

**METHOD OF ADVANCED CALL HANDLING AND EXCHANGE
AND SYSTEM THEREOF**

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FIELD OF THE INVENTION

The present invention relates to advanced call handling and exchange. More particularly, a private call-back exchange (PCBX) system using only a single telephony link is capable of providing call routing and call session establishment between a calling party and a called party by means of a plurality of advanced call establishment processes comprising a call-back process and a call-through process; and in its call routing process, the system takes reference of a plurality of criteria comprising the identity of said calling party, the selected service option and the telephone number of the intended called party.

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BACKGROUND OF THE INVENTION

With the telecommunications industry being opened up for higher level of competition, telecommunication operators have been active in widening product ranges to attract new users and reduce subscriber churn rate. However, low-cost telephony services using the conventional call-back mechanism has its own limitations and drawbacks, as they rely upon originating telephone calls from countries having lower telecommunications tariffs. As such, these services are available for international and long-distance call services. Furthermore, the quality of services and call charges vary a great deal for different destinations and operators. Conventional call-back

systems, such as those disclosed in US patents 5784438 & 6088436, are operator grade and they may not be suitable for private use.

5 In contrast, the PCBX system of the present invention is implementable with a dedicated small form-factor embedded device having micro-controller capability. In addition, the system requires only a single telephony line and it may be used to serve a group of registered users, thus the system is
10 ideal for use at homes and offices.

The advanced call handling and exchange processes implemented by the PCBX system of the present invention enable personal users to take advantage of today's telephony products including free outgoing calls on the majority of cellular networks,
15 low-cost or free three-party conference and explicit call transfer services, low-cost unlimited broadband access capable of supporting high-quality voice over internet protocol (VOIP) services that require high transfer data rates.

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Furthermore, the PCBX performs advanced call handling and exchange using innovative call establishment and routing processes, which enable private users to enjoy high-quality and low-cost or even free cellular telephony and long-distance
25 call services.

The PCBX of the present invention is capable of providing call routing and call session establishment between a calling party and a called party by means of a plurality of advanced
30 call establishment processes comprising a call-back process and a call-through process. In addition, the system uses a plurality of unique routing criteria comprising the identity

of said calling party, the selected service option and the telephone number of the intended called party.

5 SUMMARY OF THE INVENTION

The present application provides a method and system for advanced call handling and exchange.

10 A method of advanced call handling and exchange is provided. In the method, a private call-back exchange (PCBX) system is used to continuously monitor for an incoming call and service request initiated by a calling party and establish a call session with an intended called party when the respective
15 routing criteria are met, and both the calling and called parties are coupled to the PCBX via at least one public telephony exchange and network which is coupled to the PCBX system via a single telephony link, and one of the calling and called parties is a registered user whose telephone num-
20 ber has been saved in the PCBX.

The method begins with the derivation of a call routing decision through executing a call routing process and the routing decision is based upon a plurality of criteria comprising the
25 identity of the calling party, the service option selected by the calling party and the telephone number of the intended called party entered by the calling party. Then a call establishment process is selected out of a plurality of available establishment processes. The selection is based upon the de-
30 rived call routing decision, and the available call establishment processes comprise a call-back process. The method further executes the selected call establishment process.

In the method, the selected call establishment process is the call-back process if the calling party is a registered user. The call-back process begins with the system making an outgoing call and establishing a call session with the calling party upon detecting that the calling party has terminated the incoming call. The process then awaits the calling party to enter the telephone number of the called party, and any predefined code sequences used to represent service options and any other predefined tasks. The process further establish a call session between the calling and called parties by executing a call connection process. Announcements may be played to remind the calling party of the routed calls that he has failed to answer, and the announcements may comprise any other necessary reminders for the calling party, such as available service options and their respective code sequences. The entered code sequence may be continuously compared against some default code sequences for service options, telephone numbers stored and telephone numbers saved in system call records, and if the level of similarity exceeds a predefined level, the PCBX automatically may complete the code sequence, and prompt the calling party for selection if the code sequence is sufficiently close to more than one service option or stored telephone number.

In the method, the selected call establishment process is a call-through process if the called party is a registered user and the calling party has previously requested for call session establishment with the called party, or the called party is a registered user who has stored the telephone number of said called party in said PCBX. The call-through process begins with the system prompting the calling party to choose the telephone number of the intended registered user, and es-

establishing a call session between the calling and called parties by executing a call connection process.

