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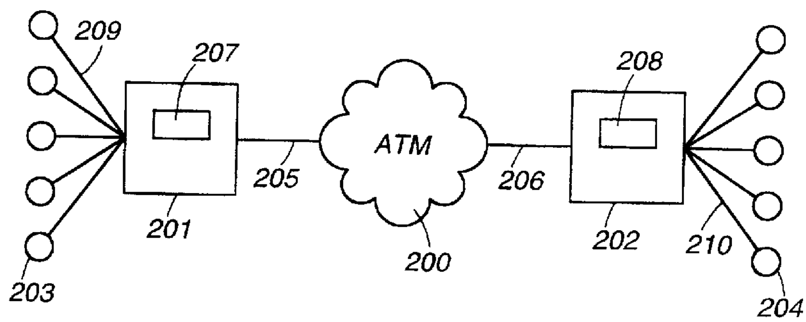
(54) **MINI-CELLULES A TAILLE DE CHARGE UTILE VARIABLE**
(54) **MINI CELLS WITH VARIABLE PAYLOAD SIZE**



(57) Procédé permettant d'indiquer la longueur d'une mini-cellule dans un réseau de radiotéléphonie mobile. On décrit le codage non linéaire d'une zone de longueur courte fixe dans l'en-tête de la mini-cellule. On utilise un procédé d'extension de bit ou un procédé d'extension de code pour étendre la zone de longueur de manière à augmenter le nombre de valeurs de longueur disponibles pour le codage des tailles de mini-cellules. La longueur d'une mini-cellule est indiquée dans la mini-cellule individuelle ou bien elle est indiquée indirectement au moyen d'une table de mappage identificateur de circuit (IC)/longueur. Les tailles des mini-cellules sont modifiées pendant une connexion, des procédés associés sont décrits pour effectuer cela. Des dispositifs de lecture des en-têtes de cellules qui permettent d'extraire les informations d'utilisateur des mini-cellules individuelles sont également décrits ainsi qu'un réseau de radiotéléphonie mobile utilisant les dispositifs de lecture des en-têtes de cellules.

(57) A method of indicating the length of a mini cell in a mobile telephony network. Nonlinear coding of a short fixed length field in the header of the mini cell is described. Either an extension bit method or an extension code method is used to extend the length field so as to increase the number of length values available for coding of the mini cell sizes. The length of a mini cell is indicated in the individual mini cell or is indicated indirectly using a CID/length mapping table. Mini cell sizes are changed during a connection and methods are described for doing this. Cell header reading devices for extracting user information of individual mini cells are described. A mobile telephone network using the cell header reading devices is described.

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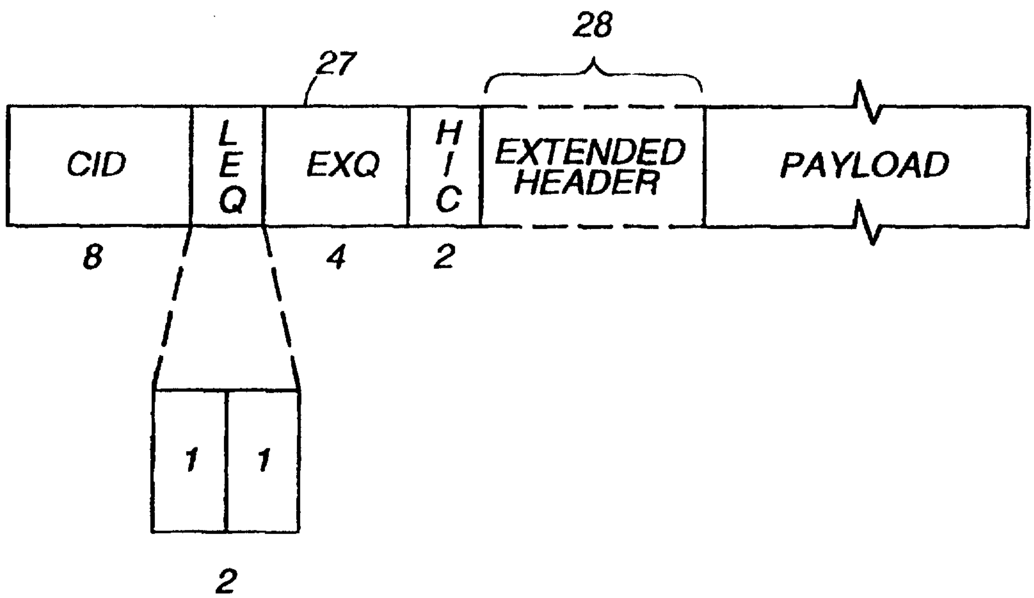


(57) Abstract

A method of indicating the length of a mini cell in a mobile telephony network. Nonlinear coding of a short fixed length field in the header of the mini cell is described. Either an extension bit method or an extension code method is used to extend the length field so as to increase the number of length values available for coding of the mini cell sizes. The length of a mini cell is indicated in the individual mini cell or is indicated indirectly using a CID/length mapping table. Mini cell sizes are changed during a connection and methods are described for doing this. Cell header reading devices for extracting user information of individual mini cells are described. A mobile telephone network using the cell header reading devices is described.

MINI CELLS WITH VARIABLE PAYLOAD SIZE

TECHNICAL FIELD OF THE INVENTION

This invention relates to telecommunication networks in general and to the transport network of a mobile telephone network. ATM cells are used for transmission of data. The payload of an ATM cell comprises mini cells.

DESCRIPTION OF RELATED ART

EP-A1 528 085 describes the use on non-standard short cells, called mini cells, for transmission of information. Mini cells are used in order to reduce the time it takes to fill an empty mini cell with information, the so called packetizing time. Reduced packetizing time will eliminate the need of echo cancellers for a connection which extends between two STM switches via an intermediate ATM switch. Standard ATM cells, comprising 53 octets, are used for connections which extends between a STM switch and ATM switch via an intermediate ATM switch.

PCT/SE95/00575 describes an ATM switch for emulating circuit oriented traffic using short cells in order to reduce the delay through the ATM switch. Small cells are also used in order to save bandwidth on a physical route within the switch. A switch internal interface defines the small cells. Within an ATM switch mini cells of different sizes are used simultaneously. The size of a mini cell is selected from a number of predefined cell sizes. In the payload of a cell, and in particular in the payload of an ATM cell, one or more mini cells are transported within the ATM switch. A central controller selects the cell size to be used for an individual connection. The cell size is changed at a mapping unit resident in the ATM switch. In the header of a short cell a field of fixed length, 4 bits, is used to indicate the size of the cell. The cell header also comprises a cell format indicator bit. If the cell format indicator is 0 the payload of the cell comprises 3 octets (time slots) and if the cell format indicator equals 1 this indicates that the header is extended by on octet. The extended header comprises a field of fixed length, 4 bits, which is used to indicate the size of the payload of the cell. In this patent it is also indicated that the size of the cell may be indirectly given by the cell's physical route identifier PRI and the virtual path VP to which it is assigned within the switch. No method for changing the size of a cell of an ongoing connection is disclosed in the patent.

DE 43 26 377 relates to frame relay and describes a method by which it is possible to distinguish between user data frames on the one hand and operation and maintenance frames on the other hand by using a particular bit in a particular octet of the address field of a frame. It the particular bit is 0 the frame is an ordinary user data frame and if it is set to 1 the frame is an operation and maintenance cell. This is possible since, according to CCITT recommendation Q.922, this particular bit is not used for any purpose of carrying information.

Japanese patent 58-181392 relates to a pulse modulated remote controlling system. Transmission time of a control instruction is decreased by using an extension code in predefined bits. The predefined bits are, according to the standardized transmission format, not used for any purpose of carrying information.

In ANSI T1S1.5/95-001 Revision 1, "An AAL for transporting Short Multiplexed Packets (SMAAL)", Dec 95, the ATM adaptation layer AAL encapsulates and transports short user packages inside an ATM cell stream. A field of fixed length is used to indicate the length of the mini cell. The main shortcoming adhering the use of a field of fixed length to indicate the size of the mini cell is poor transmission efficiency, in particular when the size of the user data of the cell is significantly small. For example, with a payload size of 17 octets the size of the field of fixed length would be 7 bits which translates into about 6% of the band width.

