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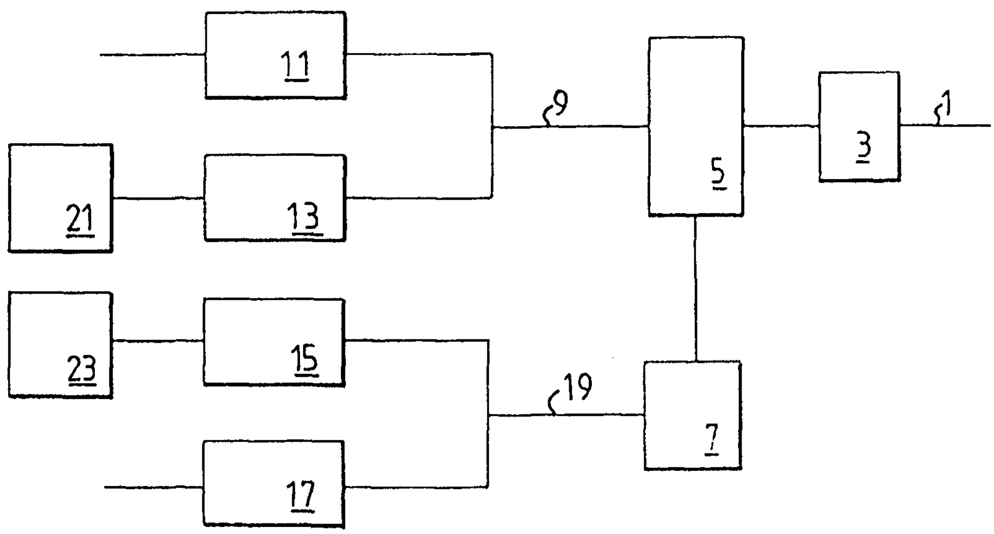

(57) Abstract

An apparatus and a method for tele- and or data communication comprising a transmission medium for transmission and reception of combined signals is disclosed, said signals comprising at least a first and a second subsignal according to at least two different communication protocols, said apparatus comprising: a multiplexer/demultiplexer (5), a first bus (9) for conveying signals according to the first communication protocol from the multiplexer/demultiplexer to at least one service unit (11, 13), and vice versa, a second bus (19) for conveying signals according to the second communication protocol from the multiplexer/demultiplexer (5) to at least one service unit (15, 17), and vice versa, said service units (11, 13, 15, 17) constituting interfaces between the apparatus and external equipment units (21, 23).

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Method and Apparatus in a Communication Network

Technical Field

The present invention relates to data communications and telecommunications and more specifically to a method and an apparatus for the combination of data and/or telecommunications signals according to two or more standards in a communications system.

Description of Related Art

Both tele- and data communications are becoming increasingly important and new standards and applications are developing fast.
There is a desire to achieve efficient, flexible and inexpensive solutions that can handle more than one type of signals.

Telecommunications networks have, traditionally, been circuit switched, but now, packet-switched networks are being used to an increasing degree. This changes some of the fundamental assumptions in telecommunications:
Companies (other than telecommunications operators) are able to offer services and applications to telephone subscribers, reducing the operator's role as a service provider. In time, networks will become service and application-independent.
Data traffic, or more specifically, IP traffic will constitute a larger fraction of the total traffic, in time probably more than the voice traffic.
Telecommunications markets are being, and will be, deregulated.

These factors will force the convergence of data and telecommunications services in the same network.

The fundamental feature required for flexibility in a Wireless Broadband Access (WBA) system is an efficient media access control protocol that provides
fast dynamic capacity allocation to handle bursty traffic;

fairness among the different access terminals;
support for multiple qualities of service.

Object of the Invention

It is an object of the present invention to facilitate the handling of communications according to two or more different standards.

Summary of the Invention

This object is achieved according to the invention by an an apparatus for tele- and/or data communication, comprising:
a transmission medium for transmission and reception of combined signals comprising at least a first subsignal according to a first communication protocol, and a second subsignal, according to a second communication protocol different from the first communication protocol,
-a multiplexer/demultiplexer coupled to the transmission medium;
-a first bus for conveying subsignals according to the first communication protocol from the multiplexer/demultiplexer to and from at least one service unit;
-a second bus for conveying signals according to the second communication protocol from the multiplexer/demultiplexer to and from at least one service unit, each of said service units constituting an interface between the apparatus and at least one external equipment unit.

The object is also achieved according to the invention by a method for tele- and/or data communication characterized by the steps of
handling incoming and outgoing signals, each signal combined of at least a first subsignal according to a first protocol and a second subsignal, according to a second protocol, said method comprising the following steps:
-receiving an incoming combined signal comprising at least the first and the second subsignal;
-demultiplexing said incoming combined signal to obtain the at least two subsignals;

-forwarding one of the subsignals to at least one service unit adapted to handle the protocol to which this subsignal conforms and serving as an interface towards at least one external communication equipment unit;
-forwarding another one of the subsignals to at least one service unit adapted to handle the protocol to which this subsignal conforms and serving as an interface towards at least one external communication equipment unit;
- multiplexing the at least first and second subsignals transmitted from the external communication equipment units to form one combined signal;
- transmitting the outgoing combined signal comprising the multiplexed subsignals.

