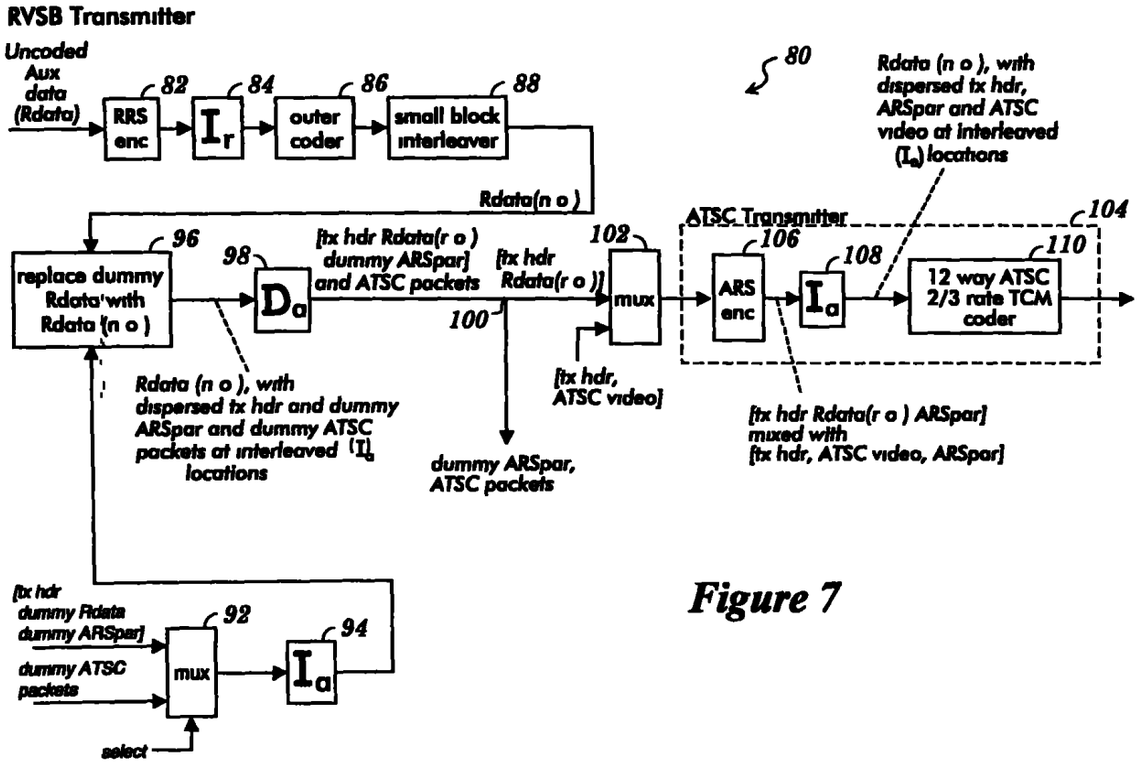
RVSB Transmitter
Uncoded Aux data (Rdata)
RRS enc
82
I_r
84
outer coder
86
small block interleaver
88
80
Rdata (n o), with dispersed tx hdr, ARSpar and ATSC video at interleaved (I_a) locations
Rdata(n o)
ATSC Transmitter
104
replace dummy Rdata with Rdata (n o)
96
98
D_a
[tx hdr Rdata(r o) dummy ARSpar] and ATSC packets
[tx hdr Rdata(r o)]
102
mux
100
ARS enc
106
I_a
108
12 way ATSC 2/3 rate TCM coder
110
[tx hdr, ATSC video]
Rdata (n o), with dispersed tx hdr and dummy ARSpar and dummy ATSC packets at interleaved (I_a) locations
dummy ARSpar, ATSC packets
[tx hdr Rdata(r o) ARSpar] mixed with [tx hdr, ATSC video, ARSpar]
[tx hdr dummy Rdata dummy ARSpar]
dummy ATSC packets
mux
92
I_a
94
select

