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**H04M 3/00 7/00**

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**H4K KMC KOA**

(56) Documents Cited:  
**US 6404887 B1** **US 6141345 A**  
**US 20030058807 A1**

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 UK CL (Edition X ) **H4K, H4R**  
 INT CL<sup>7</sup> **H04B, H04L, H04M**  
 Other: **On-Line - EPODOC, WPI**

(54) Abstract Title: **Controlling echo cancelling in an exchange supporting analogue and packetised voice communications**

(57) A telephone exchange apparatus 1 includes a plurality of first IP extension interfaces 12,13 each of which connects a first communication line 5,4 for transmitting a voice packet and comprises an echo canceller 131,121 that cancels an echo added to the voice packet. A second office line interface 14 connects a second communication line L for transmitting an analogue voice signal, and a controller 11 selectively connects between the first interfaces and at least one of the other first interfaces and the second interface. The controller also controls the execution and stopping of the processing of the echo canceller according to a call setting request. The call setting request typically includes a connection request origin and destination such that the control unit may disable use of the echo canceller for packet-to-packet voice calls and enable it for packet-to-analogue voice calls.

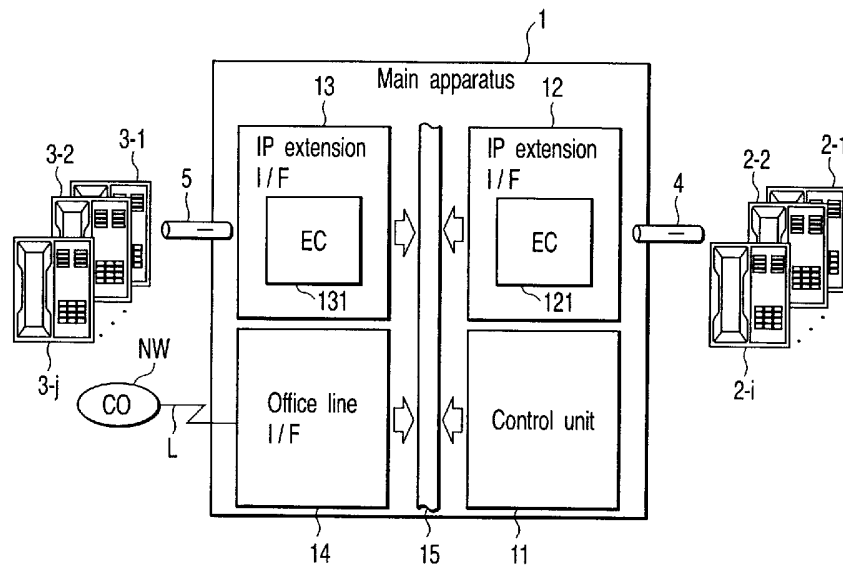


FIG. 1

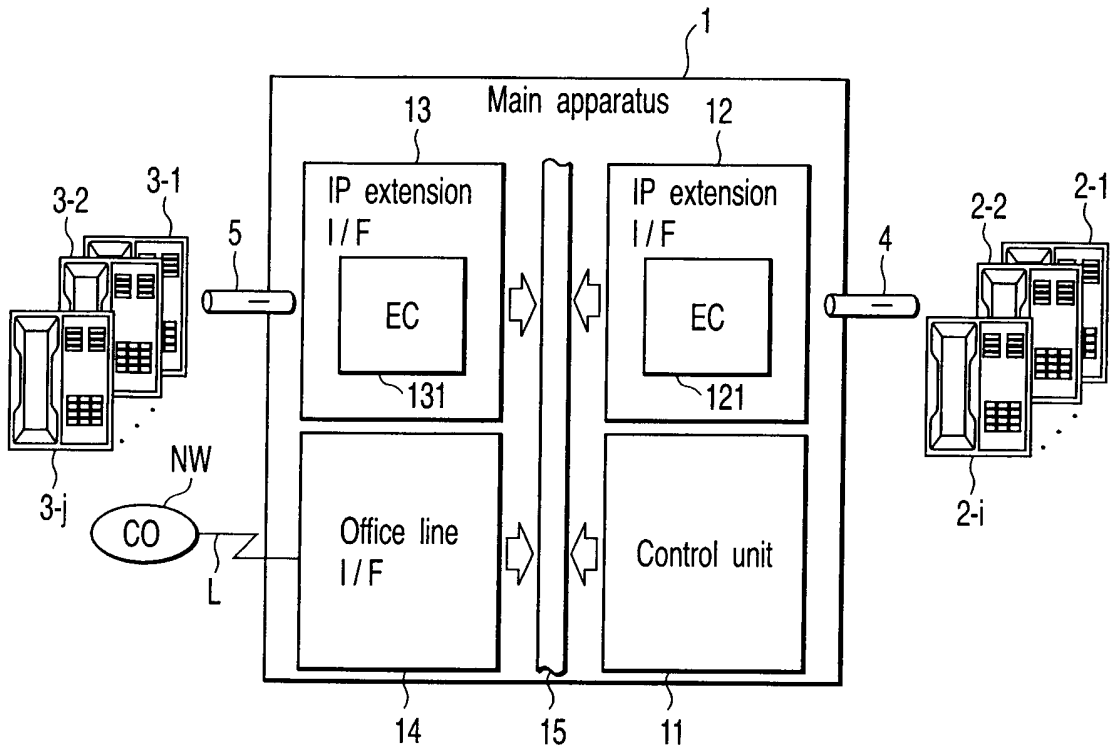


FIG. 1

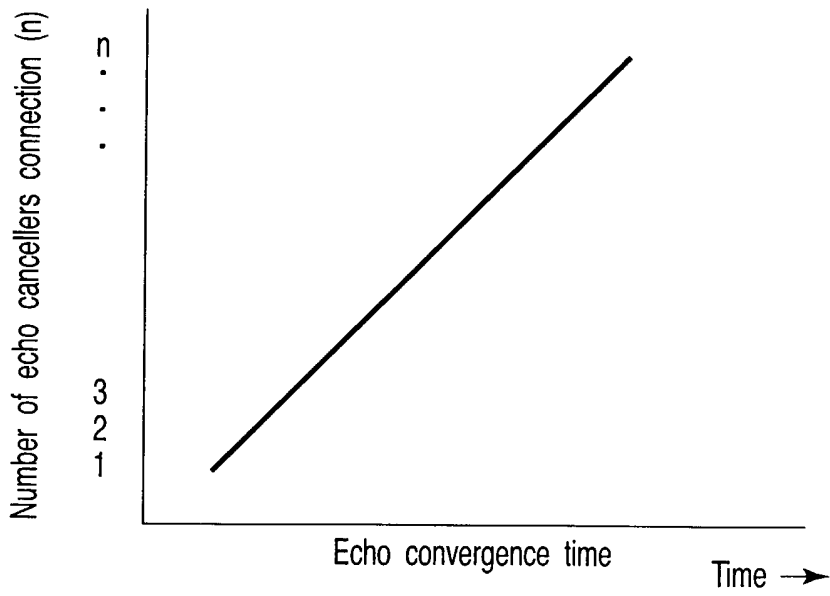


