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(54) **METHOD OF PROCESSING TRAFFIC INFORMATION AND DIGITAL BROADCAST SYSTEM**

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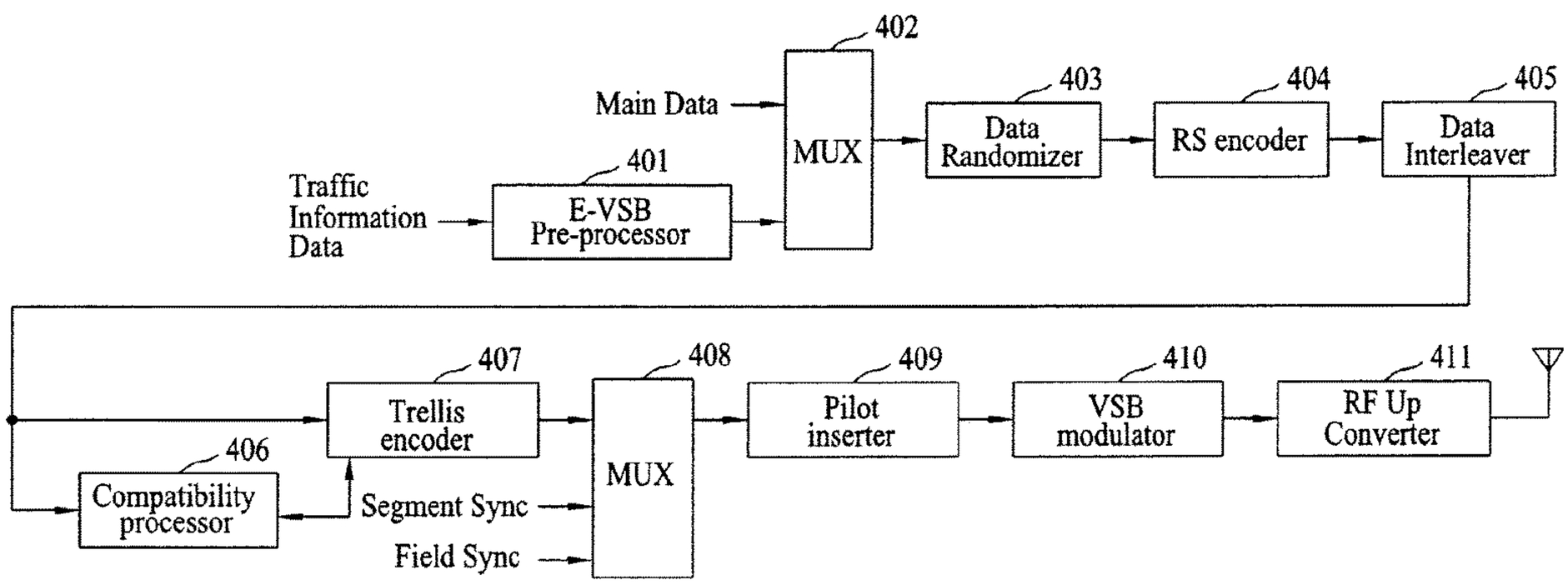
(57) **ABSTRACT**

A digital broadcast transmitting/receiving system and a method for processing data are disclosed. The method for processing data may enhance the receiving performance of the receiving system by performing additional coding and multiplexing processes on the traffic information data and transmitting the processed data. Thus, robustness is provided to the traffic information data, thereby enabling the data to
(Continued)



respond strongly against the channel environment which is always under constant and vast change.

8 Claims, 26 Drawing Sheets

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application for the reissue of Pat. No. 8,473,807, and a continuation of application No. 14/552,652, filed on Nov. 25, 2014, now Pat. No. Re. 47,294, which is a continuation of application No. 14/534,912, filed on Nov. 6, 2014, now Pat. No. Re. 46,891, which is an application for the reissue of Pat. No. 8,473,807, said application No. 14/534,912 is a continuation of application No. 11/542,161, filed on Oct. 4, 2006, now Pat. No. 7,840,868.

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See application file for complete search history.

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European Broadcasting Union, Transport Protocol Experts Group (TPEG), TPEG specifications—Part 5: Public Transport Information Application, TPEG-PTI_3.0/001, BPN 027-5, Dec. 19, 2002.
European Broadcasting Union, Transport Protocol Experts Group (TPEG), TPEG specifications—Part 6: Location Referencing for Applications, TPEG-Loc_3.0/001, BPN 027-6, Oct. 29, 2002.
Traffic and Travel Information (TTI)—TTI via Transport Protocol Expert Group (TPEG) data-streams—Part 1: Introduction, numbering and versions, ISO/TS 18234-1, Jun. 2006.
Traffic and Travel Information (TTI)—TTI via Transport Protocol Expert Group (TPEG) data-streams—Part 2: Syntax, Semantics and Framing Structure (SSF), ISO/TS 18234-2, Jun. 2006.
Traffic and Travel Information (TTI)—TTI via Transport Protocol Expert Group (TPEG) data-streams—Part 3: Service and Network Information (SNI) application, ISO/TS 18234-3, Jun. 2006.
Traffic and Travel Information (TTI)—TTI via Transport Protocol Expert Group (TPEG) data-streams—Part 4: Road Traffic Message (RTM) application, ISO/TS 18234-4, Jun. 2006.
Traffic and Travel Information (TTI)—TTI via Transport Protocol Expert Group (TPEG) data-streams—Part 5: Public Transport Information (PTI) application, ISO/TS 18234-5, 2006.
Traffic and Travel Information (TTI)—TTI via Transport Protocol Expert Group (TPEG) data-streams—Part 6: Location referencing applications, ISO/TS 18234-6, 2006.
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FIG. 1

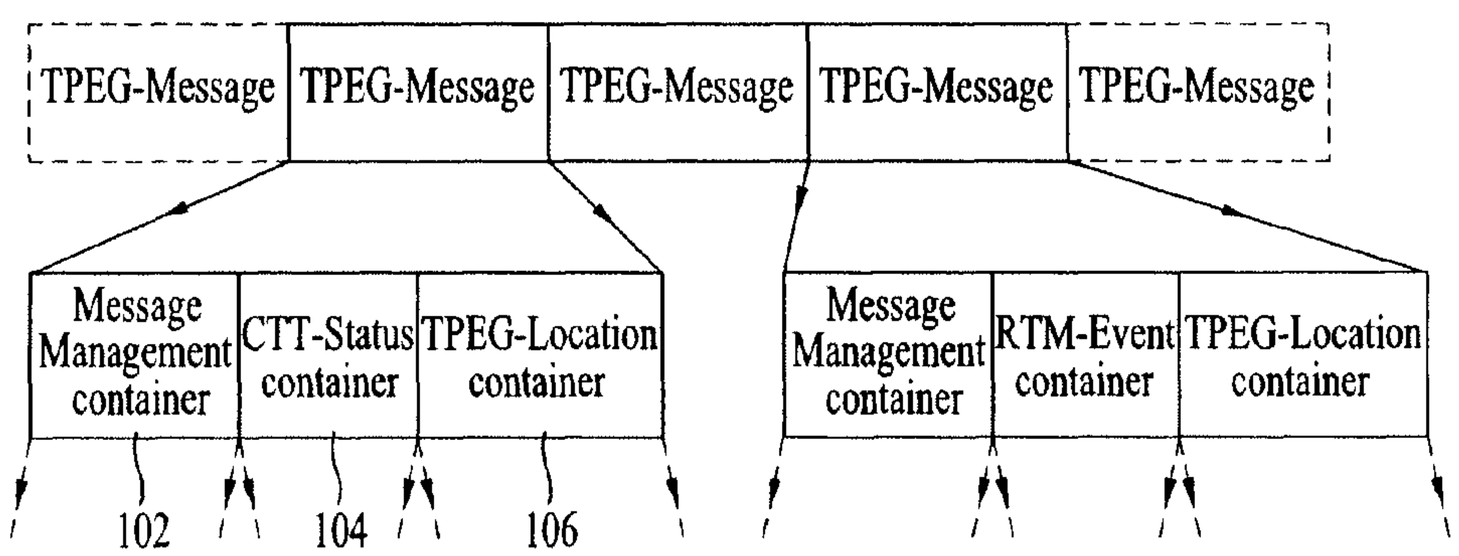

TPEG-Message
TPEG-Message
TPEG-Message
TPEG-Message
TPEG-Message
Message Management container
CTT-Status container
TPEG-Location container
Message Management container
RTM-Event container
TPEG-Location container
102
104
106

FIG. 2A

```
<ctt_components>:=
<intunti>(n),                    : number of components ~~ 202
.n*<ctt_component()>;            : traffic information message component
                                                          \
                                                           204
```

FIG. 2B

```
<ctt_component(x)>:=             : Traffic information message component template
<intunti>(id),                   : Identifier(id) ~~ 222        224
<intunti>(n),                    : Length, n, of component data in bytes(n)
n*<byte>;                        : component data ~~ 226
```

FIG. 3

	Class	Description
232	CTT_Status	Describe vehicle's traffic-carrying status at traffic network or predetermined road link
234	Prediction_CTT_Status	Describe vehicle's traffic-carrying prediction status at traffic network or predetermined road link
236	Additional Information	Describe traffic-carrying status additional information in the form of text data

FIG. 4A

<ctt_component(80)>:=	: CTT status
<intunti>(id),	: Identifier,id=80 hex ~ 242
<intunti>(n),	: Length, n, of component data in bytes (n) ~ 244
m*<status_component>;	: Status component ~ 246

FIG. 4B

<status_component(00)>:=	: Average link speed
<intunti>(id),	: Identifier,id=00 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<intunli>;	: speed(Km/h)

FIG. 4C

<status_component(01)>:=	: Travel time
<intunti>(id),	: Identifier,id=01 hex
<intunti>(n),	: Length, n, of component data in bytes (n)
<intunli>;	: time (sec.)

FIG. 4D

<status_component(02)>:=	: Link delay time
<intunti>(id),	: Identifier,id=02 hex
<intunti>(n),	: Length, n, of component data in bytes (n)
<intunli>;	: time (sec.)

FIG. 4E

<status_component(03)>:=	: Congestion type
<intunti>(id),	: Identifier,id=03 hex
<intunti>(n),	: Length, n, of component data in bytes (n)
<ctt03>;	: Congestion type

FIG. 5A

<ctt_component(81)>:=	: Prediction CTT status
<intunti>(id),	: Identifier,id=81 hex ~ 252
<intunti>(n),	: Length, n, of component data in bytes (n) 254
m*<prediction_status_component()>;	: Prediction status component ~ 256

FIG. 5B

<prediction_status_component(00)>:=	: Prediction average link speed
<intunti>(id),	: Identifier,id=00 hex
<intunti>(n),	: Length, n, of component data in bytes (n)
<intunti>;	: Speed(Km/h)
<intunlo>;	: Prediction time (UTC)

FIG. 5C

<prediction_status_component(01)>:=	: Prediction travel time
<intunti>(id),	: Identifier,id=01 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<intunli>;	: Time (sec.)
<intunlo>;	: Prediction time (UTC)

FIG. 5D

<prediction_status_component(02)>:=	: Congestion tendency
<intunti>(id),	: Identifier,id=02 hex
<intunti>(n),	: Length, n, of component data in bytes (n)
<ctt04>;	: Congestion tendency

FIG. 6

<ctt_component(8A)>:=	: Additional information
<intunti>(id),	: Identifier,id=8A hex
<intunli>(n),	: Length, n, of component data in bytes (n)
<ctt41>;	: Language code
<short_string>;	: Additional information

FIG. 7

```
<ctt_component(90)>:=                    : TPEG Location Referencing ToolBox
  <intunti>(id),                         : Identifier, id=90 hex      ~ 262
  <intunli>(n),                          : Length, n, of component data in bytes (n)  ~ 264
  m*<tpeg_loc_container()>;              : TPEG Location Container component
                                                                      266
```

FIG. 8

```
<tpeg_loc_container>:=                   :
  <loc41>,                               : Default language for TPEG-Loc Component
  m*<tpeg-loc-component()>;              : TPEG-Loc component
```

FIG. 9A

<tpeg_loc_component(00)>:=	: Location co-ordinates component
<intunti>(id),	: Identifier, id=00 hex ~ 272
<intunli>(n),	: Length, n, of component data in bytes (n) ~ 274
<loc01>,	: Location type, TPEG table loc01 ~ 276
m*<co-ordinates component()>;	: Location co-ordinates component ~ 278

FIG. 9B

<co-ordinates_component(00)>:=	: Road type list
<intunti>(id),	: Identifier, id=00 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
m*<roadtype_component()>;	: Road type component

FIG. 9C

<roadtype_component(00)>:=	: Road type component
<intunti>(id),	: Identifier, id=00 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<loc42>;	: Road type, TPEG table loc42

FIG. 9D

<co-ordinates_component(01)>:=	: WGS94
<intunti>(id),	: Identifier, id=01 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<intunloi>(longitude),	: Longitude(in 10 micro-degrees units)
<intunlo>(latitude),	: Latitude(in 10 micro-degrees units)
m*<WGS84_component>;	: WGS 84 component

FIG. 9E

<WGS84_component(00)>:=	: Expansion
<intunti>(id),	: Identifier, id=00 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<intunli>;	: Radius of circle (in meters * 10)

FIG. 9F

<co-ordinates_component(02)>:=	: Vertex information
<intunti>(id),	: Identifier, id=02 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<intunti>,	: The number of vertexes
m*<Vertex_component>	: Vertex component

FIG. 9G

<vertex_component(00)>:=	: Vertexes(wgs84)
<intunti>(id),	: Identifier, id=00 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<intunti>,	: the order of vertexes from 0
<intunlo>(longitude),	: Longitude(in 10 micro-degrees units)
<intunlo>(latitude);	: Latitude(in 10 micro-degrees units)

FIG. 9H

<co-ordinates_component(10)>:=	: Link ID
<intunti>(id),	: Identifier, id=10 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<loc43>,	: ID type
m*<link_component>;	: link component

FIG. 9I

<Link_component(00)>:=	: Expansion
<intunti>(id),	: Identifier, id=00 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<intunlo>;	: Link ID

FIG. 9J

<co-ordinates_component(03)>:=	: Descriptor
<intunti>(id),	: Identifier, id=03 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<loc03>,	: Descriptor type
<short_string>(name)	: Descriptor
m*<descriptor_component>;	: Descriptor components

FIG. 9K

<descriptor_component(00)>:=	: Direction type
<intunti>(id),	: Identifier, id=00 hex
<intunti>(n),	: Length, n, of component data in bytes(n)
<loc02>;	: Direction type, TPEG table loc02

FIG. 10A

TPEG table CTT 03: traffic delay degree			
Code	Type	Content	example
0	unknown		
1	noncongested		
2	crowded		
3	congested		
4	traffic jam		
...			
...			
255			

FIG. 10B

TPEG table CTT 04: link speed variation			
Code	Type	Content	example
0	unknown		
1	drawing		
2	eliminating		
3	constant		
...			
...			
255			

FIG. 11

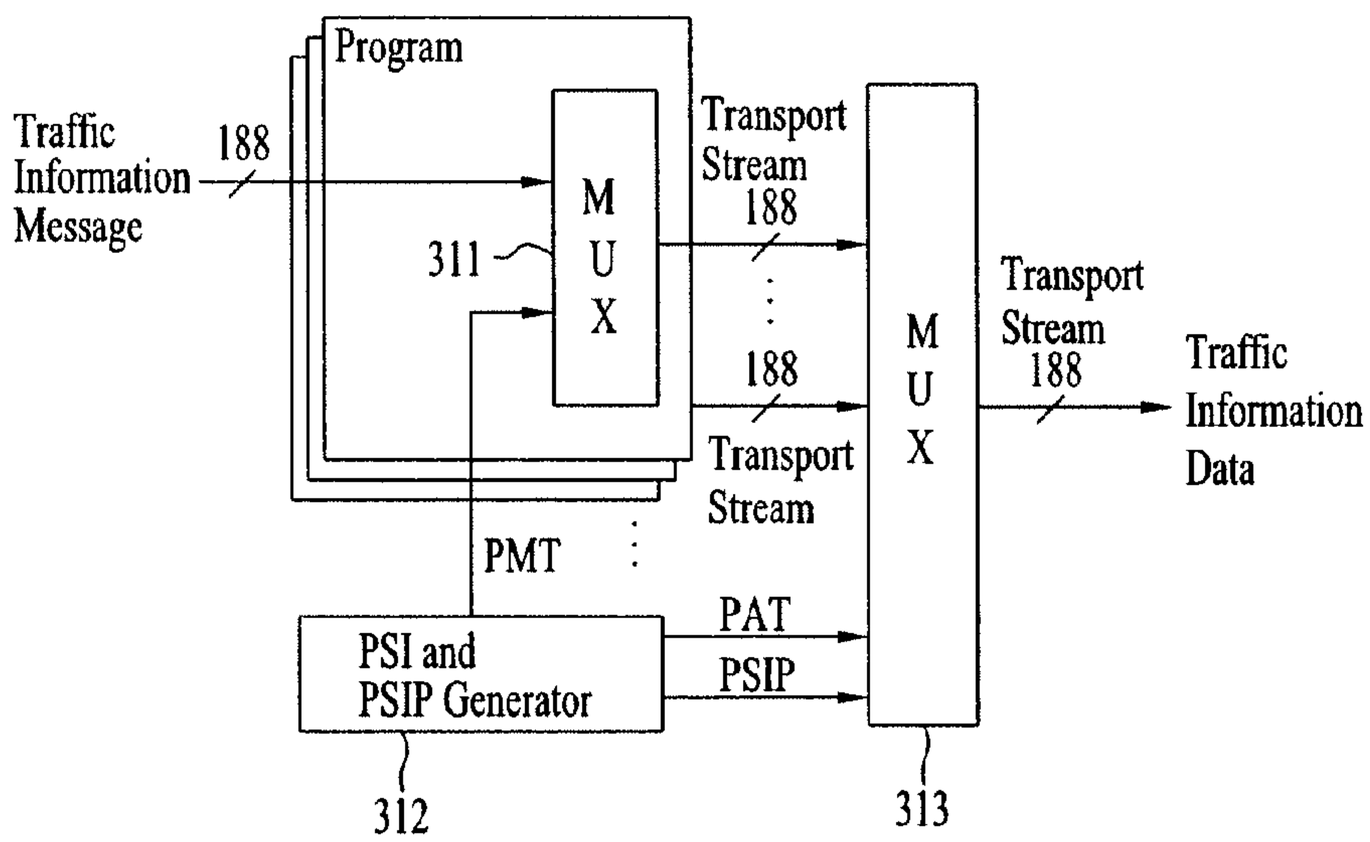

Program
Traffic Information Message
188
311
M U X
Transport Stream
188
188
Transport Stream
PMT
PAT
PSIP
PSI and PSIP Generator
312
M U X
313
Transport Stream
188
Traffic Information Data

FIG. 12

Syntax	No. of Bits	Format
TPEG_service_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
Number_of_TPEG_service_components	8	uimsbf
for(i=0;i<Number_of_TPEG_service_components;i++){		
Service_component_ID	8	uimsbf
Application_ID	16	uimsbf
Service_name	var	
Service_description	var	
Service_logo	var	
Subscriber_information	var	
Free_text_information	var	
Help_information	var	
}		
}		

FIG. 13

Descriptor Name	Descriptor Tag	PSI/PSIP Table					
		PMT	MGT	VCT	EIT	DCCT	DCCSCT
stuffing descriptor	0x80	*	*	*	*	*	*
AC-3 audio descriptor	0x81	M			M		
caption service descriptor	0x86	O			M		
content advisory descriptor	0x87	O			M		
program identifier descriptor	0xnn	O			M		
extended channel name descriptor	0xA0			M			
service location descriptor	0xA1			S			
time-shifted service descriptor	0xA2			M			
component name descriptor	0xA3	M					
dcc departing request descriptor	0xA8					M	
dcc arriving request descriptor	0xA9					M	
dcc location code descriptor	0xAB						M
user private	0xC0-0xFE	*	*	*	*	*	*
TPEG service descriptor	0xAC	M		M			

FIG. 14

Syntax	No. of Bits	Format
virtual_channel_table_section(){		
table_id	8	0xC8
section_syntax_indicator	1	'1'
Private_indicator	1	'1'
reserved	2	'11'
section_length	12	uimsbf
transport_stream_id	16	uimsbf
reserved	2	'11'
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
protocol_version	8	uimsbf
num_channels_in_section	8	uimsbf
for(i=0;i<num_channels_in_section;i++){		
short_name	7*16	uimsbf
reserved	4	'1111'
major_channel_number	10	uimsbf
minor_channel_number	10	uimsbf
modulation_mode	8	uimsbf
carrier_frequency	32	uimsbf
channel_TSID	16	uimsbf
program_number	16	uimsbf
ETM_location	2	uimsbf
access_controlled	1	bslbf
hidden	1	bslb
reserved	6	'111111'
service_type	6	uimsbf
source_id	16	uimsbf
reserved	6	'111111'
descriptors_length	10	uimsbf
for(i=0;i<N;i++){		
descriptors()		
}		
}		
reserved	6	'111111'
additional_descriptors_length	10	uimsbf
for(j=0;j<N;j++){		
additional_descriptors()		
}		
CRC_32	32	rpchof
}		

FIG. 15

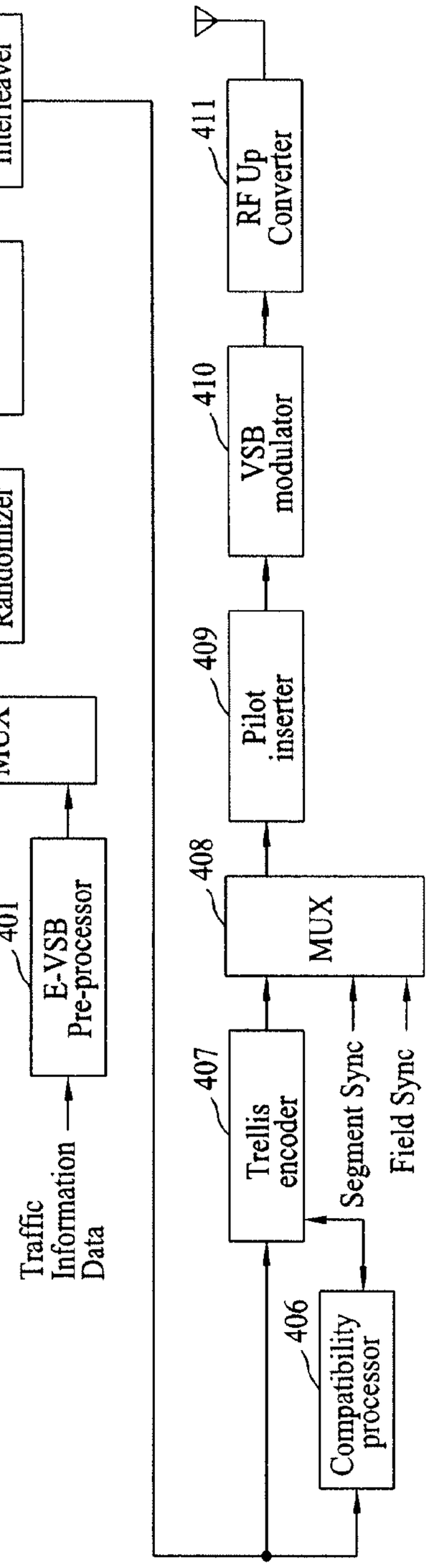

Main Data
Traffic Information Data
401
E-VSB Pre-processor
402
MUX
403
Data Randomizer
404
RS encoder
405
Data Interleaver
406
Compatibility processor
407
Trellis encoder
408
MUX
409
Pilot inserter
410
VSB modulator
411
RF Up Converter
Segment Sync
Field Sync