Figure 7

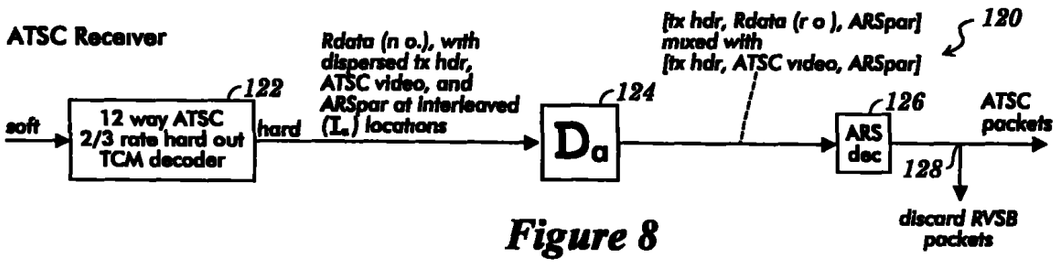

Figure 8

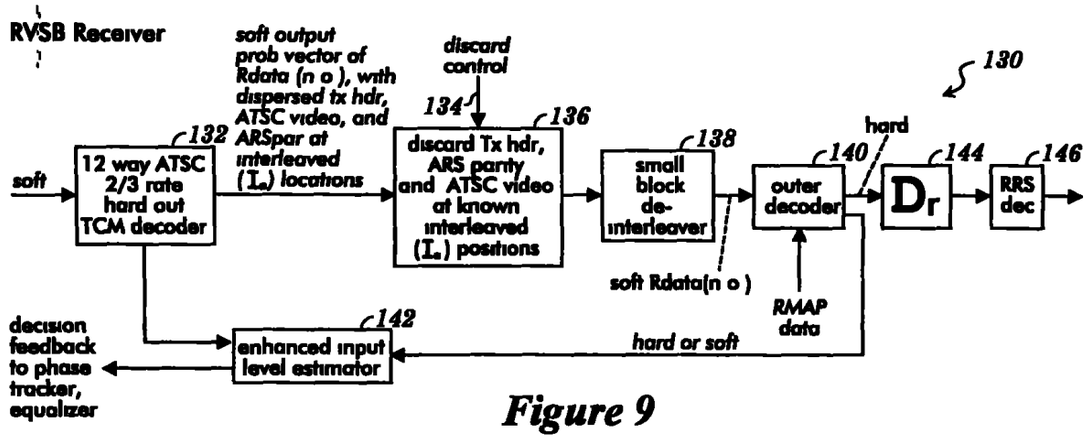

Figure 9

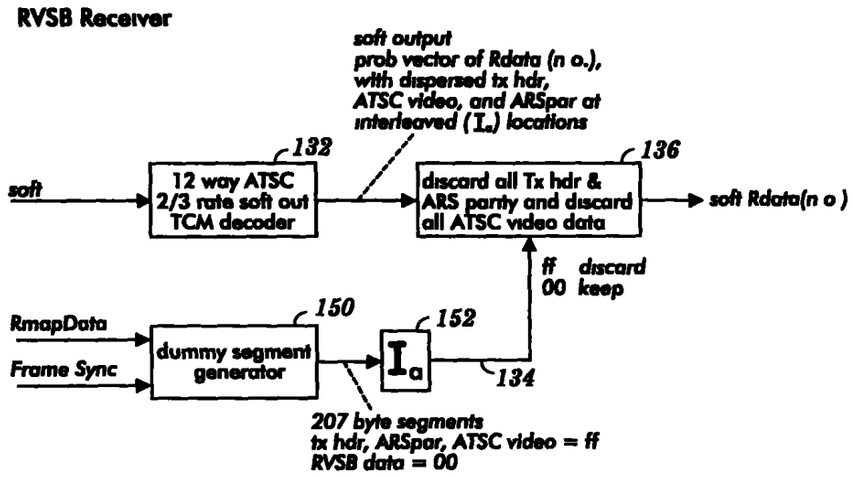
RVSB Receiver
soft output
prob vector of Rdata (n o.),
with dispersed tx hdr,
ATSC video, and ARSpar at
interleaved (I_a) locations
132
136
soft
12 way ATSC
2/3 rate soft out
TCM decoder
discard all Tx hdr &
ARS parity and discard
all ATSC video data
soft Rdata(n o)
ff discard
00 keep
RmapData
Frame Sync
150
dummy segment
generator
152
I_a
134
207 byte segments
tx hdr, ARSpar, ATSC video = ff
RVSB data = 00

