Description

Field of the invention

This invention relates generally to the field of trunked radio systems and specifically to a method and means of providing simplex dispatch trunked system operation while also providing duplex telephone interconnect operation in one subscriber unit. This invention also provides a method and means of implementing simplex dispatch/interconnect and duplex interconnect communication where calls may be initiated from either the landline or subscriber unit, while remaining compatible with conventional simplex trunked system operation.

Background of the invention

Incorporating a telephone interconnect call mode of operation onto a trunked system has generally been constrained by the simplex (voice and data signalling) nature of trunked system subscriber units. Similarly, signalling and call processing by fixed-end control equipment is also simplex formatted. While the introduction of duplex voice/RF-capable subscriber units utilizing simplex data signalling with fixed-end control equipment improves the grade of uses interconnect service, their use restricts the amount of dynamic control and call status changes possible while processing a current, duplex voice-only call.

An example of a simplex system is found in patent document US—A—3586978 which describes a circuit designed to provide an interface between a private automatic telephone exchange and a base radio station serving mobile radio units equipped with touch calling units.

There is a need for a more versatile trunked radio system.

Summary of the invention

According to the present invention, there is provided a method of establishing a duplex call and a method for simplex or duplex telephone interconnect communication, in accordance with the independent method claims, as well as a system for dispatch trunking and simplex/duplex telephone interconnect communication according to claim 9.

Briefly described the present invention contemplates a method and means of providing duplex telephone interconnect service in subscriber units which are otherwise operational on conventional trunked radio systems. According to the principles of the present invention, a duplex capable subscriber unit cooperates with a plurality of duplex trunked repeaters, a trunking central control unit, and a telephone interconnect control unit in accordance with a predetermined signalling scheme. The signalling scheme of the present invention is initiated by a mobile unit transmitting an inbound signalling word (ISW) to central control unit, on a predetermined frequency, wherein the ISW indicates that duplex interconnect call service has been requested. The mobile then receives an outbound signalling work (OSW) from the central control unit, wherein the OSW constitutes a grant for the mobile unit to operate on an assigned frequency. The mobile then transmits a connect tone for a predetermined period to the central control unit, on an assigned frequency, while concurrently receiving a low-speed handshake signal transmitted from the central control unit.

Next, the mobile unit concurrently transmits a sequential DTMF signal for a predetermined period, at the termination of the connect tone, while also receiving a low-speed handshake signal, wherein the DTMF signal comprises desired telephone interconnect dialling information, and finally concurrently transmits a voice and connect tone signal while receiving a voice signal combined with said low speed handshake signal, as the termination of said DTMF signal.

Accordingly, it is an advantage of the present invention that duplex telephone interconnect service, simplex telephone interconnect and conventional simplex trunked radio service is achieved utilizing common control equipment.

It is another advantage of the present invention that a method and means for unifying the operation of a hybrid communication system is provided.

It is still another advantage of the present invention that a trunked radio system which is compatible with duplex telephone service can be implemented.

It is another advantage of the present invention that a method and means of providing DTMF signalling over a simplex trunked radio channel can be provided.

Brief description of the drawings

Figure 1 is a block diagram of a trunked radio system which is interfaced to a conventional duplex telephone system.

Figures 2a and 2b are timing diagrams showing the details of inbound and outbound signalling words used in accordance with the teachings of the present invention.

Figures 2c, and 2d are timing diagrams showing the sequential signalling between a subscriber unit and the system central control unit which may be encountered in a typical simplex trunked radio system.

Figure 2e is a timing diagram showing the sequential signalling between a subscriber unit and the system control unit which would be encountered in the duplex interconnect dispatch trunked radio system of the present invention.

Figure 3 is a more detailed block diagram detailing the construction of the fixed-site portion of the trunked radio system of Figures 1 and 2.

Figure 4 is a schematic and block diagram of the central control unit of Figure 3.

Figure 5 is a schematic diagram of the interconnect control unit of Figure 3.

Figure 6 is a schematic and block diagram of the subscriber unit configuration which may be used in accordance with the teachings of the present invention.

Figures 7 through 13 are flow diagrams detailing the operation of the subscriber unit microprocessor of Figure 6.

Detailed description of the drawings

Figure 1 is a block diagram of a trunked radio system which is coupled to a conventional telephone interconnect system. The trunked land mobile radio system 100 consists of subscriber units 102, 104, which may be either mobile or portable units, a plurality of trunked repeaters 106, and a trunked central controller 110. The trunked central controller 110 is also coupled to a control channel transceiver 108 which transmits and receives control information on a separate frequency. The trunked central controller 110 and trunked repeaters 106 are also connected to an interconnect control unit which controls the trunked repeaters and the public switched telephone network interface. The trunked radio system utilizes additional trunked repeaters as dictated by the number of channels operative on the trunked system. In the quiescent state, all subscriber units 102, 104 monitor the outbound frequency of the trunked repeater 108 which is designated as the control channel.

Referring now to Figure 2c, to establish a "dispatch call" between a group of units operating on the trunked system, a subscriber unit 102 sends a data packet called an "Inbound Signalling Word" (ISW). The ISW is shown in Figure 2a and it contains the requesting unit's unique ID code, consisting of a fleet ID, an individual ID, and a "subfleet" code indicating to which group of units it wants to talk. The ISW also contains a unique "call type" code which indicates that a dispatch call is the type of call desired. The request is forwarded to the central controller 110, which decodes the request, and transmits a data packet called an "Outbound Signalling Word" (OSW) to all subscriber units 102, 104 which are monitoring the outbound control channel. The OSW is a channel grant which contains the subfleet code, the requesting unit's ID code, and the voice channel number assigned for the conversation. The OSW causes the requesting unit to move to the voice channel and commence transmitting, and causes all mobiles with matching fleet and subfleet ID's to move to the voice channel as listening units. In this way, a group or "subfleet" call conversation is set up. If all the voice channels are in use, the central controller 110 sends the requesting subscriber unit 102 a "Busy OSW."

In the trunked radio system of the present invention, telephone interconnect calls may be established on the trunked radio system from either a mobile unit or a land based telephone interconnect caller. In the case of calls initiated from mobile units, an ISW request is sent to the central controller 110 to instruct the mobile to move to the voice channel while at the same time directing the interconnect control unit 112 to establish a connection from the corresponding repeater to the land based telephone line. A duplex unit receiving a channel grant also causes a duplex-capable controller to dynamically reconfigure its audio signal paths for duplex audio routing. In the preferred embodiment of the present invention, a subscriber unit 104 is also configurable to allow simplex interconnect telephone calls. If the central controller determines that an interconnect call should not be made, the central controller 110 sends the requesting unit 102 an "interconnect busy" OSW.

In the trunked radio system of the present invention, telephone interconnect calls may be established on the trunked radio system from either a mobile unit or a land based telephone interconnect caller. In the case of calls initiated from mobile units, an ISW request is sent to the central controller 110 to instruct the mobile to move to the voice channel while at the same time directing the interconnect control unit 112 to establish a connection from the corresponding repeater to the land based telephone line. A duplex unit receiving a channel grant also causes a duplex-capable controller to dynamically reconfigure its audio signal paths for duplex audio routing. In the preferred embodiment of the present invention, a subscriber unit 104 is also configurable to allow simplex interconnect telephone calls. If the central controller determines that an interconnect call should not be made, the central controller 110 sends the requesting unit 102 an "interconnect busy" OSW. For calls initiated from the land line, the interconnect control unit 112 generates a request to the central controller 110 for a particular mobile to be assigned to an interconnected voice channel. The request takes the form of an ISW with the identification and call type information as described above. If a channel is available to be assigned, a "transmit OSW" is sent to the target mobile 102 or 104 in an effort to determine if it is actively turned on or operational. If it is, a "ring OSW" is sent via the outbound control channel to the target mobile 102. As in the case of the mobile land call above, this central controller audio routing is adaptive to the type of target unit service requested. If the central controller 110 determines that an interconnect call should not be made at this time, a busy identification is returned to the land line caller. If the target mobile does not respond to the transpond OSW by issuing an "acknowledge ISW", the land line party is returned to a predetermined signal indicating this and the central controller are terminating the call.

