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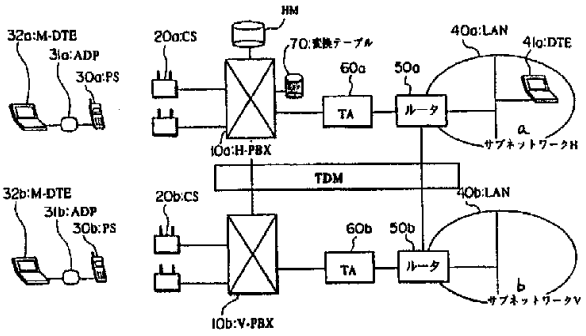


50a, 50b ... router
70 ... conversion table
a ... sub-network H
b ... sub-network V

(57) Abstract

In a mobile radio data communication system in which a wireless circuit switching network system composed of a mobile radio station (30a), a radio connecting device (20a), and an exchange (10a) is connected to a LAN (40a) through a TA (60a) and a router (50a) so that users of the system can transmit packet data to a desired communication party in a virtual network extending over the wireless circuit switching network system and a LAN without being bothered with the conversion of the address of a physical network to an address; the exchange (10a) performs the address conversion which is required for establishing a communication channel between terminals in the system based on a conversion table.

ABSTRACT

In order for the user to perform a transmission of packet data to a desired communication partner on a virtual network across a wireless circuit exchange type network system and a LAN without being bothered by address conversion between an address in a physical network and an address in a virtual network, an exchange (10a) performs an address conversion necessary for establishing a communication channel between the terminal devices within the system using a conversion table, in a mobile wireless data communication system in which a wireless circuit type network system including a wireless mobile station (30a), a wireless connection device (20a) and the exchange (10a) is connected to a LAN (40a) through a TA (60a) and a router (50a).

MOBILE WIRELESS DATA COMMUNICATIONS SYSTEM

Technical Field

This invention relates to a mobile wireless data communications system capable of transmitting packet data between the data communication terminal devices in a virtual network across a mobile communications network and a LAN.

Technical Background

The progress in recent wireless technology has been remarkable. Even if it is limited to private usage, the technology for making indoor telephones fully wireless became a reality with the use of PBX (private branch exchange) systems etc., based on the personal communications technology which is a result of the development of cordless telephones. Moreover, wireless LANs (local area network) are widely used also in the field of data communications. These LANs undertake a role of making offices and the like wireless.

In wireless PBXs, mobility, as well as wirelessness of telephones, has been pursued. That is, movement in the wireless area under the control of a single PBX is possible as a matter of course, and in addition, even movement between PBXs is also made possible by automatic position registration, without compelling the user to make a useless registration change (or, transmitting an incoming signal, etc.). This technology is often referred to as "roaming between PBXs". In principle, it realises the possibility of unrestricted movement even within the private branch. Moreover, PBX-added services which assume a voice-oriented PBX format are able to be realised in an almost complete form with the realisation of this type of mobility.

On the other hand, recently, the need for non-telephone communication as represented by e-mail has been increasing. Such non-telephone communication methods include a method for performing communication through a telephone line (channel exchange) and a method for performing communication from a terminal device accommodated within a LAN. Needless to say, the method using the LAN is chiefly employed in modern offices. In addition, the appearance of the Internet is further spurring the popularisation of such LANs. Now, the technology of the Internet is briefly described.

The Internet is a form of virtual network which aims at performing worldwide communications across various physical networks represented by LANs such as Ethernet, essentially satisfying the following conditions:

(a) The network principle of the Internet is based on the realisation of a virtual network and does not specify the form of realisation of the physical network.

(b) An Internet address does not require the existence of a switching node which performs the switching intensively. On the other hand, it is necessary for the terminal device to be connected to a physical network.

In order to perform routing between the terminal devices in various physical networks, it is necessary for the terminal devices to be uniquely identified in the world. Specifically, it is necessary for the connection point with a physical network where a specific terminal device is accommodated to be uniquely identified in the world. On the Internet, therefore, an address called an "IP (Internet Protocol) address" is assigned to each terminal device based on a system which is common throughout the world, and the routing is performed based on this Internet Protocol address.

Wireless PBXs chiefly involving channel switching and the Internet based on LANs have been explained. The former is becoming the main communication means in offices by providing mobility, and the latter is becoming the main communication means for data communications. It is foreseen that the importance of these communication means will rise more and more as the basic structures for supporting office based activities in the future.

In the virtual network encompassing wireless PBXs and LANs the data communication terminal devices, which are under the control of the wireless PBXs occasionally transmit packet data. On such occasions, a communication channel in the wireless PBX system is established by a signal outputted from a telephone (personal station) connected to the data communication terminal equipment, and data communication is performed via a LAN. That is, the role of making the address in the virtual network and the address (in this case, telephone number) in the physical network correspond to each other is performed by the

person who is the addresser of the data. Therefore, the operation is cumbersome.

Disclosure of Invention

This invention was accomplished in view of the above-mentioned circumstances.

In accordance with one aspect of the present invention there is provided a mobile wireless data communications system including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of said telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet based on the packet address; wherein said exchange has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

In accordance with another aspect of the present invention there is provided a mobile wireless data communications system including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of said telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein

said wireless personal station has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

In accordance with still another aspect of the present invention there is provided a mobile wireless data communications system including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on said telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein said control unit has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

In accordance with a further aspect of the present invention there is provided a mobile wireless data communications system including a plurality of systems each including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the

packet address; wherein said exchanges of said systems are connected together and said control units of said systems are also connected together, said wireless personal station of each system is capable of communicating with a control unit in a desired system through a wireless connection device and an exchange not only within its own system but also within other systems, and said exchange has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

In accordance with still a further aspect of the present invention there is provided a mobile wireless data communications system including a plurality of systems each including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein said exchanges of said systems are connected together and said control units of said systems are also connected together; said wireless personal station of each system is capable of communicating with a control unit in a desired system through a wireless connection device and an exchange not only within its own system but also within other systems; and said wireless personal station has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between the wireless personal station and said terminal device connected to said LAN.

In accordance with yet a further aspect of the present invention there is provided a mobile wireless data communications system including a plurality of systems each including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through said LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein said exchanges of said systems are connected together and said control units of said systems are also connected together, said wireless personal station of each system is capable of communicating with a control unit in a desired system through a wireless connection device and an exchange not only within its own system but also within other systems, and said control unit has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

Brief Description of Drawings

Fig. 1 is a diagram showing a configuration of the first embodiment of the present invention.

Fig. 2 is a connection sequence diagram showing the operation of the above embodiment.

Fig. 3 is a connection sequence diagram showing the operation of the above embodiment.

Fig. 4 is a connection sequence diagram showing the operation of the above embodiment.

Fig. 5 is a connection sequence diagram showing the operation of the above embodiment.

Fig. 6 is a diagram showing a configuration of the second embodiment of the present invention.

Fig. 7 is a connection sequence diagram showing the operation of the embodiment of Fig. 6.

Fig. 8 is a connection sequence diagram showing the operation of the embodiment of Fig. 6.

Fig. 9 is a connection sequence diagram showing the operation of the embodiment of Fig. 6.

Fig. 10 is a connection sequence diagram showing the operation of the embodiment of Fig. 6.

Fig. 11 is a diagram showing a configuration of the third embodiment of the present invention.

Fig. 12 is a connection sequence diagram showing the operation of the embodiment of Fig. 11.

Fig. 13 is a connection sequence diagram showing the operation of the embodiment of Fig. 11.

Fig. 14 is a connection sequence diagram showing the operation of the embodiment of Fig. 11.

Fig. 15 is a connection sequence diagram showing the operation of the embodiment of Fig. 11.

Fig. 16 is a connection sequence diagram showing the operation of the embodiment of Fig. 11.

Best Mode for Carrying out the Invention

The best mode for carrying out the present invention will now be described in detail.

<1: First Embodiment>

In this embodiment, the present invention is applied to an in-house communications system having a wireless PBX system and a LAN connected to the wireless PBX system and in which routing is performed using the IP as a communication protocol.

<1-1: Configuration of First Embodiment>

A configuration of the first embodiment is illustrated in Fig. 1. As shown in this Figure, the wireless PBX system among many in-house communication systems includes a PBX, a CS (Cell Station), and a PS (Personal Station). In the configuration of Fig. 1, reference numerals 10a and 10b denote the PBX; 20a and 20b, the CS; and 30a and 30b, the PS, respectively.

Here, the PBX 10a and 10b each include a control portion, a switching portion, a base band processing portion and a memory for storing initial registration data of the PS which is under the control of the PBX 10a, 10b. The PBX 10a and 10b have the functions of controlling the overall system, switching the channel of data flowing on the communication channel, coding voices, switching the channel during communication, verifying the PS, registering the location of the PS, and roaming for communications which the PSs make while moving between different PBXs.

If the PBX, where the initial registration data of the PS are present, is assumed to be a home PBX (H-PBX) of its PS and the PBX of its next visiting place is assumed to be a visitor PBX (V-PBX), a roaming is performed by connecting the call with reference to the location registration data of the PS stored in the memory of the H-PBX when data are sent to or received by the PS which is currently present in the wireless area of the V-PBX. In the example of Fig. 1, the PBX 10a is the H-PBX and the PBX 10b is the V-PBX for the PS 30a. HM denotes a home memory within the H-PBX which stores therein the location registration data. In order to send and receive the control data necessary for roaming, the PBXs are connected by an ISDN (Integrated Services Digital Network) multiplexed by a time-division multiplexing device (TDM) or a private channel.

The CS 20a and 20b each include a wireless portion (modulation and demodulation portion), and a pair of PBX interface portions. The CS 20a and 20b are connected respectively to the PBX through a wired special-purpose interface, and transmit control signals and data between the PBX and the PS through a wireless section (radio section).

The PS 30a and 30b each include a wireless portion (modulation and demodulation portion), a base band processing portion, an external terminal device interface portion, etc. The PS 30a and 30b perform transmission/reception of signals, voice-coding, etc. for voice and data communications. When data communication is performed, the PS 30a and 30b are connected to DTE (Data Terminal Equipment) having a serial interface such as RS232C to transmit a control signal, data, etc. from the DTE through the wireless section.

LAN 40a and 40b use the Ethernet as a physical medium, including sub-networks which are divided by routers 50a and 50b for routing IC packets. The LAN 40a and 40b may use media other than the Ethernet. Each sub-network is connected to the PBX 10a or 10b within the wireless PBX system through the router 50a and 50b and a TA (Terminal Adapter) 60a or 60b. The TA 60a or 60b each include a protocol conversion portion and an interface portion. The TA 60a and 60b are connected together through the PBX, ISDN or a special-purpose interface. The TA 60a and 60b perform the transmission and reception of signals and the termination of protocol. The routers and the TA have the role of a control unit, for controlling the transmission of packet data through the LAN.