Figure 10

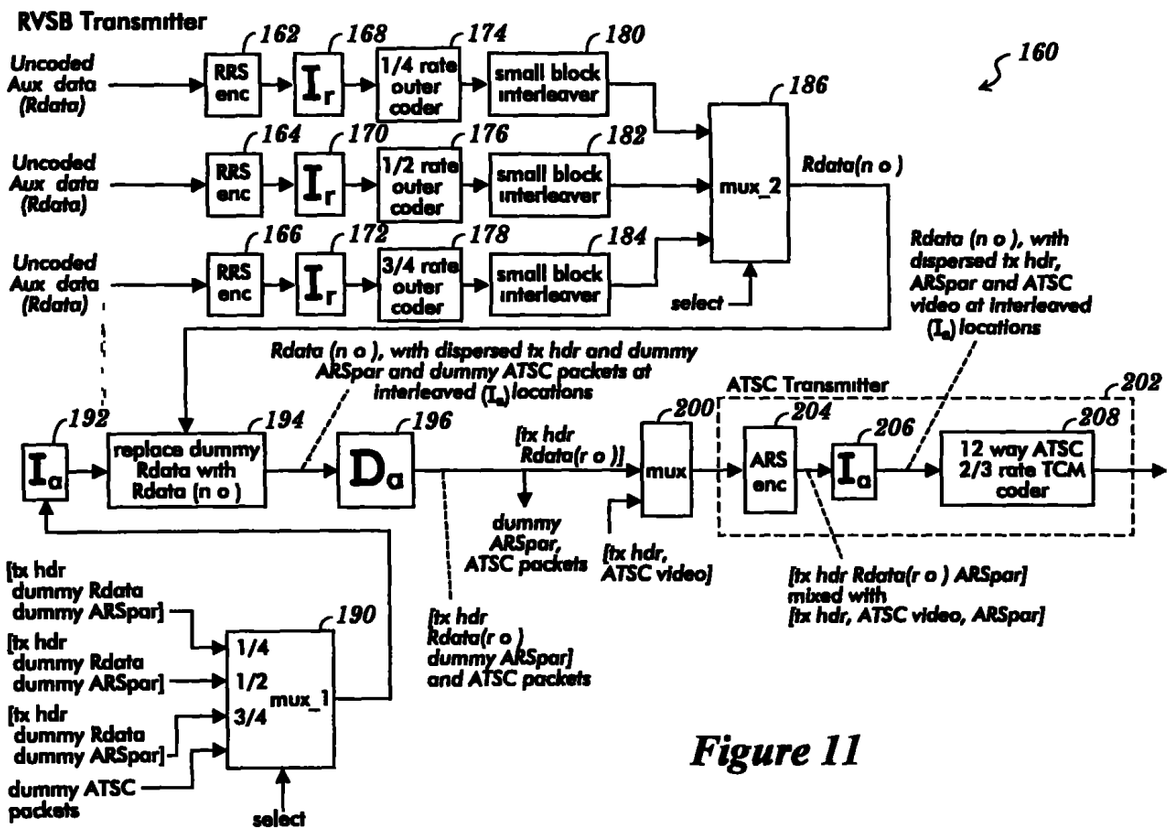
RVSB Transmitter
160
Uncoded Aux data (Rdata)
RRS enc
I_r
1/4 rate outer coder
small block interleaver
162
168
174
180
Uncoded Aux data (Rdata)
RRS enc
I_r
1/2 rate outer coder
small block interleaver
164
170
176
182
Uncoded Aux data (Rdata)
RRS enc
I_r
3/4 rate outer coder
small block interleaver
166
172
178
184
mux_2
186
Rdata(n o)
select
Rdata (n o), with dispersed tx hdr, ARSpar and ATSC video at interleaved (I_a) locations
Rdata (n o), with dispersed tx hdr and dummy ARSpar and dummy ATSC packets at interleaved (I_a) locations
ATSC Transmitter
202
192
I_a
replace dummy Rdata with Rdata (n o)
194
D_a
196
[tx hdr Rdata(r o)]
mux
200
ARS enc
204
I_a
206
12 way ATSC 2/3 rate TCM coder
208
dummy ARSpar, ATSC packets
[tx hdr, ATSC video]
[tx hdr Rdata(r o) ARSpar] mixed with [tx hdr, ATSC video, ARSpar]
[tx hdr dummy Rdata dummy ARSpar]
[tx hdr dummy Rdata dummy ARSpar]
[tx hdr dummy Rdata dummy ARSpar]
dummy ATSC packets
1/4
1/2
3/4
mux_1
190
select
[tx hdr Rdata(r o) dummy ARSpar] and ATSC packets