In the method, the selected call establishment process is a
5 call-premises process if the telephone number of the calling party cannot be retrieved from the incoming call, or the telephone number of the intended called party entered by the calling party is the telephone number of the telephony link connecting the PCBX and the public telephony exchange and
10 network, or the criteria for the above-said call-back and call-through process are not met. The call-premises process begins with the incoming call originated by the calling party is routed to a premises telephony device which is directly coupled to the PCBX. The process further alerts any user at
15 the premises to answer the call by means of activating the appropriate visual or audio transducers on the PCBX or the premises telephony device.

In the method, the call connection process begins with the
20 system putting the calling party on hold while making an outgoing call to the called party using the telephone number provided by the calling party. The process further establishes a call session between the called and calling parties based upon the supplementary telephony services available to
25 the telephony link connecting the PCBX and the public telephony exchange and network. The supplementary services comprise at least one of three-party conference call and explicit call transfer services. Announcements may be played to request for the called party to press a key on his telephony device, and
30 when the called party activates the key as requested, a DTMF tone is sent to alert the PCBX that the call session with the called party has been established. Furthermore, the telephone

number of any unregistered user is saved in the system call records of the PCBX.

In the method, a calling party who is a registered user may enter the telephone number of a user to be registered, and the entered telephone number is then saved in the corresponding memory of the PCBX. In addition, a calling party who is a registered user may enter the telephone number of an existing registered user, and the entered telephone number is removed from the corresponding memory of the PCBX. Furthermore, for first-time registration and when the PCBX has no record of any registered user, a calling party may originate a call to the PCBX and activate a dedicated switch on the PCBX.

A separate and dedicated communication link coupling the PCBX system and the Internet may be used in the method to provide voice over internet protocol (VOIP) communications between a registered user and a called party having access to equipment and network capable of VOIP communications.

A system for advanced call handling and exchange is provided. The system comprises a private call-back exchange (PCBX) having memories for storing call records, telephone numbers of called parties and registered users, and a processor capable of computing call routing decision and executing call establishment processes. The call establishment process comprises a call-back process in which the PCBX calls back a calling party, who is a registered user, for the telephone number of a called party and intended service option when the PCBX has detected that the calling party has terminated an incoming call, a call-through process in which an unregistered user being routed and connected to a registered user, and a call-premises process in

which the calling party being routed and connected to a premises telephony device directly coupled to the PCBX.

In the system, the calling and called parties are coupled to the PCBX via at least one public telephony exchange and network which is coupled to the PCBX system via a single telephony link. Furthermore, the telephony link supports supplementary comprising at least one of three-party conference call and explicit call transfer services.

The PCBX may have a dedicated switch for first-time registration and when the PCBX has no record of any registered user. The user activates the switch while originates a call to the PCBX to complete the process.

The public telephony exchange and network and the telephony devices used by the calling and called parties may be of any types including analogue, digital, fixed-line, wireless, cellular, circuit-switched, VOIP (voice over internet protocol) and other types of packet-switched networks, and the calling and called parties may be in the same or in different countries.

The PCBX may be implemented by programming all associated call handling process flows in a software or firmware application executable in an embedded device with micro-controller capability and the call handling software application may also be executable on computing devices including server computers, client computers, personal computers and portable computers.

A separate and dedicated communication link coupling the PCBX system and the Internet may be used in the system to provide

voice over internet protocol (VOIP) communications between a registered user and a called party having access to equipment and network capable of VOIP communications.

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BRIEF DESCRIPTION

Embodiments according to the present invention will now be described with reference to the following figures, in which
10 like reference numerals denote like elements.

FIG. 1 illustrates a private call-back exchange (PCBX) system configured to implement all the call-handling processes of the present invention.

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FIG. 2 illustrates the flow of a call handling process executed by the private call-back exchange system of FIG. 1.

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FIG. 3 illustrates the flow of the call routing process executed in the call handling process of FIG. 2.

FIG. 4 illustrates the flow of the call-back process executed in the call handling process of FIG. 2.

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FIG. 5 illustrates the flow of the call connection process executed in the call-back process of FIG. 4 and call-through process of FIG. 2 & FIG. 7.

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FIG. 6 illustrates the flow of a call-premises process executed in the call handling, call-back and call-through processes of FIG. 2, FIG. 4 & FIG. 7 respectively.

FIG. 7 illustrates the flow of a call-through process executed in the call handling process of FIG. 2.