In this embodiment, a communication can be performed between one DTE on the LAN side and other DTE on the wireless PBX system side. In the example of Fig. 1, the LAN 40a is connected with a DTE 41a, and M-DTEs (Mobile Data Terminal Equipment) 32a and 32b are present on the wireless PBX system side.

The M-DTE and DTE each include a personal computer, so-called PDA (Personal Digital Assistant), or the like. They serve as a communication protocol for supporting TCP/IP (Transmission Control Protocol/Internet Protocol). The M-DTE 32a and 32b are connected respectively to ADP (Adapters) 31a and 31b through a serial interface, and the ADP 31a and 31b are connected respectively to the PS 30a and 30b through a serial interface. The ADP 31a and 31b each include a protocol conversion portion, an interface portion, and the like. The ADP 31a and 31b perform the termination of the protocol. The M-DTE, ADP and PS may be designed such that they are functionally separate but physically integral.

In order to perform a data communication between the M-DTE and the DTE or M-DTE, it is necessary to make an address (IP address) used in an IP layer correspond to an address (Ethernet address in the LAN, and extension number in the wireless PBX system) used in a physical layer lower than the IP layer. In general, the LAN is a connectionless type network, in which a node (in general, a router) for relaying an IP package exchanges the IP address for the Ethernet address, and performs a relay transmission of the IP packet.

On the other hand, the wireless PBX system is a connection type network which establishes an end-to-end physical link through the PBX and performs communications by channel switching. Here, if the IP address is not identical with the physical address, it is necessary to prepare a table (conversion table) for making the former correspond to the latter. With the use of the conversion table, a physical link is established over which IP packets are transmitted. In this embodiment, a conversion table 70 for performing this conversion function is provided on the H-PBX.

<1-2: Operation of First Embodiment>

Operation of this embodiment will now be described.

<1-2-: Communication Performed between M-DTE and DTE under the Control of H-PBX>

A connection procedure for sending data from a certain M-DTE to a DTE within the LAN shall be described first with reference to the connection sequence diagram of Fig. 2.

In the first step, the M-DTE sends a communication start request to the PS. At that time, the M-DTE simultaneously notifies the PS of an incoming IP address indicating a DTE as the addressee. Recognising that the call is for data communication, the PS sends the H-PBX a connection request designating an IP/extension number conversion connection special number (special number) requesting a conversion from the IP to an extension number. At that time, the above connection request includes the incoming IP address so that the request can be distinguished from a connection request for voice communication.

Receiving the special number for IP/extension number conversion connection from the PS and recognising it as a call for data communication, the

H-PBX converts the incoming IP address included in the connection request to an extension number using the conversion table and sends a connection request to the TA corresponding to this extension number. In this case, the H-PBX may send the connection request directly and unconditionally to the TA without referring to the incoming IP address information contained in the conversion table.

In response to the connection request from the H-PBX, the TA sends a connection acknowledgement and establishes a communication channel between the PS and the TA through the H-PBX. Thereafter, the M-DTE communicates with the DTE through the router connected to the LAN.

<1-2-2: Transmission of Data from One M-DTE to Another M-DTE>

With reference to Fig. 3, a connection procedure for the M-DTE 1 under the control of the H-PBX to communicate with another M-DTE shall be described first.

In the first step, the M-DTE 1 sends a communication start request to the PS 1. At that time, the M-DTE 1 simultaneously notifies the PS 1 of an incoming IP address indicating a M-DTE 2 as the addressee. Recognising that the call is for data communication, the PS 1 sends the H-PBX a connection request designating an IP/extension number conversion connection special number (special number) requesting a conversion from the IP to an extension number.

Receiving the special number for the IP/extension number conversion connection from the PS 1 and recognising it as a call for data communication, the H-PBX converts the incoming IP address included in the connection request to an extension number using the conversion table. Finishing the conversion to the extension number, the H-PBX accesses a home memory HM within the H-PBX, which stores the location registration data and confirms which PBX controls the PS, for example, the destination PS 2 corresponding to the specific extension number. Confirming that the PS 2 is under the control of the H-PBX, the H-PBX sends a connection request to the PS 2. Thereafter, a connection acknowledgement from the destination PS 2 is sent to the source PS 1. As a consequence, a communication channel is established between the PS 1 and the

PS 2 through the H-PBX and communication is performed between the M-DTE 1 and M-DTE 2.

The connection procedure described above is used for the case where both the PS 1 and PS 2 are under the control of the same PBX (H-PBX in the above example). If the destination PS 2 for the PS 1 is under the control of an other PBX, namely, V-PBX aside from the H-PBX, the roaming function is used. A connection sequence for such a case is shown in Fig. 4. In this case, in addition to the connection sequence of Fig. 3, a procedure for establishing a communication channel between the H-PBX and the V-PBX through a multiplex channel is needed.

More specifically, in this case, after receiving a connection request from the PS 1 and finishing the conversion of the incoming IP address to an extension number, the H-PBX accesses the home memory HM and confirms that the PS (PS 2) corresponding to the extension number is under the control of another PBX, namely V-PBX. As a consequence, control data are sent and received between the H-PBX and V-PBX through a multiplex channel, and a communication channel is established between the PS 1 and PS 2. This makes it possible for the PS 1 to communicate with the PS 2 in a different PBX from the H-PBX whose control it is under.

<1-2-3: Transmission of Data from DTE to M-DTE>

With reference to the connection sequence diagram of Fig. 5, a connection procedure for sending data from the DTE to the M-DTE shall be described next.

When the router connected to the H-PBX through the TA receives an IP packet from the DTE to be addressed to the M-DTE, it sends a request to the TA requesting the TA to send the IP packet to the special number of the H-PBX, judging that the addressee of the packet is the H-PBX. At that time, it is simultaneously informed of an incoming IP address corresponding to the M-DTE as the addressee. In response to the request from the router, the TA sends a connection request designating an IP/extension number conversion connection special number (special number) of the H-PBX. At that time, an incoming IP address is included in the connection request.

Receiving the connection request from the TA with the special number and recognising it as a call for data communication, the H-PBX converts the incoming IP address included in the connection request to its corresponding extension number using the conversion table. Then, the H-PBX accesses the home memory HM and confirms which PNX controls the PS corresponding to the specific extension number. Confirming that the PS is under the control of the H-PBX, the H-PBX sends a connection request to the destination PS. The destination PS sends a connection acknowledgement in response to the connection request from the H-PBX. As a consequence, a communication channel is established between the PS and the TA through the PBX. Thereafter, the DTE communicates with the M-DTE through the router connected to the LAN.

If the destination PS is under the control of the V-PBX, a communication channel is established between the H-PBX and the V-PBX through a multiplex channel, using the roaming function. This makes it possible for the DTE to communicate also with a PS which is under the control of the V-PBX other than the H-PBX whose control it is under.

<2: Second Embodiment>

Next, the second embodiment of the present invention shall be described.

<2-1: Configuration of Second Embodiment>

Fig. 6 illustrates a configuration of this second embodiment. This embodiment is different from the first embodiment only in the respect that the conversion tables for converting the IP address of the addressee to a physical address (extension number) are each provided on each PS 30a, 30b.

<2-2: Operation of Second Embodiment>

Operation of this embodiment will now be described.

<2-2-1: Transmission of Data from M-DTE to DTE>

A connection procedure for sending data from a certain M-DTE to a DTE within the LAN is described first with reference to the connection sequence diagram of Fig. 7. This procedure is different from that of the first embodiment only in the respect that the address conversion table is provided on the PS. The PS converts the incoming IP address to a corresponding extension number using the conversion table and sends a connection request including the extension

number as in the case with a voice communication (in this case, no incoming address data may be contained in the conversion table and a connection request including the extension number of the TA may be set unconditionally). The H-PBX receives a connection request from the PS and sends it to the TA. In response to the connection request from the H-PBX, the TA sends a connection acknowledgement and establishes a communication channel between the PS and the TA through the H-PBX. Thereafter, the M-DTE communicates with the DTE through the router connected to the LAN.

<2-2-2: Transmission of Data from one M-DTE to Another M-DTE>

With reference to Fig. 8, a connection procedure for sending data from one M-DTE to another M-DTE is described next. In this case, after the incoming IP address is converted to an extension number at the PS, the H-PBX accesses a home memory HM within the H-PBX which stores the location registration data and sends a connection request to the destination PS. Thereafter, a connection acknowledgement from the destination PS is sent to the source PS. As a consequence, a communication channel is established between the destination PS and the source PS through the PBX. Thereafter, a communication is performed between the first M-DTE and the second M-DTE.

If the destination PS is under the control of the V-PBX, the roaming function is used in accordance with the connection sequence of Fig. 9, so that a communication channel is established between the H-PBX and the V-PBX through a multiplex channel.

<2-2-3: Transmission of Data from DTE to M-DTE>

With reference to the connection sequence diagram of Fig. 10, a connection procedure for sending data from the DTE to the M-DTE shall be described next. This procedure is different from that of the first embodiment only in the respect that the H-PBX has no conversion table. For this reason, an arrival notification with the use of the incoming IP address is sent from the H-PBX. Upon receipt of the arrival notification, the PS sends an acknowledgement when the incoming IP address therein is in agreement with the IP address of the connected M-DTE and establishes a communication channel between the PS and the TA through the PBX. Thereafter, the DTE communicates with the M-DTE through the

router connected to the LAN. If the destination PS is under the control of the V-PBX, a communication channel is established between the H-PBX and the V-PBX through a multiplex channel, using the roaming function.

<3: Third Embodiment>

Next, the third embodiment of the present invention is described.

<3-1: Configuration of Third Embodiment>

Fig. 11 illustrates a configuration of the third embodiment. This embodiment is different from the first embodiment only in the respect that a conversion table for converting the IP address of the addressee to a physical address (extension number) is provided on a router 50a.

<3-2: Operation of Third Embodiment>

Operation of this embodiment will now be described.

<3-2-1-: Transmission of Data from M-DTE to DTE>

A connection procedure for sending data from a certain M-DTE to a DTE within the LAN is described with reference to the connection sequence diagram of Fig. 12. This procedure is different from that of the first embodiment only in the respect that the router (H-router) has the address conversion table. The incoming IP address is converted to a corresponding extension number using this conversion table. Further, the data of extension number corresponding to the incoming IP address of the DTE at that time do not exist on the conversion table. Recognising that the call is for data communication, the PS sends a connection request designating the IP/extension number conversion connection special number (special number) of the destination H-PBX. At that time, the connection request includes the incoming IP address, so that this request can be distinguished from a connection request for voice communication. The H-PBX receives a connection request from the PS with the special number and sends it to the TA when the H-PBX recognises it as a call for data communication. At that time, the connection request includes the incoming IP address. In response to the connection request from the H-PBX, the TA searches the conversion table within the H-router and judges that the specific DTE exists on the LAN because no data of the incoming IP address are found. Then, the TA sends a connection acknowledgement to the H-PBX and establishes a communication channel

between the PS and the TA through the PBX. Thereafter, the M-DTE communicates with the DTE through the router connected to the LAN.

