

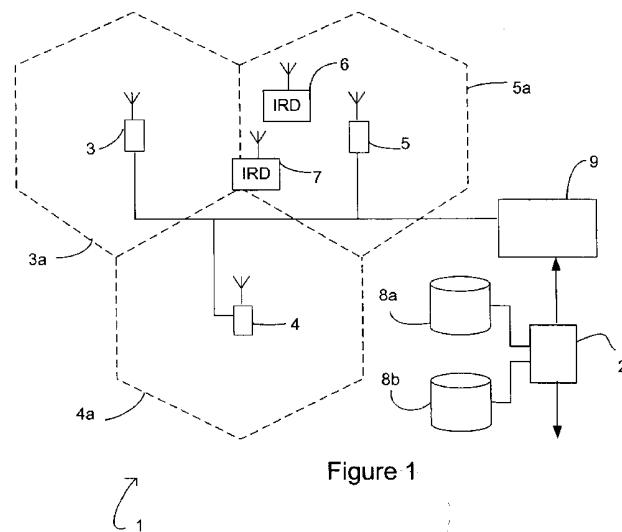
(12) UK Patent Application (19) GB (11) 2 399 986 (13) A

(43) Date of A Publication 29.09.2004

(21) Application No:	0306840.0	(51) INT CL ⁷ : H04Q 7/38
(22) Date of Filing:	25.03.2003	(52) UK CL (Edition W): H4L LRADS L205
(71) Applicant(s): Nokia Corporation (Incorporated in Finland) Keilalahdentie 4, FIN-02150 Espoo, Finland		(56) Documents Cited: EP 0808073 A2 US 20020054578 B1 HTTP://WWW.RDS.ORG.UK/RDS98/WHATISRDS.HTM
(72) Inventor(s): Jani Väre Jarno Kallio Matti Puputti Pekka Talmola		(58) Field of Search: UK CL (Edition V) H4L INT CL ⁷ H04L, H04Q Other: On-line: WPI, EPODOC, JAPIO, Internet via Google
(74) Agent and/or Address for Service: Venner Shipley LLP 20 Little Britain, LONDON, EC1A 7DH, United Kingdom		

(54) Abstract Title: **Transmission parameter information**

(57) A terrestrial digital video broadcast (DVB-T) network comprises a content provider 2 and first to third transmitters 3 to 5. Each transmitter may transmit more than one signal, different signals having different frequencies, multiplexes and the like and relating to different network types. An integrated receiver/decoder (IRD) 6 is mobile in the area around transmitters 3 to 5. As well as transmitting service information as part of a network information table on a data layer, the transmitters 3 to 5 provide in their output signals transmitter parameter information as TPS data on a physical layer. This TPS information includes one bit identifying the type of the network to which the signal relates and information identifying whether or not the signal contains time-sliced data streams. This information is used by the IRD 6 both in signal scan, or initialising the IRD with parameters needed for OSI layers 1 to 2 service discovery, and for deselecting signals as handover candidates. Since the transmission parameter information is transmitted more frequently and in a lower OSI layer than the network information table, the IRD 6 can more efficiently make decisions as to whether or not a signal is suitable for handover, or is otherwise a signal of interest. The network identifying data is positioned in bits S48-S53 of the TPS signal and can be used to distinguish between DVB-T and Internet Protocol Data Cast (IPDC) networks.