Other shortcomings related to the use of a fixed length field in the header of a mini cell relates to transmission delay. The transmission delay depends on inefficient bandwidth utilization when the mini cells are subjected to statistical multiplexing.

SUMMARY

A main object of the invention is to save band width on a link in a mobile telecommunication system.

Another object of the invention is to shorten the fixed length field and to use the bits gained in doing so either to save bandwidth or to extend the circuit identifier field, referred to as the CID field, in the header of a mini cell.

The main object of the present invention is to reduce and even eliminate the number of bits used in the header of a mini cell to indicate the size of the cell.

Another object of the invention is to indicate the length of a mini cell by using a short fixed length field using non-linear coding in order to provide a wide range of many different cell sizes.

Still another object of the invention is to provide an extension bit by which the fixed length field is extended. The extension bit is provided in the short fixed length field of the header of a mini cell.

Still another object of the invention is to indicate the length of a mini cell using a an extension code provided in the short fixed length field of the header of the mini cell.

Still another object of the invention is to indicate the length of a mini cell using a short fixed length field in combination with a length extension qualifier field.

Another object of the invention is to use length extension qualifier field as an indicator of an extended header format of the mini cell.

Still another object of the invention is to indicate the length of a mini cell indirectly by associating the circuit identifier CID of an individual connection with a cell size which is selected from a group of predefined cell sizes.

Still another object of the invention is to indicate the cell size of a mini cell indirectly by associating, on a system wide basis, a circuit identifier CID with a cell size. Each cell size is associated with a respective circuit identifier CID which in turn is global in the transport network.

In a mobile telephone system that uses ATM cells in the transport network reduced bandwidth or enhanced use of the available bandwidth will make it possible to add more channels into the system.

A large number of connections, which require a larger CID field, will increase the bandwidth gain if statistical multiplexing is used.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and other characteristics thereof will emerge from the following description made with reference to the appended Figures wherein:

Figure 1 shows the format of an ATM cell transporting mini cells therein,

Figure 2 shows the header of a mini cell transported in the ATM cell in Figure 1,

Figure 3 shows an octet of the cell header of Figure 2, said octet comprising a fixed size length field for indicating the length of the mini cell,

Figure 4 shows an octet in the header of a mini cell, said octet comprising a fixed size length field linearly coded in accordance with the invention,

Figure 5 is a mapping table,

Figure 6 shows the fixed size length field and an extended fixed size length field created by the extension bit method in accordance with the invention,

Figure 7 is a mapping table,

Figure 8 shows a fixed size length field and an extended fixed size length field created with the extension code method in accordance with the invention,

Figure 9 shows the basic format of a mini cell the header of which is provided with a short fixed length field and a length extension qualifier field LEQ comprising different extension codes,

Figure 10 is a table,

Figure 11 shows the extended format of a mini cell,

Figure 12 shows the mini cell of Figure 9 in its extended format when predefined extension codes are present in the length extension qualifier field,

Figure 13 is a table,

Figure 14 shows an operation and maintenance cell,

Figure 15 is a block diagram showing a mini cell header analyzing unit used to extract, from the user data channel, the user data part of a mini cell in which the fixed size length field carries the non-linear coding in accordance with the invention,

Figure 16 shows a mini cell's header and user data as extracted from the user data channel,

Figure 17 is a block diagram of a mini cell header analyzing unit used to extract the user data part of a mini cell from a user data channel using the extension code method in accordance with the invention,

Figure 18 is a block diagram of a modified mini cell header analyzing unit used to extract the user data part of a mini cell from a user data channel using either the extension code method or the extension bit method,

Figure 19 is a block diagram showing a mini cell header analyzing unit used to extract the user data part of a mini cell from a user data channel using the bit extension method in accordance with the invention,

Figure 20 shows a mini cell's header wherein the circuit identifier CID is used to indirectly indicate the mini cell size,

Figure 21 is a mapping table used together with the indirect method for indicating the cell size,

Figure 22 shows different tables which together span up an address space used on the links of the transport network in a mobile telephone system,

Figure 23 is a block diagram of mobile telephone system provided with the cell header analyzing units.

DETAILED DESCRIPTION OF EMBODIMENTS

In Figure 1 an ATM cell 1 is shown which comprises a header 2 and a payload 3. Conventionally the payload comprises user data relating to an individual connection. In the aforesaid PCT/SE95/00575 patent document an ATM cell is disclosed which in its payload carries one or more mini cells. In the example shown in Figure 1 three mini cells 4, 5 and 6 of different sizes are shown. The ATM header 2 comprises 5 octets (1 octet = 8 bits = 1 byte) and its payload 3 comprises 48 octets. Each mini cell 4, 5, 6 comprises a header 7 and user data.

In Figure 2 an example of a mini cell header 7 is shown to comprise 2 octets 8, 9. Other mini cell header sizes are also conceivable depending on the ATM system design. A mini cell header size of 3 octets or more are also conceivable. The mini cell header 7 comprises a circuit identifier CID, which identifies the established connection/circuit, a payload type selector PTS which identifies different payload types such as user data, control data, maintenance data, a length indicator LEN, and a header integrity check field/bit HIC, which supervises the header integrity. The length indicator LEN defines the size of the payload of the individual mini cell.

There is a need for distinguishing between different types of mini cells. The following is required to indicate with the PTS field:

User information of fixed length: The length indicator LEN is not necessary in the header and the user information length is instead configured into the system and into the service. For "GSM full rate", the user information length is 35 octets, for PDC full rate it is 20 octets and for "D-AMPS full rate" it is 23 octets.

User information of different sizes, i.e. user information with variable length: This is the preferred embodiment and will be described below. To use the PTS field in order to indicate user information with variable length is a future proof solution.

User information of different sizes of extended lengths.

OAM information per circuit/connection.

Synchronization information: The use of the PTS field for this purpose is optional.

In Figure 3 the cell header 7 is shown to comprise a fixed size length field 10, referred to as LEN field, which is used to indicate the size of the user data of the mini cell to which the header belongs. The size of the mini cell is indicated in this field 10 using linear coding. Linear coding means that the code corresponds to the actual size of the mini cell. For example, if the cell length is 5 octets a binary 5 (000101) is written into the LEN field. For short mini cell sizes the fixed length field 10 will occupy much band width but all of the occupied band width is not used for transmission of useful information as exemplified by the leading zeros in the two examples given. It should be noted that the LEN field 10 is carried by each mini cell of an individual connection. A further drawback with this fixed size LEN field 10 is that the range of cell sizes which can be expressed with linear coding is restricted. With a fixed size LEN field 10 comprising 6 bits cell sizes from 1 to 64 octets can be indicated. Should larger cell sizes be used for an individual connection, then the length of the fixed size length field 10 must be enlarged which in turn leads to even more waste of band width.

In Figure 4 a fixed size length field 11 in accordance with the invention is shown. Non-linear coding is used to indicate a wide range of different cell sizes. In the example given 3 bits are used in an octet, for example octet 9, of a mini cell's header. The rest of the bits of the same octet are free and can be used for any of the above listed purposes. This contributes to reduce the overall size of the header which in its turn increases the efficiency with which the band width is used.

In a mobile telephony system mini cells are generated by voice coders. Today the current IS 95 voice coders uses 2, 5, 10 or 22 octets. Using the fixed size length field 10 in accordance with said ANSI document 7 bits would be required in the header of the mini cell in order to indicate a cell size of 22 octets. With the non-linear coding in accordance with Figure 4 the fixed size length field 11 is 3 bits. This gives a band width saving of 10% for an IS 95 voice coder that operates at 2 kbps (5 octets per 20 ms).

