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TELEPHONE EXCHANGE CONFERENCE CIRCUIT

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This invention relates to a conference circuit for a telephone exchange, especially for a small exchange such as used as a PABX in a small organisation.

According to the present invention there is
15 provided a telephone exchange conference circuit, for setting up a conference call including n exchange terminations, where n is an integer greater than 2, in a PCM-TDM telephone exchange, which circuit includes an input store for the reception of n PCM code bytes from the
20 conferees, an output store from which n PCM code bytes can be sent to the conferees, a processor which controls the operations of the conference circuit, an input to the processor over which the identities of $2n$ TDM time slots to be used for the connection are received when the
25 circuit is in use, there being separate 'talk' and 'listen' time slots allocated to each of the conferees, connections from the processor to the stores via which the input store is set to its condition for the reception of bytes from the n conferees and to the output store via
30 which said output store is set to its condition for sending bytes to the n conferees, and connections from the stores via which bytes are transferred from the input store to the processor and from the processor to the output store, wherein on reception of n bytes from the input
35 store the processor compares these bytes and selects the one which represents the largest speech amplitude, wherein the processor, after having made said selection, sends the

selected byte to the output store for the time slots for the (n-1) conferees other than the one from which it came, wherein the processor sends a silent code byte to the output store for the time slot for the selected conferee, and wherein the n PCM bytes thus sent to the output store are sent each at the appropriate one of said time slots to the respective ones of the conferees, whereby the conferee whose byte is selected as representing the largest speech amplitude receives said silent code byte while the other conferees receive the byte from the said selected conferee.

An embodiment of the invention will now be described with reference to the accompanying drawing, which is a highly schematic block diagram of an implementation of the invention.

The arrangement described is intended for use in a telephone exchange such as that of our Application No. 2,820,606 (G.A. Sarson et al 5-4-1), although it is applicable to other time division multiplex (TDM) telephone exchanges using PCM. For convenience a brief description of our exchange such as that described in that Application follows.

The exchange is a small "business-type" exchange in which calls are set up in TDM manner using PCM to convey speech, and also data if the exchange serves any data terminals. It has subscriber line ports each of which serves two subscriber lines and a smaller number of trunk line ports each of which serves a trunk to a local exchange. Each port has a local processor with, in the case of analogue lines and trunks, analogue-to-digital and digital-to-analogue conversion circuitry. Where a line or trunk is of the digital type, naturally no conversion circuitry is needed. The exchange has a central processor, with its associated memories and interfaces.

The ports and the central processor are interconnected by an intelligence bus, referred to as the PCM bus, and by a signalling bus. The PCM bus has separate conductors for the two directions of transmission. The

central processor and the port processors co-operate in
call setting, with all inter-processor communications
taking place over the signalling bus. During operations,
the central processor polls the ports' processors via the
5 signalling bus in search of ports needing the services of
the central processor. This polling technique is also
used for the transmission of information from the central

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processor to the ports, this of course including call setting information.

5 To set up a call between two lines, or a line and a trunk, two time slots in the TDM cycle are allocated to that call by the central processor, one for each direction of transmission. By this time the central processor will have identified the calling line from the time slot in the polling cycle in which the calling line was identified. It will also have received the identity
10 of the wanted line or trunk. Note that the operation is similar if the calling condition was detected on a trunk. Call release is effected when, in the course of polling, the central processor detects that one of the parties to the call has hung up.

15 With the use of a standard 32 time slot PCM system, two of the time slots are permanently allocated to the emission of tones (e.g. calling tone, busy tone, etc.) and the other 30 slots are available for call setting. Thus if the system is to be non-blocking the
20 total number of lines and trunks served is 15, e.g. 10 lines and 5 trunks. Two such exchanges can be coupled by linking their busses to give a double capacity exchange. Note that the number of lines and/or trunks served can be increased if some blocking is tolerated.

25 As will have been seen, a major feature of the above-described exchange is that call signalling and other transmissions needed for call setting and control are effected over the signalling bus. Thus the intelligence bus only conveys the PCM codes for speech
30 (or data if there are data terminals) and tones.

