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Abstract

The invention concerns a method to provide connections between a calling communication instrument of a first communication network and a called communication instrument of a further communication network by using a gateway as well as it concerns a corresponding gateway. In this conjunction the gateway manages a first group of a first number \(N\) of available channels of a first further communication network and at least one second group of a second number \(M\) of available channels of a second further communication network and provides an available channel of the relevant communication network for a request for connection is made. The invention provides that the number of available channels is dynamically determined in each group, while when changing the determination at least one available channel of one of the groups is removed and is allocated to another group and consequently allocated to another communication network. For this purpose a plug-in card, provided with an identification signal specific to each communication network is provided for each available channel. A changing of the number of useful channels in a group is carried out thus that the plug-in card is changed for one or several available channels and at the same time the plug-in card of another communication network is used. This makes a utilisation of the resources, taking the requirements into consideration, possible.
Invention Title: Method and gateway to provide connections, particularly between a fixed telecommunication network and a mobile radio telecommunication network

The following statement is a full description of this invention, including the best method of performing it known to us:
Method and gateway to provide connections, particularly between a fixed telecommunication network and a mobile radio telecommunication network

Description

The invention concerns a method to provide connections between a calling communication instrument of a first communication network and a called communication instrument of a further communication network by using a gateway according to the preamble of claim 1. The method is particularly used for the provision of connections between a fixed telecommunication network and a mobile radio telecommunication network. Furthermore the invention concerns a gateway that is located at the transition point between the two communication networks.

Background of the invention

So called mobile radio gateways are known, that provide an interface between the fixed telecommunication network and mobile radio telecommunication networks. A mobile radio gateway is called by the user of a fixed network terminal and establishes the required connection in the mobile radio network in which the called subscriber is situated. For this purpose the mobile radio gateway implements the functionality of a mobile radio telephone and accordingly, as a mobile radio telephone, calls the called subscriber.

At the same time provision is made for the mobile radio gateway to contain a plurality of so called SIM cards for the mobile radio channels that are to be managed. By virtue of the SIM cards each mobile radio channel is allocated precisely to one network operator.

Summary of the invention

In one aspect the present invention provides a method to provide connections between a calling communication instrument of a first communication network and a called communication instrument of a further communication network by using a gateway, that is connected to a first communication network wherein

- the gateway
manages a first group of a first number \((N)\) of available channels of a first further communication network and

- at least one second group of a second number \((M)\) of available channels of a second further communication network;

- to establish a connection between the calling communication equipment and the called communication equipment information regarding a request for connection from the calling communication equipment is routed first to the gateway,

- based on the information received, the gateway determines as to which further communication network the called communication equipment is allocated, and

- the gateway provides an available channel of the relevant communication network for the connection,

characterised in that

the number of available channels is dynamically determined in each group, while when changing the determination at least one available channel of one of the groups is removed and is allocated to another group and consequently allocated to another communication network,

- for this purpose for each available channel a plug-in card, specific for a communication network and having an identification signal, is provided, while plug-in cards of the same communication network are allocated to the available channels of a group, and

- a change of the number of available channels in a group is carried out by that for one or several available channels the plug-in card is changed and in this conjunction the plug-in card of another communication network is used.

The present invention is based on the idea that the available channels, managed by the gateway, are dynamically allocated to the individual communication networks, i.e. depending on the actual demand. When the demand changes, the communication network is automatically changed to one or several available channels, so that a greater number of available channels and a greater band width is available to this communication network. Such a change takes place, of course, only when the available channels allocated so far to other
communication networks, are at least partially available, i.e. is not busy, so that they can be allocated to another communication network.

The solution according to the preferred embodiments of the invention substantially improves the utilization of the existing network resources by means of a flexible and dynamic allocation of available channels to the individual communication networks depending on the demand. Thus a preferred embodiment of present invention provides a method to enable connections between a calling communication instrument of a first communication network and a called communication instrument of a further communication network by using a gateway to be used in such a method, that is characterised by a great degree of flexibility and makes an effective use possible of the existing available channels.

It is pointed out, that in the sense of this invention it is understood that the term gateway is any system, that is provided at a network point, at which a transition or an access to another communication network is present. In particular, it is understood that the term gateway is a system, that is provided at the interface between a fixed telecommunication network and a mobile radio telecommunication network, and that establishes requests for connection arriving from the fixed network to the associated mobile radio network.