Referring now to Figure 3a, there is shown a block diagram of a trunked radio system coupled to a telephone interconnect system which embodies the features of the present invention. The present invention operates with, but is not limited to, the trunked radio system of Figure 1 with the addition of the telephone interconnect control unit 112. A mobile radio suitable for use as a subscriber unit 102, 104 in the trunked radio system of Figure 1 is shown and described in detail in Motorola Instruction Manual 68P81064E20 entitled "Privacy Plus 1000 Radiotelephone". A repeater suitable for use in

the trunking system of Figure 1 is shown and described in Motorola Instruction Manual 68P81038E85 entitled "Micor Trunked Repeater". The above-mentioned manuals are incorporated herein by reference and may be obtained from the Service Publications Department of Motorola, Inc., 1301 East Algonquin Road, Schaumburg, Illinois, or from Motorola C & E Parts, 1303 East Algonquin Road, Schaumburg, Illinois.

Referring now to Figures 2a and 2b, there is shown a timing diagram detailing the configuration of the Inbound and Outbound Signalling Words described in Figure 1. The Inbound Signalling Word comprises a 21 bit data packet which is sent from a requesting subscriber to the central controller when a channel assignment is required. The first sixteen bits correspond to an identification field, which identifies a particular unit's fleet, subfleet, and individual address assignments. The remaining five bits of 21 bit packet identify the type of call or messages to be communicated on the voice channel.

Referring now to Figure 2b, the configuration of the Outbound Signalling Word is shown in detail. The Outbound Signalling Word is used to communicate channel assignments from the central control unit to the requesting subscriber unit. The Outbound Signalling Word comprises a 27 bit data packet wherein the first sixteen bits are used as a subscriber identification field. The remaining 11 bits communicate channel assignments or status information to the requesting mobile unit.

Figure 3a is a more detailed block diagram of the trunked radio system of Figures 1 and 2. The trunked system central controller 110 of Figure 1 consists of a central site controller module 302 which communicates with a receiver site controller module 304, a transmitter site control module 310, and the interconnect module 352. Communication between these modules is via a conventional RS-232C serial interface. The central site controller 110 receives ISW's which are recovered from the receiver site controller module 304. The receiver site controller 304 is coupled to a plurality of receiver interface boards and an inbound recovery board 308 through an address data bus which communicates the decoded repeater output from the inbound recovery board 308 or receiver interface board 306 to the receiver site controller 304.

After the ISW has been received, the central site controller module 302 responds to the requesting unit by generating an OSW containing channel assignment information. The OSW is communicated to the requesting unit via the serial data link coupled between the central site controller 302 and the transmitter site controller module 310. After the transmitter site interface board 312 receives the OSW from the central control module, it is placed on an address/data bus which is shared commonly with a plurality of transmitter interface boards which ultimately control the repeaters 316, 318, 320, etc. In response to an ISW, the central control unit 302 may additionally instruct the interconnect control unit 352 to interconnect a telephone line to a particular repeater. Communication between the central control module and the interconnect control module is via another RS-232C serial interface. The exact circuit configuration and detailed description of the operation of the central control unit 110 is described in conjunction with Figure 5 and is further described in Motorola Instruction Manual entitled "Trunked System Central Controller", Numbers 68P81047E50 and 68P81066E60, available from the Service Publications Department of Motorola, Inc., 1301 East Algonquin Road, Schaumburg, Illinois.

The interconnect control unit 112 of Figure 1 consists of the interconnect control module 352 which controls the operation of the switch matrix boards 354, the interconnect line interface boards 362, 364, 366, and the trunked repeater interface boards 356, 358, and 360. The interconnect control module 352 communicates with the switch matrix 354 via a parallel address/data bus. The interconnect control unit communicates with the interconnect line interface boards through the matrix 354 and a serial link which couples the phone line interface boards 362, 364, and 366 with the switch matrix 354. The interconnect control module communicates with the trunked repeater interface boards 356, 358, and 360 via the auxiliary parallel address/data bus coupled between the switch matrix 354 and the trunked repeater interface boards 356, 358, and 360. The phone line interface boards 362, 364, and 366 are additionally coupled to telephone registered interface boards 368, 370, and 372. The telephone line interface boards 362, 364, and 366 are used to generate and decode the various signalling tones which are required to control the operation of the telephone interconnect system. The registered interface boards are used for signal conditioning and level control before the telephone signal is applied to the switch matrix 354. The operation of the interconnect control unit 112 is described further in conjunction with Figure 5. A detailed circuit diagram and operation of the interconnect control unit 112 is shown and described in Motorola Instruction Manual 68P81063E20 entitled "Trunked System Central Controller", available from the Service Publications Department of Motorola, Inc., 1301 East Algonquin Road, Schaumburg, Illinois. This and the above-mentioned manuals are all incorporated herein by reference.

When a given telephone interconnect is requested from a subscriber unit, control module 302 instructs the interconnect control module 352 to obtain a telephone connection via the phone line interface board and couple the phone line to a specific repeater. The phone line interface board output 362, 364, or 366 and the trunked repeater interface boards 356, 358, or 360 are then coupled via the switch matrix 354. The output of the particular trunked repeater interface board is then coupled to a particular trunked repeater as instructed by the interconnect control unit. Telephone interconnect calls either requested or

targeted for a duplex subscriber unit are also received from same to be mixed with land line audio via the trunked repeater interface boards, 356, 358, or 360 instead of being directly transmitted via repeaters 316, 318, or 360. Audio control circuitry located on interface boards 356, 358 or 360 establishes this audio gating via trunked repeaters audio line drive circuitry, based upon commands from the interconnect control module 352.

If an interconnect is required from land line to a mobile unit, the telephone interface boards 362, 364, or 366 detect the phone signalling on the land line and then notify the interconnect control unit that a call is waiting on line "N". This message is communicated via a serial link. The interconnect control then requests a repeater channel by placing an ISW on the serial link coupled between the interconnect control unit and the system central controller. The system then assigns a repeater and instructs the interconnect control module 352 to couple telco line "N" to a specific repeater via the switch matrix 354 and the trunked repeater interfaces 356, 358 and 360.

Telephone interconnect calls for both mobile-initiated and land line initiated calls are terminated by the central controller 110 according to the same method wherein the central control unit 110 signals the mobile unit and the land line interconnect that the call is about to be terminated by sending commands which instruct the interconnect control unit to terminate the interconnect and instruct the mobile unit to return to monitoring the control channel. The mobile unit may terminate an interconnect call by sending an end of call signal in the form of an ISW, to the central controller 110. In a similar fashion, if the telephone interconnect caller terminates the call, the interconnect control unit 112 signals the end of the interconnect by sending an end of call ISW to the central control unit 110.

Referring now to Figure 3b, there is shown the interconnect call time-out routine. Whenever an interconnect call is assigned, a timer the length of the interconnect call limit is started. According to Figure 3b, Item 384 is selected whenever the timer expires. When the timer expires, the call is terminated after warning tones are sounded to the mobile and land line callers. Item 384 selects decision 386 which examines the repeater output 106 receiver to determine whether the particular subscriber unit is currently "keyed" or transmitting. If the mobile is still keyed, decision 386 selects decision 388. If the unit is duplex, alert tones are sent to the subscriber via item 392 and the call is terminated via item 394. Else decision 388 waits for a subscriber to dekey before starting the call termination sequence.

