

Description

This invention relates generally to arrangements for data conferencing between a plurality of data stations.

The art recognizes the desirability of data conferencing between a plurality of data stations. For example, "How an ISDN Terminal Could Be Used", Computing Canada, Vol. 12, No. 17 (21 August 1986), pp. 11-12, mentions an application that allows two people to share information on a PC's screen and jointly control an application in an ISDN environment. The application executes on one PC, but its results are displayed on the screens of both PCs and both PCs have access to the application through their keyboards.

Existing arrangements for data conferencing between a plurality of data stations, such as computers or terminals, use complex centralized conference circuits to interconnect the data stations. Such circuits become especially complex when adapted to interconnect stations of different types and operating at different transmission rates. It is a problem in the art that such data conference arrangements are complex, expensive, functionally dependent upon the inter-station communication medium and hence typically incompatible with any but one type of medium, and unable to make use of the often-large base of application programs available on the interconnected stations.

According to one aspect of the invention, there is provided a data conferencing arrangement as claimed in claim 1.

In an illustrative embodiment, the first and the second station comprise a first and a second computer, respectively, and the first and the second control arrangement comprise a first and a second control program, respectively, each executing on the respective computer. The object of the conference, which is the destination of the keyboard input and the origin of the display output, illustratively comprises an application program executing on the second computer. The second control arrangement illustratively further comprises a control arrangement for effecting execution of both the application program and the second control program on the second computer in a time-shared manner.

According to a second aspect of the invention, there is provided an arrangement for data conferencing a plurality of first stations with a second station, as claimed in claim 6.

In an illustrative embodiment, the second station comprises a computer, whereas the first stations comprise computer terminals. The control arrangement illustratively comprises a control program executing either on the second station's computer, or on a second computer interposed between the second station's computer and the terminals. The object of the conference, which is again the destination of the

keyboard output and the origin of the display output, illustratively comprises an application program executing on the second station's computer. The control arrangement illustratively further comprises a second control program for enabling the first-mentioned control program to receive from, and transmit to, the first stations. Illustratively, in the case of the computer executing the first-mentioned control program comprising an operating system including a shell program an instance of which executes for each first station to receive keystroke signals from, and to transmit display signals to, that first station, an instance of the second control program executes for each but one first station and causes that station's shell instance to suspend execution, in order to enable the first program instead of the shell to receive from and transmit to the first stations.

The data conferencing arrangement characterized above is generally simple and inexpensive, regardless of the types of stations and inter-station communication media used. It is independent of the type of inter-station medium used, and hence may be used with various types of media. And it does not require that any modifications be made to existing application programs, and hence is able to make use, as conference objects, of the often-large base of existing and available application programs.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a block diagram of a computer system including a first illustrative embodiment of the invention;

FIG. 2 is a flow diagram of the RAP program of FIG. 1;

FIG. 3 is a flow diagram of the SCP program of FIG. 1;

FIG. 4 is a block diagram of a computer system including a second illustrative embodiment of the invention;

FIG. 5 is a flow diagram of a PART. program of FIG. 5; and

FIGS. 6-7 are a flow diagram of the LINK program of FIG. 5.

Detailed Description

FIG. 1 shows an illustrative computer system, comprising a pair of personal computers (PCs) 1 and 2 interconnected for communication through a private branch exchange (PBX) 7. Illustratively, PCs 1 and 2 are each an AT&T PC 6300 personal computer operating under the control of the MS-DOS operating system, and PBX 7 is an AT&T System 85 PBX. PCs 1 and 2 are connected to PBX 7 by communication links 5 and 6, respectively, which are, for example, conventional telephone lines. PCs 1 and 2 are coupled to links 5 and 6, respectively, by interfaces 3 and 4, re-

spectively, which interface PCs 1 and 2 to the communication protocol used by PBX 7 on the links. Any number of interfaces are suitable for this purpose. For example, each interface 3 or 4 comprises an AT&T PC/PBX board whose software is modified to permit direct communication therewith by a program executing on the attached PC. Alternatively, each interface 3 or 4 comprises a modem connected between a serial port of the PC and the link. This latter arrangement is assumed to exist in the illustrative embodiment described below.

A program 22 which users of PCs 1 and 2 wish to conference is located on one of the PCs, shown illustratively as PC 1. Program 22 may be any program, for example, an application program such as a spread sheet or an editor. The PC on which program 22 resides is referred to as the application PC.

Program 22 is co-resident on application PC 1 with two other pieces of software. One is a program 20 that enables application PC 1 to function as a time-sharing computer system. Program 20 is illustratively the AT&T Concurrent Context Switch (CCS) program. The other program 21 is a primary conferencing program, described further below. Program 21 is conventionally loaded into application PC 1 as the Resident Application Program (RAP) of CCS program 20. Program 22 is in turn conventionally loaded into application PC 1 as the Transient Application Program (TAP) of CCS program 20. CCS program 20 allows both RAP programs 21 and TAP program 22 to run on PC 1 concurrently, i.e., on a time-shared basis.

The only program of interest for purposes of this application which is loaded into PC 2 is a Secondary Conferencing Program (SCP) 23, described further below. The PC on which program 23 resides is referred to as the conference PC.

Each PC 1 and 2 has a conventional keyboard buffer 100 and 200, respectively, for storing input to the PC that has been keyed-in on the PC's keyboard. Each PC 1 and 2 also has a conventional screen buffer 101 and 201, respectively, for storing output generated by the PC for display on the PC's screen. The function of primary conferencing program 21 is to receive keyboard input from PC 2 and load the input into keyboard buffer 100 as if it were input from the keyboard of PC 1, and to send display output changes entered into screen buffer 101 to PC 2. The function of secondary conferencing program 23 is to send keyboard input from keyboard buffer 200 to PC 1, and to receive display output changes from PC 1 and load them into screen buffer 201 as if they were display output generated by PC 2. Hence, keyboard input on both PCs 1 and 2 is entered as keyboard input of PC 1 to TAP 22, while display output of TAP 22 generated in PC 1 is displayed on the screens of both PCs 1 and 2. Thus, a conference by users of both PCs 1 and 2 with TAP 22 is established in real-time.