In Figure 5 a mapping table 12 is shown which is to be used together with a fixed size length field 11 in accordance with the invention. As appears from the table the code values do not correspond to the mini cells sizes but instead predefined cell sizes are allocated to a respective code value only three code bits are used. Examples of mini cells sizes are given in the size column of the mapping list. The sizes vary from 4 to 60 octets. Of course the range can be increased, but the maximum number of sizes is given by the number of code bits used.

To expand the number of sizes that can be used together with the non-linear coding it is possible to extend the fixed LEN field 11 on demand. Two methods will be described. Either an extension bit in the fixed size LEN field 11 is used as a qualifier for extension of the LEN field 11 and the method is referred to as the extension bit method, or is one of the length field codes used as qualifier for extension of the LEN field 11 in which case the method is referred to as the extension code method.

In Figure 6 a bit 13, also labeled E, following the LEN field 11 is reserved as an extension bit 13. When the extension bit 13 is set to 1 this will indicate that the header of the mini cell comprises an extended LEN field 14 of the same size as the fixed size LEN field. When the extension bit is zero, the cell header comprises the fixed LEN field 11 only.

The extended length field 14 comprises 3 bits in the illustrated example.

When the extension bit 13 is set the number of bits available for the mapping table 12 will increase from 3 to 6 bits leaving a mapping table 15 shown in Figure 7. Since the extension bit 13 is reserved for this purpose it cannot be used for code size mapping purposes.

A variation of the extension bit method is to append an extension bit 11B to the extended LEN field 14. The appended extension field is used to indicate if there is a further extended LEN field in the header in the mini cell or not. If the appended extension bit 11B is set to 1 this indicates that a second extended length field 14A should be added to the header, thus increasing the number of code bits in table 15 from 6 to 9. If the appended extension field comprises a bit which is set to 0 no such second field is used.

In Figure 8 the extension code method is illustrated. In accordance with this method a code in the fixed length field 11 of Figure 4 is reserved and is used as extension code. Suppose, as an example, that binary code 111 in mapping table 12 is used as an extension code. When this code 111 is present in the fixed length field 11 it means that an extended length field 14 should be included in the header of the mini cell. Thus another 3 bits are available for size mapping. This has been illustrated in Figure 8. This method will reduce the number of sizes in mapping table 12 with 1 and will add another seven cell sizes that can be mapped on the additional 8 code values of the extended length field 14.

From band width efficiency view the extension code method is better than the extension bit method since it requires 3 bits, while the extension bit method requires 4 bits. Looking on the value range the extension bit method is better than the extension code method since it provides 16 different cell sizes compared to 14 as provided by the extension code method.

In Figure 9 the extension bit method has been combined with the extension code method in a manner that allows for high efficiency use of the bits available in a cell header while at the same time a broad range of cell sizes are covered and the band width is used efficiently.

The basic format of the mini cell using this combined coding method is shown in Figure 9. The mini cell comprises a header 21 of 2 octets and a payload part 22 which may comprise from 1 to 48 octets. The four least significant bits of the length of the mini cell is indicated in a small fixed size length field 23, LEN field, in the header. The LEN field 23 comprises 4 bits. The header also comprises a CID field 24 which occupies 8 bits and which identifies the circuit to which the mini cell belongs. Also in the header there is a length extension qualifier field 25, LEQ field, and a header integrity field 26, HIC field, both 2 bits long.

In accordance with the invention the length extension qualifier LEQ 25 is defined as a length extension for the payload and as a header extension. When LEQ takes the binary codes of 00, 01 and 10 the mini cell has the basic format shown in Figure 9 and the code bits of LEQ constitute bits to be appended to the LEN field 23. In this case the LEQ field will thus serve as an extension of the LEN field 23.

In particular, 2^4 different values in LEN field 23 is associated to the binary 00 code existing in the LEQ field 25, 2^4 different values in LEN field 23 is associated with the binary 01 code existing in LEQ field 25 and 2^4 different values in LEN 23 is associated with the binary code 10 existing in LEQ field 25. This is illustrated in Figure 10. This gives a total of 48 different length values in accordance with the following general expression:

$$[2^{\text{length of LEQ in bits}}-m] \times [2^{\text{length of LEN in bits}}],$$

where m is the number of codes used to indicate the extended format of the mini cell.

Accordingly the payload size can be chosen from forty-eight length values. In the example given the length values are coded as 1 to 48.

When the LEQ field 25 takes the binary code 11 this signifies that the basic cell format should be extended. The extended format is shown in Figure 11. The LEQ field 25 has a double meaning. The double meaning of LEQ is (i) it is used as the two most significant bits of length indication, i.e. LEQ x

2^4+LEN as shown in Figure 9 and (ii) it is used as indication of extended header format as shown in Figures 11 and 12, i.e. the LEN field 23 is interpreted as an extension qualifier field 27, EXQ field 27. The EXQ field 27 comprises 4 bits.

Of the four bits of the EXQ field 27 the binary values of 0000 and 0001 are reserved for use together with a further length field 29, LENE field, in the manner shown in Figures 12 and 13. In particular the least significant bit in EXQ field 27 should be appended to the seven bits in the further LENE field 29 in a manner shown in the dashed rectangle 31 in Figure 13. This is similar to what shown in Figure 10. For the EXQ binary value of 0 this will give 128 different length values and for the EXQ binary value of 1 this will give another 128 different length values.

The number of different length values that can be used with this method is given by the following general expression:

$$[2^{\text{number of EXQ bits used}}] \times [2^{\text{number of bits in LEN 29}}]$$

In a preferred embodiment of the invention an EXQ value of 0 is used to indicate mini cell lengths varying from 1 to 128 octets and an EXQ value of 1 is used to indicate mini cell lengths varying from 129 to 256 octets.

It should be noted that the length of the mini cell shown in Figures 9 and 12 is indicated by using a linear coding.

An EXQ value of 2 (binary 0010) is used to signify that the mini cell is an operation and maintenance cell, OAM cell, that comprises a header 32, and an OAM information field 33 as shown in Figure 14. The header 32 is similar to the header 21 in Figure 12. In the LEQ field 25 the binary code 11 is present and in the EXQ field 27 the binary code 0010 is present.

The EXQ code 3 (binary 0011) is used to indicate a fixed length mini cell, for example for the DAMPS system standard. Other EXQ values can be used for other systems standards or services.

EXQ code values 1xxx are used as synchronization cells; wherein xxx is timing information.

In the preferred embodiment a main requirement is that the header of the mini cell at the maximum has a length of 2 octets. Given this restriction the available bits are used in an efficient way to cover all ranges of values.

In Figures 9, 11, 12, 14 preferred sizes are indicated under the respective fields. The indicated sizes are just examples and many other sizes of the different fields can be used. Other LEQ and EXQ codes than the indicated can be used as bits that are appended to the LEN field 23 and LENE field 29.

In Figure 15 a block schema of a cell header reading device is shown. It comprises a shift register 19, a first counter 20, a latch register 30, a ROM memory 40, a second counter 50 and a multiplexor 60. A bit stream comprising the user data of the mini cells is shifted into shift register 19 at one input thereof. A clock signal controls the frequency at which the data bits are shifted into the shift register 19. The clock signals are counted by the first counter 20 which is used to extract the fixed size length field 11 of a mini cell and write its data into the register 30. The fixed length field or rather the information therein is used as address to the ROM memory 40 which has been configured with the mapping table shown in Figure 5. Accordingly, an individual code, in the following referred to as length code, will correspond to a specific length of the user data. From the ROM memory 40 the size of the user data (mini cell size minus the size of the header) is read and is sent to the second counter 50 which controls the multiplexor 60 such that at the output 61 thereof the user data will appear. Suppose the first counter 20 reads the binary code 011 from the user data channel. This code is used as address to the ROM memory and at this address the cell size 20 is stored. Accordingly the length of the user data should be 20 octets. Next the second counter 50 counts the following 20 octets bit by bit by counting a corresponding number of clock pulses. The multiplexor 60 is shown to have an arm 62 which is movable between the indicated two positions. Initially counter 50 sets the arm 62 to the lower position shown with dashed lines and no output data will appear at output 61. When the second counter 50 receives the cell size from the ROM memory 40 it moves arm 62 into the upper position. In the upper position arm 62 connects to a line 63 which in its turn is connected to the input user data channel. When the second counter 50 has counted 20 octets it moves arm 62 back to its initial position and the correct number of octets has now been produced at output 61.