<3-2-2: Transmission of Data from one M-DTE to another M-DTE>

With reference to Fig. 13, the connection procedure for sending data from one M-DTE to another M-DTE shall be described next. In this case, after the incoming IP address is converted to an extension number at the PS, the H-PBX accesses a home memory HM within the H-PBX which stores the location registration data and sends a connection request to the destination PS. Thereafter, a connection acknowledgement from the destination PS is sent to the source PS. As a consequence, a communication channel is established between the destination PS and the source PS through the PBX. Thereafter, a communication is performed between the first M-DTE and the second M-DTE. If the destination PS is under the control of the V-PBX, the roaming function is used, so that a communication channel is established between the H-PBX and the V-PBX through a multiplex channel in accordance with a connection sequence of Fig. 14.

<3-2-3: Transmission of Data from DTE to M-DTE Under Control of H-PBX>

With reference to the connection sequence diagram of Fig. 15, a connection procedure for sending data from the DTE to the M-DTE under the control of the H-PBX shall be described next. In this case, the IP packet is transmitted to the H-router no matter which network the DTE is visiting. Upon receipt of the packet from the DTE, the H-router converts the IP address to an incoming extension number using the conversion table within the H-router and performs a communication by making an incoming call from the TA to the M-DTE.

If the M-DTE is under the control of the V-PBX, a communication is performed by making a call from the H-router to the M-DTE in accordance with the connection sequence of Fig. 16, using the roaming function of H-PBX.

<4: Other Embodiments>

The present invention has been described in the form of one embodiment in which the invention is applied to an in-house communication system having a wireless PBX system connected to the LAN. As the wireless access method and duplex formats of the wireless PBX system, TDMA and TDD are employed,

respectively (reference documents: "Second Generation Cordless Telephone System, Standard Specifications, first issue (revision-1), RCR STD-28", Old Juridical Foundation Wave System Development Center (New Name: Wave Industrial Society). Alternatively, other wireless access formats such as CDMA, and other duplex formats such as FDD may be employed. Further, by connecting the PBX within the wireless PBX system to other networks such as general public networks (PSTN/ISDN), mobile networks (cellular networks, public PHS networks, radio paging, and the like), connectionless type networks and the like, communications can be performed between a data communication terminal device under the control of the network and a data communication terminal device under the control of the wireless PBX system.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A mobile wireless data communications system including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of said telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet based on the packet address; wherein

said exchange has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

2. A mobile wireless data communications system including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of said telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein

said wireless personal station has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order

to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

3. A mobile wireless data communications system including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on said telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein

said control unit has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

4. A mobile wireless data communications system including a plurality of systems each including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein

said exchanges of said systems are connected together and said control units of said systems are also connected together,

said wireless personal station of each system is capable of communicating with a control unit in a desired system through a wireless connection device and an exchange not only within its own system but also within other systems, and

said exchange has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

5. A mobile wireless data communications system including a plurality of systems each including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through a LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein

said exchanges of said systems are connected together and said control units of said systems are also connected together;

said wireless personal station of each system is capable of communicating with a control unit in a desired system through a wireless connection device and an exchange not only within its own system but also within other systems; and

said wireless personal station has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between the wireless personal station and said terminal device connected to said LAN.

6. A mobile wireless data communications system including a plurality of systems each including a wireless personal station assigned with a telephone number in accordance with a single telephone number scheme, a wireless connection device for performing a wireless connection with said wireless personal station, an exchange for controlling said wireless connection device, a control unit connected to said exchange and adapted to perform transmission control of packet data through said LAN, and a terminal device connected to said LAN and assigned with a packet address independent of the telephone number scheme; said exchange performing routing based on the telephone number; said control unit performing transmission control of the packet data based on the packet address; wherein

said exchanges of said systems are connected together and said control units of said systems are also connected together,

said wireless personal station of each system is capable of communicating with a control unit in a desired system through a wireless connection device and an exchange not only within its own system but also within other systems, and

said control unit has a correspondence table in which the packet address is mapped to the telephone number, and the packet address is converted to the telephone number based on said correspondence table in order to establish a communication channel between said wireless personal station and said terminal device connected to said LAN.

7. A mobile wireless data communications system substantially as herein described with reference to figures 1 to 5 or figures 6 to 10 or figures 11 to 16 of the accompanying drawings.

DATED this 4th day of October, 1999

NTT MOBILE COMMUNICATIONS NETWORK INC.

WATERMARK PATENT & TRADE MARK ATTORNEYS
290 BURWOOD ROAD
HAWTHORN VIC 3122
AUSTRALIA

RCS/MBP/SH DOC 28 AU1171797.doc

FIG. 1

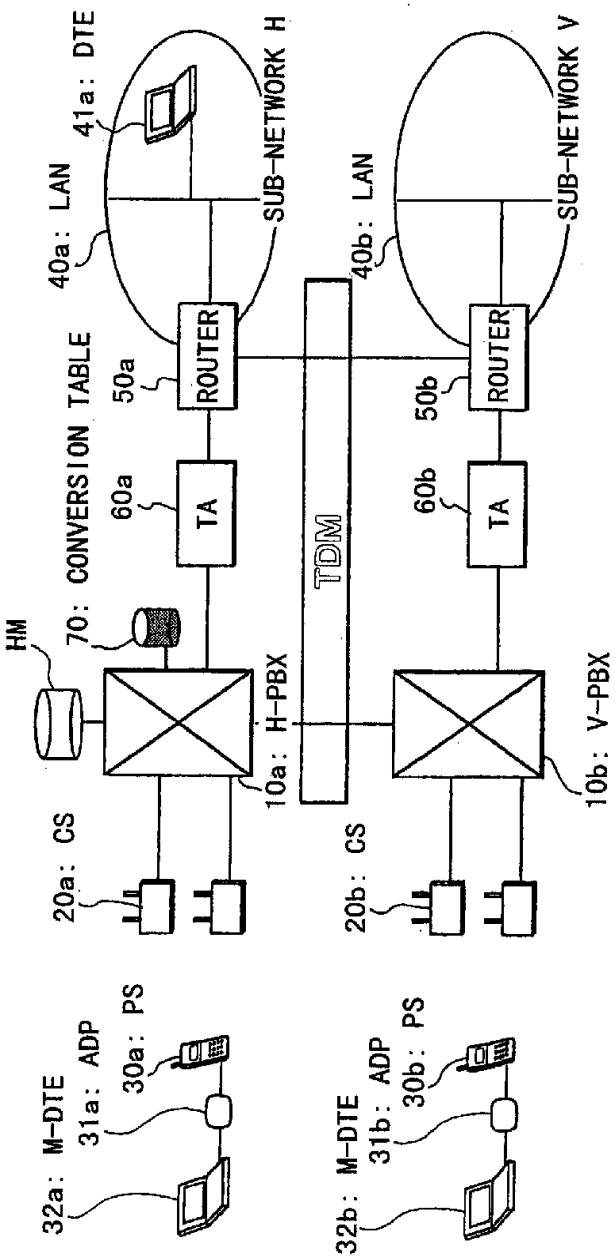

41a: DTE
SUB-NETWORK H
40a: LAN
SUB-NETWORK V
40b: LAN
ROUTER
50a
ROUTER
50b
70: CONVERSION TABLE
60a
TA
TDM
60b
TA
HM
10a: H-PBX
10b: V-PBX
20a: CS
20b: CS
30a: PS
31a: ADP
32a: M-DTE
30b: PS
31b: ADP
32b: M-DTE