Under a connection between a calling communication instrument and a called communication instrument any configuration is understood, that enables a transfer of data between the communication instruments feasible. A request for connection comprises signalling information, emitted by the calling communication instrument to establish a connection with the called communication instrument. Depending on the transmission technique used, such signalling data can be transmitted on the same channel on which the useful data is transmitted (in-band signalling) or on another channel (out-band signalling).

An available channel is every path through a communication network or a plurality of communication networks connected with one another, through which signals and data can be carried. At the same time the term "available channel" should embrace both the physical transmission channels and the logical channels. Physical transmission channels are, for example, a channel of a classical telephone network, an ISDN-B channel or a physical radio transmission
channel of a mobile radio network. A logical channel abstracts the actual data transmission path and disconnects a point-to-point communication via defined physical media.

It is further pointed out, that in the sense of this invention the term plug-in card is to be understood with regard to its function. In fact, as a rule one deals with a physical card having a chip. Basically, however, the function of a plug-in card can also be provided by means of software, that is downloaded over the Internet, by radio or a CD on a telecommunication instrument.

A preferred development of the invention provides that the determination of the number of available channels is carried out automatically within the individual groups, in a case when a specifiable number of free available channels of a group is no longer available. As an example, in each group of available channels one available channel is always kept ready. Thus, if based on the actual load, it is determined that a group of available channels does not have any free available channel or only a number of free available channels that is below a specified number, a check will be carried out in another group whether there are any free available channels available. If that is the case, at least one free available channel of the other group is added to the group being considered in the first place, the one that has no free available channels at all or only an inadequate number of them. Accordingly, the available resources of available channels can be automatically and in real time adjusted to suit the existing demand. Thus the changing and new reallocation of available channels can be carried out in a proactive manner.

By virtue of the preferential readiness of at least one free available channel in each group of available channels it will be ensured that an incoming request to connect can be immediately established.

Alternatively, the number of available channels of each group is determined initially when a request for connection is presented, and in this situation at least one available channel is newly allocated when during an incoming request for connection it is established that no available channel is available in the communication network allocated to the called communication instrument. In the case of this version an available channel of another group is
allocated to the group with the actual demand for an available channel only when that demand arises.

In the case of the first communication network one preferably deals with a fixed telecommunication network and in the case of the further communication networks with mobile radio telecommunication networks. At the same time the gateway has facilities for a mobile radio communication with communication instrument of further mobile radio networks. For this purpose a plug-in card, provided with an identification signal specific to each mobile radio network, is provided for each available channel. One deals here particularly with a SIM card.

A SIM card contains an identification signal by which it can be unambiguously identified in all mobile radio networks. Moreover, a SIM card has a PIN (personal identity number) number, security-relevant data like communication codes and security algorithms, user-specific data like speed dial numbers as well as network-specific data like the identification signal of the actual area of location. A SIM card personalises a mobile station with regard to the subscriber and the service provider and enables the service provider to bill the call fees.

A preferred development provides that for each available channel plug-in cards are reserved for at least two communication networks, in particular mobile radio networks. A change of a plug-in card is then executed by using a program in such a manner that the required new plug-in card for the available channel being considered is activated, and its current plug-in card is deactivated.

In a second aspect there is provided a gateway that is connected with a first communication network and manages a first group of a first number \(N\) of available channels of a first further communication network and at least one second group of a second number \(M\) of available channels of a second further communication network, and has:

- means to evaluate information regarding a request to connect by a calling communication instrument of the first communication network;

- means to establish a connection to a called communication instrument of one of the further communication networks; and for this purpose
- means to make an available channel of the relevant communication network available for the connection required,

characterised by

- a plurality of plug-in cards provided with an identification signal,

wherein a plug-in card, specific to a communication network is allocated to each available channel and plug-in cards of the same communication network are allocated to the available channels of a group,

- means dynamically determining the number of available channels in each group, while when the determination is changed at least one available channel is removed from one of the groups and thus is allocated to another communication network, and wherein

- the means of determination of a change of the number of available channels of a group bring about a change of the plug-in card for one or several available channels, while a changed plug-in card is allocated to another one of the communication networks.