Figure 11

204
205

for 1/2 rate outer code

ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 92 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (576 symbols) 72 bytes payload	RRS parity (160 symbols) 20 bytes	ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 92 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (576 symbols) 72 bytes payload	RRS parity (160 symbols) 20 bytes	ARS parity (80 symbols)
2 bits/symbol	1 bit/symbol		2 bits/symbol

Figure 12

for 1/4 rate outer code

ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 46 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 46 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 46 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (416 symbols) 26 bytes payload	RRS parity (320 symbols) 20 bytes	ARS parity (80 symbols)
2 bits/symbol	0 5 bit/symbol		2 bits/symbol

Figure 13

for 3/4 rate outer code

ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 138 bytes payload		ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 26 bytes payload	20 bytes RRS parity | 92 bytes payload	ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 72 bytes payload	20 bytes RRS parity | 46 bytes payload	ARS parity (80 symbols)
ATSC tx hdr (12 symbols)	RVSB data (736 symbols) 118 bytes payload	20 bytes RRS parity	ARS parity (80 symbols)
2 bits/symbol	1 5 bit/symbol		2 bits/symbol

Figure 14

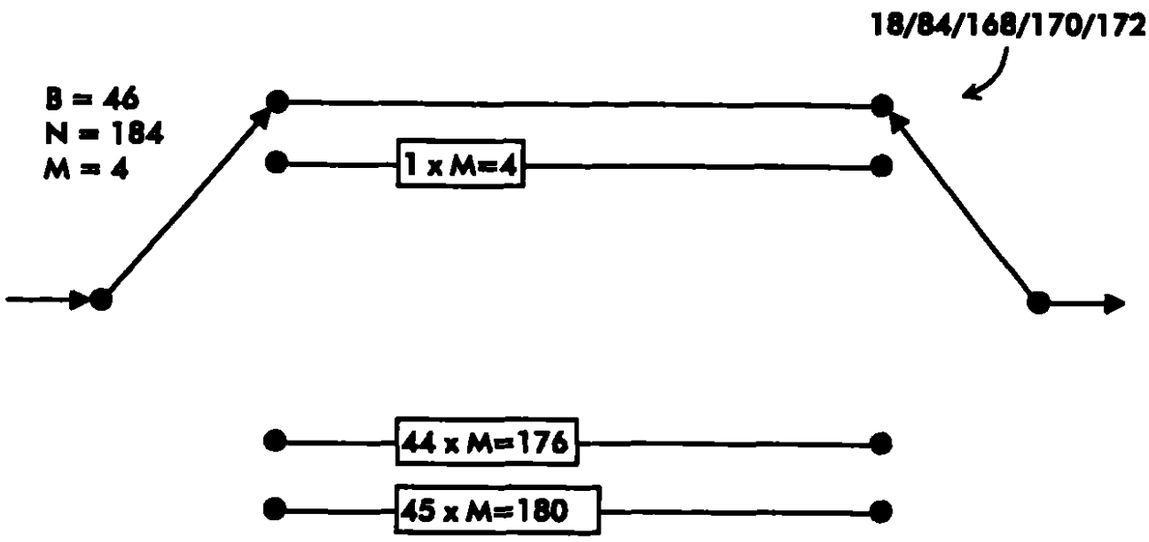

Figure 15