Referring now to Figure 4, there is shown an electrical schematic and block diagram of the central controller 110, and the telephone interconnect control unit 112 of Figure 1. As mentioned earlier, the central controller and telephone interconnect controller 112 utilize the same processing unit. The control unit comprises a general purpose microprocessor 402 which interfaces with a bus buffer 404 and a bus transceiver 406. The microprocessor supports the basic operation of the central control unit, as well as the operation of the telephone interconnect control unit. Microprocessor 402 may be any general purpose microprocessor such as Motorola MC6809 available from Motorola Semiconductor, Inc., 3501 Ed Bluestein Boulevard, Austin, Texas. The bus buffer 404 is additionally coupled to bus buffer 408 which provides address information to the peripheral interface adapter (PIA) 412, the random access memories (RAM) 414, and 416, the read-only memory (ROM) 418 and the asynchronous interface adapter (ACIA) 424. Bus transceiver 406 communicates data between the microcomputer 402 and the peripheral interface adapter 412, the RAM memories 414, 416, the ROM 418 and the asynchronous interface adapter 424. The PIA 412 is additionally coupled to a front panel display which serves as a system indicator. The asynchronous interface adapter converts the data present on the data bus to the serial signals communicated between the central control module and the receiver site controller, the transmitter site controller and the interconnect control unit 112 of Figure 4. The peripheral interface adapter 412, the RAM memories 414, 416, the ROM 418, and the asynchronous interface adapter 424 may be any of several off-the-shelf components which are designed to interface with the microcomputer described above.

Referring now to Figure 5, there is shown an electrical schematic and block diagram of the interconnect control unit 112 of Figure 1. The interconnect control unit comprises a general purpose microprocessor 502 which interfaces with a bus buffer 504 and a bus transceiver 506. Microprocessor 502 may be any general pupose microprocessor such as a Motorola MC6809 available from Motorola Semiconductor, Inc., 3501 Ed Bluestein Boulevard, Austin, Texas. The bus buffer 504 is additionally coupled to bus buffer 508 which provides address information to the peripheral interface adapter 512, the random access memories 514 and 516, the read-only memory 518 and the asynchronous interface adapter 524. Bus transceiver 506 communicates data between the microcomputer 502 and the peripheral interface adapter 512, the RAM memories 514, 515, the ROM 518 and the asynchronous interface adapter 524. The PIA 512 is additionally coupled to a front panel display 522 which serves as a system indicator, and a parallel data bus which couples the phone line interface circuits 362, 364, and 366 of Figure 3a. The interconnect control module is also coupled to the switch matrix 354 and trunked repeater interface boards 356, 358, and 360 of Figure 3 via the data and address bus outputs of bus buffer 504 and bus transceiver 506. The asynchronous interface adapter converts the data present on the data bus to the serial signals communicated between the central control module and the interconnect control unit 112 of Figure

4. The peripheral interface adapter, the RAM memories, the ROM, and the asynchronous interface adapter may be any of several readily available components which are designed to interface with the microcomputer described above. The operation of the present invention will be discussed in full detail below. Briefly, however, the operation of the present invention may be summarized as follows.

All activated trunked subscriber units which are not currently processing a call are directed by an internal radio control process to continuously receive a binary-encoded data stream from the Central Site Controller (CSC). This sequence is shown in lines A, E, and I of Figures 2c, 2d, and 2e, respectively. This data stream consists of a sequence of data packets transmitted over a single RF channel. The data may contain specific information to by used by one or more subscribers in originating a request for, or commencing an actual call on a dedicated voice RF repeater channel. In the absence of any user-specific call grant information, the data stream is used by a radio for the purpose of bit-syncing its internal data recovery circuit.

For calls initiated from subscriber units, an ISW request is sent from the unit to the central controller 110 as line dispatch calls above, except that the "call type" code is that for an interconnect call. The central controller sends an OSW "channel grant" to the requesting subscriber, causing it to move to the voice channel, while at the same time directing the interconnect control unit to establish a connection from the corresponding repeater to the land based telephone line.

For calls initiated from the land line, the interconnect control unit generates a request to the central controller for a particular subscriber to be assigned to an interconnect voice channel. The request takes the form of an ISW with the identification and call type information as described above. If a channel is available to be assigned to the interconnect call, a "ring OSW" is sent via the outbound control channel to the target subscriber.

Once transferred to a voice channel, the present invention causes the target subscriber to begin a unique duplex data signalling protocol concurrent to the RF duplex operation just begun, when a duplex telephone interconnect call is being processed.

The operation of the present invention is best described in two parts. The first portion below involves an operational overview of the subscriber units, including a functional description of circuit elements and related control functions. The second portion of the description relates to the key control algorithms which operate in accordance with the teachings of the present invention.

Referring now to Figure 6, there is shown an electrical schematic and block diagram of a subscriber unit 104. In the operation of the subscriber unit, an RF signal is either received or transmitted through the duplex filter element 602. The duplex filter element 602 is comprised of two subsections, which provide overload protection to receiver circuit 608 while concurrently routing amplified transmitter energy via circuitry 604, 602, and to antenna 616 thus providing RF duplex operation.

In the case of a mobile to land call, once the subscriber unit 104 is transferred to the "granted" voice channel for a duplex interconnect call, the present invention causes the requesting subscriber unit to execute a duplex data protocol in cooperation with the central controller 110 of Figure 1 for the duration of the RF duplex operation. The subscriber unit 104 concurrently decodes and processes received data that has been demodulated via receive circuitry 608, filtered via receive filter 606, and processed via host processor 614. This process is shown in lines K and L of Figure 2e. Microcomputer 614 may be any general purpose microcomputer such as Motorola MC6803 available from Motorola Semiconductor, Inc., 3501 Ed Bluestein Boulevard, Austin, Texas. Microcomputer 614 is also the source of a data or tone transmitted signal that is monitored by the central controller 110, for the purposes of establishing and monitoring the presence of subscriber activity on the grant voice channel. This signal is coupled to a summing circuit 610, that is also used as a common node for other signal outputs from processor 614. The signal is then filtered via encode filter 612. This filter, along with input filter 606, is capable of operating with one of two selectable frequency characteristics via switch 618 controlled by processor 614. For the present discussion involving a duplex interconnect call type, filters 606, 612 are configured to pass signals having low or subaudible spectral components. The filtered transmit tone signal is passed to transmit circuitry 604 for modulating an RF carrier, which is amplified and coupled to an input port of duplex filter 602, which is in turn coupled to antenna 616.

A dial-tone is supplied to the radio subscriber user once the audio is unmuted. In response to this, the user may either enter telephone number digits via a DTMF encoder or as in the preferred embodiment of the invention in Figure 6. The circuitry in Figure 6 is capable of outputting low or high speed or frequency tones for transmission, tones, whose two frequency components are summed via summer 610, to become DTMF-formatted as well as high-speed data and tones. Summer 610 then operates as a stage which provides gain.

This signalling continues for the user-active (voice) portion of the telephone interconnect call. By allowing reception and decoding of inbound data, the present invention allows the subscriber unit 102, 104 to be dynamically controlled via the central controller during a call. This capability improves call handling in several ways. The subscriber units call status, which is stored and internally updated, can be changed by a data word change (OSW) received and decoded via

processor 614. For example, an emergency status situation could override the priority of a phone call type and alert the operator. Further, the subscriber unit could detect a marginal RF signal environment by loss of decoded inbound data; the receiver audio from circuit 608 could be muted. The present invention also permits the subscriber unit to automatically terminate the call if a long-term data loss is detected. In addition, the central controller may terminate the interconnect call without waiting for a (simplex data-equipped) subscriber unit 104 to stop transmitting, since it is aware that the request subscriber is duplex-capable, as was described above in conjunction with the description of Figure 3b. This duplex data handling capability may improve system access delays for interconnect call requests, since a voice channel could subsequently be reassigned with little further delay. Finally, the duplex data signalling of the present invention allows for a smooth control channel data handoff and/or interconnect call continuation (if in progress) if the subscriber unit 104 is operating in an area having a plurality of active trunked systems as shown in Figure 1. If the subscriber radio 104 physically leaves the primary coverage area of one system and enters another system capable of supporting this form of extended coverage, the current interconnect call can continue with minimum handoff delay in data and voice signalling.