The method and apparatus according to the invention enable data and telecommunications traffic of two or more different standards to share the same network resources, enabling a more efficient signal handling and a more optimized use of the network resources.

At least one of the subsignals may be processed during transmission between the multiplexer/demultiplexer and the appropriate service unit. This enables the use of a number of different signal protocols together.

One or more subsignals may be retrieved in the multiplexer/demultiplexer and/or in another unit and fed to one or more control units for control of the functions of the system, such as synchronization, transmission control, etc. In this case, the apparatus may also comprise a control unit arranged to add control bits to the combined signal before transmission and to extract the corresponding control bits from a received combined signal.

Preferably, said first bus is adapted for telecommunications and said second bus is adapted for PCI communication.

In a preferred embodiment, said first and second bus are adapted for ATM traffic and IP traffic, respectively.

The combination of ATM traffic and IP traffic gives the operators access both to the quality of service features offered by ATM and the efficient support of IP services. The price of transporting IP traffic in an ATM network is limited, since the addressing capability in the ATM cell overhead is reused to identify the service interface ports.

Recently, a CompactPCI standard for telecommunications has been developed. This standard, however, only describes the handling of telecommunications traffic on a specific board.

The PCI standard has several major advantages:

- It is relatively inexpensive previous industrial data buses.
- It is well defined in standards.
- It is flexible, since it allows functions to be implemented in different ways, and in different units in the system.

The ATM Forum (ATMF) has specified a bus for ATM traffic, called the UTOPIA bus. This bus is normally used as a communications bus between two circuits on the same circuit board. It enables various types of ATM traffic, including Constant Bit Rate (CBR) and Unspecified Bit Rate (UBR).

The use of a PCI bus and a UTOPIA bus in the same system provides a full telecommunications functionality together with a well-defined bus for control and data communication. The UTOPIA bus has effectively no bandwidth limitations, whereas the bandwidth on the PCI bus is limited in the system according to the invention, since the signals require software processing.

The solution according to the invention is particularly well suited for small and medium-sized businesses, since it provides high bandwidth at a lower cost than the solutions that are common today, such as fibre access solutions or Integrated Services Digital Network (ISDN).

Brief Description of the Drawings

Figure 1 is an overall block diagram illustrating the general principle of the network unit according to a first embodiment of the invention;
Figure 2 is an overall block diagram illustrating the general principle of the network unit according to a second embodiment of the invention;
Figure 3 is a block diagram illustrating an physical implementation of the network unit according to the invention;
Figure 4 is a block diagram of a preferred embodiment of the network unit according to the invention;
Figure 5 is a block diagram of a system using several network units like the one shown in Figure 4.

Detailed Description of Embodiments

Figure 1 is an overall block diagram illustrating the general principle of the network unit according to the invention.

The network unit according to the invention transmits and receives signals from at least one source through a transmission medium 1. This may be an air interface, an electrical or optical cable, or any other type of medium used for receiving and transmitting signals. The signals transmitted and received are combined signals comprising payload signals according to at least a first and a second communication protocol. The signal according to the second protocol is converted so that it conforms to the first protocol.

The signal is first processed in a first function block 3, the functions of which is dependent on the type of signals received, the type of transmission medium used, and possibly other factors. The first function block 3 may perform functions such as modulation/demodulation, transmission control, and other functions, as will be described below in connection with specific embodiments. Normally, these functions will be implemented as several function blocks. Here, for simplicity, only one block is shown.

The first function block 3, is connected to a multiplexer/demultiplexer unit 5 which multiplexes outgoing signals and demultiplexes incoming signals. The multiplexer/demultiplexer unit 5 is connected to a processing unit 7, which handles part of the signal to/from the multiplexer/demultiplexer unit 5. The multiplexer/demultiplexer unit 5 is also connected, through a first communication bus 9, to one or more service units 11, 13.

The processing unit 7 is connected to one or more service units 15, 17, through a second communication bus 19. The first and second communication bus, 9, 19 handle two different types of communication protocols, for example, a telecommunications protocol and a data communications protocol, respectively. The service units 11, 13 served by the first bus 9 are adapted for communication according to the first protocol, i.e. the telecommunications protocol. These service units 11, 13 in turn serve telecommunications units, for example, the exchange 21 connected to the service unit 13 in Figure 1. The service units 15, 17 served by the second bus 19 are adapted for communication according to the second protocol, i.e. the data communications protocol. These service units 15, 17 then serve data communication units, for example the computer 23 connected to the service unit 15 in Figure 1.

The service units 11, 13, 15, 17 can be, for example, 10BaseT/100BaseT Ethernet, ATM User Network Interface (UNI) or E1/T1.