In Figure 16 the extraction of the fixed size length field 11 from the user data channel at time t_0 is indicated. At time t_0 counter 20 starts to count 20 octets bit by bit and at time t_1 counter 20 has counted 20 octets. Accordingly arm 62 will be in the upper position in Figure 15 between times t_0 and t_1.

In the cell header reading device shown in Figure 15 a predefined number of length codes and cell sizes are stored in ROM 40. In the cell header reading device shown in Figure 17 a RAM memory 70 is used to which length codes and cell sizes are written from a control system 80. In this manner it is possible to configure different specific mini cell sizes for individual mobile telephone systems.

The mini cell sizes stored in ROM 40 are global in the sense that an individual length code, for example 101, relate to all connections which use mini cells with this length code.

It is, however possible to have a specific mini cell size for a specific connection or for a specific physical link by using the control system 80 and the RAM memory 70 as will be described in connection with Figures 18-27.

Figure 18 is a block diagram of a cell header reading device used for implementing the extension code method. In

Figure 18 blocks with the same functions as corresponding blocks in Figures 15 and 17 have the same reference designations. The circuit differs from that shown in Figures 15 and 17 in that there is a comparator 90 which is used to detect the extension code. If there is a match, the comparator triggers a subtractor 100 which counts down the first counter 20 by 3 counts. When this has been done the extended length field, or specifically the data therein, is again written into the register 30. The various sizes associated with the extended field 14 must be added to the RAM memory 70. This implies that the number of cell sizes in the RAM memory will be doubled. In practice this means that a new memory bank will be used in the RAM memory 70. Unit 110 is a D-latch which latches the output value of the comparator 90 and uses it to address the new memory bank, in the RAM memory 70.

The comparator 90 and the subtractor 100 are the units that will handle the extended length field 14 so that the position in the header will be moved when the extension code is detected. Three extra bits will be added to the length field 11 and it is these extra bits that will be used to indicate the cell length. Accordingly the fixed size length field 11 is replaced with the extended length field 14 which is inserted into the data stream.

Compared with the operation of the circuit in Figure 15 or 17 where a field is written into the memory, in Figure 18 another field is written into the memory 70.

The cell header reading device shown in Figure 18 can also be used in order to implement the extension bit method. This is indicated in Figure 19. From the register 30 that contains the fixed size length field 11 the extension bit 13 is extracted and is used to increase the address range. The extension bit will count down the first counter 20 with three bits, indicated by the subtractor 100. This implies that three new bits will be written into register 30 and these new three bits plus the old three bits, i.e. altogether six bits, are used to address the RAM memory 70 as symbolized by the six arrows. In this manner the number of cell sizes has been increased.

The ROM memory 40 may have several different mapping tables of the kind shown in Figure 5. It is possible to change from one mapping table to another in response to a predefined length code provided in the header of a mini cell. In this mammer it will be possible to switch from a first set of mini cell lengths, for example 4, 8, 16, 20 to a second set of lengths, for example 3, 6, 9, 12. Instead of using a ROM memory 40 configured with the mapping table shown in Figure 5 a RAM memory can be used for the same purpose. This will enable the control system 80 to write in new a new set of mini cell lengths in the RAM memory. The whole table can also ne transferred in a control message.

Instead of providing each cell with a fixed size length field which is used to indicate the mini cell size it is possible to use an implicit method of indicating the mini cell size which does not use any length field in the mini cell header. According to the implicit method of indicating mini cell sizes, information relating to the sizes is resident within the system network. Instead of using a dedicated field to indicate the cell size an existing field in the mini cell header is used. In the preferred embodiment of the invention mini cell sizes are mapped on the identities of established connections. Accordingly sizes are not global but connection oriented.

The identity of a connection is given by the CID field of a connection. In Figure 20 the mini cell header 7 is shown to comprise a CID field 71. The actual size of the CID field 71 depends on the system but generally two octets should be sufficient. By using the same mapping method as described in connection with Figures 6 and 7 a mapping table 72 results.

Accordingly the fixed length field 11 has been discarded. This will increase the band width efficiency. The CID value is used as address to the RAM memory 70 in Figure 17 and is provided by the control system 80. So, instead of latching the length field 11 in the register 30, the CID value is latched in register 30 and is used as address to the RAM memory 70. In this manner there will be a relation between the identity of the established connection and the length of the mini cells used in the connection. Accordingly no additional memory places are needed for storing the relation between a CID and a size of the mini cell associated with said CID.

At set up of a connection the control system 80 will receive a message which requests (a) that a connection should be set up between to identified end points and (b) that this connection shall use mini cells having a size of X octets. X is supposed to be an integer selected among the available cell sizes. Next the control circuit selects a free CID among logical addresses provided by the ATM network. For the sake of the example CID=7 is selected. The control system 80 will now use 7 as an address to the RAM memory 70 and will write at this address the mini cell size X. The cell header reading device shown in Figure 17 will then operate in the same manner as described. It should be noted that the mapping takes place at connection set-up.

It should be noted that one and the same CID may relate to several different mini cell sizes depending on the fact that cells having the same CID can be transported on different virtual connections VC:s. This is illustrated in Figure 22 wherein a typical address structure used in an ATM network is shown. To each physical link, referred to as physical route, in the ATM network, there is a physical link table 140 having a number of entries, for example the indicated entries 0-23. To each physical link is associated a respective VPI/VCI (virtual path/virtual identifier) table 150. As an example there are 256 virtual paths VP 0-255 in each physical link. In each VC connection, identified with an VCI-/VPI value, there is as an example 256 mini cell connections each having its individual CID.

In Figure 23 there is shown a mobile telephone system comprising an ATM network 200 with a sending unit 201 and a receiving unit 202 are connected via respective link 205 and 206. User data sources 203 are connected to the sending unit over a respective connection as shown symbolically by the lines 209. User data sinks 204 are connected to the receiving unit 202 over a respective connection 210. Connections 209, formed by mini cells, are multiplexed together in the sending unit 201 with a non shown multiplexor. Likewise there is a non shown demultiplexor in the receiving unit 202 that demultiplexes mini cells belonging to connections which are terminated by the user data sinks 204. In the sending unit 201 there is a mini cell header reading device 207 of the kind shown in any of Figures 15, 17, 18 or 19 and in the receiving unit there is a similar mini cell header reading device 208 of the kind shown in any of Figures 15, 17, 18 or 19.

AMENDED CLAIMS

1. A method to indicate the size of a mini cell in a mobile telephone communications system, said mini cell comprising a cell header and a payload, wherein said header comprises:
(a) a fixed length field associated with a first set of non-linear codes used to indicate the size of the mini cell and
(b) an extension bit for extending the fixed length field with an additional length field **characterized in that** one value (0) of the extension bit is associated with a second set of non-linear codes which are used for small mini cell sizes; the other value (1) of the extension bit is associated with said first set of non-linear codes which are used for large mini cell sizes, thus rendering the header small for small mini cell sizes.

2. A method to indicate the size of a mini cell in a mobile telephone communications system, said mini cell comprising a cell header and a payload, wherein said header comprises a fixed length field which is associated with a first set of non-linear codes used to indicate the size of the mini cell **characterized in that** one (111) of said codes is used to extend the fixed length field with an additional length field in order to provide a second set of non-linear codes used to indicate the size of the mini cell, said first set of codes being used for small mini cell sizes.

3. A method to indicate the size of a mini cell in a mobile telephone communications system **characterized in that** the mini cell size is indicated indirectly by the identity CID of the connection which is made up of the cells the size of which are to be indicated.

4. A method in accordance with claim 3 **characterized in that** said size is mapped on said connection identity CID during connection set up.