5 FIG. 8 illustrates the flow of a registration process executed in the call-back process of FIG. 4.

DETAILED DESCRIPTION

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FIG. 1 illustrates a private call-back exchange (PCBX) system configured to implement all the call-handling processes of the present invention.

15 A private call-back exchange (PCBX) 130 capable of routing calls and supporting telephony communications is coupled to the telephony devices 110 and 150 via public telephony exchanges and networks 120, and telephony links 125, 115 & 155. The PCBX 130 is in further communication with a premises telephony device 140 via a telephony link 145.

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The PCBX 130 has access to memory devices for writing and retrieving records 132 of the numbers of telephony devices used by registered users 150, call records 134 as well as any other telephone numbers 136 entered by the registered users.

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The PCBX 130 is capable of routing and connecting incoming calls initiated by the telephony devices of registered users 150 to a specific called party through a call-back process 400 (Fig. 4). The PCBX 130 is able to connect calls initiated from the telephony devices of unregistered users 110 to a specific called party by means of a call-through process 700 (Fig. 7). Furthermore, the PCBX 130 is capable of routing an

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incoming call to the premises telephony device 140 through a call-premises process 600 (Fig. 6).

The public telephony exchanges and networks (Public TXN) 120 are telecommunications infrastructures assessable to the registered and unregistered users. The Public TXN 120 may be a single network or it may comprise a plurality of inter-connecting telecommunications networks and exchanges. In addition, the PCBX 130, the telephony devices of unregistered users 110 and registered users 150 may be coupled to a single Public TXN 120 or they may be coupled to different public exchanges and networks 120 operated by the same or different telecommunications operators.

The Public TXN 120 can be of any types including analogue, digital, fixed-line, wireless, cellular, circuit-switched, VOIP and other types of packet-switched networks. As such, the PCBX 130 is capable of routing and connecting calls even when the calling and called parties are not in the same country. Furthermore, a second PCBX (not shown) may be connected between Public TXN 120 and the telephony devices of the unregistered users 110 to provide the unregistered users with the above-said call-back 400, call-through 700 and call-premises 600 processes.

The telephony links 125, 115, 145 & 155 provide fixed-line; wireless or cellular connection and they are capable of supporting all the telephony signals exchanged between the respective connected devices and equipments.

The telephony devices 140, 110 & 150 are fixed-line, wireless or cellular equipment used to enable the calling party to initiate calls and the called party to receive calls via the

respective telephony links to which said telephony devices are coupled. The telephony devices 140, 110 & 150 may range from analogue fixed-line to digital VOIP telephone sets of various international telecommunications standards and their
5 variants.

As an example of a deployment scenario, the telephony devices of registered users 150 may be cellular telephones and the registered users may be all the members of a family or all
10 the staff members of a company. Thus, the Public TXN 120 coupled to the telephony devices 150 comprises a cellular and a fixed-line networks and exchanges. The telephony link 155 is a cellular link whereas the telephony link 125 is a conventional analogue link supporting plain old telephone services
15 as well as Internet access. The telephony devices of unregistered users 110 may be cellular telephones and the unregistered users may be the friends and business associates of the registered users. Thus, the Public TXN 120 coupled to the telephony devices 110 may comprise a cellular network for un-
20 registered users who are in the same country as the registered users. The Public TXN 120 coupled to the telephony devices 110 may comprise the Internet (VOIP) for unregistered users who are not in the same country as the registered users.

25 For communication involving VOIP, a single telephony link 125 is typically sufficient to support both land-line and Internet connections. Without loss of generality, a separate and dedicated communication link coupling the PCBX system and the
30 Internet may also be used in the system to provide VOIP communications between a registered user and a called party having access to equipment and network capable of VOIP communications.

In order to access the features and services provided by the PCBX 130, a calling party, who may be a registered or unregistered user, initiates a call to the PCBX 130 by dialling
5 the telephone number uniquely associated with the telephony link 125 or the PCBX 130. The PCBX 130 is coupled to the Public TXN 120 via a single telephony link 125. In order to achieve call establishment between a calling party and a called party, the telephony link 125 must support three-party
10 conference calls or explicit call transfer service or any supplementary services that allow the PCBX 130 to establish call sessions between the calling and called parties. Thus, the PCBX 130 differs from some conventional call-back systems which require two such telephony links for normal operations.