FIG. 16

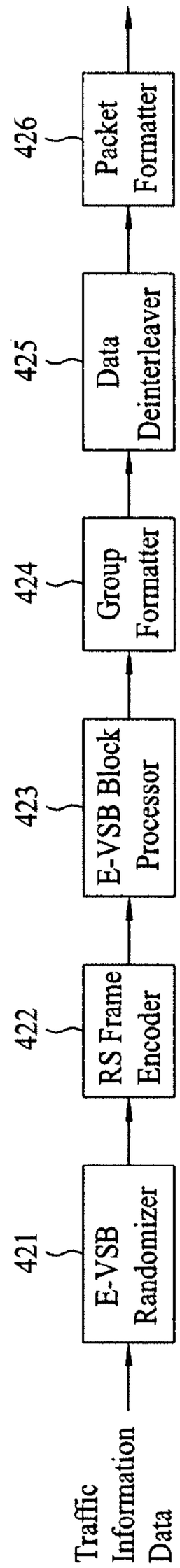

Traffic Information Data
421
E-VSB Randomizer
422
RS Frame Encoder
423
E-VSB Block Processor
424
Group Formatter
425
Data Deinterleaver
426
Packet Formatter

FIG. 17A

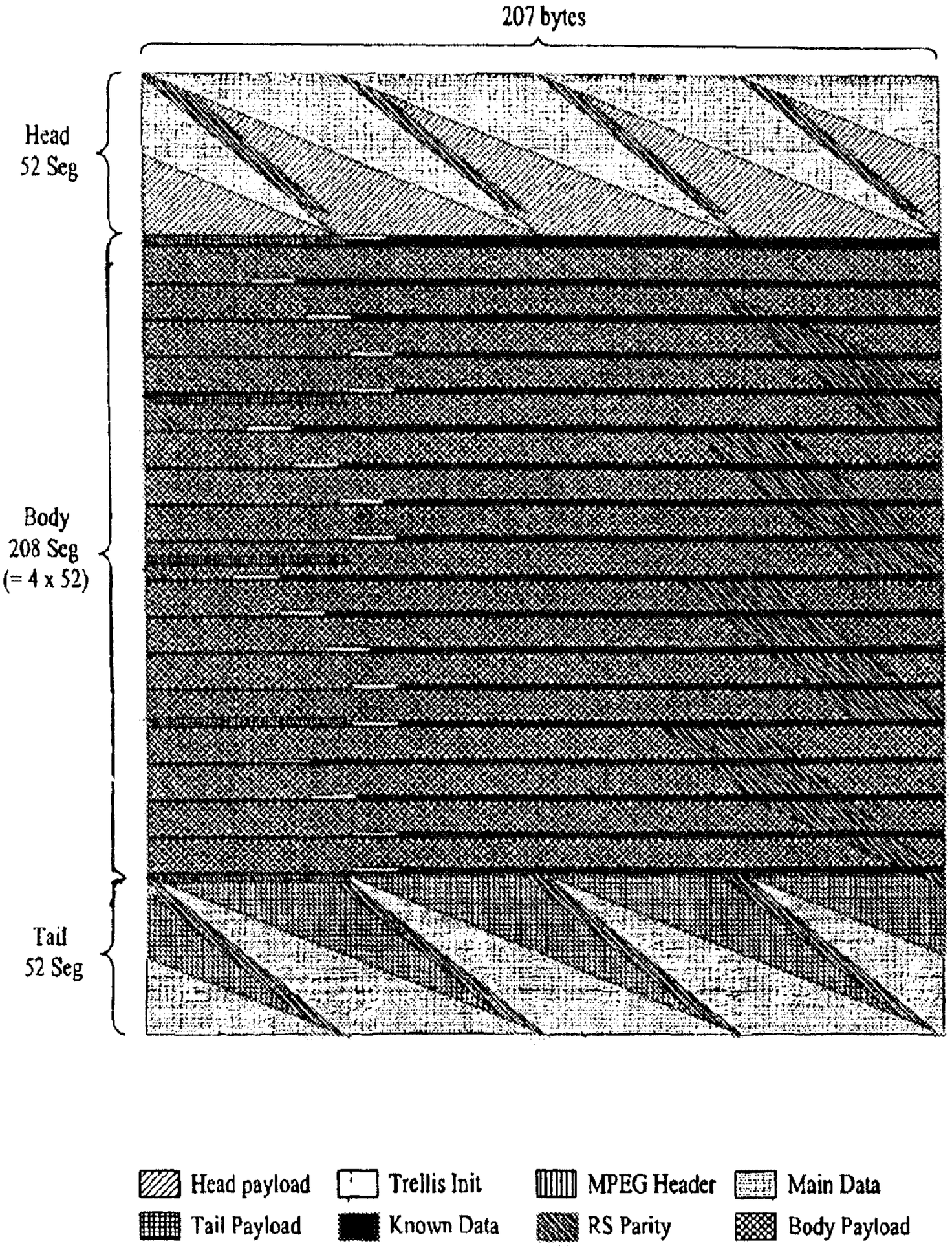

207 bytes
Head
52 Seg
Body
208 Seg
(= 4 x 52)
Tail
52 Seg
Head payload
Trellis Init
MPEG Header
Main Data
Tail Payload
Known Data
RS Parity
Body Payload

FIG. 17B

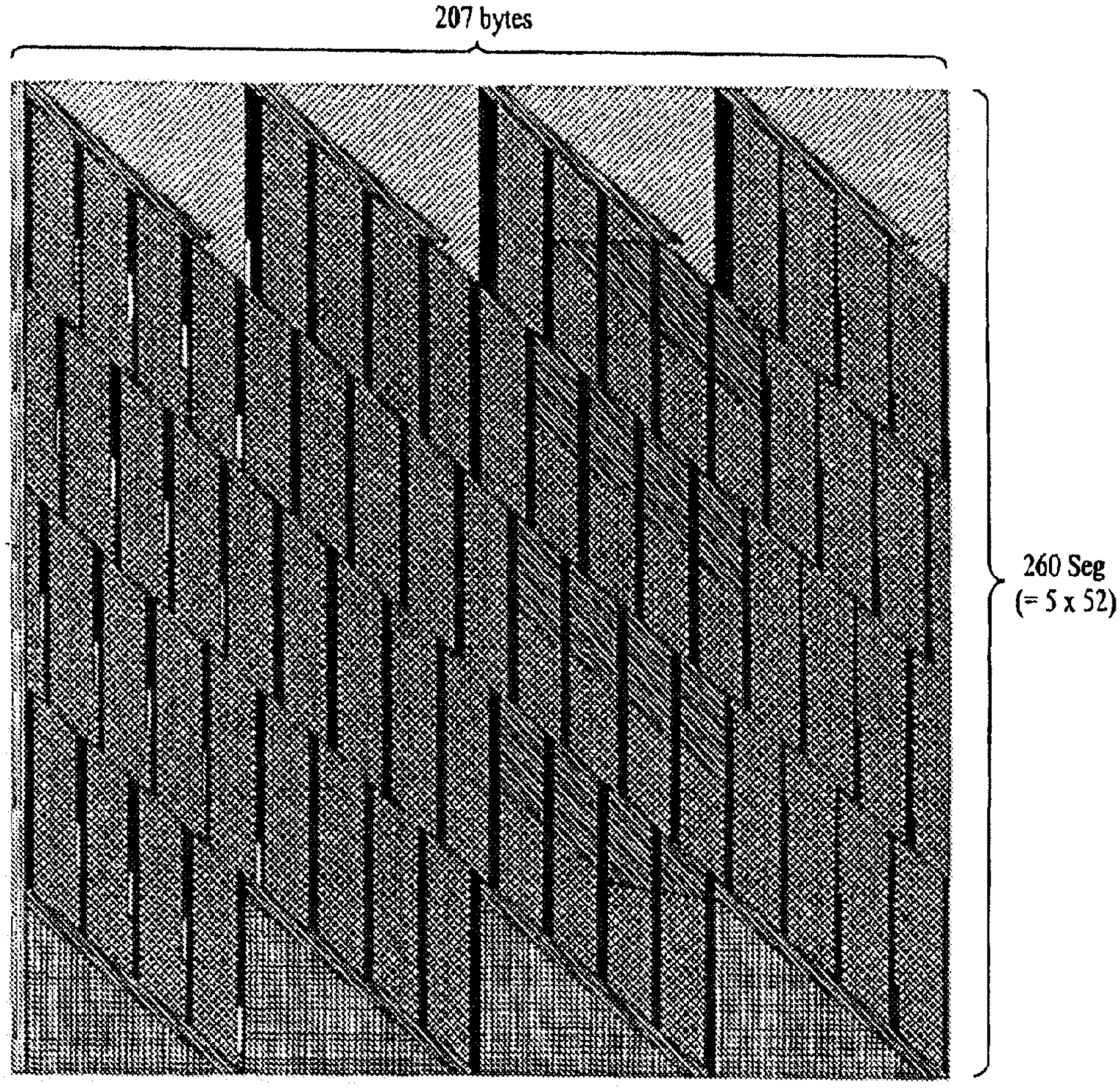

207 bytes
260 Seg
(= 5 x 52)
Head payload
Trellis Init
MPEG Header
Main Data
Tail Payload
Known Data
RS Parity
Body Payload

FIG. 18

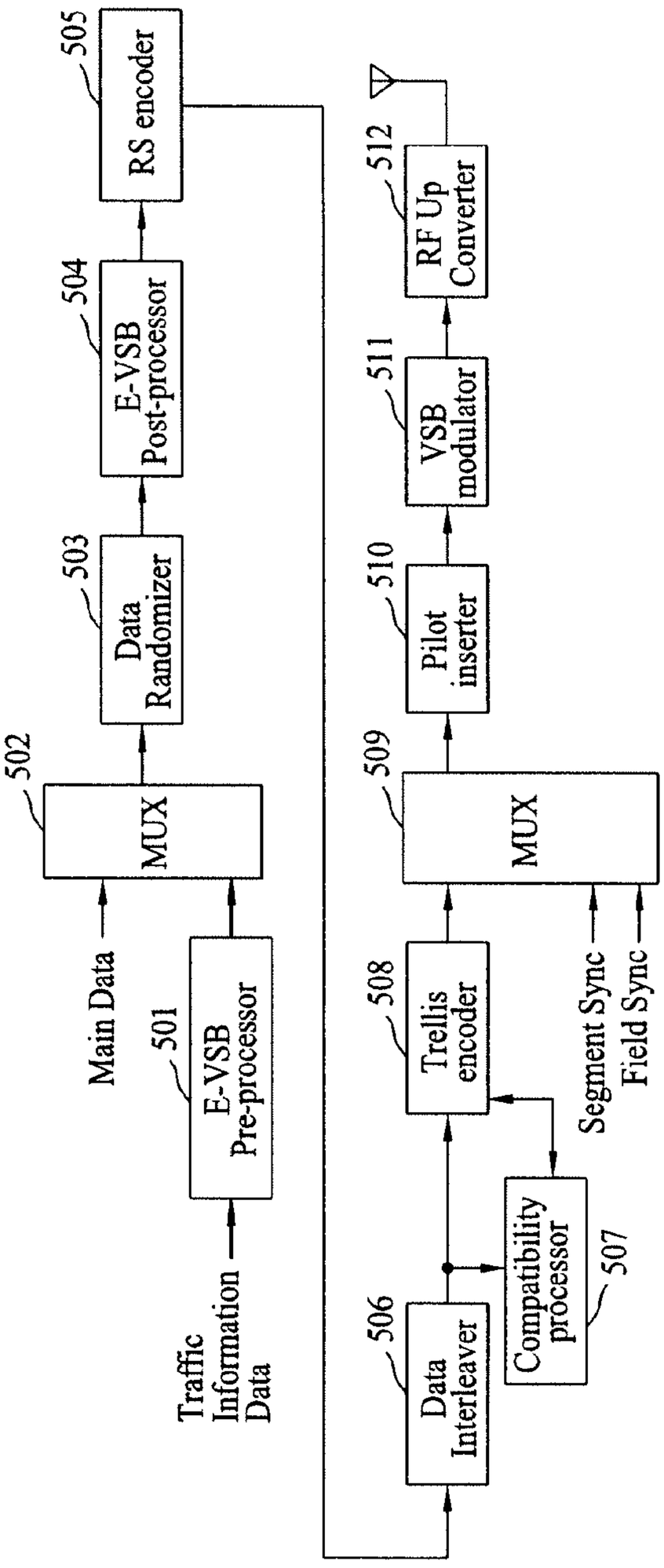

Main Data
Traffic Information Data
501 E-VSB Pre-processor
502 MUX
503 Data Randomizer
504 E-VSB Post-processor
505 RS encoder
506 Data Interleaver
507 Compatibility processor
508 Trellis encoder
509 MUX
510 Pilot inserter
511 VSB modulator
512 RF Up Converter
Segment Sync
Field Sync

FIG. 19

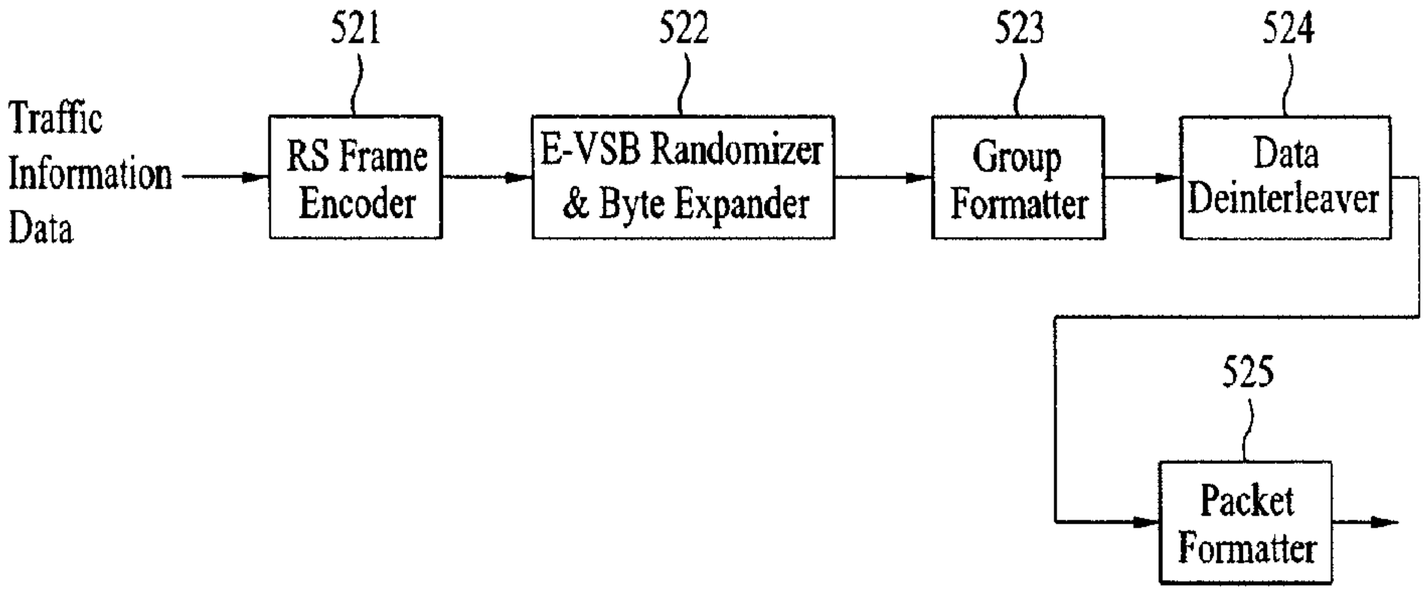

Traffic Information Data
521
RS Frame Encoder
522
E-VSB Randomizer & Byte Expander
523
Group Formatter
524
Data Deinterleaver
525
Packet Formatter

FIG. 20

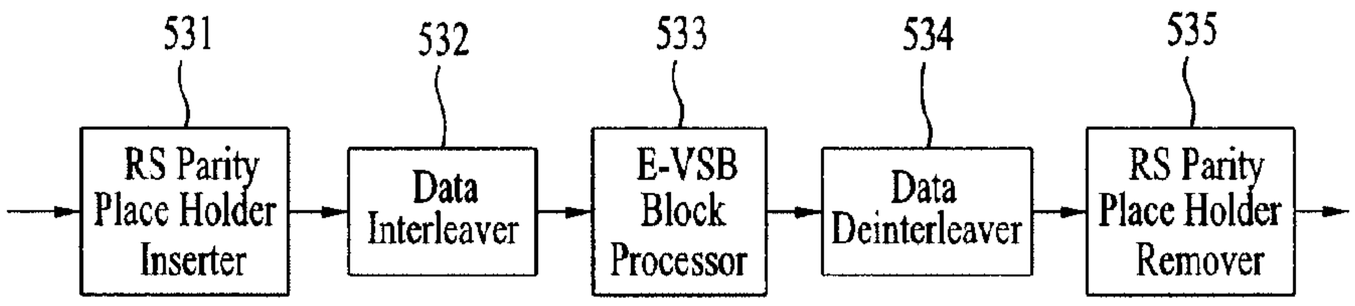

531
RS Parity Place Holder Inserter
532
Data Interleaver
533
E-VSB Block Processor
534
Data Deinterleaver
535
RS Parity Place Holder Remover

FIG. 21

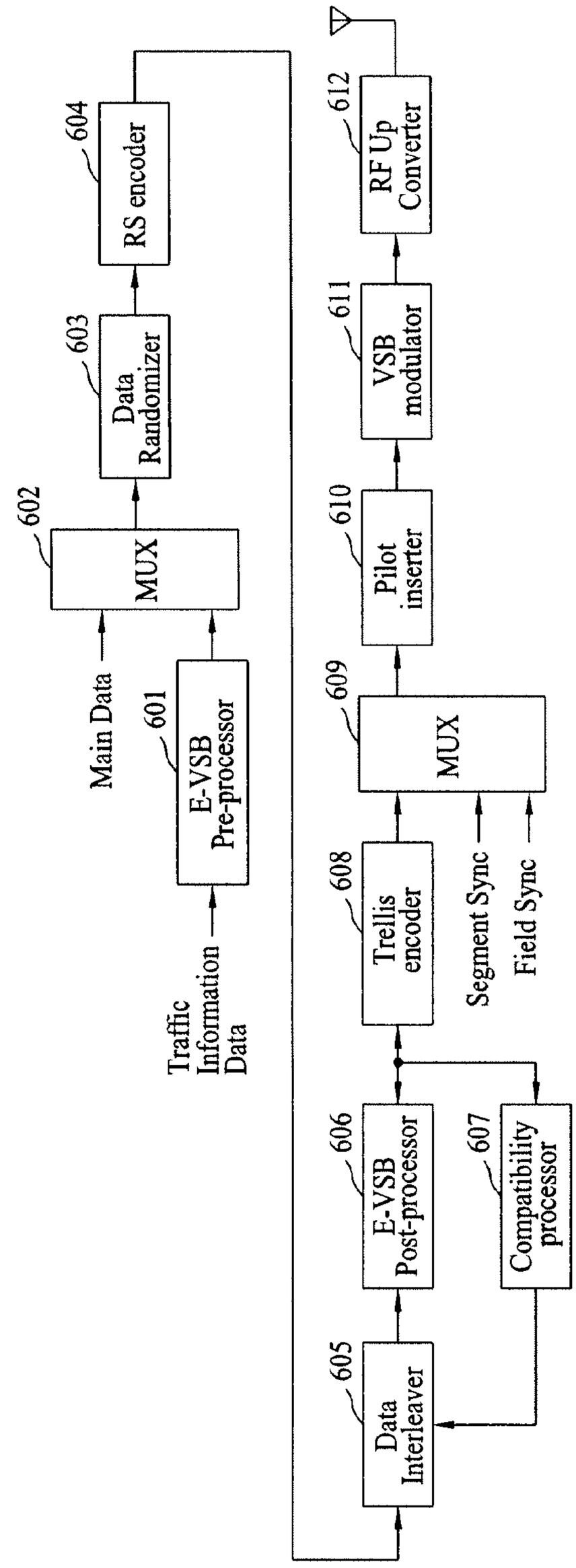

Traffic Information Data
Main Data
601 E-VSB Pre-processor
602 MUX
603 Data Randomizer
604 RS encoder
612 RF Up Converter
611 VSB modulator
610 Pilot inserter
609 MUX
608 Trellis encoder
Segment Sync
Field Sync
606 E-VSB Post-processor
607 Compatibility processor
605 Data Interleaver

