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OPERATING APPARATUS WITH PAYMENT FOR USAGE

The present invention relates to a method and apparatus for operating apparatus (particularly a telecommunications terminal) for value.

In one aspect, the invention provides a mechanism for charging for the use of different services which are represented on an integrated digital network in the same format. For example, voice services, facsimile services and data services will all appear similar when carried by ATM cells on a high speed digital network. The ability to differentially charge for different services will therefore be difficult to achieve.

Accordingly, in a further aspect, the invention provides apparatus and a method for charging for the use of services carried in a common format on a digital communications network in which the charge is levied on the basis of information which is determined prior to the conversion of the services into the common format.

For example, the local interface for converting a service such as voice telephony or video telephone into a common format is provided at a user's premises, and the interface is operable to issue a charging signal prior to the conversion into the common format.

Preferably, the interface will only permit communication on receipt of return signals. However, the concept of generating charging events for the use of a common format digital network by reference to the format of data prior to conversion to the common format is applicable independently of the features of the below described embodiments; if the physical security of the interface and ISDN channel is sufficiently good, it may be sufficient merely to transmit forward billing messages from the interface, without requiring return messages from a billing centre to be received thereat.

The interface is preferably a separate unit, for increased security, but could be for example a card within a personal computer forming the communications terminal, or even

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a program executed by the processor of a personal computer forming the communications terminal. Naturally, other types of communications terminals (such as videophones) may be substituted for personal computers. Multiple such communications terminals may be connected to a single interface device.

Other aspects and preferred embodiments of the invention will be apparent from the following description and claims.

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

Figure 1 is a block diagram showing the elements of a system for operating a communications terminal for value according to a first embodiment of the invention;

Figure 2 is a block diagram showing elements of the system according to the first embodiment of the invention;

Figure 3a is a flow diagram showing the operation of the programmed apparatus of the embodiment of Figure 1;

Figure 3b is a flow diagram showing the operation of a billing station in the embodiment of Figure 1;

Figure 3c is a flow diagram further showing the operation of the programmed apparatus in one example of an embodiment according to Figure 1;

Figure 4 is a flow diagram modifying the operation of Figures 3a and 3c in a first example according to the second embodiment;

Figure 5 is a block diagram showing the elements of a system for operating a programmable apparatus for value according to a third embodiment of the invention;

Figure 6 is a block diagram showing the elements of a local billing device in the embodiment of Figure 5;

Figure 7 corresponds to Figure 6 and is a block diagram showing the elements of a system according to a fourth embodiment of the invention;

Figures 8a and 8b are flow diagrams showing the operation of the device of Figure 7 according to the fourth embodiment; and

Figure 8c is a flow diagram showing the operation of a remote monitoring station of the fourth embodiment;

First Embodiment

In this embodiment, the invention is utilised to provide different charge rates for different services carried via a network such as the ISDN in which such different services are represented in a common data format.

In an integrated services digital network, multiple different communications services may be represented by the same physical data structures (e.g. asynchronous transfer mode (ATM) packets or "cells", or synchronous digital hierarchy (SDH) frames). Accordingly, it is generally assumed that charges for the use of such networks will be on a per cell, per frame or per bit basis.

Referring to Figure 1, according to the present embodiment, a communications terminal 90 (here a multi media personal computer) capable of communicating using one or more communications services (e.g. PCM audio, compressed audio, fax image, joint picture expert group (JPEG) image, moving picture expert group (MPEG) video, or ASCII file data) is connected via a connector 11 to an ISDN interface 40 connected in turn to an ISDN channel 10. The interface 40 comprises a protocol conversion device for receiving the communications service in its source format, as a digital bit stream via the link 11, from the communications terminal 90; and for converting the source format into a common network format (e.g. ATM cells or SDH frames).

The data in common network format is then transmitted, for example, on the "B" channels of the ISDN link, to its destination 500 via the network 20. At the same time, charging initiating signals which indicate the format from which the data was converted by the interface 40 (and hence the communications service in use) are transmitted via the "D" channel to the billing centre 200.