In a third aspect the present invention provides a method to provide connections between a calling communication instrument of a first communication network and a called communication instrument of a further communication network using a gateway connected to the first communication network, said gateway being configured to manage a first group of \( N \) available channels of a first further communication network and at least one second group of \( M \) available channels of a second further communication network to establish a connection between the calling communication instrument and the called communication instrument, wherein each channel is provided with a plug-in card corresponding to one of said further communication networks and wherein channels having plug-in cards corresponding to the same further communication network are allocated the group of channels for that respective further communications network, said method including:

routing information regarding a request for connection from the calling communication instrument to the gateway;

determining, based on the information received, which further communication network the called communication instrument is allocated to, and
providing an available channel of the relevant further communication network for the connection, wherein the number of available channels in each group is dynamically determined, and in the event that a change in the number of available channels in a particular group is required,

exchanging the one or more plug-in cards allocated to one or more channels of the particular group with plug-in cards of a different group.

In a fourth aspect the present invention provides a gateway that is connected with a first communication network and manages a first group of a first number \((N)\) of available channels of a first further communication network and at least one second group of a second number \((M)\) of available channels of a second further communication network, said gateway including:

- a plurality of plug-in cards corresponding to channels of the further communications networks, wherein each plug-in card is associated with a particular one of said further communications network, and channels having plug-in cards corresponding to the same communication network are allocated to the available channels of a group,

- means to evaluate information regarding a request to connect received from a calling communication instrument of the first communication network;

- means to establish a connection to a called communication instrument of one of the further communication networks; and

- means to make an available channel of the relevant further communication network available for the connection required, including

  - means for dynamically determining the number of available channels in each group, and in the event that the determined number of channels in a particular group changes, replacing the plug-in card allocated to at least one channel of the particular group with a plug-in card associated with another group, to allocate the at least one channel to the other communication network.

**Description of several preferred embodiments**

The invention is explained in detail below with reference to the figures of the drawing based on several embodiments. They show in:

- Fig.1 - a telecommunication configuration with a fixed telecommunication network and a mobile radio gateway connected to it,
Fig. 2 - schematically the construction of a mobile radio gateway according to Fig. 1.

Fig. 3 - schematically the construction of a plug-in card of a gateway according to Fig. 2.

Fig. 4 - the top and bottom sides of a SIM card plug-in unit of a plug-in card according to Fig. 3.

Fig. 5a - schematically a functional block circuit diagram of a mobile radio gateway in a first allocation state, and

Fig. 5b - schematically a functional block circuit diagram of a mobile radio gateway in a second allocation state.

Fig. 1 shows a telecommunication configuration that enables a connection between a calling communication instrument 1, 1' of a first communication network and a called communication network 2, 2' of a further communication network. In the case of the communication instrument 1, 1' the embodiment illustrated deals with a telecommunication terminal unit, for example a telephone or a computer with an ISDN card.

A telecommunication terminal unit 1, in Fig. 1 illustrated in the form of an example as a telephone, is connected in a manner known per se via a local exchange (not illustrated) with a line switched telecommunication network 3 (PSTN - public switched telephony network). In the case of the telecommunication network 3 one deals particularly with the network of the former monopoly, in Germany the Deutsche Telekom AG. Via a so called interconnect connection ICA 6 the telecommunication network 3 is connected with the telecommunication network 4 of a further alternative network supplier. The connection of the communication networks via the interconnection switches is known per se, so that it will be not discussed in detail. The operator of network 4 pays an interconnect fee for the connection to the operator of network 3. Alternatively, corresponding to the terminal unit 1' illustrated in Fig. 1, a terminal unit is directly connected to network 4 of an alternative network supplier.

Furthermore, a mobile radio gateway 5 is connected to network 4. The connection of the mobile radio gateway 5 to network 4 is carried out, for example, by at least one primary rate interface (PRI) connection 18 of the integrated
service network ISDN, that makes available thirty B data channels and one D signalling channel (E1 line). Alternatively, the mobile radio gateway 5 can be basically also directly connected to network 3 of the former monopolies.

The mobile radio gateway 5 enables a network entry to a plurality of mobile radio networks 7, 8. In this case one deals, for example in Germany, with the networks D1, D2 and E-Plus. Fig.1 shows, for example, two networks 7, 8. A called communication instrument of such a mobile radio network 7, 8 is, for example, a mobile radio telephone 2, 2', that is individualised by the SIM card and allocated to the corresponding mobile radio network 7, 8. Thus via the respective mobile radio network 7, 8 a telecommunication connection with a mobile radio telephone 2, 2' can be formed.