The exchange is provided with two conference circuits, each of which can be used to set up a three-party conference, as will be described later. It also has a so-called watch dog controller which
35 continuously monitors the working of the exchange and gives an alarm if certain fault conditions are detected.

Each conference can be either two lines and one

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trunk, one line and two trunks (if desired - this facility is currently not allowed in an exchange connected to the British Telecoms network), or three lines. As will be seen a conference circuit receives the A-law PCM code combinations representing the speech from the three parties and selects the one for the largest speech amplitude. This selected combination is then passed to the "listen" time slots of the parties whose combinations indicate lower (or zero) amplitudes. Thus a conferee always hears the loudest conferee's voice, but does not hear himself via his earphone.

The control of the conference circuit is by a microprocessor in this case an Intel 8041A UPI, which acts as a signalling interface processor for the conference circuit. It is connected to the signalling bus in a manner similar to that used for the port processors referred to above.

When a conference request is received by the central processor over the signalling bus, the central processor allocates two time slots, one for "talk" and one for "listen" to each conferee. The time slot allocation devices of the individual lines or trunks are now, via the signalling bus, set to these allocated slots for the duration of the conference call. The six time slots thus allocated are also signalled to the conference circuit processor, which then sets its input and output PCM stores to their conditions appropriate to those time slots.

The conference circuit is caused by its processor to read out serially the PCM bytes for each of the three "talk" time slots, converts them to parallel, and loads them into three incoming stores. The three bytes are then compared, and the byte which represents the largest speech amplitude is loaded into the outgoing store for the other two slots. The outgoing store for the selected byte's time slot is loaded with a "silent" code. The three stores are then read, the contents

thereof are converted to serial representation, and the serial codes thus produced are then sent via the PCM bus using the three "listen" time slots of the next TDM frame.

We now refer to the drawing, which only shows as much of the circuit as is necessary to understand the invention. The arrangement includes the processor 1 which is connected to the signalling bus 2, and controls all operations of the conference circuit, with the co-operation of the central processor (not shown) and to some extent of the port processors (not shown) of the exchange.

When the central processor receives a request to set up a conference call, with the identities of the three conferees, it allocates two time slots on the intelligence bus 3, one for "talk" and one for "listen", to the call for each of the conferees. The identities of these six time slots are sent to the port processors and to the conference circuits' processor 1 over the signalling bus 2. In response to this, the processor 1 sets its incoming and outgoing stores 4 and 5 to their conditions appropriate to these slots. These stores are first-in-first-out (FIFO) stores, readily available commercially.

The time slot allocations as received by the processor 1 are transmitted to the three TSA (time slot allocation) circuits 6, 7 and 8 over the conference circuits' control bus 9. This bus also extends to the FIFO's to set them appropriately, i.e. to enable the FIFO 4 to receive the bytes from the three conferees, and to enable the FIFO 5 to be set to its conditions to send its contents to the three conferees.

The FIFO 4 thus receives the three bytes over the intelligence bus 3, and it converts them into parallel format. They are now passed via the DATA IN channel 10 to the processor 1, which compares them and selects the byte representing the largest signal amplitude. This byte is passed via the DATA OUT channel

11 to the FIFO 5 where it is loaded, under processor control into the portions of that FIFO for the other two conferees' time slots. In addition a "silent code" byte is sent to the FIFO 5 for loading into the portion
5 thereof for the selected conferee's time slot. The FIFO 5 converts each of the bytes which it has received into serial format, and sends them out on the intelligence bus 3 during the next time frame, using the three "listen" time slots for that next frame.

10 When the central processor detects that the conference call has ended, a suitable signal is sent therefrom to the processor 1 via the signalling bus 2, and this causes the conference circuit to be cleared and released. This can be a complete release of all three
15 parties, or a release of only one party to leave a normal two party call.

Although the arrangement has been described for three-party conference it will be appreciated that the technique used is not so limited, and that it can be used
20 for larger conferences.

Another method of performing the conference selection at the processor which is specifically intended for use when there are three conferees, hereinafter called A, B and C, will now be described. In this method
25 the processor does three comparisons, as follows :-

- (a) the bytes received from conferees A and B are compared and the larger of the two is sent in the listen time slot to conferee C.
- (b) the bytes from conferees B and C are compared
30 and the larger of the two is sent in the listen time slot to conferee A.
- (c) the bytes from conferees C and A are compared and the larger of the two is sent in the listen time slot to conferee B.