To use the real-time data conferencing feature, a

user of application PC 1 runs CCS program 20 and strikes the CCS "hot" key. Illustratively, on the PC 6300, the CCS "hot" key corresponds to keying "ALT-SHIFT-SHIFT". Striking the "hot" key causes CCS program 20 to invoke RAP program 21, the primary conferencing program.

Primary conferencing program 21 is a communications package that calls conference PC 2, performs initial handshaking, and handles the conferencing requirements for application PC 1.

In order to accept a conference call from application PC 1, conference PC 2 must be running secondary conference program 23. Illustratively, a communication, such as a person-to-person call, is required between the users of PCs 1 and 2 so that the user of PC 2 knows to start program 23 running.

FIG. 2 illustrates the operational steps of primary conferencing program 21. Assuming that interfaces 3 and 4 each comprise a modem, when primary conferencing program 21 is invoked, at step 298, it prompts the user of PC 1 via screen buffer 101 for the parameters according to which transmissions will proceed, at step 299. These parameters are conventional, and include the type of transmission stop and start characters to be used, the baud rate of transmission, the type of parity to be used, the number of stop bits, and the number of bits per character. When the user keys-in the parameters, program 21 receives that information via keyboard buffer 100, at step 300. (If interfaces 3 and 4 each comprise a PC/PBX board, steps 299 and 300 are skipped.) Program 21 then prompts the user of PC 1, at step 301, for the identification number of PC 2 — illustratively the data telephone extension number of PC 2 within the system of FIG. 1. When the user keys-in the extension, program 21 receives that information via keyboard buffer 100, at step 302, and in response establishes a call to PC 2, at step 303. Program 21 interacts with interface 3 in a conventional manner to establish a call to switch 7 and to provide switch 7 with the extension of PC 2. Switch 7 then sets up the call to PC 2 and connects PC 1 to PC 2.

If program 21 determines from input received from interface 3 that establishment of the call is unsuccessful, at step 304, program 21 terminates, at step 305. Illustratively, call establishment may be unsuccessful because transmission parameters used by interface 3 are not the same as the transmission parameters used by interface 4. (But assuming that interfaces 3 and 4 each comprise a PC/PBX board, if call establishment is successful, program 21 next sets up transmission between PC 1 and PC 2 by causing interface 3 to communicate with interface 4 via the established call and negotiate, in a conventional manner, the transmission parameters, described above in conjunction with steps 299 and 300, that will be followed during subsequent data exchanges. Program 21 then proceeds to step 308.)

Assuming that interfaces 3 and 4 each comprise a modem, if call establishment is successful at step 304, program 21 computes and stores, at step 308, a line-by-line checksum on the display of screen of PC 1 as represented by contents of screen buffer 101, for later use in determining whether any changes have been made to the screen's display. Program 21 then goes to sleep, at step 309, in a conventional manner.

When program 21 is sleeping, CCS program 20 runs TAP program 22, and the user of PC 1 may interact with program 22 via the screen and keyboard of PC 1, in a conventional manner. As part of its execution, program 22 receives as input the contents of keyboard buffer 100 and generates display data that are loaded into screen buffer 101.

CCS program 20 automatically alternates between running TAP program 22 and RAP program 21, devoting to TAP program 22 a certain percentage of execution time of PC 1. The percentage is determined by a CCS program 20 initialization parameter, and typically is set at from 50% to 70% of execution time. After TAP program 22 has been executing for a while, CCS program 20 causes execution of TAP program 22 to become suspended and wakes up RAP program 21 to resume its execution.

Upon being awakened, at step 310, primary conferencing program 21 checks whether a "disconnect" command has been received, at step 311. Program 21 performs the check by examining the contents of keyboard buffer 100 to determine whether the user of PC 1 has keyed in a disconnect command, and by examining input received from interface 3 to determine whether a disconnect command has been received from PC 2. If a disconnect command has been given, program 21 terminates, at step 312.

If a disconnect command has not been given, as determined at step 311, program 21 checks input received from interface 3 to determine if any data has been received from conference PC 2, at step 313. If interface 3 has received any data, program 21 retrieves the data from interface 3 and loads the retrieved data into keyboard buffer 100, at step 314.

If no data has been received from PC 2 as determined at step 313, or following step 314, program 21 checks, at step 316, whether the screen display of PC 1 has changed. Program 21 makes the check by again computing line-by-line checksums on the display of the screen of PC 1, as at step 308, and then comparing the newly-computed checksums with those computed previously (e.g., at step 308) to determine if they are different.

If there has been a change in the display, program 21 causes interface 3 to send information defining the changes to conference PC 2, at step 317. Illustratively, this information comprises the addresses of the changed display lines and the values of the pixels of those lines. At step 318, program 21 stores the newly-computed checksums in place of those that

were stored previously.

If there has not been a change in the display as determined at step 316, or following step 318, program 21 returns to sleep, at step 309, thereby giving TAP program 22 a chance to execute again.

Turning now to FIG. 3, it shows the operational steps of secondary conferencing program 23. Program 23 is responsible for accepting a data call from application PC 1, initial handshaking, and handling of the conferencing requirements for conference PC 2. Those requirements involve sending keystrokes made on PC 2 to PC 1, and displaying screen display information received from PC 1 on PC 2.