An incoming signal on the transmission medium 1 is received in the first function block 3 and subjected to the appropriate processing, for example, demodulation, decoding, descrambling, and/or other types of processing. The multiplexing/demultiplexing unit 5 then demultiplexes the signal to obtain the different signal components. One component of the signal is transmitted directly to one or more of the service units 11, 13 on the first bus 9. Another component of the signal is transmitted to the processing unit 7 for processing, that is, conversion to the correct format, before it is transmitted, on the second bus 19, to one or more of the service units 15, 17. From the service units 11, 13, 15, 17 the signals are forwarded to external equipment, such as the exchange 21 and the computer 23 shown in Figure 1.

Outgoing signals are received in the service units 11, 13, 15, 17 from the external equipment 21, 23. From one or more of the service units 11, 13 the signals are transmitted directly to the multiplexer/demultiplexer 5, on the first bus 9. From one or more other service units 15, 17, the signals are transmitted on the second bus 19 to the processing unit 7, where it is translated to the first data protocol. From the processing unit 7 the translated signal is fed to the multiplexer/demultiplexer 5. After multiplexing in the multiplexer/demultiplexer 5, the signal is subjected to processing in the first function block 3, for example, modulation, coding, scrambling, and/or other types of processing, corresponding to the processing of the incoming signals discussed above. The processed signal is then transmitted through the transmission medium 1.

In Figure 1 it is assumed that one part of the combined signal can be transmitted directly to the appropriate service unit.

Figure 2 shows a somewhat less simplified block diagram of the network unit according to the invention. As in Figure 1, the combined signals comprise payload signals according to two or more different protocols, and are received and transmitted on a medium 101, which may be any kind of transmission medium known in the art. A first function block 103 performs the same type of processing as the function block 3 in Figure 1, that is, it processes the combined signals directly before transmission, and after reception, depending on the type of signal. A multiplexer/demultiplexer 105 receives signals from the first function block 103 for demultiplexing, and feeds multiplexed signals to the first function block 103 for transmission.

In this embodiment, it is assumed that both the payload signals need conversion before multiplexing or after demultiplexing, respectively. Therefore, there is a first processing unit 107 processing a first one of the signals between the multiplexer/demultiplexer 105 and the data bus 109 conveying the signal between the multiplexer/demultiplexer unit 105 and one or more service units 111, 113. There is also a second processing unit 115 processing another one of the signals between the multiplexer/demultiplexer 105 and the data bus 117 conveying signals between the multiplexer/demultiplexer unit 105 and one or more other service units 119, 121. The first and second processing units 107, 115 convert signals passing in both directions between the multiplexer/demultiplexer 105 and the service units 111, 113, 119, 121.

In Figure 2, the combined incoming signal also comprises one or more control signals. These signals are obtained in the function block 103 and/or when the multiplexer/demultiplexer 105 demultiplexes the signal, and are passed from the function block and/or multiplexer/demultiplexer 105 to one or more control units 123. This control unit 123 may control, for example, synchronization, adjustment of radio parameters, amplification, and other functions.

Of course, the embodiment shown in Figure 1 may be extended to also handle control signals in one or more control units like the control unit in Figure 2. Similarly, the control unit in Figure 2 could be omitted if it was not needed.

The blocks shown in Figures 1 and 2 are functional units, that is, each block represents one or more functions rather than physical units. For example, each service unit 11, 13, 15, 17, 111, 113, 119, 121 may be implemented on a separate printed board assembly (PBA), or two or more may share one PBA. One PBA may hold one service unit for different communication protocols.

This is illustrated in Figure 3. As before, a transmission medium carries incoming and outgoing signals combined of subsignals according to different protocols. A multiplexer/demultiplexer 203 demultiplexes incoming signals to obtain the subsignals. A first PBA 205 comprises two service units, one adapted for each of the protocols used by the subsignals. A second PBA 207 comprises one service unit, adapted for a first one of the protocols. A third PBA 209 comprises one service unit adapted for the second protocol. One subsignal, according to the first protocol, is transmitted directly to the first 205 and the second 207 PBA on a first bus 211. The other subsignal, according to the other protocol, is first processed in a processing device 213 before it is transmitted to the first 205 and the third 209 PBA on a second bus 215. A part of the signal from the processing device 213 may also be transmitted to a control device 217, if present, and used to control functions such as synchronization, power adjustment and so on.

Of course, an arbitrary number of PBAs may be used, each comprising one or more service units.

Figure 4 shows a specific embodiment of the invention in which IP signals and ATM signals are combined. The IP signals in the incoming signal have been converted to ATM format, so that the incoming signal has ATM format.

The embodiment comprises three main parts: a modem board 301 for preparing outgoing signals for transmission and preparing incoming signals for further processing by the system, a network unit control unit 302 for separating the different types of signals from each other and feeding them to the appropriate units, and one or more service units 303, which constitute interfaces between the system and the external equipment (not shown in the figure) using the system for communication.