Referring to Figure 2, in greater detail, the interface 40 comprises first and second communications interfaces 110, 111 coupled to the telecommunications links 10, 11 and

comprising a modem and associated signalling components; a processor 120 operable under stored program control; and memory for storing the control program for the processor 120 operable to perform signal format conversion. Conveniently, and conventionally, the memory in this embodiment may comprise a read only memory 130 which stores an operating system kernel (e.g. a machine BIOS); a random access memory 140 for storing an active control program; and a permanent memory 150 (a hard disk drive) for storing currently inactive programs and maintaining program storage during power-down of the apparatus 100.

General details of the structure of a billing station 200 (shown here as being coupled to the network 20 via a telecommunications signalling link 21) are to be found in the Journal "British Telecommunications Engineering" Special Issue on Billing, vol. 11 part 4, January 1993. The components necessary for an understanding of the present invention are an interface circuit 210 for receiving and transmitting signalling data via the telecommunications channel 21; a control processor 220 (which may be provided by the mainframe billing computer); a code store 230 storing encoding and verification data; and a billing store 240 in which charging information is stored (which in this embodiment is conveniently provided by the mainframe billing stores used to record telephone charging information for use of the network 20).

Preferably, the interface 40 comprises a stored program for executing the processes of Figures 3a and 3c. Thus, the interface 40 will only permit use of the ISDN 20 when billing events for the corresponding service are being recorded in the billing centre 200 as described below.

The operation of this embodiment will now be explained in greater detail with reference to Figure 3.

Validation

In this embodiment, the program contains code for performing the process shown in Figure 3a, which provides a validation process on each use of the program. In a step

1102, the program is activated by receipt of a signal from the terminal 90 and, prior to setting up the required telecommunications service, (step 1106) in a step 1104, a validation routine is called. In the validation routine, in a step 1202, a use request signal is transmitted to the network 20. The use request signal has a format which will cause it to be directed by the network 20 to the billing station 200. For example, where the link 10 is an ISDN link comprising 2 "B" (64 kilobit per second) data channels and a "D" (16 kilobit per second) signalling channel, the use request signal comprises a data packet consisting of a header portion (indicating that this is a use request packet to be directed to the billing station 200); and a data portion (indicating the identity of the service and terminal to be used).

Although it is not essential, it is preferred in this embodiment that the data portion should be encrypted for additional security. To ensure that the encrypted data portion differs on subsequent use request signals from the same apparatus, the data portion prior to encryption may comprise additional, time varying, data such as the date.

In a step 1204, it is determined whether a reply has been received from the telecommunications link 10 (for example, a packet received on the D channel of an ISDN link 10 the header portion of which identifies it as a return message). In the absence of a reply, no further execution of the program is performed and hence the telecommunications service is not set up. It may be convenient to provide an exit from the program after a predetermined time (for example on the order of several minutes).

When a reply is received, in a step 1206 the data portion of the return message is decrypted by performing a predetermined decryption algorithm thereon, and the result is compared with a stored unique code held at the interface 40 in step 1208. If the two correspond, the processor returns in a step 1210 to execute the signal format conversion program in step 1106. If the two do not correspond, in a step 1212

all further execution of the program is ceased.

It may be convenient to provide that, after a predetermined number of invalid replies are received, the program is arranged to erase or override a portion of the copy of itself stored on the permanent store 150, or otherwise to render itself inoperable.

Billing

Referring to Figure 3b, the operation of the billing station 200 in this embodiment will now be described in greater detail.

On receiving a use request signal (previously transmitted in step 1202) in step 1302, the billing station 200 determined the identity of the transmitting apparatus 100; in this embodiment, for example by determining the telecommunications link 10 via which the use request signal was transmitted. This information may also be appended to the header portion of the use request signal by the first node encountered within the network 20, for instance.

In a step 1306, the control processor 220 reads the code data store 230 to determine whether the identity corresponds to an identity stored therein with a corresponding unique code word indicating a right to use the apparatus. In the event that a corresponding entry is found in the code data store 230, the processor 220 is arranged to generate a reply in step 1308, by encrypting the unique code using an encryption process which can be decrypted by the decryption process performed in the interface 40. Preferably, the encrypted return message is arranged to vary, for each interface 40 over time; this may be achieved, for example by encrypting time variable data such as the date together with the unique code.

In a step 1310, the return signal thus generated is provided with a header to cause it to be routed by the network 20 to the interface 40 and is transmitted back to the interface 40.