GB 2399 986 A

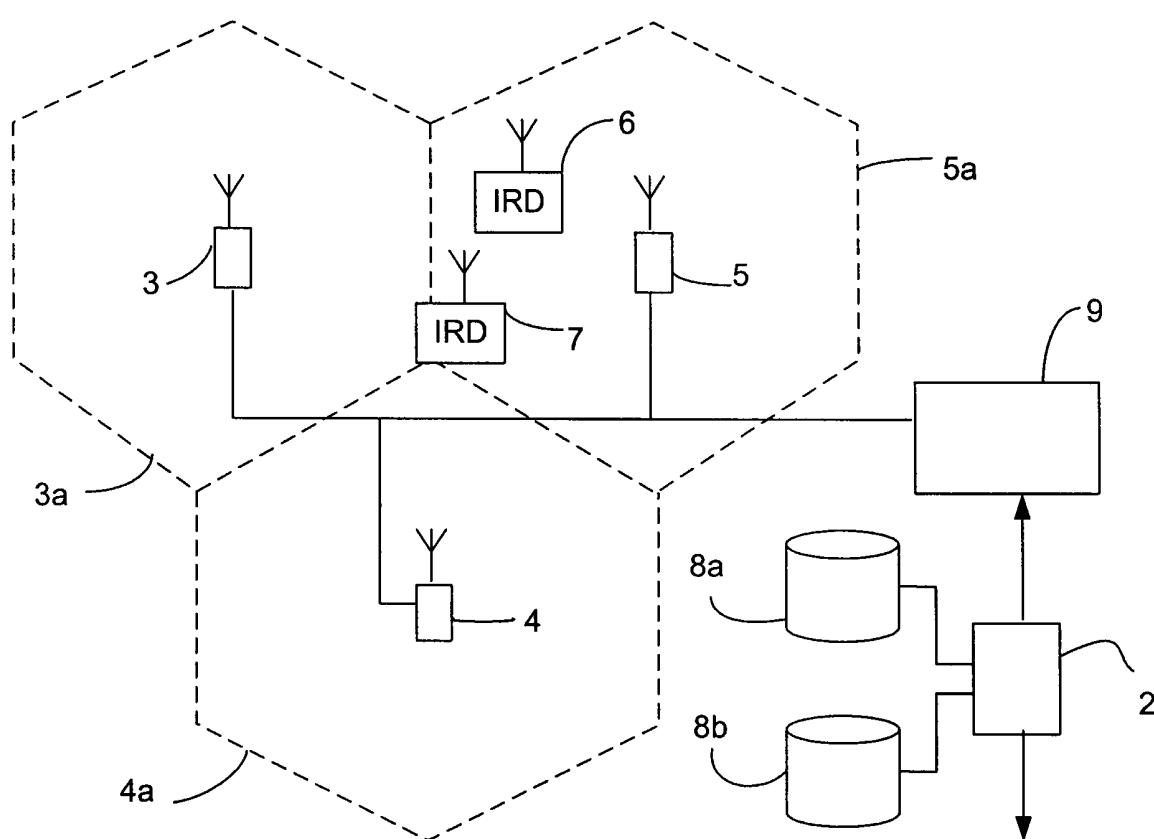


Figure 1

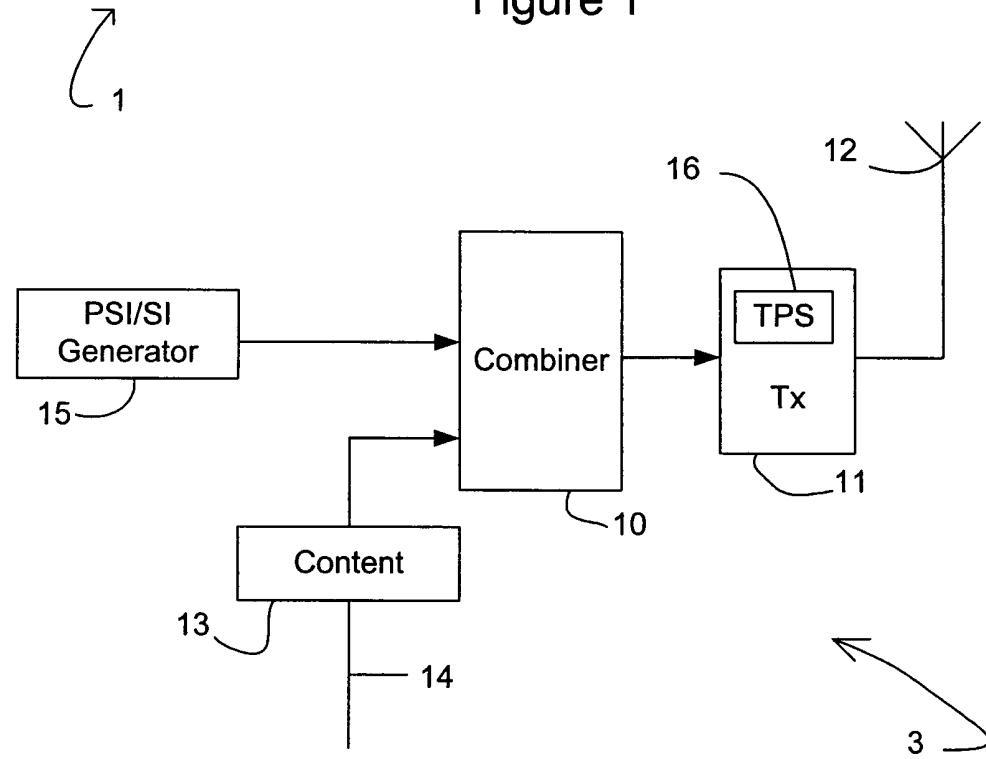


Figure 2

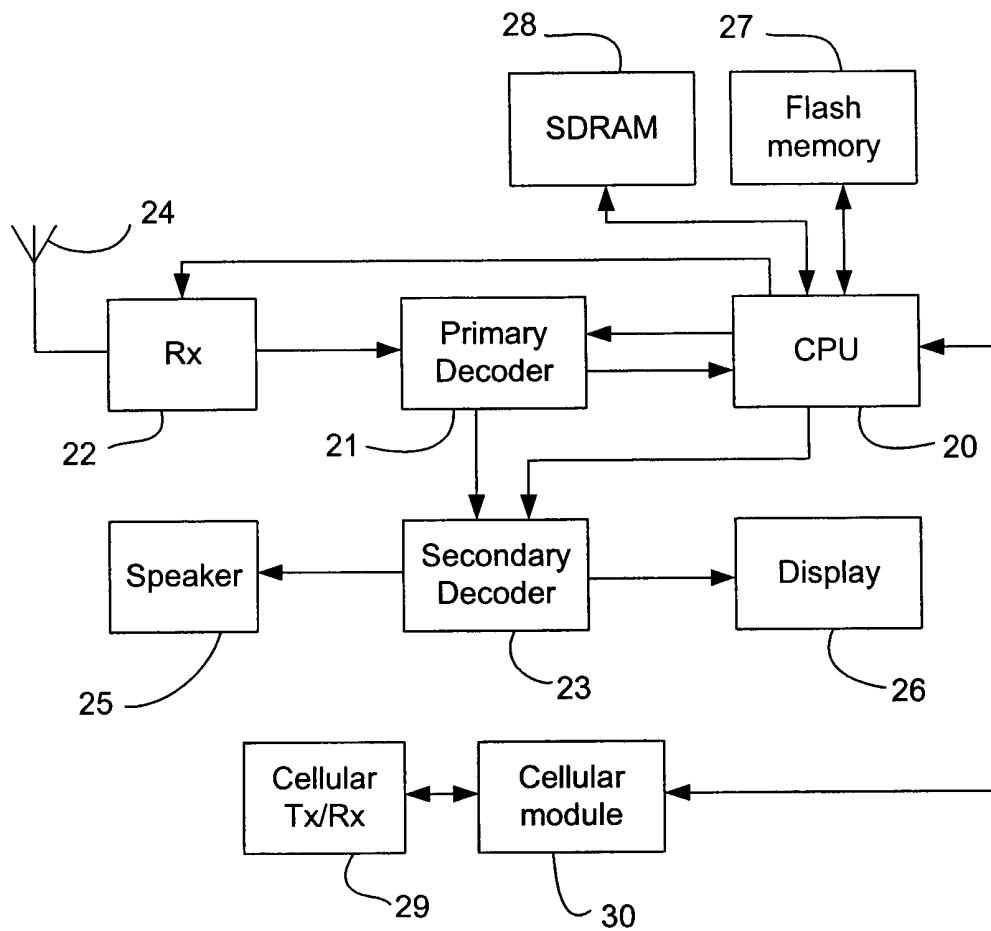


Figure 3

6 ↗

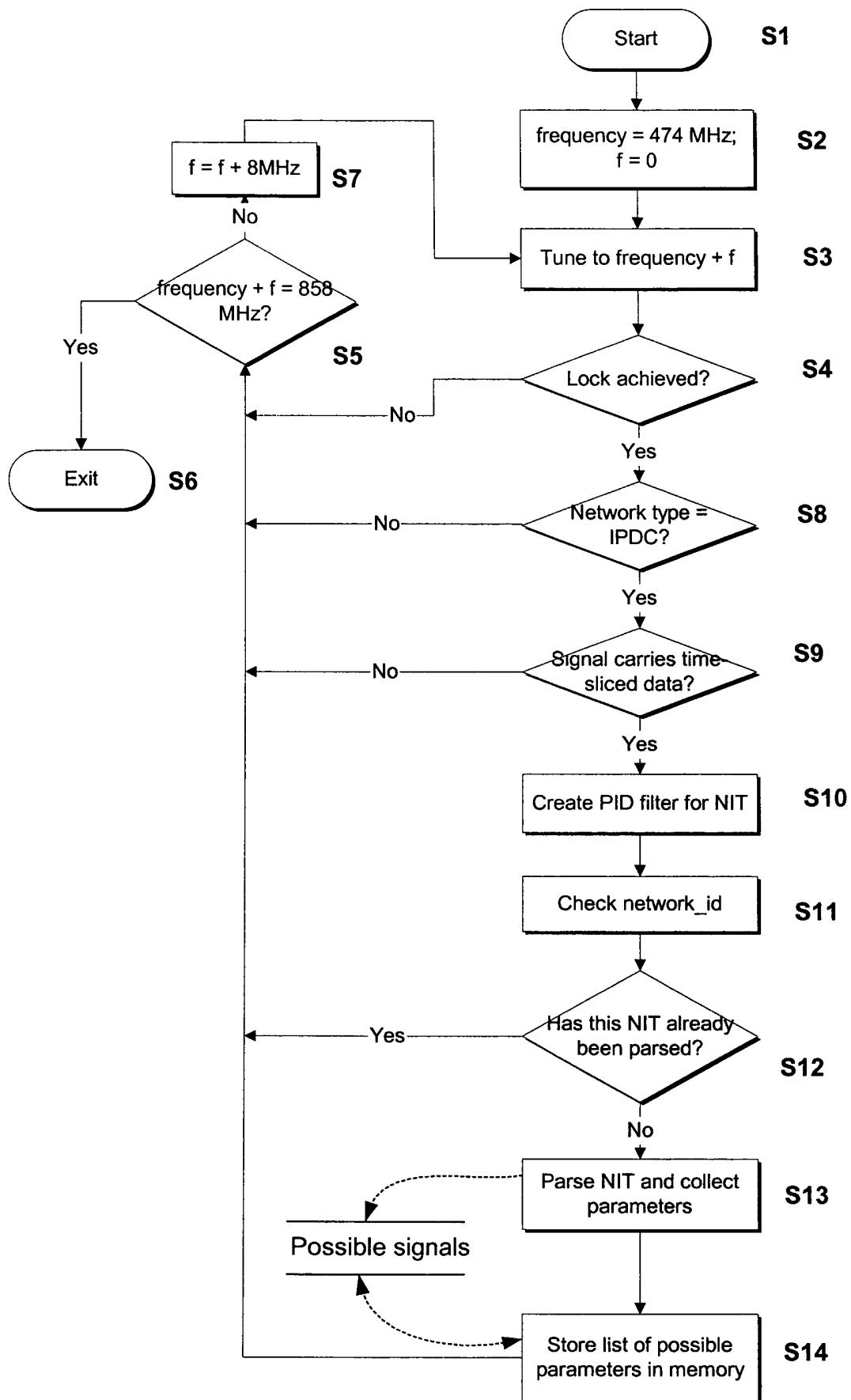


Figure 4

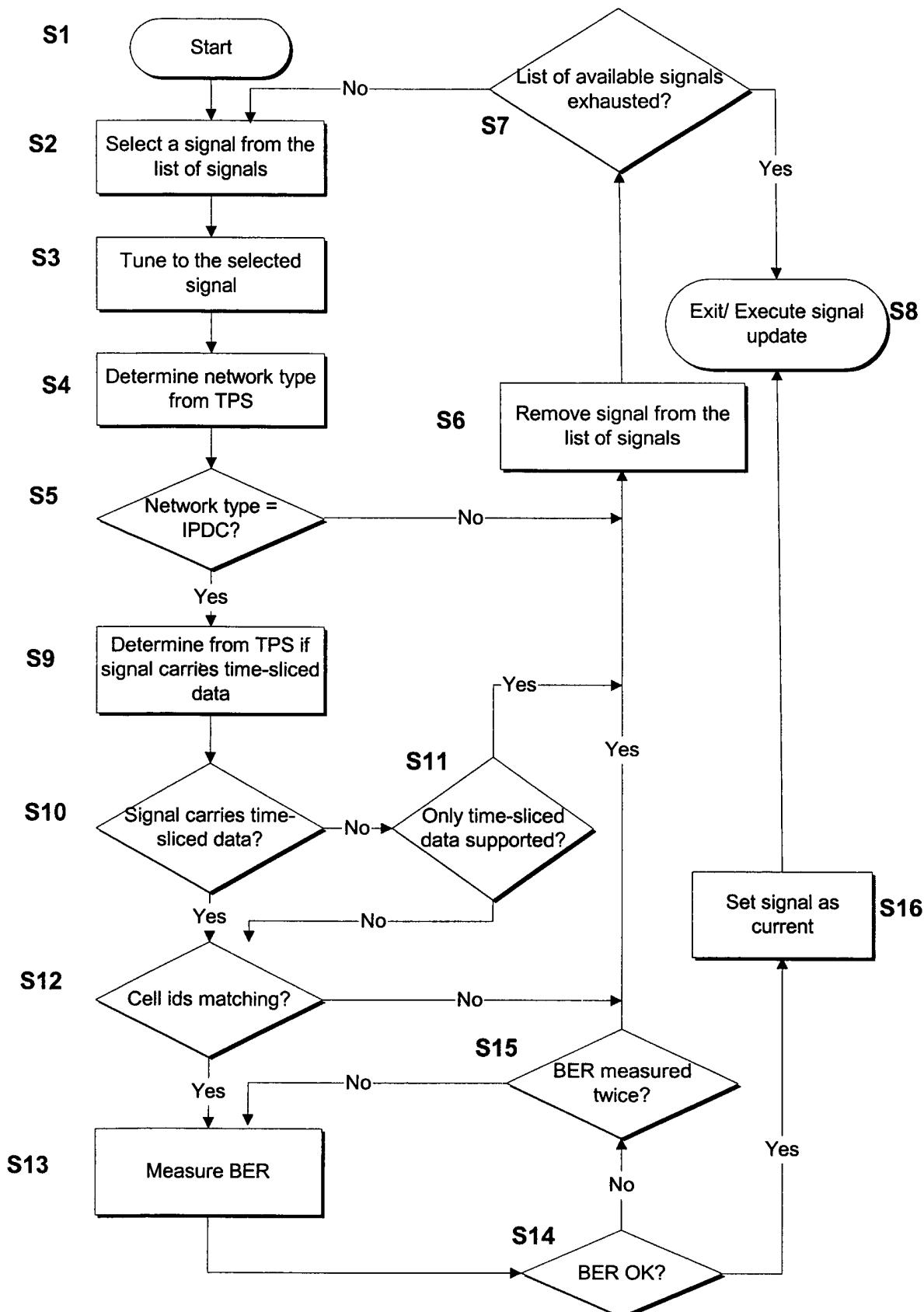


Figure 5

Transmission Parameter Information

This invention relates to transmission parameter information. In particular, the invention relates to the provision of and use of network type information in 5 transmission parameter information.

Digital broadcasting systems, such as various DVB-T (Terrestrial Digital Video Broadcasting) and DAB (Digital Audio Broadcasting) systems, ATSC, ISDB and other similar broadcasting systems allow for a system comprising transmitters 10 arranged in a cellular fashion, allowing signal reception of a suitable quality over a geographical area through suitable transmitter site selection. The cellular nature of the transmitters' coverage allows mobile receivers to be able to achieve satisfactory performance even when moving. Steps are being taken to incorporate DVB receivers into mobile telephones and Personal Digital Assistants (PDAs), for which 15 applications the DVB standards were not primarily designed. Steps are also being taken to provide services over DVB transmissions. A user may buy services using, for example, the telephone or other data transceiver forming part of the mobile telephone or PDA.

20 A receiver, on decoding the transmission parameter information like the Transmission Parameter Signalling (TPS) data in DVB for a received signal, can use it in certain decision making processes. In particular, a DVB-T receiver in a mobile device can use the cell identification information to eliminate some candidate signals in a handover procedure.

25 According to a first aspect of the present invention there is provided a method of operating a receiver which is arranged to operate in a network in which transmission parameter information is transmitted on a lower level than service information, (e.g. presented in physical layer (OSI layer 1), while the PSI/SI information is presented 30 in data link layer (OSI layer 2)), the method comprising: decoding transmission parameter information from a signal; determining from the decoded transmission parameter information if the signal relates to a suitable network type; and disregarding the signal in the event of a negative determination.

According to a second aspect of the invention, there is provided a receiver arranged to operate in a network in which transmission parameter information is transmitted on a lower level than service information (e.g. presented in physical layer (OSI layer 1), while the PSI/SI information is presented in data link layer (OSI layer 2)), the receiver comprising: a decoder for decoding transmission parameter information from a signal; a determiner for determining from decoded transmission parameter information if the corresponding signal relates to a suitable network type; and a controller for disregarding a signal associated with a negative determination.