FIG. 22

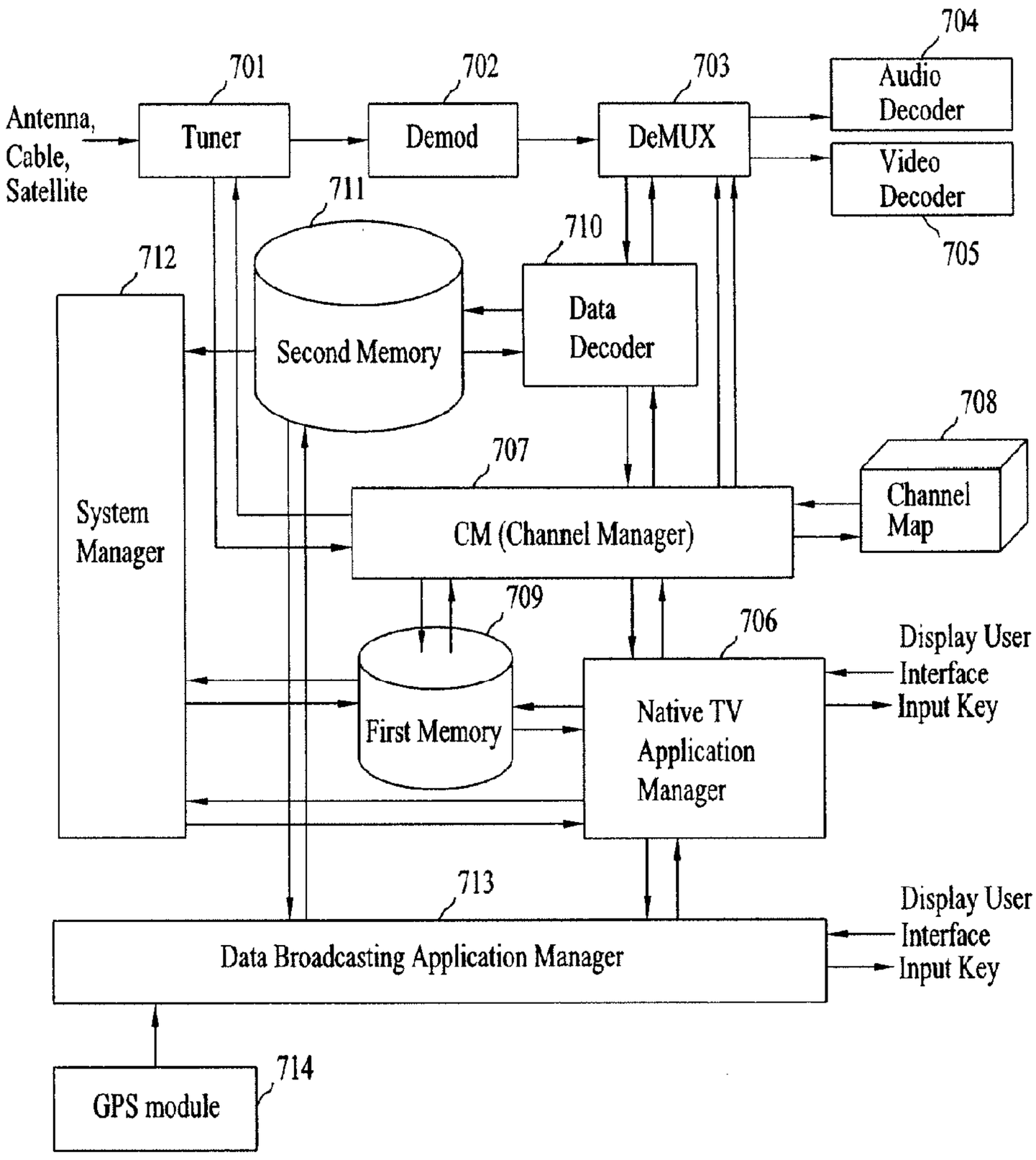

701
Antenna,
Cable,
Satellite
Tuner
702
Demod
703
DeMUX
704
Audio
Decoder
Video
Decoder
705
711
710
712
Second Memory
Data
Decoder
708
707
System
Manager
CM (Channel Manager)
Channel
Map
709
706
Display User
Interface
Input Key
First Memory
Native TV
Application
Manager
713
Display User
Interface
Input Key
Data Broadcasting Application Manager
714
GPS module

FIG. 23

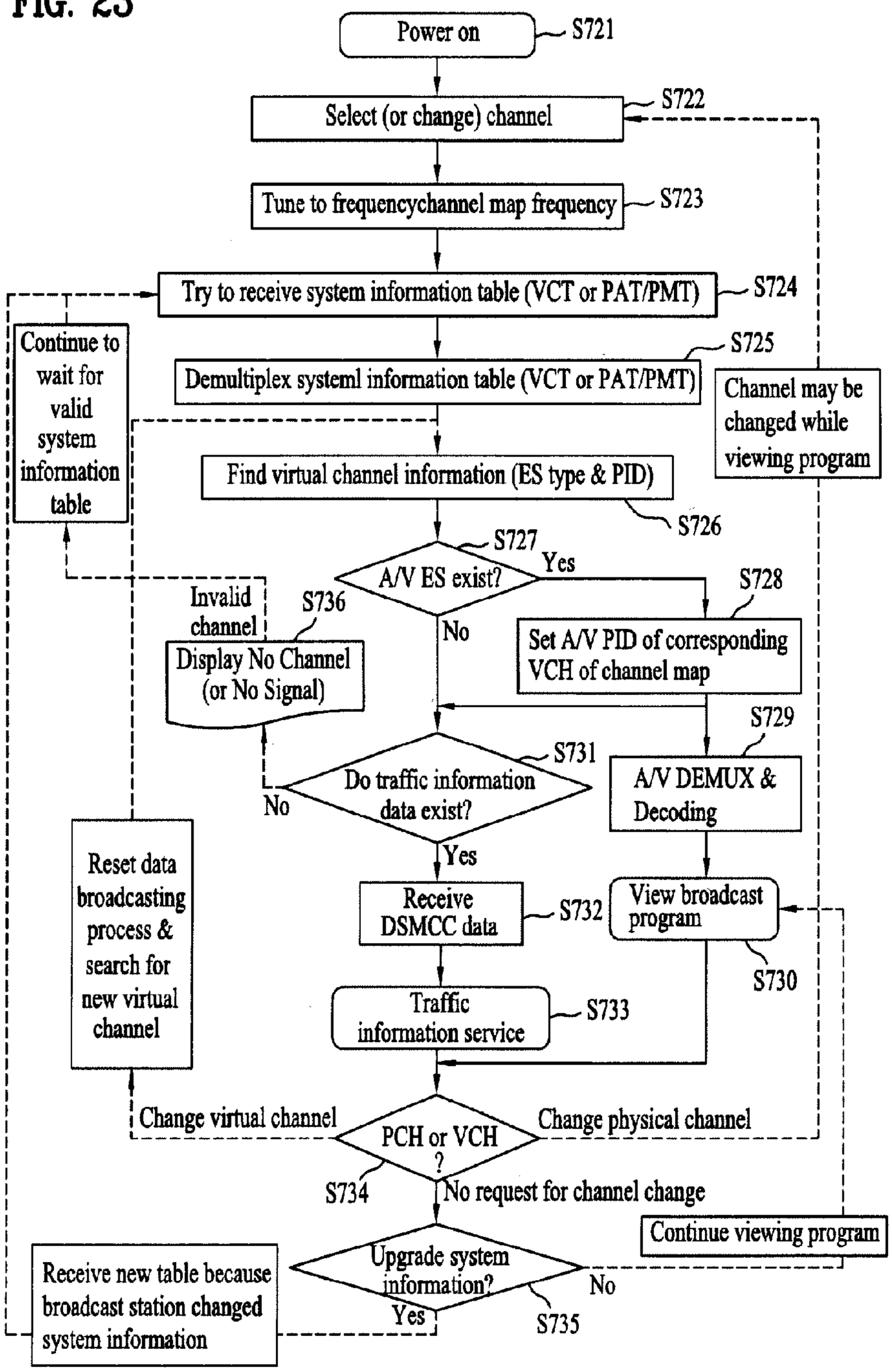

Power on
S721
Select (or change) channel
S722
Tune to frequencychannel map frequency
S723
Try to receive system information table (VCT or PAT/PMT)
S724
Continue to wait for valid system information table
Demultiplex systeml information table (VCT or PAT/PMT)
S725
Channel may be changed while viewing program
Find virtual channel information (ES type & PID)
S726
S727
A/V ES exist?
Yes
No
S728
Invalid channel
S736
Display No Channel (or No Signal)
Set A/V PID of corresponding VCH of channel map
S729
S731
Do traffic information data exist?
No
Yes
A/V DEMUX & Decoding
Reset data broadcasting process & search for new virtual channel
Receive DSMCC data
S732
View broadcast program
S730
Traffic information service
S733
Change virtual channel
PCH or VCH ?
Change physical channel
S734
No request for channel change
Continue viewing program
Upgrade system information?
No
Yes
S735
Receive new table because broadcast station changed system information

FIG. 24

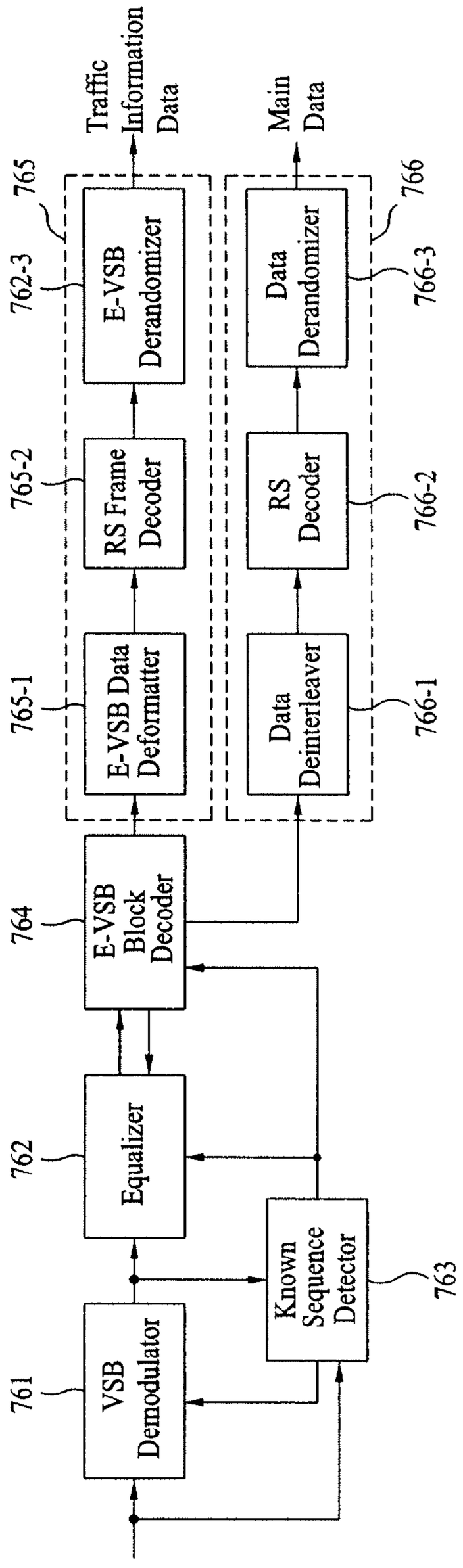
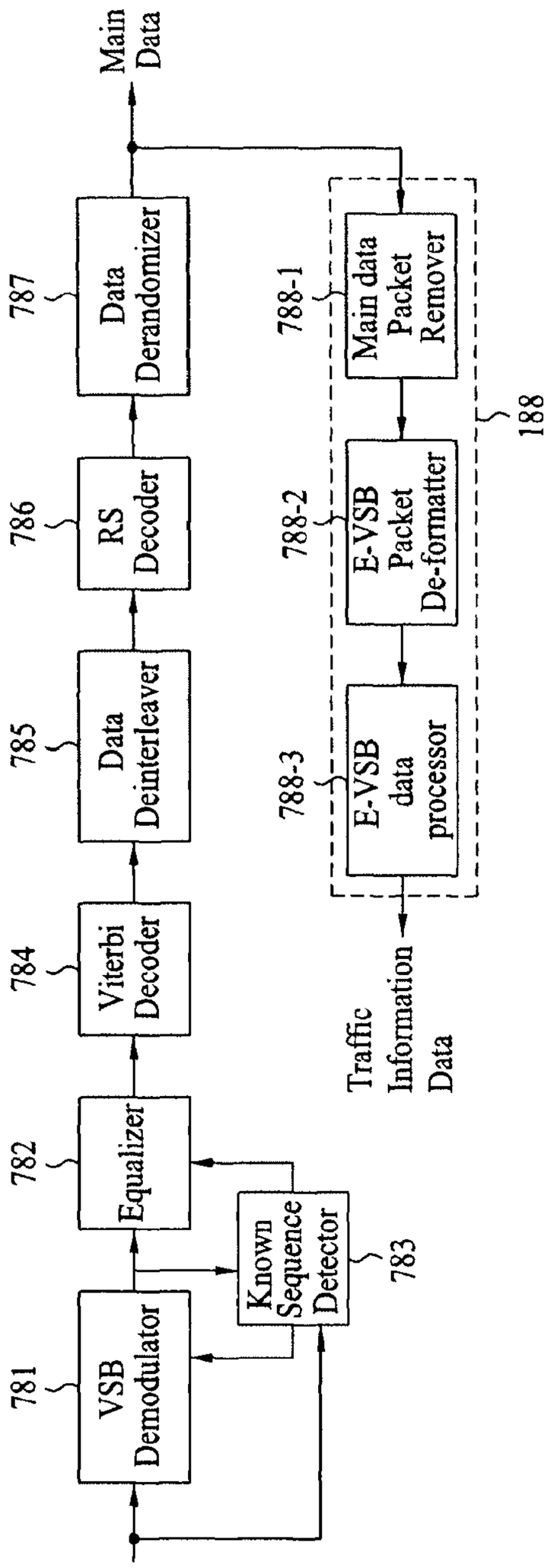

Traffic Information Data
Main Data
765
766
762-3
E-VSB Derandomizer
Data Derandomizer
766-3
765-2
RS Frame Decoder
RS Decoder
766-2
765-1
E-VSB Data Deformatter
Data Deinterleaver
766-1
764
E-VSB Block Decoder
762
Equalizer
761
VSB Demodulator
Known Sequence Detector
763

FIG. 25


Main Data
787
Data Derandomizer
788-1
Main data Packet Remover
784
Viterbi Decoder
785
Data Deinterleaver
786
RS Decoder
788-2
E-VSB Packet De-formatter
788-3
E-VSB data processor
188
Traffic Information Data
782
Equalizer
781
VSB Demodulator
Known Sequence Detector
783

METHOD OF PROCESSING TRAFFIC INFORMATION AND DIGITAL BROADCAST SYSTEM

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

More than one reissue application has been filed for the reissue of U.S. Pat. No. 8,473,807, including the present reissue application, continuation reissue application Ser. No. 14/260,646, filed Jan. 29, 2019, (now U.S. Pat No. RE48,627, issued Jul. 6, 2021), continuation reissue application Ser. No. 14/552,652, filed Nov. 25, 2014, (now U.S. Pat. No. RE47,294, issued Mar. 12, 2019), and continuation reissue application Ser. No. 14/534,912, filed Nov. 6, 2014, (now U.S. Pat. No. RE46,891, issued Jun. 12, 2018).

This application is a [Continuation of application Ser. No. 12/542,161 filed Oct. 4, 2006 now U.S. Pat. No. 7,840,868] *continuation Reissue of U.S. patent application Ser. No. 16/260,646, filed Jan. 29, 2019, (now U.S. Pat. No. RE48,627, issued Jul. 6, 2021), which is a continuation Reissue of U.S. patent application Ser. No. 14/552,652, filed Nov. 25, 2014, (now U.S. Pat. No. RE47,294, issued Mar. 12, 2019), which is a continuation reissue of U.S. patent application Ser. No. 14/534,912, filed Nov. 6, 2014, (now U.S. Pat. No. RE46,891, issued Jun. 12, 2018), which is a reissue of U.S. patent application Ser. No. 12/840,878, filed on Jul. 21, 2010 (now U.S. Pat. No. 8,473,807, issued Jun. 25, 2013), which is a continuation of U.S. patent application Ser. No. 11/542,161 (now U.S. Pat. No. 7,840,868), issued on Nov. 23, 2011,* which claims the benefit of Korean Patent Application Nos. 10-2005-0093639, filed Oct. 5, 2005; *10-2006-0027063, filed Mar. 24, 2006;* 10-2006-0039117, filed Apr. 29, 2006; *and* 10-2006-0089736, filed *on* Sep. 15, 2006[and 10-2006-0027063, filed Mar. 24, 2006], all of which are [hereby] incorporated by reference *for all purposes as if fully set forth herein.*

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a digital broadcasting system, and more particularly, to a digital broadcast transmitting/receiving system and a method for processing traffic data.

2. Discussion of the Related Art

Presently, the technology for processing digital signals is being developed at a vast rate, and, as a larger number of the population uses the Internet, digital electric appliances, computers, and the Internet are being integrated. Therefore, in order to meet with the various requirements of the users, a system that can add video/audio data through a digital broadcasting (or television) channel so as to transmit diverse supplemental information needs to be developed.

Some users may assume that supplemental data broadcasting would be applied by using a PC card or a portable device having a simple in-door antenna attached thereto. However, when used indoors, the intensity of the signals may decrease due to a blockage caused by the walls or disturbance caused by approaching or proximate mobile objects. Accordingly, the performance of the received digital signals may be deteriorated due to a ghost effect and noise caused by reflected waves. Therefore, a system highly resistant to (or robust against) ghost effects and noise is required to be developed. Particularly, in order for the supplemental data to be used in portable and mobile broadcast receivers, a higher degree of resistance (or robustness) against channel interruption and noise is required.

The supplemental data are generally transmitted by a time-division method through the same channel as the MPEG video/audio data. However, with the advent of digital broadcasting, ATSC VSB digital television receivers that receive only MPEG video/audio data are already supplied to the market. Therefore, the supplemental data that are transmitted through the same channel as the MPEG video/audio data should not influence the conventional ATSC VSB receivers that are provided in the market. In other words, this may be defined as ATSC VSB compatibility, and the supplemental data broadcast system should be compatible with the ATSC VSB system. Herein, the supplemental data may also be referred to as enhanced data or EVSB data. Furthermore, as the number of possessed automobiles (or cars) is in constant increase, and with the influence of the working-5-days-a-week policy (which eventually leads to an increase in the usage of cars), the need for traffic information is also increasing accordingly.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a digital broadcast transmitting/receiving system and a method for processing data that substantially obviate one or more problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a digital broadcast system and a method for processing data that can be compatible to the ATSC VSB system, that is suitable for transmitting enhanced data, and that is resistant to and robust against noise.

Another object of the present invention is to provide a digital broadcast transmitting/receiving system and a method for processing data that can effectively receive and transmit traffic information by applying the traffic information data as the enhanced data.

Another object of the present invention is to provide a digital broadcast transmitting/receiving system and a method for processing data that can enhance the receiving performance of the receiving system by performing additional coding on the traffic information data and transmitting the processed data.

A further object of the present invention is to provide a digital broadcast transmitting/receiving system and a method for processing data that can enhance the receiving performance of the receiving system by multiplexing the known data, which correspond to data known in advance according to an agreement between the transmitting system and the receiving system, and the traffic information data.

Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a digital broadcast transmitter

according to an embodiment of the present invention includes a traffic information message generator, a pre-processor, a multiplexer, a trellis encoder, and a transmitter.

The traffic information message generator may generate a traffic information message including status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information. The pre-processor may pre-process traffic information data including the traffic information message by encoding the traffic information data and by generating a traffic information data packet including the encoded traffic information data and known data.

The multiplexer may multiplex the traffic information data packet with one or more main audio and video (AV) data packets. The trellis encoder may have at least one memory and trellis-encoding the multiplexed data packets, the at least one memory being initialized by initialization data when data outputted from the multiplexer correspond to a beginning of a known data sequence. The data transmission unit may insert synchronization data into the trellis-encoded data, modulating the trellis-encoded data having the synchronization data, and transmitting the modulated data.

In other aspect of the present invention, a digital broadcast transmitter may include a traffic information message generator, a pre-processor, a multiplexer, a post-processor, a data encoding and interleaving unit, a trellis encoder, and a transmitter.

The traffic information message generator may generate a traffic information message including status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information. The pre-processor may pre-process traffic information data including the traffic information message by encoding the traffic information data for at least one of error correction and error detection and by generating a traffic information data packet including the encoded traffic information data and known data. The multiplexer may multiplex the traffic information data packet with one or more main audio and video (AV) data packets. The post-processor post-processing the multiplexed data by encoding only traffic information data included in the multiplexed data with a coding rate of G/H, wherein G and H are positive integers and G is less than H. The data encoding and interleaving unit may add first parity data into the post-processed data and interleave the post-processed data having the first parity data. The trellis encoder may have at least one memory and trellis-encoding the interleaved data, the at least one memory being initialized by initialization data when data outputted from the data encoding and interleaving unit correspond to a beginning of a known data sequence. The data transmission unit may insert synchronization data into the trellis-encoded data, modulating the trellis-encoded data having the synchronization data, and transmitting the modulated data.

In another aspect of the present invention, a digital broadcast transmitter may include a traffic information message generator, a pre-processor, a multiplexer, a data encoding and interleaving unit, a post-processor, a trellis encoder, and a transmitter.

The traffic information message generator may generate a traffic information message including status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information. The pre-processor may pre-process traffic information data including the traffic information message by encoding the traffic information data for at least one of error correction and error detection and by generating a traffic information data packet including the encoded traffic information data and known data. The multiplexer may multiplex the traffic information data packet with one or more main audio and video (AV) data packets. The data encoding and interleaving unit may add first parity data into the multiplexed data and interleave the multiplexed data having the parity data. The post-processor may post-process the interleaved data by coding only traffic information data included in the interleaved data with a coding rate of G/H, wherein G and H are positive integers and G is less than H. The trellis encoder having at least one memory and trellis-encoding the post-processed data, the at least one memory being initialized by initialization data when data outputted from the post-processor correspond to a beginning of a known data sequence. The data transmission unit may insert synchronization data into the trellis-encoded data, modulating the trellis-encoded data having the synchronization data, and the transmitting the modulated data.

In another aspect of the present invention, a method of processing traffic data in a digital transmitter may include generating a traffic information message including status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information, generating at least one system information table required for decoding the traffic information message, and multiplexing the traffic information message and the system information table.

In another aspect of the present invention, a digital broadcast transmitter may include a traffic information message generator, a system information generator, and a multiplexer.

The traffic information message generator may generate a traffic information message including status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information. The system information generator may generate system information required for decoding a traffic information message. The multiplexer may multiplex the traffic information message and the system information.

In another aspect of the present invention, a data structure may include system information required for decoding a traffic information message including status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information, the system information comprising a traffic information table which includes at least one of a traffic information application identifier, a service component identifier, and service information.

In another aspect of the present invention, a method of processing traffic information data in a digital broadcast receiver may include receiving traffic information data including a traffic information message and system information, demultiplexing the traffic information message and the system information from the traffic information data, and decoding the traffic information message using the system information, thereby extracting status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information.

In a further aspect of the present invention, a digital broadcast receiver may include, a demodulator, a data demultiplexing and decoding unit, a data storage, and an application manager.

The demodulator may demodulate traffic information data including a traffic information message and system information and performing error correction to the demodulated data. The data demultiplexing and decoding unit may demultiplex the traffic information message and system information from the error-corrected data and decode the demultiplexed traffic information message using the system information. The data storage may store the system information and the decoded traffic information message. The application manager may provide a traffic information service to a user using the stored traffic information message by extracting status information, which includes at least one of information on traffic circulation, prediction information on the traffic circulation, and additional information, and location information associated with the status information.