In the event that the identity of the interface 40 is not found to be valid in step 1306, no return signal is generated (it would alternatively be possible to generate a

predetermined invalid return signal).

In a step 1312, a charge record is recorded in the billing store 240. For example where calling line identification has been used, the record may be recorded in the entry under the identified telephone number. In this embodiment, the charge record comprises date and time information, an indication of the requested telecommunications service (received in the use request signal or derived therefrom), and an indication of a unit charge for the use of that service.

Thus, the above described embodiment is operable on each occasion that an attempt is made by a user of the apparatus to use it. On each such attempt, the identity of the user is checked (by confirming his telephone number). If the identity is not acceptable, no return signal will be sent and the program will not operate. On each occasion when a return signal is transmitted, a charge is made for the use.

Billing by time

Preferably, a charge is also made based on the period of use of the program. This is achieved, as shown in Figure 3c, by performing a call to point A at the start of the verification routine of Figure 3a on each occasion when a predetermined interval of time ΔT has elapsed (for example, every five minutes). Figure 3c illustrates a time test step 1108 at which the program periodically reads a real time clock (not shown) of the interface 40 and calls the verification routine in a step 1110 on the elapsing of the predetermined time. It may, however, be more convenient for the program to set a real time clock of the interface 40 to generate an interrupt after the predetermined time ΔT, and to perform step 1110 in response to the interrupt.

The operation of the billing station 200 is substantially unchanged, except that rather than recording a sequence of successive different charge entries in successive repetitions of step 1312, successive charge event signals may be generated in repetitions of step 1312, which are accumulated and recorded as a single charge entry comprising a single date and

time, and a charge consisting of the product of the number of charging events thus generated and a predetermined charging rate for use of the program.

Rather than varying the data to be encrypted over time, it would be possible to vary parameters of the encryption process (and the corresponding decryption process). In the same manner, rather than distributing a unique code for each copy of the program, it would be possible to distribute a unique decryption algorithm in each interface 40 and a corresponding encryption algorithm to the billing station 200.

Second Embodiment

The second embodiment in general fulfils the same function as the first, and like steps and components will be given the same reference numerals and will not be described further. For convenience, several differences from the first embodiment are here described together, but it will be realised that each difference could be used with the features of the first embodiment (or other embodiments) and separately of each other. Specifically, the second embodiment differs from the first in the following respects:

1. Use request messages are generated in a progressive series and, conveniently, return messages are generated by encrypting the use request messages.
2. Use is monitored over time.

The operation of the interface 40 in performing Figures 3a and 3c is also modified in this embodiment to call the sub routine of step 1502 of Figure 4, rather than that of step 1202, at steps 1104 and 1110.

In step 1502, the processor 120 reads a message number M stored at a predetermined location on the permanent store 150, and in step 1504, the number is incremented and re-written to the permanent store 150.

The message number M is preferably incremented only where a valid return signal has been received.

In step 1506, a use request signal data portion is generated by encryption of the feature number and the message number M. The encryption scrambles the data so that the

encrypted data portion bears no resemblance to that generated for the previous message number M.

In step 1508, the process of the validation sub routine commencing at step 1202 of Figure 2b is executed, so as to transmit the use request message.

At the billing device 320, the process of Figure 3b is performed; in this embodiment, in the step 1304 after decryption of the use request message data portion, it is determined whether the unique code is a valid code and, if so, whether the message number M follows in sequence after the last received message number. If so, the identity is judged to be valid.

It is also determined whether the unique code corresponds to a user who is entitled to use the telecommunications service corresponding to the received feature number. For additional security, calling line identification may also be performed in this embodiment as in the first, but this is not essential.

Where the received use request message is verified as valid in step 1306, in step 1308 the return authorisation message is generated utilising the received unique code and message number, and a different encryption process to that used by the apparatus 100 in step 1506. The corresponding decryption process is utilised in step 1206, and in the event that upon decryption the unique code matches that stored within the program, the processor 120 executes a return from step 1210 to step 1510 to step 1408, and proceeds to execute the desired service format conversion.