Referring now to Figures 7 and 8, there are shown flow diagrams which describe a portion of the control operation of the host processor 614 of Figure 6 as it relates to the present invention. Processor 614 is controlled by a real-time, interrupt-driven program comprised of an interrupt service routine and a number of related background routines (not shown) that control the primary function being performed at any one time. These background routines are relatively simple in nature and are used to activate the method of the present invention as well as control the overall operation of the radio. The structure of this background would be obvious to one of ordinary skill in the art and many alternative routines would function satisfactorily in accordance with the teachings of the present invention. Periodic timer interrupts are controlled by an internal programmable timer resident in microcomputer 614.

According to Figure 7, routine 700 begins execution when the microcomputer 614 internal timer interval is reached. Decision 702 examines a stored vector which is stored by one of several currently executed background routines and is caused to be set by the radio operator requesting DTMF service or by current data decoding or bit sync status. Decision 702 determines whether item 704, 710, or decision 716 is to be executed next. If transmission of a DTMF tone was requested after receiving an interconnect voice channel grant, initialization for 200 msec. of low speed connect tone transmission is provided by item 704. DTMF tone transmission parameters are set up by item 706, and item 708 resumes subsequent connect tone transmission, as is shown in Figures 2e, line 1. Connect tone is both prefixed and suffixed by DTMF tones to ensure that the central controller does not falsely decode a loss of voice channel activity and erroneously terminate a call.

Decision 716 is selected periodically to maintain bit synchronization via a software phase-locked loop or to buffer the latest data bit and record its passing. Bit sync via items 724, 726 and 728 to the control channel data is accomplished by interrupting the processor 614 at twice the data rate. This is equivalent to taking two samples per bit. The phase-locking (clock phase) process attempts to sample the bit in the bit time chamber as well as the edge times. Briefly, the phase-lock correction (not shown) operates as follows: If the two most recent edge samples are compared, and if found to be different, a data edge exists between them. In this case, the state of the center sample determines whether clock phase is advanced or retarded. If adjacent samples agree, no incremental clock phase correction is done and if either buffers the latest data via 718 or samples the received data to test for a bit boundary via item 724. After item 718, item 720 updates an internal OSW bit counter whenever a bit boundary has passed. This is used for subscriber unit 104 synchronization relative to the central controllers 1100 outbound OSW data word boundaries. Item 722 updates the status of any user alert tones that may be currently being generated by processor 614 and routed to a user loudspeaker, then control returns to the previously-interrupted background routine. Decision 702 selects item 710, if neither bit sync nor DTMF tone service is required. Item 710 updates the processor time interval for the next interrupt, and item 712 causes sampling of the next received data bit via data filter 606 output. Item 714 then updates the status of any active user alert tone by either toggling or maintaining the current state of the processor 614 output port.

Routine 800 of Figure 8 is the continuation of execution given decision 702 selected item 710. Decision 802 selects either item 804, 806, 808, 810, 812, 814, 816, or 818 as set by the corresponding background routine to accomplish a specific periodic task. Control may be passed to item 804 which tests the currently-buffered receive data bits to determine if the control channel synchronization frame was received. The background vector was previously set here if the radio is in the quiescent state on the control data channel attempting to remain in bit and OSW word synchronization. Alternatively, control is passed to item 806 when there is a need to transmit an ISW. Control is subsequently returned here each interrupt period until the entire ISW is transmitted. Item 808 is executed to detect whether high speed hand shake data was detected in response to a central controller channel grant for a dispatch call. If detected, an acknowledgement (ACK) is transmitted when the currently-executed back-

ground routine sets the interrupt vector to item 812, which would be selected by decision 802. Processor 614 samples each of the central-controller generated bits transmitted via repeater 106. If not detected, the radio returns to the control channel and attempts resynchronization.

Item 810 is executed for the present invention when a duplex interconnect call grant directs the subscriber unit to a voice channel. It majority votes these data samples, storing the voted result each bit time in a temporary register. Executed during the same interrupt service routine interval is item 820 which manages the generation of low speed connect tone which is required by the central controller 110 for the present invention, to maintain an assignment to the current voice channel. Items 810 and 820 are executed for the duration of the user-active voice portion of a duplex interconnect call as discussed above in conjunction with Figure 2e.

Either item 812 or 814 is executed during either simplex interconnect dispatch call types, depending upon the unit's receive or transmit state. Item 812 generates either high speed, low speed, or disconnect tones for transmission depending upon call status as described above for item 820. A disconnect tone is formatted and transmitted upon de-keying the user transmit switch. Item 814 is similar to item 820.

Item 816 formats and stores buffered OSW data bits for further decoding by a background software routine. Item 818 alternatively is executed when no tasks other than common service in Figure 7 are required during the current interrupt period. Interrupt service execution terminates at this point for all control flow paths discussed above.

Figures 9, 10, 11, and 12 relate to the control flow executed when either a dispatch (simplex) or interconnect (simplex or duplex) call type request has been processed and voice-channel operation is ready to commence within the subscriber unit. Control is transferred to routine 900 from a call-type executive routine (not shown) that initializes parameters tested below.

Briefly, this high level routine is responsible for directing control once the outbound signalling word data in Figure 2b has been decoded. If a subscriber unit I.D. match is found, routines 900, 1000, 1100, and 1200 are executed based upon data derived from the outbound signalling word, such as the units I.D., the type of call, etc., and subscriber unit hardware and option information stored in the long term memory (I.E., a EEPROM). RAM variables derived from this data are used to alter the control flow of these routines, as will be described below.

Referring now to Figure 9, background routine 900 begins with decision 902 to determine whether the current call-type is duplex interconnect. Subscriber unit hardware and software status is typically initialized for simplex dispatch or via the call type executive routine. If the call is duplex, hardware is initialized to commence operation. Item 904 activates transmitter circuitry control signals to insure that analog circuitry is activated from the quiescent state. Filters 606 and 612 in Figure 6 are activated in the low speed data or low frequency mode.

Item 908 sets an interrupt vector to execute subroutine 810 and then 820 in Figure 8. Decision 910 is reached in this manner of if the cell is simplex.

Routine execution is set such that decision 910 is reached each time a complete low speed data bit has been received. A state reset condition is flagged if the current call has been terminated. In this case, the routine is exited and control transfers to the call executive routine. The subscriber unit 104 then resynchronizes to the central controller control channel data stream.

Decision 914 is selected if a state reset flag is not detected. If not, decision 914 selects routine 1200 in Figure 12 if either a duplex interconnect call or DTMF tones are required. If the call type is simplex, decision 916 tests to determine whether a valid push-to-talk (PTT) state exists. If so, decision 1104 in Figure 11 checks to see if the allowed transmission time has expired. If this is the case, control is returned to the cell type executive routine to terminate the current transmission and initiate a user timeout tone that is active as long as push-to-talk is asserted. This condition is stored via item 918.

Alternatively, if a valid push-to-talk condition is not detected, but decision 920 determines that DTMF tones are needed, item 922 stores this condition, the routine exits via decision element 1104 and item 1108 in Figure 11, control is returned to the call type executive routine, and finally to a DTMF tone service routine (not shown) that directs the microprocessor to generate the high group (H.G.) and low-group (L.G.) tones, that when summed via summer 610 in Figure 6, become DTMF tone signals.

Routine 1000 in Figure 10 is selected if the requested call is simplex, and no DTMF tones are needed, and the subscriber unit is in receive mode. Decisions 1002 and 1006 measure the number of sequential, correctly-decoded low speed data words. If less than three words have been correctly decoded, a buffer is checked for two central controller-issued disconnects. If this is found to be true in decision 1010, control is transferred to subroutine 1100, item 1104 after which an appropriate exit status is flagged via item 1008.