FIG. 2

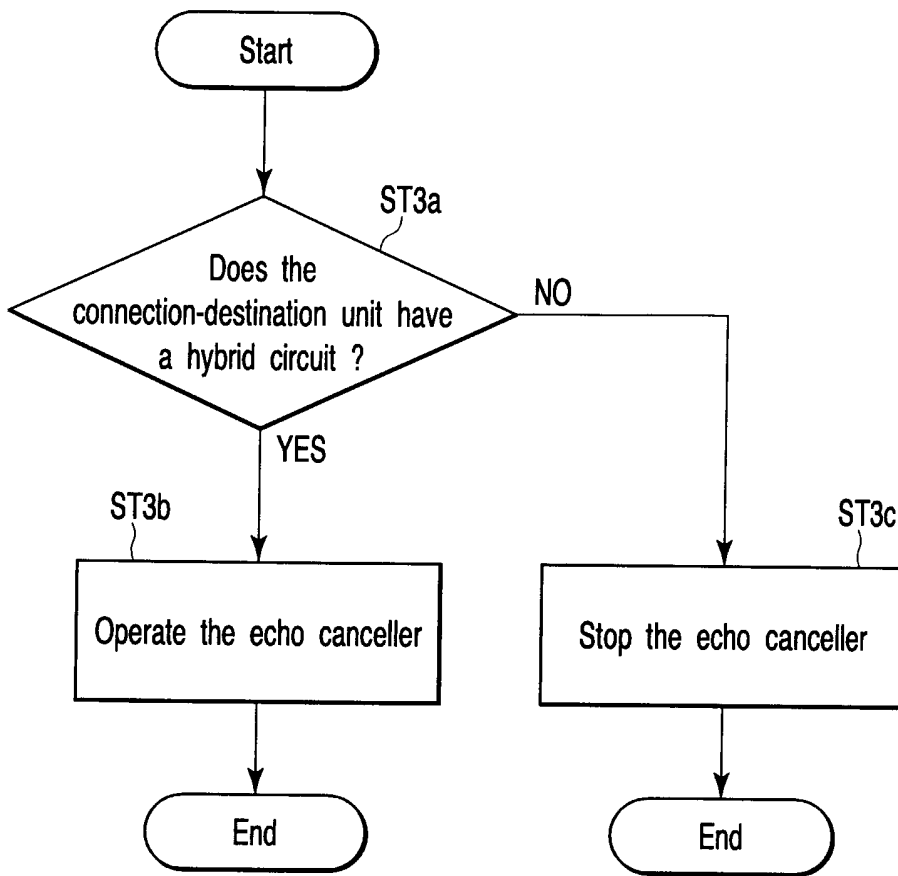


FIG. 3

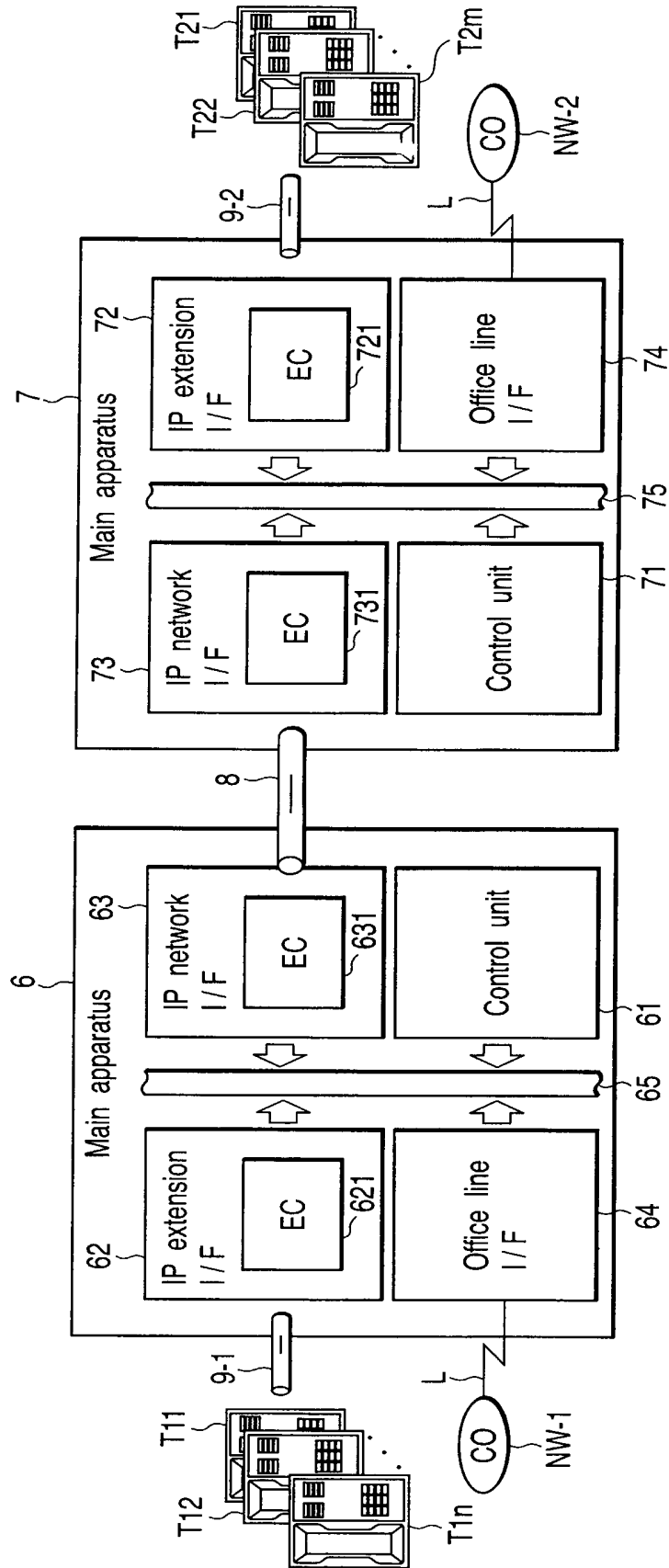


FIG. 4

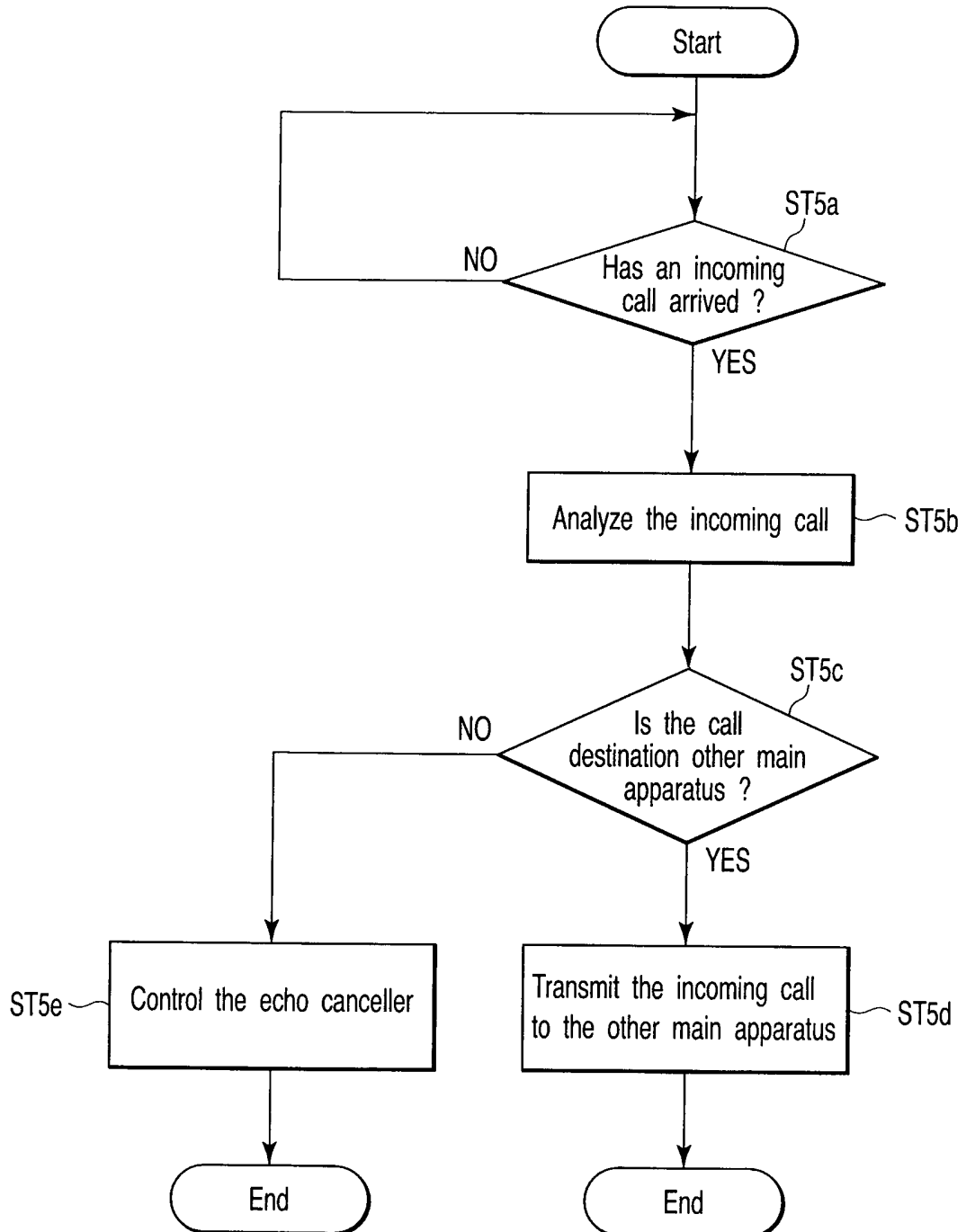


FIG. 5

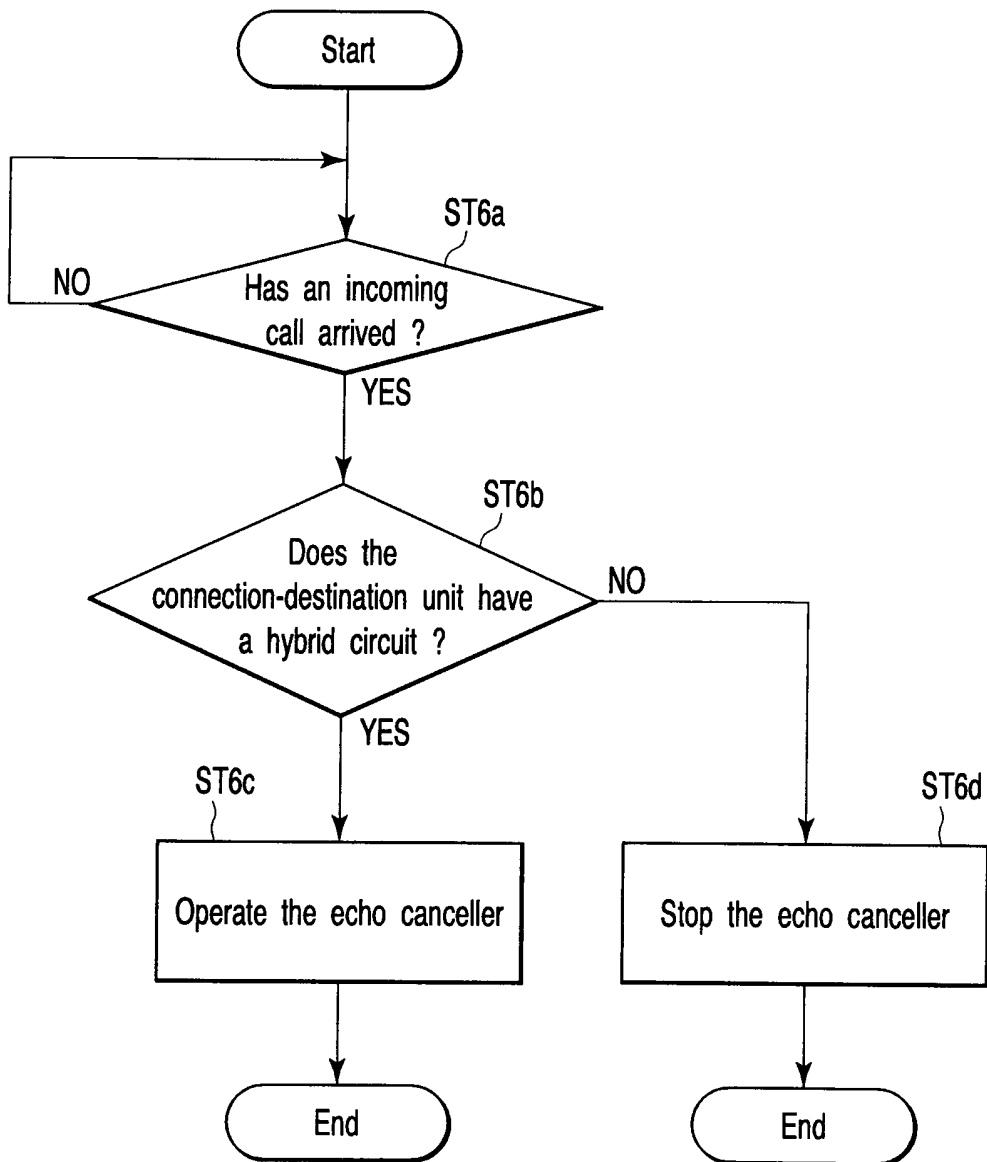


FIG. 6

## TITLE OF THE INVENTION

TELEPHONE EXCHANGE APPARATUS AND NETWORK TELEPHONE  
SYSTEM

## BACKGROUND OF THE INVENTION

5           The present invention relates to a telephone  
exchange apparatus to which an internet protocol (IP)  
network to transmit a voice packet can be connected and  
which has an echo canceller function of canceling an  
echo that is added to the voice packet. The invention  
10 also relates to a network telephone system to which  
a plurality of telephone exchange apparatuses are  
connected via the IP network.

          In recent years, the following system is proposed.  
A network telephone terminal (i.e., an internet  
15 Protocol (IP) telephone terminal) having a telephone  
call processing function and a media information  
processing function is connected to a local area  
network (LAN). The LAN is connected to an external  
communication network such as a public network via  
20 a main apparatus. The IP telephone terminal and the  
main apparatus carry out a protocol conversion and  
a data format conversion. With this arrangement,  
communications can be achieved between the IP telephone  
terminals and between the IP telephone terminal and the  
25 external communication network.

          In this type of system, an echo is added to  
a voice signal when the IP telephone terminal is