Assuming that interfaces 3 and 4 each comprise a modem, when secondary conferencing program 23 is started, at step 398, it prompts the user of PC 2 via screen buffer 101 for the parameters according to which transmission will proceed, at step 399. When the user keys-in the parameters, program 23 receives that information via keyboard buffer 200, at step 400. (If interfaces 3 and 4 each comprise a PC/PBX board, steps 399 and 400 are skipped.) Program 23 then checks input from interface 4, at step 401, to determine if a call has been received from application PC 1. If not, program 23 checks keyboard buffer 200, at step 402, to determine if any input has been keyed-in by the user of PC 2. If not, program 23 merely returns to step 401. If input has been keyed-in by the user of PC 2, program 23 checks the input, at step 403, to determine if it is a disconnect command. If not, program 23 merely returns to step 401; if so, program 23 causes interface 4 to send the command to application PC 1, at step 415, and then terminates, at step 416.

Returning to step 401, if program 23 determines that a call has been received from application PC 1, it undertakes activities to accept the call, at step 406. These activities include reading the communications port status for modems, or validating the return code for a PC/PBX connection. (If interfaces 3 and 4 each comprise a PC/PBX board, program 23 then sets up the transmission between PC 1 and PC 2 by causing interface 4 to communicate with interface 3 via the established call and negotiate, in a conventional manner, the transmission parameters that will be followed in subsequent exchanges of data. Program 23 then proceeds to step 408.)

Assuming that interfaces 3 and 4 each comprise a modem, following call acceptance at step 406, program 23 checks keyboard buffer 200 for input, at step 408. If there is input, program 23 examines the input to determine whether it is a disconnect command, at step 409. If so, program 23 proceeds to steps 415 and 416 to send the command to PC 1 and to terminate. If the input is not a disconnect command, program 23 causes interface 4 to send the contents of keyboard buffer 200 to application PC 1, at step 410.

Following step 410, or if program 23 determines

at step 408 that there is no keyboard input, program 23 examines input received from interface 4 to determine if any input has been received from application PC 1, at step 411. If not, program 23 merely loops back to step 408 to check again for keyboard input; if so, program 23 examines the input to determine if it is a disconnect command, at step 412. If a disconnect command has been received from PC 1, program 23 proceeds to step 416 and terminates. If input received from PC 1 is not a disconnect command, it is screen display update information, and program 23 loads that information into screen buffer 201, at step 413, to cause the display of PC 2 to become updated. Program 23 then loops back to step 408.

FIG. 4 shows a second illustrative computer system comprising a plurality of terminals 501-503, an intermediary computer 504, and a host computer 505. Terminals 501-503 are conventional terminals. For ease of description, terminals 501-503 are considered to have compatible input and output formats. Terminals 501-503 are each connected to a port 530 of intermediary computer 504 in a conventional manner, for example, via a standard ASCII interface 510.

Intermediary computer 504 simulates a switch, channeling output from terminals 501-503 to host computer 505, and broadcasting output from host computer 505 to terminals 501-503. Illustratively, intermediary computer 504 is an AT&T 3B2 computer operating under control of the UNIX® operating system.

Host computer 505 is a conventional computer, typically a minicomputer or a mainframe. Illustratively, computer 505 is a DEC VAX minicomputer operating under control of the UNIX operating system. Computers 504 and 505 are interconnected by a conventional communication link 551. Computers 504 and 505 are known to each other through their internal systems files, as is conventional.

Programs with which users of terminals 501-503 wish to conference, such as an application program 550 taken to be illustrative thereof, are located in computer 505 -- hence the name "host" computer. Terminals 501-503 are provided access to program 550 by a link program 511 in cooperation with participant program 512. Link program 511 and participant program 512 are located in computer 504 -- hence the name "intermediary" computer.

As is conventional, when a terminal logs into computer 504, the operating system of computer 504 assigns a buffer 520 to port 530 at which the terminal is connected to computer 504. Each port 530 has an address which is also used by the operating system to identify buffer 520 associated with that port 530. Terminals 501-503 and the operating system then communicate with each other through buffers 520: the operating system's shell, an instance of which is assigned to each logged-in terminal 501-503, reads terminal output from the associated buffer 520 and

writes terminal input to that buffer 520.

A conference has a plurality of participants, but only one of the participants is the conference initiator. A voice call among the users of terminals 501-503 -- the assumed conference participants -- that either precedes, or is contemporaneous with, the data conference is assumed for the purpose of deciding who among conference participants 501-503 will be the initiator.

Assume that terminal 501 is selected to be the conference initiator. Each of the non-initiator conference participants 502-503 sends a "part" command to intermediary computer 504. The commands are retrieved from the terminals' buffers 520 each by the associated instance of the shell. Each instance of the shell responds to the command by invoking participant program 512 and suspends itself by executing a conventional UNIX system "WAIT", waiting for a UNIX system SIGCLD signal. Hence, a number of instances of participant program 512 begin to execute in computer 504, one instance for each non-initiator participant terminal 502-503.

The operational steps of participant program 512 are shown in FIG. 5. During the conference, it is desired that link program 511, and not the shell, communicate with participant terminals 501-503. For this purpose, it is the function of each instance of participant program 512 merely to keep the corresponding instance of the shell suspended in the "WAIT" state. Upon being invoked, at step 700, the invoked instance of participant program 512 merely puts itself to sleep, at step 702, in a conventional manner, while awaiting receipt of a KILL signal from link program 511.

The KILL signal indicates that the corresponding terminal is ceasing participation in the conference. Receipt of the KILL signal causes the recipient instance of participant program 512 to wake up, in a conventional manner, at step 703. The instance of participant program 512 then terminates at step 705, thereby causing a SIGCLD signal to be sent to the corresponding instance of the shell in a conventional manner. Receipt of the SIGCLD signals unblocks the shell from the "WAIT" state and it resumes execution.