Alternatively, if decision 1002 determines that more than three words are erroneously decoded, item 1004 disables all audio outputs of the subscriber unit. The present invention will still allow transmission from the subscriber unit unless decision 1006 determines that more than six incorrectly-decoded words have passed, else decision 1010 is again executed, as above.

Then, if two disconnects are not present, the previously-buffered data are decoded. Decision 1016 tests for a properly decoded entire word data. If one is not decoded, a smaller data subframe is checked in a final effort by decision 1018

to enable or continue duplex receive audio. If decision 1018 fails, data bit buffering continues in the present invention as control is transferred to routine 900, Figure 9. If the test in either decision 1016 or 1018 passes, speaker audio is (re) unmuted, depending upon previous status.

Finally, routine 1000 concludes with decision 1022 testing for the presence of a duplex call status. If the call is not duplex, the present invention disables the transmitter in item 1024, Figure 11. A detected duplex call causes control to be transferred to routine 900 to continue receiving and buffering additional low speed data.

Returning briefly to decision 914 in Figure 9, if a duplex call was detected, control is transferred to routine 1200 in Figure 12. Since this routine can be entered from several other routines, decision 1202 again tests for a unit state reset. If one is found, control returns to the call executive routine to terminate the current call. Decision 1204 tests for, and item 1206 services a DTMF tone service request if one is pending. In this fashion, multiple DTMF tones corresponding to multiple subscriber key closures are processed.

Decision 1208 enables the subscriber unit microphone audio if the current call is duplex, else control transfers to decision 916 in routine 900. If the current call transmission time has a pre-set timeout, subinterval, decision 1216 tests to see if this has expired. If it has not, the present invention allows control to transfer to routines 900 and then to return to routine 1000, so as to allow the receiver continue to receive and buffer data from the central controller concurrent to the presently described transmitter operation.

If the timeout subinterval is done, decision 1218 tests the transmission time against the entire timeout period for completion. If not completed, the routine 1200 repeatedly executes, after the periodic interrupt service routine is completed. Else, if the timeout time expires, an exit code is set via item 1220, which returns control to routine 900. Routine 900 in turn transfers control to routine 1100, which finally returns control to the call type executive routine and thus terminates the call (duplex) or transmitter transmission (simplex interconnect or dispatch).

In summary, a method and means of achieving duplex voice interconnect over a conventional trunked radio system has been described. According to the principles of the present invention, a duplex capable subscriber unit, cooperates with a plurality of duplex trunked repeaters, a trunking central control unit, and a telephone interconnect control unit in accordance with a predetermined signalling scheme. The signalling scheme of the present invention is initiated by a mobile unit transmitting an inbound signalling word (ISW) to a central control unit, on a predetermined frequency, wherein the ISW indicates that duplex interconnect call service has been requested. The mobile then receives an outbound signalling word (OSW) from the central control unit, wherein the OSW constitutes a grant for the mobile unit to operate on an assigned frequency. The mobile then transmits a connect tone for a predetermined period to the central control unit, on an assigned frequency, while concurrently receiving a low-speed handshake signal transmitted from the central control unit. Next, the mobile unit concurrently transmits a sequential DTMF signal for a predetermined period, at the termination of the connect tone, while also receiving a low-speed handshake signal, wherein the DTMF signal comprises desired telephone interconnect dialing information, and finally concurrently transmitting a voice and connect tone signal while receiving a voice signal combined with said low-speed handshake signal, as the termination of said DTMF signal. Accordingly, other uses and modifications of the present invention will be obvious to one of ordinary skill in the art without departing from the spirit and scope of the present invention.

Claims

1. A method for establishing a duplex call from a subscriber unit (102, 104) to a land based party connected to a duplex interconnect/dispatch trunked radio system (100) under the control of a central control unit (10), said method characterised by the steps of:

a) transmitting an inbound signalling work (ISW) from the subscriber unit to the central control unit (10) on a predetermined frequency, said ISW indicating that interconnect call service is requested;

b) receiving an outbound signalling word (OSW) at the subscriber unit from said central control unit, said OSW constituting a grant to the subscriber unit to operate on an assigned frequency;

c) transmitting a connect tone for a predetermined period from the subscriber unit to said central control unit (10) on said frequency, while concurrently receiving a low-speed handshake signal transmitted from said central control unit.

2. The method of claim 1 further including the step of:

d) concurrently transmitting a sequential DTMF signal from the subscriber unit for a predetemined period, at the termination of said connect tone, while receiving a low-speed handshake signal at the subscriber unit, said DTMF signal comprising desired telephone interconnect dialling information.

3. The method of claim 2 including the further step of:

e) concurrently transmitting a voice and connect tone signal from the subscriber unit while receiving a voice signal combined with said low-speed handshake signal, at the termination of said DTMF signal.

4. The method of claim 1 wherein said subscriber units audio is muted when said low-speed handshake signal reception is interrupted.

5. The method of claim 1 wherein said central control unit transmits a disconnect signal to said mobile unit before terminating a call.

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to enable or continue duplex receive audio. If decision 1018 fails, data bit buffering continues in the present invention as control is transferred to routine 900, Figure 9. If the test in either decision 1016 or 1018 passes, speaker audio is (re) unmuted, depending upon previous status.

Finally, routine 1000 concludes with decision 1022 testing for the presence of a duplex call status. If the call is not duplex, the present invention disables the transmitter in item 1024, Figure 11. A detected duplex call causes control to be transferred to routine 900 to continue receiving and buffering additional low speed data.

Returning briefly to decision 914 in Figure 9, if a duplex call was detected, control is transferred to routine 1200 in Figure 12. Since this routine can be entered from several other routines, decision 1202 again tests for a unit state reset. If one is found, control returns to the call executive routine to terminate the current call. Decision 1204 tests for, and item 1206 services a DTMF tone service request if one is pending. In this fashion, multiple DTMF tones corresponding to multiple subscriber key closures are processed.

Decision 1208 enables the subscriber unit microphone audio if the current call is duplex, else control transfers to decision 916 in routine 900. If the current call transmission time has a pre-set timeout, subinterval, decision 1216 tests to see if this has expired. If it has not, the present invention allows control to transfer to routines 900 and then to return to routine 1000, so as to allow the receiver continue to receive and buffer data from the central controller concurrent to the presently described transmitter operation.

If the timeout subinterval is done, decision 1218 tests the transmission time against the entire timeout period for completion. If not completed, the routine 1200 repeatedly executes, after the periodic interrupt service routine is completed. Else, if the timeout time expires, an exit code is set via item 1220, which returns control to routine 900. Routine 900 in turn transfers control to routine 1100, which finally returns control to the call type executive routine and thus terminates the call (duplex) or transmitter transmission (simplex interconnect or dispatch).

In summary, a method and means of achieving duplex voice interconnect over a conventional trunked radio system has been described. According to the principles of the present invention, a duplex capable subscriber unit, cooperates with a plurality of duplex trunked repeaters, a trunking central control unit, and a telephone interconnect control unit in accordance with a predetermined signalling scheme. The signalling scheme of the present invention is initiated by a mobile unit transmitting an inbound signalling word (ISW) to a central control unit, on a predetermined frequency, wherein the ISW indicates that duplex interconnect call service has been requested. The mobile then receives an outbound signalling word (OSW) from the central control unit, wherein the OSW constitutes a grant for the mobile unit to operate on an assigned frequency. The mobile then transmits a connect tone for a predetermined period to the central control unit, on an assigned frequency, while concurrently receiving a low-speed handshake signal transmitted from the central control unit. Next, the mobile unit concurrently transmits a sequential DTMF signal for a predetermined period, at the termination of the connect tone, while also receiving a low-speed handshake signal, wherein the DTMF signal comprises desired telephone interconnect dialing information, and finally concurrently transmitting a voice and connect tone signal while receiving a voice signal combined with said low-speed handshake signal, as the termination of said DTMF signal. Accordingly, other uses and modifications of the present invention will be obvious to one of ordinary skill in the art without departing from the spirit and scope of the present invention.