connected to an office line in the main apparatus.  
To overcome this problem, a main apparatus that has  
an echo canceller function of canceling the echo added  
to the voice signal is investigated, as disclosed (see,  
5 for example, Document 1: US Patent No. 6,404,887, B1).

The echo canceller function is incorporated in  
an IP interface unit that connects the IP telephone  
terminal. This function works effectively when the  
IP telephone terminal is connected with the office  
10 line. However, when the IP telephone terminals having  
small influence of the echo are connected to each  
other, the echo canceller function becomes unstable.  
Particularly, in the IP telephone system, a plurality  
of main apparatuses are connected via the IP network.  
15 In this case, the echo cancellers are in multiple  
connection, which makes the echo canceling operation  
unstable.

#### BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to  
20 provide a telephone exchange apparatus and a network  
telephone system capable of effectively canceling the  
echo added to the voice signal even when a plurality of  
mutually different communication lines are handled or  
when the echo cancellers are in multiple connection.

25 According to an aspect of the present invention,  
there is provided a telephone exchange apparatus  
comprising: a plurality of first interfaces each of



which connects a first communication line for  
transmitting a voice packet and comprises an echo  
canceller that cancels an echo added to the voice  
packet; a second interface which connects a second  
5 communication line for transmitting an analog voice  
signal; and a controller which selectively connects  
between the first interfaces and between at least one  
of the first interfaces and the second interface, and  
controls the execution and stopping of the processing  
10 of the echo canceller according to a call setting  
request.

According to another aspect of the present  
invention, there is provided a network telephone  
system which comprises two or more telephone exchange  
15 apparatuses each of which connects between a first  
communication line for transmitting a plurality of  
voice packets and a second communication line for  
transmitting an analog voice signal, and connects  
between a plurality of the telephone exchanges with  
20 a third communication line for transmitting a voice  
packet, the network telephone system comprising: a  
first interface which connects the first communication  
line, and comprises an echo canceller which cancels  
an echo added to the voice packet, in each of the  
25 plurality of telephone exchange apparatuses; a second  
interface which connects the second communication  
line, in each of the plurality of telephone exchange

apparatuses; a third interface which connects the third  
communication line, and comprises an echo canceller  
that cancels an echo added to the voice packets,  
in each of the plurality of telephone exchange  
5 apparatuses; a deciding circuit to decide a connection  
request origin and a connection request destination  
in a receiver-side telephone exchange, to generate a  
result of decision, when the connection request using  
the third communication line occurs; and a controller  
10 which controls execution and stopping of the echo  
canceller processing based on the result of decision.

Additional objects and advantages of the invention  
will be set forth in the description which follows, and  
in part will be obvious from the description, or may be  
15 learned by practice of the invention. The objects and  
advantages of the invention may be realized and  
obtained by means of the instrumentalities and  
combinations particularly pointed out hereinafter.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

20 The accompanying drawings, which are incorporated  
in and constitute a part of the specification,  
illustrate presently preferred embodiments of the  
invention, and together with the general description  
given above and the detailed description of the  
25 preferred embodiments given below, serve to explain  
the principles of the invention.

FIG. 1 is a diagram of an approximate

configuration of an exchange system according to  
a first embodiment of the present invention.

FIG. 2 is a diagram showing a relationship between  
number of echo cancellers in multiple connection and  
5 an echo convergence time.

FIG. 3 is a flowchart of control procedure of the  
echo canceller according to the first embodiment.

FIG. 4 is a diagram of an approximate configura-  
tion of an exchange system according to a second  
10 embodiment of the present invention.