AMENDED SHEET

5. A method in accordance with claim 4 **characterized in that** a number of different cell sizes are mapped on a number of predefined connection identities during system initialization.

6. A method in accordance with claim 5 **characterized in that** mini cell size is indicated indirectly by a group identifier (VP or VC) common to a number of different connections extending along a common path.

7. A method of indicating the size of a mini cell in accordance with claim 1 **characterized in that** the information resident in the first and second sets of non-linear codes are mapped on cell sizes at memory locations of a memory in a mini cell header reading device, and that the non-linear code used in the length field is used as address to said cell size.

8. A method of indicating the size of a mini cell in accordance with claim 4 **characterized in that** the connection identity CID is mapped on cell size at memory locations of a memory in a mini cell header reading device, and that the length field is used as address to said cell size.

9. A method of indicating the size of a mini cell which comprises a header and a payload, said header comprising a length field (23), LEN field, comprising a first number of bits used to indicate the size of the mini cell **characterized in that** said header comprises a length extension qualifier field (25), LEQ field, having a predefined second number of bits used as length extension code for extending the length field (23) and for extending the header (21) of said mini cell as well as for extending the payload of the mini cell.

10. A method in accordance with claim 9 **characterized in that** said bits of said LEQ field are defining a first set of code values, which when present is said LEQ field are appended to said first number of bits in the LEN field so as to indicate the size of the payload of said mini cell using a linear coding scheme.

11. A method in accordance with claim 10, **characterized in that** to each code value of said first set there are associated 2^N different values, where N equals said second number of bits.

12. A method in accordance with claim 11 **characterized in that** said bits of said LEQ field (27) define a second a second code value, different from said first set of code values, said second code value when present in the LEQ field indicates that the header of the mini cell is extended with a further header (28), comprising a further length field (29) and that said length field (23) is replaced with an extension qualifier field (27), EXQ field, which is used to extend said further length field of said mini cell.

13. A method in accordance with claim 12 **characterized by** said EXQ field comprises said first number of bits and that said further LEN field comprises a third number of bits.

14. A method in accordance with claim 13 **characterized in that** a sub set of bits of said EXQ field are used as extension code appended to said third number of bits of said further LEN field (29) so as to increase the number of sizes available for said mini cell.

15. A method in accordance with claim 14 **characterized in that** to each extension code there is associated 2^M different length values, where M is the number of bits of said further length field (29).

16. A method in accordance with claim 15 **characterized in that** said EXQ field comprises a cell type code which when present in the header of the mini cell indicates that the cell is an operation and maintenance cell comprising a header (32) and a payload (33) comprising operation and maintenance information.

17. A cell header reading device for extracting, from a user data channel the user data part of an individual connection, compris-

ing a shift register into which the bit stream of the user data channel is shifted in synchronism with clock pulses, a first counter counting the size of a cell size indicating field in the header of the mini cell shifted into the shift register in synchronism with said clock pulses, a latch register connected to the first counter and to the shift register to latch the information resident in the cell size indicating field as counted by the first counter, a memory connected to said latch register, a second counter connected to the latch register and the memory for controlling a multiplexor so that the user part of the mini cell in the shift register is extracted from said user data bit stream, **characterized in that** the information in the latch register is used as address to the memory, and that at said address the size of the user data part is stored.

18. A cell header reading device in accordance with claim 17, **characterized in that** said memory is a ROM memory in which there is mapped at each address received from said latch register an individual cell size.

19. A cell header reading device in accordance with claim 18, wherein there is a control system for controlling set up and release of connections in a mobile telephone system **characterized in that** said memory is a RAM memory in which said control system writes at each address received from said latch register an individual cell size.

20. A mobile telephone system comprising an ATM network to which a sending unit (201) and a receiving unit (202) are connected over a respective link (205, 206), said sending device comprising means for multiplexing mini cells from user data sources (203) into a user data stream, said receiving device receiving a user data stream from said ATM network, said latter user data stream comprising mini cells which belong to connections that are to be terminated by user data sinks (204) connected to the receiving device, **characterized in that** said receiving device (202) comprises a cell header reading device (208).

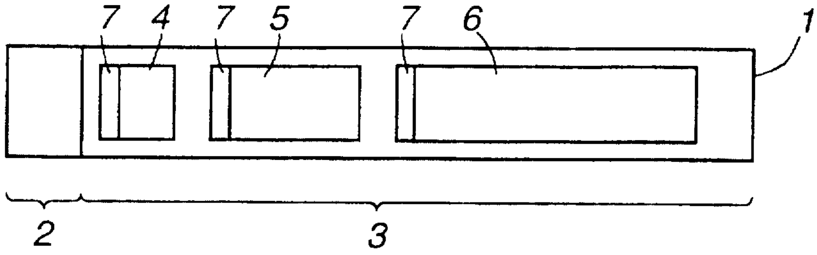
21. A mobile telephone system in accordance with claim 20, **characterized in that** said sending device comprises a cell header reading device (207).

22. A mobile telephone system in accordance with claim 21, wherein said cell header reading device comprises a shift register into which said user data stream is shifted in synchronism with clock pulses, a first counter counting the size of a cell size indicating field in the header of the mini cell shifted into the shift register in synchronism with said clock pulses, a latch register connected to the first counter and to the shift register to latch the information resident in the cell size indicating field as counted by the first counter, a memory connected to said latch register, a second counter connected to the latch register and the memory for controlling a multiplexor so that the user part of the mini cell in the shift register is extracted from said bit stream, **characterized in that** the information in the latch register is used as address to the memory, and that at said address the size of the user data part is stored.

23. A mobile telephone system in accordance with claim 22 **characterized in that** said memory is a ROM memory in which there is mapped at each address received from said latch register an individual cell size.

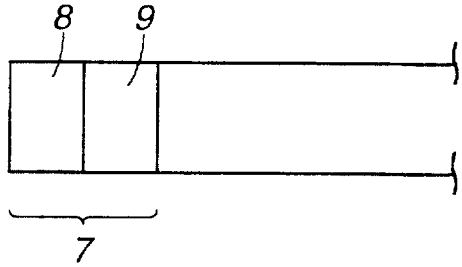
24. A mobile telephone system in accordance with claim 23, wherein there is a control system for controlling set up and release of connections in the mobile telephone system **characterized in that** said memory is a RAM memory in which said control system writes at each address received from said latch register an individual cell size.

Fig.1



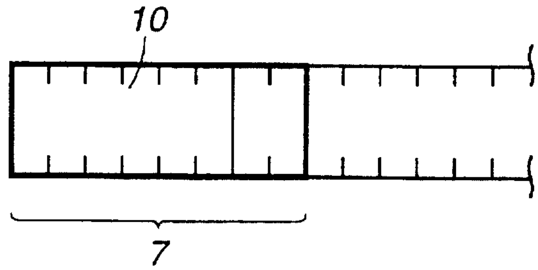
PRIOR ART

Fig.2



PRIOR ART

Fig.3



PRIOR ART

Fig.4

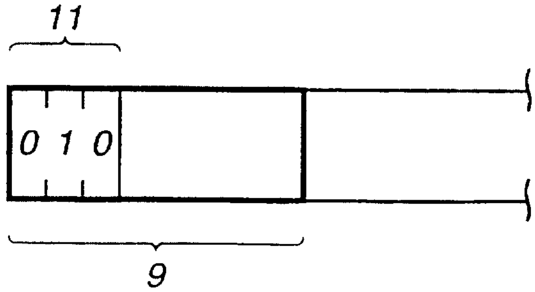


Fig.5

12

CODE	SEIZE (OCTETS)
0 0 0	4
0 0 1	8
0 1 0	16
0 1 1	20
1 0 0	35
1 0 1	43
1 1 0	56
1 1 1	60

Fig.6

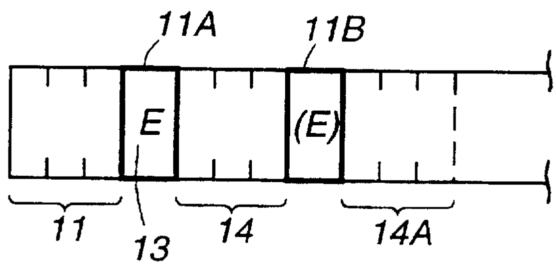


Fig.7

15

CODE	SEIZE (OCTETS)
0 0 0 0 0 0	2
0 0 0 0 0 1	4
0 0 0 0 1 0	5
1 1 1 1 0 0	100
1 1 1 1 0 1	125
1 1 1 1 1 0	150
1 1 1 1 1 1	200