Use Monitoring

On each occasion when a feature is used in this manner, a record is stored in the use monitor store 310, indicating the identity of the user and of the feature. Preferably, any further available information about the apparatus 100 is also stored. The records held in the usage monitor store 310 are periodically analysed and used in one or more of the following ways:

1. The relative usage of different services is determined.

This may be used in developing further improvements or modifications to the service (and such usage data may be further analysed by reference to the types of apparatus 100);

2. A long term pattern of the amount of use made by each user of the various services may be built up. This may then be used to detect radical changes (when averaged over a relatively short period of time, on the order of weeks) in the use pattern of a user to detect fraudulent practices.

The use of a time varying series of use request messages prevents the fraudulent recording and reuse of a single use request message.

Furthermore, the recording of the message number on permanent storage media in the apparatus 100 ensures that even after the apparatus 100 is switched off and then switched on again the sequence is continuous.

Rather than using the charging events to generate a charge to the user of the apparatus, in some circumstances the user of the apparatus may have pre-paid in advance and the charging events may be used solely to distribute payments to be made between different parties (e.g. different service providers).

In this embodiment, as in the first, a charge may be made on the basis of elapsed time. In this case, the charge may be at a different rate for different services; thus, in invoking a function, the length of the time interval ΔT may be set in dependence upon the function. Thus, the billing station 320 may accumulate a single tariff amount for each charging event, the charging events occurring at different rates for different types of telecommunications service.

Third Embodiment

In the third embodiment, the system of the first (or second) embodiment is varied so that historical billing information is held in a billing apparatus local to each user, in the manner of a usage meter, rather than being held centrally in a telecommunications billing station 200.

Referring to Figure 5, in this embodiment, the apparatus 100 is connected via a local communications link 11 to an interface which also comprises a local billing device 400, which is connected via the line 10 and network 20 to the central billing station 200 of the first embodiment. Preferably, in this embodiment, the usage monitoring store 320 of the second embodiment is provided, in communication with the central billing station 200.

Referring to Figure 6, each device 400 comprises a robust housing 401, and is provided with a fail to safe control system which permanently disables the device on detection of an attempt to tamper, and with tamper proof seals which make it evident when tampering has occurred.

Within the housing 401 are a local interface circuit 411 connected to the local communications link 11 and a line side interface circuit 410 connected to the telecommunications channel 10. In communication with the interfaces 411, 410 is a processor 420 (for example a microcontroller or microcomputer) operating in accordance with a stored program held in a read only memory 430. The processor 420 is connected to a display panel 460 (for example a liquid crystal display) to generate a display thereon of billing data, a printer 462, and a keypad 470 from which it is arranged to accept input instructions to control the data displayed on the display 460. Also provided in this embodiment is a local billing data store 440, which is conveniently static RAM or EPROM.

Validation

In this embodiment, the validation is conveniently performed as in the first embodiment.

Billing

In this embodiment, charge records are held locally rather than centrally. However, bills are generated centrally. Accordingly, this embodiment differs from the first embodiment in that the processor 220 of the central billing station 200 is arranged to store, for each user, a simple running total of the amount due for usage of the

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telecommunications network, which total is incremented on each charging event.

The processor 420 of the local billing station 400 is arranged to detect each occurrence of an authorisation signal (and hence each charging event) and to log the charging events in the record created for the program in the billing data store 440 on downloading of the program as described above. Thus, the local billing device 400 keeps a complete transaction log locally. The processor 420 is arranged to accept a command from the keypad 470 to display the log, together with the associated total charge, on the display device 460, so that the user of the apparatus 100 may monitor the level of charges.

Bill Generation

Periodically (for example once a month or once a quarter) the central billing station 200 is arranged to print a bill for the total amount due stored in its record for each of the apparatus 100. The central billing station in this case is arranged to generate to all local billing apparatus 400 to cause the processor 420 thereof to print out the log stored in the local billing store 440 for the use of the apparatus 100, in the form of a statement.

Various modifications may be made to the operation of this embodiment. For example, as in our above referenced earlier European application 943089904 (agents ref A24829), a limited amount of call record data may be held in the store 240 at the central billing station and a reconciliation performed between the records held in the central billing station and the local billing stations 400.

Alternatively, rather than generating a statement locally, on receipt of a bill generation signal from the central billing station 200, the local billing device 400 may transmit the accumulated transaction log from its billing store 440 to the central billing station (this does, however, entail a higher volume of data being transmitted through the network 20).