FIG. 5 is a flowchart of an incoming call  
processing operation of a main apparatus as a call  
origin according to the second embodiment.

FIG. 6 is a flowchart of an echo canceller control  
15 procedure of a main apparatus as a call destination  
according to the second embodiment.

#### DETAILED DESCRIPTION OF THE INVENTION

The embodiment of the present invention will be  
explained in detail with reference to the drawings.

20 (First Embodiment)

FIG. 1 is a diagram of an approximate configura-  
tion of an exchange system according to a first  
embodiment of the present invention.

As shown in FIG. 1, the exchange system includes  
25 a main apparatus 1, and a plurality of IP telephone  
terminals 2 (2-1 to 2-i) and 3 (3-1 to 3-j) that are  
connected optionally to the main apparatus 1 via LANs 4

and 5 respectively.

The main apparatus 1 has a control unit 11, IP extension interface circuits 12 and 13 (hereinafter referred to as IP extension I/Fs 12 and 13), and an office line interface circuit 14 (hereinafter referred to as an office line I/F 14). The control unit 11, the IP extension I/Fs 12 and 13, and the office line I/F 14 are connected to each other via a bus 15.

The control unit 11 optionally exchanges and connects the IP extension I/Fs 12 and 13 and the office line I/F 14.

The IP telephone terminal 2 is connected to the IP extension I/F 12 when necessary. The IP extension I/F 12 carries out an extension interface operation concerning the connected IP telephone terminal 2. The IP extension I/F 12 also gives and receives various kinds of control information concerning the extension interface operation with the control unit 11 via the bus 15.

The IP telephone terminal 3 is connected to the IP extension I/F 13 when necessary. The IP extension I/F 13 carries out an extension interface operation concerning the connected IP telephone terminal 3. The IP extension I/F 13 also gives and receives various kinds of control information concerning the extension interface operation with the control unit 11 via the bus 15.

An office line L to be connected to a public network NW is connected to the office line I/F 14 when necessary. The office line I/F 14 carries out the interface operation concerning the connected office  
5 line L. The office line I/F 14 also gives and receives various kinds of control information concerning the interface operation with the control unit 11 via the bus 15.

The IP extension I/Fs 12 and 13 have echo  
10 cancellers 121 and 131 respectively that cancel an echo added to the voice signal. The control unit 11 controls to execute or stop a processing of the echo cancellers 121 and 131.

The operation of the exchange system having the  
15 above configuration will be explained next.

When telephone calls are carried out between the IP telephone terminal 2-1 and the IP telephone terminal  
3-1, the echo cancellers 121 and 131 are in multiple connection. In general, when the echo cancellers 121  
20 and 131 are in multiple connection, the convergence time of echo may become long, or the echo may not be converged in the worst case, as shown in FIG. 2.

To cope with this situation, the control unit 11 controls to execute or stop the echo cancellers 121 and  
25 131 according to the call setting request. FIG. 3 is a flowchart of the processing operation of the control unit 11.

Assume that the IP telephone terminal 2-1 transmits a call to a subscriber telephone terminal of the public network NW, and that the incoming call arrives at the main apparatus 1 via the LAN 4 accordingly. Then, the IP extension I/F 12 detects the incoming call, and notifies the arrival of the incoming call to the control unit 11 via the bus 15.

The control unit 11 analyzes the dial number of a call destination based on the notified incoming call, and decides whether a call destination unit has a hybrid circuit based on the result of the analysis (step ST3a). When the control unit 11 decides that the call destination is the public network NW (YES at step ST3a), the control unit 11 operates the echo canceller 121 (step ST3b).

On the other hand, assume that the IP telephone terminal 2-1 transmits a call to the IP telephone terminal 3-2, and that the incoming call arrives at the main apparatus 1 via the LAN 4 accordingly. When the control unit 11 decides that the call destination is the IP telephone terminal 3-2 (NO at step ST3a), the control unit 11 stops the echo cancellers 121 and 131 (step ST3c).

When the call origin is a subscriber telephone terminal of the public network NW, a similar processing operation is carried out.

As explained above, according to the first

embodiment, the control unit 11 has the control  
function of executing or stopping the processing of the  
echo cancellers 121 and 131. Therefore, when the IP  
extension I/Fs 12 and 13 having small influence of echo  
5 are connected, the control unit 11 controls to stop the  
echo cancellers 121 and 131. When the IP extension I/F  
12 is connected to the office line I/F 14, the control  
unit 11 controls to execute the echo canceller 121.  
In this way, only an optimum echo canceller can be  
10 operated for each connected communication line.  
(Second Embodiment)

FIG. 4 is a diagram of an approximate configura-  
tion of an exchange system according to a second  
embodiment of the present invention.

15 As shown in FIG. 4, the exchange system has main  
apparatuses 6 and 7 that are connected to each other  
via a LAN 8. The main apparatus 6 optionally connects  
each of a plurality of IP telephone terminals T1 (T11  
to T1n) via a LAN 9-1. The main apparatus 7 optionally  
20 connects each of a plurality of IP telephone terminals  
T2 (T21 to T2m) via a LAN 9-2.