FIG. 2

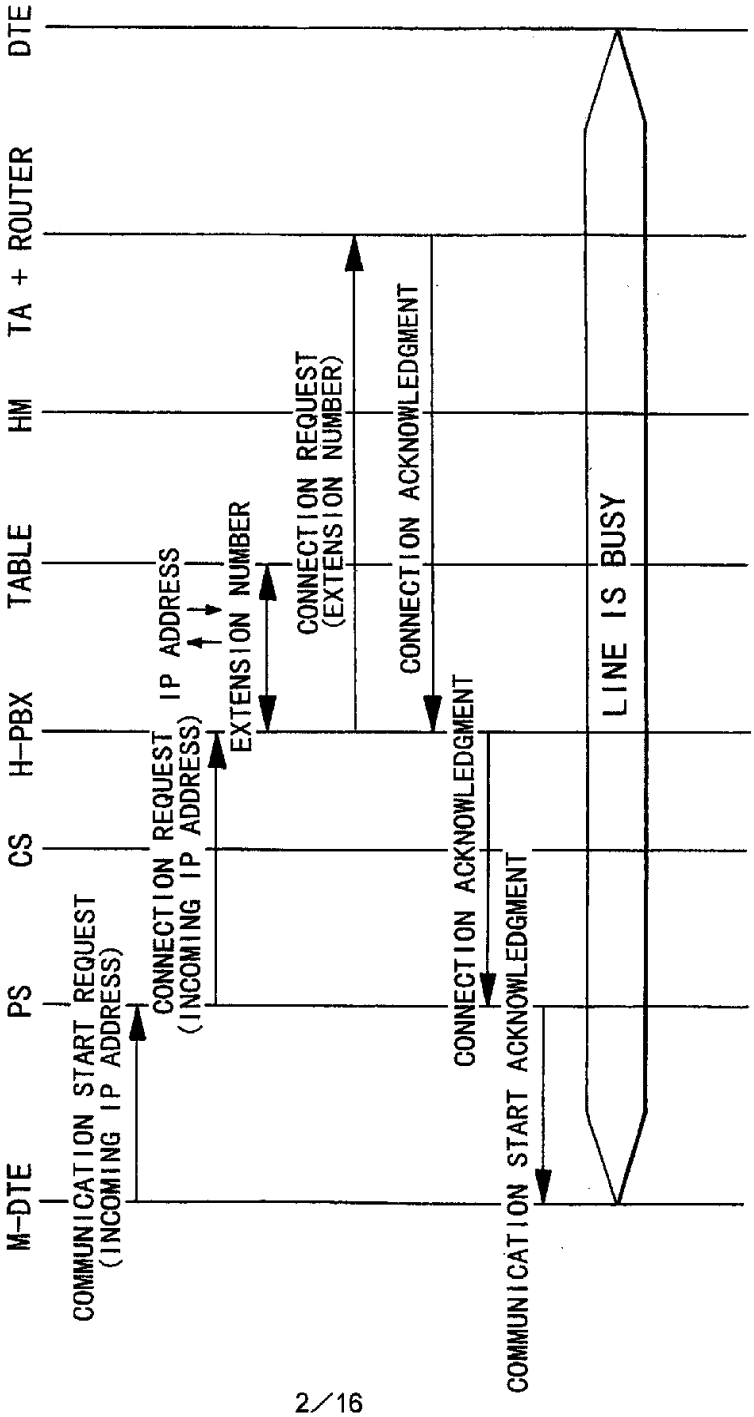
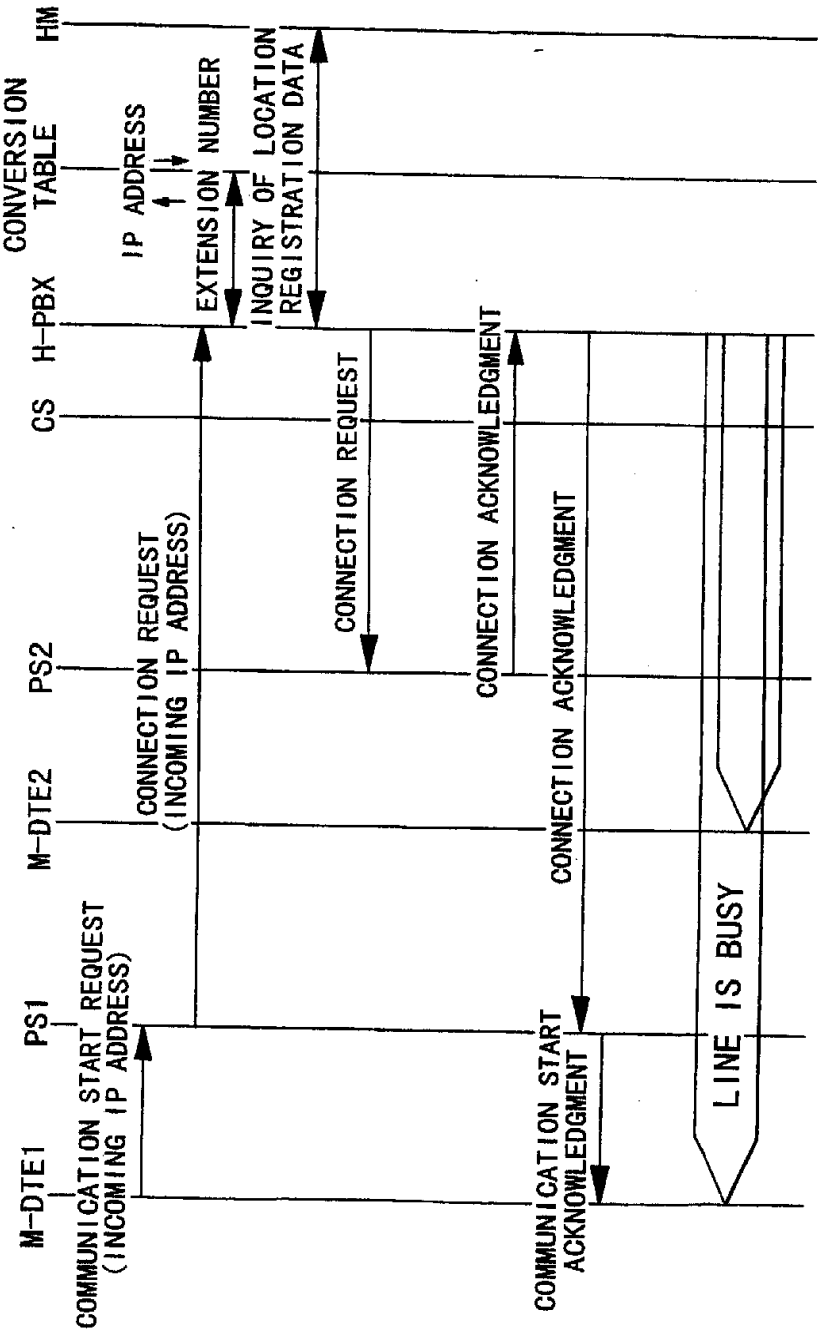

M-DTE
PS
CS
H-PBX
CONVERSION TABLE
HM
TA + ROUTER
DTE
COMMUNICATION START REQUEST (INCOMING IP ADDRESS)
CONNECTION REQUEST (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
CONNECTION REQUEST (EXTENSION NUMBER)
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
COMMUNICATION START ACKNOWLEDGMENT
LINE IS BUSY

FIG. 3


M-DTE1
PS1
M-DTE2
PS2
CS H-PBX
CONVERSION TABLE
HM
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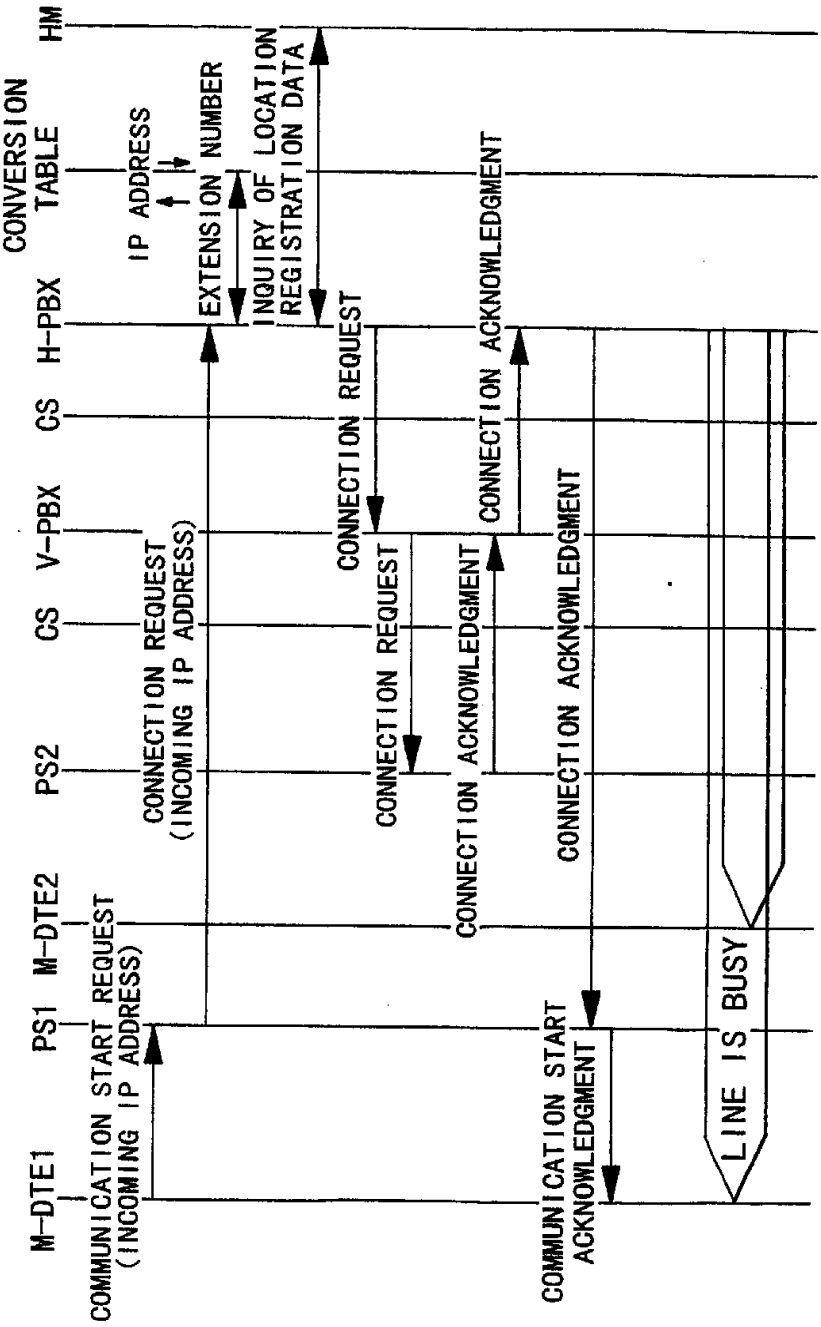
CONNECTION REQUEST (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
COMMUNICATION START ACKNOWLEDGMENT
LINE IS BUSY

FIG. 4


M-DTE1
PS1
M-DTE2
PS2
CS
V-PBX
CS
H-PBX
CONVERSION TABLE
HM
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CONNECTION REQUEST (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
COMMUNICATION START ACKNOWLEDGMENT
LINE IS BUSY

FIG. 5

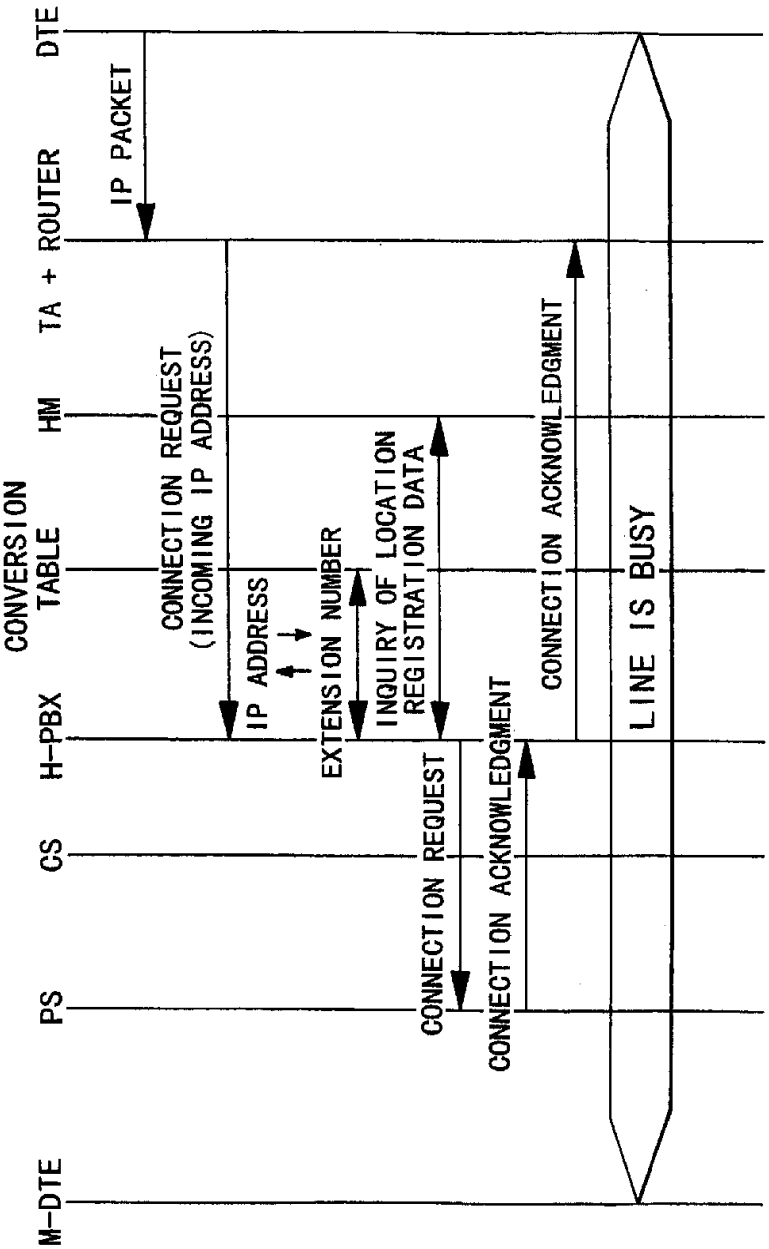

DTE
TA + ROUTER
HM
CONVERSION TABLE
H-PBX
CS
PS
M-DTE
IP PACKET
CONNECTION REQUEST (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
LINE IS BUSY