Since in this embodiment the total amount due is stored

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centrally, with only descriptive data being held locally, attempts to tamper with the local billing device 400 will not in general lead to a loss of revenue, but merely to the possibility for disagreement between the user of the apparatus and the operator of the central billing station 200.

Finally, instead of maintaining a running total of the amount due for the use of each apparatus 100 in a central billing store 240 (or a billing store at the downloading centre of the second embodiment) it would be possible, in this embodiment, to store all charging information locally.

In this case, at periodic intervals (for example monthly or quarterly), or when the total charge reaches a predetermined level, the processor 420 is arranged to transmit billing data comprising at least the total due to the central station (or downloading station) for the generation of a bill. If no central record of the amount due is maintained, then the physical security (geographical location and strength of the housing 401) of the local billing device 400 is of greater importance.

Third Embodiment

In this embodiment, to avoid potential attempts to defraud the program supplier, by tampering with the local billing device 400, the continued operation of the local billing device 400 is continually monitored via the network 20.

Referring to Figure 7, in this embodiment, the central billing station 200 is replaced by a central monitoring station 500, which is arranged to monitor the correct functioning of the local billing device 400.

Validation

The validation process in this embodiment operates as described above in relation to the first or second embodiments.

Billing

On each occasion when an authorisation signal is returned to the apparatus 100, a charging event occurs, and a corresponding record is recorded in the store 440, as in the

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third embodiment.

The operating condition of the local billing unit 400 is periodically monitored. In greater detail, referring to Figure 8a, in a step 1650 the processor 420 checks for receipt of a signal at the interface 411 from the terminal 100.

If no signal was received in step 1650, or if an invalid signal was received (step 1654), in step 1656, the processor 420 determines whether a predetermined period of time has elapsed since a monitoring signal was last sent to the monitoring station 500. The period of time Δt may be on the order of several minutes; at any rate, it is sufficiently short that a fraudulent user cannot within the period dismantle the local billing station 400 and circumvent the operation of the processor 420.

If the predetermined period has elapsed, then in step 1658, the processor performs the monitoring routine of Figure 8b. In a step 1660, the processor 420 performs a self-test to determine whether it is functioning correctly, and to determine whether the housing 401 is still closed. In a step 1662, the results of the self test are assessed and, if the self test indicates defective operation, in a step 1664 the process 420 sends (or attempts to sends) a failure signal by the interface 410 to the monitoring station 500, and terminates operation.

If the self test indicates no failure, in a step 1666 the processor 420 generates a condition monitoring signal which is transmitted via the interface 410 to the monitoring station 500. Preferably, the condition monitoring signal comprises encoded data selected from a non repeating sequence known both to the local billing device 400 and the condition monitoring centre 500, in the same manner as described above in the second embodiment.

Referring to Figure 8c, in steps 1750 and 1752, the central monitoring station 500 determines whether a condition monitoring signal has been received within the predetermined time Δt, and if not, then the local billing device is recorded as being faulty. If a signal has been received, in a step

1754 the monitoring station 500 determines the validity of the signal by decoding the signal and determining whether it follows in the predetermined sequence; if not, then as before the local billing device 400 is recorded as being faulty. If the received signal is valid, then an encrypted reply (based, as described above, on the received signal) is transmitted back in a step 1756.

Referring once more to Figure 7b, in step 1670, on receipt of the reply signal transmitted from the central monitoring station 500, in step 1668, the processor 420 is arranged to determine whether or not the reply signal is valid, by decoding the reply signal and testing whether it corresponds to the signal transmitted in step 1666. In the event that the reply signal is incorrect, an attempt to tamper with the line 10, the network 20 or the local billing device 400 is likely. Accordingly, the processor 420 performs the step 1664 as described above.

When a valid reply signal is received, the processor 420 returns to its departure point (Figure 7a).

The connection of the local billing device 400 to the telecommunications network 20 enables remote monitoring of the condition of the local billing device 400 to be performed, which thus reduces the possibility of attempts to tamper with the local billing device, by periodic self test and transmission of signals to the remote monitoring device 500. Attempts to tamper with the link 10 to defraud the local billing device 400 are defeated by the provision of return messages from the remote monitoring device 500.