Turning now to initiator terminal 501, it sends a "conf" command to intermediary computer 504 to initiate the conference. The command is retrieved from buffer 520 by the associated instance of the shell, and the shell responds to the command by invoking link program 511 and suspending itself, i.e., executing a conventional UNIX system "WAIT".

The operational steps of link program 511 are shown in FIGS. 6-7. Upon being invoked, at step 600, link program 511 prompts initiator terminal 501, at step 601, for information identifying the other participant terminals 502-503. This information is, for example, the login ID of the terminal, or the device number of port 530 at which the terminal is connected to com-

puter 504. Program 511 accomplishes the prompt by loading a prompt display message into buffer 520 of initiator terminal 501. Program 511 then loops between steps 602 and 603, polling the initiator's buffer 520, at step 602, and awaiting receipt of the identifying information, at step 603.

Upon receipt of the sought-after information, at step 603, program 511 prompts all participant terminals 501-503 for information identifying host computer 505, at step 604. This information is, for example, a UNIX system machine name of host 505. Program 511 prompts for the information by placing a prompt display message in buffers 520 of terminals 501-503. Program 511 then polls buffers 520 of terminals 501-503, at step 605, looking for a response, at step 606.

When a user of one of the terminals 501-503 keys in the host-identifying information, program 511 receives it, at step 606, via that terminal's buffer 520. Upon receipt of the identifying information, program 511 causes a connection to be established to host computer 505, at step 607. Illustratively, program 511 does so by invoking the UUCP program of the UNIX operating system of computer 504, and passing to it the host computer's machine name or dial-up number as a parameter. Program 511 then checks whether connection establishment was successful, at step 608. If not, program 511 sends a display message to terminals 501-503 via their buffers 520 to inform them of the failure, at step 609, and through the UNIX operating system posts a KILL signal to each instance of participant program 512, at step 610. Program 511 then terminates, by returning to the shell program, at step 611. The shell program is thereby unblocked and resumes communicating with terminal 501.

If establishment of a connection to host computer 505 is found at step 608 to have been successful, program 511 polls each participant terminal's buffer 520 for terminal output, at step 613. If output is received from a terminal, as determined at step 613, program 511 checks, at step 614, whether the output is a local command, that is, a command intended for intermediary computer 504. Illustratively, a local command is one preceded by the symbol "~". If the output is not a local command, program 511 treats the output as input for host computer 505, and causes it to be sent to host computer 505, at step 615. Illustratively, program 511 accomplishes the transfer by invoking the UUCP program and passing the output to it as an argument. Host computer 505 then conveys the output to program 550 in a conventional manner.

If the output is found at step 614 to be a local command, program 511 processes it, at steps 616-623. Illustratively, program 511 recognizes three local commands: an "~exit" command, at step 616, an "~add" command, at step 618, and an "~end" command, at step 620. If the local command is an "~exit" command, program 511 terminates participation in the conference of the terminal that originated the com-

mand, by sending a KILL signal to that terminal's associated instance of participant program 512, at step 617. If the local command is an "~add" command, program 511 includes as a participant in the conference a terminal whose ID accompanies the command as a parameter, at step 619, by including that terminal's buffer 520 among the buffers 520 with which program 511 is communicating. If the local command is an "~end" command, program 511 terminates the conference by sending a KILL signal to all non-initiator participant terminals' 502-503 instances of participant program 512, at step 621. Program 511 then causes the connection to host computer 505 to be broken, at step 622, by invoking the UUCP program with appropriate parameters. Finally, program 511 terminates by returning to the shell program, at step 623.

If no output is received from a terminal 501-503 during the poll cycle of step 612, as determined at step 613, or following steps 615, 617, or 619, program 511 polls host computer 505 for output, at step 624. Program 511 does so by again using the services of the UUCP program. Typically, such host output represents information being sent by program 550 to conference participants 501-503. If output is received from host computer 505, as determined at step 625, program 511 broadcasts it to all participant terminals 501-503, at step 626, by loading a copy thereof into each participant terminal's buffer 520. If no output is received from host computer 505 at step 625, or following step 626, program 511 loops back to step 612 to poll participant terminals 501-503 for output.

Of course, it should be understood that various changes and modifications may be made to the above-described illustrative embodiments of the invention. For example, compression algorithms may be applied to the display output to reduce the amount of information that must be transferred. Also, the display transmissions may be accomplished by hardware instead of software. Also, in the first illustrative embodiment, multiple conference PCs may be used, by using a multiple serial port board or a LAN connection. Or, in the second embodiment, the UUCP link may be replaced with a program that uses standard UNIX system pipes, thereby eliminating the intermediary computer.

Claims

1. A data conferencing arrangement for a first station (PC 2) and a second station (PC 1) each having a keyboard and a display, the second station having a screen buffer for storing display signals that represent images displayed by the display of the second station and a keyboard buffer for storing keystroke signals generated by the keyboard of the second station, which stations are intercon-



puter 504. Program 511 accomplishes the prompt by loading a prompt display message into buffer 520 of initiator terminal 501. Program 511 then loops between steps 602 and 603, polling the initiator's buffer 520, at step 602, and awaiting receipt of the identifying information, at step 603.

Upon receipt of the sought-after information, at step 603, program 511 prompts all participant terminals 501-503 for information identifying host computer 505, at step 604. This information is, for example, a UNIX system machine name of host 505. Program 511 prompts for the information by placing a prompt display message in buffers 520 of terminals 501-503. Program 511 then polls buffers 520 of terminals 501-503, at step 605, looking for a response, at step 606.

When a user of one of the terminals 501-503 keys in the host-identifying information, program 511 receives it, at step 606, via that terminal's buffer 520. Upon receipt of the identifying information, program 511 causes a connection to be established to host computer 505, at step 607. Illustratively, program 511 does so by invoking the UUCP program of the UNIX operating system of computer 504, and passing to it the host computer's machine name or dial-up number as a parameter. Program 511 then checks whether connection establishment was successful, at step 608. If not, program 511 sends a display message to terminals 501-503 via their buffers 520 to inform them of the failure, at step 609, and through the UNIX operating system posts a KILL signal to each instance of participant program 512, at step 610. Program 511 then terminates, by returning to the shell program, at step 611. The shell program is thereby unblocked and resumes communicating with terminal 501.