15 The call-back process 400 enables a registered user, who is the calling party, to establish a call session with a called party by means of a mechanism in which the PCBX 130 calls back the telephony device of the registered user 150 upon receiving a call from the calling party. The PCBX 130 receives
20 and interprets a code sequence that the calling party has entered. The entered code sequence may comprise service option and the telephony number of the called party to which the PCBX 130 attempts to connect. The call-through process 700
25 allows an unregistered user to establish a call session with a registered user. The call-premises process 600 establishes a call session between a calling party and the premises telephony device 140 when the calling party indicates in the call-through process 700 or call-back process 400 that he or
30 she intends to call the premises telephony device or when the PCBX 130 fails to establish the identity of the calling parties in the call routing process 300.

Each call record 134 stores the telephone number of the called party and the telephone number of the corresponding calling party, who is a registered user, in the call-back process 400. The call record database 134 may be grouped under each registered user of the PCBX 130 for easy retrieval.

When attempting to establish a call session with the intended called party in the call-back 400 and call-through 700 processes, the PCBX 130 may repeatedly play a pre-recorded message informing the called party to press a key on his telephony device. The called party is able to listen to the recorded message when he answers the call. When the called party activates the key as requested, a DTMF (dual-tone multi-frequency) tone is sent to alert the PCBX 130 that the call session with the called party has been established. This is particularly useful for minimizing connection time when the called party has subscribed to ringback tone service for his telephony link or device. Ringback tones are network-generated melodies or music clips that a calling party can hear while the telephony device of the called party is ringing. Ringback tones may not be detectable by the PCBX 130 as ringing tones, hence affecting the normal call-back 400 and call-through 700 operations of the PCBX 130.

The PCBX 130 may possess smart features for enhancing system usability. The PCBX 130 may accept at least one predetermined code sequence as an instruction from the calling party to ignore the code sequence that he or she has entered and that the calling party intends to re-enter a new code sequence. In addition, the PCBX 130 may continuously keep track of a code sequence that the calling party is entering and continuously compare the similarity of the partially entered code sequence with default code sequences for service options, telephone

numbers captured in the call records 134 as well as stored telephone numbers 136. If the level of said similarity exceeds a predefined level, the PCBX 130 may automatically complete the code sequence for the user, or it may prompt the calling party for selection if the partially entered code sequence is sufficiently close to more than one service option or stored telephone number.

The premises telephony device 140 may have a display device indicating the calling party telephone number when calls are routed to the device. When there are no records of registered users (132), the PCBX 130 may bypass its call-back 400 and call-through 700 processes and allow the premises telephony device 140 to initiate and receive calls via the telephony link 125.

The memory used for storing call records 134 and telephone numbers 132 & 136 are typically non-volatile memory modules, and they may be integrated in or interfaced externally to the PCBX 130. The PCBX 130 may provide an utility for the registered users to transfer part or all the contact telephone numbers stored in their telephony devices 150 to the PCBX memory 136.

A first-time registration switch is provided in the PCBX 130 for a user to activate when the system is used the first time or when there is no record of registered users stored (132) in the PCBX 130. The first registration can be completed by the user calling the PCBX 130 while activating said registration switch. The PCBX 130 stores the telephone number of the user as the first registered user in its records 132 when the PCBX 130 is ringing or when said user initiated call is an-

swered by the premises telephony device 140 provided that the first-time registration switch is activated.

The PCBX 130 may be implemented by programming all the call handling process flows in a software or firmware application executable in an embedded device with micro-controller capability. The call handling software application may also be executable on computing devices including server computers, client computers, personal computers and portable computers.

FIG. 2 illustrates the flow of a call handling process executed by the private call-back exchange system of FIG. 1. The PCBX 130 continuously executes a call handling process 200 for request monitoring, call routing and connection, as well as call records management.

The PCBX 130 executes a looping process in step 220 for continuously monitoring for an incoming call originated from the telephony devices of registered 150 and unregistered 110 users.

The users may access the services and features provided by the PCBX 130 by dialling the telephone number uniquely associated with the telephony link 125 or the PCBX 130.

When an incoming call has been detected, the call handling process 200 proceeds to execute a call routing process (step 300) whose call routing decision would be used to determine in step 240 the specific call establishment process (400, 700 & 600) to be executed in accordance with predetermined criteria including the identity of the calling party, the service option and called party telephone number entered by the calling party.

Depending upon the matched criteria, the call handling process 200 proceeds to execute the call-back process 400, or the call-through process 700 or the call-premises process 600.

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The call handling process 200 terminates the call session in step 280 when the selected call establishment process 400, 700 & 600 has ended. The process 200 then loops back to step 220 for monitoring the next incoming call. This loop process
10 ends when the PCBX 130 is powered down or switched off.