FIG. 6

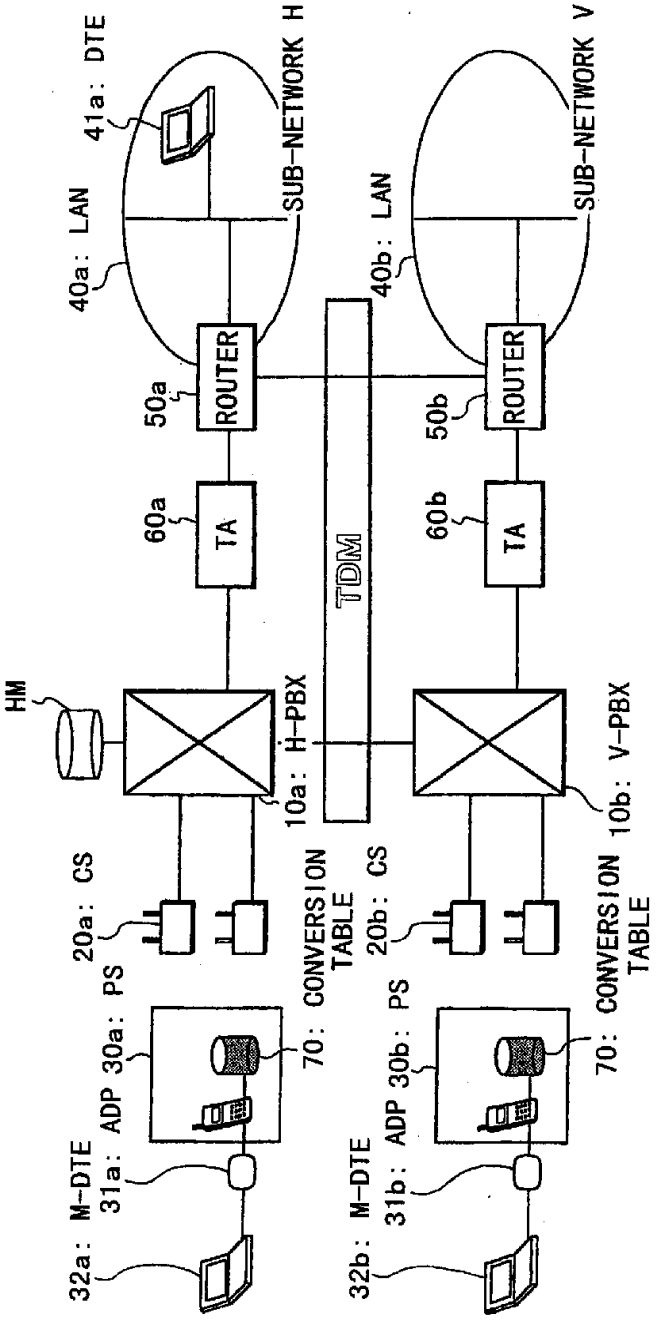
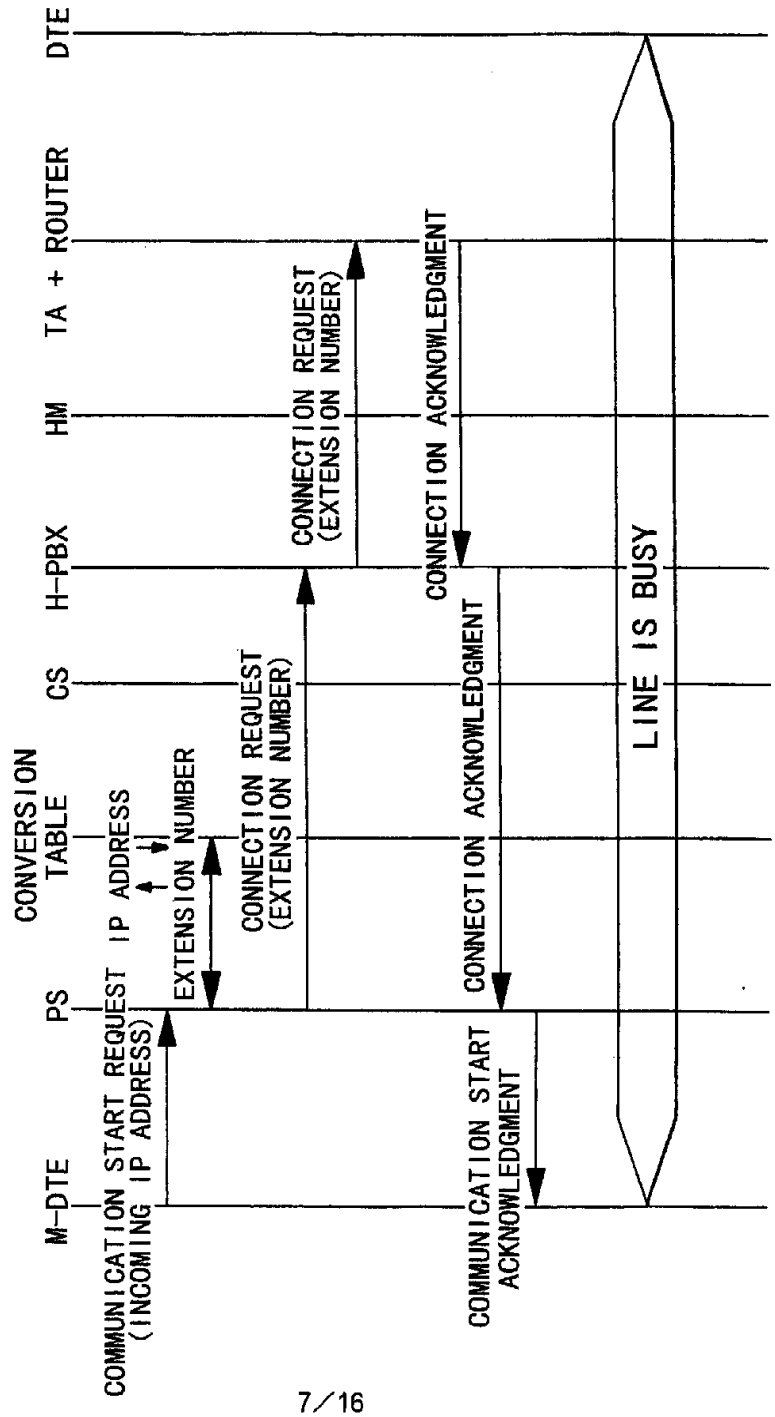

41a: DTE
SUB-NETWORK H
SUB-NETWORK V
40a: LAN
40b: LAN
50a
ROUTER
50b
ROUTER
60a
TA
60b
TA
TDM
HM
10a: H-PBX
10b: V-PBX
20a: CS
20b: CS
70: CONVERSION TABLE
70: CONVERSION TABLE
30a: ADP PS
30b: ADP PS
31a: M-DTE
31b: M-DTE
32a:
32b:

FIG. 7


M-DTE
PS
CONVERSION TABLE
CS
H-PBX
HM
TA + ROUTER
DTE
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IP ADDRESS
EXTENSION NUMBER
CONNECTION REQUEST (EXTENSION NUMBER)
CONNECTION REQUEST (EXTENSION NUMBER)
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
COMMUNICATION START ACKNOWLEDGMENT
LINE IS BUSY

FIG. 8

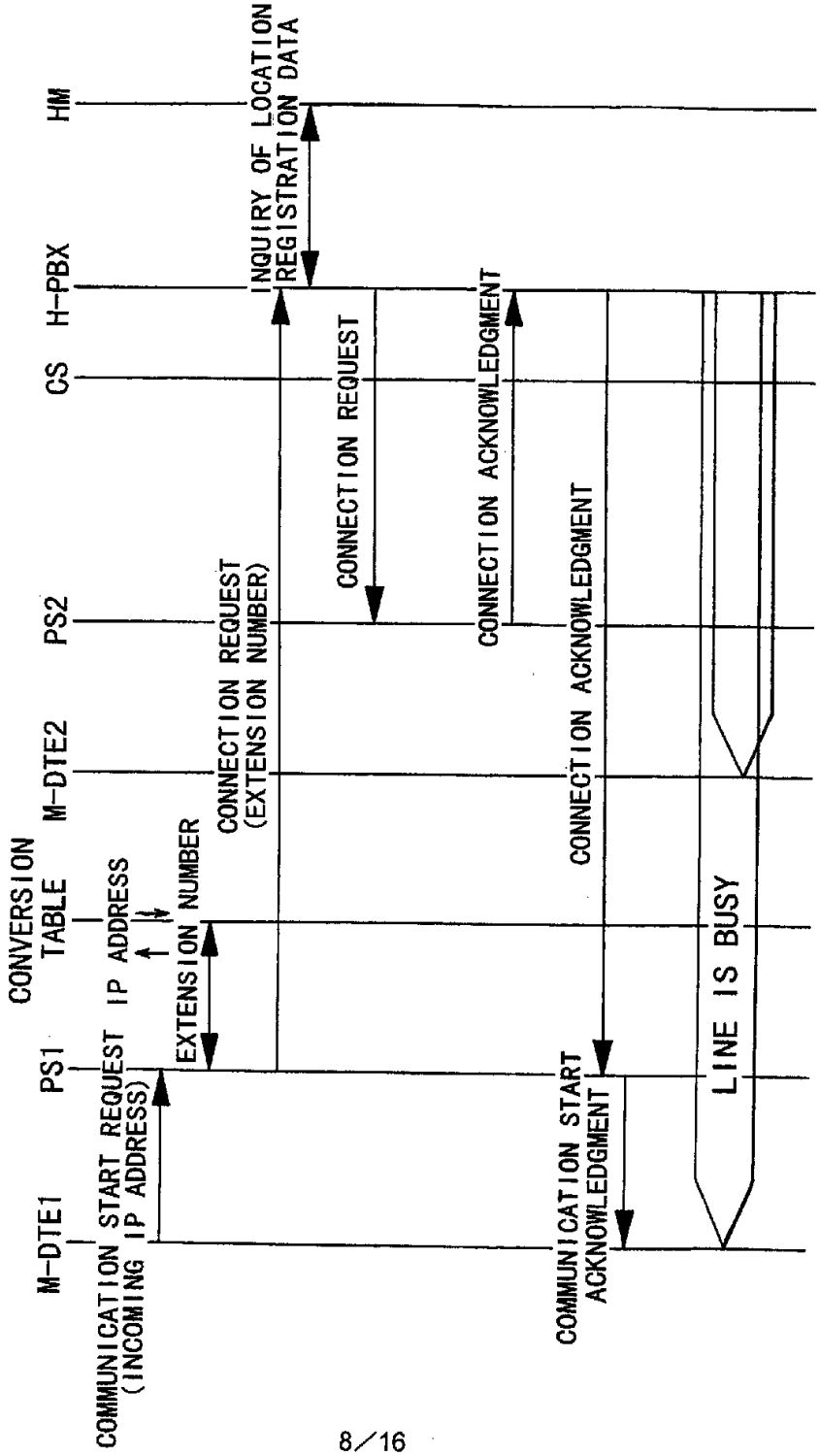

M-DTE1
PS1
CONVERSION TABLE
M-DTE2
PS2
CS
H-PBX
HM
COMMUNICATION START REQUEST (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
CONNECTION REQUEST (EXTENSION NUMBER)
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
LINE IS BUSY
COMMUNICATION START ACKNOWLEDGMENT