Claims

1. A method for establishing a duplex call from a subscriber unit (102, 104) to a land based party connected to a duplex interconnect/dispatch trunked radio system (100) under the control of a central control unit (10), said method characterised by the steps of:

a) transmitting an inbound signalling work (ISW) from the subscriber unit to the central control unit (10) on a predetermined frequency, said ISW indicating that interconnect call service is requested;

b) receiving an outbound signalling word (OSW) at the subscriber unit from said central control unit, said OSW constituting a grant to the subscriber unit to operate on an assigned frequency;

c) transmitting a connect tone for a predetermined period from the subscriber unit to said central control unit (10) on said frequency, while concurrently receiving a low-speed handshake signal transmitted from said central control unit.

2. The method of claim 1 further including the step of:

d) concurrently transmitting a sequential DTMF signal from the subscriber unit for a predetemined period, at the termination of said connect tone, while receiving a low-speed handshake signal at the subscriber unit, said DTMF signal comprising desired telephone interconnect dialling information.

3. The method of claim 2 including the further step of:

e) concurrently transmitting a voice and connect tone signal from the subscriber unit while receiving a voice signal combined with said low-speed handshake signal, at the termination of said DTMF signal.

4. The method of claim 1 wherein said subscriber units audio is muted when said low-speed handshake signal reception is interrupted.

5. The method of claim 1 wherein said central control unit transmits a disconnect signal to said mobile unit before terminating a call.

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6. A method for establishing a duplex call from a subscriber unit (102, 104) to a land based party, in a duplex interconnect/dispatch trunked radio system having a central control unit and a telephone interconnect control unit, said method comprising the steps of:

a) receiving with said central control unit an inbound signalling word (ISW) from a subscriber unit, on a predetermined frequency, said ISW indicating that duplex interconnect call service has been requested by said subscriber unit;

b) transmitting an outbound signalling word (OSW) to said subscriber unit, said OSW constituting a grant to the subscriber unit to operate an an assigned voice frequency;

c) receiving a connect tone for a predetermined period from said subscriber unit, on said assigned frequency, while concurrently transmitting a dial tone to said subscriber unit; and

d) establishing a connection with a telephone landline through the telephone interconnect control unit, and coupling said landline to said central control unit for communication with said subscriber unit;

e) concurrently receiving a sequential DTMF signal for a predetermined period, at the termination of said connect tone, while transmitting a low-speed handshake signal, said DTMF signal comprising desired telephone interconnect dialling information;

f) concurrently receiving a voice and connect tone signal while transmitting a voice signal combined with said low-speed handshake signal, at the termination of said DTMF signal.

7. A method for simplex or duplex telephone interconnect communication from a subscriber unit to the land based portion of a dispatch trunked radio system having a plurality of duplex-capable subscriber units, a plurality of duplex trunked repeaters operating on assigned frequencies, a telephone interconnect control unit and a central control unit, said method characterised by:

a) transmitting an inbound signalling word (ISW) from a duplex-capable subscriber unit, said ISW indicating whether dispatch or interconnect service has been requested;

b) receiving said ISW and decoding it with the central control unit to determine whether simpex or duplex interconnect or dispatch service has been requested;

c) initiating a simplex communication mode if a dispatch call type has been requested, by transmitting an outbound signalling word (OSW) to said subscriber unit, said OSW constituting dispatch channel granting information;

d) initiating a duplex communication mode by coupling a telephone land-line to an assigned repeater through the telephone interconnect control unit and under the control of the central control unit, if telephone interconnect service was requested by a subscriber unit;

e) transmitting an OSW from the central control unit to said subscriber unit, said OSW authorizing the subscriber to operate with the repeater assigned for telephone interconnect communication;

f) concurrently transmitting a dial tone and low-speed grant data from the central control unit to the subscriber unit on the voice channel until a sequential DTMF signal is received from the subscriber unit;

g) concurrently transmitting low-speed grant data and receiving connect tone while sending received DTMF signals to the telephone network through the telephone interconnect control unit;

h) concurrently transmitting and receiving voice signals accompanied by low-speed data grant from the central control unit to a subscriber unit and connect tone from the subscriber unit to the central unit, respectively;

i) terminating a call if an end-of-call signal is received from the telephone interconnect control unit or a subscriber unit, or if no activity is detected on the communications channel for a predetermined period.

8. The method of claim 7 further including the steps of:

j) continuously monitoring the subscriber units received data signal to determine whether a signal of good quality is being received;

k) muting the subscriber unit's receiver audio channel if a signal of low quality is detected.

9. A system for dispatch trunking and simplex/duplex telephone interconnect communication comprising:

a subscriber unit (102, 104),

a central control unit (10) for control of connections between the subscriber unit and a land based party, characterised by:

a) means at the subscriber unit for transmitting an inbound signalling word (ISW) on a predetermined frequency, said ISW indicating that interconnect call service is requested, and means at the central control unit for receicing said ISW;

b) means at the central control unit for transmitting an outbound signalling word (OSW) said OSW constituting a grant to the subscriber unit to operate on an assigned frequency and means at the subscriber unit for receiving said OSW;

c) means at the subscriber unit for transmitting a connect tone for a predetermined period on said frequency; and

d) means at the central control unit for transmitting a low-speed handshake signal at the same time as the transmission of the connect tone by the subscriber unit and means at the subscriber unit for receiving said low-speed handshake signal.

Patentansprüche

1. Verfahren zum Aufbau eines wechselweisen Gespräches von einer Teilnehmereinheit (102, 104) zu einem landgestützten Partner, der unter der Mitwirkung einer zentralen Steuereinheit (10) an ein Duplexverbindungs-/Sendesprechfunksystem (100) angeschlossen wird, dadurch gekennzeichnet,

a) daß ein Eingabe-Markierungsmerkmal (ISW)

bei einer vorgegebenen Frequenz von der Teilnehmereinheit an die zentrale Steuereinheit (10) gesendet wird und anzeigt, daß eine Bedienung von Gesprächen in der Verbindung angefordert wird,

b) daß ein Ausgabe-Markierungswort (OSW) aus der zentralen Steuereinheit an der Teilnehmereinheit empfangen wird und dieser einen Betrieb auf einer zugeordneten Frequenz gewährt,

c) daß von der Teilnehmereinheit ein Verbindungston während einer vorgegebenen Zeitspanne bei dieser Frequenz an die zentrale Steuereinheit (10) gesendet wird, während ein von der zentralen Steuereinheit gesendetes Anerkenntnissignal von niedriger Frequenz gleichzeitig empfangen wird.

2. Verfahren des Anspruches 1, das ferner den Arbeitsschritt enthält,

d) daß am Ende des Verbindungstones von der Teilnehmereinheit zugleich während einer vorgegebenen Zeitspanne ein sich anschließendes DTMF-Signal gesendet wird, während ein Anerkenntnissignal von niedriger Frequenz an der Teilnehmereinheit empfangen wird, wobei das DTMF-Signal die gewünschte Anwählinformation der Telefonverbindung enthält.

3. Verfahren des Anspruches 2, das den weiteren Arbeitsschritt enthält,

e) daß ein Sprech- und Verbindungstonsignal gleichzeitig von der Teilnehmereinheit gesendet wird, während am Ende des DTMF-Signals ein Sprechsignal empfangen wird, das mit dem Anerkenntnissignal von niedriger Frequenz kombiniert ist.

4. Verfahren des Anspruches 1, bei dem das Sprechsignal der Teilnehmer-Einheiten gedämpft wird, wenn der Empfang des Anerkenntnissignals von niedriger Frequenz unterbrochen wird.