The process 200 ends when all the associated processes and steps have completed.

15 FIG. 3 illustrates the flow of the call routing process executed in the call handling process of FIG. 2. The call routing process 300 determines the appropriate actions that the call handling process 200 takes with regard to a specific incoming call originated from any one of the telephony devices
20 of registered 150 and unregistered 110 users. The call routing process 300 outputs a call routing decision upon which the call handling process 200 is based when selecting the appropriate call establishment process (400, 700 or 600).

25 The call routing process 300 begins with step 310 in which the telephone number of the calling party (caller ID) is retrieved.

If there is no caller ID detected in step 320, the routing
30 process 300 ends with a routing decision of "call premises" (350). If the caller ID exists, the process 300 proceeds to compare, in step 330, the caller ID against the telephone numbers of registered users stored (132) in the PCBX 130. If

the calling party is found to be one of the registered users, then the routing decision "call back" (335) is chosen. Otherwise, process 300 advances to conduct a search in step 340 and determine if the caller ID matches any of the entries in the call records and telephone numbers database 134 & 136. Call records 134 and stored telephone numbers 136 are grouped under each registered user. If the PCBX 130 has handled call establishment between the calling party and the called party who, in this case, is one of the registered users of the PCBX 130, or said registered user has stored the telephone number of the calling party in memory 136, then the matching performed in step 340 yields a routing decision of "call through" (345), otherwise the routing process 300 ends with the decision "call premises" (350).

The process 300 ends when all the associated processes and steps have completed.

FIG. 4 illustrates the flow of the call-back process executed in the call handling process of FIG. 2. The call-back process 400 enables a registered user, who is the calling party, to establish a call session with a called party by means of a mechanism in which the PCBX 130 calls back the telephony device of the registered user 150 upon receiving a call from him or her.

The call-back process 400 is executed when an incoming call is detected and the caller identifier (caller ID) has been retrieved (405). The process 400 begins with step 410 in which the PCBX 130 awaits the calling party to terminate the call session he has initiated with the PCBX 130. When the call termination is detected, the PCBX 130 makes an outgoing

call to establish a call session with the calling party in step 420.

A specific broadcast may be played once or repeatedly in step 5 430 when the calling party answers the call. The broadcast comprises announcements from the PCBX 130 to remind the calling party of the routed calls that he has recently failed to answer (missed calls). The announcements may comprise any other necessary reminders that the PCBX 130 intends to inform 10 the calling party, such as available service options and their respective code sequences.

In the next step 440, the PCBX 130 waits for the calling party to enter the telephone number of the called party, as 15 well as predefined code sequences used to represent service options and any other predefined tasks.

The data entered by the calling party is typically fixed-length data string or it may end with a special key entry. 20 Furthermore, the PCBX 130 may continuously keep track of the characters in the code sequence that the calling party is entering and continuously compare the similarity of the partially entered code sequence with default code sequences for service options, telephone numbers captured in the call re- 25 cords 134 as well as stored telephone numbers 136. If the level of said similarity exceeds a predefined level, the PCBX 130 may automatically complete the code sequence for the user, or it may prompt the calling party for selection if the partially entered code sequence is sufficiently close to more 30 than one service option or stored telephone number.

Upon detecting the end of the entered instruction code sequence, the PCBX 130 proceeds to parse the content of the

code sequence in step 445. The call-back process terminates in 490 if the PCBX 130 fails to interpret the entered sequence. The failure may happen when the entered sequence does not match any of the predefined codes or the entered sequence does not conform to the formats of a telephone number known to the PCBX 130. Furthermore, the call-back process 400 terminates in 490 when the calling party does not enter any instruction code sequence within a predetermined duration of time.

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If the entered instruction code sequence is in order, then the PCBX 130 advances to step 450 in which the code sequence is decoded to derive the service option, if any, and telephone number of the called party. If the decoded instruction is a telephone number of the telephony link 125 or PCBX 130 or premises telephony device 140, the process 400 advances to execute the call-premises process 600. If the decoded instruction is one of the predetermined service options, the PCBX 130 proceeds to execute the corresponding tasks such as memory management and user registration 800. If the decoded instruction is a valid telephone number but not associated with the link 125, PCBX 130 or premises device 140, the PCBX 130 advances to execute the call connection process 500.

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The process 400 ends when all the associated processes and steps have completed.