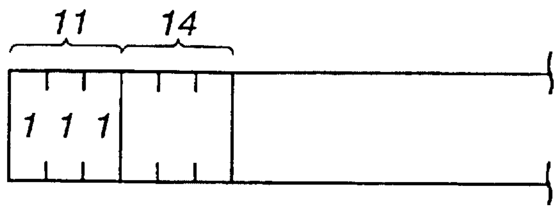


Fig.8

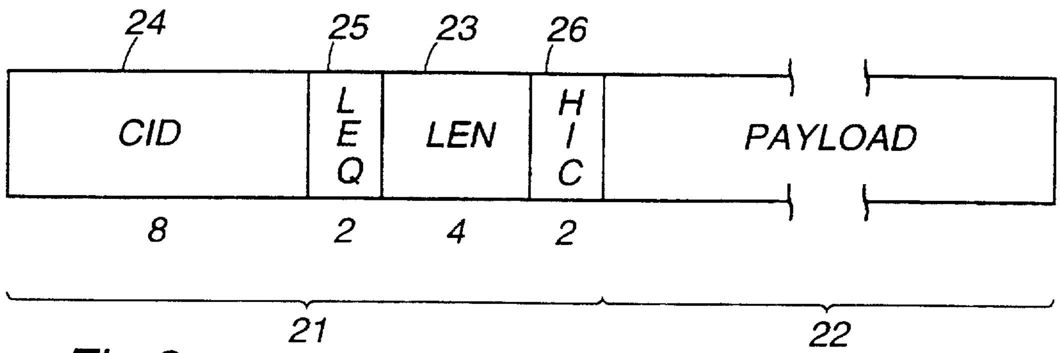


Fig.9

Fig.10

LEQ	LEN
0 0	0 0 0 0
0 0	0 0 0 1
0 0	0 0 1 0
.	.
.	.
0 0	1 1 1 1
0 1	0 0 0 0
0 1	0 0 0 1
.	0 0 1 0
.	.
.	.
0 1	1 1 1 1
1 0	0 0 0 0
.	0 0 0 1
.	0 0 1 0
.	.
1 0	1 1 1 1

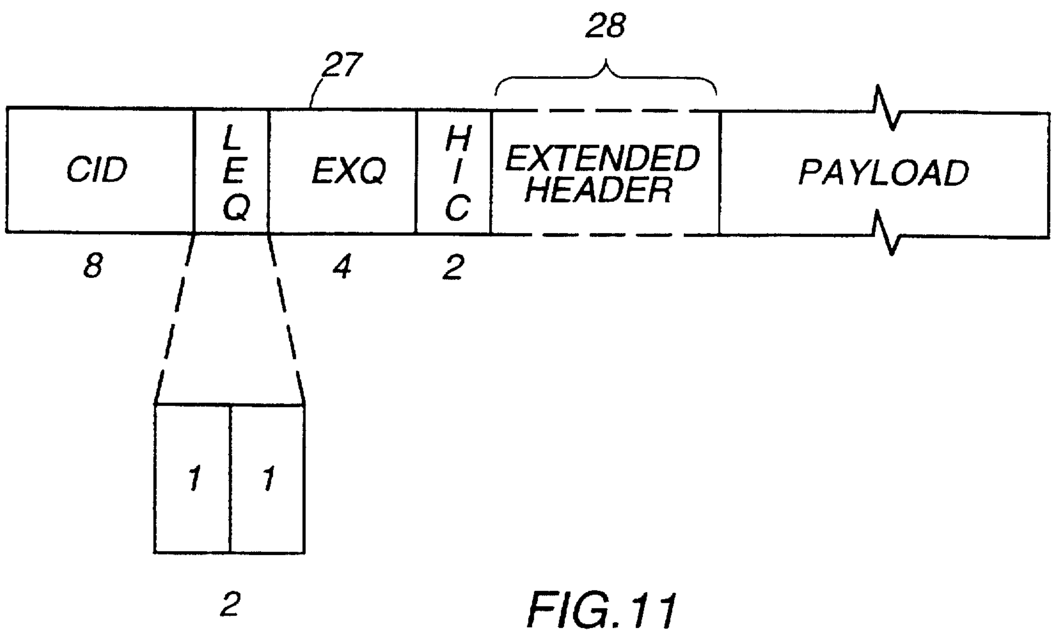


FIG.11

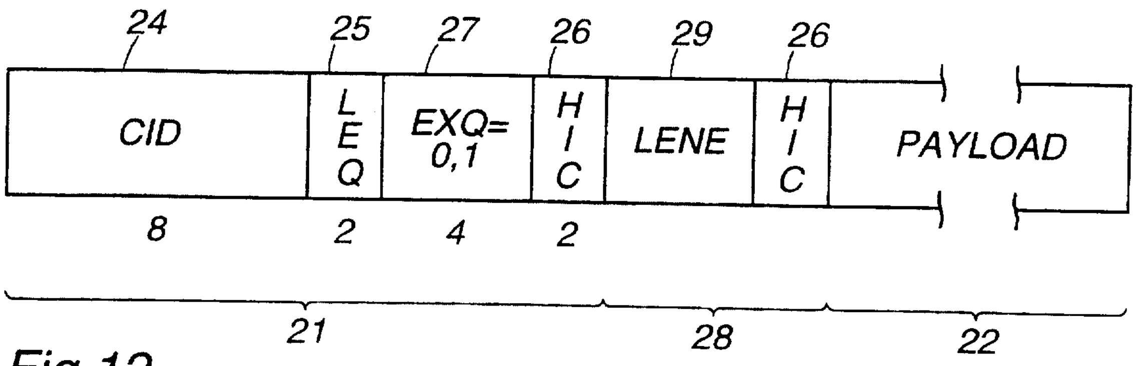


Fig. 12

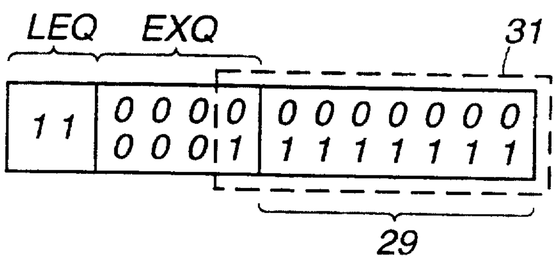


Fig. 13

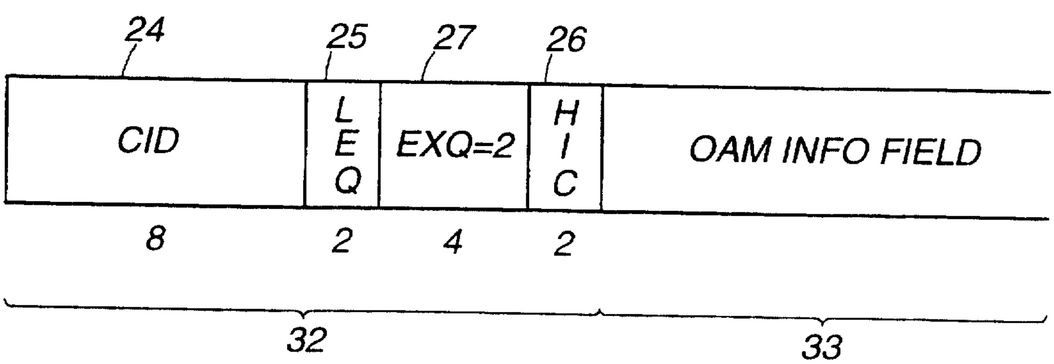


Fig. 14

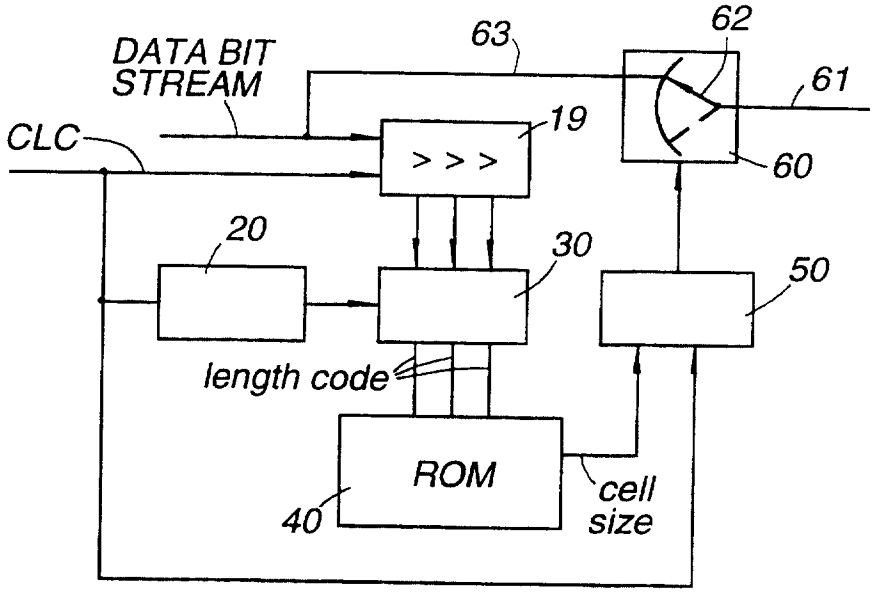

DATA BIT
STREAM
CLC
63
62
61
19
> > >
60
20
30
50
length code
ROM
40
cell
size

Fig. 15

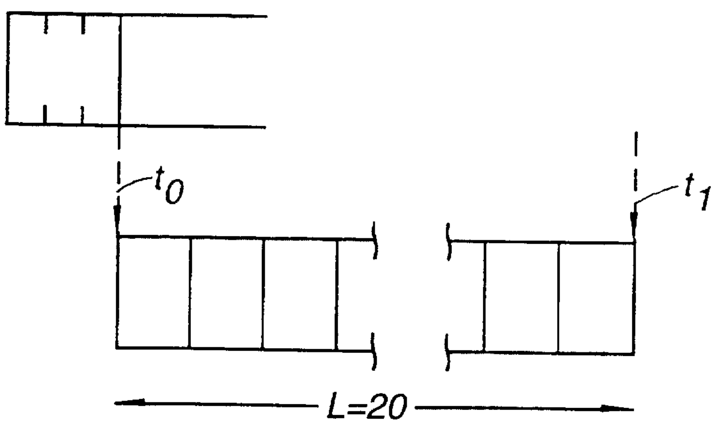

t_0
t_1
L=20

Fig. 16

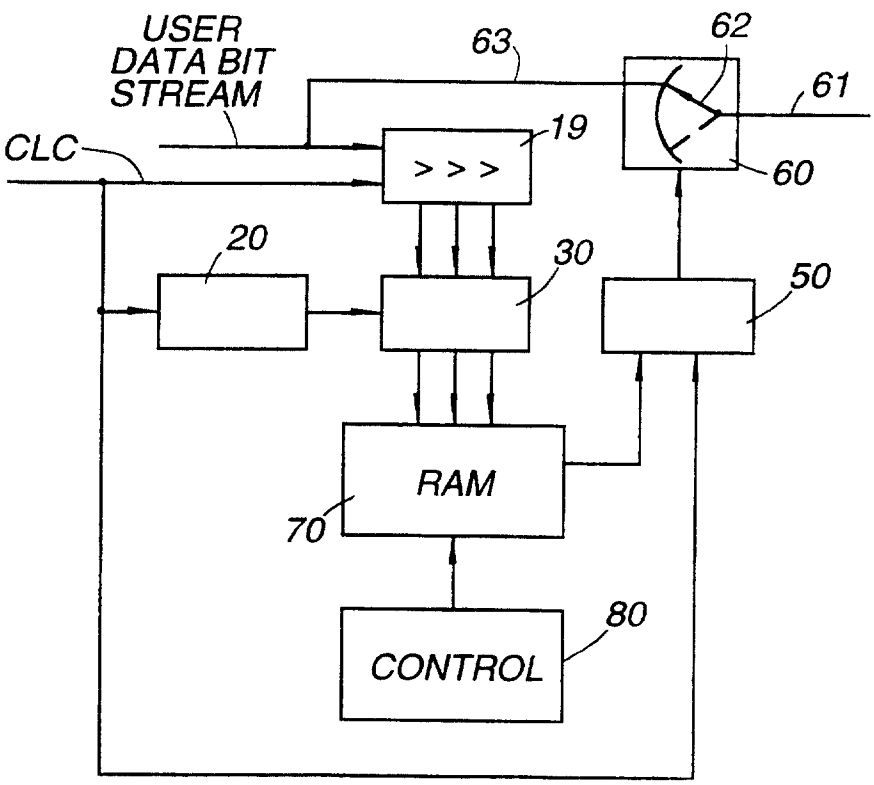

USER
DATA BIT
STREAM
63
62
61
19
CLC
> > >
60
20
30