If now a terminal unit 1, 1' of the fixed network 3, 4 wants to establish a telecommunication connection, in particular a telephone connection, with a terminal unit 2, 2' of a mobile radio network 7, 8, the request to connect will be transmitted to the mobile radio gateway 5 via the telecommunication network 3, 4 to which the calling terminal unit 1, 1' is connected, with the possible interconnection of a further telecommunication network 4.

As will be explained further below, in the mobile radio gateway 5 a plurality of mobile stations are integrated, that make an access of the mobile radio gateways 5 to the individual mobile radio networks 7, 8 possible. Based on the prefix number of the incoming call the mobile radio gateway 5 recognises the mobile radio network allocated to the called terminal unit 2, 2'. To establish a connection between the calling terminal unit 1, 1' and the called terminal unit 2, 2' it makes an available channel of the corresponding mobile radio network 7, 8 available. At the same time the mobile radio gateway 5 itself serves as a mobile radio equipment and calls it via the mobile radio network in which the called terminal unit 2, 2' is situated.

The call is the relayed in a manner known per se via a transmitting/receiving station BTS (base transceiver station), an associated control device and a further network infrastructure of the mobile radio network 7, 8 to the called terminal unit 2, 2'.

As an alternative, it is feasible to establish a connection in a mobile radio network 7, 8 via a transfer point of the telecommunication network 3. Such
transfer points, that relay the call to the mobile radio network, are known per se and are being used. However, telecommunication connections formed in this manner have the disadvantage of high fees raised by the operator of the telecommunication network 3 for relaying the call to the mobile radio network, while interconnect fees may also be added. In contrast to this, a connection formed in accordance with Fig.1 between a calling terminal unit 1, 1' in the fixed network and a called terminal unit 2, 2' of a mobile radio network is characterised by a basically more favourable price structure, since the mobile radio connection between the gateway 5 with the called terminal equipment 2, 2' as well as the fixed network connection between the called terminal equipment 1, 1' and the mobile radio gateway 5 are comparatively cost effective. Instead of the cost for a call from the fixed network to the mobile one, the cost of a call is from mobile to mobile plus modest additional cost for the fixed network.

Figs. 2 to 4 show in detail the construction of a mobile radio gateway 5. According to Fig. 2 the mobile radio gateway has a central processor unit 51, a graphic card 52, a hard disk and floppy drive 53, a power supply 54 and a fan 56. A plug-in card 55 provides three PRI (E1) links to the fixed network, while a different quantity of E1 links may also be envisaged. The plug-in card 55 provides a coupling multiplexer, via which the incoming connections are allocated to an output or an available channel of the mobile radio network. Alternatively, the coupling multiplexer can be provided by appropriate software in the central processing unit 51.

Furthermore, the mobile radio gateway 5 has a plurality of plug-in cards 57 for the mobile radio, each of them making available a plurality of mobile stations, in the embodiment illustrated four mobile stations. According to the prevailing standard in the field of mobile radios one deals with GSM mobile stations (GSM – global system for mobile communication).

A plug-in card 57 for the mobile radio is illustrated in detail in Fig. 3. The plug-in card 57 has on its front and rear sides two GSM modules 10a, 10b each, while Fig. 3 shows only the GSM modules 10a, 10b illustrated on the top side. Each GSM module 10a, 10b, illustrated only schematically, has the functionality of a mobile equipment of a mobile radio network. To each GSM module 10a, 10b a plurality of SIM cards are allocated, while at any given time only one SIM card
is activated. The SIM cards are arranged in a SIM card insertion slot 11. A GSM module 10a, 10b and a SIM card form a mobile station of a mobile radio network.

The address of the plug-in card 57 can be set via a DIP field 12. A connection to an internal coupling multiple of the gateway 5 is carried out via a PCM bus 14 or an IOM bus 13. An aerial 15 to transmit or receive radio signals is screwed to the rear of the card. Furthermore, the plug-in card 57 has preferably an independent processor 16 with an operating system, that controls the individual modules. Alternatively, the control is carried out exclusively via the central processing unit.