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FIG. 5 illustrates the flow of the call connection process executed in the call-back process of FIG. 4 and call-through process of FIG. 2 & FIG. 7. The call connection process 500 routes and establishes a call session between a called party and a calling party, who may be a registered user or an unregistered user of the PCBX 130.

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The call connection process 500 begins with step 510 in which the PCBX 130 puts the calling party on hold while making an outgoing call to the called party using the telephone number
5 established in the call-back 400 and call-through 700 processes.

A specific broadcast may be played repeatedly in step 520. The broadcast comprises announcements from the PCBX 130 about
10 the identity of the caller. The announcements may further comprise a request for the called party to press a key on his telephony device. When the called party activates the key as requested, a DTMF tone is sent to alert the PCBX 130 that the call session with the called party has been established. This
15 is particularly useful for minimizing connection time when the called party has subscribed to ringback tone service for his telephony link or device. The announcements may comprise any other necessary information that the PCBX 130 intends to notify the called party.

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If the PCBX 130 fails to establish a call session with the intended called party, the system updates the call records
134 in step 550 and ends the process in step 590. The call record database 134 is typically grouped under each regis-
25 tered user of the PCBX 130 for easy cross reference.

If the PCBX 130 successfully establishes a call session with the intended called party in step 530, the system first updates the call record 134 in step 560, followed by connecting
30 the calling and called parties in step 570 using predetermined means such as three-party conference calls or explicit call transfer service or any supplementary services that allow the PCBX 130 to establish call sessions between the call-

ing and called parties. The mechanism that the PCBX 130 employs to connect a calling party with a called party depends upon the supplementary service that the telephony link 125 supports. If the telephony link 125 supports explicit call transfer service, then the PCBX 130 typically disconnects itself (on-hook) from all calls and parties before a call session establishment with the called party is made; If the telephony link 125 supports three-party conference call, then the PCBX 130 typically performs a flash hook, which puts the telephony link 125 on-hook for a short duration of time, followed by off-hook, to engage all three parties, namely the calling party, called party and the PCBX 130. In this case, the PCBX 130 remains engaged throughout the call session.

If the PCBX 130 fails to detect any call session established between the calling and called parties in step 575, the call connection process ends in step 590. If such establishment is successful, the call connection process 500 advances to step 578 to determine the type of supplementary call service used. For three-party conference calls, the PCBX 130 proceeds from step 578 to step 580 in which the established call session between the calling and called parties is maintained until at least one of the parties has terminated the call, and for explicit call transfer service and similar types of supplementary services, the PCBX 130 ends the call connection process in step 590.

The process 500 ends when all the associated processes and steps have completed.

FIG. 6 illustrates the flow of a call-premises process executed in the call handling, call-back and call-through processes of FIG. 2, FIG. 4 & FIG. 7 respectively. The call-

premises process 600 establishes a call session between a calling party and the premises telephony device 140 when the calling party indicates in the call-through process 700 and call-back process 400 that he or she intends to call the premises telephony device or when the PCBX 130 fails to establish the identity of the calling party in any of the call routing process 300.

The call-premises process 600 begins with step 610 in which the PCBX 130 routes the call to the premises telephony device 140. Next, the PCBX 130 sounds an internal buzzer or it signals the connected premises telephony device 140 to ring in step 620. The premises telephony device 140 may display the calling party telephone number.

The call-premises process ends in step 660 if the call has not been answered by any user in the same premises within a predetermined duration. Conversely, if the call is answered in step 630, the call session is maintained in step 640 until at least one of the calling and called parties terminates the call.

The process 600 ends when all the associated processes and steps have completed.

FIG. 7 illustrates the flow of a call-through process executed in the call handling process of FIG. 2. The call-through process 700 allows an unregistered user (110) to establish a call session with a registered user (150).

The call-through process begins with step 710 in which the PCBX 130 determines if the telephone number of the calling party matches with any of the entries in the call records and

telephone numbers database 134 & 136. If the PCBX 130 has handled call establishment between the calling party and the called party who, in this case, is one of the registered users of the PCBX 130, or said registered user has stored the telephone number of the calling party in memory 136, then process 700 advances to step 720, otherwise the call-through process proceeds to execute the call-premises process in step 600.

10 In step 720, the PCBX 130 prompts the calling party to choose the telephone number of the intended registered user (150) or the attached premises telephony device 140.

If the calling party has not returned any valid option within a predetermined duration, or the calling party explicitly seeks a connection with the premises telephony device 140, then the call-through process 700 proceeds to execute the call-premises process 600. Otherwise, the process 700 advances to step 500 for executing the call connection process 500.