If establishment of a connection to host computer 505 is found at step 608 to have been successful, program 511 polls each participant terminal's buffer 520 for terminal output, at step 613. If output is received from a terminal, as determined at step 613, program 511 checks, at step 614, whether the output is a local command, that is, a command intended for intermediary computer 504. Illustratively, a local command is one preceded by the symbol "~". If the output is not a local command, program 511 treats the output as input for host computer 505, and causes it to be sent to host computer 505, at step 615. Illustratively, program 511 accomplishes the transfer by invoking the UUCP program and passing the output to it as an argument. Host computer 505 then conveys the output to program 550 in a conventional manner.

If the output is found at step 614 to be a local command, program 511 processes it, at steps 616-623. Illustratively, program 511 recognizes three local commands: an "~exit" command, at step 616, an "~add" command, at step 618, and an "~end" command, at step 620. If the local command is an "~exit" command, program 511 terminates participation in the conference of the terminal that originated the com-

mand, by sending a KILL signal to that terminal's associated instance of participant program 512, at step 617. If the local command is an "~add" command, program 511 includes as a participant in the conference a terminal whose ID accompanies the command as a parameter, at step 619, by including that terminal's buffer 520 among the buffers 520 with which program 511 is communicating. If the local command is an "~end" command, program 511 terminates the conference by sending a KILL signal to all non-initiator participant terminals' 502-503 instances of participant program 512, at step 621. Program 511 then causes the connection to host computer 505 to be broken, at step 622, by invoking the UUCP program with appropriate parameters. Finally, program 511 terminates by returning to the shell program, at step 623.

If no output is received from a terminal 501-503 during the poll cycle of step 612, as determined at step 613, or following steps 615, 617, or 619, program 511 polls host computer 505 for output, at step 624. Program 511 does so by again using the services of the UUCP program. Typically, such host output represents information being sent by program 550 to conference participants 501-503. If output is received from host computer 505, as determined at step 625, program 511 broadcasts it to all participant terminals 501-503, at step 626, by loading a copy thereof into each participant terminal's buffer 520. If no output is received from host computer 505 at step 625, or following step 626, program 511 loops back to step 612 to poll participant terminals 501-503 for output.

Of course, it should be understood that various changes and modifications may be made to the above-described illustrative embodiments of the invention. For example, compression algorithms may be applied to the display output to reduce the amount of information that must be transferred. Also, the display transmissions may be accomplished by hardware instead of software. Also, in the first illustrative embodiment, multiple conference PCs may be used, by using a multiple serial port board or a LAN connection. Or, in the second embodiment, the UUCP link may be replaced with a program that uses standard UNIX system pipes, thereby eliminating the intermediary computer.

Claims

1. A data conferencing arrangement for a first station (PC 2) and a second station (PC 1) each having a keyboard and a display, the second station having a screen buffer for storing display signals that represent images displayed by the display of the second station and a keyboard buffer for storing keystroke signals generated by the keyboard of the second station, which stations are intercon-



- nectable by a signal transmission path, the arrangement being CHARACTERISED BY first control means (23) resident on the first station for transmitting keystroke signals generated at the first station's keyboard (200) to the second station, and responsive to display signals received from the second station for displaying an image represented by the received display signals on the first station's display (201), and second control means (20,21) resident on the second station responsive to keystroke signals received from the first control means for storing the received keystroke signals in the keyboard buffer of the second station as keystroke signals received from the second station's keyboard (100), and responsive to the second station storing in the screen buffer of the second station signals representing an image for display by the second station's display (101), for transmitting display signals representing the image to the first control means.
2. An arrangement as claimed in claim 1 wherein the second station includes an application program (22) resident on the second station, and the second control means includes means (21) for storing received keystroke signals in the keyboard buffer of the second station for provision to the application program, and responsive to signals representing an image output by the application program for storage in the screen buffer of the second station for transmitting display signals representing the image to the first control means.
 3. An arrangement as claimed in claim 2 wherein the second control means includes a control program (21), and third control means (20) resident on the second station for effecting execution of both the application program and the control program in a time-shared manner.
 4. An arrangement as claimed in claim 3 wherein the first and second stations include computers (PC 1, PC 2) for executing programs, and the first control means includes a terminal emulation program (23) executing on the computer of the first station.
 5. An arrangement as claimed in claim 1 wherein the first and second stations include first and second computers, respectively, (PC 1, PC2) for executing programs, the second control means is resident on the second computer for coordinating the data conferencing operation of both the first and the second computers, the first control means is resident on the first computer for transmitting all keystroke signals generated at the first computer keyboard to the second control means, and responsive to display signals received from the second control means for displaying the received display signals on the first computer display, the second control means is responsive to (i) keystroke signals received from the first control means for entering those received keystroke signals into the keyboard buffer of the second computer as keystroke signals received from the second computer keyboard, and (ii) the second computer storing in the screen buffer of the first computer signals representing a new image for display on the second computer display, for transmitting the signals representing the new image to the first control means.
 6. An arrangement for data conferencing a plurality of first stations (501-503) with a second station (505), the second station and each first station having a keyboard and a display and the second station having a screen buffer for storing display signals that represent images displayed by the display of the second station and a keyboard buffer for storing keystroke signals generated by the keyboard of the second station, which first stations are connectable to the second station by a transmission path, the arrangement being CHARACTERISED BY control means (504; 511, 512, 520) interposed between the plurality of first stations and the second station, for receiving keystroke signals generated at the keyboards of the first stations and storing the received keystroke signals in the keyboard buffer of the second station as keystroke signals received from the second station's keyboard, and for receiving signals representing an image generated by the second station for display on the second station's display and stored in the screen buffer of the second station, and transmitting display signals representing the image to the first stations to display the image on the displays of the first stations.
 7. An arrangement as claimed in claim 6 wherein the control means includes means (511,520) for receiving display signals generated by the second station and transmitting the received display signals to the displays of the first stations.
 8. An arrangement as claimed in claim 6 wherein the second station includes an application program (550) resident on the second station, and the control means includes means (511,520) for receiving keystroke signals from the first stations and storing the received keystroke signals in the keyboard buffer of the second station for provision to the application program, and for receiving display signals output by the application program for storage in the screen buffer of the second sta-



tion and transmitting the received display signals to the first stations.