10

According to a third aspect of the invention, there is provided a method of forming a signal for transmission, the method comprising: creating service information; creating transmission parameter information including an indication of a type of network to which the signal relates; and including the service information on one level with the transmission parameter on a lower level to form the signal.

According to a fourth aspect of the present invention there is provided apparatus for forming a signal for transmission, the apparatus being arranged for creating service information, for creating transmission parameter information including an indication of the type of network to which the composite signal relates, and for including the service information on one level with the transmission parameter information on a lower level to form the signal.

According to a fifth aspect of the invention, there is provided a transmission parameter signaling data signal comprising a predetermined number of data bits defined over consecutive orthogonal frequency division multiplex symbols, the data signal comprising at a predetermined location a group of one or more information bits having a state dependent on the network type to which the data signal relates..

30 According to a sixth aspect of the invention, there is provided a receiver arranged to receive and decode a transmission parameter signaling information data signal comprising a predetermined number of data bits defined over consecutive orthogonal frequency division multiplex symbols, the receiver being arranged to determine from data found at a

predetermined location of the data signal information concerning the network type to which the data signal relates.

In the DVB-T standard, the predetermined number of bits is sixty eight, defined as bit 5 numbers zero to sixty seven, and the predetermined location is between bit numbers forty eight to fifty three.

These aspects of the invention can allow improved receiver operation. In particular, the invention can allow at least some irrelevant signals to be deselected 10 or disregarded without requiring network information from the signal to be analysed, or even decoded. This is particularly important when identifying handover candidate signals, and when performing signal scan, for initialising a receiver with parameters needed for service discovery. In systems such as the DVB system, this is particularly advantageous since the service information, in a worst 15 case, may be transmitted only once in a ten second interval, whereas the transmission parameter information may be available very quickly after achieving lock to the tuned signal. Since one TPS bit is transmitted in every DVB-T frame, all the TPS bits are available to the receiver after 64 DVB-T frames have been received. The inter-bit interval of TPS bits depends on the symbol speed of the 20 signal. Typically all the TPS bits are received within 100 ms or less.