5. Verfahren des Anspruches 1, bei dem die zentrale Steuereinheit vor Beendigung eines Gespräches ein Unterbrechungssignal an die mobile Einheit sendet.

6. Verfahren zum Aufbau eines wechselweisen Gespräches von einer Teilnehmereinheit (102, 104) zu einem landgestützen Partner in einem Duplexverbindungs-/Sendesprechfunksystem mit einer zentralen Steuereinheit und mit einer Telefonanschluß-Steuereinheit, das die Arbeitsschritte aufweist,

a) daß von der zentralen Steuereinheit ein Eingabe-Markierungswort (ISW) aus einer Teilnehmereinheit auf einer vorgegebenen Frequenz empfangen wird und dieses Wort (ISW) angibt, daß von der Teilnehmereinheit eine Bedienung mit Gesprächen in der Duplexverbindung angefordert worden ist,

b) daß ein Ausgabe-Markierungsmerkmal (OSW) an die Teilnehmereinheit gesendet wird und dieser einen Betrieb auf einer zugeordneten Sprechfrequenz gewährt,

c) daß von der Teilnehmereinheit während einer vorgegebenen Zeitspanne bei dieser Frequenz ein Verbindungston empfangen wird, während gleichzeitig ein Anwählton an die Teilnehmereinheit gesendet wird,

d) daß eine Verbinding mit einer über Land geführten Telefonleitung über die Telefonanschluß-Steuereinheit aufgebaut und diese Leitung an die zentrale Steuereinheit zum Nachrichtenaustausch mit der Teilnehmereinheit angeschlossen wird,

e) daß am Ende des Verbindungstones gleichzeitig ein nachfolgendes DTMF-Signal während einer vorgegebenen Zeitspanne empfangen wird, während ein Anerkenntnissignal von niedriger Frequenz gesendet wird, und das DTMF-Signal gewünschte Anwählinformationen der Telefonverbindung enthält, und

f) daß gleichzeitig ein Sprech- und Verbindungstonsignal empfangen werden, während am Ende des DTMF-Signals ein Sprechsignal gesendet wird, das mit dem Anerkenntnissignal von niedriger Frequenz kombiniert ist.

7. Verfahren für eine Simplex- oder Duplextelefonverbindung von einer Teilnehmereinheit zu dem landgestützten Abschnitt eines Sendesprechfunksystems mit mehreren für einen Duplexverkehr fähigen Teilnehmer-Einheiten, mit mehreren im Duplexbetrieb sendenden, auf zugeordneten Frequenzen arbeitenden Verstärkern, mit einer Telefonanschluß-Steuereinheit und mit einer zentralen Steuereinheit, dadurch gekennzeichnet,

a) daß von einer zum Duplexbetrieb fähigen Teilnehmereinheit ein Eingabe-Markierungswort (ISW) gesendet wird, das anzeigt, ob eine Bedienung zum Sprechen oder Verbinden angefordert worden ist,

b) daß das Eingabe-Markierungswort (ISW) empfangen und an der zentralen Steuereinheit zur Feststellung decodiert wird, ob eine Bedienung durch eine Verbinding oder durch Sprechen im Simplex- oder Duplexbetrieb angefordert worden ist,

c) daß durch Senden eines Ausgabe-Markierungswortes (OSW) an die Teilnehmereinheit eine Übertragung im Simplexbetrieb eingeleitet wird, wenn ein Anruf zum Sprechen angefordert worden ist, wobei das Ausgabe-Markierungswort (OSW) als Information den Sprechkanal gewährt,

d) daß eine Übertragung im Duplexbetrieb durch Anschließen einer landgestützten Telefonleitung an einen zugeordneten Verstärker über die Telefonanschluß-Steuereinheit unter Mitwirkung der zentralen Steuereinheit eingeleitet wird, wenn eine Bedienung als Telefonverbindung von einer Teilnehmereinheit angefordert worden ist,

e) daß von der zentralen Steuereinheit an die Teilnehmereinheit ein Ausgabe-Markierungswort (OSW) gesendet wird, das den Teilnehmer berechtigt, mit dem Verstärker zu arbeiten, der für eine Übertragung durch eine Telefonverbindung zugeordnet ist,

f) daß gleichzeitig von der zentralen Steuereinheit auf dem Sprechkanal ein Anwählton und Gewährungsdaten bei niedriger Frequenz

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an die Teilnehmereinheit gesendet werden, bis aus der Teilnehmereinheit ein nachfolgendes DTMF-Signal empfangen wird,

g) daß gleichzeitig Gewährungsdaten bei niedriger Frequenz gesendet werden und ein Verbindungston empfangen wird, während empfangene DTMF-Signale über die Telefonanschluß-Steuereinheit an das Telefonnetz gesendet werden,

h) daß gleichzeitig Sprechsignale, die von Gewährungsdaten bei niedriger Frequenz begleitet sind, aus der zentrale Steureinheit zu einer Teilnehmereinheit und ein Verbindungston aus der Teilnehmereinheit zu der zentralen Einheit gesendet bzw. empfangen werden, und

i) daß ein Gespräch beendet wird, wenn ein dieses Gesprächsende angebendes Signal aus der Telefonanschluß-Steuereinheit oder einer Teilnehmereinheit empfangen wird, oder wenn auf dem Übertragungskanal während einer vorgegebenen Zeitspanne keine Signale wahrgenommen werden.

8. Verfahren des Anspruches 7, das die weiteren Arbeitsschritte enthält,

j) daß das von den Teilnehmer-Einheiten empfangene Datensignal ständig zur Bestimmung überwacht wird, ob gerade ein Signal hoher Güte empfangen wird, und

k) daß der dem Empfang dienende Audiokanal der Teilnehmer-Einheiten gedämpft wird, wenn ein Signal geringer Güte wahrgenommen wird.

9. System zum Aufbau von Verbindungsleitungen und zur Übertragung durch Simplex-/Duplex-Telefon-Verbindungen mit einer Teilnehmereinheit (102, 104), mit einer zentralen Steuereinheit (10) zur Beeinflussung von Verbindungen zwischen der Teilnehmereinheit und einem landgestützten Partner, gekennzeichnet, durch

a) an der Teilnehmereinheit befindliche Hilfsmittel zum Senden eines Eingabe-Markierungswortes (ISW) auf einer vorgegebenen Frequenz, das angibt, daß eine Gesprächsbedienung über eine Verbindung angefordert wird, und durch an der zentralen Steuereinheit befindliche Hilfsmittel zum Empfang des Eingabe-Markierungswortes (ISW).

b) durch an der zentralen Steuereinheit befindliche Hilfsmittel zum Senden eines Ausgabe-Markierungswortes (OSW), das der Teilnehmereinheit einen Betrieb auf einer zugeordneten Frequenz gewährt, und durch an der Teilnehmereinheit befindliche Hilfsmittel zum Empfang des Ausgabe-Markierungswortes (OSW),

c) durch an der Teilnehmereinheit befindliche Hilfsmittel zum Senden eines Verbindungstones auf dieser Frequenz während einer vorgegebenen Zeitspanne und

d) durch an der zentralen Steuereinheit befindliche Hilfsmittel zum Senden eines Anerkenntnissignals bei niedriger Frequenz, wenn zugleich der Verbindungston von der Teilnehmereinheit übertragen wird, und durch an der Teilnehmereinheit befindliche Hilfsmittel zum Empfang des Anerkenntnissignals bei niedriger Frequenz.