50
RAM
70
80
CONTROL

Fig.17

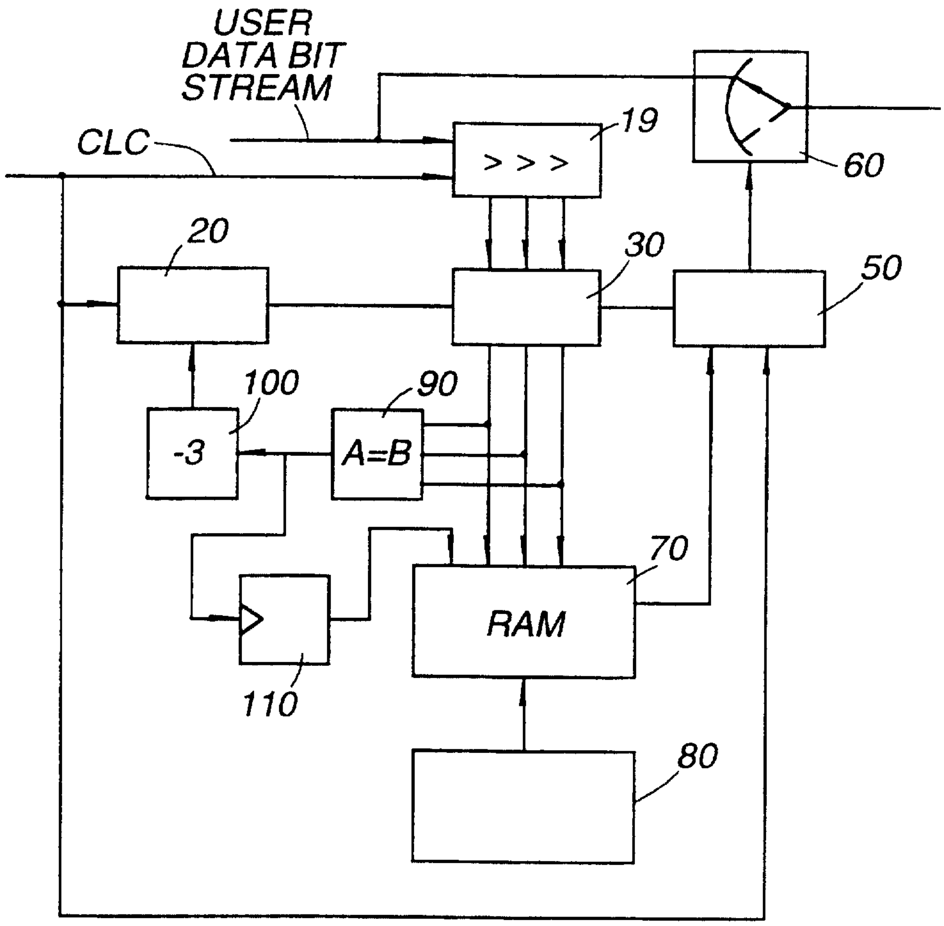


Fig. 18

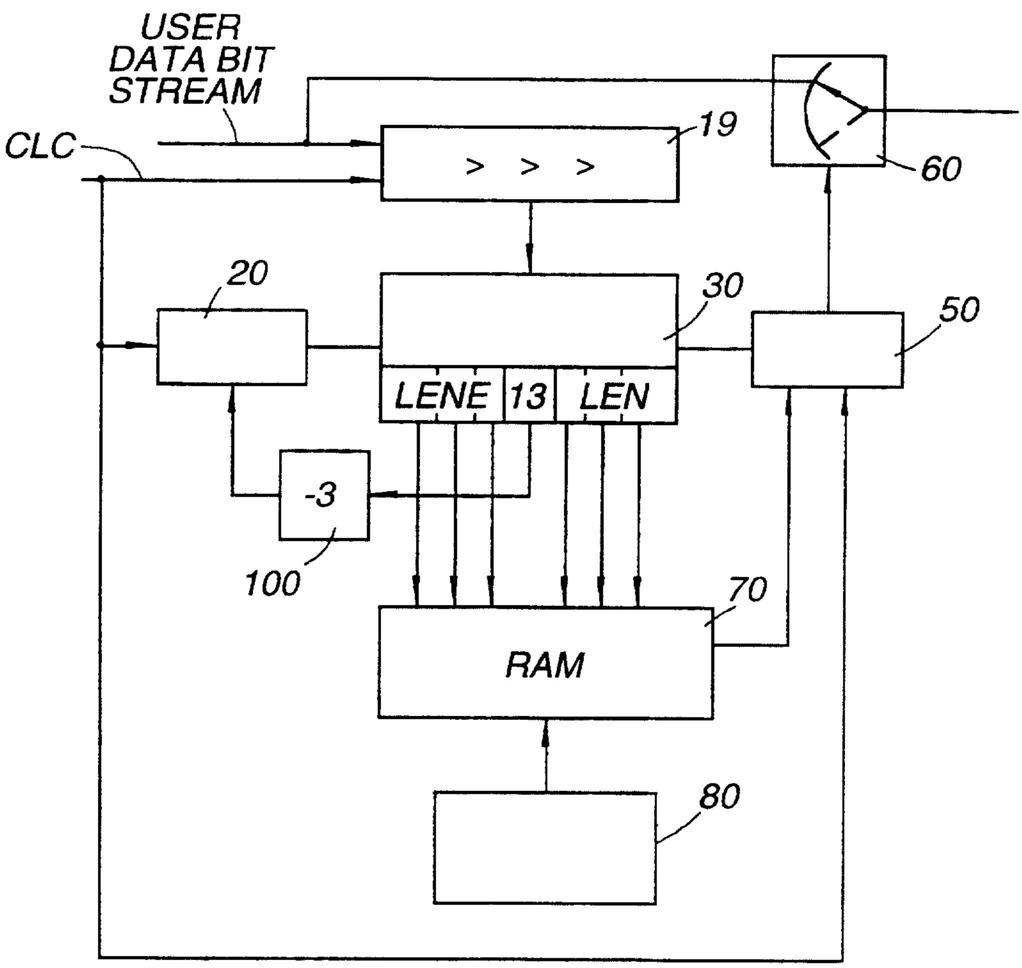

USER DATA BIT STREAM
CLC
19
> > >
60
20
30
50
LENE
13
LEN
-3
100
70
RAM
80

Fig. 19

Fig.20

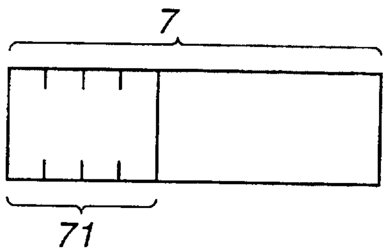
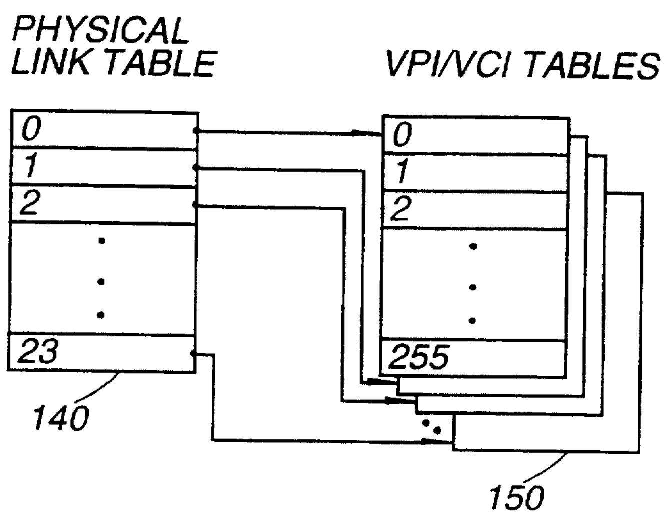


Fig.21

CID	SIZE
0 0 1	2
0 1 0	2
0 1 1	4

72

Fig.22



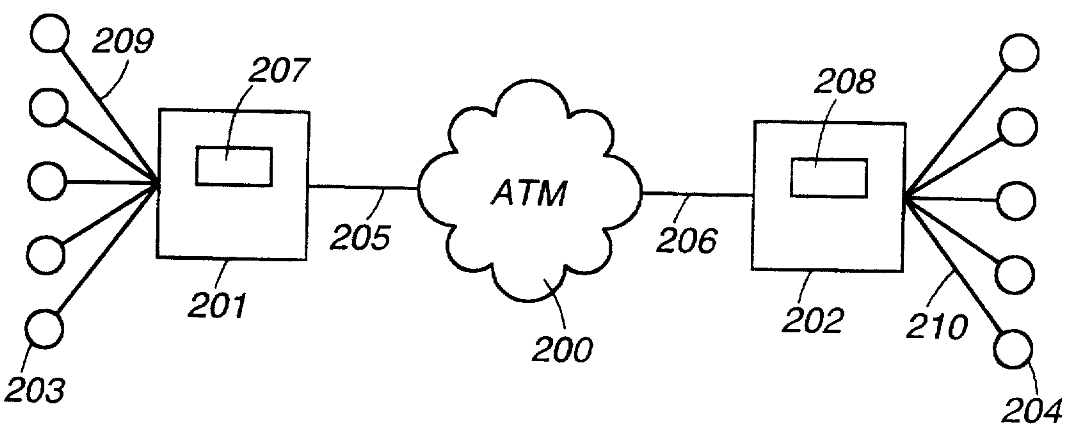
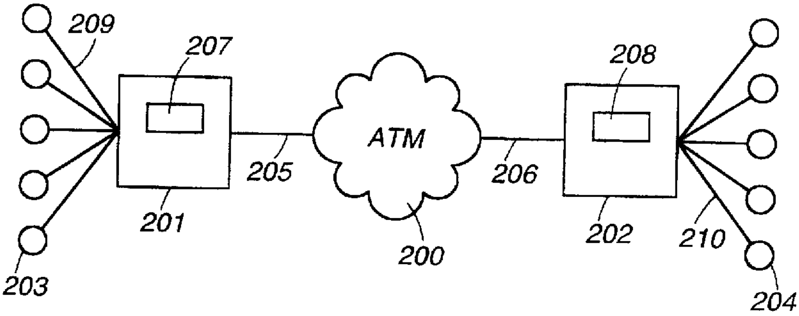


Fig.23


209
207
208
ATM
205
206
201
200
202
210
203
204