Fig. 4 shows in detail the SIM card insertion slot 11 of Fig. 3. Accordingly, on the front and rear sides of the SIM card insertion slot 11 accommodation is provided for eight SIM cards 17 each, so that a total of sixteen SIM cards 17 can be accommodated. At the same time a maximum of four SIM cards 17 can be allocated to each GSM module 10a, 10b. For example, to one GSM module 10a four SIM cards 17-1, 17-2, 17-3, 17-4, to GSM module 10b four plug-in cards 17-5, 17-6, 17-7, 17-8, etc. are allocated. In any case, not all the accommodation spaces have to be used.

The way things stand, for each actual connection in a mobile radio network 7, 8 only one SIM card 17 can be inserted. For each mobile radio connection or each available channel allocated to it, a selection has to be and can be made, as to which of the four available SIM cards 17 will be allocated to a required connection. For example, SIM card 17-1 may mean a SIM card of D1 network, SIM card 17-2 a SIM card of the D2 network, and SIM card 17-3 a SIM card of the E-Plus network. Depending on whether a called terminal subscriber is part of D1, D2 or E-Plus network, the corresponding SIM card will be activated.

At the same time an initial allocation is carried out. In the embodiment illustrated the mobile radio gateway 5 has eight mobile radio plates 57 with four GSM modules each, so that a maximum of thirty-two available channels can be made available for a mobile radio network. As an example, it would be possible to provide ten of these thirty-two available channels to access the D1 network, ten available channels to access the D2 network and twelve available channels to access the E-Plus network. This would be achieved by activating ten available channels the SIM cards for the D1 network, for a further ten available channels
the SIM cards for the D2 network and for a further twelve available channels the SIM cards for the E-Plus network. Thus groups of available channels are formed for the D1, D2 and E-Plus networks.

If now the central processing unit 51 of the gateway 5 or another control unit determines that for a certain mobile radio network, e.g. the D1 network, the available channels provided are fully or almost fully engaged, for example only one more free available channel or another, allocatable number of free available channels are available, it will then check whether in the other group of available channels for D2 and/or in the other group of available channels for E-Plus adequate mobile radio channels are still available. An adequate number of mobile radio channels are available when, for example, the occupation is lower than the inadequate occupation of the group being considered. For this case an available channel of the group with a low load is dynamically connected to the group of available channels of the D1 network, so that now it will have eleven available channels.

To achieve this switchover of an available channel, on one of the mobile radio cards 57 for an available channel, that so far was allocated to another group or another mobile radio network, the SIM card for the D1 network is activated and the card used so far will be deactivated. This is possible, since corresponding SIM cards are reserved for all or at least two networks and they are inserted into corresponding SIM card insertion slots 11.

In this conjunction the switchover of the SIM card is performed automatically by a relevant programming and dynamically depending on the loading of the available channels of the individual mobile radio networks. The available resources of available channels adapt automatically to suit the requirement at the time.

This process is additionally explained on Figs.5a and 5b. Fig.5a shows a coupling multiplexer 19, that is illustrated, for example, in the plug-in card 55 for a PRI (E1) - connection in to Fig.2. The coupling multiplexer 19 is connected to a fixed network via a PRI terminal 18 according to Fig.1. The incoming, multiplexed data channels of the PRI terminal 18 are divided via the coupling network 19 to a plurality of individual data channels 20-1, 20-2, 20-3 and 20-4. This is controlled by the central processor 51 of the gateway 5 or another control unit.
For the purpose of a simpler illustration in Fig.5 only four GSM modules 10a, 10b, 10c, 10d, each with two SIM cards 17-1, 17-2, 17-3, 17-4, 17-5, 17-6, 17-7, 17-8 and two mobile radio networks 7, 8 are provided. By means of the software-controlled switch S one SIM card each 17-1, 17-3, 17-6, 17-8 are assigned to the data channels 20-1, 20-2, 20-3, 20-4. The control of switch S is carried out by means of the central processor 51 or another control unit. For a mobile radio transmission an available channel 21, 22, 23, 24 is provided to data channels 20-1, 20-2, 20-3, 20-4, respectively, via the GSM modules 10a, 10b, 10c, 10d. The assignment of an available channel 21, 22, 23, 24 to a mobile radio network 7, 8 is carried out via the selected SIM card. In the embodiment of Fig. 5a SIM cards 17-1, 17-3, that are assigned to the SIM cards of mobile radio network 7, are selected for the two upper available channels 21, 22. For the two lower available channels 23, 24 the SIM cards 17-6, 17-8, that are assigned to the mobile radio network 8, are selected. The other SIM cards 17-2, 17-4, 17-5, 17-7 are not activated.