It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiments of the invention and together with the description serve to explain the prinicple of the invention. In the drawing:

FIG. **1** illustrates a transmission format of traffic information according to the present invention;

FIG. **2**A is a syntax of some parts of a component frame including traffic information according to the present invention;

FIG. **2**B is a structural diagram illustrating a common structure of a traffic information message component according to the present invention;

FIG. **3** is a structural diagram illustrating a class contained in a status container according to the present invention;

FIG. **4**A is a structural diagram illustrating a traffic congestion status component equipped with traffic information contained in a CTT-status container according to the present invention;

FIGS. **4**B to **4**E show exemplary syntaxes of several status components contained in the traffic congestion status component of FIG. **4**A according to the present invention;

FIG. **5**A is a structural diagram illustrating a traffic congestion status component equipped with traffic prediction information contained in a CTT-status container according to the present invention;

FIGS. **5**B to **5**D show exemplary syntaxes of several prediction status components contained in the traffic congestion status component of FIG. **5**A according to the present invention;

FIG. **6** is a syntax of a status component including additional information according to the present invention;

FIG. **7** is a structural diagram illustrating a traffic congestion status component equipped with location reference information of a specific section corresponding to status information according to the present invention;

FIG. **8** is a structural diagram illustrating a TPEG location container including location information corresponding to status information according to the present invention;

FIG. **9**A is a structural diagram illustrating a TPEG location component equipped with location information contained in a TPEG location container according to the present invention;

FIGS. **9**B to **9**K exemplarily show a plurality of location coordinates components contained in a status component of FIG. **9**A according to the present invention;

FIG. **10**A is a code table illustrating the degree of traffic delay from among traffic information according to the present invention;

FIG. **10**B is a code table illustrating a link-speed variation from among traffic information according to the present invention;

FIG. **11** illustrates a block view showing a general structure of a digital broadcast transmitting system according to an embodiment of the present;

FIG. **12** illustrates a syntax structure of traffic information descriptors according to an embodiment of the present invention;

FIG. **13** illustrates an example of table that may include the traffic information descriptors of FIG. **12**;

FIG. **14** illustrates a syntax structure on a virtual channel table wherein the traffic information descriptors of FIG. **12** are included according to an embodiment of the present invention;

FIG. **15** illustrates a block view showing a structure of a digital broadcast transmitting system according to a first embodiment of the present invention;

FIG. **16** illustrates an example of a detailed block view showing an E-VSB pre-processor of FIG. **15**;

FIG. **17**A and FIG. **17**B each illustrates a data structure before and after a data deinterleaver of FIG. **15**, respectively;

FIG. **18** illustrates a block view showing a structure of a digital broadcast transmitting system according to a second embodiment of the present invention;

FIG. **19** illustrates an example of a detailed block view showing an E-VSB pre-processor of FIG. **18**;

FIG. **20** illustrates an example of a detailed block view showing an E-VSB post-processor of FIG. **18**;

FIG. **21** illustrates a block view showing a structure of a digital broadcast transmitting system according to a third embodiment of the present invention;

FIG. **22** illustrates a block view of a digital broadcast receiving system according to an embodiment of the present invention;

FIG. **23** illustrates process steps of receiving traffic information data according to an embodiment of the present invention;

FIG. **24** illustrates a detailed view of a demodulator of FIG. **22** according to a first embodiment of the present invention; and

FIG. **25** illustrates a detailed view of a demodulator of FIG. **22** according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. In addition, although the terms used in the present invention are selected from generally known and used terms, some of the terms mentioned in the description of the present invention

have been selected by the applicant at his or her discretion, the detailed meanings of which are described in relevant parts of the description herein. Furthermore, it is required that the present invention is understood, not simply by the actual terms used but by the meaning of each term lying within.

In the present invention, the known data refer to a set of data known in advance according to an agreement between a transmitting system and a receiving system. The main data refer to a set of data that can be received by a conventional receiving system. Both known data and main data may include video data and/or audio data. Also, in the present invention, the enhanced data may refer to data including information, such as a program execution file, stock information, traffic information, and so on. The enhanced data may also include video data and/or audio data. Such enhanced data may include, traffic information, data for providing data service, system information for ground (or terrestrial) wave broadcasting such as PSI and/or PSIP, system information for cable broadcasting such as out of band system information (OOB-SI), supplemental data configured of diverse Java language or HTML language for data services providing a wide range of applications, audio data, and video data. The enhanced data may also include various control software for controlling the receiver, and meta data that are configured of an XML language, for example, in order to provide diverse information to the user.

In the description of the present invention, traffic information data will be applied for the enhanced data, so as to be transmitted and received. A road searching service and a traffic information providing service according to the present invention may be applied to a variety of digital broadcast standards. Representative examples of the digital broadcast standards are a European Digital Audio Broadcasting (DAB) service based on the Eureka-147 [ETSI EN 300 401], a Digital. Video Broadcasting-Terrestrial (DVB-T) service provided in Europe, a Digital Video Broadcasting-Handheld (DVB-H) service also provided in Europe, a Media Forward Link Only (FLO) service provided in the United States, and a Digital Multimedia Broadcasting (DMB) service that is provided in the Republic of Korea. The DMB service of the Republic of Korea is classified into a Terrestrial Digital Multimedia Broadcasting (T-DMB) service based on the Eureka-147 and a Satellite Digital Multimedia Broadcasting (S-DMB) service using satellite communication.

Herein, the traffic information includes information on public transportation, congestion and/or travel time, road traffic, emergency events and situation, and so on. The traffic information also includes information associated with all types of transportation means including train, ship (or cruiser), airplane, and so on. Furthermore, the traffic information may also include information on factors that may influence traffic, such as travel information, information parking facilities, weather information, environmental pollution information, and so on. Most particularly, although the congestion and/or travel time (hereinafter referred to as "CTT") information is given as an example of the present invention, any other information type may be applied herein. Furthermore, as long as the term indicates a particular function, the terms used in the present invention are not limited only to the ones used in the description set forth herein.

The term "traffic status" is indicative of a road congestion status (i.e., a flow status), however, it is not limited to the above-mentioned road congestion status and can be applied to similar examples as necessary. For the convenience of description and better understanding of the present invention, the term "traffic status" is referred to as a Congestion and/or Travel. Time Information (CTT) status. The above-mentioned CTT status includes CTT status information, and CTT status prediction information, additional information, and so on. The tem "section" or "link" is indicative of a specific area of roads. However, it is not limited to the above-mentioned meanings and may be applied to other similar meanings as necessary.

The traffic information service according to the present invention is provided to the users by a receiver having only one or none of an electronic map and a GPS mounted therein in the form of at least one of a text, a voice, a graphic, a still image, and a motion picture. The traffic information data are configured and transmitted by traffic information message units. More specifically, the traffic information message is the smallest unit for transmitting the traffic information. Herein, information on a single traffic information application is included in a traffic information message. In the present invention, the term "Transport Protocol Expert Group (TPEG)" will be used on the traffic information for simplicity. Furthermore, as described above, as long as the term indicates a particular function, the terms used in the present invention are not limited only to the ones used in the description set forth herein.

The traffic information application corresponds to the highest hierarchy within an ISO/OSI protocol stack. Each traffic information application is assigned with a unique identification number, which is referred to as an application identification (AID). Each time a new application is developed and created, a new application identification is assigned. For example, each of the congestion and/or travel time (CTT) information, the road traffic message (RTM), the public transport information (PTI), and so on, is a traffic information application that is given unique application identification. The traffic information data correspond to a stream form including various traffic information messages. Herein, the traffic information messages correspond to at least one application.

FIG. **1** illustrates an example of two traffic information applications (e.g., CTT and RTM) being included in a stream.

Traffic information message generator (not shown in figure) generating a traffic information message can be a broadcast station. For simplicity of the description of the present invention, the traffic information message generator is referred to as a traffic information providing server. The traffic information message generator construct in a traffic information message unit traffic congestion information collected from various sources (e.g., operator input, or information received from another server or probe cars through a network).

At this point, each traffic information message has the same container configuration, which may be referred to as a traffic information (or TPEG) message container. The CTT message container described herein corresponds to one of the traffic information message containers. More specifically, the CTT message container according to the present invention, which transmits the CTT message, includes a CTT message management container **102**, a CTT-status container **104**, and a TPEG-location container **106**.

The above-mentioned CTT message management container **102** includes a message identification information and date and time information, and uses the message identification information and the date and time information as management information of the information received by the receiving system. The message ID information requisite for the message includes a message identifier (MID) and a

version number (VER). In this case, the message ID (MID) is indicative of an identifier of a single message associated with individual status of a service component. The MID according to the present invention gradually increases the MID number from 0 by a predetermined number "1" at a time. If the MID value reaches the maximum value "65535", the maximum value "65535" is initialized to zero. The version number (VER) is indicative of a sequential number for identifying successive messages having a single message ID. The version number according to the present invention may be determined to be any one of 0 to 255, and it should be noted that the version number is sequentially increased in the range from 0 to 255.

The date/time information contained in the CTT message management container **102** according to the present invention does not include start and end times, a message deletion time, and schedule information in the traffic congestion information, differently from other information (i.e., an incident and unexpected accident (road traffic message), and a public transportation status) of the TPEG message.

The congestion and travel time information is not like the unexpected accident varying with time, and includes current congestion and travel time information of each road, therefore it is sequentially transmitted.

Specifically, a message generation time is based on a real message generation time. A message transmission time among the message generation time is based on a transmission time of a corresponding message, and is contained in all messages. The message generation time and the message transmission time are required for a receiving side to manage received messages.

The above-mentioned CTT status container **104** includes a plurality of CTT components (ctt_component), each of which includes CTT status information. The CTT status component (ctt_component) includes CTT status information (ID "80 hex"), CTT status prediction information (ID "81 hex"), and additional information (ID "8A hex"), etc. The CTT status component (ctt_component) to which the identifier "80 hex" is assigned includes a status component (status_component). The status component (status_component) includes an average link speed, a travel time, a link delay time, and a congestion type.

A CTT component (ctt_component) to which the identifier "81 hex" is assigned includes a prediction status component (prediction_status_component) for transmitting. CTT prediction information. The prediction status component (prediction_status_component) includes an average link speed prediction, a link travel time prediction, and prediction status information associated with a congestion change. A CTT component (ctt_component) to which the identifier "8A hex" is assigned includes additional information of basic status information of the CTT information or of prediction status information. The status component including the above-mentioned additional information is formed on the condition that the presence of the additional information is determined.

The TPEG location container 106 includes a plurality of TPEG location components (tpeg_loc_component) equipped with link location information. In this case, the location information may be information based on a coordinates system and information of a predetermined link ID. Each TPEG location container (tpeg_loc_container) includes at least one location coordinates component (location_co-ordinates_component) to which an ID "00 hex" is assigned. The above-mentioned CTT component includes information of a link as a target object both the CTT status information and the CTT status prediction information. The above-mentioned link information includes a road-type list, a WGS 84 indicative of location coordinates, a link shape point, a link ID, link description, and so on.

FIG. **2**A is a syntax of some parts of a component frame including traffic information according to the present invention. FIG. **2**B is a structural diagram illustrating a common structure of a traffic information message component according to the present invention.

Referring to FIGS. **2**A to **2**B, traffic congestion information wirelessly transmitted from the traffic information message generator, that is, the traffic information providing server is configured in the form of a component frame. As shown in FIG. **2**A, the frame includes a message number field **202** indicating the number of messages contained in the frame and a traffic congestion information message sequence **204** corresponding to the number of messages contained in the message number field **202**.

The traffic congestion information message component includes an ID field **222**, a byte-unit's component data length field **224**, and a corresponding data field **226**.

FIG. **3** is a structural diagram illustrating a class contained in a status container according to the present invention.

Referring to FIG. **3**, the CTT-status container according to the present invention hierarchically includes a traffic-flow status(CTT_Status) class **232**, a traffic-flow prediction(prediction CTT_Status) class **234**, and an additional information class **236**. The reason why the traffic-flow status class (CTT_Status) **232**, the traffic-flow prediction(prediction CTT_Status) class **234**, and then the additional information class **236** are hierarchically configured is to guarantee terminal compatibility required for the extended standard and the added component.

In this case, the traffic-flow status class **232** describes information of the degree of traffic-flow of vehicles for each link, the traffic-flow status prediction class **234** describes information of the degree of traffic-flow of vehicles for each link. The additional information class **236** describes traffic congestion information for each TPEG message, and additional- or auxiliary-information associated with the traffic congestion information, and is configured in the form of text data differently from other classes.

Components contained in each class will hereinafter be described with reference to FIGS. **4**A□**4**E and **5**A□**5**D.

FIG. **4**A is a structural diagram illustrating a traffic congestion status component equipped with traffic information contained in a CTT-status container according to the present invention. FIGS. **4**B to **4**E show exemplary syntaxes of several status components contained in the traffic congestion status component of FIG. **4**A according to the present invention.

Referring to FIG. **4**A, a specific ID "80 hex" **242** is allocated to a traffic congestion status component (ctt_component) 80 transmitting current traffic-flow status information contained in a CTT-status container. The CTT component **80** includes a byte-unit data length field **244** of a corresponding component, and m status components (status_component) **246**.

Each status component (status_component) includes the link average speed, the link-travel time, the link delay time, and/or the link congestion type, which are configured in the forms of FIGS. **4**A to **4**E.

Referring to FIG. **4**B, the status component ("status_component(00)") including the link average speed is allocated with the ID "00 hex", and data of the speed defined in units of Km/h is contained in the status component ("status_compoent(00)").

As shown in FIG. **4**C, an ID "01 hex" is allocated to the status component("status_component(01)") equipped with link-travel time information, and data of the link-travel time is defined in units of seconds (i.e., sec units).

As shown in FIG. **4**D, an ID "02 hex" is allocated to the status component("status_component(02)") equipped with the link-delay time information, and data of the delay time is defined in units of seconds.

As shown in FIG. **4**E, an ID "03 hex" is allocated to the status component("status_component(03)") equipped with data indicating the type of congestion, and the type of congestion is represented by tables shown in FIG. **9**A.

FIG. **5**A is a structural diagram illustrating a traffic congestion status component equipped with congestion and travel time prediction information contained in a CTT-status container according to the present invention. FIGS. **5**B to **5**D show exemplary syntaxes of several prediction status components contained in the traffic congestion status component of FIG. **5**A according to the present invention.

Referring to FIG. **5**A, an ID "81 hex" is allocated to a CTT-status container ("ctt_component(81)") for transmitting congestion and travel time prediction information contained in the CTT status container. The CTT-status container ("ctt_component(81)") includes a field **254** indicating the length of yte-unit data and a plurality of prediction status components (prediction_status_component) **606**.

Each prediction status component (prediction_status_component) includes the above-mentioned prediction link average speed of FIG. **5**B, the prediction link-travel time of FIG. **5**C, and/or the prediction speed change information of FIG. **5**D.

As shown in FIG. **5**B, an ID "00 hex" is allocated to the prediction status component ("prediction_status component (00)") equipped with the prediction link average speed, and speed data is defined in units of Km/h, such that the Km/h-unit speed data is contained in the prediction status component ("prediction_status_component(00)"). Also, prediction time data defined by a user is contained in the prediction status component ("prediction_status_component (00)").

As shown in FIG. **5**C, a specific ID "01" is allocated to the prediction status component ("prediction_status_component (01)") equipped with the prediction link-travel time, and time data is defined in units of seconds, such that second-unit time data is contained in the prediction status component ("prediction_status_component(01)"). User-defined prediction time is contained in the prediction status component ("prediction_status_component(01)").

As shown in FIG. **5**D, an ID "02 hex" is allocated to the prediction status component ("prediction_status_component (02)") equipped with congestion tendency information. Congestion tendency is represented by the table shown in FIG. **9**B.

FIG. **6** is a syntax of a status component including additional information according to the present invention. FIG. **9**A is a code table illustrating the congestion type among traffic information according to the present invention. FIG. **9**B is a code table illustrating a congestion tendency among traffic information according to the present invention.

Referring to FIG. **6**, a specific ID "8A hex" is allocated the CIT component (8A) equipped with additional information. Additional information data contained in the CTT component 8A includes CTT-associated additional information for each message and auxiliary information for each message. In this case, the CTT-associated additional information and the auxiliary information are configured in the form of text data.

For example, if the status component("status_component (03)") equipped with the congestion type information shown in FIG. **5**E does not recognize congestion type for each link shown in FIG. **9**A in a specific field indicating the traffic-delay degree, a specific code is recorded in the status component("status_component(03)").

If the congestion type for each link shown in FIG. **9**A is determined to be a smooth traffic status in the aforementioned specific field, a specific code "1" is recorded in the status component("status_component(03)"). If the degree of traffic delay for each link shown in FIG. **10**A is determined to be a delayed traffic status in the aforementioned specific field, a specific code is recorded in the status component ("status_component(03)"). If the congestion type for each link shown in FIG. **10**A is determined to be a traffic jam status in the aforementioned specific field, a specific code "4" is recorded in the status component("status_component (03)").

If the degree of traffic status is not defined in the form of code tables, a CTT component 8A including additional information may be used for the above-mentioned situation.

For another example, if a speed change information field contained in the prediction status component("prediction_status_componet(02)") equipped with the link speed change information of FIG. **5**D does not recognize a difference between a first speed for each link and a second speed prior to a predetermined time as shown in FIG. **10**B, a specific code is recorded in the status component("status_component (03)"). If the first speed for each link is higher than the second speed prior to the predetermined time, a specific code "1" is recorded in the the status component("status_component(03)"). If the first speed for each link is lower than the second speed prior to the predetermined time, a specific code "2" is recorded in the status component("status_component (03)"). If the first speed for each link is maintained to be equal to the second speed prior to the predetermined time, a specific code "3" is recorded in the status component (03).

However, if the link speed change information is not defined by the above-mentioned code tables, the additional information component may be used for the above-mentioned situation. In more detail, video data captured by a camera capable of capturing a traffic status for each link is contained in an additional information component, such that the additional information component equipped with the video data may be transmitted to a user or users. In this case, the video data may include moving images and still images.

For still another example, if a famous restaurant or a historical place or theater is contained in a specific link indicating the status information, information associated with the above-mentioned places may also be contained in the CTT component (8A).

For still another example, the CTT component (8A) equipped with the additional information may include multimedia information, which includes text data, variety of video data, and variety of audio data. The multimedia information using the additional information component can be provided via a unidirectional service (e.g., a broadcast service), however, it can be more efficiently used for a communicational service associated with either a unique. IP address of a wired/wireless LAN or a unique code (e.g., a CDMA).

For example, if a user defines his or her interest area or place (e.g., a POI (Point Of Interest)), the additional information component may also be provided to the user using multimedia information associated with the above-mentioned interest area or place.

In more detail, if the user selects a movie theater, he or she may recognize title information of currently-played movies by referring to the above-mentioned multimedia information, may buy a ticket of a desired movie in advance by referring to the same, and may recognize the number of unsold tickets, a current parking status of a parking lot of the movie theater, and the number of vehicles capable of entering the parking lot using audio (video) data, video data, or text data.

Also, if the user selects a desired restaurant, he or she may recognize a menu of the selected restaurant, its price, the number of remaining tables using moving images, still images, audio data or text data by referring to the multimedia information.

For still another example, the CTT component("ctt_component(8A)") may include additional information associated with detailed location data. For example, the CTT component (8A) may include not only longitude- and latitude coordinates but also angle or height information incapable of being expressed by coordinates. By means of the above-mentioned information, subway route map information, underground passage information, and overpass information may also be provided to the user. Otherwise, a cubic map (e.g., a 3D or 4D map) may also be provided to the user as necessary.

FIG. **7** is a structural diagram illustrating a traffic congestion status component equipped with location reference information of a specific link corresponding to status information according to the present invention. FIG. **8** is a structural diagram illustrating a TPEG location container including location information corresponding to status information according to the present invention.

As shown in FIG. **7**, a specific ID "90 hex" denoted by **262** is allocated to a CTT component 90 indicating link location information as denoted by **262**. A field **264** for representing a data length of a corresponding component in byte units is contained in the CTT component 90. The CTT component 90 further includes at least one TPEG location sub-container (tpeg_loc_container) **266**.

As can be seen from FIG. **8**, the TPEG location sub-container (tpeg_loc_container) includes a specific field represented by codes defined in a table "loc41" (not shown) for the TPEG location component. For example, in the case of the Korean language, data "loc41_65" is recorded in the TPEG location sub-container. Also, the TPEG location container may include at least one TPEG location container (tpeg_loc_component).

FIG. **9**A is a structural diagram illustrating a TPEG location component equipped with location information contained in a TPEG location container according to the present invention. FIGS. **9**B to **9**K exemplarily show a plurality of location coordinates components contained in a status component of FIG. **9**A according to the present invention.

Referring to FIG. **9**A, a specific ID "00 hex" (**272**) is allocated to the TPEG location component (00) "tpeg_loc_component" indicating location information. The TPEG location component (00). "tpeg_loc_component" includes a field **274** indicating a corresponding component data length in byte units. Also, the TPEG location component (00) "tpeg_loc_component" includes a specific field **276** capable of indicating a location type using codes prescribed in the location reference table "loc01" (not shown), and also includes at least one coordinates component (co_ordinates_component) **278**.

Referring to FIG. **9**B, a specific ID "00 hex" is allocated to the coordinates component ("co_ordinates_component (00)") equipped with road type information. The coordinates component ("co_ordinates_cmponent(00)") also includes at least one road type component "roadtype_component".

Referring to FIG. **9**C, an ID "00 hex" is allocated to the road type component "roadtype_component", such that the road type component "roadtype_component" indicates whether a road is a national road (code loc42_1), a local road (code loc42_2), or an expressway (code loc42_3) by referring to the codes defined in the location reference table (loc42) (not shown).

Referring to FIG. **9**D, a specific ID "01 hex" is allocated to the coordinates component ("co_ordinates_component (01") for indicating location coordinates information using the WGS 84 format. The above-mentioned coordinate component (01) includes at least one WGS component "WGS84_component". Also, the coordinates component (01) further includes a specific field capable of indicating longitude/latitude information in 10 micro-degree units.

Referring to FIG. **9**E, a specific ID "02 hex" is allocated to the coordinates component "co-ordinates_component 02" indicating vertex information, and the coordinates component (02) includes a specific field indicating the number of vertexes. Also, the coordinates component (02) includes at least one vertex component ("vertex_component") to which vertex data is loaded.

In this case, the above-mentioned vertex allows a terminal for receiving traffic information to recognize either coordinates or a link shape designated by a link ID, such that the above-mentioned terminal can express the recognize coordinates or link shape in the form of graphic data using the vertex. The vertex is latitude/longitude information defined by the WGS 84 format. However, it should be noted that the scope of the above-mentioned tenn "vertex" can also be applied to similar terms or other examples as necessary.

Referring to FIG. **9**G, a specific. ID. "00 hex" is allocated to a vertex component("vertex component (00)") indicating the vertex information. The above-mentioned vertex component("vertex_component (00)") includes latitude/longitude data designated by 10 micro-degree units. In this case, the latitude/longitude data starts from "0", such that it increases by 10 micro-degree units.

The traffic-information receiving terminal unequipped with an electronic map can more realistically display the road shape on the basis of a current location on the screen.

Therefore, the number of vertexes has a scale (e.g., a scale of 10000:1) lower than that of an electronic map stored in a disc. The vertex component (00) may include the number of vertexes to visually display a desired road on a VGA or QVGA. For example, the number of vertexes may be determined to be equal to or less than 23.

Referring to FIG. **9**H, a specific ID "10 hex" is allocated to the coordinates component("co-ordinates_component (10)") indicating link ID information. The vertex component ("vertex_component(01)") indicates location reference link ID categories using the location reference table "loc 43" (not shown). For example, in the case of using a specific ID contained in an intelligent traffic system standard node link prescribed by Ministry Of Construction & Transportation (MOOT) of Republic of Korea, the above-mentioned location reference link ID category information is denoted by "loc 43_1". At least one link component "link_component" is contained in vertex component("vertex_component(00)").

Referring to FIG. **9**I, a specific ID "00 hex" is allocated to the link component("link_component(00)") equipped with link ID data, such that the link component("link_com-

ponent (00)") includes predetermined link ID data defined in either the traffic information receiving terminal or the traffic information server.

Referring to FIG. **9**J, a specific ID "03 hex" is allocated to a coordinates component("co-ordinates_component(03)") equipped with link descriptor information. The coordinates component("co-ordinates_component(03)") includes link descriptor information written in either a descriptor format or text data using codes defined in the table loc03 (not shown) indicating a location reference descriptor format. Also, the coordinates component("co-ordinates_component (03)") includes at least one descriptor component ("descriptor_component").

A specific ID "00 hex" is allocated to the descriptor component("descriptor_component(00)") equipped with direction type information, such that the descriptor component ("descriptor_component(00)") indicates a direction type using codes defined in the table (loc02). For example, the descriptor component ("descriptor_component(00)") may indicate whether a current direction is the east, the west, or the opposite direction.

The above described traffic information data require a more stable receiving performance than the general audio and/or video data, i.e., the main data. In case of the main data, small errors that cannot be noticed by the eyes and ears of a user are not problematic. Conversely, in case of the traffic information data, even a 1-bit size error can cause a serious problem. Therefore, the traffic information data are processed with an additional coding process, which is then multiplexed with the main data and transmitted. Thus, robustness is provided to the traffic information data, such as the CTT data, thereby enabling the data to respond strongly against the channel environment which is always under constant and vast change. At this point, system information is required in order to extract the traffic information data from the channel through which the traffic information data are transmitted and, then, to decode the extracted traffic information data. In some cases, the system information is referred to as service information. The system information may include channel information, event information, and so on.

In the preferred embodiment of the present invention, program specific information/program and system information protocol (PSI/PSIP) is applied as the system information. However, the present invention is not limited only to the example given in the description set forth herein. More specifically, if the system information corresponds to a protocol being transmitted in a table format may be applied to the present invention regardless of name of the system information. The PSI is an MPEG-2 system standard defined for classifying the channels and the programs. And, PSIP is an advanced television systems committee (ATSC) standard having channels and programs that can be classified.

Herein, the PSI may include a program association table (PAT), a conditional access table (CAT), a program map table (PMT), and a network information table (NIT). More specifically, the PAT corresponds to a special information that can be transmitted by a packet having a packet identification (PID) of '0'. The RAT transmits the corresponding PID information of the PMT and the corresponding PID information of the NIT for each program. The CAT transmits information on a paid broadcast system that is used by the transmitting end. The PMT transmits. PID information of a transport stream packet to which the program identification number and separate bit sequences, such as video data and audio data configuring the corresponding program, are transmitted. The PMT also transmits. PID information to which the PCR is transmitted. The NIT transmits information of the actual transmission network.

On the other hand, the PISP may include a virtual channel table (VCT), a system time table (STT), a rating region table (RRT), an extended text table (ETT), a direct channel change table (DCCT), a direct channel change selection code table (DCCSCT), an event information table (EIT), and a master guide table (MGT). The VCT transmits information on the virtual channel such as channel information for selecting the channel and a packet identification (PID) for receiving audio data and/or video data. More specifically, by parsing the VCT, PIDs of the audio data and video data corresponding to the broadcast program that is being transmitted through the channel along with the channel name, channel number, and so on. The STT transmits information on the current weather and time, and the RRT transmits information on the region and deliberation committee for program rating. The EIT transmits information on the events of a virtual channel (e.g., program title, program start time, etc.). The DCCT/DCCSCT transmits information associated with automatic channel change, and the MGT transmits version and PID information of each table within the PSIP.

Each table within the above-described PSI/PSIP includes a basic unit referred to as a "section", and at least one or more sections are combined to configure a table. For example, the VCT may be divided into 256 sections. Herein, a single section may carry a plurality of channel information. However, the information on the virtual channel is not divided into two or more sections. An example of multiplexing and transmitting a traffic information message and a table associated with a system information is given in the description of the present invention.

FIG. **11** illustrates a block view showing a general structure of a digital broadcast transmitting system according to an embodiment of the present, wherein a traffic information message and a table associated with the system information are multiplexed and transmitted. Referring to FIG. **11**, the transmitting system includes a first multiplexer **311**, a PSI/PSIP generator **312**, and a second multiplexer **313**. More specifically, for example, the transmitting system may correspond to a broadcast station. In order words, the traffic information message is inputted to the first multiplexer **311** in a 188-byte transport stream (TS) packet unit. Herein, the traffic information message a traffic information application (e.g., a CTT application) that is to be transmitted.

The TS packet is configured of a header part and a payload part. Herein, the header part includes information indicating the beginning of the data and packet identification (PID) identifying the data part corresponding to the payload part. And, the payload part includes a traffic information message that is intended to be transmitted. At this point, the PID within the header part may either correspond to an identifier that can identify the data carried by the payload part as the traffic information message among the enhanced data, or correspond to an identifier that can identify the enhanced data. In case the PID of the header can identify the traffic information message, the traffic information message may be extracted from the TS packet. On the other hand, in case the PID of the header can identify the enhanced data, all TS packets identified as the enhanced data are received. Thereafter, the traffic information message is extracted from the received enhanced data. Furthermore, the Ts packet which carries the traffic information message may correspond either to a packetized elementary stream (PES) type or to a section type. In other words, either a PES type traffic

information message may be configured as the TS packet, or a section type traffic information message may be configured as the TS packet.

An example of the traffic information message being transmiffed as the section type will be described in the present invention. In this embodiment of the present invention, the traffic information message is included in a digital storage media-command and control (DSM-CC) section, and the DSM-CC section is then configured as a 188-byte size TS packet. Herein, the identifier of the TS packet configuring the DSM-CC section is included in a data service table (DST). When transmitting the DST table, '0×95' is assigned as a stream_type field value within a service location descriptor of either the PMT or the VCT. More specifically, in the receiving system, when the stream_type field value of the PMT or VCT is equal to '0×95', this indicates that data broadcasting (i.e., enhanced data) including the traffic information data is being received. At this point, the traffic information data may be transmitted by a data carousel method. Herein, the data carousel method refers to repeatedly transmitting the same data periodically.

Meanwhile, the PSI/PSIP generator **312** is an example of a system information generator. The table that may be created by the PSI is at least one of PMT, PAT, CAT, and NIT. And, the table that may be created by the PSIP is at least one of VCT, STT, RRT, ETT, DCCT, DCCST, EIT, and MGT. The table created by the PSI/PSIP generator **312** includes a system information so that the receiving system may parse and decode the traffic information message. At this point, the receiving system may use only the tables within the PSI, or only the tables within the PSIP, a combination of tables within both the PSI and the PSIP, so as to parse and decode the traffic information message. At least the PAT and PMT of the PSI and at least the VCT of the PSIP is required for parsing and decoding the traffic information message. For example, the PAT may include the system information transmitting the traffic information message and the PID of the PMT corresponding to the traffic information message (or program number). The PMT may include the PID of the TS packet transmitting the traffic information message. The VCT may include the PID of the TS packet transmitting the information of the virtual channel, which transmits the traffic information message, and the traffic information message.

Also, the present invention includes supplemental information associated with traffic information specifically indicating to which application the traffic information message belonged and information specifically indicating which information is included. The supplemental information associated with the traffic information may include service component identification information, application identification information, service information, and so on. The service information may include service name, service description, service logo, subscriber information, free text information, help information, and so on. Furthermore, such supplemental information may be included in a particular table within the PSI/PSIP either in a descriptor format or in a field format.

For simplicity of the description of the present invention, a descriptor including the supplemental information associated with the traffic information that is included in a particular table within the PSI/PSIP is referred to as a traffic information descriptor. Herein, the traffic information descriptor may also be referred to as a TPEG service descriptor. As described above, the term "traffic information descriptor" is only an example given to facilitate the understanding of the present invention. Therefore, any other term having the same function as the traffic information descriptor may also be applied herein. Moreover, in the description of the present invention, the particular table including the traffic information descriptor is defined as a traffic information providing table. Furthermore, the particular table including the traffic information descriptor is defined as a system information (SI) table wherein the traffic information descriptor is included.

FIG. **12** illustrates a syntax structure of traffic information descriptors according to an embodiment of the present invention. Referring to FIG. **12**, the TPEG service descriptor may include a Descriptor_tag field, a Descriptor_length field, a Number_of TPEG_Service_Components field, and a 'for' loop repetition statement. Herein, the Number_of_TPEG_Service_Components field indicates the number of service components included in the TPEG service descriptor (or traffic information descriptor). And, the 'for' loop repetition statement is repeated as much as the value of the Number_of_TPEG_Service_Components field. The repetition statement may include a Service_Component_ID field, an Application_ID field, and a service information field.

More specifically, the Descriptor_tag field is an 8-bit field, which is given a value that can uniquely identify the TPEG service descriptor. In the example of the present invention, a value of O×AC is given as the tag value of the TPEG service descriptor. However, this is only an example provided for an easier understanding of the present invention. Depending upon the design of the system designer, other kind of unused tag values may be allocated to the Descriptor_tag field. The Descriptor_length field is an 8-bit field, which indicates in byte units the length starting from the Descriptor_length field to the end of this field.

The Service_component_ID (SCID) field is also an 8-bit field, which indicates a value that can uniquely identify the service component within a service. The SCID field may be decided by the service provider. Herein, a single service component substantially corresponds to a single channel within the TPEG stream. The Application_ID field is a 16-bit field, which indicates a value that can uniquely identify each application. More specifically, a unique application identifier (AID) is assigned to each traffic information application, and a new AID is allocated whenever a new application is developed (or created).

The service information field within the repetition statement may include a Service_name field, a Service_description field, a Service_logo field, a Subscriber_information field, a Free_text_information field, and a Help_information field. The length of each field within the service information field is variable and is indicates in the form of at least one of a text sequence, numbers, and graphics. The Service_name field indicates the name of a service, which allows the user to identify a particular service. For example, a service name such as 'TPEG service of broadcast company A' may be included when the broadcast program is being transmitted. The Service_description field indicates a detailed description of the corresponding service. This field is for describing the service contents in more detail. For example, a service named "suburban public transportation information in the southern urban area" may be included and transmitted. The Service_logo field indicates a service logo, so as to allow a service or a service provider to be identified visually. The service logo is generally transmitted in a bitmap format or any other image format.

The Subscriber_information field indicates the subscriber information. For example, information such as a user fee for limited (or restricted) service components and payment information may be included and transmitted. The Free_t-

ext_information field indicates additional infomation that is to be transmitted to the user. For example, information on an interruption (or suspension) of a service, cancellation of a particular information, and so on, may be included and transmitted. And, the Help_information field indicates help information which the user can refer to. For example, information such as Internet addresses, telephone numbers, and so on may be included herein and transmitted.

The order, location, and meaning of each field shown in FIG. **12** are merely examples for facilitating the understanding of the present invention. And, since the order, location, and meaning of each field, and the number of field being additionally allocated can be adequately modified by anyone skilled in this field, the present invention is not limited only to the examples set forth herein. Also, in the example given in the present, invention, the traffic information descriptor shown in FIG. **12** is included in at least one of the PMT of the PSI and the VCT of the PSIP and then transmitted.

More specifically, in the description of the present invention, an example of applying the PMT of the PSI and the VCT of the PSIP as the traffic information providing table. This indicates that the supplemental information associated with the traffic information may be transmitted through the PMT and/or VCT of the descriptor or the field. Similarly, when supplemental information associated with the traffic information is described in a field format, it is apparent that the fields can be applied to at least one of the tables of the PMT of the PSI and the VCT of the PSIP. Herein, the process of including the PMT and/or the VCT in the traffic information descriptor may be either mandatory or optional. Furthermore, whether the PMT and/or the VCT are/is mandatorily or optionally included is also merely an example of the present invention. Accordingly, the example does not limit the scope and spirit at the present invention.

FIG. **13** illustrates an example of table that may include the traffic information descriptors of FIG. **12**. More specifically, FIG. **13** shows examples of the main descriptor types used in the PSI/PSIP table, the descriptor tag values allocated to each descriptor, and the PSI/PSIP tables using at least one of the above-described descriptors. Referring to FIG. **13**, a service location descriptor indicated as 'S' must always exist in the VCT. More specifically, the service location descriptor carries the audio. PID and video. PID of a broadcast program. Also, in a corresponding service each of the descriptors must be included in the tables indicated as 'M (i.e., mandatory)' and may or may not be included in the tables indicated as 'O (i.e., optionally)'.

For example, AC-3 audio descriptor is given a value of 0×81 as the descriptor tag value and must indicate that it is used in the PMT and EIT. Furthermore, the TPEG service descriptor according to the example of the present invention is given a value of 0×AC the descriptor tag value and is marked as 'mandatory (M)' on the PMT and VCT. The above-described example is only proposed to simplify the description of the present invention. The TPEG service descriptor may also be marked as 'mandatory (M)' or 'optional (O)' on at least one of the PMT and VCT. The 0×AC value given as the TPEG service descriptor tag value is also only proposed as an example for facilitating the understanding of the present invention. Accordingly, depending upon the design of the system designer, other unused tag values may also be assigned herein.

FIG. **14** illustrates a syntax structure on a virtual channel table (VCT) wherein the traffic information descriptors of FIG. **12** are included according to an embodiment of the present invention. Herein, the syntax structure and its meaning correspond to those of a private section. The VCT syntax of FIG. **14** is configured by including at least one of a table_id field, a section_syntax_indicator field, a private_indicator field, a section_length field, a transport_stream_id field, a version_number field, a current_next_indicator field, a section_number field, a last_section_number field, a protocol_version field, and a num_channels_in_section field.

The VCT syntax further includes a first 'for' loop repetition statement that is repeated as much as the num_channels_in_section field value. The first repetition statement may include at least one of a short_name field, a major_channel_number field, a minor_channel_number field, a modulation_mode field, a carrier_frequency field, a channel_TSID field, a program_number field, an ETM_location field, an access controlled field, a hidden field, a service_type field, a source_id field, a descriptor_length field, and a second 'for' loop statement that is repeated as much as the number of descriptors included in the first repetition statement. Herein, the second repetition statement will be referred to as a first descriptor loop for simplicity. The descriptor descriptors( ) included in the first descriptor loop is separately applied to each virtual channel.

Furthermore, the VCT syntax may further include an additional_descriptor_length field, and a third 'for' loop statement that is repeated as much as the number of descriptors additionally added to the VCT. For simplicity of the description of the present invention, the third repetition statement will be referred to as a second descriptor loop. The descriptor additional_descriptors( ) included in the second descriptor loop is commonly applied to all virtual channels described in the VCT.

As decribed above, referring to FIG. **12**, the table_id field indicates a unique identifier (or identification) (ID) that can identify the information being transmitted to the table as the VCT. More specifically, the table_id field indicates a value informing that the table corresponding to this section is a VCT. For example, a 0×C8 value may be given to the table_id field.

The version_number field indicates the version number of the VCT. The section_number field indicates the number of this section. The last_section_number field indicates the number of the last section of a complete. VCT. And, the num_channel_in_section field designates the number of the overall virtual channel existing within the VCT section. Furthermore, in the first 'for' loop repetition statement, the short_name field indicates the name of a virtual channel. The major_channel_number field indicates a 'major' channel number associated with the virtual channel defined within the first repetition statement, and the minor_channel_number field indicates a 'minor' channel number. More specifically, each of the channel numbers should be connected to the major and minor channel numbers, and the major and minor channel numbers are used as user reference numbers for the corresponding virtual channel.

A virtual channel number is assigned to the traffic information message according to the present invention, and the traffic information message may be transmitted through the assigned virtual channel. In this case, the short name field indicates the name of the virtual channel through which the traffic information message is transmitted. The major_channel_number/minor_channel_number field the number of the virtual channel through which the traffic information message is transmitted. The program_number field is shown for connecting the virtual channel having an MPEG-2 program association table (PAT) and program map table (PMT) defined therein, and the program_number field matches the program number within the PAT/PMT. Herein, the PAT

describes the elements of a program corresponding to each program number, and the PAT indicates the PID of a transport packet transmitting the PMT. The PMT described subordinate information, and a PID list of the transport packet through which a program identification number and a separate bit sequence, such as video and/or audio data configuring the program, are being transmitted.

The source_id field indicates a program source connected to the corresponding virtual channel. Herein, a "source" refers a particular source such as a video image, data or sound. The value of the source_id field corresponds to a unique value within the transport stream, which transmits the VCT. In an example according to the present invention, the traffic information descriptor describing the supplemental information associated with traffic information (i.e., supplemental information associated with the CTT) is included in the first descriptor loop. As described above in the description of the VCT, it is apparent that anyone skilled in the art can apply the example given in the present invention to other tables.

According to the present invention, there are two different methods of defining the PID of the VCT, which includes the traffic information descriptor. Herein, the PID of the VCT is a packet identifier (PID) required for identifying (or distinguishing) the VCT from the other tables. In the first method, the PID of the VCT according to the present invention may be set to depend upon the MGT. In this case, the receiving system cannot directly identify (or verify) the plurality of tables of the PSIP or PSI. Therefore, the VCT can be read only after the PID defined by the MGT is checked. Herein, the MGT is a table defining the PID, size, version number, and so on, of the plurality of tables. In the second method, the PID of the VCT according to the present invention may be set to have a base PID value (i.e., a fixed PID value) that is independent from the MGT. Unlike the first method, the second method is more advantageous in that the VCT can be identified without having to verify every single PID of the MGT. Evidently, the agreement on the base PID should precede the transmitting system and the receiving system.

As described above, the PAT, PMT, VCT, MGT, DCCT, and so on, describing the system information and supplemental information associated with traffic information are generated by the PST/PSIP generator **312**. Herein, the PMT is provided to the first multiplexer **311**, and the remaining tables excluding the PMT (i.e., PAT, VCT, MGT, DCCT, and so on) are provided to the second multiplexer **313**. The first multiplexer **311** multiplexes the traffic information message, which includes information on the traffic information application that is to be transmitted (e.g., CTT application), with the PMT, which is generated from the PSI/PSIP generator **312**, to a 188-byte transport stream (TS) packet. Thereafter, the multiplexed message and table are outputted to the second multiplexer **313**. The second multiplexer **313** multiplexes the output of the first multiplexer **311** with the tables outputted from the PSI/PSIP generator **312** to a 188-byte transport stream (TS) packet. Subsequently, the multiplexed message and table are outputted for additional coding.

An example of providing the PMT to the first multiplexer **311** and providing the remaining tables to the second multiplexer **313** is proposed in the description of the present invention. However, the present invention may also be designed to have a single multiplexer by integrating the first multiplexer **311** and the second multiplexer **313**. The traffic information data that are outputted from the multiplexer of FIG. **11** for additional coding include a traffic information message and PSI/PSIP tables associated with the traffic information message multiplexed therein. Also, at least one of the above-described tables (e.g., PMT, VCT) may include a traffic information descriptor shown in FIG. **12**.

Hereinafter, the coding and transmitting processes of the traffic information data will be described in detail according to first, second, and third embodiments of the present invention. By performing the additional coding process on the traffic information data, robustness can be provided to the traffic information data, such as the CTT data. Thus, the data can respond swiftly and appropriately to the channel environment that undergoes fast and frequent change.

First Embodiment

FIG. **15** illustrates a block view showing a structure of a digital broadcast transmitting system according to a first embodiment of the present invention. Referring to FIG. **15**, the digital broadcast transmitting system includes an E-VSB pre-processor **401**, a packet multiplexer **402**, a data randomizer **403**, a RS encoder **404**, a data interleaver **405**, a backward compatibility processor **406**, a trellis encoder **407**, a frame multiplexer **408**, a pilot inserter **409**, a VSB modulator **410**, and a RF up-converter **411**. Herein, as shown in FIG. **16**, the E-VSB pre-processor **401** includes an E-VSB randomizer **421**, a RS frame encoder **422**, an E-VSB block processor **423**, a group formatter **424**, a data deinterleaver **425**, and a packet formatter **426**.

In the digital broadcast transmitting system having the above described structure, the main data are inputted to the packet multiplexer **402**. On the other hand, the traffic information data are inputted to the E-VSB pre-processor **401**, which performs additional coding processes so as to enable the traffic information data to respond quickly with robustness against noise and channel change. The E-VSB randomizer **421** of the E-VSB pre-processor **401** receives the traffic information data, thereby randomizing the received data and outputting the randomized data to the RS frame encoder **422**. Herein, since the E-VSB randomizer **421** randomizes the traffic information data, the randomizing process of data randomizer **403** on the traffic information in a later process may be omitted.

The RS frame encoder **422** receives the randomized traffic information data and performs at least one of an error correction coding process and an error detection coding process on the received data. Accordingly, by providing robustness to the traffic information data, the data can scatter group error that may occur due to a change in the frequency environment. Thus, the data can respond appropriately to the frequency environment which is very poor and liable to change. The RS frame multiplexer **422** also includes a process of mixing in row units many sets of traffic information data each having pre-determined size. By performing an error correction coding process on the inputted traffic information data, the RS frame encoder **422** adds data required for the error correction and, then, performs an error detection coding process, thereby adding data required for the error detection process.

The error correction coding uses the RS coding method, and the error detection coding uses the cyclic redundancy check (CRC) coding method. When performing the RS coding process, parity data required for error correction are generated. And, when performing the CRC coding process, CRC data required for error detection are generated. More specifically, the RS frame encoder **422** identifies the traffic information data by units of a predetermined length (A). Then, a plurality of (A)-length units of traffic information data is grouped so as to form (or configure) a RS frame. Thereafter, an RS coding process is performed in at least one

of a row direction and a column direction on the newly configured RS frame. In the present invention, the predetermined length unit (A) corresponds to 187 bytes.

If the inputted traffic information data correspond to a 188-byte unit. MPEG transport stream (TS) packet, the first MPEG synchronization byte is removed, so as to form a 187-byte unit packet. Herein, the MPEG synchronization byte is removed because all traffic information data packets are given the same value. The MPEG synchronization byte may also be removed during the randomizing process on the E-VSB randomizer **421**. In this case, the process of removing the MPEG synchronization byte performed by the RS frame encoder **422** is omitted. More specifically, if the inputted traffic information data does not include a fixed byte that can be removed, or if the length of the inputted packet is not 187 bytes, the inputted traffic information data is distinguished by 187-byte units. Thereafter, a plurality of 187-byte units of traffic information data is grouped so as to form (or configure) a RS frame. Thereafter, an RS coding process is performed in at least one of a row direction and a column direction on the newly configured RS frame.

Depending upon the channel situation between the transmission and the reception, an error may be included in the RS frame. When such error occurs, the CRC data (or CRC code or CRC checksum) may be used for checking whether an error exists by each row unit. In order to generate (or create) the CRC checksum, the RS frame encoder **422** performs CRC coding on the RS-coded traffic information data. The CRC checksum created by the CRC coding process may be used for notifying whether a damage has occurred by an error while the traffic information data are being transmitted through a channel. In the present invention, error detection coding method other than the CRC coding method may be used. Alternatively, an error correction coding method may be used in order to enhance the overall error correction ability of the receiving end.

The traffic information data sets RS-coded and CRC-coded, as described above, are outputted to the E-VSB block processor **423**. The E-VSB block processor **423** codes the RS-coded and CRC-coded traffic information data at a coding rate of G/H (wherein G and H are integers, and G<H) and then outputs the G/H-rate coded data to the group formatter **424**. For example, if 1 bit of the input data is coded to 2 bits and outputted, then G is equal to 1 and H is equal to 2 (i.e., G=1 and H=2). Alternatively, if 1 bit of the input data is coded to 4 bits and outputted, then G is equal to 1 and H is equal to 4 (i.e., G=1 and H=4).

An example performing a coding process at a coding rate of 1/2 (also referred to as a 1/2-rate coding process) or a coding process at a coding rate of 1/4 (also referred to as a 1/4-rate coding process) on the traffic information data is given in the description of the present invention. More specifically, in case of performing the 1/2-rate coding process, the E-VSB block processor **423** receives 1 bit and codes the received 1 bit to 2 bits (i.e., 1 symbol). Then, the E-VSB block processor **423** outputs the processed 2 bits (or 1 symbol). On the other hand, in case of performing the 1/4-rate coding process, the E-VSB block processor **423** receives 1 bit and codes the received 1 bit to 4 bits (i.e., 2 symbols). Then, the E-VSB block processor **423** outputs the processed 4 bits (or 2 symbols). At this point, in case of performing the 1/4-rate coding process, the symbol coded at a 1/2 coding rate may be repeated twice so as to output 2 symbols, or the input data may be coded twice at a 1/2 coding rate so as to output 2 symbols.

The 1/4-rate coding process may provide more enhanced error correction ability, due to the higher coding rate as compared to the 1/2-rate coding process. For this reason, the data coded at a 1/4 coding rate by the group formatter **424** in a later process are allocated to locations (or positions) in which the channel may affect the performance. On the other hand, the data coded at a 1/2 coding rate are allocated to locations having better performance. Thus, a difference in performance may be decreased. The above-mentioned 1/2-coding rate and 1/4-coding rate are only exemplary embodiments proposed in the description of the present invention, and the coding rate may vary depending upon either the selection of the coded symbols or the number of repetition.

The group formatter **424** inserts the traffic information data outputted from the E-VSB block processor **423** in a corresponding area within a data group formed according to a pre-defined rule. Also, the group formatter **424** inserts various place holders related to data interleaving or known data sets to a corresponding area within the data group. At this point, the data group may be described by at least one hierarchical area. And, depending upon the characteristic of each hierarchical area, the data type being allocated to each area may also vary.

FIG. **17**A illustrates a data structure of data groups prior to the data deinterleaving process, and FIG. **17**B illustrates a data structure of data groups after the data deinterleaving process. FIG. **17**A illustrates an example of a data group within a data structure prior to the data deinterleaving, the data group being divided into three hierarchical areas: a head area, a body area, and a tail area. Accordingly, in the data group that is inputted for the data deinterleaving process, data are first inputted to the head area, then inputted to the body area, and inputted finally to the tail area. The three areas described above are only exemplary to facilitate the understanding of the present invention. Depending upon the design of the system designer, the areas may be described in a smaller number of areas or a larger number of areas. Further, the data being inserted in each area may also vary. Therefore, the present invention is not limited only to the example proposed herein.

As described above, the head, body, and tail areas have been given as an example to simplify the description of the present invention. Additionally, in the example shown in FIG. **17**A, the data group is set to have head, body, and tail areas so that the body area is defined as the area which is not mixed with the main data area within the data group. The data group is divided into a plurality of areas so that each area may be used differently. More specifically, the area that is not interfered by the main data has a highly resistant receiving performance as compared to the area that is interfered by the main data. Furthermore, when using a system inserting and transmitting the known data to the data group, and when a long and continuous set of known data is to be inserted periodically in the enhanced data, a predetermined length of known data may be periodically inserted in the body area. However, since the main data may be mixed in the head and tail areas, it is difficult to periodically insert the known data, and it is also difficult to insert a long and continuous set of known data.

Assuming that the data group is allocated to a plurality of hierarchical areas, as shown in FIG. **17**A, the above-described E-VSB block processor **423** may code the data that are to be inserted in each area, according to the characteristic of each hierarchical area, at different coding rates. In the example of the present invention, the receiving system uses different coding rates based on areas in which it is assumed that performance may vary after performing an equalization process using channel information that may be used for channel equalization.

For example, the traffic information data that are to be inserted in the body area are 1/2-rate coded by the E-VSB block processor **423**, and such 1/2-rate coded traffic information data are inserted to the body area by the group formatter **424**. Additionally, the traffic information data that are to be inserted in the head and tail areas are 1/4-rate coded by the E-VSB block processor **423**. Herein, the 1/4-rate coding provides greater error correction performance as compared to 1/2-rate coding. Thereafter, 1/4-rate coded traffic information data are inserted to the head and tail areas by the group formatter **424**. Alternatively, the traffic information data that are to be inserted in the head and tail areas may be coded by the E-VSB block processor **423** at a coding rate providing more efficient error correction performance. Subsequently, such coded traffic information data are inserted in the head and tail areas by the E-VSB block processor **423**, or such coded data may be stored in a reserve area for future usage.

As shown in FIG. **17**A, apart from the traffic information data coded and outputted from the E-VSB block processor **423**, the group formatter **424** also inserts an MPEG header place holder, a non-systematic. RS parity place holder, and a main data place holder in relation with the data deinterleaving. Referring to FIG. **17**A, the main data place is allocated because the traffic information data and the main data are alternately mixed in the head and tail areas based upon the input of the data deinterleaver. In the output data that have been data deinterleaved, the place holder for the MPEG header is allocated to the very beginning of each packet.

The group formatter **424** either inserts the known data generated by a pre-decided method in a corresponding area, or inserts a known data place holder in a corresponding area so as to insert the known data in a later process. Moreover, a place holder for initializing the trellis encoder **407** is inserted in the corresponding area. For example, the initialization data place holder may be inserted in front of the known data sequence. The output of the group formatter **424** is inputted to the data interleaver **425**. The data deinterleaver **425** performs an inverse process of the data interleaver on the data within the data group and the place holder outputted from the group formatter **424**. And, then, the data deinterleaver **425** outputs the deinterleaved data to the packet formatter **426**. More specifically, when the data within the data group and the place holder the configuration shown in FIG. **17**A are deinterleaved by the data deinterleaver **425**, the data group being outputted to the packet formatter **426** has the structure (or configuration) shown in FIG. **17**B.

Among the deinterleaved and inputted data, the packet formatter **426** removes the main data place holder and the RS parity place holder that have been allocated for the deinterleaving process. Then, the packet formatter **426** groups the remaining portion of the input data and inserts the remaining data to the 4-byte MPEG header place holder in the MPEG header. Furthermore, when the known data place holder is inserted by the group formatter **424**, the packet formatter **426** may insert the known data in the known data place holder. Alternatively, the known data place holder may be directly outputted without any modification for the replacement insertion in a later process.

Thereafter, the packet formatter **426** configures the data within the data group packet that is formulated as described above, as a 188-byte unit traffic information data packet. Then, the packet formatter **426** provides the configured 188-byte unit traffic information data packet to the packet multiplexer **402**. The packet multiplexer **402** multiplexes the 188-byte traffic information data packet and the main data packet outputted from the packet formatter **426** according to a predefined multiplexing method. Then, the multiplexed packets are outputted to the data randomizer **403**. The multiplexing method may be altered or modified by various factors in the design of the system.

In a multiplexing method of the packet multiplexer **402**, a traffic information data burst section and a main data section are distinguished (or identified) along a time axis, then the two sections are set to be repeated alternately. At this point, in the traffic information data burst section, at least one of the data groups may be transmitted, and only the main data may be transmitted in the main data section. In the traffic information data burst section, the main data may also be transmitted. When the traffic information data are transmitted in the above-described burst structure, the digital broadcast receiving system receiving only the traffic information data may turn on the power only during the data burst section. Alternatively, in the main data section whereby only the main data are transmitted, the power is turned off during the main data section, thereby preventing the main data from being received. Thus, excessive power consumption of the digital broadcast receiving system may be reduced or prevented. As described above, the packet multiplexer **402** receives the main data packet and the data group, which is outputted from the packet formatter **426**, and transmits the received packets in a burst structure.

When the inputted data correspond to the main data packet, the data randomizer **403** performs a randomizing process identical to that of the conventional randomizer. More specifically, the MPEG synchronization byte within the main data packet is discarded (or deleted). Then, the remaining 187 bytes are randomized by using a pseudo random byte generated from within the data randomizer **403**. Subsequently, the randomized data bytes are outputted to the RS encoder **404**.

However, when the inputted data correspond to the traffic information data packet, the MPEG synchronization byte among the 4 bytes inserted in the traffic information data packet by the packet formatter **426** is discarded (or deleted) and only the remaining 3 bytes are randomized. The remaining portion of the traffic information data excluding the MPEG header is not randomized and outputted directly to the RS encoder **404**. This is because a randomizing process has already been performed on the traffic information data by the E-VSB randomizer **421**. The RS encoder **404** RS-codes the data randomized by the data randomizer **403** or the data bypassing the data randomizer **403**. Then, the RS encoder **404** adds a 20-byte RS parity to the coded data, thereby outputting the RS-parity-added data to the data interleaver **405**.

At this point, if the inputted data correspond to the main data packet, the RS encoder **404** performs a systematic RS-coding process identical to that of the conventional ATSC VSB system on the inputted data, thereby adding the 20-byte RS parity at the end of the 187-byte data. Alternatively, if the inputted data correspond to the traffic information data packet, each place of the 20 parity bytes is decided within the packet. Thereafter, the 20 bytes of RS parity gained by performing the non-systematic RS-coding are respectively inserted in the decided parity byte places. The data interleaver **405** receives the data having the parity added by the RS encoder **404** and interleaves the received data. Thereafter, the data interleaver **405** outputs the interleaved data to the backward compatibility processor **406** and the trellis encoder **407**. Herein, the data interleaver **405** corresponds to a byte unit convolutional interleaver.

Meanwhile, a memory within the trellis encoder **407** should first be initialized in order to allow the output data of the trellis encoder **407** so as to become the known data defined based upon an agreement between the receiver and the transmitter. More specifically, the memory of the trellis encoder **407** should first be initialized before the known data sequence being inputted is trellis-encoded. At this point, the beginning of the known data sequence that is inputted corresponds to the initialization data place holder inserted by the group formatter **424** and not the actual known data. Therefore, a process of generating initialization data right before the trellis-encoding of the known data sequence being inputted and a process of replacing the initialization data place holder of the corresponding trellis encoder memory with the newly generated initialization data are required. This is to ensure the backward-compatibility with the conventional receiving system.

The trellis memory initialization data generated to replace the initialization data place holder are decided based upon the current status of the memory within the trellis encoder **407** and the desired initialization status. Further, due to the replaced initialization data, a process of recalculating the RS parity of the corresponding data packet and a process of replacing the newly calculated RS parity with the RS parity outputted from the data interleaver **405** are required. Therefore, the backward compatibility processor **406** receives the traffic information data packet including the initialization data place holder that is to be replaced with the initialization data from the data interleaver.

Subsequently, the backward compatibility processor **406** receives the initialization data from the trellis encoder **407**. Then, the backward compatibility processor **406** calculates a new non-systematic RS parity and outputs the newly calculated non-systematic RS parity to the trellis encoder **407**. Thereafter, the trellis encoder **405** selects the output of the data interleaver **405** as the data within the traffic information data packet including the initialization data place holder that is to be replaced. The trellis encoder **405** also selects the output of the backward compatibility processor **406**. Accordingly, the trellis encoder **405** trellis-encodes the selected outputs by symbol units. More specifically, the trellis encoder **407** trellis-encodes the initialization data instead of the initialization data place holder included in the traffic information data packet which has been inputted.

Meanwhile, when the main data packet is inputted or when the traffic information data packet is inputted, wherein the traffic information data packet does not include the initialization data place holder that is to be replaced, the trellis encoder **407** selects the data outputted from the data interleaves **405** and the RS parity, thereby performing a trellis-encoding process by symbol units. Then, the data trellis-encoded by the trellis encoder **407** are inputted to the frame multiplexer **408**. The frame multiplexer **408** inserts field and segment synchronization signals in the output of the trellis encoder **407** and outputs the processed data to the pilot inserter **409**. The pilot inserter **409** adds a pilot signal to the output symbol sequence of the frame multiplexer **408**. The pilot-added symbol sequence is modulated to a 8VSB signal of an intermediate frequency band and, then, converted to a RF band signal, thereby being transmitted through the antenna.

Meanwhile, the embodiment shown in FIG. **16** for the components and positioning of the components of the E-VSB pre-processor **401** is merely an example for the simplicity of the description of the present invention. According to a second embodiment of the present invention, the E-VSB pre-processor **401** includes a RS frame encoder, an E-VSB randomizer, an E-VSB block processor, a group formatter, a data interleaver, and a packet formatter. The difference between the second embodiment and the E-VSB pre-processor shown in FIG. **16** is the positioning order of the RS frame multiplexer and the E-VSB randomizer. More specifically, in the second embodiment of the present invention, RS frame coding is first performed on the traffic information data, and then the data randomizing process is performed. Apart from this detail, the remaining structure of the second embodiment is identical to the embodiment shown in FIG. **16**. Therefore, a detailed description of the same will be omitted for simplicity.

In a third embodiment of the present invention, the E-VSB pre-processor **401** includes a RS frame encoder, an E-VSB randomizer, a group formatter, an E-VSB block processor, a data interleaver, and a packet formatter. The difference between the third embodiment and the E-VSB pre-processor shown in FIG. **16** is the positioning order of the RS frame multiplexer and the E-VSB randomizer and, also, the positioning order of the group formatter and the E-VSB block processor. More specifically, in E-VSB pre-processor according to the third embodiment of the present invention, RS frame coding is first performed on the traffic information data, and then the data randomizing and byte expansion processes are performed. Thereafter, group formatting, E-VSB block processing, data randomizing, and packet formatting processes are sequentially performed on the byte-expanded traffic information data.

In this case, since the group formatter is positioned before the E-VSB block processor, a byte expansion process needs to be performed before the group formatter in order to correspond to the coding process of the E-VSB block processor, thereby enabling the group formatter to operate without trouble. Therefore, the E-VSB randomizer not only randomizes the traffic information data but also performs byte expansion by inserting null data bits. Furthermore, the E-VSB block processor performs one of a 1/2-rate coding process and a 1/4-rate coding process on only the valid data of the byte-expanded traffic information data, which correspond to the data bits having the actual information. As described above, the E-VSB pre-processor **401** performing additional coding processes on the traffic information data may be applied in various methods. Thus, the present invention is not limited only to the examples given in the description set forth herein.

Second Embodiment

FIG. **18** illustrates a block view showing a structure of a digital broadcast transmitting system according to a second embodiment of the present invention. Referring to FIG. **18**, the digital broadcast transmitting system includes an E-VSB pre-processor **501**, a packet multiplexer **502**, a data randomizer **503**, an E-VSB post-processor **504**, a RS encoder **505**, a data interleaver **506**, a backward compatibility processor **507**, a trellis encoder **508**, a frame multiplexer **509**, a pilot inserter **510**, a VSB modulator **511**, and a RF up-converter **512**. Herein, as shown in FIG. **19**, the E-VSB pre-processor **501** includes a RS frame encoder **521**, an E-VSB randomizer **522**, a group formatter **523**, a data deinterleaver **524**, and a packet formatter **525**. Further, as shown in FIG. **20**, the E-VSB post-processor **504** includes RS parity place holder inserter **531**, data interleaver **532**, an E-VSB block processor **533**, data deinterleaver **534**, and a RS parity place holder remover **535**.

In the digital broadcast transmitting system according to the second embodiment of the present invention having the

above described structure, the main data are inputted to the packet multiplexer **502**. On the other hand, the traffic information data are inputted to the E-VSB pre-processor **501**, which performs additional coding processes so as to enable the traffic information data to respond quickly with robustness against noise and channel change.

The RS frame encoder **521** of the E-VSB pre-processor **501** receives the randomized traffic information data and performs at least one of an error correction coding process and an error detection coding process on the received data. Accordingly, by providing robustness to the traffic information data, the data can scatter group error that may occur due to a change in the frequency environment. Thus, the data can respond appropriately to the frequency environment which is very poor and liable to change. The RS frame multiplexer **521** also includes a process of mixing in row units many sets of traffic information data each having pre-determined size. The error correction coding uses the RS coding method, and the error detection coding uses the cyclic redundancy check (CRC) coding method. When performing the RS coding process, parity data required for error correction are generated. And, when performing the CRC coding process, CRC data required for error detection are generated.

In the RS frame encoder **521**, the process of creating the RS frame creating process and the process of performing error correction coding and error detection coding on the created RS frame are identical to those of the RS frame encoder **422** shown in FIG. **16**. Therefore, a detailed description of the same will be omitted for simplicity. The traffic information data coded by the RS frame encoder **521** are inputted to the E-VSB randomizer/byte expander **522**. The E-VSB randomizer/byte expander **522** receives the coded traffic information data and performs data randomizing and byte expansion processes thereon.

At this point, since the E-VSB randomizer/byte expander **522** already performs a randomizing process on the traffic information data, the process of randomizing the traffic information by the data randomizer **503** at a later end may be omitted for simplicity. Further, the order of performing the data randomizing process and the byte expansion process may be altered. More specifically, the byte expansion process may be performed after the data randomizing process. Alternatively, the data randomizing process may be performed after the byte expansion process. The order may be selected while taking into consideration the overall system and its structure.

The byte expansion may differ depending upon the coding rate of the E-VSB block processor **533** within the E-VSB post-processor **504**. More specifically, when the coding rate of E-VSB block processor **533** is G/H, the byte expander expands G bytes to H bytes (wherein G and H are integers, and G<H). For example, if the coding rate if 1/2, 1 data byte is expanded to 2 data bytes. Alternatively, if the coding rate if 1/4, 1 data byte is expanded to 4 data bytes. Then, the traffic information data outputted from the E-VSB randomizer/byte expander **522** is inputted to the group formatter **523**. The operations of the group formatter **523**, data deinterleaver **524**, and the packet formatter **525** within the E-VSB pre-processor **501** are similar to those the group formatter **424**, data deinterleaver **425**, and the packet formatter **426** within the E-VSB pre-processor **401** shown in FIG. **15**. Therefore, a detailed description of the same will be omitted for simplicity.

The traffic information data packet pre-processed by the E-VSB pre-processor **501** is inputted to the packet multiplexer **502** so as to be multiplexed with the main data packet. The data multiplexed and outputted from the packet multiplexer **502** are data randomized by the data randomizer **503** and, then, inputted to the E-VSB post-processor **504**. Herein, the operations of the packet multiplexer **502** and data randomizer **503** are identical to those shown in FIG. **15**, and therefore a detailed description of the same will be omitted for simplicity. Hereinafter, the E-VSB post-processor **504** will now be described in detail.

More specifically, the data randomized by the data randomizer **503** or bypassing the data randomizer **503** are inputted the RS parity place holder inserter **531** of the E-VSB post-processor **504**. When the inputted data correspond to a 187-byte main data packet, the RS parity place holder inserter **531** inserts a 20-byte RS parity place holder at the back of the 187-byte data, thereby outputting the processed data to the data interleaver **532**. Alternatively, when the inputted data correspond to a 187-byte traffic information data packet, the RS parity place holder inserter **531** inserts a 20-byte RS parity place holder within the data packet in order to perform a non-systematic RS-coding process in a later end. Thereafter, in the remaining portion of the 187 byte places bytes are inserted in the traffic information data packet, which are then outputted to the data interleaver **532**.

The data interleaver **532** performs a data interleaving process on the output of the RS parity place holder inserter **531** and, then, outputs the processed data to the E-VSB block processor **533**. The E-VSB block processor **533** performs additional coding processes on the valid data among the traffic information data being outputted from data interleaver **532**. For example, if 1 byte has been expanded to 2 bytes by inserting null bits between data bits from the E-VSB randomizer/byte expander **522**, the E-VSB block processor **533** 1/2-rate codes only the valid data bit among the symbol configured of a null bit and a valid data bit and, then, outputs the processed data. On the other hand, if 1 byte has been expanded to 4 bytes by inserting null bits between data bits from the E-VSB randomizer/byte expander **522**, the E-VSB block processor **533** 1/4-rate codes only the valid data bit among the symbol configured of 3 null bits and 1 valid data bit and, then, outputs the processed data.

Either the main data or the RS parity place holder directly bypasses the E-VSB randomizer/byte expander **522**. Also, the known data and the initialization data place holder may directly bypass the E-VSB randomizer/byte expander **522**. In case of the known data place holder, the known data generated from the E-VSB block processor **533** may be outputted instead of the known data place holder. The data being coded, replaced, and bypassed from the E-VSB block processor **533** are inputted to the data deinterleaver **534**. The data deinterleaver **534** performs an inverse process of the data interleaver **532**, whereby a data deinterleaving process is performed on the input data, which are then outputted to the RS parity place holder remover **535**.

The RS parity place holder remover **535** removes the 20-byte RS parity place holder inserted by the RS parity place holder inserter **531** for the operations of the data interleaver **532** and the data deinterleaver **534** and, then, outputs the processed data to the RS encoder **505**. At this point, if the inputted data correspond to main data packet, the last 20 bytes of RS parity place holders are removed from the 207 bytes of the main data packet. Alternatively, if the inputted data correspond to the traffic information data packet, the 20 bytes of RS parity place holders are removed from the 207 bytes of the traffic information data packet in order to perform the non-systematic RS-coding process.

As another embodiment of the E-VSB post-processor **504**, if the inputted data correspond to the 187-byte main

data packet, the RS parity place holder inserter **531** may perform a systematic RS-coding process so as to insert a 20-byte RS parity at the end of the 187-byte main data. Accordingly, the RS parity place holder inserter **531** removes the last 20 bytes of RS parity from the 207 bytes of the main data packet. Meanwhile, the RS encoder **505**, the data interleaver **506**, the backward compatibility processor **507**, the trellis encoder **508**, the frame multiplexer **509**, the pilot inserter **510**, the VSB modulator **511**, and the RF up-converter **512** which are provided behind the E-VSB post-processor **504** are identical to those shown in FIG. **15**. Therefore, a detailed description of the same will be omitted for simplicity.

Third Embodiment

FIG. **21** illustrates a block view showing a structure of a digital broadcast transmitting system according to a third embodiment of the present invention. Referring to FIG. **21**, the digital broadcast transmitting system includes an E-VSB pre-processor **601**, a packet multiplexer **602**, a data randomizer **603**, a RS encoder **604**, a data interleaver **605**, an E-VSB post-processor **606**, a backward compatibility processor **607**, a trellis encoder **608**, a frame multiplexer **609**, a pilot inserter **610**, a VSB modulator **611**, and a RF up-converter **612**.

In the digital broadcast transmitting system according to the third embodiment of the present invention having the above described structure, the main data are inputted to the packet multiplexer **602**. On the other hand, the traffic information data are inputted to the E-VSB pre-processor **601**, which performs additional coding processes so as to enable the traffic information data to respond quickly with robustness against noise and channel change. The structure and operation of each component of the E-VSB pre-processor **601** are identical to those of the E-VSB pre-processor **501** shown in FIG. **19**. Therefore, a detail description of the same will be omitted for simplicity.

The traffic information data packet pre-processed by the E-VSB pre-processor **601** is inputted to the packet multiplexer **602** so as to be multiplexed with the main data packet. The multiplexed data outputted from the packet multiplexer **602** are data randomized by the data randomizer **603** and, then, inputted to the RS encoder **604**. The packet multiplexer **602** multiplexes the main data packet and the traffic information data packet according to a pre-defined multiplexing rule. At this point, the main data packet and the traffic information data packet may be multiplexed to have burst structures as shown in FIG. **15**. Furthermore, if the traffic information data have been data randomized by the E-VSB pre-processor **601**, then the data randomizing process on the traffic information data performed by the data randomizer **603** may be omitted.

The RS encoder **604** RS-codes the data being randomized from or bypassing the data randomizer **603**, thereby adding a 20-byte RS parity and outputting the processed data to the data interleaver **605**. At this point, if the inputted data correspond to the main data packet, the RS encoder **604** performs a systematic RS-coding process identical to that of the conventional. ATSC VSB system on the input data, thereby adding a 20-byte RS parity at the end of the 187-byte data. Conversely, if the inputted data correspond to the traffic information data packet, the RS encoder **604** first decides 20 parity byte places and, then, performs a non-systematic RS-coding process on the decided parity byte places, thereby inserting the 20 bytes of non-systematic RS parity in the traffic information data packet.

The non-systematic coding process is performed on the traffic information data packet because, when the value of the traffic information data is changed by the E-VSB post-processor **606**, the process of which will be described in detail in a later process, the RS parity is required to be recalculated. And, at this point, the parity bytes should be outputted later than the traffic information data bytes at the output end of the data interleaver **605**. The data interleaver **605** receives the data having parity added thereto by the RS encoder **604**. Then, after performing an interleaving process, the data interleaver **605** outputs the processed data to the E-VSB post-processor **606** and the backward compatibility processor **607**. Herein, the data interleaver **605** receives the RS parity newly recalculated and outputted from the backward compatibility processor **607**, thereby outputting the received RS parity to instead of non-systematic. RS parity which is not yet outputted.

The E-VSB post-processor **606** performs additional coding processes in symbol units only on the traffic information data being outputted from the data interleaver **605**. For example, if 1 byte has been expanded to 2 bytes by inserting null bits between data bits from the E-VSB pre-processor **606**, the E-VSB post-processor **606** 1/2-rate codes only the valid data bit among the symbol configured of a null bit and a valid data bit and, then, outputs the processed data. On the other hand, if 1 byte has been expanded to 4 bytes by inserting null bits between data bits from the E-VSB pre-processor **601**, the E-VSB post-processor **606** 1/4-rate codes only the valid data bit among the symbol configured of 3 null bits and 1 valid data bit and, then, outputs the processed data.

The main data or the RS parity being outputted from the data interleaver **605** directly bypass (or bypasses) the E-VSB post-processor **606**. Moreover, the known data and initialization data place holder also directly bypass (or bypasses) the E-VSB post-processor **606**. At this point, the known data place holder may be replaced with the known data generated from the E-VSB post-processor **606** and then outputted. Furthermore, the E-VSB post-processor **606** generates initialization data so as to initialize the memory within the trellis encoder **608** to a decided status at the beginning of a known data sequence. Thereafter, the initialization data generated from the E-VSB post-processor **606** is outputted instead of the initialization data place holder. Accordingly, the value of the memory within the trellis encoder **608** should be received from the E-VSB post-processor **606**.

The backward compatibility processor **607** calculates the 20-byte non-systematic RS parity corresponding to the traffic information data packet configured on 187 data bytes and outputted from the E-VSB post-processor **606**. Subsequently, the calculated non-systematic RS parity is outputted to the data interleaver **605**. The data interleaver **605** receives the RS parity bytes calculated and outputted from the backward compatibility processor **607** and, then, outputs the received RS parity bytes instead of the non-systematic RS parity. Herein, the backward compatibility processor **607** performs a non-systematic RS-coding process because the E-VSB post-processor **606** changes the values of the traffic information data and the initialization data place holder. Accordingly, when a decoding process is performed by the conventional ATSC VSB receiver, a decoding error may be prevented. In other words, this process is performed to provide backward compatibility to the conventional ATSC VSB receiver.

The data that are additionally coded and replaced by the E-VSB post-processor **606** and that bypass the E-VSB post-processor **606** are inputted to the trellis encoder **608** so as to be trellis-encoded. Thereafter, the trellis-encoded data

sequentially pass through the frame multiplexer **609**, the pilot inserter **610**, the VSB modulator **611**, and the RF up-converter **612**. Meanwhile, according to another embodiment of the present invention, initialization data, which are generated for initializing a memory within the trellis encoder **608**, are generated from the trellis encoder **608** instead of the E-VSB post-processor **606**. In this case, the backward compatibility processor **607** receives a traffic information data packet from the E-VSB post-processor **606** in order to calculate the parity value. Herein, the traffic information data packet includes an initialization data place holder that is to be replaced by the initialization data. Further, the backward compatibility processor **607** receives the initialization data from the trellis encoder **608**. Thereafter, the calculated non-systematic RS parity is outputted to the trellis encoder **608**. The remaining processes that may follow are identical to those shown in FIG. **15**. Therefore, a detailed description of the same will be omitted for simplicity. Furthermore, the frame multiplexer **609**, the pilot inserter **610**, the VSB modulator **611**, and the RF up-converter **612** are also identical to those shown in FIG. **15**. Therefore, a detailed description of the same will also be omitted for simplicity.

FIG. **22** illustrates a block view of a digital broadcast receiving system according to an embodiment of the present invention. More specifically, FIG. **22** illustrates a block view showing an example of a digital broadcast receiving system that can receive traffic information data being transmitted from a transmitting system and that demodulates and equalizes the received data, thereby recovering the processed data to its initial state. Referring to FIG. **22**, the receiving system includes a tuner **701**, a demodulator **702**, a demultiplexer **703**, an audio decoder **704**, a video decoder **705**, a native TV application manager **706**, a channel manager **707**, a channel map **708**, a first memory **709**, a data decoder **710**, a second memory **711**, a system manager **712**, a data broadcasting application manager **713**, and a GPS module **714**. Herein, the first memory **709** corresponds to a non-volatile memory (NVRAM) (or a flash memory).

The tuner **701** tunes a frequency of a particular channel through any one of an antenna, a cable, and a satellite, thereby down-converting the tuned frequency to an intermediate frequency (IF) signal. Thereafter, the down-converted signal is outputted to the demodulator **702**. At this point, the tuner **701** is controlled by the channel manager **707**. The result and strength of the broadcast signal corresponding to the tuned channel are reported to the channel manager **707**. Herein, the data being received through the frequency of a particular channel include the main data, the enhanced data, and the table data which are used for decoding the main data and enhanced data. In the example given in the present invention, traffic information data and a traffic information providing table may be applied to the enhanced data.

The demodulator **702** performs VSB demodulation and channel equalization processes on the signal outputted from the tuner **701**. Then, after identifying the main data and the traffic information data from the signal, the demodulator **702** outputs the data (or signal) by TS packet units. The structure and operation of the demodulator **702** will be described in detail in a later process. In the example of the present invention, only the traffic information data packet outputted from the demodulator **702** is inputted to the demultiplexer **703**. In other words, the main data packet may be inputted to another demultiplexer (not shown) that processes main data packets. Furthermore, the present invention may also be designed in a way that the demultiplexer **703** also demultiplexes the enhanced data packet as well as the main data packet. In the description of the present invention, the receiving and processing of traffic information data are described in detail. And, it should be noted that a detailed description of the processing of main data starting from the demultiplexer **703** may be omitted.

The demultiplexer **703** demultiplexes the traffic information messages and the PSI/PSIP tables from the traffic information data packets being inputted based upon the control of the data decoder **710**. Thereafter, the demultiplexed traffic information messages and PSI/PSIP tables are outputted to the data decoder **710** in a section format. In an example given in the present invention, a traffic information message carried by a payload within the TS packet is outputted in a DSM-CC section format. At this point, the demultiplexer **703** performs a section filtering process based upon the control of the data decoder **710** so as to delete duplicate sections and to output only the non-duplicate sections to the data decoder **710**. Moreover, the demultiplexer **703** may output the section configuring a desired table (e.g., VCT) through a section filtering process to the data decoder **710**. Herein, the VCT includes traffic information descriptors shown in FIG. **12**. The traffic information descriptors may also be included in the PMT.

The section filtering method includes a method of initiating section filtering after verifying the PID of a table defined by the MGT (e.g., VCT), and, when the VCT has a fixed PID (i.e., a base PID), a method of initiating section filtering without verifying the MGT. At this point, the demultiplexer **703** performs section filtering by referring to the table_id field, the version_number field, the section_number field, and so on. The data decoder **710** parses the DSM-CC section configuring the demultiplexed traffic information message. Then, the data decoder **710** decodes the traffic information message being a result of the parsing process and, then stores the traffic information message in a database of the second memory **711**. The data decoder **710** groups a plurality of sections having the same table identifiers (table_id) to configure and parse a table. Then, the data decoder **710** stores the system information being the parsed result in the database of the second memory **711**.

The second memory **711** is a table and data carousel database storing system information parsed from the tables and traffic information messages parsed from the DSM-CC section. Whether or not a table is configured of a single section or a plurality of sections can be known by the table_id field, the section_number field, and the last_section_number field within the table. For example, grouping only the TS packets having the PID of the VCT becomes a section. On the other hand, grouping sections having table identifiers allocated to the VCT becomes the VCT.

When parsing the VCT, information on the virtual channel to which traffic information is transmitted may be obtained. In addition, supplemental information associated with the traffic information message described, as shown in FIG. **12**, in the traffic information descriptors included in the VCT may also be obtained. More specifically, when parsing the traffic information descriptors, application identification information, service component identification information, service information (e.g., service name, service description, service logo, subscriber information, free text information, help information, etc.), and so on, of the traffic information message being transmitted to the corresponding virtual channel can be obtained.

The application identification information, service component identification information, and service information of the traffic information message obtained as described above

may either be stored in the second memory **711** or outputted to the data broadcasting application manager **713**. Additionally, reference may be made to the application identification information, service component identification information, and service information for decoding the traffic information message. Alternatively, the application identification information, service component identification information, and service information may also be used for preparing the operation of the application program for the traffic information message.

The data decoder **710** controls the demultiplexing of the system information table corresponding to the table associated with channel and event information. Thereafter, the data decoder **710** can transmit an A/V PID list to the channel manager **707**. The channel manager **707** may refer to the channel map **708** to send a request (or command) for receiving an information table associated with the system, and then the channel manager **707** can receive the corresponding result. The channel manager **707** may also control the channel tuning of the tuner **701**. Furthermore, the channel manager **707** directly controls the demultiplexer **703** so as to directly set up the A/V PID, thereby controlling the audio and video decoders **704** and **705**.

The audio and video decoders **704** and **705** may respectively decode and output the audio and video data demultiplexed from the main data packet, or respectively decode and output the audio and video data demultiplexed from the traffic information data packet. Meanwhile, according to the embodiment of the present invention, it is apparent that when traffic information data and also audio data and video data are included in the enhanced data, the audio data and video data demultiplexed by the demultiplexer **703** may be respectively decoded by the audio decoder **704** and the video decoder **705**. For example, the audio decoder **704** may decode the audio data by using an audio coding (AC)-3 decoding algorithm, and the video decoder **705** may decode the video data by using an MPEG-2 decoding algorithm.

Meanwhile, the native TV application manager **706** operates a native application program stored in the first memory **709**, thereby performing general functions such as channel switching. The native application program refers to a software that is being mounted upon shipping of the receiving system. More specifically, when a user request is transmitted to the receiving system through a user interface (UI), the native TV application manager **706** the request onto the screen through a graphic user interface (GUI), thereby responding to the user request. The user interface receives the user request through an inputting device, such as a remote controller, a key pad, a jog dial, and a touch screen provided on the display screen. Thereafter, the user interface outputs the received user request to the native TV application manager **706**, the data broadcasting application manager **713**, and so on.

The native TV application manager **706** controls the channel manager **707**, thereby controlling channel associated operations, such as managing the channel **708** and controlling the data decoder **710**. In addition, the native TV application manager **706** stores the GUI control of the general receiving system, the user request, and the status of the receiving system to the first memory **709**, and also recovers the information stored in the first memory **709**. The channel manager **707** controls the tuner **701** and the data decoder **710**, thereby managing the channel map **708** so as to be able to respond to the channel request made by the user.

More specifically, the channel manager **707** sends a request to the data decoder **710** so that the table associated with the channel, which is to be tuned, can be parsed. Thereafter, the channel manager **707** receives a report on the parsing result of the corresponding table from the data decoder **710**. Then, depending upon the reported parsing result, the channel manager **707** updates the channel map **708**. The channel manager **707** also sets up a PID to the demultiplexer **703** so as to demultiplex the table associated with the traffic information message from the traffic information data. The system manager **712** controls booting of the receiving system by turning on and off the power and, then, stores a ROM image (including downloaded software images) to the first memory **709**. In other words, the first memory **709** stores operation programs, such as operation system (OS) programs required for operating the receiving system, and application programs performing data service functions.

The application program is a program that processes the traffic information message stored in the second memory **711**, thereby providing the traffic information service to the user. If a data broadcasting data type other than the traffic information data is stored in the second memory **711**, the corresponding data are processed by the application program or another type of application program and, then, provided to the user. The operation program and application program stored in the first memory **709** may be updated or corrected with a newly downloaded program. Furthermore, since the stored operation program and application program are not deleted even when the driving power supply is shut down, when the driving power is supplied, the program can be performed without having to download a new program.

The application program for providing the traffic information service according to the present invention may be mounted in the first memory **709** upon shipping of the receiving system, or stored later on in the first memory **709** after being downloaded. Also, the application program for the traffic information service (i.e., traffic information providing application program) that is stored in the first memory **709** can be deleted, updated, and corrected. Furthermore, the traffic information providing application program may also be downloaded along with the traffic information data and executed each time the traffic information data are being received.

When a data service request is made through the user interface, the data broadcasting application manager **713** operates the corresponding application program stored in the first memory **709** so as to process the requested data, thereby providing the requested data service to the user. And, in order to provide such data service, the data broadcasting application manager **713** supports the GUI. Herein, the data service is provided in the form of text, voice, graphic, still image, motion picture, and so on. The data broadcasting application manager **713** may be provided with a platform for executing the application program stored in the first memory **709**. The platform may be, for example, a Java virtual machine for executing a Java program.

Hereinafter, an example of providing traffic information service to the user by having the data broadcasting application manager **713** execute the traffic information providing application program stored in the first memory **709** and, then, process the traffic information message stored in the second memory **711** will now be described in detail. The traffic information service according to the present invention is provided to the users by a receiver having only one or none of an electronic map and a GPS mounted therein in the form of at least one of a text, a voice, a graphic, a still image, and a motion picture. If the GPS module **714** is mounted on the receiving system shown in FIG. **19**, the GPS module **714** receives satellite signals transmitted from a plurality of low

earth orbit satellites so as to extract a current location information (i.e., longitude, latitude, altitude), thereby outputting the extracted information to the data broadcasting application manager **713**. At this point, it is assumed that the electronic map including information on each link and node and the various graphic information are stored in a storage unit (or memory) other than the first memory **709** or the second memory **711**.

By executing the traffic information providing application program, the data broadcasting application manager **713** provides the traffic information service requested by the user based upon the current location information acquired from the GPS module **714** and the traffic information message stored in the second memory **711**. More specifically, based upon the request of the data broadcasting application manager **713**, the traffic information message stored in the second memory **711** is read and inputted to the data broadcasting application manager **713**. The data broadcasting application manager **713** analyses the traffic information message read from the second memory **711**, thereby extracting required information and/or control signals in accordance with the contents of the message. In the description of the present invention, it is assumed that a request for a CTT service has been made by the user.

More specifically, the data broadcasting application manager **711** extracts a message ID (i.e., a message component), a message generation time, a message transmission time from the message management container **102** of each traffic information message (or TPEG message), such that it determines whether the following container is equal to a CTT-status container on the basis of information of the message compovent. In this case, the message component information includes a message ID and a version number. Also, the message component is requisite for all messages and is adapted to manage the messages of the data broadcasting application manager **713**.

If the following container is determined to be the CTT-status container **104**, the data broadcasting application manager **713** acquires (or obtains) information from the CTT status component of the CTT status container **104**. The data broadcasting application manager **713** acquires (or obtains) from the TPEG location container **106** a location information corresponding to a currently-transmitted traffic-carrying information. In this case, the location information may be location coordinates (latitude and longitude) of start and end points or a link of the start and end points according to location type information of the TPEG location container. In other words, the location information may be a link ID assigned to a road section (i.e., a road link). Whenever necessary, a section may be specified as a link corresponding to the received information by referring to link- or node-information stored in the second memory **711**.

Provided that the location type information is a link ID, and the location information is text data (e.g., a road name) associated with the link ID or a link, the present invention can specify a link corresponding to the received traffic-carrying status information by referring to the corresponding link information. If the location information acting as a link ID is a code for defining the link ID, the present invention can specify a link corresponding to the received traffic-carrying status information by referring to the corresponding link systern stored in the second memory **711**.

In the meantime, the data broadcasting application manager **713** reads data of an electronic map from the second memory **711** on the basis of current location coordinates received from the GPS module **714**, and displays the read electronic map data on a display screen. In this case, a specific graphic sign is displayed at a specific point corresponding to the current location. Under the above-mentioned situation, the data broadcasting application manager **713** receives average link speed information, such that the received information is displayed at specific location coordinates of a location container following the container equipped with the average like speed information or at a link correcponding to a link ID. For the above-mentioned operation, different colors are assigned individual average link speeds.

For example, if the road on the image is determined to a current road, the red color is indicative of 0 to 10 km per hour, the orange color is indicative of 10 to 20 km per hour, the green color is indicative of 20 to 40 km per hour, and the blue color is indicative of at least 40 km per hour. If the congestion change information has a specific value "1" or "2", a character string ("Increase" or "Reduction") or icon assigned to the specific value "1" or "2" may also be displayed on a corresponding link along with the congestion change information. If the congestion change information has a specific value "0" or "3", a displayed status is not updated to a new status, such that a current displayed status remains.

If the congestion change information is determined to be average speed change rate information, it is displayed on the screen according to the user's request, such that it can reduce the degree of visual confusion of a vehicle driver. For example, paths of possible routes (e.g., a predetermined traveling path and a predetermined forwarding path) may be simultaneously displayed on the screen as necessary. If the terminal does not include the second memory unit **711** equipped with the electronic map, an average link speed associated with only a forward link of a current traveling path may be displayed in different colors, or may be displayed in different numerals.

If a traveling path of the vehicle equipped with the TPEG terminal is predetermined, the average link speed information of links contained in the traveling path, instead of the forwarding links, may be displayed. If the additional information received from the data broadcasting application manager **713** is indicative of a famous restaurant or movie theater contained in the link, the corresponding points at the link may be displayed on the display screen, such that the point corresponding to the restaurant is visually distinguished from the other point corresponding to the movie theater. And, the data broadcasting application manager **713** may convert the corresponding information into text information, such that it may display the text information on the screen.

Upon receiving the user's request, the data broadcasting application manager **713** receives a link travel time, a link delay time, and congestion type information associated with individual links, such that it may display the received information, instead of the average link speed, on the display screen. If the user specifies a prediction time and requests prediction information associated with the road traffic-carrying status, the data broadcasting application manager **713** receives a prediction average speed of each link, such that it indicates the received link prediction average speed in the form of color- or numeral-data, instead of a current average speed.

Needless to say, if the user requests a display mode of a prediction travel time mode, instead of the prediction average speed, the data broadcasting application manager **713** displays the received prediction travel time information of each link on an electronic map or graphic screen of the display according to the above-mentioned user's request. In

the meantime, if a function for automatically searching for a path of a destination is pre-established, the data broadcasting application manager **713** may search for or may re-search for a desirable path on the basis of the received link prediction average speed or the received link prediction travel time.

For example, in association with individual links leading to a node at which a user's vehicle will arrive after the lapse of 30 minutes from a current time at a current traveling speed, the data broadcasting application manager **713** selects a specific link having the shortest time to the destination as a traveling path using a prediction average speed or link prediction travel time acquired over the past 30 minutes, and displays the selected link on the screen. If the receiving system of FIG. **19** includes an audio output unit (or a voice output unit), traffic-carrying status information or traffic-carrying status prediction information received from a designated link may be outputted in the form of voice or audio signals.

As described above, the information and/or control signals are temporarily stored in the non-volatile memory unit (not shown), and are then used in the data broadcasting application manager **713**. The data broadcasting application manager **713** employs the information of the non-volatile memory unit, does not discard the employed information, and stores information created within a predetermined time (e.g., within the last 1 hour). In this case, the data broadcasting application manager **713** stores the last 1-hour information as an average speed or link travel time at intervals of 20 minutes (i.e., 0 minutes, 20 minutes, and 40 minutes). The last time may be set to other time longer or shorter than the aforementioned 1 hour according to the available memory capacity.

In this way, if the user selects a specific link on the condition that an average speed of each link is stored in the memory unit, the data broadcasting application manager **713** displays not only an average speed history and link travel time history of the selected link, but also a prediction link average speed and prediction link travel time of the selected link in the form of a graph. As a result, the graph indicating the average speed history, the link travel time history, the prediction average link speed, and the prediction link travel time of the selected link is displayed on the display screen.

In this case, if a number marked on the graph is speed information, the data broadcasting application manager **713** converts the stored information into data of units of km/h, and displays the data of km/h units on the display screen. And, current link name (e.g., a road name) is displayed at an upper part of the graph. The road name of the link is contained in the location coordinates of the TPEG location container or a rear part of a link ID, and is then received. Otherwise, the above-mentioned link road name is contained in the electronic map of the second memory **711**.

FIG. **23** illustrates a flow chart showing process steps of receiving and processing traffic information data according to an embodiment of the present invention. Referring to FIG. **23**, a method of processing traffic information data according to the present invention will now be described in detail. More specifically, when the power of the receiving system is turned on (S**721**), and when a channel selection or channel switching is inputted (S**722**), a received channel signal is tuned to a physical frequency so as to correspond to the selected or switched channel by using the channel map (S**723**). Herein, the channel selection or channel switching is performed in accordance with a user command or a system command.

At this point, the traffic information data having the traffic information message and the system information multiplexed therein may be received through the channel frequency tuned as described above. If the traffic information data are received (S**724**), the demultiplexer **703** may demultiplex the traffic information message and system information tables by using PID extraction and section filtering (S**725**). Among the system information, tables associated with channel information include the VCT or the PAT/PMT. Herein, at least one of the PMT and VCT may include the traffic information descriptor(s) according to the present invention. By parsing the system information table, information on the virtual channel can be obained, and whether an A/V element stream is being transmitted to the corresponding virtual channel and whether the traffic information data are being transmitted can be known. If the traffic information data are transmitted to the virtual channel, an application identifier, a service component identifier, and service information can be acquired by parsing the traffic information descriptor.

More specifically, information on the virtual channel is extracted by referring to an element stream type (ES type) and PID within the system information table (i.e., VCT and/or PAT/PMT) (S**726**). If the channel information extracted from the system information table indicates that an A/V ES exists within the virtual channel (S**727**), an A/V PID of the corresponding virtual channel in the channel map is set up (S**728**), thereby performing. A/V demultiplexing and decoding (S**729**). Therefore, the user can view the broadcast program corresponding to the A/V (S**730**). Meanwhile, if it is indicated in Step **727** that an A/V ES does not exist in the virtual channel, the present invention verifies when the traffic information data are being transmitted to the virtual channel (S**731**).

A plurality of methods for verifying whether the traffic information data have been transmitted to the virtual channel may be proposed. For example, verification can be performed by parsing the system information table, and verification can also be performed by using the PID within the TS packet. When assuming that the traffic information data have been transmitted to the DSM-CC section, the existence (or presence) of the traffic information data can be known by parsing the field value of any one of the stream_type field within the PMT and the stream_type field of the service location descriptor within the VCT. In other words, if the stream type field value is '0×95', this indicates that the traffic information data have been transmitted to the corresponding virtual channel. Therefore, if it is verified in Step **731** that the traffic information data are being transmitted to the virtual channel, all traffic information having the DSM-CC data format that are being transmitted to the virtual channel are received (S**732**), thereby providing the traffic information service desired (or requested) by the user (S**733**).

If it is verified, in Step **731**, that neither the A/V ES nor the traffic information data exist in the virtual channel, then the corresponding virtual channel is determined to be an invalid channel. In this case, the system may display, for example, a message that no valid channel or signal exists (S**736**). Thereafter, the process is returned to Step **724** in order to newly receive a valid channel information table.

Meanwhile, the system verifies whether a request for changing (or switching) the channel is made during the data service or while viewing a broadcast program (S**734**). If a change in channel has been requested, and if the request corresponds to changing the virtual channel, the data broadcasting process is reset, and the process is returned to Step **726** in order to find a new set of virtual channel information.

Further, if the request corresponds to changing the physical channel, the process is returned to Step **723** so as to tune to the corresponding physical channel.

However, if there is no request for changing the channel, the system verifies whether a channel information version has been upgraded (S**735**). If it is determined in Step **735** that the channel information version has been upgraded, this indicates, that the channel information has been changed (or modified) by the broadcast station. Therefore, the process is returned to Step **724** in order to receive a new channel information table. Conversely, if it is determined in Step **735** that the channel information has not been changed (or modified), then viewing of the broadcast program may be resumed.

The demodulator (reference numeral **702** of FIG. **22**) according to the present invention uses the known data information that is inputted to a traffic information data section and, then, transmitted by a transmitting system so as to perform process such as carrier wave synchronization recovery, frame synchronization recovery, channel equalization, and so on. Thus, the receiving performance can be enhanced. FIG. **24** and FIG. **25** respectively illustrate detailed block views of the demodulator shown in FIG. **22**.

Referring to FIG. **24**, the demodulator includes a VSB demodulator **761**, an equalizer **762**, a known sequence (or data) detector **763**, an E-VSB block decoder **764**, an E-VSB data processor **765**, and a main data processor **766**. More specifically, an intermediate frequency (IF) signal of a channel frequency tuned by the tuner **701** (shown in FIG. **22**) is inputted to the VSB demodulator **761** and the known sequence detector **763**. The VSB demodulator **761** performs self gain control, carrier wave recovery, and timing recovery processes on the inputted IF signal, thereby modifying the IF signal to a baseband signal. Then, the VSB demodulator **761** outputs the newly created baseband signal to the equalizer **762** and the known sequence detector **763**. The equalizer **762** compensates the distortion of the channel included in the demodulated signal and then outputs the error-compensated signal to the E-VSB block decoder **764**.

At this point, the known sequence detector **763** detects the known sequence location inserted by the transmitting end from the input/output data of the VSB demodulator **761** (i.e., the data prior to the demodulation or the data after the modulation). Thereafter, the location information along with the symbol sequence of the known data, which are generated from the detected location, is outputted to the VSB demodulator **761** and the equalizer **762**. Further, the known sequence detector **763** outputs information related to the traffic information data additionally coded by the transmitting end and the main data that have not been additionally coded to the E-VSB block decoder **764**. Herein, the information allowing the traffic information data and the main data to be differentiated (or identified) by the E-VSB block decoder **764** is outputted to the E-VSB block decoder **764**. Although the connection state is not shown in FIG. **24**, the information detected by the known sequence detector **763** may be used throughout almost the entire receiving system. Herein, the detected information may also be used in the E-VSB data deformatter **765-1** and in the RS frame decoder **765-2**.

The VSB demodulator **761** uses the known data symbol sequence during the timing and/or carrier recovery, thereby enhancing the demodulating performance. Similarly, the equalizer **762** uses the known data sequence, thereby enhancing the equalizing performance. Furthermore, the decoding result of the E-VSB block decoder **764** may also be fed-back to the equalizer **762**, thereby enhancing the equalizing performance. Meanwhile, when the data being inputted to the E-VSB block decoder **764**, after being equalized by the equalizer **762**, correspond to the traffic information data being additionally coded and trellis-encoded by the transmitting end, the equalizer **762** performs an inverse process of the transmitting end by additionally decoding and trellis-decoding the inputted enhanced data. On the other hand, when the data being inputted correspond to the main data being trellis-encoded only and not additionally coded, the equalizer **762** only performs trellis-decoding on the inputted main data.

The data group decoded by the E-VSB block decoder **764** is outputted to the E-VSB data processor **765**, and the main data packet is outputted to the main data processor **766**. More specifically, when the inputted data correspond to the main data, the E-VSB block decoder **764** performs Viterbi-decoding on the input data so as to output a hard decision value or to perform hard decision on a soft decision value and output the hard-decided result. Meanwhile, when the inputted data correspond to the traffic information data, the E-VSB decoder **764** outputs a hard decision value or a soft decision value on the inputted enhanced value.

More specifically, when the inputted data correspond to the traffic information data, the E-VSB block decoder **764** performs a decoding process on the data encoded by the E-VSB block processor and the trellis encoder of the transmitting system. At this point, the data outputted from the RS frame encoder of the E-VSB pre-processor included in the transmitting system may correspond to an external code, and the data outputted from each of the E-VSB block processor and the trellis encoder may correspond to an internal code. When decoding such concatenated codes, the decoder of the internal code should output a soft decision value, so that the external coding performance can be enhanced. Therefore, the E-VSB block decoder **764** may output a hard decision value on the traffic information data. However, it is more advantageous to output a soft decision value.

As an example of the present invention, the E-VSB data processor **765** includes an E-VSB data deformatter **765-1**, a RS frame decoder **765-2**, and an E-VSB derandomizer **765-3**. It would be efficient to apply this structure in the E-VSB pre-processor of the transmitting system (shown in FIG. **16**) which includes an E-VSBG randomizer, a RS frame encoder, an E-VSB block processor, a group formatter, a data deinterleaver, and a packet formatter. The main data processor **766** includes a data deinterleaver **766-1**, a RS decoder **766-2**, and a data derandomizer **766-3**.

Herein, the data deinterleaver **766-1**, the RS decoder **766-2**, and the data derandomizer **766-3** included in the main data processor **766** are blocks required for receiving the main data. Therefore, these blocks may not be required in the structure of the receiving system that only receives the traffic information data. The data deinterleaver **766-1** performs an inverse process of the data interleaver included in the transmitting end. More specifically, the data deinterleaver **766-1** deinterleaves the main data being outputted from the E-VSB block decoder **764** and outputs the deinterleaved data to the RS decoder **766-2**.

The RS decoder **766-2** performs systematic RS decoding on the deinterleaved data and outputs the RS-decoded data to the data derandomizer **766-3**. The data derandomizer **766-3** receives the output of the RS decoder **766-2** and generates a pseudo random data byte identical to that of the randomizer included in the transmitting system. Thereafter, the data derandomizer **766-3** performs a bitwise exclusive OR (XOR) operation on the generated pseudo random data byte, thereby inserting the MPEG synchronization bytes to the beginning of each packet so as to output the data in

188-byte main data packet units. At this point, the output of the data derandomizer **766-3** may be inputted to the demultiplexer **703** shown in FIG. **22**. Alternatively, the output of the data derandomizer **766-3** may be inputted to a main data specific demultiplexer (not shown), which demultiplexes the A/V data and channel information associated tables from the main data.

The data being outputted from the E-VSB block decoder **764** are inputted to the E-VSB data deformatter **765-1** in a data group form. At this point, the E-VSB data deformatter **765-1** already knows the configuration of the input data group. Accordingly, the E-VSB data deformatter **765-1** removes the main data, the known data that have been inserted in the data group, the trellis initialization data, the MPEG header, and the RS parity added by the RS encoder of the transmitting system that all were inserted in the main data group. Thereafter, the E-VSB data deformatter **765-1** outputs only the traffic information data to the RS frame decoder **765-2**. More specifically, the RS frame decoder **765-2** receives only the traffic information data RS-coded and/or CRC-coded by the E-VSB data deformatter **765-1**.

The RS frame decoder **765-2** performs an inverse process of the RS frame encoder included in the transmitting system. Accordingly, the RS frame decoder **765-2** corrects the errors within the RS frame. Thereafter, the RS frame decoder **765-2** adds a 1-byte. MPEG synchronization byte, which was removed during a RS frame coding process, to the error-corrected traffic information data packet. Then, the processed data are outputted to the E-VSB data derandomizer **766-3**. At this point, if a row permutation process was performed on the traffic information data, an inverse row permutation process is also required. The E-VSB data derandomizer **766-3** performs a derandomizing process, which corresponds to an inverse process of the E-VSB randomizer included in the transmitting system, on the inputted traffic information data and outputs the processed data. Thus, the transmitting system can receive the transmitted traffic information data.

Meanwhile, if the E-VSB randomizer is positioned after the RS frame encoder in the structure of the E-VSB pre-processor included in the transmitting system, the E-VSB data processor may include only the E-VSB data deformatter and the RS frame decoder. In this case, the operation of the E-VSB data defonnatter becomes partially different from that of the E-VSB data deformatter shown in FIG. **24**. In other words, the difference between the E-VSB data deformatter of FIG. **24** and the above-described E-VSB data deformatter is that a derandomizing process is first performed on the traffic information data, and the RS frame decoding process is performed afterwards.

In this case, only the data derandomizing process may be performed, or the data derandomizing process may be processed along with the null data removing process. This may differ depending upon the structure and operation of the E-VSB pre-processor included in the transmitting system. More specifically, only the data derandomizing process may be performed, or the data derandomizing process and the null data removing process may both be processed depending upon the positioning order of the E-VSB block processor and the group formatter, and whether the coding process was performed only on the valid data by the E-VSB block processor.

For example, if the E-VSB block processor is positioned before the group formatter in the E-VSB pre-processor, the receiving system does not require the null data to be removed, since byte expansion has not been performed. In addition, even though a byte expansion process has been performed, if the E-VSB block processor has performed an additional coding process only on the valid data (e.g., if the coding process was performed at a coding rate of 1/2 or at a coding rate of 1/4), the receiving system does not require the process of removing the null data. Conversely, if the E-VSB block processor is positioned after the group formatter in the E-VSB pre-processor, the receiving system requires a byte expansion process to be performed. In this case, if the E-VSB block processor has performed an additional coding process all data types (e.g., if the coding process was performed at a coding rate of 1/2 or at a coding rate of 1/4), the receiving system requires the null data to be removed.

However, if the removal of the expanded byte is required, the order of the byte removal process and the derandomizing process may vary depending upon the structure of the transmitting system. More specifically, if the byte expansion is performed after the randomizing process in the transmitting system, then the byte removal process is first performed before performing the derandomizing process in the receiving system. Conversely, of the order to the process is changed in the transmitting system, the order of the respective processes in the receiving system is also changed.

When performing the derandomizing process, if the RS frame decoder requires a soft decision in a later process, and if, therefore, the E-VSB block decoder receives a soft decision value it is difficult to perform an XOR operation between the soft decision and the pseudo random bit, which is used for the derandomizing process. Accordingly, when an XOR operation is performed between the pseudo random bit and the soft decision value of the traffic information data bit, and when the pseudo random bit is equal to '1', the E-VSB data deformatter changes the code of the soft decision value and then outputs the changed code. On the other hand, if the pseudo random bit is equal to '0', the E-VSB data deformatter outputs the soft decision value without any change in the code. Thus, the state of the soft decision may be maintained and transmitted to the RS frame decoder.

If the pseudo random bit is equal to '1' as described above, the code of the soft decision value is changed because, when an XOR operation is performed between the pseudo random bit and the input data in the randomizer of the transmitter, and when the pseudo random bit is equal to '1', the code of the output data bit becomes the opposite of the input data (i.e., 0 XOR 1=1 and 1 XOR 0=0). More specifically, if the pseudo random bit generated from the E-VSB packet deformatter is equal to '1', and when an XOR operation is performed on the hard decision value of the traffic information data bit, the XOR-operated value becomes the opposite value of the hard decision value. Therefore, when the soft decision value is outputted, a code opposite to that of the soft decision value is outputted.

Accordingly, the RS frame decoder performs an inverse process of the RS frame encoder included in the transmitting system. Therefore, the RS frame decoder corrects the errors within the RS frame. Subsequently, the RS frame decoder adds a 1-byte MPEG synchronization byte, which was removed during a RS frame coding process, to the error-corrected traffic information data packet. Thus, the initial traffic information data transmitted by the transmitting system can be obtained.

FIG. **25** illustrates a detailed block view of the demodulator according to a second embodiment of the present invention. Referring to FIG. **25**, the demodulator includes a VSB demodulator **781**, an equalizer **782**, a known sequence (or data) detector **783**, a Viterbi decoder **784**, a data deinterleaver **785**, a RS decoder **786**, a data derandomizer **787**, and

an E-VSB data processor **788**. Herein, the E-VSB data processor **788** includes a main data packet remover **788-1**, an E-VSB packet deformatter **788-2**, and an E-VSB data processor **788-3**. It would be efficient to apply the demodulator shown in FIG. **25** to the transmitting system having the structure shown in FIG. **21**. Furthermore, the VSB demodulator **781**, the equalizer **782**, and the known sequence detector **783** are identical to those shown in FIG. **24**. Therefore, since reference can be made for the structure of the same components, a detailed description of the same will be omitted for simplicity.

The Viterbi decoder **784** Viterbi-decodes the data outputted from the equalizer **782** and converts the Viterbi-decoded data to bytes. Thereafter, the converted data are outputted to the data deinterleaver **785**. The data deinterleaver **785** performs an inverse process of the data interleaver of the transmitting system and outputs the deinterleaved data to the RS decoder **786**. If the received data packet is the main data packet, the RS decoder **786** RS-decodes the received main data packet. Alternatively, if the received data packet is the traffic information data packet, the RS decoder **786** removes the non-systematic RS parity bytes and outputs the processed data to the data derandomizer **787**.

The data derandomizer **787** performs an inverse process of the randomizer of the transmitting system on the output of the RS decoder **786**. Thereafter, the data derandomizer **787** inserts the MPEG synchronization byte in the beginning of each packet, thereby outputting the data in 188-byte packet units. The output of the data derandomizer **787** is simultaneously outputted to the demultiplexer **703** (shown in FIG. **22**) or the main data specific demultiplexer (not shown) and outputted to the main data packet remover **788-1** of the E-VSB data processor **788**.

The main data packet remover **788-1** removes the 188-byte main data packet from the data outputted from the data derandomizer **787** and outputs the processed data to the E-VSB packet deformatter **788-2**. The E-VSB packet deformatter **788-2** removes the 4-byte. MPEG header, known data, and trellis initialization data from the 188-byte data packet. Then, the E-VSB packet deformatter **788-2** outputs only the traffic information data to the E-VSB data processor **788-3**. At this point, the E-VSB packet deformatter **788-2** may or may not remove the null data.

More specifically, when the E-VSB post-processor of the transmitting system shown in FIG. **21** performs additional coding on the traffic information data, and, accordingly, when the coding is performed only on the valid traffic information data, the removing of the null data is not required. Conversely, however, if the additional coding process is performed on all byte-expanded traffic information data, the null data must be removed. The E-VSB data processor **788-3** performs an inverse process of the E-VSB pre-processor included in the transmitting system on the output of the E-VSB packet deformatter **788-2**. Thus, the traffic information data initially transmitted from the transmitting system may be obtained.

As described above, the digital broadcast transmitting/receiving system and the method for processing data are advantageous in that when receiving traffic information data through a channel, the data are robust against error and are compatible with the conventional. VSB receiver. Furthermore, data can be received more efficiently without error even in channels having severe noise and ghost effect.

In addition, by performing additional error correction coding and error detection coding processes on the traffic information data and transmitting the processed data, robustness is provided to the traffic information data, thereby allowing the data to respond appropriately to the changes in the channel environment. Furthermore, by using link identifiers for providing the traffic information data, the transmission capacity may be minimized. And, by warning in advance the information on heavy congested traffic status, the amount of traffic may be adequately dispersed, thereby allowing the roads to be circulated efficiently. The present invention having the above-described advantages may be more efficiently used when applied in mobile and portable receiver which requires a greater degree of robustness against noise and ghost effect.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifictions and varitions of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

[1. A broadcast transmitter comprising:

a randomizer for randomizing enhanced data;

a first encoder for Reed Solomon (RS) encoding and Cyclic Redundancy Check (CRC) encoding the randomized enhanced data;

a block processor for encoding the RS-CRC encoded enhanced data at a coding rate of 1/H, wherein H is greater than 1;

a group formatting unit for forming a data group including the encoded enhanced data and de-interleaving data of the data group, wherein the formed data group further includes main data place holders, known data sequences, trellis initialization data, MPEG header place holders, and RS parity data place holders;

a packet formatter for removing the RS parity data place holders and the main data place holders from the data group in which data are deinterleaved and replacing the MPEG header place holders in the data group, in which data are deinterleaved, with MPEG headers, thereby outputting enhanced data packets;

a first multiplexer for multiplexing the enhanced data packets with main data packets including main data;

a second encoder for adding RS parity data to the multiplexed enhanced and main data packets by RS encoding the main data packets of the multiplexed enhanced and main data packets with a systematic RS encoding scheme and RS encoding the enhanced data packets of the multiplexed enhanced and main data packets with a non-systematic RS encoding scheme; and

an interleaver for interleaving data of the RS-encoded enhanced and main data packets.**]**

[2. The broadcast transmitter of claim **1**, wherein the interleaver is a convolutional data byte interleaver.**]**

[3. The broadcast transmitter of claim **1**, further comprising:

a trellis encoder for trellis encoding the interleaved data, wherein at least one memory included in the trellis encoder is initialized when the trellis initialization data are inputted to the trellis encoder.**]**

[4. The broadcast transmitter of claim **3**, further comprising:

a second multiplexer for multiplexing the trellis-encoded data with field synchronization data and segment synchronization data.**]**

[5. A method of processing broadcast data in a broadcast transmitter, the method comprising:

randomizing, by a randomizer, enhanced data;

Reed Solomon (RS) encoding and Cyclic Redundancy Check (CRC) encoding, by a first encoder, the randomized enhanced data;

encoding, by a block processor, the RS-CRC encoded enhanced data at a coding rate of 1/H, wherein H is greater than 1;

forming a data group including the encoded enhanced data, wherein the formed data group further includes main data place holders, known data sequences, trellis initialization data, MPEG header place holders, and RS parity data place holders;

de-interleaving data of the data group;

removing, by a packer formatter, the RS parity data place holders and the main data place holders from the data group in which data are deinterleaved and replacing the MPEG header place holders in the data group, in which data are deinterleaved, with MPEG headers, thereby outputting enhanced data packets;

multiplexing the enhanced data packets with main data packets including main data;

adding, by a second encoder, RS parity data to the multiplexed enhanced and main data packets by RS encoding the main data packets of the multiplexed enhanced and main data packets with a systematic RS encoding scheme and RS encoding the enhanced data packets of the multiplexed enhanced and main data packets with a non-systematic RS encoding scheme; and

interleaving data of the RS-encoded enhanced and main data packets.]

[6. The method of claim 5, wherein the data of the RS-encoded enhanced and main data packets are interleaved by a convolutional data byte interleaver.]

[7. The method of claim 5, further comprising:

trellis encoding, by a trellis encoder, the interleaved data, wherein at least one memory included in the trellis encoder is initialized when the trellis initialization data are inputted to the trellis encoder.]

[8. The method of claim 7, further comprising:

multiplexing the trellis-encoded data with field synchronization data and segment synchronization data.]

9. A method of processing data in a transmitting system, the method comprising:

generating first information and second information, wherein the first information includes information for acquisition of the second information, and wherein the second information includes service component identification information for identifying each of one or more service components, service name information and service description information;

randomizing data for a service;

first encoding the randomized data to add parity data;

second encoding the first encoded data at a code rate;

interleaving the second encoded data;

modulating a broadcast signal including the interleaved data, the first information and the second information and known data, wherein the known data is data for synchronization; and

transmitting the modulated broadcast signal.

10. The method of claim 9, wherein the second information further includes information for representing the service.

11. A transmitting system for processing data, the transmitting system comprising:

a system information generator to generate first information and second information, wherein the first information includes information for acquisition of the second information, and wherein the second information includes service component identification information for identifying each of one or more service components, service name information and service description information;

a randomizer to randomize data for a service;

a first encoder to first encode the randomized data to add parity data;

a second encoder to second encode the first encoded data at a code rate;

an interleaver to interleave the second encoded data;

a modulator to modulate a broadcast signal including the interleaved data, the first information, the second information and known data, wherein the known data is data for synchronization; and

a transmitter to transmit the modulated broadcast signal.

12. The transmitting system of claim 11, wherein the second information further includes information for representing the service.

13. A method of processing data in a receiving system, the method comprising:

receiving a broadcast signal including data for a service, first information, and second information, wherein the first information includes information for acquisition of the second information, and wherein the second information includes service component identification information for identifying each of one or more service components, service name information, and service description information;

demodulating the broadcast signal;

deinterleaving the demodulated broadcast signal;

decoding the deinterleaved broadcast signal;

derandomizing the decoded broadcast signal;

acquiring the second information based on the first information; and

providing the service to a user by processing the data based on the second information,

wherein the broadcast signal further includes known data and wherein the known data is used for synchronization.

14. the method of claim 13, wherein the second information further includes information for representing the service.

15. A receiving system for processing data, the receiving system comprising:

a tuner to receive a broadcast signal including data for a service, first information, and second information, wherein the first information includes information for acquisition of the second information, and wherein the second information includes service component identification information for identifying each of one or more service components, service name information, and service description information;

a demodulator to demodulate the broadcast signal;

a deinterleaver to deinterleave the demodulated broadcast signal;

a decoder to decode the deinterleaved broadcast signal;

a derandomizer to derandomize the decoded broadcast signal;

a first processor to acquire the second information based on the first information; and

a second processor to provide the service to a user by processing the data based on the second information,

wherein the broadcast signal further includes known data and wherein the known data is used for synchronization.

16. The receiving system of claim 15, wherein the second information further includes information for representing the service.

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