As in the third embodiment, at periodic intervals (for example once a month or once a quarter) the local billing device 400 transmits a total due signal, indicating the amount of payment due, via the line 10.

If the bill is not paid, to the remote monitoring centre 500 ceases further communication with the local billing device 400, which therefore ceases to receive return messages and ceases to function, preventing further use of the network 20 until the bill is paid.

As in the third embodiment, in this embodiment the local billing device 400 is arranged to display totalised charges to the user, or to print them out, on request via the input device 470.

As in the third embodiment, the local billing device may transmit transaction details, rather than just the total due, to the downloading station 30.

In an alternative arrangement according to this embodiment, rather than accumulating billing information, the local billing device 400 may be equipped with a means for receiving electronic payment (for example a smart card reader) and may debit a users payment device (for example smart card) on each charging event. In this case, the local billing device 400 utilises the telecommunications network 20 to perform the electronic payment signalling (according to, for example, the MONDEX (TM) payment system).

Bills can be generated either on reaching a locally met threshold or on a time basis (e.g. monthly or quarterly).

It will be recognised that the above described embodiments are merely examples of the invention, and that the features of various embodiments may be used in different combinations than those described explicitly above. Moreover, the skilled reader will recognise many modifications and substitutions which may be made without departing from the present invention. Accordingly, any and all such modifications or substitutions are to be regarded as forming part of the invention. Protection is sought for any and all novel subject matter or combinations of subject matter which may be disclosed herein.

CLAIMS:

1. A method of charging for use of a digital network in which different services are carried in a common format, comprising a step of generating charging signals at the originating terminal based on the original service format prior to conversion to said common format.

2. A method according to claim 1 comprising the steps of:

transmitting a forward message to a remote location via said telecommunications channel;

receiving a corresponding return message from said remote location via said telecommunications channel;

verifying said return message to determine whether it is authentic; and, if so;

permitting the operation of said terminal; and, if not;

inhibiting the operation of said terminal.

3. A method according to claim 1 comprising the steps of;

receiving a forward message associated with said terminal;

verifying said forward message to determine whether it corresponds to a predetermined said terminal; and, if so;

transmitting a return message; and

generating a charging event associated with said use of said terminal.

4. A method according to any of claims 2 to 3, in which there is provided a predetermined progressive sequence of differing said forward messages.

5. A method according to any of claim 2 to 4, in which said forward message comprises an encoding of predetermined forward message data.

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6. A method according to any of claims 2 to 5, in which said return message comprises an encoding of predetermined return message data.

7. A method according to claim 6 when appended to claim 4, in which said predetermined data comprises said forward message data.

8. A method according to claim 3 or any of claims 4 to 7 appended thereto, further comprising the step of recording said charge in a stored record associated with said terminal.

9. A method according to claim 8 in which said stored record is stored at a distributed site associated with the terminal.

10. A method according to claim 3 or any of claims 4 to 7 appended thereto, further comprising the step of generating a debit signal to an electronic payment means.

11. A method according to claim 10, in which the electronic payment means is a payment card.

12. A method according to claim 10 or claim 11, further comprising the step of inhibiting the operation of said terminal in the absence of a payment corresponding to said debit signal.

13. A method according to any preceding claim, in which the forward messages are generated at predetermined time intervals whilst the terminal is in use.

14. A method according to any preceding claim, in which the terminal comprises a communications device and is associated with a programmable processor operating under the control of a stored program.

15. A method according to claim 14, in which the program is an operating system.

16. A method according to any preceding claim, in which the telecommunications channel is a digital channel capable of carrying multiple communications services in a common format, and further comprising an interface arranged to provide a said communications service by converting data into said common format, in which the step of transmitting said forward message is performed on converting said data.

17. A method according to claim 16 appended to claim 5, in which the communications terminal is arranged to provide a plurality of said services, and said forward message data indicates the identity of one of the services.

18. A method according to any preceding claim, in which the common format is Asynchronous Transfer Mode (ATM).

19. A method according to any of claim 1 to 17, in which the common format is Synchronous Digital Highway (SDH).

20. A method according to any of claims 1 to 17, in which the telecommunications channel is an Integrated Services Digital Network (ISDN) channel.

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