Both upper available channels 21, 22 form a first group of a first number $N$ of available channels of the mobile radio network 7, where $N$ in the example illustrated equals two. The two lower available channels 23, 24 form a second group of a second number $M$ of available channels of the mobile radio network 8, where $M$ in the example illustrated also equals two.

When an additional available channel is required for the mobile radio network 7, by changing the SIM card of an available channel an additional available channel is made available for the mobile radio network 7. In the embodiment of Fig.5b the SIM card 17-6 for the network 8 is deactivated and instead of it the SIM card 17-5 is activated for the network 7. The control is carried out by means of the central processor 51 of the gateway 5 or another control unit. The available channel 23 is now assigned also to the network 7. The number of available channels of the first group is increased by one, the number of available channels of the second group reduced by one. When the load of the available channels changes, the configuration of the available channels can be dynamically changed again.

Returning to Fig.1, in the form of an example, a call directed to a terminal unit 2 of the network 7 is established by the mobile radio gateway 5 to a GSM
module 10a, 10b, 10c, 10d, that is connected with a SIM card 17 of the corresponding network 7. Provided the central processor 51 or another control unit of the mobile radio gateway 5 determines that no available channel or an inadequate number of available channels is available for network 7 under consideration, yet available channels for other mobile radio networks 8 are available in adequate numbers, the number of the available channels is newly determined for at least two groups of available channels and on this occasion at least one available channel of the group of available channels is added to the mobile radio network 7 under consideration. As explained, this is carried out by changing the SIM card 17 for the available channel in question.

The invention is not limited to the embodiments illustrated above. For example, a mobile radio gateway may have a different number of mobile radio plug-in cards, each mobile radio plug-in card a different number of GSM modules and each GSM module a different number of SIM cards than those illustrated.

The invention is not limited to the fact that the gateway represents an interface between a fixed network and a plurality of mobile radio networks. The dynamic allocation of available channels can also be essentially carried out in other communication networks.
Claims

1. A method to provide connections between a calling communication instrument of a first communication network and a called communication instrument of a further communication network by using a gateway, that is connected to a first communication network wherein

- the gateway
  - manages a first group of a first number \(N\) of available channels of a first further communication network and
  - at least one second group of a second number \(M\) of available channels of a second further communication network;
- to establish a connection between the calling communication equipment and the called communication equipment information regarding a request for connection from the calling communication equipment is routed first to the gateway,
- based on the information received, the gateway determines as to which further communication network the called communication equipment is allocated, and
- the gateway provides an available channel of the relevant communication network for the connection,

characterised in that

- the number of available channels is dynamically determined in each group, while when changing the determination at least one available channel of one of the groups is removed and is allocated to another group and consequently allocated to another communication network,
- for this purpose for each available channel a plug-in card, specific for a communication network and having an identification signal, is provided, while plug-in cards of the same communication network are allocated to the available channels of a group, and
- a change of the number of available channels in a group is carried out by that for one or several available channels the plug-in card is changed and in this conjunction the plug-in card of another communication network is used.
2. A method according to claim 1, characterised in that a change in the
determination of the number of available channels is carried out automatically
within the individual groups when a specifiable number of free available channels
of a group is no longer available.

3. A method according to claim 2, characterised in that in each group
of available channels one available channel is always kept ready.

4. A method according to at least one of claims 1 to 3, characterised in
that the number of available channels in each group is determined initially when a
request for connection is presented and at least one available channel is newly
allocated, provided no available channel of the communication network allocated
to the called communication instrument is available.

5. A method according to at least one of claims 1 to 4, characterised in
that the first communication network is a fixed telecommunication network and
the further communication networks are mobile radio telecommunication
networks.

6. A method according to at least one of claims 1 to 5, characterised in
that a change of a plug-in card is executed by using a program, wherein for each
available channel plug-in cards of at least two communication networks are
reserved, and the required new plug-in card is activated, in contrast to this the
current plug-in card is deactivated.