9. An arrangement as claimed in claim 6 wherein the control means includes a third station (504) interposed between, and connectable by a transmission path to, the plurality of first stations and the second station, and a first program (511) resident on the third station.
10. An arrangement as claimed in claim 9 wherein the control means includes a second program (512) resident on the third station for enabling the first program to receive from, and transmit to, the plurality of first stations.
11. An arrangement as claimed in claim 9 wherein there is provided an operating system included in the third station and including a shell program an instance of which executes for each first station to receive keystroke signals from, and to transmit display signals to, the first station, and wherein the control means includes a second program (512) an instance of which executes for each but one first station, each second program instance for suspending execution of a shell instance, to enable the first program to receive from, and transmit to, the plurality of first stations.

Patentansprüche

1. Datenkonferenz-System für eine erste Station (PC2) und für eine zweite Station (PC1), die jeweils eine Tastatur und eine Anzeigeeinrichtung aufweisen, wobei die zweite Station einen Bildschirmzwischenspeicher zum Speichern von Anzeigesignalen, die Bilder darstellen, die von der Anzeigeeinrichtung der zweiten Station angezeigt werden, sowie einen Tastaturzwischenspeicher zum Speichern von Tastenanschlagssignalen aufweist, die von der Tastatur der zweiten Station erzeugt werden, wobei die Stationen über einen Signalübertragungsweg miteinander verbunden sind, gekennzeichnet durch eine in der ersten Station angeordnete Steuereinrichtung (23) zum Übertragen von durch die Tastatur (200) der ersten Station erzeugten Tastenanschlagssignalen zu der zweiten Station und zum Anzeigen eines Bildes, das durch die empfangenen Anzeigesignale auf der Anzeigeeinrichtung (201) der ersten Station dargestellt ist unter Ansprechen auf die von der zweiten Station empfangenen Anzeigesignale, und durch eine zweite, in der zweiten Station angeordnete Steuereinrichtung (20, 21) zum Speichern der empfangenen Tastenanschlagssignale in dem Tastaturzwi-

schenspeicher der zweiten Station als Tastenanschlagssignale, die von der Tastatur (100) der zweiten Station empfangen werden, unter Ansprechen auf die Tastenanschlagssignale, die von der ersten Steuereinrichtung empfangen werden, und zum Übertragen von Anzeigesignalen, die das Bild darstellen, an die erste Steuereinrichtung unter Ansprechen auf die zweite Station, die in dem Bildschirmzwischenspeicher der zweiten Station Signale speichert, die ein Bild für die Anzeige durch die Anzeigeeinrichtung (101) der zweiten Station darstellen.

2. System nach Anspruch 1, dadurch gekennzeichnet, daß die zweite Station ein residentes Anwendungsprogramm (22) und die zweite Steuereinrichtung eine Einrichtung (21) enthält, die empfangene Tastenanschlagssignale in den Tastaturzwischenspeicher der zweiten Station zur Bereitstellung für das Anwendungsprogramm speichert und auf Signale anspricht, die ein Bild darstellen, das von dem Anwendungsprogramm zur Speicherung in dem Bildschirmzwischenspeicher der zweiten Station ausgegeben wird, um die das Bild darstellenden Anzeigesignale zu der ersten Steuereinrichtung zu übertragen.
3. System nach Anspruch 2, dadurch gekennzeichnet, daß die zweite Steuereinrichtung ein Steuerprogramm (21) und eine in der zweiten Station angeordnete dritte Steuereinrichtung (20) zum Veranlassen der Ausführung sowohl des Anwendungsprogramms als auch des Steuerprogramms nach einem Time-Sharing-Betrieb enthält.
4. System nach Anspruch 3, dadurch gekennzeichnet, daß die erste und zweite Station Computer (PC1, PC2) zum Ausführen der Programme aufweisen, wobei die erste Steuereinrichtung ein Anschluß-Emulationsprogramm (23) aufweist, welches auf dem Computer der ersten Station ausführbar ist.
5. System nach Anspruch 1, dadurch gekennzeichnet, daß die erste und zweite Station einen ersten bzw. zweiten Computer (PC1, PC2) zum Ausführen der Programme aufweist, daß die zweite Steuereinrichtung in dem zweiten Computer angeordnet ist und den Datenkonferenzbetrieb sowohl des ersten als auch des zweiten Computers koordiniert, daß die erste Steuereinrichtung zur Übertragung aller Tastenanschlagssignale, die in der Tastatur des ersten Computers erzeugt werden, an die zweite Steuereinrichtung in dem ersten Computer angeordnet ist, und auf die von der zweiten Steuereinrich-



tung empfangenen Anzeigesignale anspricht, um die empfangenen Anzeigesignale auf der Anzeigeeinrichtung des ersten Computers darzustellen, daß die zweite Steuereinrichtung

(i) auf von der ersten Steuereinrichtung empfangene Tastenanschlagssignale anspricht, um diese empfangenen Tastenanschlagssignale in den Tastaturzwischenpeicher des zweiten Computers als Tastenanschlagssignale einzugeben, die von der Tastatur des zweiten Computers empfangen werden, und (ii) auf den zweiten Computer anspricht, der in dem Bildschirmzwischenpeicher des ersten Computers Signale speichert, die ein neues Bild für die Darstellung auf der Anzeigeeinrichtung des zweiten Computers darstellen, um die Signale, die das neue Bild darstellen, zu der ersten Steuereinrichtung zu übertragen.