In this embodiment, a microwave modem is used for reception and transmission, as will be briefly described in the following. Transmission and reception could also be carried out using any type of ATM transmission link, that is, optical fibre, coaxial cable, etc. The signals are received and transmitted on a transmission medium 304. The modem board 301 comprises a modulation/demodulation unit 305 for modulating outgoing signals and demodulating incoming signals. The modulation/demodulation unit 305 is connected to one or more an error correction unit 307, 309 of a kind known in the art, for example a Forward Error Correction (FEC) unit. The error correction units 307, 309 are connected to a scrambler 311 and a descrambler 313, respectively. The function of the scrambler 311 and the descrambler is also well known in the art. The modem board 301 also comprises one or more control units. In this embodiment, two control units 315, 317 are used, the function of which will be described in the following.

The network unit control unit 302 comprises a Media Access Control (MAC) unit 319, the function of which is to determine which one of the service units 303 is allowed to transmit at any particular time. In a packet switched network, like the one used in this embodiment, the main function of the MAC unit is to control the transmission of packets, as will be described below.

The network unit control unit 302 also comprises an ATM multiplexer/demultiplexer 321, which multiplexes outgoing data from the system to one signal and demultiplexes incoming signals to separate data streams. The multiplexed signals may comprise payload according to two or more different standards, and signals used to control the transmission/reception and other functions. In this embodiment, the multiplexed signals comprise IP signals and ATM signals comprising payload data, together with two different control signals. The control signals will be discussed below.

The MAC unit 319 and the multiplexer/demultiplexer 321 are connected to a network unit board controller (NUBC) 323. The NUBC 323 controls and supervises the MAC unit 319, for example, to initiate communication error alarms. This connection is a simple microprocessor bus enabling reading from and writing to a memory in the MAC unit 319. The NUBC 323 converts the ATM cells that should be converted to IP format. The NUBC 323 is connected to a PCI controller 325, which acts like a bridge to a PCI bus 327, which conveys the IP signals to and from the service units 303.

The ATM part of the signal from the multiplexer/demultiplexer 321 is transmitted on an ATM bus 329 to the service units 303.

The multiplexer/demultiplexer 321 and the PCI controller 325 are the units in the network unit control unit 302 constituting the interface to the service units 303.

In this embodiment, each one of the service units 303 comprises two parts: one part (the lower part of each unit in Figure 3) handling IP signals and one part (the upper part of each unit in Figure 3) handling ATM signals. Therefore, both the PCI bus 327, on which IP signals are conveyed, and the ATM bus 329 are connected to all service units.

Where the incoming and outgoing signals take different paths, the path followed by an incoming signal is indicated by the letters Rx and the path followed by an outgoing signal is indicated by the letters Tx.

An incoming signal is received in a receiving/transmitting unit 304. As described above, the signal may comprise payload signals according to two or more protocols and may be received via any kind of transmission medium. In this embodiment the signal is received via an air interface, for example, as radio frequency waves, and comprises an ATM signal and an IP signal. The signal is fed to the modulation/demodulation unit 305 where it is demodulated and passed on to one of the error correction units 307. From the error correction unit 307 the signal passes to the descrambler 313.

From the descrambler 313 the signal is passed to the MAC unit 319 and from there to the ATM multiplexer/demultiplexer 321, in which the signal is demultiplexed. The ATM part of the signal is forwarded to the service units through the UTOPIA bus 329 without any further processing. The IP part of the signal is forwarded to the NUBC unit 323 in which it is processed before it is transmitted to the service units 303 through the PCI bus 327.

The MAC unit 319 extracts the bits identifying the network unit from which the signal was received and passes this signal to the control unit 315 of the modem board 301. This signal is also used to control which network unit is allowed to transmit at any given time. The MAC unit also monitors the amount of data that is to be transmitted from the network unit at any given time, to enable dynamic allocation of bandwidth.

The incoming signal preferably also comprises control signals to be used for the control of the modem board 301. These signals are in ATM format and are obtained in the demultiplexing performed by the multiplexer/demultiplexer 321 and passed to the other control unit 317 of the modem board 301 through the NUBC 323. This control unit is used for synchronization, amplification, adjustment of radio parameters and other functions.

From the service units 303 the signals are passed on to external equipment (not shown). For ATM signals, the external equipment may be, for example, private exchanges (PABX) where the PABX interface has been converted to ATM format, or a local ATM network. For PCI signals, the external equipment may be computers, such as personal computers, or personal computer networks, or IP routers or bridges.

The outgoing signal is combined of signals from the external equipment units. These signals are received in the respective service units 303. ATM signals, received, for example, from ATM exchanges, are forwarded from the service units through the UTOPIA bus 329 directly to the multiplexer/demultiplexer 321. IP signals, received, for example, from computers, are forwarded on the PCI bus 327 to the PCI controller 325, which acts as a bridge. From the PCI controller 325 the IP signal passes to the NUBC 323, which converts the IP signal into ATM format before it is passed to the multiplexer/demultiplexer 321. The multiplexer/demultiplexer multiplexes the received signals to form one signal. Next, in the MAC unit 319, control bits are added to identify the network unit transmitting the packet. From the MAC unit 319 the signal is fed to the scrambler unit 311 on the modem board 301 which scrambles the signal, in a way known in the art, and forwards it to the error correction unit 309. The multiplexed and scrambled signal is then modulated in the modulation/demodulation unit 305 before it is transmitted through the same interface that is used for receiving signals.