FIG. 9

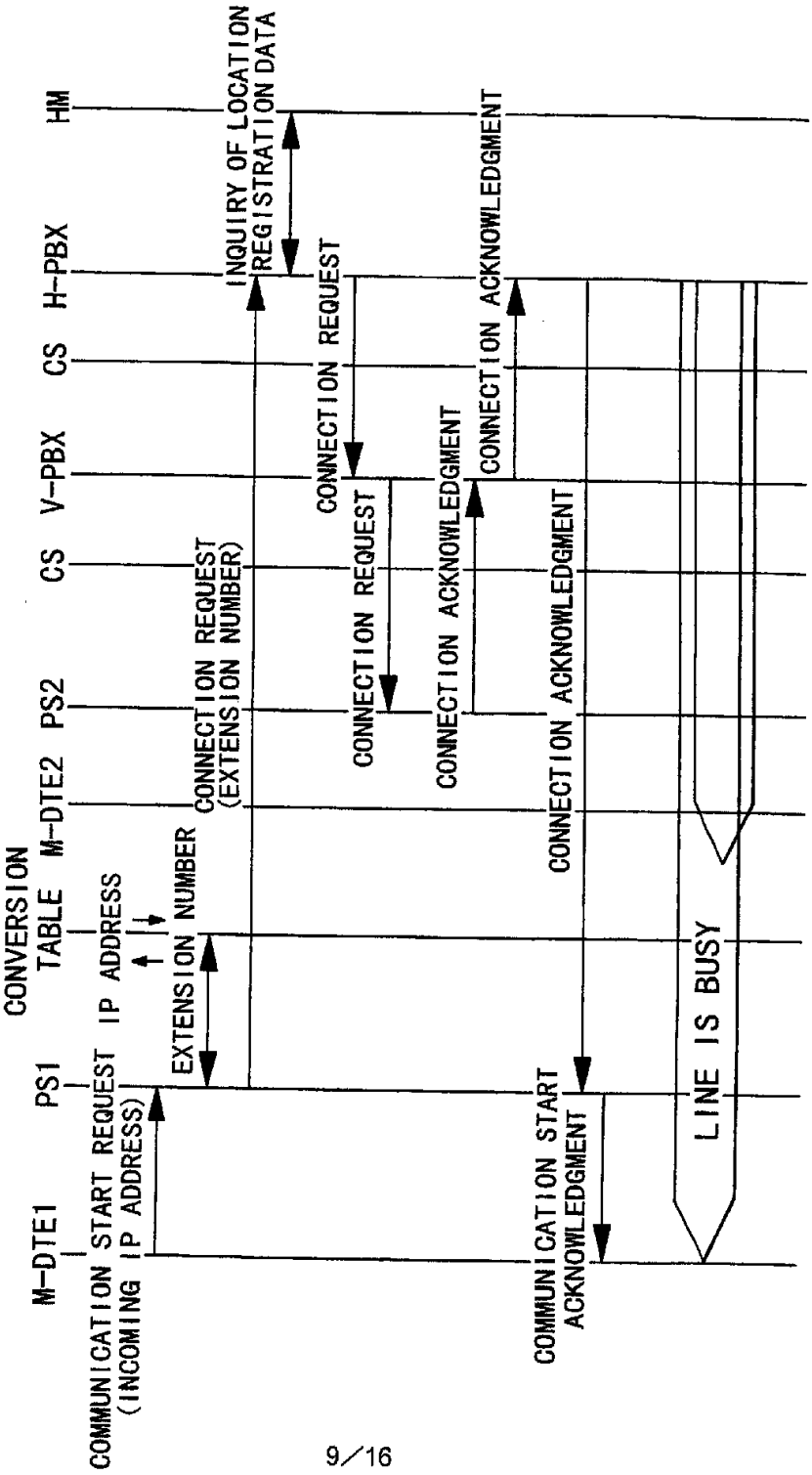

M-DTE1
PS1
CONVERSION TABLE
M-DTE2
PS2
CS
V-PBX
CS
H-PBX
HM
COMMUNICATION START REQUEST (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
CONNECTION REQUEST (EXTENSION NUMBER)
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
LINE IS BUSY
COMMUNICATION START ACKNOWLEDGMENT

FIG. 10

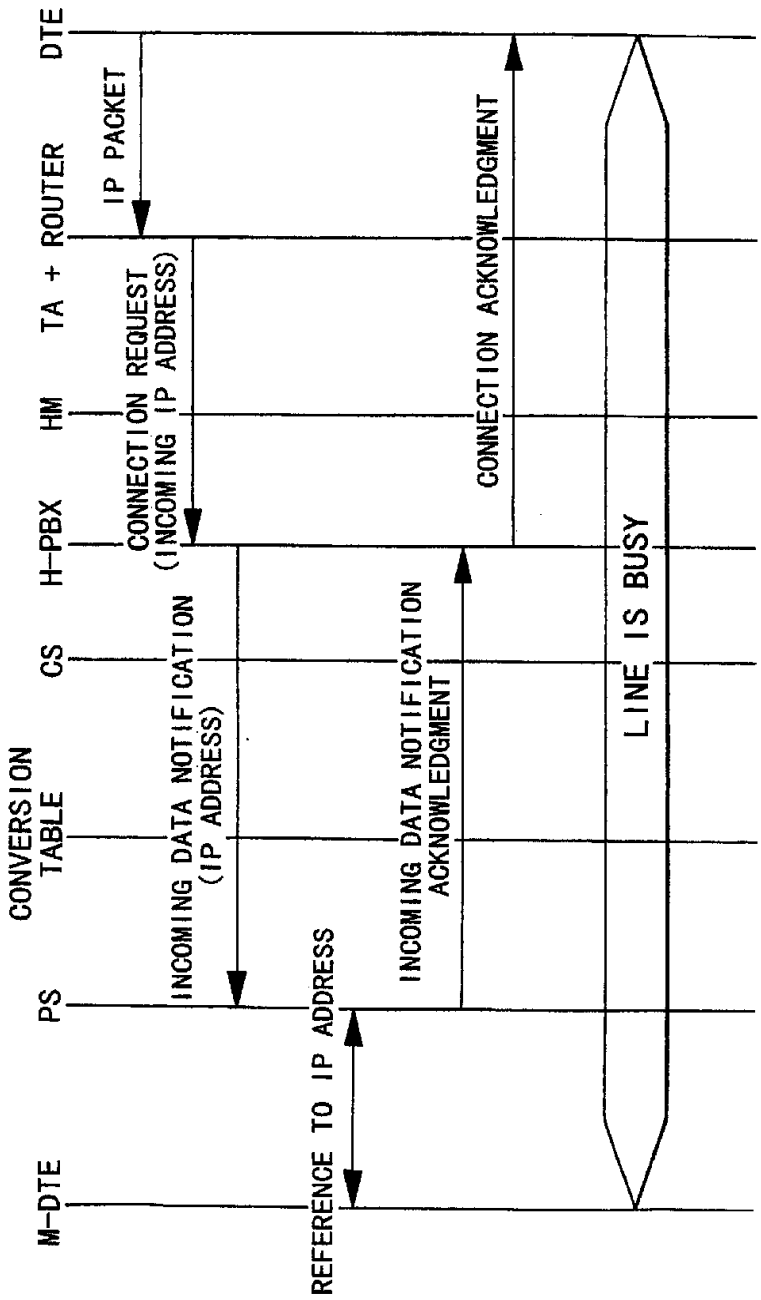

DTE
ROUTER
TA + HM
H-PBX
CS
CONVERSION TABLE
PS
M-DTE
IP PACKET
CONNECTION REQUEST (INCOMING IP ADDRESS)
CONNECTION ACKNOWLEDGMENT
INCOMING DATA NOTIFICATION (IP ADDRESS)
INCOMING DATA NOTIFICATION ACKNOWLEDGMENT
LINE IS BUSY
REFERENCE TO IP ADDRESS

FIG. 11

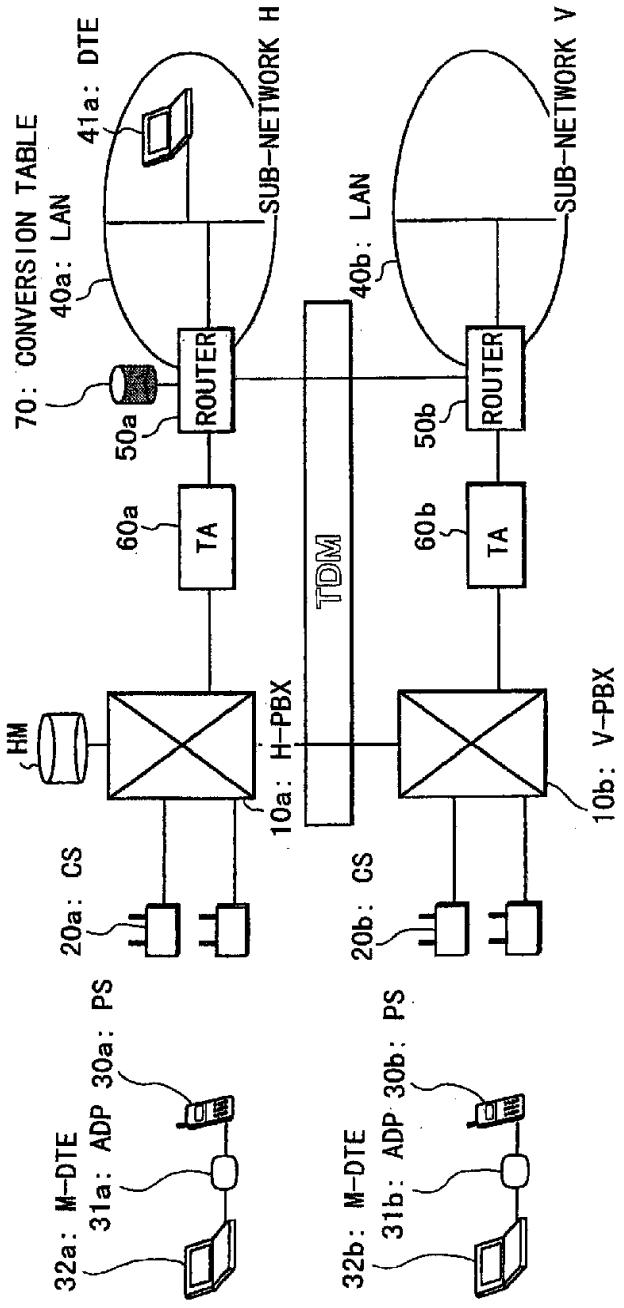

SUB-NETWORK H
SUB-NETWORK V
41a: DTE
40a: LAN
40b: LAN
70: CONVERSION TABLE
ROUTER
ROUTER
50a
50b
60a
60b
TA
TA
TDM
HM
10a: H-PBX
10b: V-PBX
20a: CS
20b: CS
30a: PS
30b: PS
31a: ADP
31b: ADP
32a: M-DTE
32b: M-DTE

FIG. 12

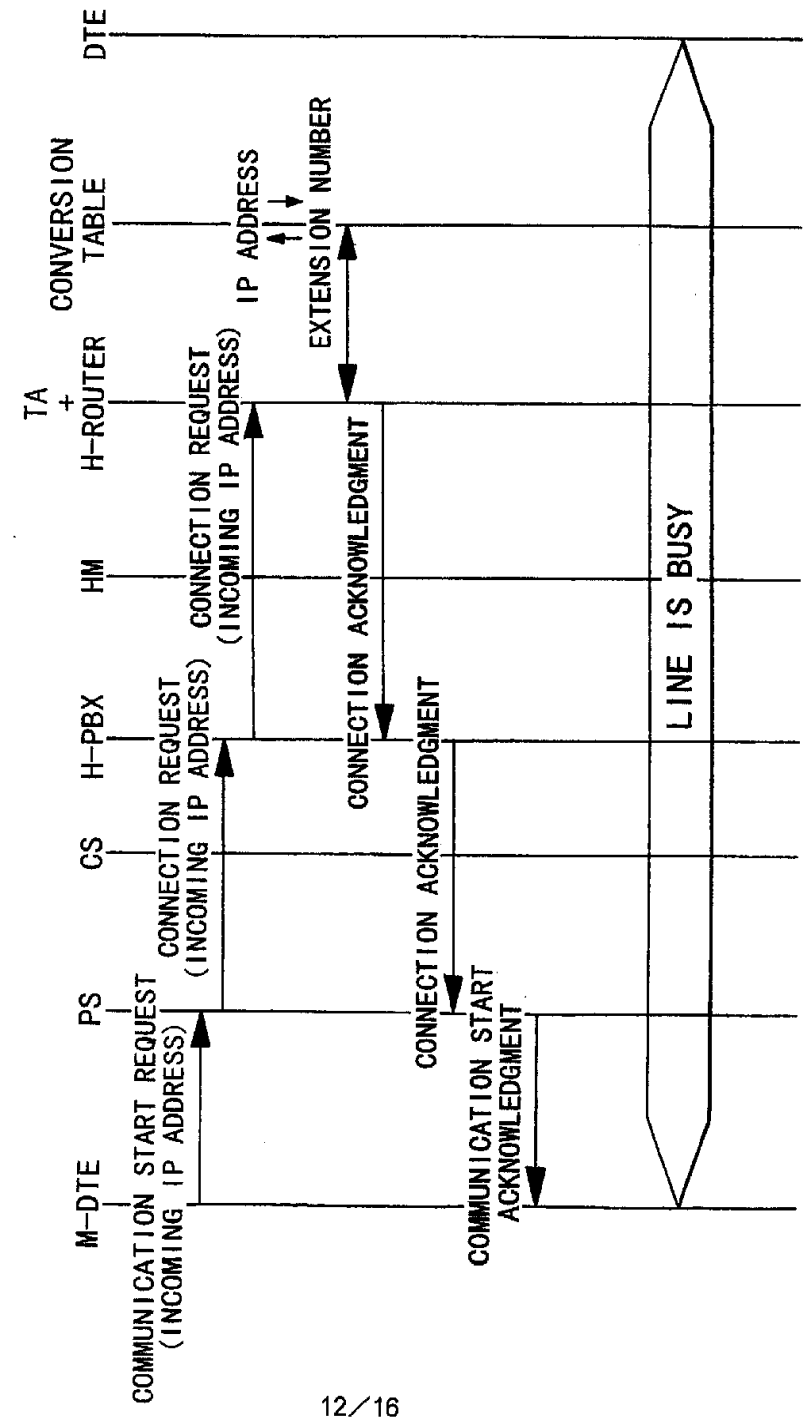
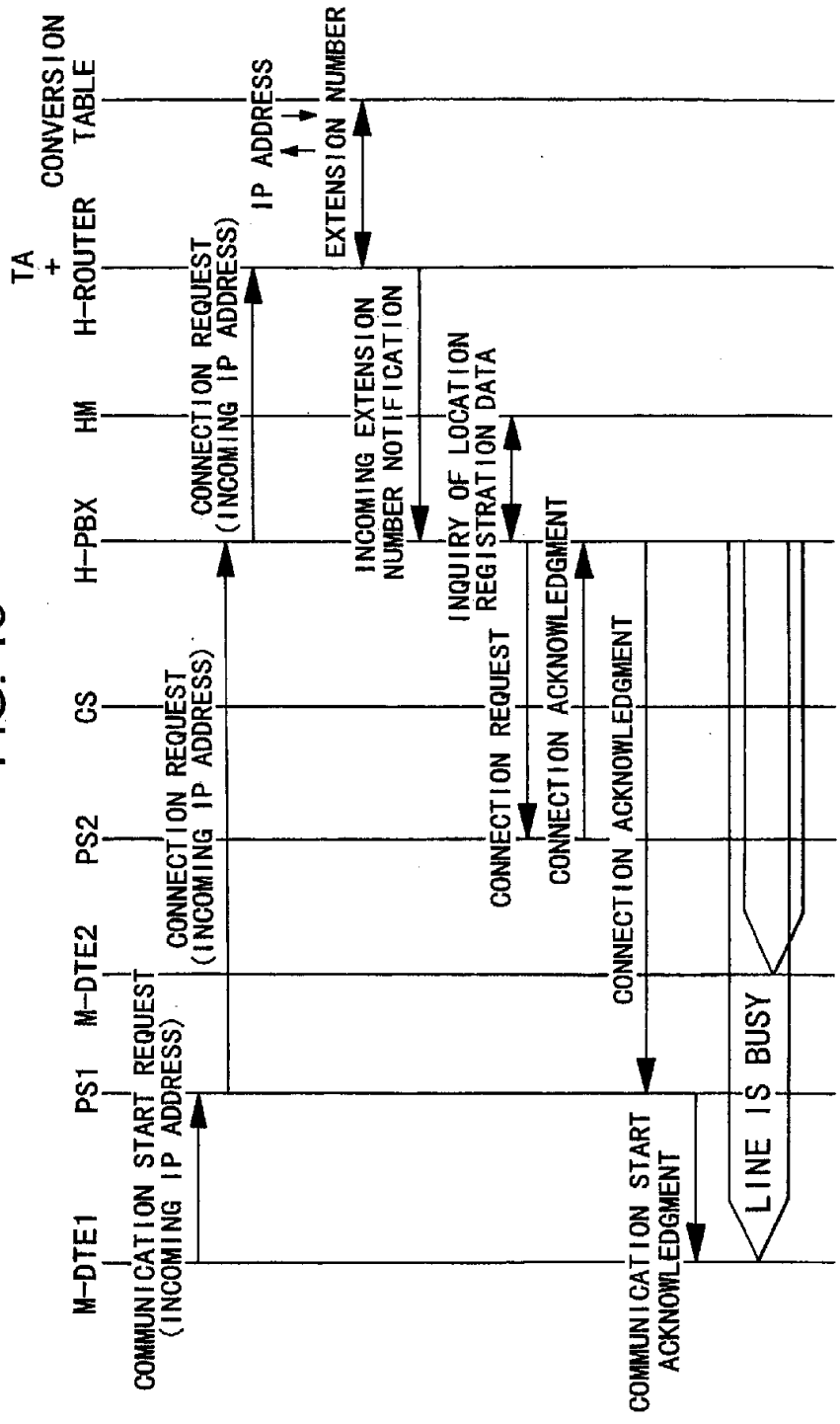

M-DTE
PS
CS
H-PBX
HM
TA + H-ROUTER
CONVERSION TABLE
DTE
COMMUNICATION START REQUEST (INCOMING IP ADDRESS)
CONNECTION REQUEST (INCOMING IP ADDRESS)
CONNECTION REQUEST (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
CONNECTION START ACKNOWLEDGMENT
COMMUNICATION START ACKNOWLEDGMENT
LINE IS BUSY

FIG. 13


M-DTE1
PS1
M-DTE2
PS2
CS
H-PBX
HM
TA + H-ROUTER
CONVERSION TABLE
IP ADDRESS
EXTENSION NUMBER
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CONNECTION REQUEST (INCOMING IP ADDRESS)
CONNECTION REQUEST (INCOMING IP ADDRESS)
INCOMING EXTENSION NUMBER NOTIFICATION
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
LINE IS BUSY
COMMUNICATION START ACKNOWLEDGMENT