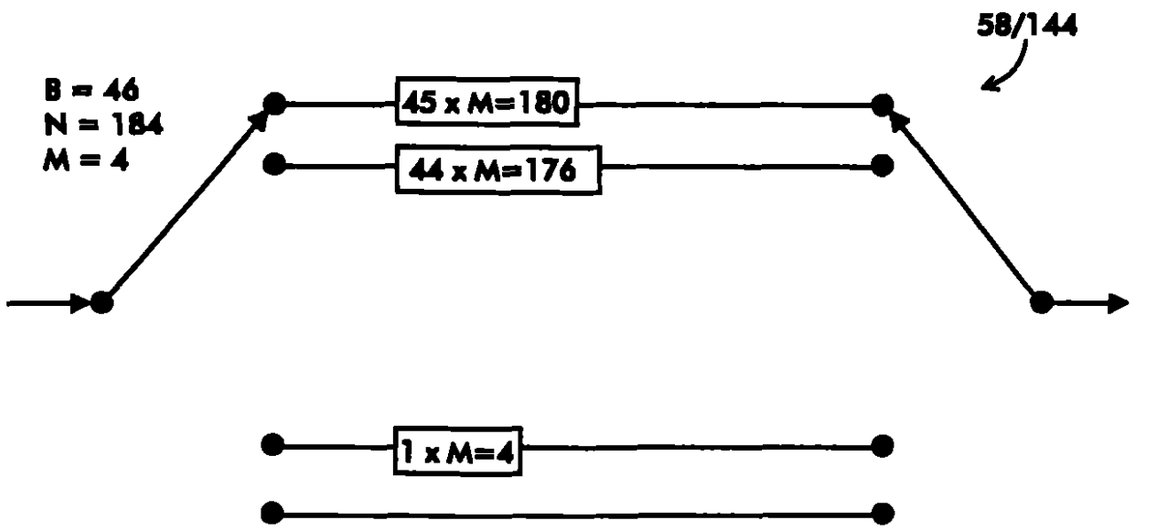

Figure 16

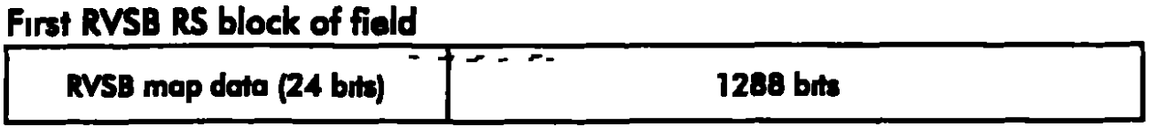

Figure 17

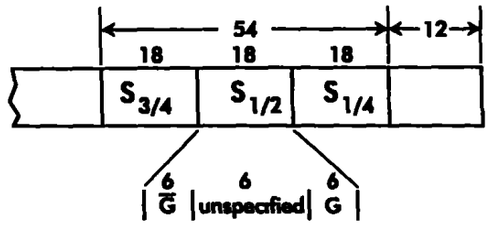

Figure 18

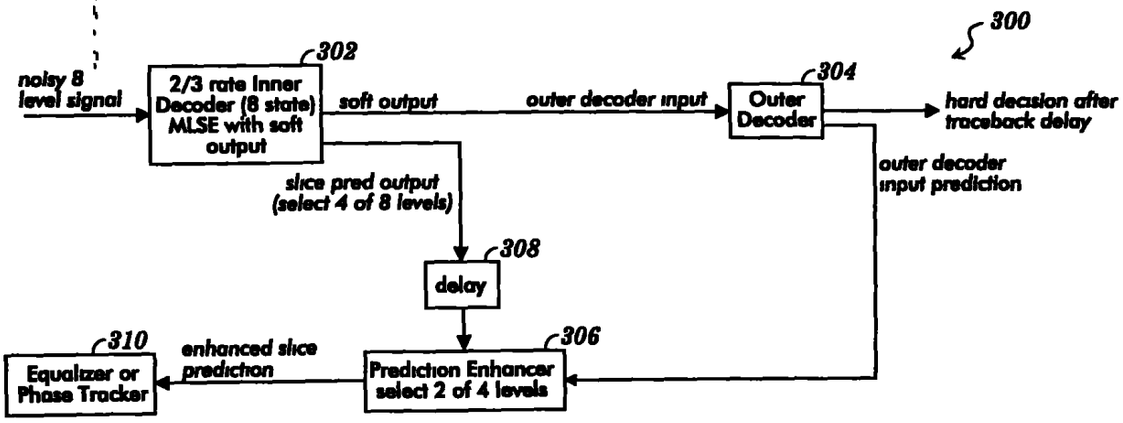

Figure 19

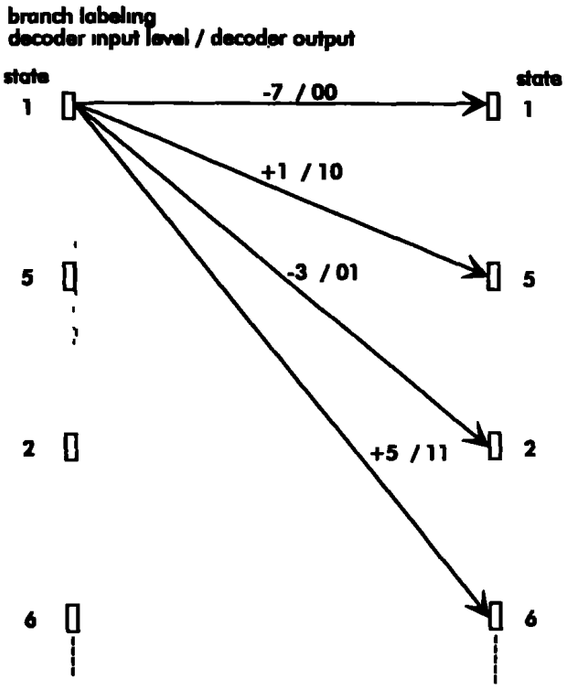

Figure 20

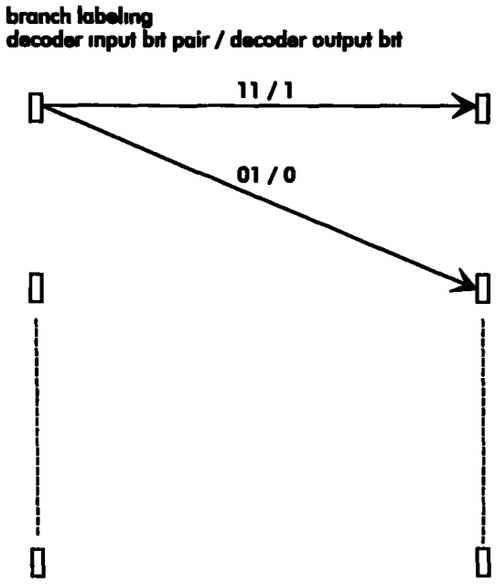

Figure 21

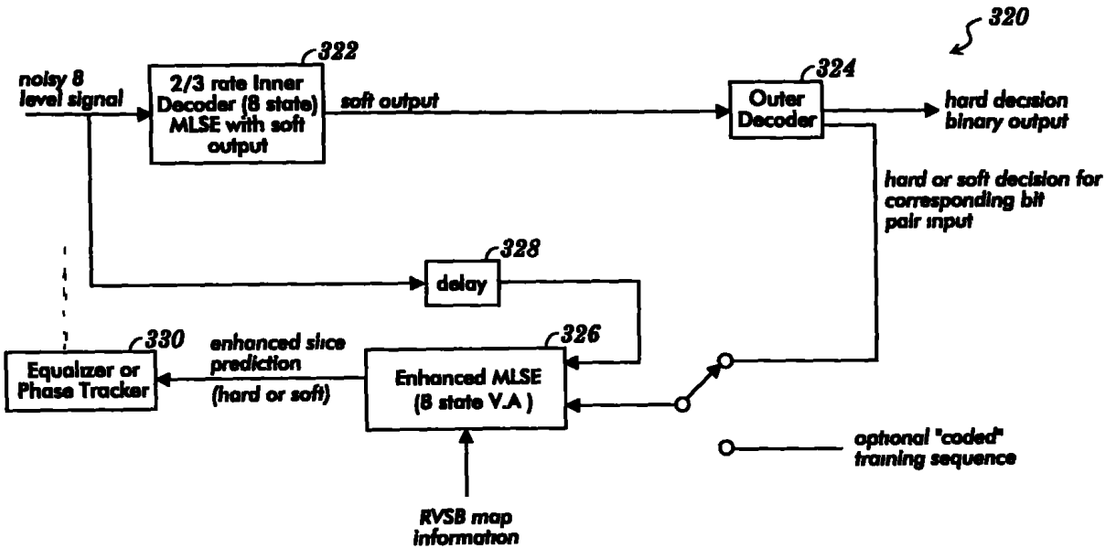
320
322
noisy 8 level signal
2/3 rate Inner Decoder (8 state) MLSE with soft output
soft output
324
Outer Decoder
hard decision binary output
hard or soft decision for corresponding bit pair input
328
delay
330
Equalizer or Phase Tracker
enhanced slice prediction
(hard or soft)
326
Enhanced MLSE (8 state V.A)
optional "coded" training sequence
RVSB map information

Figure 22