Figure 5 is an overview of a system comprising a number of network units 401 like the ones shown in Figures 1-4. As can be seen, each network unit 401 comprises an antenna 402, a modem part 403, a network unit control part 405 and a number of service units 407 served by two buses 409, 411. All network units 401 communicate with the same central unit 413 by means of radio signals. An antenna 415 on the central unit receives signals from the antennas 402 of the network units 401. The received signals are processed in the central unit and forwarded in the appropriate network, or to the appropriate receiver.

An ordinary small or medium-sized business typically has a PBX running on either analogue or digital lines. To support analogue telephony services, the operator augments the wireless broadband access with a channel bank. A digital PBX can interface directly with the ports of the access termination. An ATM virtual connection links the access termination port to the circuit emulation shelf where the ATM traffic is terminated and the data is then delivered to the PBX. This implementation does not take advantage of the statistical multiplexing capability of the WBA system, since system capacity is continuously booked, regardless of whether telephone channels are used or not. Moreover, the capacity needed to transport voice on 64 kbit/s channels over a radio link seems rather inefficient compared with the capacity needed by modern voice codes. An alternative solution is offered by voice over IP technology. With this solution the IP packets containing telephony information are handled by the system as high-priority data packets. This solution has two major advantages: no capacity is permanently reserved in the WBA system and a convergence of the customer data and telephony service is achieved.

In small and medium-sized companies packet switched traffic will probably be predominant, offering the advantages of statistical multiplexing and Time Division Multiple Access (TDMA). If the traffic behaviour of certain customers is mainly characterized by a fixed capacity, a traditional approach based on point-to-point links may prove to be more appropriate, thus motivating the integration of point-to-point links in the WBA system. The uplink and downlink may be separated either in frequency (frequency division duplex - FDD) or in time (time division duplex - TDD).

In TDD systems the radio frame is divided into a downlink and an uplink section, offering flexible allocation of the upstream and downstream capacity. TDD is typically used in wireless LANs where no consistent delay is introduced between transmission and reception and the downlink and uplink sections are basically synchronous. In WBA systems, where the delay between transmission and reception can consist of a few time slots, a guard time between the downlink and uplink sections of the frames has to be introduced in order to avoid collision between time slots. However, the guard time reduces system throughput, especially if the system is designed for low latency. FDD systems on the other hand, allocate a fixed proportion between uplink and downlink capacity. Residential users are likely to request asymmetrical uplink and downlink capacity, while in a business-user scenario, more symmetrical traffic behaviour is likely to be the rule. The WBA system, which primarily addresses the business market segment, is therefore designed as an FDD system with full flexibility for instantaneous capacity allocation in the uplink and downlink directions for each access termination and connection.

An existing end-to end access solution for a WBA system based on a point-to-multipoint microwave transport scheme can be utilized in the applicable frequency spectrum, such as the 24, 26 or 28 GHz bands. The core of the system is the ATM-based broadband access platform. All customer traffic is mapped on ATM cells and administered over the 37.5 Mbit/s symmetrical air interface in a time-division multiplexing (TDM) scheme in the uplink direction. The throughput of the ATM cell over the radio interface is approximately 78,000 cells/s in each direction.

Claims

1. An apparatus for tele- and/or data communication, **characterized** in that it comprises:

a transmission medium (1; 101; 304) for transmission and reception of combined signals comprising at least a first subsignal according to a first communication protocol, and a second subsignal, according to a second communication protocol different from the first communication protocol,

-a multiplexer/demultiplexer (5; 105; 321) coupled to the transmission medium (1; 101; 304);

-a first bus (9; 109; 329) for conveying subsignals according to the first communication protocol from the multiplexer/demultiplexer (5; 105; 321) to and from at least one service unit (11, 13; 111, 113; 303);

-a second bus (19; 117; 327) for conveying signals according to the second communication protocol from the multiplexer/demultiplexer to and from at least one service unit (15, 17; 119, 121; 303),

each of said service units (11, 12, 15, 17; 111, 113, 119, 121; 303) constituting an interface between the apparatus and at least one external equipment unit (21, 23).

2. An apparatus according to claim 1, further comprising at least one processing unit (7; 107, 115; 323, 325) for processing at least one of the subsignals passing to and from the multiplexer/demultiplexer (5; 105; 321).

3. An apparatus according to claim 1 or 2, wherein said first bus (9; 109; 329) is adapted for telecommunications.

4. An apparatus according to any one of the claims 1-3, wherein said second bus (19; 117; 327) is adapted for PCI communication.