35 In this case no silent code is required.

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CLAIMS :

1. A telephone exchange conference circuit, for setting up a conference call including n exchange terminations, where n is an integer greater than 2, in a
5 PCM-TDM telephone exchange, which circuit includes an input store for the reception of n PCM code bytes from the conferees, an output store from which n PCM code bytes can be sent to the conferees, a processor which controls the operations of the conference circuit, an
10 input to the processor over which the identities of 2n TDM time slots to be used for the connection are received when the circuit is in use, there being separate 'talk' and 'listen' time slots allocated to each of the conferees, connections from the processor to the stores
15 via which the input store is set to its condition for the reception of bytes from the n conferees and to the output store via which said output store is set to its condition for sending bytes to the n conferees, and connections from the stores via which bytes are transferred from the
20 input store to the processor and from the processor to the output store, wherein on reception of n bytes from the input store the processor compares these bytes and selects the one which represents the largest speech amplitude, wherein the processor, after having made said
25 selection, sends the selected byte to the output store for the time slots for the (n-1) conferees other than the one from which it came, wherein the processor sends a silent code byte to the output store for the time slot for the selected conferee, and wherein the n PCM bytes
30 thus sent to the output store are sent each at the appropriate one of said time slots to the respective ones of the conferees, whereby the conferee whose byte is selected as representing the largest speech amplitude receives said silent code byte while the other conferees
35 receive the byte from the said selected conferee.



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2. A conference circuit as claimed in claim 1, wherein the input store is a first in - first out (FIFO) store which receives the bytes from the n conferees sequentially in serial format, wherein the FIFO store converts all n bytes into parallel format for
5 transmission to the processor, and wherein the output store is also a FIFO store which receives the n bytes from the processor in parallel format and converts them to serial format, whereafter they are sent out, each at
10 its appropriate time slot, to the n conferees.

3. A telephone exchange conference circuit, for setting up a conference call including n exchange terminations, where n is an integer greater than 2, in a PCM-TDM telephone exchange, which includes a processor
15 which controls the operations of the conference circuit, an input store for the reception of n PCM code bytes from the conferees, which input store is of the first in - first out (FIFO) type, which receives the bytes from the n conferees sequentially in serial form and converts all
20 n bytes into parallel format for transmission to said processor, an output store from which n PCM code bytes can be sent to the conferees, which output store from which n PCM code bytes can be sent to the conferees, which output store is also a FIFO store and receives the
25 n bytes from the processor in parallel format and converts them to serial format, an input to the processor over which the identities of $2n$ TDM time slots to be used for the connection are received when the circuit is in use, there being separate 'talk' and 'listen' time slots
30 allocated to each of the conferees, connections from the processor to the FIFO stores via which the input store is set to its condition for the reception of bytes from the n conferees and to the output store via which said output store is set to its condition for sending bytes to the n
35 conferees, and connections from the FIFO stores via which bytes are transferred from the input store to the processor and from the processor to the output store,



wherein on reception of n bytes from the input store to the processor compares these bytes and selects the one which represents the largest speech amplitude, wherein the processor, after having made said selection, sends
5 the selected byte to the output store for the time slots for the (n-1) conferees other than the one from which it came, wherein the processor sends a silent code byte to the output store for the time slot for the selected conferee, and wherein the n PCM bytes thus sent to the
10 output store are sent each at the appropriate one of said time slots to the respective ones of the conferees, said bytes being sent from the output store each in serial format, whereby the conferee whose byte is selected as representing the largest speech amplitude receives said
15 silent code byte while the other conferees receive the byte from the said selected conferee.

4. A conference circuit as claimed in claim 1, 2 or 3, wherein the exchange is a PABX connected to a local exchange via one or more trunk lines, and wherein when n
20 = 3 a conference call can be establishable between three lines, or between two lines and a trunk, or between a line and two trunks.

5. A telephone exchange conference circuit substantially as described with reference to the
25 accompanying drawing.

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