FIG. 14

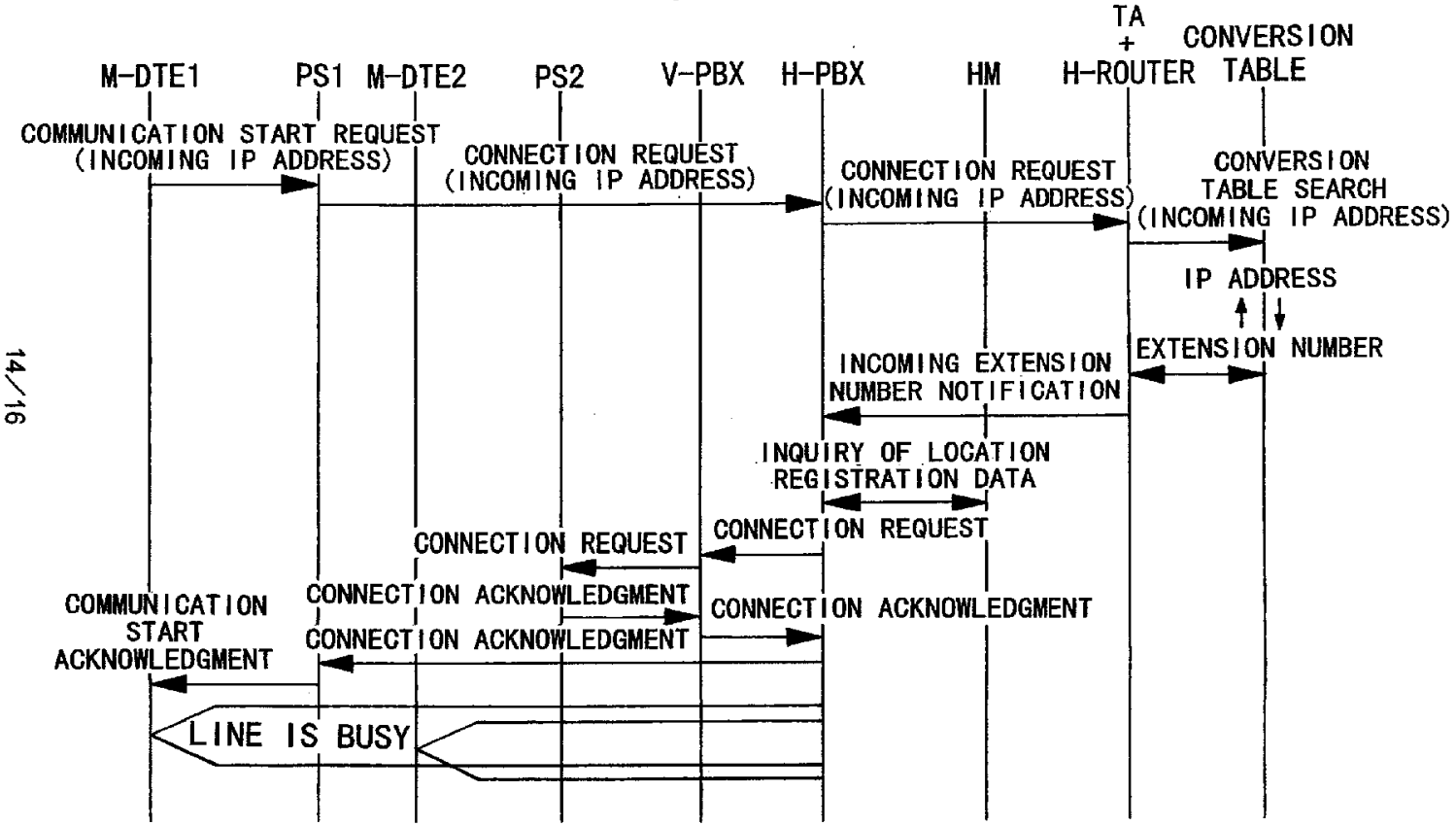

M-DTE1
PS1
M-DTE2
PS2
V-PBX
H-PBX
HM
TA + H-ROUTER
CONVERSION TABLE
COMMUNICATION START REQUEST (INCOMING IP ADDRESS)
CONNECTION REQUEST (INCOMING IP ADDRESS)
CONNECTION REQUEST (INCOMING IP ADDRESS)
CONVERSION TABLE SEARCH (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
INCOMING EXTENSION NUMBER NOTIFICATION
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
COMMUNICATION START ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
LINE IS BUSY

FIG. 15

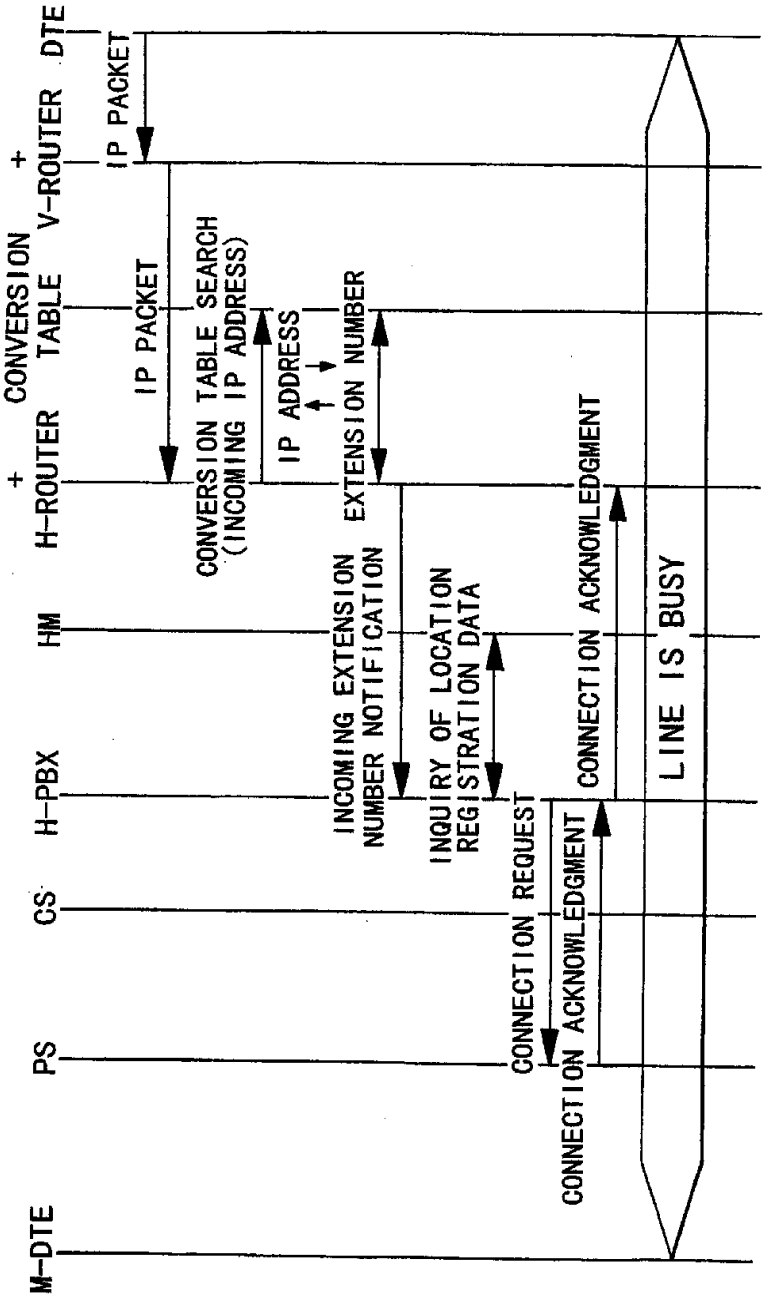
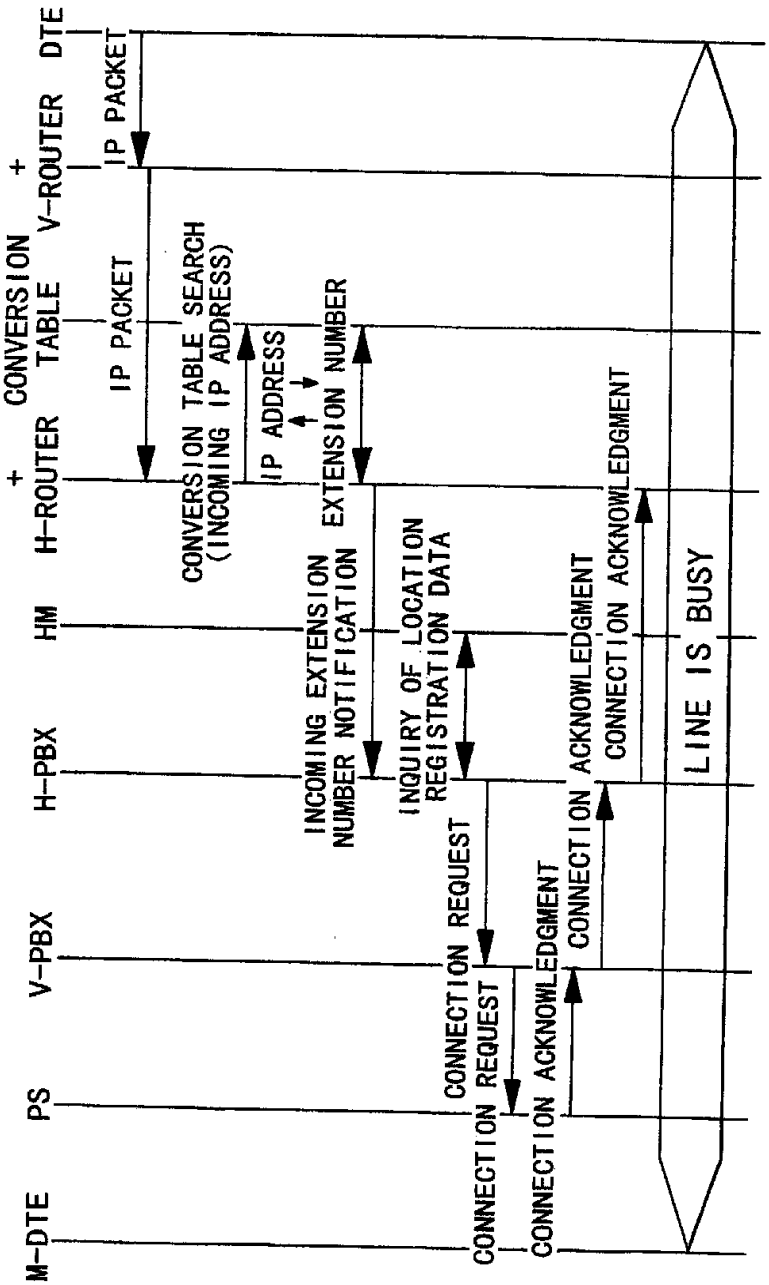

TA + V-ROUTER DTE
TA + CONVERSION TABLE H-ROUTER
HM
H-PBX
CS
PS
M-DTE
IP PACKET
IP PACKET
CONVERSION TABLE SEARCH (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
INCOMING EXTENSION NUMBER NOTIFICATION
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
LINE IS BUSY

FIG. 16


M-DTE
PS
V-PBX
H-PBX
HM
H-ROUTER
TA
+
CONVERSION TABLE
V-ROUTER
TA
+
DTE
IP PACKET
IP PACKET
CONVERSION TABLE SEARCH (INCOMING IP ADDRESS)
IP ADDRESS
EXTENSION NUMBER
INCOMING EXTENSION NUMBER NOTIFICATION
INQUIRY OF LOCATION REGISTRATION DATA
CONNECTION REQUEST
CONNECTION REQUEST
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
CONNECTION ACKNOWLEDGMENT
LINE IS BUSY