5. An apparatus according to any one of the claims 1-4 further comprising at least one control unit (123; 315, 317), arranged to receive a part of the combined received signal as a control signal.

6. An apparatus according to any one of the preceding claims, comprising a unit (319) arranged to add control bits to the combined signal before transmission and to extract the corresponding control bits from a received combined signal.

7. A method for tele- and/or data communication characterized by the steps of handling incoming and outgoing signals, each signal combined of at least a first subsignal according to a first protocol and a second subsignal, according to a second protocol, said method comprising the following steps:

-receiving an incoming combined signal comprising at least the first and the second subsignal;
-demultiplexing said incoming combined signal to obtain the at least two subsignals;
-forwarding one of the subsignals to at least one service unit adapted to handle the protocol to which this subsignal conforms and serving as an interface towards at least one external communication equipment unit;
-forwarding another one of the subsignals to at least one service unit adapted to handle the protocol to which this subsignal conforms and serving as an interface towards at least one external communication equipment unit;
- multiplexing the at least first and second subsignals transmitted from the external communication equipment units to form one combined signal;
- transmitting the outgoing combined signal comprising the multiplexed subsignals.

8. A method according to claim 7, comprising the step of translating at least one of the subsignals during transmission from the multiplexer/demultiplexer and vice versa.

9. A method according to claim 7 or 8, further comprising the step of feeding at least one subsignal obtained when demultiplexing the received combined signal to at least one control unit (123; 315, 317).

10. A method according to any one of the claims 7-9 further comprising the step of adding information to the combined signal before transmission, said information identifying the unit from which it is transmitted.

11. A method according to any one of the claims 7-10 further comprising the step of extracting from the received combined signal before demodulation, information identifying the unit from which it was transmitted.

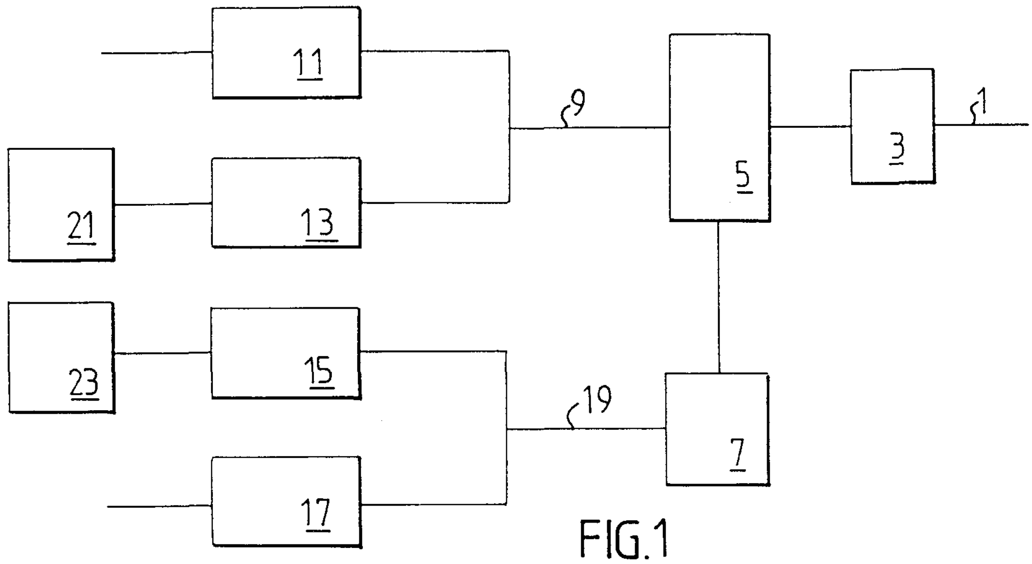
11
13
15
17
21
23
9
19
5
7
3
1

FIG.1

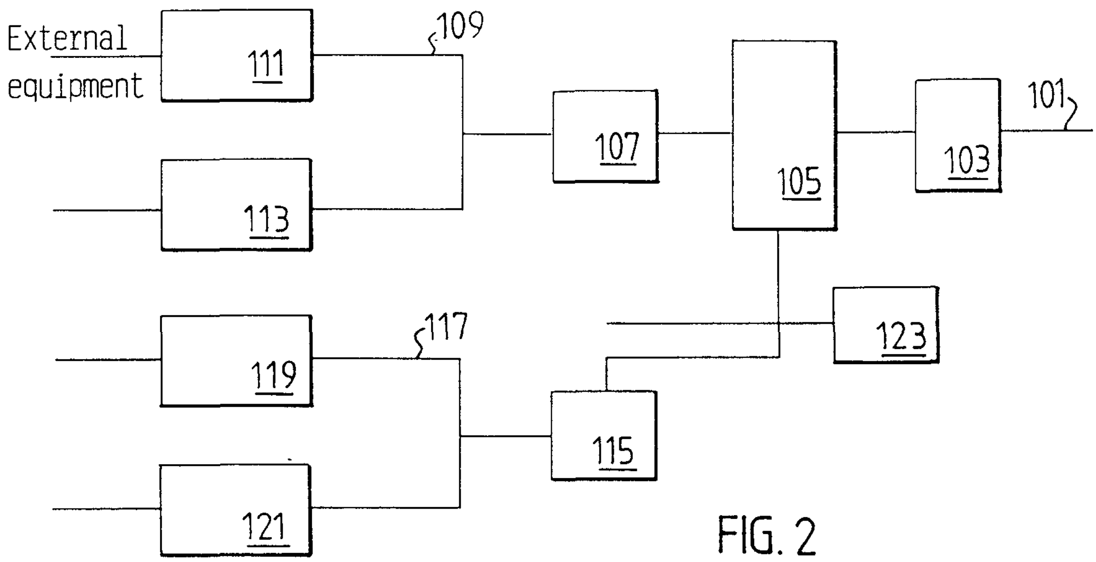
External equipment
111
113
119
121
109
117
107
115
105
123
103
101