In the embodiments, service information is transmitted on a data level (OSI level 2) whereas TPS information is transmitted on a physical level (OSI level 1). The term 'level' will be understood to mean a layer in a protocol stack, such as but not limited 25 to the OSI seven layer model.

Preferably, the transmission parameter information indicates whether the signal relates to a network of the Internet protocol data cast type. This can allow a receiver to identify signals which do not relate to a network type of interest, so that 30 appropriate action can be taken to avoid the unnecessary use of receiver resources.

Advantageously, the transmission parameter information concerns the division of multiplexes carried in a network to which the signal relates. Here, the transmission

parameter information could indicate whether the network to which the signal relates contains heterogeneous multiplexes, whether it contains homogenous multiplexes or whether it contains mixed multiplexes. If a receiver can determine from a received signal that all the multiplexes are homogeneous, i.e. they are all the

5 same, then it need only monitor the available frequencies in the network. To ensure that all available signals are checked, the receiver would need to gather information concerning the available services only on initialisation, and to update this information. If the transmission parameter information also indicates that the prevailing network is a single frequency network, then the receiver does not need to

10 monitor anything relating to that characteristic of the network.

Further preferably, the transmission parameter information concerns the network topology of the network to which the signal relates. The information preferably identifies if the signal relates to a network having a single frequency topology

15 and/or whether the signal relates to a network having a multi frequency topology. A receiver that can determine from transmission parameter information that the network is a single frequency network knows that there are no signals at other frequencies to monitor prior to handover.

20 The transmission parameter information preferably gives an indication of the size of the cell to which the signal relates. The indication may be in the form of whether the size of the cell to which the data signal is less than, or greater than, a predetermined threshold, or if it falls between upper and lower thresholds.

25 The transmission parameter information may be as follows:

Bits m, n	Current cell diameter
00	< first threshold
01	\geq first threshold < second threshold
10	\geq second threshold < third threshold
11	\geq third threshold

Providing information concerning cell size can allow a receiver to perform scanning for signals from adjacent cells at a frequency which is most appropriate to the network.

Smaller cells may require more frequent scanning than would be appropriate for larger cell sizes, for example.

5

The transmission parameter information may concern whether or not cells in the network to which the signal relates have substantially the same cell size. A receiver can use this information in determining a frequency of scanning for signals from adjacent cells. If cells are large, then infrequent scanning may be optimal, and vice versa. If the cells can be of different sizes, though, then the receiver can detect this using the cell size information and set a scanning frequency as appropriate. In most circumstances, the optimal scanning frequency is one which is optimal where the cells are relatively small.

10 15 The transmission parameter information might concern the mapping between multiplexes and cells of a network to which the data signal relates. The information might indicate whether all cells in the prevailing network have only one multiplex, whether they have two or more multiplexes, or whether they have one or more multiplexes.

20

The transmission parameter information might provide information concerning the mapping between the multiplex to which the signal relates and other multiplexes in a same cell. This may indicate whether the current cell consists of only one multiplex, or whether the current cell consists of two or more multiplexes, for 25 example.

30 Providing a receiver with mapping information using the transmission parameter information is beneficial since the receiver can use the information to optimise memory usage for stored parameters. For example, if a receiver determines that a cell contains only one multiplex, then it can just use cell identification information to map multiplexes with signals. Otherwise, original network identification information and transport stream identification information is required to allow such mapping.

To advantage, the transmission parameter information may concern whether the prevailing signal has time-sliced elementary streams. Here, the information may also indicate whether the time-sliced elementary streams have an additional or 5 different framing structure, such as e.g. forward error control. A receiver may be able to use this information to take steps to obtain the additional data from an appropriate source.

10 Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

- Figure 1 is a schematic drawing of a digital video broadcast system, including components operating according to the invention;
- Figure 2 is a schematic drawing of one of the transmitter stations of the 15 system of Figure 1;
- Figure 3 is a schematic drawing of an integrated receiver/decoder of the system of Figure 1;
- Figure 4 is a flowchart illustrating operation of the integrated receiver/decoder of Figure 3 in a signal scan procedure; and
- 20 Figure 5 is a flow diagram illustrating operation of the integrated receiver/decoder of Figure 3 in a handover procedure .

The standards document EN 300 744 V1.4.1 published by the European Telecommunications Standards Institute (ETSI) specifies TPS carriers, which are 25 used for signalling parameters related to the transmission scheme used. The TPS carriers are constituted at a physical layer, or OSI layer 1, of the communication protocol stack. The decoding of the TPS in a receiver allows the channel coding and modulation used in the transmission to be determined, which information is used in controlling the receiver to operate accordingly. The TPS data is defined 30 over 68 consecutive OFDM (Orthogonal Frequency Division Multiplex) symbols, referred to as one OFDM Frame. The TPS data is transmitted in parallel on seventeen TPS carriers for the DVB 2K mode, and on 68 carriers for the 8K mode.

Every TPS carrier in the same symbol conveys the same differentially encoded information bit. The TPS is transmitted as shown in Table 1.

Bit Numbers	Purpose/content
S_0	Initiation
S_1-S_{16}	Synchronisation Word
$S_{17}-S_{22}$	TPS length indicator
$S_{23}-S_{24}$	Frame Number (in a Super-Frame)
S_{25}, S_{26}	Constellation (QPSK or 16 or 64 QAM)
S_{27}, S_{28}, S_{29}	Hierarchy Information
S_{30}, S_{31}, S_{32}	Code rate, HP stream
S_{33}, S_{34}, S_{35}	Code rate, LP stream
S_{36}, S_{37}	Guard Interval
S_{38}, S_{39}	Transmission Mode (2k or 8k)
$S_{40}-S_{47}$	Cell identifier
$S_{48}-S_{53}$	Reserved for future use
$S_{54}-S_{67}$	Error protection (BCH code)

5

Table 1

It should be noted that the synchronisation word takes one value for odd numbered frames and the inverse for even numbered frames in a Super-Frame. Also, the cell identifier is two bytes long, and is divided between successive Frames.

10

More important to some decision-making processes is the information received as service information (SI), which is described in detail in DVB standards document ETS 300 468. The standard document ISO/IEC 13818-1 specifies SI, which is referred to as Program Specific Information (PSI). The PSI/SI data provides 15 information for enabling automatic configuration of a receiver to demultiplex and decode the various streams of programs within the multiplex signal. The PSI/SI data includes a Network Information Table (NIT), which provides information relating to the physical organisation of the multiplexes, also known as Transport Streams (TS), carried via a given network,. A receiver can store the NIT contents,

to minimise access time when switching between channels. The PSI/SI data forms part of the data layer, or OSI layer 2, of the communication protocol stack.

A receiver, also known as an Integrated Receiver/Decoder (IRD) detects parameters 5 of a prevailing signal and/or network by filtering and parsing a received PSI/SI table. From this information, an IRD can determine whether or not a signal is a valid handover candidate. However, since typically PSI/SI tables may be transmitted in any interval from 25 milliseconds to 10 seconds, depending on the table (e.g. maximum interval for NIT table is 10 seconds), and since the PSI/SI 10 information is transmitted on a data layer (i.e. OSI level 2), signal scanning and handover processes can be expected to involve utilisation of a significant amount of the processing, receiver and power resources of the IRD, as well as being time consuming. This is of particular importance as regards power consumption in battery-operated mobile handheld devices.