Revendications

1. Un procédé pour établir un appel en duplex à partir d'un poste d'abonné (102, 104) vers un poste fixe, connecté à un système de radiocommunication à canaux partagés fonctionnant dans les modes d'interconnexion en duplex/diffusion (100), sous la commande d'une unité de commande centrale (110), ce procédé étant caractérisé par les étapes suivantes:

a) on émet un mot de signalisation entrant (ISW) à partir du poste d'abonné vers l'unité de commande centrale (110), sur une fréquence prédéterminée, ce mot ISW indiquant qu'un service d'appel d'interconnexion est demandé;

b) on reçoit un mot de signalisation sortant (OSW) au poste d'abonné, à partir de l'unité de commande centrale, ce mot OSW constituant pour le poste d'abonné une autorisation à fonctionner sur une fréquence attribuée;

c) on émet une fréquence audio de connexion, pendant une période prédéterminée, du poste d'abonné vers l'unité de commande centrale (110), sur la fréquence précitée, tout en recevant simultanément un signal lent d'établissement de liaison que est émis par l'unité de commande centrale.

2. Le procédé selon la revendication 1, comprenant en outre l'étape suivante:

d) on émet simultanément un signal séquentiel de signalisation multifréquence DTMF à partir du poste d'abonné, pendant une période prédéterminée, à la terminaison de la fréquence audio de connexion, tout en recevant au poste d'abonné un signal lent d'établissement de liaison, ce signal de signalisation multifréquence DTMF constituant l'information de numérotation d'interconnexion téléphonique désirée.

3. Le procédé selon la revendication 2, comprenant l'étape supplémentaire suivante:

e) on émet un signal vocal et un signal de fréquence audio de connexion, à partir du poste d'abonne, tout en recevant simultanément un signal vocal combiné avec le signal lent d'établissement de liaison à la terminaison du signal de signalisation multifréquence DTMF.

4. Le procédé selon la revendication 1, dans lequel la sortie audio du poste d'abonné est bloquée lorsque la réception du signal lent d'établissement de liaison est interrompue.

5. Le procédé selon la revendication 1, dans lequel l'unité de commande centrale émet un signal de déconnexion vers un poste mobile avant de mettre fin à un appel.

6. Un procédé pour établir un appel en duplex à partir d'une poste d'abonné (102, 104) vers un poste fixé, dans un système de radiocommunication à canaux partagés fonctionnant dans les modes d'interconnexion en duplex/diffusion, qui comporte une unité de commande centrale et une unité de commande d'interconnexion téléphonique, ce procédé comprenant les étapes suivantes:

a) on reçoit avec l'unité de commande centrale un mot de signalisation entrant (ISW) qui provient d'un poste d'abonné, sur une fréquence prédéter-

minée, ce mot ISW indiquant qu'un service d'appel d'interconnexion en duplex a été demandé par le poste d'abonné;

b) on émet vers le poste d'abonné un mot de signalisation sortant (OSW), ce mot OSW constituant pour le poste d'abonné une autorisation à fonctionner sur une fréquence attribuée;

c) on reçoit une fréquence audio de connexion pendant une période prédéterminée, à partir du poste d'abonné, sur la frequence attribuée, tout en émettant simultanément une tonalité d'invitation à numéroter vers le poste d'abonné; et

d) on établit une connexion avec une ligne téléphonique fixe, par l'intermédiaire de l'unité de commande d'interconnexion téléphonique, et on connecte cette ligne fixe à l'unité de commande centrale pour la communication avec le poste d'abonné;

e) on reçoit un signal séquentiel de signalisation multifréquence DTMF pendant une période prédéterminée, à la terminaison de la fréquence audio de connexion, tout en émettant simultanément un signal lent d'établissement de liaison, ce signal de signalisation multifréquence DTMF constituant une information de numérotation d'interconnexion téléphonique désirée;

f) on reçoit un signal vocal et signal de fréquence audio de connexion, tout en émettant simultanément un signal vocal combiné avec le signal lent d'établissement de liaison, à la terminaison du signal de signalisation multifréquence DTMF.

7. Un procédé pour réaliser une communication d'interconnexion téléphonique en simplex ou en duplex à partir d'un poste d'abonné vers une partie fixe d'un système de radiocommunication à canaux partagés pouvant fonctionner en mode de diffusion, qui comporte un ensemble de postes d'abonné capables de fonctionner en duplex, un ensemble de répéteurs à canaux partagés fonctionnant en duplex et travaillant sur des fréquences attribuées, une unité de commande d'interconnexion téléphonique et une unité de commande centrale, ce procédé étant caractérisé per les étapes suivantes:

a) on émet un mot de signalisation entrant (ISW) à partir d'un poste d'abonné capable de fonctionner en duplex, ce mot ISW indiquant si un service de diffusion ou d'interconnexion a été demandé;

b) on reçoit le mot ISW et on le décode avec l'unité de commande centrale, pour déterminer si un service d'interconnexion en simplex ou en duplex ou un service de diffusion a été damandé;

c) on déclenche un mode de communication en simplex si un type d'appel de diffusion a été demandé, en émettant vers le poste d'abonné un mot de signalisation sortant (OSW), ce mot OSW constituant une information d'attribution de canal de diffusion;

d) on déclenche un mode de communication en duplex en connectant une ligne téléphonique fixe à un répéteur attribué, par l'intermédiaire de l'unité de commande d'interconnexion téléphonique et sous la commande de l'unité de commande centrale, si un poste d'abonné a demandé un service d'interconnexion téléphonique;

e) on émet un mot OSW à partir de l'unité de commande centrale vers le poste d'abonné, ce mot OSW autorisant l'abonné à fonctionner avec le répéteur qui est attribué pour une communication d'interconnexion téléphonique;

f) on émet simultanément une tonalité d'invitation à numéroter et des données lentes d'autorisation, à partir de l'unité de commande centrale vers le poste d'abonné, sur le canal vocal, jusqu'à ce qu'un signal séquentiel de signalisation multifréquence DTMF soit reçu à partir du poste d'abonné;

g) on émet des données lentes d'autorisation et on reçoit une fréquence audio de connexion, tout en émettant simultanément les signaux DTMF reçus vers le réseau téléphonique, par l'intermédiaire de l'unité de commande d'interconnexion téléphonique;

h) on émet et on reçoit sumultanément des signaux vocaux accompagnés de données lentes d'autorisation, de l'unité de commande centrale vers un poste d'abonné, et une fréquence audio de connexion du poste d'abonné vers l'unité de commande centrale, respectivement;

i) on met fin à un appel si un signal de fin d'appel est reçu à partir de l'unité de commande d'interconnexion téléphonique ou d'un poste d'abonné, ou si aucune activité n'est détectée sur le canal de communication pendant une période prédéterminée.

8. Le procédé de la revendication 7, comprenant en outre les étapes suivantes:

j) on contrôle continuellement le signal de données reçu à partir d'un poste d'abonné, pour déterminer si un signal de bonne qualité est reçu;

k) on bloque le canal audio du récepteur du poste d'abonné si un signal de mauvaise qualité est détecté.

9. Un système pour établir une communication par canaux partagés en mode de diffusion et une communication par interconnexion téléphonique en simplex/duplex, comprenant:

un poste d'abonné (102, 104),

une unité de commande centrale (110) pour la commande de connexions entre le poste d'abonné et un poste fixe, caractérisé par:

a) des moyens dans le poste d'abonné pour émettre un mot de signalisation entrant (ISW) sur une fréquence prédéterminée, ce mot ISW indiquant qu'un service d'appel d'interconnexion est demandé, et des moyens dans l'unité de commande centrale pour recevoir le mot ISW;

b) des moyens dans l'unité de commande centrale pour émettre un mot de signalisation sortant (OSW), ce mot OSW constituant pour le poste d'abonné une autorisation à fonctionner sur une fréquence attribuée, et des moyens dans le poste d'abonné pour recevoir le mot OSW;

c) des moyens dans le poste d'abonné pour émettre une fréquence audio de connexion, pendant une période prédéterminée, sur la fréquence précitée; et

d) des moyens dans l'unité de commande

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centrale pour émettre un signal lent d'établissement de liaison, simultanément à l'émission de la fréquence audio de connexion par le poste d'abonné, et des moyens dans le poste d'abonné pour recevoir ce signal lent d'établissement de liaison.