The process 700 ends when all the associated processes and steps have completed.

25 FIG. 8 illustrates the flow of a registration process executed in the call-back process of FIG. 4. The registration process 800 allows a first-time user to register his telephone number as the first registered user 150. The process 800 also accepts deregistration and new registration initiated by an existing registered user.

With the telephone number of a first-time user or a registered user captured, the registration process 800 begins with

step 810 in which the PCBX 130 determines if there is any registered user telephone number stored in the system memory 132.

5 If there is no registered number found, then the process 800 proceeds to prompt the user to activate a dedicated registration switch on the PCBX 130. The registration switch is provided for user to activate when the system is used the first time or when there is no record of registered users stored
10 (132) in the PCBX 130. The process 800 proceeds to step 880 for storing the telephone number of the calling party as the first registered user in its records 132 when the PCBX 130 is ringing or when said user initiated call is answered by the premises telephony device 140 provided that the first-time
15 registration switch is activated.

The registration process 800 advances to step 820 if there is at least one registered number found in step 810. The system prompts the calling party, who is a registered user of the
20 PCBX 130, to enter the service option in the form of code sequence in step 820. The system decodes the code sequence and determines in step 840 if the registered user intends to register a new user or remove an existing registered user from the system memory 132.

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For a request of registration, the registration process advances to step 870 to prompt the user for the telephone number to be registered. Next, the entered telephone number is added to the records of registered telephone numbers 132 in
30 step 880.

For a request of deregistration, the registration process advances to step 850 to prompt the user for the telephone num-

ber to be deregistered. Next, the entered telephone number is removed from the records of registered telephone numbers 132 in step 860.

5 Although the above description contains much specificity,
these should not be construed as limiting the scope of the
embodiments but merely providing illustration of the foresee-
able embodiments. Especially the above stated advantages of
the embodiments should not be construed as limiting the scope
10 of the embodiments but merely to explain possible achieve-
ments if the described embodiments are put into practise.
Thus, the scope of the embodiments should be determined by
the claims and their equivalents, rather than by the examples
given.

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CLAIMS

1. A method of advanced call handling and exchange, wherein
5 a private call-back exchange (PCBX) system is used
to continuously monitor for an incoming call and service
request initiated by a calling party and establish a
call session with an intended called party when the re-
spective routing criteria are met, and both said calling
10 party and called party are coupled to said PCBX via at
least one public telephony exchange and network which is
further coupled to said PCBX system via a single teleph-
ony link, and one of said calling party and called party
being a registered user whose telephone number has been
15 saved in the memory of said PCBX, and

the method comprising the steps of

deriving a call routing decision through executing
a call routing process and said routing decision being
based upon a plurality of criteria comprising the iden-
20 tity of said calling party, the service option selected
by said calling party and the telephone number of said
intended called party entered by said calling party,

selecting a call establishment process out of a
plurality of available establishment processes, with the
25 selection being based upon said derived call routing de-
cision, and said available call establishment processes
comprising a call-back process, and

executing said selected call establishment process.

30 2. The method of claim 1, wherein

said selected call establishment process being said
call-back process if said calling party is a registered
user.

3. The method of claim 2, wherein

said call-back process comprising the steps of
making an outgoing call and establishing a call
5 session with the calling party upon detecting that the
calling party has terminated said incoming call,

awaiting the calling party to enter the telephone
number of the called party, and any predefined code se-
quences used to represent service options and any other
10 predefined tasks, and

establishing a call session between said calling
party and called party by executing a call connection
process.

15 4. The method of claim 3, wherein

announcements being played to remind said calling
party of the routed calls that he has previously failed
to answer, and the announcements may comprise any other
necessary reminders for the calling party, such as
20 available service options and their respective code se-
quences.

5. The method of claim 3, wherein

said entered code sequence being continuously com-
25 pared against some default code sequences for service
options, telephone numbers stored and telephone numbers
saved in system call records, and if the level of simi-
larity exceeds a predefined level, said PCBX automati-
cally completing the code sequence, and prompting said
30 calling party for selection if said code sequence being
sufficiently close to more than one service option or
stored telephone number.

6. The method of claim 1, wherein

said selected call establishment process being a call-through process if said called party is a registered user and said calling party has previously requested for call session establishment with said called party.

7. The method of claim 1, wherein

said selected call establishment process being a call-through process if said called party is a registered user who has stored the telephone number of said called party in said PCBX.