7. A gateway that is connected with a first communication network and
manages a first group of a first number \( N \) of available channels of a first further
communication network and at least one second group of a second number \( M \)
of available channels of a second further communication network, and has:

- means to evaluate information regarding a request to connect by a calling
communication instrument of the first communication network;

- means to establish a connection to a called communication
instrument of one of the further communication networks; and for this purpose

- means to make an available channel of the relevant communication

network available for the connection required,

characterised by
- a plurality of plug-in cards provided with an identification signal, wherein a plug-in card, specific to a communication network is allocated to each available channel and plug-in cards of the same communication network are allocated to the available channels of a group,

5 means dynamically determining the number of available channels in each group, while when the determination is changed at least one available channel is removed from one of the groups and thus is allocated to another communication network, and wherein

- the means of determination of a change of the number of available channels of a group bring about a change of the plug-in card for one or several available channels, while a changed plug-in card is allocated to another one of the communication networks.

8. A gateway according to claim 7, characterised in that the means of determination automatically carry out a change of the determination of the number of available channels in the individual groups when a specifiable number of free available channels of a group is no longer available.

9. A gateway according to claim 8, characterised in that the means of determination always keeps one free channel available in each group of available channels.

10. A gateway according to at least one of claims 7 to 9, characterised in that the means of determination newly determines the number of available channels in each group initially when a request for connection is presented and, if no available channel of the communication network allocated to the called communication instrument is available, newly allocate at least one available channel.

11. A gateway according to at least one of claims 7 to 10, characterised in that the first communication network is a fixed telecommunication network and the further communication networks are mobile radio telecommunication networks.

12. A gateway according to at least one of claims 7 to 11, characterised in that for each available channel plug-in cards of at least two communication networks are allocated to the gateway and when the determination changes by
using a program the means of determination deactivate the currently activated
plug-in card for the available channel in question and activate another plug-in
card allocated to the required communication network.

13. A method to provide connections between a calling communication
instrument of a first communication network and a called communication
instrument of a further communication network substantially as described herein
with reference to any one of the illustrative embodiments.

14. A gateway substantially as described herein with reference to any
one of the illustrative embodiments.

15. A method to provide connections between a calling communication
instrument of a first communication network and a called communication
instrument of a further communication network using a gateway connected to the
first communication network, said gateway being configured to manage a first
group of $N$ available channels of a first further communication network and at
least one second group of $M$ available channels of a second further
communication network to establish a connection between the calling
communication instrument and the called communication instrument, wherein
each channel is provided with a plug-in card corresponding to one of said further
communication networks and wherein channels having plug-in cards
corresponding to the same further communication network are allocated the
group of channels for that respective further communications network, said
method including:

- routing information regarding a request for connection from the calling
  communication instrument to the gateway;

- determining, based on the information received, which further
  communication network the called communication instrument is allocated to, and

- providing an available channel of the relevant further communication
  network for the connection, wherein the number of available channels in each
group is dynamically determined, and in the event that a change in the number of
available channels in a particular group is required,

- exchanging the one or more plug-in cards allocated to one or more
  channels of the particular group with plug-in cards of a different group.
16. A gateway that is connected with a first communication network and manages a first group of a first number \(N\) of available channels of a first further communication network and at least one second group of a second number \(M\) of available channels of a second further communication network, said gateway including:

a plurality of plug-in cards corresponding to channels of the further communications networks, wherein each plug-in card is associated with a particular one of said further communications network, and channels having plug-in cards corresponding to the same communication network are allocated to the available channels of a group,

means to evaluate information regarding a request to connect received from a calling communication instrument of the first communication network;

means to establish a connection to a called communication instrument of one of the further communication networks; and

means to make an available channel of the relevant further communication network available for the connection required, including

means for dynamically determining the number of available channels in each group, and in the event that the determined number of channels in a particular group changes, replacing the plug-in card allocated to at least one channel of the particular group with a plug-in card associated with another group, to allocate the at least one channel to the other communication network.
FIG 2

- Power Supply
- CPU board
- VGA board
- 3PRI-Board
- 4GSM-Board 1
- 4GSM-Board 2
- 4GSM-Board 3
- 4GSM-Board 4
- 4GSM-Board 5
- 4GSM-Board 6
- 4GSM-Board 7
- 4GSM-Board 8
- Harddisk + Floppy
- Fan
FIG 4

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