FIG. 2

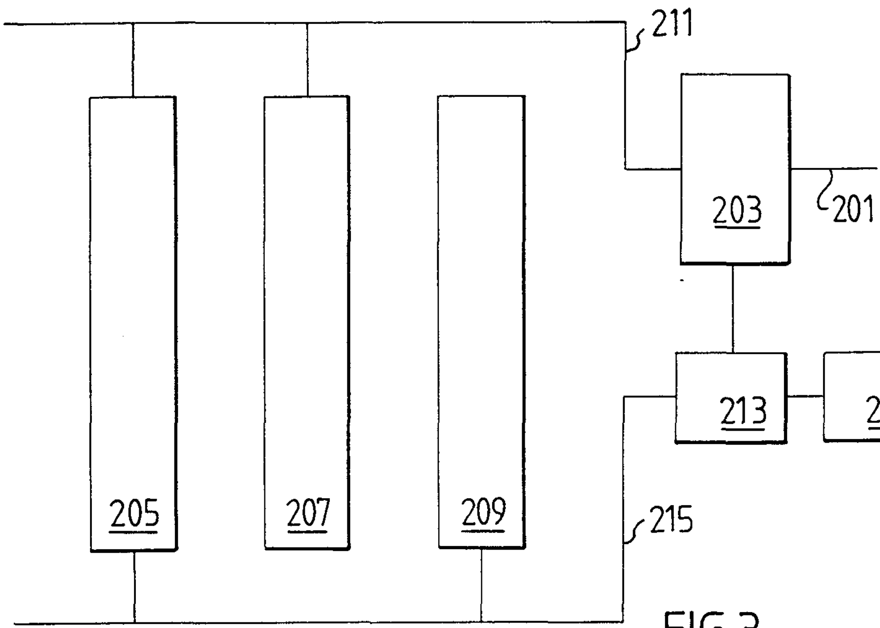
211
203
201
213
217
205
207
209
215

FIG.3

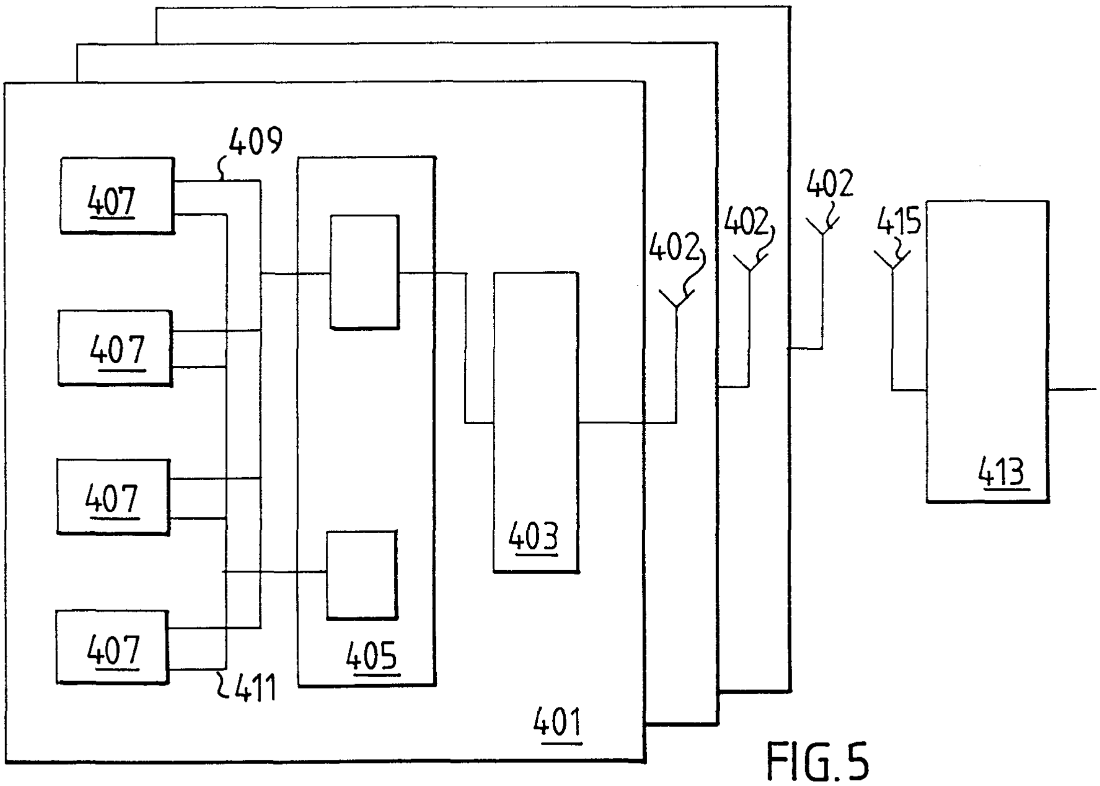
409
407
407
407
407
411
405
403
402
402
402
415
413
401