8. The method of claims 6 or 7, wherein

said call-through process comprising the steps of prompting the calling party to choose the telephone number of the intended registered user, and establishing a call session between said calling party and called party by executing a call connection process.

9. The method of claim 1, wherein

said selected call establishment process being a call-premises process if the telephone number of said calling party cannot be retrieved from said incoming call.

10. The method of claims 1, 3 or 8, wherein

said selected call establishment process being a call-premises process if the telephone number of the intended called party entered by said calling party is the

telephone number of the telephony link connecting said PCBX and said public telephony exchange and network.

11. The method of claims 1, 2, 6 or 7, wherein

5 said selected call establishment process being a call-premises process if the criteria for said call-back process and call-through process are not met.

12. The method of claims 9, 10 or 11, wherein

10 said call-premises process comprising the steps of said call to be routed being connected to a premises telephony device directly coupled to said PCBX, and alerting any user at the premises to answer the call by means of activating the appropriate visual or
15 audio transducers on the PCBX or on said premises telephony device.

13. The method of claims 1 or 3 or 8, wherein

20 said call connection process comprising the steps of

 putting the calling party on hold while making an outgoing call to said called party using the telephone number provided by said calling party, and

25 establishing a call session between said called party and calling party based upon the supplementary telephony services available to the telephony link connecting said PCBX and said public telephony exchange and network.

30 14. The method of claim 13, wherein

 said supplementary telephony services comprising at least one of three-party conference call and explicit call transfer services.

15. The method of claims 13 or 14, wherein

announcements being played to request for said
called party to press a key on his telephony device for
5 sending a DTMF (dual-tone multi-frequency) tone to alert
said PCBX that the call session with the called party
has been established.

16. The method claims 13 or 14, wherein

10 The telephone number of any unregistered user being
saved in the system call records of said PCBX.

17. The method of claim 1, wherein

15 a calling party who is a registered user enters the
telephone number of a user to be registered, and the en-
tered telephone number being saved in the corresponding
memory of said PCBX.

18. The method of claim 1, wherein

20 a calling party who is a registered user enters the
telephone number of an existing registered user, and the
entered telephone number being removed from the corre-
sponding memory of said PCBX.

25 19. The method of claim 1, wherein

a calling party originating a call to said PCBX and
activating a dedicated switch on said PCBX for first-
time registration and when said PCBX has no record of
any registered user.

30 20. The method of any of the claims 1 to 19, wherein

a separate and dedicated communication link cou-
pling said PCBX system and the Internet being used to

provide voice over internet protocol (VOIP) communications between a registered user and a called party having access to equipment and network capable of VOIP communications.

5

21. A system for advanced call handling and exchange comprising

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a private call-back exchange (PCBX) having memories for storing call records, telephone numbers of called parties and registered users, and a processor capable of computing call routing decision and executing call establishment processes comprising

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a call-back process in which said PCBX calls back a calling party, who is a registered user, for the telephone number of a called party and intended service option when said PCBX having detected that the calling party has terminated an incoming call,

20

a call-through process in which an unregistered user being routed and connected to a registered user, and

a call-premises process in which said calling party being routed and connected to a premises telephony device directly coupled to said PCBX.

25

22. The system of claim 21, wherein

said calling party and called party being coupled to said PCBX via at least one public telephony exchange and network which is further coupled to said PCBX system via a single telephony link.

30

23. The system of claims 21 or 22, wherein

said telephony link supporting supplementary services comprising at least one of three-party conference call and explicit call transfer services.

5 24. The system of claims 21, 22 or 23, wherein

a user activating a dedicated switch on said PCBX while originating a call to said PCBX for first-time registration and when said PCBX does not have any registered user.

10

25. The system of any of claims 21 to 24, wherein

said public telephony exchange and network and the telephony devices used by said calling party and called party being of any types including analogue, digital, fixed-line, wireless, cellular, circuit-switched, VOIP (voice over internet protocol) and other types of packet-switched networks, and the calling party and called party may be in the same or in different countries.

20

26. The system of any of claims 21 to 25, wherein

said PCBX being implemented by programming all associated call handling process flows in a software or firmware application executable in an embedded device having micro-controller capability, and said call handling software application may also be executable on computing devices including server computers, client computers, personal computers and portable computers.

25

30 27. The system of any of the claims 21 to 26, wherein

a separate and dedicated communication link coupling said PCBX system and the Internet being used to provide voice over internet protocol (VOIP) communica-

tions between a registered user and a called party having access to equipment and network capable of VOIP communications.