6. System für eine Datenkonferenzschaltung zwischen mehreren ersten Stationen (501-503) mit einer zweiten Station (505), wobei die zweite Station und jede erste Station eine Tastatur und eine Anzeigeeinrichtung besitzen und die zweite Station einen Bildschirmzwischenpeicher zum Speichern von Anzeigesignalen, die Bilder darstellen, die von der Anzeigeeinrichtung der zweiten Station dargestellt werden, sowie einen Tastaturzwischenpeicher zum Speichern von Tastenanschlagssignalen aufweist, die von der Tastatur der zweiten Station erzeugt werden, wobei die ersten Stationen mit der zweiten Station über einen Übertragungsweg verbindbar sind, gekennzeichnet durch eine Steuereinrichtung (504; 511, 512, 520), die zwischen den ersten Stationen und der zweiten Station angeordnet ist, zum Empfang von Tastenanschlagssignalen, die in den Tastaturen der ersten Stationen erzeugt werden, und zum Speichern der empfangenen Tastenanschlagssignale in dem Tastaturzwischenpeicher der zweiten Station als Tastenanschlagssignale, die von der Tastatur der zweiten Station empfangen werden, sowie zum Empfang von Signalen, die ein Bild darstellen, welches von der zweiten Station für die Anzeige auf der Anzeigeeinrichtung der zweiten Station erzeugt und in dem Bildschirmzwischenpeicher der zweiten Station gespeichert werden, und zur Übertragung von Anzeigesignalen, die das Bild darstellen, zu den ersten Stationen, um das Bild auf den Anzeigeeinrichtungen der ersten Stationen darzustellen.

7. System nach Anspruch 6, dadurch gekennzeichnet, daß die Steuereinrichtung eine Einrichtung (511, 520) zum Empfang von Anzeigesignalen, die von der zweiten Station

erzeugt werden, und zur Übertragung der empfangenen Anzeigesignale an die Anzeigeeinrichtungen der ersten Stationen aufweist.

8. System nach Anspruch 6, dadurch gekennzeichnet, daß die zweite Station ein residentes Anwendungsprogramm (550) enthält und daß die Steuereinrichtung eine Einrichtung (511, 520) zum Empfang von Tastenanschlagssignalen von den ersten Stationen, zur Speicherung der empfangenen Tastenanschlagssignale in dem Tastaturzwischenpeicher der zweiten Station zur Bereitstellung für das Anwendungsprogramm, zum Empfang von Anzeigesignalen, die von dem Anwendungsprogramm zur Speicherung in dem Bildschirmzwischenpeicher der zweiten Station ausgegeben werden, sowie zur Übertragung der empfangenen Anzeigesignale zu den ersten Stationen enthält.

9. System nach Anspruch 6, dadurch gekennzeichnet, daß die Steuereinrichtung aufweist eine dritte Station (504), die zwischen den mehreren ersten Stationen und der zweiten Station angeordnet und über einen Übertragungsweg mit den ersten Stationen und der zweiten Station verbindbar ist, und ein in der dritten Station residentes erstes Programm (511).

10. System nach Anspruch 9, dadurch gekennzeichnet, daß die Steuereinrichtung ein in der dritten Station residentes zweites Programm (512) für die Freigabe des ersten Programms zum Empfang von und zur Übertragung zu den ersten Stationen enthält.

11. System nach Anspruch 9, dadurch gekennzeichnet, daß ein Betriebssystem vorgesehen ist, welches in der dritten Station enthalten ist und ein Programm für eine Benutzeroberfläche enthält, dessen eine Instanz für jede erste Station ausgeführt wird, um Tastenanschlagssignale von der ersten Station zu empfangen und Anzeigesignale zu der ersten Station zu senden, wobei die Steuereinrichtung ein zweites Programm (512) enthält, dessen eine Instanz für jede erste Station außer einer ersten Station ausgeführt wird, wobei jede zweite Programminstanz die Ausführung einer Benutzeroberflächeninstanz unterbricht, damit das erste Programm von den ersten Stationen empfangen und zu den ersten Stationen senden kann.

Revendications

1. Une structure de mise en conférence de données



pour une première station (PC 2) et une seconde station (PC 1) ayant chacune un clavier et un visuel, la seconde station ayant une mémoire tampon d'écran pour enregistrer des signaux de visualisation qui représentent des images visualisées par le visuel de la seconde station et une mémoire tampon de clavier pour enregistrer des signaux de manipulation de touches qui sont générés par le clavier de la seconde station, ces stations pouvant être interconnectées par une voie de transmission de signaux, la structure étant CARACTERISEE PAR des premiers moyens de commande (23) qui résident dans la première station pour émettre vers la seconde station des signaux de manipulation de touches qui sont générés au clavier (200) de la première station, et qui réagissent à des signaux de visualisation reçus à partir de la seconde station en visualisant sur le visuel (201) de la première station une image qui est représentée par les signaux de visualisation reçus, et des seconds moyens de commande (20, 21) qui résident dans la seconde station et réagissent à des signaux de manipulation de touches reçus à partir des premiers moyens de commande, en enregistrant les signaux de manipulation de touches reçus dans la mémoire tampon de clavier de la seconde station, comme des signaux de manipulation de touches reçus à partir du clavier (100) de la seconde station, et réagissent au fait que la seconde station enregistre dans la mémoire tampon d'écran de la seconde station des signaux représentant une image pour la visualisation par le visuel (101) de la seconde station, en émettant vers les premiers moyens de commande des signaux de visualisation représentant l'image.