FIG.5

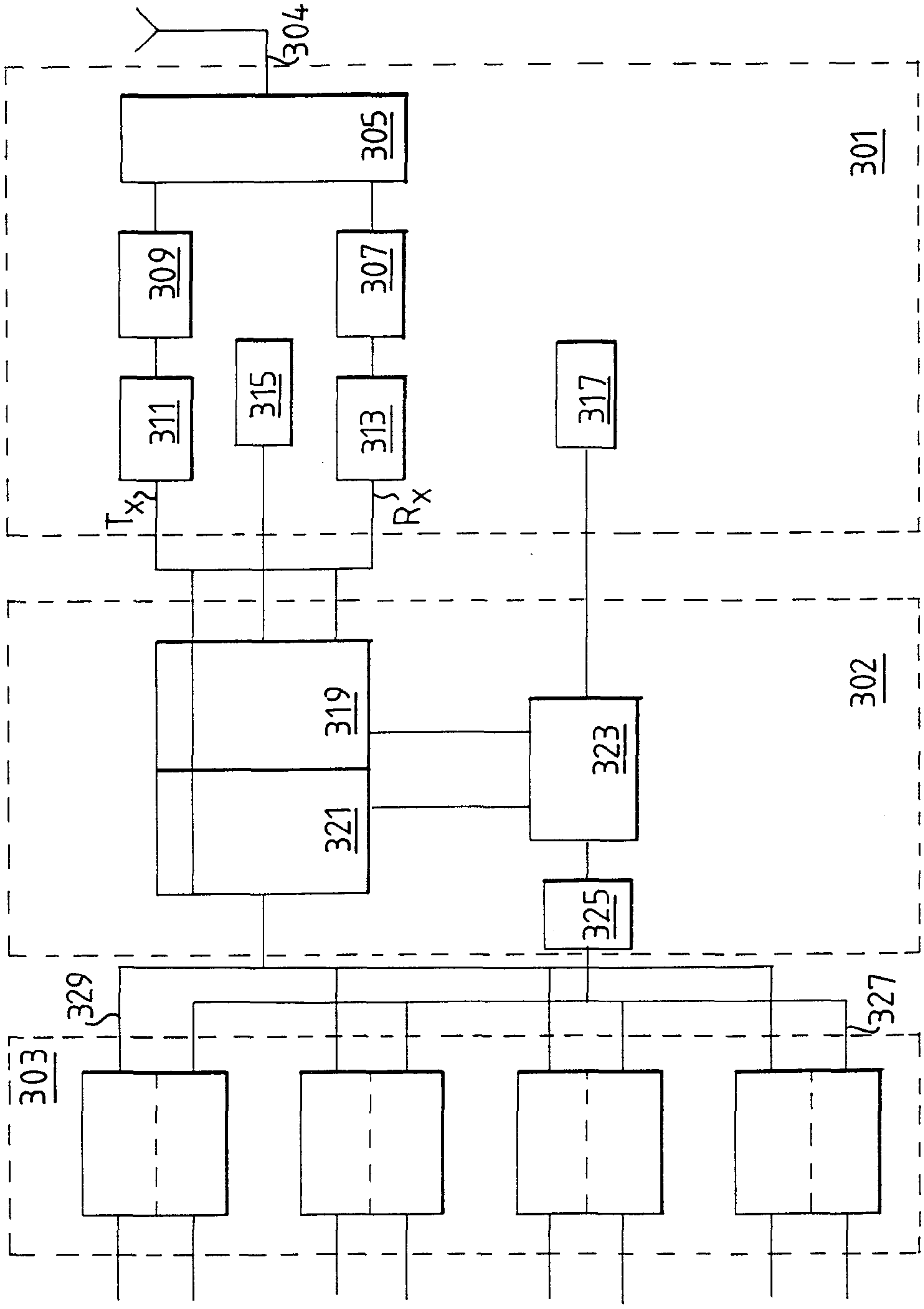
304
305
301
309
307
311
315
313
317
Tx
Rx
302
319
321
323
325
329
327
303

FIG.4