The main apparatus 6 has a control unit 61, an IP  
extension interface circuit 62 (hereinafter referred to  
as an IP extension I/F 62), an IP network interface  
25 circuit 63 (hereinafter referred to as a network  
I/F 63), and an office line interface circuit 64  
(hereinafter referred to as an office line I/F 64).

The control unit 61, the IP extension I/F 62, the network I/f 63, and the office line I/F 64 are connected to each other via a bus 65.

5 The control unit 61 optionally exchanges and connects the IP extension I/F 62, the network I/F 63, and the office line I/F 64.

10 The IP telephone terminal T1 is connected to the IP extension I/F 62 when necessary. The IP extension I/F 62 carries out an extension interface operation concerning the connected IP telephone terminal T1. The IP extension I/F 62 also gives and receives various kinds of control information concerning the extension interface operation with the control unit 61 via the bus 65.

15 The LAN 8 is connected to the network I/F 63 when necessary. The network I/F 63 carries out the extension interface operation concerning the connected LAN 8. The network I/F 63 also gives and receives various kinds of control information concerning the extension interface operation with the control unit 61 via the bus 65.

25 The office line L to be connected to a public network NW-1 is connected to the office line I/F 64 when necessary. The office line I/F 64 carries out the interface operation concerning the connected office line L. The office line I/F 64 also gives and receives various kinds of control information concerning the



interface operation with the control unit 61 via the bus 65.

The IP extension I/F 62 and the network I/F 63 have echo cancellers 621 and 631 respectively that  
5 cancel the echo added to the voice signal. The control unit 61 controls to execute or stop the processing of the echo cancellers 621 and 631.

On the other hand, the main apparatus 7 has a control unit 71, an IP extension interface circuit 72  
10 (hereinafter referred to as an IP extension I/F 72), an IP network interface circuit 73 (hereinafter referred to as a network I/F 73), and an office line interface circuit 74 (hereinafter referred to as an office line I/F 74). The control unit 71, the IP extension I/F 72,  
15 the network I/F 73, and the office line I/F 74 are connected to each other via a bus 75.

The control unit 71 optionally exchanges and connects the IP extension I/F 72, the network I/F 73, and the office line I/F 74.

20 The IP telephone terminal T2 is connected to the IP extension I/F 72 when necessary. The IP extension I/F 72 carries out an extension interface operation concerning the connected IP telephone terminal T2. The IP extension I/F 72 also gives and receives various  
25 kinds of control information concerning the extension interface operation with the control unit 71 via the bus 75.

The LAN 8 is connected to the network I/F 73 when necessary. The network I/F 73 carries out the extension interface operation concerning the connected LAN 8. The network I/F 73 also gives and receives  
5 various kinds of control information concerning the extension interface operation with the control unit 71 via the bus 75.

The office line L to be connected to a public network NW-2 is connected to the office line I/F 74  
10 when necessary. The office line I/F 74 carries out the interface operation concerning the connected office line L. The office line I/F 74 also gives and receives various kinds of control information concerning the interface operation with the control unit 71 via the  
15 bus 75.

The IP extension I/F 72 and the network I/F 73 have echo cancellers 721 and 731 respectively that cancel the echo added to the voice signal. The control unit 71 controls to execute or stop the processing of  
20 the echo cancellers 721 and 731.

The operation of the exchange system having the above configuration will be explained next.

FIG. 5 is a flowchart of the processing operation of the control unit 61.

25 Assume that the IP telephone terminal T11 transmits a call to a subscriber telephone terminal of the public network NW-2, and that an incoming call

arrives at the main apparatus 6 via the LAN 9-1 accordingly (step ST5a). Then, the IP extension I/F 62 detects the incoming call, and notifies the arrival of the incoming call to the control unit 61 via the bus 65.

The control unit 61 analyzes the dial number of a call destination based on the notified incoming call (step ST5b), and decides whether a call destination is the main apparatus 7 based on the result of the analysis (step ST5c). When the control unit 61 decides that the call destination is the main apparatus 7 (YES at step ST5c), the control unit 61 transmits the incoming call to the main apparatus 7 via the LAN 8 (step ST5d). In this case, the echo cancellers 621 and 631 are stopped.

On the other hand, when the call destination is the main apparatus 6 (NO at step ST5c), the control unit 61 controls the execution or stopping of the echo canceller 621 (step ST5e).

FIG. 6 is a flowchart of the processing operation of the control unit 71.

The control unit 71 always monitors the arrival of an incoming call (step ST6a). When an incoming call arrives (YES at step ST6a), the control unit 71 decides whether a call destination unit has a hybrid circuit (step ST6b). When the control unit 71 decides that the call destination is the public network NW-2 (YES at

step ST6b), the control unit 71 operates the echo canceller 731 (step ST6c).

On the other hand, assume that the IP telephone terminal T11 transmits a call to the IP telephone terminal T21, and that an incoming call arrives at the main apparatus 7 via the LAN 8 accordingly. When the control unit 71 decides that the call destination is the IP telephone terminal T21 (NO at step ST6b), the control unit 71 stops the echo cancellers 721 and 731 (step ST6d).