15 Referring firstly to Figure 1, a digital video broadcasting (DVB) system is shown generally at 1. The system comprises a content provider station 2, which is connected by suitable links to each of first, second and third transmitter stations 3,4,5. The transmitter stations 3-5 are separated from each other at locations 20 selected such as to provide suitable coverage of the surrounding geography. In Figure 1, the transmitters 3-5 are shown having respective coverage areas 3a, 4a and 5a, although it will be appreciated that in practice the area covered by a given transmitter will not be so regular and that there will be significant amount of overlap between the coverage areas 3a-5a. Also shown in Figure 1 are first and 25 second integrated receiver/decoders (IRD) 6, 7. The content provider 2 has access to sources of content 8a, 8b, such as audio-visual content, data files or images. The content is transmitted using IP over DVB-T network, in what is known as an IP Datacasting (IPDC) service, to one or more of the IRDs 6,7, which are configured to receive data from at least two different communication channels. The IRDs 6, 7 30 in this embodiment are mobile devices that may be incorporated in mobile telephones or personal digital assistants (PDA), for example.

The content data is transmitted to a network element 9, which is a server configured

to receive the content data and to generate recovery data for use in forward error correction of the content data. The content data is transmitted to the IRDs 6, 7 via the transmitters 3-5. The recovery data is transmitted to the IRDs in one embodiment of the invention via a second communication channel provided for 5 example by a Third Generation (3G) mobile network (not shown). It should be noted that the communication paths for the content and recovery data are described with reference to and shown in Figure 1 in a simplified form. However, other elements such as further transmitters, network elements or networks may be situated in these communication paths

10

Each IRD 6, 7 is able to receive and decode signals transmitted by any or all of the transmitters 3-5. Each of the transmitters 3-5 is substantially the same, and one is illustrated in Figure 2.

15 Referring to Figure 2, a transmitter station 3 is shown in a very schematic form, comprising generally a data source in the form of a combiner 10, a transmitter 11 and an antenna 12. The combiner 10 receives input data from a content provider 13, which is connected via an input 14 to the content provider 2 shown in Figure 1. Also arranged to provide data to the combiner is a Program Specific Information 20 (PSI) (or Service Information (SI)) data generator 15. The transmitter 11 includes a transmission parameter signalling (TPS) data generating device 16. The combiner 10 is arranged to source data from the content provider device 13 and the PSI/SI generator device 15 and to provide a data stream according to the DVB standards for inclusion with TPS data and subsequent transmission by the transmitter 11.

25 According to the DVB broadcasting standards, data provided by the TPS generator 16 is included in the physical layer of the transmitted signals many times a second, whereas the PSI/SI generating device 15 data is included in the data layer of the transmitted signal and much less frequently, with up to 10 second intervals between data transmissions. As is conventional the PSI/SI generator 15 generates data 30 representing a network information table (NIT), which is in accordance with the DVB standards. The transmitter 11 can therefore be considered to include transmission parameter information provided by the TPS generator 16 with service information provided as part of the data generated by the PSI/SI generator 15. The

resultant signal can be considered as a composite signal, and it is the composite signal which is then transmitted by the transmitter 11 by way of the antenna 12. Of course, the composite signal also includes content data provided by the content generator 13, and other data which is outside the scope of this disclosure.

5

According to this one embodiment of the invention, the transmission parameter information generated by the TPS generator 16 includes the information shown below in table 2.

10

Bit Numbers	Purpose/Content
S ₄₈	Network Type
S ₄₉	Cell Size
S ₅₀ -S ₅₁	Current Cell Size
S ₅₂	Topology Information
S ₅₃	Time Slice Information

Table 2

Each of the transmitters 3-5 may transmit plural signals according to the DVB standards. In this connection, the transmitters 3-5 may include plural physical transmitters at a single location and sharing a common antenna. Each signal transmitted by a given one of the transmitters 3-5 may differ from other signals in terms of the frequency of the signal, the network type, the format of the transport stream, the network's topology, the transmitter power, and the nature of the multiplexing used. For example, multiplexing may be in a time-sliced nature, which is conceptually similar to time division multiplexing, or it may be that multiplexing is effected other than in the time domain. The types of transport stream which might be used will be known by those skilled in the art. The network type might be, for example, a DVB network or an Internet Protocol Data Cast (IPDC) network.

15 The topology of the network might be single frequency or multiple frequency. A multiple frequency network might have transmissions on plural contiguous frequency bands. The DVB standards allow for bandwidths of 6, 7 and 8 MHz.

20

25

The implementation of DVB in Europe will utilise signals having a bandwidth of 8MHz.

The TPS data generated includes in bit S_{48} an indicator of the type of network. A 5 databit “0” indicates a network of the type DVB, whereas a databit “1” indicates a network of the type IPDC. In bit S_{49} of the TPS data, a databit “0” indicates that all the cells in the network from which the signal is derived have the same size cell. A databit “1” indicates that cells in the network from which the signal is derived may have a different size to the other cells in the network. The current cell size is given 10 by bits S_{50} and S_{51} . In this embodiment, both of these databits being “0” indicates that the current cell has a diameter of less than 30km. Databit S_{50} taking a value of “0” and databit S_{51} taking a value of “1” means that the current cell size has a diameter of between 30 and 40km. Databit S_{50} having a value of “1” and databit S_{51} having a value of “0” means that the current cell has a diameter of between 40 and 15 50km. If both of these bits has a value of “1” then the current cell size is greater than 50km. The network topology being a single frequency network is indicated by bit S_{52} having a value of “0” whereas a multifrequency network is indicated by this bit having a value of “1”. A value of “0” being found for databit S_{53} indicates that signal carries time-sliced elementary streams, whereas a value of “1” indicates that 20 the signal does not carry such streams.

The TPS data transmitted by the transmitter 11 via the antenna 12 differs from conventional TPS data by the inclusion of information in the bits S_{48} to S_{53} thereof. The TPS data includes additionally one bit indicating the type of the network from 25 which the signal originates, one bit identifying whether or not differing cell sizes are used in the network, two bits identifying the size of the current cell, one bit identifying network topology and one bit identifying whether or not time-sliced data forms part of the signal.

30 The IRD 6,7 will now be described with reference to Figure 3. Referring to Figure 3, the IRD 6, is shown very schematically, comprising generally a central processing unit (CPU) 20, which is connected to control each of a primary decoder 21, a

receiver 22, a second decoder, e.g. an MPEG-2 and IP (Internet Protocol) decoder 23, to a non-volatile flash memory 27, and to a volatile SDRAM memory 28.

The receiver 22 is connected to receive radio frequency signals via an antenna 24, 5 and to provide demodulated signals to the decoder 21. The primary decoder 21 is arranged under control of the CPU 20 to provide decoded data both to the CPU and to provide MPEG or IP data to the secondary decoder 23. The secondary decoder 23 provides audio outputs to a speaker 25 and visual outputs to a display 26, whereby audiovisual content present in the signal received at the receiver 22 can 10 be presented to a user. Although in this example IP and MPEG signals are able to be processed by a common decoder 23, it will be appreciated that separate decoders could be used instead.

The flash memory 27 is used to store data parsed from an NIT during signal scan. 15 The SDRAM 28 is used to store some of the data used in earlier stages of a handover procedure.

In this embodiment, the IRD 6 also includes a transceiver 29 for allowing communication in a mobile telephone system, such as e.g. GSM, GPRS, 3G, UMTS 20 for example, which is coupled to a corresponding mobile telephone and data handling module 30. The transceiver 29 and the module 30 allow the IRD 6 to operate as a telephone and mobile Internet portal, as well as to allow the user of the IRD to subscribe to services of interest which are communicated by data cast using the DVB network. This can be achieved in any convenient manner. For example, 25 the user might send a request for service delivery to a mobile telephone operator with which the user subscribes using the UMTS components 29,30. The operator may then arrange for the service to be provided via DVB using an Internet service provider. Notifications of service delivery may be communicated to the IRD using the UMTS system or the DVB system.

30

The IRD 6 differs from conventional IRDs in that it is arranged to detect information forming part of TPS data, and to utilise that data appropriately. Operation of the IRD 6 in a signal scan procedure will now be described with

reference to Figure 4. It will be understood that the signal scan procedure is performed for initialising the receiver 6 with parameters needed for OSI layers 1 and 2 service discovery and for subsequently updating these parameters.

- 5 Referring to Figure 4, the procedure is started at step S1. At step S2 a variable "frequency" is set to 474 MHz, and a variable "f" is set to a value of 0. At step S3 the receiver 22 is tuned to a frequency equal to "frequency" plus "f". At step S4, it is determined by the CPU 20 whether or not tuning lock is achieved. The absence of a tuning lock is used to infer that no signal of sufficient strength is being transmitted at that frequency. Accordingly, a negative determination to step S4 leads to step S5 where it is determined if the sum of the variables "frequency" and "f" is equal to 858 MHz. If a positive determination is made, it is inferred that the entire frequency band has been searched and the procedure proceeds to exit at step S6. Otherwise, the procedure advances to step S7, where the variable "f" is increased by 8 MHz and the procedure returns again to step S3.
- 10
- 15

When at step S4 tuning lock is achieved, the operation proceeds to step S8, where bit S_{48} of the TPS data is examined by the CPU 20. If the examination reveals that bit S_{48} is set to "0", it is inferred that the signal does not emanate from a network type IPDC and the procedure retreats to step S5. If, however, it is determined that the network type is IPDC, then the procedure advances to step S9. Here, bit S_{53} of the TPS is examined, from where it is determined by CPU 20 whether or not the signal carries time-sliced data. If a negative determination is made, the procedure retreats to step S5; otherwise, the procedure advances to step S10.

- 20
- 25
- 30

At step S10, the PSI/SI data is decoded, and the NIT is examined. This examination involves the creation of a PID (Packet IDentifier) filter for the NIT forming part thereof. At step S11, it is then determined what the identifier associated with the network is. At step S12, it is determined from the identifier of the network by the CPU 20 whether or not the NIT has already been filtered and parsed. If a negative determination is made, the procedure retreats to step S5. Otherwise, it is inferred that the signal which is being processed is a new signal, and the procedure progresses to step S13. Here, the NIT is parsed by the CPU 20 and

the parameters needed for OSI layers 1 and 2 service discovery are collected therefrom. The relevant data is stored in an area temporary memory, indicated at "possible signals", at step S14. Following this, the procedure moves onto step S5, where the frequency is incremented.

5

The topology information given by bit S_{52} may be used by the IRD 6 so that the procedure shown in Figure 4 is not performed unnecessarily. In particular, once tuning lock has been achieved at step S4, and it is determined from examination of bit S_{52} that the signal is transmitted in respect of a single frequency network, the

10 IRD 6 makes arrangement such that the procedure is not performed again in respect of a different frequency, since this is deemed unnecessary.

As it can be seen, the procedure illustrated in Figure 4 can allow for the de-selection of certain irrelevant signals even without the receiving and decoding of the NIT

15 from the PSI/SI data. Since the TPS data is transmitted on a lower level than the NIT data, the procedure of Figure 4 can allow the creation of a list of possible signals utilising fewer resources and in a shorter period of time than can be achieved using the prior art procedure. With this example, the TPS data is also transmitted more frequently.

20

In the conventional procedure for a signal scan, it would be necessary for each signal to receive and decode the NIT and to determine therefrom whether or not the signal included time-sliced data and whether or not the signal emanated from a network of a suitable type. Using the procedure of Figure 4, however, some signals 25 can be eliminated without the NIT being decoded. This is possible only because the TPS data transmitted by the transmitter 3 to 5 and received as the IRD 6,7 includes information identifying the network type and information indicative of whether or not the signal carries time-sliced data.

30 Since the IRDs 6,7 are free to move around the coverage provided by the transmitters 3 to 5, handover situations will occasionally occur. A decision to handover may be made on any appropriate basis. Normally, a decision to handover will be made when it is determined that a measure of signal quality, e.g. the bit

error rate (BER), of received signals is deteriorating and will soon be too high to allow reliable decoding of the transmitted data. When a decision to handover is made, the IRD 6 must identify a new signal to receive and decode in place of the currently received signal. With signals, which are time-sliced, the IRD 6 need only 5 listen to the signal on a periodic basis. The interval between transmissions can be used to detect other signals, and it is from these detected signals that a signal must be selected for handover. Accordingly, the selection of a signal for handover requires either a time-sliced signal to be the current signal, or requires two or more 10 RF front ends and decoders, so that two or more signals can be listened to simultaneously. The IRD 6 according to the present invention performs the procedure of Figure 5 when determining a signal to receive following handover.

Referring now to Figure 5, the procedure begins at step S1 with a list of candidates or available signals. At step S2, a signal is selected from the list of available signals. 15 The signal is tuned to at step S3, following which the TPS data for that signal is decoded and the bit S_{48} thereof is detected. At step S5, it is determined by the CPU 20 from bit S_{48} of the TPS data whether the signal emanates from a network from the type IPDC. If a negative determination is made, the procedure progresses to step S6, where that signal is removed from the list of available signals by the CPU 20. Following this step, at step S7, it is determined by the CPU 20 whether or not 20 the list of available signals has been exhausted, i.e., that there are no further signals available for checking. Assuming that there are further signals available for checking, the procedure progresses again to step S2. Otherwise, it is inferred that all available signals have been checked without success and the procedure 25 progresses to step S8, where the procedure is terminated.

If at step S5, the network type is determined to be IPDC, then the procedure progresses to step S9. Here, the bit S_{55} of the TPS is examined. At step S10, it is determined by the CPU 20 from this inspection of bit S_{53} , whether or not the 30 current signal carries time-sliced data. If a positive determination is made, because bit S_{53} has a value of "0", the operation processes to step S11. Otherwise, progression is made to step S11, where it is determined by the CPU 20 whether or not the IRD supports signals which are not time-sliced as well as those which are

time-sliced. The IRD 6 can support non-time-sliced signals if, for example, it contains two RF front ends and decoders. If at step S11 it is determined by the CPU 20 that only time-sliced data is supported, progression is made to step S6, where the signal is removed from the list of available signals. Otherwise, the 5 procedure progresses to step S12. At step S12, it is determined by the CPU 20 from the cell ID constituted by bits S₄₀ to S₄₇ of the TPS data whether the signal emanates from the same cell as one for which a signal was included in the “possible signals” list by the procedure of Figure 4. If a negative determination is made by the CPU 20, the signal is determined not to be a suitable candidate, and progression is made 10 to step S6. Otherwise, it is inferred that the signal is a suitable candidate, and progression is made to step S13. Here, the BER of the signal is measured by the CPU 20, following which it is compared to a threshold at step 14. If the threshold is exceeded, indicating that the BER is too high, it is determined by the CPU 20 at step S15 whether a BER for that signal has been measured twice. If it has not, then 15 the BER is again measured at step S13. The inclusion of step S15 allows signals to have two opportunities to pass a BER test. If the test is failed, progression is made to step S6. Otherwise, progression is made from step S14 to step S16. Here, the signal being processed is set as the “current signal”. It is the current signal to which handover is made by a subsequently performed procedure. After step S16, progress 20 is made to step S8, where the signal is updated and the procedure is exited.

It will be appreciated that the procedure shown in Figure 5 provides a particularly convenient scheme for eliminating unsuitable signal candidates from a list of available signals for handover. This is made possible only because information 25 indicating the type of the network and information indicating whether or not the signal contains time-sliced data is transmitted as part of the TPS data for that signal.

Although in the above embodiment, certain bits of the TPS data are allocated to certain defined purposes, it will be appreciated that strict adherence to this scheme 30 is not essential. On the contrary, of the six TPS data bits which are currently reserved for future use, any number of them may be used to implement one or more of the embodiments of the invention described herein. Below is listed, as an

example, suggested uses for bits of the TPS data, together with an explanation of the meanings of the values that the bits can take.

5 One bit, as defined in Table 3, may be used for signaling the network type of the network to which the signal relates. Network type can be categorised accordingly to the characteristics of the network.

Bit n	Network type
0	DVB
1	IPDC

Table 3

10

Although not shown in a table, bits of the TPS data could be used to indicate signals relating to any other type of network instead of or in addition to the IPDC and DVB network types.

15 Two bits, as defined in Table 4, may be used for signaling information concerning the composition of the multiplexes carried in the network to which the signal relates. Multiplex information is heterogeneous if all multiplexes in the prevailing network are mutually different. Homogeneous multiplex information indicates that all multiplexes in the prevailing network carry exactly the same services. Mixed multiplex information is used
20 to indicate that the prevailing network consists both of mutually heterogeneous and homogeneous multiplexes. In Table 4, bits m and n may or may not be adjacent.

Bits m, n	Multiplex information
00	Heterogeneous multiplexes
01	Homogeneous multiplexes
10	Mixed multiplexes
11	Reserved for future use

Table 4

25

One bit, as defined in Table 5, can be used to indicate whether the network topology is multiple (MFN) or single frequency (SFN) in type.

Bit n	Topology information
0	SFN
1	MFN

5

Table 5

One bit, as defined in Table 6, can be used to indicate whether the cells in the prevailing network, i.e. the network from which the signal emanates, all have the same size or if the cells have different sizes.

10

Bit n	Cell size information
0	Cells have same sizes
1	Cells have different sizes

Table 6

15 Two bits, as defined in Table 7, may be used to indicate the mapping between multiplexes and cells of the prevailing network. From this, it can be determined if the network consist only of cells covering only one multiplex, only of cells covering two or more multiplexes or of cells covering one or more multiplexes. Here, bits m and n may or may not be adjacent in the TPS data.

20

Bits m, n	Cell to multiplex mapping
00	All cells of the network consists of only one multiplex
01	All cells of the network consists of two or more multiplexes
10	All cells of the network consist of one or more multiplexes
11	Reserved for future use

Table 7

One bit, as defined in Table 8, can be used to signal the mapping between the current 5 multiplex and other multiplexes that are part of the same cell.

Bit n	Current cell to multiplex mapping
0	Current cell consists of only one multiplex.
1	Current cell consists of two or more multiplexes.

Table 8

10 Two bits, as defined in Table 9, can be used to signal the cell size diameter (in kilometres) of the cell consisting the currently tuned signal. The cell diameters in Table 7 should be understood to be only examples. Bits m and n may or may not be adjacent in the TPS data.

Bits m, n	Current cell diameter (km)
00	< 30
01	$\geq 30 < 40$
10	$\geq 40 < 50$
11	≥ 50

15

Table 9

In an alternative embodiment, only one bit may be used to describe the cell diameter. Here, a databit "0" can indicate that the cell diameter is equal to or less 20 than a selected diameter e.g. 30 km and a databit "1" means that the cell diameter is greater than the selected diameter.

Two bits, as defined in Table 10, may be used to signal whether or not the currently tuned signal carries time sliced elementary streams and whether a time-sliced stream has an 25 additional or different framing structure, such as e.g. FEC (forward error correction).

Bit n	Current signal time slice information
00	Current signal carries time sliced elementary streams
01	Current signal does not carry time sliced elementary streams
10	Current signal carries time sliced elementary streams and has an additional framing structure (containing e.g. FEC)
11	Reserved for future use.

Table 10

5 The selection of which of the above information to select for inclusion in the TPS data transmitted with a particular network depends on a number of factors. It is possible also for more than six bits to be used. In this case, different information bits may be transmitted on different transmissions of the TPS data. For example, data bits identifying network type, current cell multiplex and current cell size may
10 be transmitted on even numbered transmissions of the TPS data, whereas network multiplex information and network cell size information may be transmitted in the corresponding bits on odd numbered transmissions of the TPS data. An IRD may be able to distinguish between the different transmissions using, for example, the synchronisation bits transmitted therewith.

15

In an enhanced embodiment, the TPS data may include two bits which identify multiplexing use in the network and in the signal to which the TPS data relates. This embodiment avoids the need for four bits to be used to describe the network and the current cell multiplex information. The two bits preferably are used as
20 shown in Table 11 below.

00	All cells consist of only one multiplex
01	All cells consist of two or more multiplexes
10	Current cell consists of only one multiplex
11	Current cell consists of two or more multiplexes

Table 11

Table 11 illustrates a principle which can be applied to others of the TPS bits. In particular, where there are two or more separate elements of the TPS data some combinations of which are not relevant or applicable, combining those two or more 5 elements together may allow all the relevant combinations to be expressed using fewer data bits than would be possible if the elements were treated separately.

Although the above embodiments have been described in relation to the DVB broadcast system, it will be appreciated that that the principles can be transferred to 10 other broadcast systems or to multicast or unicast systems. Such a system may be the Advanced Television System (ATSC) or the Japanese Integrated Services Digital Broadcasting (ISDB) system, to list some non-limiting examples.

Moreover, the invention is not limited to the specific examples given above, but by 15 the scope of the appended claims.

Claims

1. A method of operating a receiver which is arranged to operate in a network in which transmission parameter information is transmitted on a lower level than service information, the method comprising:
 - 5 decoding transmission parameter information from a signal;
 - determining from the decoded transmission parameter information if the signal relates to a suitable network type; and
 - disregarding the signal in the event of a negative determination.
- 10
2. A method as claimed in claim 1, comprising determining from one or more of bits S48 to S53 of the decoded transmission parameter information if the signal relates to an Internet protocol data cast network.
- 15
3. A method as claimed in claim 1 or claim 2, comprising determining from the decoded transmission parameter information if the signal carries time-sliced streams, and disregarding the signal in the event of a negative determination.
4. A method as claimed in claim 3, comprising determining from one, or maybe 20 more than one, of bits S48 to S53 of the decoded transmission parameter information if the signal carries time-sliced streams, and disregarding the signal in the event of a negative determination.
5. A method as claimed in any preceding claim, comprising subsequent to the 25 or each determining step, determining from decoded network information an identification of a source of the signal, comparing the identification with identifications relating to already considered signal sources, and parsing the decoded network information if the comparing step reveals no match.
- 30
6. A receiver arranged to operate in a network in which transmission parameter information is transmitted on a lower level than service information, the receiver comprising:
 - a decoder for decoding transmission parameter information from a signal;

a determiner for determining from decoded transmission parameter information if the corresponding signal relates to a suitable network type; and
a controller for disregarding a signal associated with a negative determination.

5

7. A receiver as claimed in claim 6, in which the determiner is arranged for determining from one, or maybe more than one, of bits S48 to S53 of the decoded transmission parameter information if the corresponding signal relates to an Internet protocol data cast network.

10

8. A receiver as claimed in claim 6 or claim 7, in which the determiner is arranged for determining from the decoded transmission parameter information if the corresponding signal carries time-sliced streams, and the controller is arranged for disregarding a signal associated with a negative determination.

15

9. A receiver as claimed in claim 8, in which the determiner is arranged for determining from one, or maybe more than one, of bits S48 to S53 of the decoded transmission parameter information if the corresponding signal carries time-sliced streams.

20

10. A receiver as claimed in any of claims 6 to 9, in which the determiner is arranged for determining from decoded network information an identification of a source of the signal, and the receiver comprises a comparator for comparing the identification with identifications relating to already considered signal sources, and a parser arranged to parse the decoded network information if the comparator reveals no match.

25

11. A method of forming a signal for transmission, the method comprising:
creating service information;
creating transmission parameter information including an indication of a type of network to which the signal relates; and
including the service information on one level with the transmission parameter on a lower level to form the signal.

12. A method as claimed in claim 11, comprising creating the transmission parameter information including at one, or maybe more than one, of bits S48 to S53 thereof an indication of whether the signal relates to an Internet protocol data cast network.

13. A method as claimed in claim 11 or claim 12, in which the transmission parameter information creating step comprises including an indication of whether the signal carries time-sliced streams.

14. A method as claimed in claim 13, in which the transmission parameter information creating step comprises including at one, or maybe more than one, of bits S48 to S53 thereof an indication of whether the signal carries time-sliced streams.

15. Apparatus for forming a signal for transmission, the apparatus being arranged for creating service information, for creating transmission parameter including an indication of the type of network to which the signal relates, and for including the service information on one level with the transmission parameter information on a lower level to form the composite signal.

16. Apparatus as claimed in claim 15, in which the transmission parameter information includes at one, or maybe more than one, of bits S48 to S52 thereof an indication of whether the signal relates to an Internet protocol data cast network.

17. Apparatus as claimed in claim 15 or claim 16, in which the apparatus is arranged for including in the transmission parameter information an indication of whether the signal carries time-sliced streams.

18. Apparatus as claimed in claim 17, in which the apparatus is arranged for including at one, or maybe more than one, of bits S48 to S53 of the transmission parameter information an indication of whether the signal carries time-sliced streams.

19. A transmission parameter signalling data signal comprising a predetermined number of data bits defined over consecutive orthogonal frequency division multiplex symbols, the data signal comprising at a predetermined location a group of one or more information bits having a state dependent on the network type to which the data signal relates.
5
20. A data signal as claimed in claim 19, in which the group of information bits has a state dependent on whether the data signal relates to a network of the Internet
10 protocol data cast type.
21. A data signal as claimed in claim 20, in which the data signal comprises at a predetermined location a group of one or more information bits having a state dependent on information concerning the division of multiplexes carried in a
15 network to which the data signal relates.
22. A data signal as claimed in claim 21, in which the group of information bits has a state dependent on whether the network to which the signal relates contains heterogeneous multiplexes.
20
23. A data signal as claimed in claim 21 or 22, in which the group of information bits has a state dependent on whether the network to which the signal relates contains homogenous multiplexes.
- 25 24. A data signal as claimed in any of claims 21 to 23, in which the group of information bits has a state dependent on whether the network to which the signal relates contains mixed multiplexes.
25. A data signal as claimed in claim 21, in which the group of information bits
30 is as shown in the following table:

Bits m, n	Multiplex information
00	Heterogeneous multiplexes
01	Homogeneous multiplexes
10	Mixed multiplexes

26. A data signal as claimed in any of claims 19 to 25, the data signal comprising at a predetermined location a group of one or more information bits having a state dependent on information concerning the network topology of the network to which the data signal relates.

27. A data signal as claimed in claim 26, in which the group of information bits has a state dependent on whether the data signal relates to a network having a single frequency topology.

28. A data signal as claimed in claim 26 or 27, in which the group of information bits has a state dependent on whether the data signal relates to a network having a multi frequency topology.

15

29. A data signal as claimed in claim 26, in which the group of information bits is as shown in the following table:

Bit n	Topology information
0	SFN
1	MFN

20 30. A data signal as claimed in any of claims 19 to 29, the data signal comprising at a predetermined location a group of one or more information bits having a state dependent on information concerning whether or not cells in the network to which the data signal relates have substantially the same cell size.

25 31. A data signal as claimed in claim 30, in which the group of data bits are as shown in the following table:

Bit n	Cell size information
0	Cells have same sizes
1	Cells have different sizes

32. A data signal as claimed in any of claims 19 to 31, the data signal comprising at a predetermined location a group of one or more information bits having a state dependent on information concerning the mapping between multiplexes and cells of a network to which the data signal relates.

5

33. A data signal as claimed in claim 32, in which the group of information bits has a state dependent on whether all cells in the prevailing network have only one multiplex.

10

34. A data signal as claimed in claim 32 or 33, in which the group of information bits has a state dependent on whether all cells in the prevailing network have two or more multiplexes.

15

35. A data signal as claimed in any of claims 32 to 34, in which the group of information bits has a state dependent on whether all cells in the prevailing network have one or more multiplexes.

20 36. A data signal as claimed in claim 32, in which the group of information bits is as shown in the following table:

Bits m, n	Cell to multiplex mapping
00	All cells of the network consists of only one multiplex
01	All cells of the network consists of two or more multiplexes
10	All cells of the network consist of one or more multiplexes

37. A data signal as claimed in any of claims 19 to 36, the data signal comprising at a predetermined location a group of one or more information bits having a state dependent on the mapping between the multiplex to which the signal relates and other multiplexes in a same cell.

5

38. A data signal as claimed in claim 37, in which the group of information bits has a state dependent on whether the current cell consists of only one multiplex.

39. A data signal as claimed in claim 37 or 38, in which the group of information bits
10 has a state dependent on whether the current cell consists of two or more multiplexes.

40. A data signal as claimed in claim 37, in which the group of information bits is as shown in the following table:

Bit n	Current cell to multiplex mapping
0	Current cell consists of only one multiplex.
1	Current cell consists of two or more multiplexes.

15

41. A data signal as claimed in claim 32 and 37, in which the group of information bits is as shown in the following table:

Bit m, n	Cell to multiplex mapping
00	All cells consist of only one multiplex
01	All cells consist of two or more multiplexes
10	Current cell consists of only one multiplex
11	Current cell consists of two or more multiplexes

20 42. A data signal as claimed in any of claims 19 to 41, the data signal comprising at a predetermined location a group of one or more information bits having a state dependent on the size of the cell to which the data signal relates.

43. A data signal as claimed in claim 42, in which the group of information bits has a state dependent on whether the size of the cell to which the data signal is less than a predetermined threshold.

5 44. A data signal as claimed in claim 42 or 43, in which the group of information bits has a state dependent on whether the size of the cell to which the data signal is greater than a predetermined threshold.

10 45. A data signal as claimed in any of claims 42 to 44, in which the group of information bits has a state dependent on whether the size of the cell to which the data signal relates is between a predetermined lower limit threshold and a predetermined upper limit threshold.

15 46. A data signal as claimed in claim 42, in which the group of information bits is as shown in the following table:

Bits m, n	Current cell diameter (km)
00	< first threshold
01	\geq first threshold < second threshold
10	\geq second threshold < third threshold
11	\geq third threshold

20 47. A data signal as claimed in any of claims 19 to 46, in which the data signal comprises at a predetermined location a group of one or more information bits having a state dependent on information concerning whether the prevailing signal has time-sliced elementary streams.

25 48. A data signal as claimed in claim 47, in which the group of information bits has a state dependent on whether the time-sliced elementary streams have an additional or different framing structure.

49. A data signal as claimed in claim 47, in which the group of information bits is as shown in the following table:

Bit n	Current signal time slice information
00	Current signal carries time sliced elementary streams
01	Current signal does not carry time sliced elementary streams
10	Current signal carries time sliced elementary streams and has an additional framing structure
11	

50. A method comprising generating a signal as claimed in any of claims 19 to 50.

5 51. Apparatus for forming a signal for transmission, the apparatus being arranged to form a signal according to any of claims 19 to 50.

52. A receiver arranged to receive and decode a transmission parameter signaling information data signal comprising a predetermined number of data bits defined over 10 consecutive orthogonal frequency division multiplex symbols, the receiver being arranged to determine from data found at a predetermined location of the data signal information concerning the network type to which the data signal relates.



Application No: GB 0306840.0
Claims searched: 1-18

Examiner: John Betts
Date of search: 9 September 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A		US20020054578 A1 (Guojin et al) identification of signal type by data in lower level than service data.
A		EP0808073 A2 (Motorola) selection of system by service type available
A		http://www.rds.org.uk/rds98/whatisrds.htm "What is RDS?" 3.1.2000

Categories:

X Document indicating lack of novelty or inventive step	A Document indicating technological background and/or state of the art
Y Document indicating lack of inventive step if combined with one or more other documents of same category	P Document published on or after the declared priority date but before the filing date of this invention
& Member of the same patent family	E Patent document published on or after, but with priority date earlier than, the filing date of this application

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC⁶:

H4L

Worldwide search of patent documents classified in the following areas of the IPC⁷:

H04Q H04L

The following online and other databases have been used in the preparation of this search report:

EPODOC, WPI, JAPIO
Internet via Google