2. Une structure selon la revendication 1, dans laquelle la seconde station comprend un programme d'application (22) qui réside dans la seconde station, et les seconds moyens de commande comprennent des moyens (21) pour enregistrer dans la mémoire tampon de clavier de la seconde station des signaux de manipulation de touches reçus, pour les fournir au programme d'application, et ils réagissent à des signaux représentant une image émise par le programme d'application pour l'enregistrement dans la mémoire tampon d'écran de la seconde station, en émettant vers les premiers moyens de commande des signaux de visualisation représentant l'image.
3. Une structure selon la revendication 2, dans laquelle les seconds moyens de commande comprennent un programme de commande (21) et des troisièmes moyens de commande (20) qui résident dans la seconde station pour exécuter à la fois le programme d'application et le program-

me de commande en temps partagé.

4. Une structure selon la revendication 3, dans laquelle les première et seconde stations comprennent des ordinateurs (PC 1, PC 2) pour exécuter des programmes, et les premiers moyens de commande comprennent un programme d'émulation de terminal (23) qui est exécuté dans l'ordinateur de la première station.
5. Une structure selon la revendication 1, dans laquelle les première et seconde stations comprennent respectivement des premier et second ordinateurs (PC 1, PC 2) pour exécuter des programmes, les seconds moyens de commande résident dans le second ordinateur pour coordonner l'opération de mise en conférence de données des premier et second ordinateurs, les premiers moyens de commande résident dans le premier ordinateur pour transmettre vers les seconds moyens de commande tous les signaux de manipulation de touches qui sont générés au clavier du premier ordinateur, et ils réagissent à des signaux de visualisation qui sont reçus à partir des seconds moyens de commande, en visualisant sur le visuel du premier ordinateur les signaux de visualisation qui sont reçus, les seconds moyens de commande réagissent (i) à des signaux de manipulation de touches qui sont reçus à partir des premiers moyens de commande en introduisant ces signaux de manipulation de touches reçus dans la mémoire tampon de clavier du second ordinateur, comme des signaux de manipulation de touches reçus à partir du clavier du second ordinateur, et (ii) au fait que le second ordinateur enregistre dans la mémoire tampon d'écran du premier ordinateur des signaux représentant une nouvelle image pour la visualisation sur le visuel du second ordinateur, en émettant vers les premiers moyens de commande les signaux représentant la nouvelle image.
6. Une structure pour la mise en conférence de données d'un ensemble de premières stations (501-503) avec une seconde station (505), la seconde station et chaque première station ayant un clavier et un visuel, et la seconde station ayant une mémoire tampon d'écran pour enregistrer des signaux de visualisation qui représentent des images visualisées par le visuel de la seconde station, et une mémoire tampon de clavier pour enregistrer des signaux de manipulation de touches qui sont générés par le clavier de la seconde station, ces premières stations pouvant être connectées à la seconde station par une voie de transmission, la structure étant CARACTERISEE PAR des moyens de commande (504; 511, 512, 520) intercalés entre l'ensemble de premières stations



- et la seconde station, pour recevoir des signaux de manipulation de touches qui sont générés aux claviers des premières stations, et pour enregistrer les signaux de manipulation de touches reçus dans la mémoire tampon de clavier de la seconde station, comme des signaux de manipulation de touches reçus à partir du clavier de la seconde station, et pour recevoir des signaux représentant une image, qui sont générés par la seconde station pour la visualisation sur le visuel de la seconde station et qui sont enregistrés dans la mémoire tampon d'écran de la seconde station, et émettre vers les premières stations des signaux de visualisation représentant l'image, pour visualiser l'image sur les visuels des premières stations.
7. Une structure selon la revendication 6, dans laquelle les moyens de commande comprennent des moyens (511, 520) pour recevoir des signaux de visualisation qui sont générés par la seconde station, et pour émettre les signaux de visualisation reçus vers les visuels des premières stations.
8. Une structure selon la revendication 6, dans laquelle la seconde station comprend un programme d'application (550) qui réside dans la seconde station, et les moyens de commande comprennent des moyens (511, 520) pour recevoir des signaux de manipulation de touches provenant des premières stations et pour enregistrer les signaux de manipulation de touches reçus dans la mémoire tampon de clavier de la seconde station, pour les fournir au programme d'application, et pour recevoir des signaux de visualisation qui sont émis par le programme d'application, pour l'enregistrement dans la mémoire tampon d'écran de la seconde station et émettre vers les premières stations les signaux de visualisation reçus.
9. Une structure selon la revendication 6, dans laquelle les moyens de commande comprennent une troisième station (504) interposée entre eux, et pouvant être connectée par une voie de transmission à l'ensemble de premières stations et à la seconde station, et un premier programme (511) qui réside dans la troisième station.
10. Une structure selon la revendication 9, dans laquelle les moyens de commande comprennent un second programme (512) résidant dans la troisième station, pour permettre au premier programme de recevoir de l'information à partir de l'ensemble des premières stations et d'émettre de l'information vers celles-ci.

11. Une structure selon la revendication 9, dans laquelle il existe un système d'exploitation inclus dans la troisième station et contenant un programme de coquille dont une instance est exécutée pour chaque première station, pour recevoir des signaux de manipulation de touches à partir de la première station et pour émettre des signaux de visualisation vers la première station, et dans lequel les moyens de commande comprennent un second programme (512) dont une instance est exécutée pour chaque première station sauf une, chaque instance du second programme ayant pour fonction de suspendre l'exécution d'une instance du programme de coquille, pour permettre au premier programme de recevoir de l'information à partir de l'ensemble des premières stations et d'émettre de l'information vers celles-ci.