When the call origin is a subscriber telephone terminal of the public network NW-1, a similar processing operation is carried out.

As explained above, according to the second embodiment, when the main apparatus 6 that receives the incoming call decides that the call destination is the public network NW-2, only the echo canceller 731 provided in the network I/F 73 within the main apparatus 7 is used.

Therefore, it is possible to prevent a wasteful use of the echo cancellers 621 and 631. Consequently, the effective utilization rate of the echo cancellers 621, 631, and 731 can be increased, and the whole system can reduce power consumption.

(Other Embodiments)

The present invention is not limited to the above embodiments. For example, the call origin is explained

as the IP telephone terminal in the above embodiments.  
However, when the call origin is an analog telephone  
terminal and the call destination is the IP telephone  
terminal, the execution and stopping of the echo  
5 cancellers can be controlled in a similar manner.

While two main apparatuses are connected in the  
second embodiments, two or more main apparatuses can be  
also connected.

Configurations and types of the system,  
10 configurations and types of the exchange such as the  
main apparatus, and control procedures of the echo  
cancellers can be modified within a range not deviating  
from the gist of the present invention.

Additional advantages and modifications will  
15 readily occur to those skilled in the art. Therefore,  
the invention in its broader aspects is not limited to  
the specific details and representative embodiments  
shown and described herein. Accordingly, various  
modifications may be made without departing from the  
20 spirit or scope of the general inventive concept as  
defined by the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. A telephone exchange apparatus comprising:  
means for connecting a plurality of first  
communication line for transmitting a voice packet and  
5 comprises an echo canceller that cancels an echo added  
to the voice packet, respectively;  
means for connecting a second communication line  
for transmitting an analog voice signal; and  
means for selectively connecting between the first  
10 communication lines and between at least one of the  
first communication line and the second communication  
line, and controlling the execution and stopping of the  
processing of the echo canceller, according to a call  
setting request.
- 15 2. The telephone exchange apparatus according to  
claim 1, wherein the means for controlling controls to  
stop the echo canceller when connecting between the  
first communication lines.
- 20 3. The telephone exchange apparatus according to  
claim 1, wherein the means for controlling controls to  
execute the echo canceller when connecting between at  
least one of the first communication lines and the  
second communication line.
- 25 4. A network telephone system which comprises two  
or more telephone exchange apparatuses each of which  
connects between a first communication line for  
transmitting a plurality of voice packets and a second

communication line for transmitting an analog voice  
signal, and connects between a plurality of the  
telephone exchanges with a third communication line for  
transmitting a voice packet, the network telephone  
5 system comprising:

means for connecting the first communication line,  
and comprises an echo canceller which cancels an echo  
added to the voice packet, in each of the plurality of  
telephone exchange apparatuses;

10 means for connecting the second communication  
line, in each of the plurality of telephone exchange  
apparatuses;

means for connecting the third communication line,  
and comprises an echo canceller that cancels an echo  
15 added to the voice packets, in each of the plurality of  
telephone exchange apparatuses;

means for deciding a connection request origin and  
a connection request destination in a receiver-side  
telephone exchange, to generate a result of decision,  
20 when the connection request using the third  
communication line occurs; and

means for controlling execution and stopping of  
the echo canceller processing based on the result of  
decision.

25 5. The network telephone system according to  
claim 4, when the request origin is the first  
communication line and the request destination is the

second communication line connected to other telephone  
exchange apparatus based on the result of decision,  
wherein the means for controlling executes only the  
echo canceller in the means for connecting the third  
5 communication of the other telephone exchange  
apparatus.

6. The network telephone system according to  
claim 4, when the request origin is the second  
communication line and the request destination is the  
10 first communication line connected to other telephone  
exchange apparatus based on the result of decision,  
wherein the means for controlling executes only the  
echo canceller in the means for connecting the third  
communication of the telephone exchange apparatus that  
15 becomes receiver of the connection request.

7. The network telephone system according to  
claim 4, when the request origin is the first  
communication line and the request destination is the  
first communication line connected to other telephone  
20 exchange based on the result of decision, wherein the  
means for controlling stops all the echo cancellers.

8. A telephone exchange apparatus and network  
telephone system, substantially as hereinbefore  
described with reference to the accompanying drawings.





INVESTOR IN PEOPLE

Application No: GB0420862.5

Examiner: Mr Jared Stokes

Claims searched: 1 to 8

Date of search: 18 February 2005

### Patents Act 1977: Search Report under Section 17

#### Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	US6141345 A (Goeddel et al.) See abstract
A	-	US2003/0058807 A1 (Hoffman) See abstract
A	-	US6404887 B1 (Born et al.) See abstract

#### Categories:

X Document indicating lack of novelty or inventive step	A Document indicating technological background and/or state of the art.
Y Document indicating lack of inventive step if combined with one or more other documents of same category.	P Document published on or after the declared priority date but before the filing date of this invention.
& Member of the same patent family	E Patent document published on or after, but with priority date earlier than, the filing date of this application.

#### Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup> :

H4K; H4R

Worldwide search of patent documents classified in the following areas of the IPC<sup>07</sup>

H04B; H04L; H04M

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI