A scanning radio receiver (4) for a wide area paging system which interconnects conventional radio common carriers (RCC) for broadcasting page information. A plurality of RCC’s in each geographical area served by the paging system of the invention are connected to a local page processor (3). The local page processor (3) processes incoming page information and transfers the information to an available RCC for broadcast in the local area. If broadcast of the page information is also desired in a remote geographical area, a copy of the page information is transferred to a central page processor (9) for distribution to the selected remote geographical area for broadcast. The paging receiver (4) is designed so that it scans the frequency of a plurality of RCCs. Thus, the same receiver may be used to receive pages from more than one RCC.
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SCANNING RECEIVER FOR
NATIONWIDE RADIO PAGING SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to the field of remote signaling systems, and more particularly, is directed to a nationwide radio paging system which interconnects presently existing local paging services into a nationwide network. The system permits subscribers to travel virtually anywhere in the country and continue to receive pages originated from their home service area.

The concept of a wide area paging system is not new. In fact, several such systems have been proposed and described in the prior art. One such system is described in U.S. Patent No. 3,575,558 issued to Leyburn. The Leyburn patent discloses a paging system which is said to permit simultaneous paging in more than one geographical area. The system comprises one or more storage centers which control a plurality of transmitters located in different geographical areas. When a storage center receives a page request, it consults its internal memory to determine in which areas the subscriber desires paging service. The storage center then transfers the paging information via telephone lines to dedicated transmitters serving the areas selected for paging by the subscriber.

Other wide area paging systems are disclosed in U.S. Patent No. 3,818,145 to Hanway and U.S. Patent No. 3,714,375 to Stover. The Hanway patent describes a paging system which extends the paging area by broadcasting the page over a plurality of transmitters. A page request received at one transmitter site is relayed to other transmitter sites. The transmitters are then activated to transmit the page. The Stover patent is directed to a paging system which
transmits paging information over existing AM broadcast stations using a non-interferring phase modulation technique. Extended area coverage is achieved due to the relatively high power used by the broadcast station.

A more sophisticated wide area paging system is disclosed in U.S. Patent No. 4,178,476 to Frost. The Frost patent is directed to a wide area paging system which provides local-only paging as well as wide area paging. In the local-only mode, the system operates in the same manner as conventional paging systems known prior to Frost. In the wide area paging mode, however, paging service may be transferred from one location to another by a transfer command entered into the system via a telephone hook-up. Thus, all pages originated anywhere within the system are transferred to the area where the subscriber is located. Broadcast of pages is temporarily suspended while the subscriber is in transit. Any pages which originate during this period are stored and then transferred to the area to which the subscriber has relocated when paging is reinstated on his arrival. The area from which the pages originate is also identified to the subscriber when they are broadcast. When a subscriber wishes to suspend paging service prior to travelling to another location, he first dial a predetermined telephone number to access the system. On receipt of an answer tone, the subscriber dials his unique identification number followed by a "suspend" digit. The system then suspends all paging to that subscriber and stores any pages received during the suspension period. When the subscriber reaches his destination, he makes another local telephone call to access the system in that area. Upon receipt of the answer tone the subscriber dials his unique identification number and a "reinstate" digit. Paging is then resumed and any pages originated during the time paging was suspended are forwarded to the new paging system and transmitted in the new area. Subsequent pages are transferred to the subscriber in that area until paging is again suspended and transferred to another area.
Though the above-described wide area paging systems represent an improvement over the existing prior art at the time, they fail to provide a cost effective system for broadcasting pages over a wide area. For example, these systems all rely on dedicated equipment installations to process and broadcast pages. Thus, these systems cannot be easily and economically extended to cover additional service areas.

SUMMARY OF THE INVENTION

It is therefore the overall object of the present invention to provide a wide area paging system which is simple in operation and cost effective to implement.

It is a specific object of the present invention to provide a wide area paging system which uses existing radio common carrier paging systems to broadcast pages.

It is another specific object of the present invention to provide a wide area paging system which can economically process and broadcast alphanumeric, numeric and tone only messages to a remote signalling receiver.

It is a further specific object of the present invention to provide a wide area paging system which provides distribution of pages inexpensively through an orbiting satellite to Earth stations.

It is another specific object of the present invention to provide a wide area paging system which concentrates the paging data into digital packets in order to reduce data transmission requirements.

It is another specific object of the present invention to provide a wide area paging system wherein the subscriber can roam anywhere in the country covered by the system and continue to receive pages originated from his home service area.

It is a still further specific object of the present invention to provide a wide area paging system wherein the calling party is not required to know where the subscriber is physically located within the country in order to effect a page to the subscriber.
It is a still further specific object of the present invention to provide a wide area paging system wherein local paging as well as nationwide paging is provided.

It is another specific object of the present invention to provide a wide area paging system wherein one paging receiver is used for local as well as nationwide pages.

It is another specific object of the present invention to provide a wide area paging system wherein the pages can be broadcast over any presently existing radio common carrier paging system within any of the RCC frequency bands.

It is a still further specific object of the present invention to provide a wide area paging system wherein the paging receiver automatically scans a plurality of frequency channels of presently existing radio common carrier or wireline paging systems for paging information.

These and other objects of the present invention are achieved by connecting presently existing local paging systems into a nationwide network. Local paging systems, or so-called radio common carriers (RCCs), now operate on frequencies in the low band VHF, UHF, and 900MHz band. The paging receivers used with these RCCs are tuned only to the frequency used by their respective RCC. Thus, one RCC's receivers cannot be used with another RCC operating on a different frequency. Moreover, in order to avoid interference, only one RCC can use the same frequency in the same geographical area at the same time. The RCCs are local-only systems as the subscriber can receive pages only while present in his assigned geographical area served by the RCC from which he has contracted for services.

The Federal Communications Commission (FCC) recently recognized that local-only paging systems fail to meet the paging needs of a mobile society and has taken steps to establish a structure for development of a nationwide common carrier paging system. Three frequency channels were set aside in the 900 MHz band for nationwide
paging use. Local-only paging, however, will not be permitted on these frequencies under current FCC regulations. Each of the frequencies will be controlled by one licensed common carrier, the so-called 931 MHz "Network organizers," who will determine the structure of the system and decide such technical details as the modes of operation, signaling format and interconnection schemes. The services of the 931 MHz organizers will be distributed to subscribers through a local common carrier in each community, the so-called 931 MHz "Network operator." The 931 MHz operators will provide local page initiation and/or local distribution of nationwide pages on the frequency controlled by their respective organizer. In summary, the 931 MHz organizers will be the licensees of the frequencies, control their operation and furnish nationwide interconnection services to the local 931 MHz operators around the country. Though the designs vary, each system ultimately uses one of the three 931 MHz frequencies as the nationwide connecting link to deliver the paging information.

One of the drawbacks to the 931 MHz scheme is that it does not provide for local-only paging. Thus, a subscriber would have to carry two paging receivers, one for nationwide paging tuned to one of the three nationwide paging frequencies and one for local paging tuned to one of the local paging frequencies. Secondly, the 931 MHz scheme is a totally new concept and equipment for its implementation presently exists in limited quantity only. Thus, each component of the system will have to be developed, tested and then produced in sufficient quantity to implement the 931 MHz system.

The nationwide paging system developed by applicants does not operate on the nationwide paging frequencies and thus avoids the above-mentioned drawbacks. The system of the invention basically permits connection of all of the presently existing local paging systems, i.e., radio common carriers or RCCs or wireline, by way of a satellite. Pages may then be broadcast in any of the major metropolitan areas of the United States using an existing local paging
RCC. The system of the invention also permits customary local paging as well, using the same paging receiver.

In accordance with the present invention, the subscriber is assigned a paging telephone number in his home service area by the local RCC with whom he has contracted for service. When a caller wants to page this particular subscriber, the calling party dials the assigned telephone number using a standard DTMF telephone and is connected to an RCC site processor located in the same service area as the local RCC. Once the site processor has been accessed, the calling party relays a message or other information by use of the DTMF telephone or, in the case of alphanumeric data, by use of a standard ASCII keyboard with a CRT, personal computer, or similar device in conjunction with a telephone modem. Up to this point, the paging system of the invention processes both local and nationwide pages in the same manner. Means are provided, however, such that when a subscriber travels out of his local area, the system may be controlled to forward a copy of the subscriber's pages to another area. This is the nationwide paging aspect of the invention and these copies are referred to as nationwide pages. The system continues to broadcast the original pages locally even though the subscriber may already have left the area. Continued local broadcasting permits the subscriber to receive his pages up to the very moment he leaves the area. Such a feature is important since the subscriber is assured of receiving "that very last page". Thus the paging system of the present invention eliminates the problem of premature termination of local paging. Transfer of a copy of the subscriber's pages to another area is controlled in advance by the subscriber. Using a standard DTMF telephone, the subscriber merely inputs a special code that lets the RCC site processor know where a copy of the pages are to be routed. Incoming pages are then stored for a predetermined time to permit the subscriber to arrive at this destination and then are passed along to a local RCC which serves the new area for broadcast to the subscriber.
The RCC site processor stores a copy of each page that it processes for a predetermined time. Thus, during those periods when the subscriber is not available to receive pages, he does not have to worry about missing any pages. When the subscriber becomes available to receive pages, he merely informs the system that he wishes a rebroadcast of his pages. The system then passes along copies of any pages which were previously stored, to a local RCC which serves the area where the subscriber is presently located for broadcast to the subscriber.

Where a nationwide page is to be sent, a copy of the original page is validated by the RCC site processor then routed via the most cost effective service (e.g., GTE TELENET telephone lines or satellite return link) to a traffic route processor located in a geographically convenient place. The traffic route processor receives packets of digital data (pages) from the various RCC site processors located around the country and temporarily stores this information in memory. The traffic route processor outputs the data to an uplink control processor which groups the page and/or data transmission requests into appropriate groups on a location and/or regional basis. Billing and other statistical data may also be compiled at this point. The digital data stream is then fed to a satellite uplink facility for transmission to a satellite. The data stream is then broadcast nationwide via the satellite. A nationwide network of telephone lines may also be used as an alternative to a satellite for distribution of the digital data. In each of the local cities participating in the system, the satellite downlink signal is received by a satellite receiver located at a receiver downlink facility at the same location as the RCC site processor for that city. The satellite receiver may be a direct broadcast (DBS) Ku-band receiver specially modified to receive digital data. The received data stream is input to a packet extractor which searches for address information unique to the local city. When local addresses are found, the packet extractor removes the data from the data stream and sorts
it according to the local paging systems (RCCs) which will actually broadcast the paging information and then by subscriber.

A paging formatter then transforms the digital data received from the packet extractor into the proper format necessary to broadcast the paging information by the particular RCC or wireline. The paging formatter provides special coding on the transmitted signal which allows a subscriber's paging receiver to function on any of the frequency channels now assigned to local RCCs or telephone companies. The paging receiver may be a conventional paging receiver adapted with a scanning receiver module in accordance with the present invention. Thus, a subscriber has the ability to receive several nationwide pages while in a given geographical location but not necessarily from the same local RCC over the same frequency. This redundancy is designed into the system as a safeguard should a particular frequency not be available in a given city. Thus, the subscriber is assured that an alternate paging system frequency can be used. This system also permits use of the same paging receiver for every area of the country.

Applicants have also developed the electronic circuitry needed to convert a conventional fixed frequency paging receiver to a scanning receiver which scans across a plurality of paging frequency channels in any one of the paging frequency bands looking for paging information intended for a particular subscriber. A scanning type receiver is required because nationwide page information may be broadcast locally over any frequency available to broadcast the page. The same concept is applicable in other paging frequency bands. Therefore, a subscriber may receive a number of pages from different local RCCs, thus requiring a paging receiver which can tune all of the RCC frequencies in a given paging frequency band.
BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an overall block diagram of the paging system of the present invention.

Figure 2 is a block diagram of the computer system which comprises some of the elements shown in Figure 1.

Figure 3 is an illustration of the paging record format which is created for each page processed by the paging system of the invention.

Figures 4 and 5 are more detailed illustrations of the paging record format for each page processed by the paging system of the invention.

Figure 6 is a more detailed illustration of the RCC site processor shown in Figure 1.

Figure 7 is a more detailed illustration of the up-link processor, traffic route processor, automatic page generator, and central site processor shown in Figure 1.

Figures 8-14 illustrate various signals and circuit diagrams associated with the scanning receiver of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A block diagram illustrating the wide area paging system of the present invention is set forth in Figure 1. In accordance with the invention, each subscriber is assigned a paging telephone number in his home service area by the local RCC with whom he has contracted for service. As shown in Figure 1, the local RCC is indicated by reference No. 1. When a caller wishes to page a particular subscriber, the calling party dials the subscriber's assigned telephone number using standard DTMF telephone 2 or a suitable device connected through a telephone modem and is connected to RCC site processor 3. Each service area served by the system of the invention is provided with its own site processor. The site processor is connected to all of the local RCCs in the service area and, as described below, may format a page request for broadcast by any local RCC in its own local service area.
Once site processor 3 is accessed, the calling party enters the subscriber's paging receiver identification number using DTMF telephone 2. The calling party may also enter an alphanumeric message for the subscriber using a standard ASCII keyboard and CRT, personal computer, or similar device in conjunction with a telephone modem (not shown). For those calling parties not having access to facilities for entering alphanumeric messages, RCC 1 may be equipped with one or more operator consoles through which the calling party may request that an alphanumeric message be entered for the subscriber. Another alternative is to provide a console, modem and perhaps a printer to the subscriber for installation in his office. Office personnel could then originate the page and any alphanumeric message for the subscriber by typing in the message and pressing a "send" key. The console would be programmed to automatically dial site processor 3 to initiate the page and to send the alphanumeric message. Since many subscribers are likely to already have sophisticated computer systems, word processors or personal computers, such devices could also be used to initiate pages in much the same way as a dedicated paging installation. The required interface protocol would be provided to the subscriber so that his computer system could communicate with site processor 3.

When site processor 3 receives a page request, it must determine where the identified pager is located. If the pager is currently in the local service area, site processor 3 formats the paging information for broadcast in the local service area by local RCC 1. The page is then received by paging receiver 4 carried by the subscriber.

When the subscriber travels out of his local service area, the system may be controlled to forward a copy of the subscriber's pages to another area. This is the nationwide paging aspect of the invention and these copies are referred to as nationwide pages. The system continues to broadcast the original pages over local RCC 1 to which
the subscriber is assigned even though the subscriber may already have
left the area. Continued local broadcasting permits the subscriber to
receive his pages up to the very moment paging receiving 4 is out of
range or RCC 1. Thus the paging system of the present invention
eliminates the problem of premature termination of local paging.

Transfer of a copy of the subscriber's pages to another area is
controlled in advance by the subscriber. Using a standard DTMF tele-
phone, such as telephone 2, the subscriber merely enters a transfer
code that lets RCC site processor 3 know where a copy of the pages
are to be routed. As will be described below, a copy of the page re-
quest is then transferred to traffic route processor 6 for distribution
to another subscriber service area for broadcast in accordance with the
subscriber's request.

A copy of each page request received by site processor 3 is
stored for a predetermined period. These page copies may be
retrieved by the subscriber at any time during this period by merely
accessing site processor 3 using DTMF telephone 2 and entering a
rebroadcast code. Site processor 3 then causes the rebroadcast of any
pages which were previously stored.

When site processor 3 determines that a page is to be routed to
another service area for broadcast, a copy of the original page is vali-
dated by RCC site processor 3, i.e., checked for errors and corrected
if necessary, then formatted into packets of digital information. The
packets of information are routed via the most cost effective
communication link (e.g., GTE Telenet or a satellite return link) to
traffic route processor 6. Traffic route processor 6, along with uplink
processor 7, satellite uplink 8, central site processor 9 and automatic
page generator 10, is located in a geographically convenient place for
all of the local site processors 3 in the system. Traffic route
processor 6 receives the packets of digital data page requests and page
messages from the various site processors 3 in the system, checks and
corrects the data if necessary, then temporarily stores it for transfer
to uplink control processor 7 at the appropriate time. Uplink control processor 7 groups the data into data packets on a location and/or regional basis. Billing and other statistical data may also be compiled at this time. The data packets are then transferred to satellite uplink 8 for transmission to satellite 12 for broadcast nationwide. The satellite downlink signal is received in each of the subscriber service areas by satellite receiver 5 located at a receiver downlink facility at the same location as RCC site processor 3 for that service area. Satellite receiver 5 may be a direct broadcast (DBS) Ku-band receiver specially modified to receive digital data. The received data packets are input to site processor 3 which searches for address information unique to the local service area for the particular site processor. When data packets with a local address are found, site processor 3 removes those data packets from the data stream and sorts them according to the local RCCs which will actually broadcast the paging information and then by subscriber. Site processor 3 then converts the received information into local transmission page format for forwarding to the appropriate RCC 1 for broadcast.

As shown in Figure 1, the nationwide paging system of the present invention also includes automatic page generator 10. Page generator 10 maintains a list of events that could cause pages to be generated for a particular subscriber. These automatic pages fall into two categories: time initiated pages and event initiated pages. Time initiated pages are pages that must be broadcast at a specific time. Pages of this type include wake-up calls, birthday notices, reminders to take medication, etc. When the event time occurs, page generator 10 sends a page request to traffic route processor 6 for distribution via satellite 12 to the appropriate local service area for broadcast. Event initiated pages are pages that must be broadcast when an event occurs. For example, page generator 10 could be programmed to monitor the stock market "ticker-tape" telephone lines. When the price of a specified stock value changes by a certain amount, a page
request could be generated announcing the change to the subscriber requesting the information.

The paging system of the invention also includes central site processor 9 which is very similar in operation to RCC site processor 3. However, central site processor 9 is connected to WATS lines rather than local telephone lines. The primary function of central site processor 9 is to allow remote programming changes of pager location. In those cases where a subscriber is already in a remote service area and wishes to route pages to another remote service area, the change can be effected by accessing central site processor 9 using any DTMF telephone such as telephone 11 shown in Figure 1. Central site processor 9 also includes voice generation equipment to allow auditory verification of pager location changes. The voice generation equipment also has the capacity of prompting the calling party for the information required to effect a pager location change.

At least one of the local site processors 3 of the invention includes monitoring facilities. This particular site processor, hereafter referred to as the "monitoring site processor," has the capability of monitoring all other site processors within the system. Each site processor may be accessed by the monitoring site processor to obtain detailed status information. Each site processor also periodically sends a "page" through the system containing current status information destined for the monitoring site processor. In the event that an out-of-range condition occurs anywhere in the system, the site processor which detects the condition immediately notifies the monitoring site processor of the condition by accessing a local telephone line and dialing the monitoring site processor with a service notice. The monitoring site processor stores the service notice and the status information from each site processor for "trend analysis" in order to pinpoint potential service problems. The monitoring site processor can also initiate a partial or complete warm or cold start reset of any site processor in the system.
RCC site processor 3, automatic page generator 10, central site processor 9, traffic route processor 6, and uplink control processor 7 all comprise a computer system which includes a number of interconnected elements as shown in Figure 2. Each computer system comprises master central processing unit (CPU) 200, floppy disk controller 201 and associated floppy disk drive 202, hard disk controller 203 and associated hard disk drive 204 and at least one function CPU 205. Floppy disk drive 202 and hard disk drive 204 provide mass storage and retrieval of utility programs and data. Master CPU 200 provides internal data transfer between all function CPUs (205) and controls floppy disk controller 201 and hard disk controller 203. Disk controllers 201 and 203 provide the control signals and I/O data path interfaces for floppy disk drive 202 and hard disk drive 204, respectively. Function CPUs (205) actually perform the work that the outside world calls upon the computer system to do such as the various functions performed by the site processors in processing a page request. Master CPU 200 merely supervises the operation of the function CPUs (205) and, in doing so, takes care of much of the routine housekeeping or so-called overhead for the computer system. Thus, function CPUs (205) can operate more efficiently in performing their assigned tasks.

As shown in Figure 2, master CPU 200 also includes RAM memory 206 and ROM memory 207 where instructions and temporary data storage areas of a computer program reside and peripheral I/O ports 208 which allow the master CPU to communicate with the outside world. Function CPUs (205) also has its own RAM 209 and ROM 210 where instructions and temporary data storage areas of a computer program reside and peripheral I/O ports 211 which allow the function CPUs to communicate with the outside world as well through such devices as modems 214 and 215, consoles 216 and 217, and printer 212. Consoles 216 and 217 are interactive terminals which allow the computer system to communicate with a control operator.
The computer system is electrically powered by uninterruptible power supply 218 shown in phantom in Figure 2. Power supply 218 maintains operating voltage to the computer system in the event of a local power outage. It also prevents damaging power line transients from reaching the computer system. Power supply 218 includes sufficient battery backup to operate the computer system for up to 15 minutes. This length may be increased if necessary by providing additional battery packs.

The wide area paging system of the present invention requires generation and internal storage of at least one paging record for each page processed by the system and a paging record control block. Paging records and paging record control blocks are the primary data files used by the various function CPUs. A paging record contains information pertinent to the page it represents in a format that can be used by each element of the system and which can be deciphered into a 'Page Record Line' for output on a printing device. The paging record format of the present invention is shown in Figure 3. As shown, the format provides a number of data blocks for each page including packet identification, package routing control, sortable date and time tracers, pager account identification, data type identification, send verification, data block integrity verification and variable length messages. All of this information is stored in each page record.

The first 32 bytes of each page record contain the control information which controls processing of the page through the system. The page record format is shown in Figure 4. The various bytes are described below with the byte number or range of bytes in parentheses.

**CONTROL/DATA RECORD FLAG** - (1) This byte is set to the ASCII character ' ' (SEH) to indicate the start of a 128 byte record if the first 32 bytes contain control information. Any other character defines the record as a continuation of a previous data record. If there are less than 96 data characters in the message, there will be no
continuing data records. If there are more than 96 characters in the record, there will be continuing data records containing up to 128 data characters per record. The ' ' character is the only character that may not be used in any data message.

**ORIGINATING SYSTEM PACKET ID CODE** - (2-5) These four bytes contain a hexadecimal (OOOO–OFFF) packet ID code. Each packet of data sent to the local control groups or the master control group is ID coded sequentially. If a control group receives a packet that has a higher ID code than expected, it will request a repeat of the missing packet(s). If an additional data record is required for the message data, the second data record is assigned the next packet ID code. When the value exceeds OFFFH, the ID code rolls-over to 0000H. This allows tracking up to 4096 records.

**REPEAT TO DESTINATION PACKET ID CODE** - (6-9) These four bytes contain a hexadecimal (OOOO–OFFF) packet ID code. Each packet of data sent by a control group to another control group is ID coded sequentially. The destination control group has a separate counter. If the destination control group receives a packet that has a higher ID code than expected, it will request a repeat of the missing packet(s). If an additional data record is required for the message data, the second data record is assigned the next packet ID code. When the value exceeds OFFFH, the ID code rolls-over to 0000H. This allows tracking up to 4096 records.

**OWNER SYSTEM CODE** - (10-12) These three bytes contain the hexadecimal value of the source system (RCC cite location) where the page originated. Three bytes allow up to 4096 source locations (OOOH–FFFH).

**DESTINATION SYSTEM CODE** - (13-15) These three bytes contain the hexadecimal value of the destination system (RCC cite location) where the page is to be transmitted. Three bytes allow up to 4096 destination stations (OOOH–OFFH).
To preserve space in the data records, day, month, and year are encoded in a four byte hexadecimal form, while the hour and minute information is encoded into letters. The ASCII letter ' ' is the starting point for all letter codes. The letter is equal to '0' in the case of hours and minutes. The date code starts with day 1 (0001H) equal to 01JAN48. This format allows very specific definition of a date and time in only six bytes.

All time references internally are based on Greenwich Mean Time, the international standard. Externally, all time references are based on local time, as defined by the system location. This eliminates ambiguities associated with the different time zones.

**DATE CODE** - (16-19) - The date code is a four byte entry representing an integer in hexadecimal. Day 0 is 31DEC47. The Date Code is the day the page originated.

**HOUR CODE LETTER** - (20) - The hour code letter is the hour the page originated (' ' to 'W').

**MINUTE CODE LETTER** - (21) - The minute code letter is the minute the page originated (' ' to ' ').

**PAGER ACCOUNT NUMBER** - (22-27) - The pager account number defines the 'look-up' account record which contains the Pager Cap Code (described below) and other information (see Account Record Information). The range of this number is 000000 to 999999. Hex characters A-F may also be placed in the Cap Code, allowing 16,777,200 possible Cap Codes to be handled by the system. Each RCC Site System has a look-up file containing the Cap Code of every pager in the system. When a packet data is received and formatted by the site processor, the site processor looks up the account number, obtains the Cap Code and transmits the page.

**PAGER CAP CODE** - (28-33) The Pager Cap Code is the unique identifier which causes the local site processor to generate a specific bit pattern for transmission on the RCC transmitter to set off a pager. The normal Cap Code contains the numbers 0-9, but the
system will allow full hexadeciml 0-9, A-F entry. These codes are not defined in PCOCAG, and may therefore be used by any other process in the system.

**PAGER STATUS** - (34) - The page status is not fully defined. The presence of a '0' as the page status code will, however, inhibit any paging activities regarding this pager account, and an 'Invalid Pager Number' error will be displayed.

**SOURCE SYSTEM** - (35-37) - The source system code identifies the local RCC where the current Page Record originated. (See Owner System)

**THREAD LIST** - (38-40) - The thread list is used in local systems to keep track of pages to the same pager account numbers in the local current page buffer. It is always set to '000' by the site processor for transmission to network systems.

**PAGE TYPE CODE** - (41) - This byte defines the type of data stored in the data blocks. The code is a letter, starting with the character ' Q '. The currently assigning paging codes are:

- Q None - No data is stored in the data records
- A Numeric - Numeric only data is stored
- B Alphanumeric - Alpha and numeric data is stored
- C Update - Changes to Pager Control Block File
- D Time Set - Periodic clock set for all systems

**HOUR PAGE SENT** - (42) - This byte contains, after transmission of the page at the terminating site, the Hour Code letter of the hour the page was sent.

**MINUTE PAGE SENT** - (42) - This byte contains, after transmission of the page at the terminating site, the Minute Code letter of the minute the page was sent.

**NOT USED** - (44-47) - This range of bytes is presently not defined.

**NUMBER OF BLOCKS** - (48) - This byte contains the number of data blocks in the record. The starting point is '0' (30h).
DATA BLOCKS - The subsequent data blocks are 16 bytes each. For numeric data blocks, normally only one block is required. For alphanumeric data blocks, any number of blocks may be appended, up to the range of the data block character, which is ' ' (7Eh), or 78 data blocks. Thus, an alphanumeric message for the subscriber may contain up to 1248 (78*16) characters. Five data blocks, or 80 characters, reside in the first record, and will suffice for most alphanumeric messages.

Each record is sent from one station to another station over whatever medium is available. Due to the 'printing' nature of the data record, simple monitors may be attached to the transmission link at any point to determine if data integrity is being maintained.

If a data block contains fewer than the maximum number of characters expected (16), then the data block is filled with null characters (00H). A complete data block of 16 bytes is always transmitted if there are any characters within the block.

The Pager Control Block is the primary file which controls all pager activities. It is located in every system, and is the same in all systems, each change to the pager control block file (except record pointer changes) forces a national update of all pager control block files. Each record in the Pager Control Block is eight bytes in length. The format is shown in Figure 5.

P1-P6 - Pager Cap Code in modified BCD format (0-F)
A1-A3 - Owner System. The system to receive accounting records when a page is placed to the pager.
ST - Status and Control characters.
L1-L3 - Current Location System of the Pager.
R1-R3 - Last Page Record Processed locally for their Pager

The Data Record is the method used by the system to transfer all data within the system. The type identifier is utilized to identify the type of data in the record. This allows files to be up-dated to all systems from the Uplink at the same time.
Figure 6 is a further illustration of RCC site processor 3 shown in Figure 1. As described above and shown in Figure 2, site processor 3 is a computer system which performs a number of functions with a plurality of function CPUs (205). Each function is labelled in Figure 6 to identify a particular function CPU within site processor 3. As shown in Figure 6, and in conjunction with Figure 1, the DownLink Service Unit (DSU) function CPU is connected to the output of satellite receiver 5. The DownLink Service Unit is actually two to four units. The two units work in conjunction with each other, and cross monitor receiver 5. Only one of the units is on-line at any given time.

One DownLink Service Unit constantly monitors the data flow from the satellite. When a data record address is "all" or when the correct system address is decoded in either the source or destination system field, then the receiving DSU signals the next DSU to begin decoding, stores the current record, and ceases monitoring the data flow. The received record is checked for accuracy, corrected if necessary, then "stored" for processing by the TSU, and an "event" code is sent to the TSU. Where data records are involved, a Data File Follows record is sent by up-link controller 16 followed by up to 32,768 bytes of data. The DSU decodes and stores the block of data in the appropriate data file at the location specified in the DATA FILE FOLLOWS Page Record. No actual pages will be sent during the period that a data file transfer is occurring to any RCC site. All RCC site processors may receive the same data file at the same time by using the 'All Call' destination address. Additional functions performed by site processor 3 are set forth below.

TSU - Terminal Service Unit

The Terminal Service Unit provides the interface to the area RCC transmitter(s) it controls. When an 'event' signal is received from the DSU, the TSU gets the paging record from the PAGREC file, checks to see if any records are missing (generating a RSUERR FIFD
record for processing by the RSU if so) obtains and processes the page record. The TSU loads until one of several conditions occurs. If the paging block becomes full, or 'MAXTM1' elapses prior to the filling of a paging block, then the paging output sequence will begin. On completion of the paging output sequence, the TSU writes a 'page complete' record to the ASU FIFO for accounting functions.

RSU - Remote Service Unit

The Remote Service Unit provides modem connection to other 'system' sites, using the PAGREC format. System routing is accomplished by the programming of the 'dial' number. When a page or data record is queued for output of the 'system' the local modem is activated. The appropriate 'system' number is dialed, and the data is transferred to the remote device. XON/XOFF handshake is provided. Complete Data Files may be transferred between machines by the RSU, using a data file transfer format.

LSU - Line Service Unit

The Line Service Unit controls a bank of interface circuits for telephone input of numeric only pages. The interface circuits are polled, with periodic output of paging records to the PAGREC file.

CSU - Customer Service Unit

The Customer Service Unit provides remote page entry and look-up at 300 or 1200 baud using a modem. The CSU provides two ports per slave. The accessing device or user identifies itself at the onset of the session, then may enter a page or interrogate the current page list for previous pages to a given account. System and user ID's are required for operation. The following functions are provided:

MANUAL PAGE ENTRY - If the calling device provides a 'manual flagged' access ID, then the calling device will be prompted based upon the device type. Screen formatting is provided this way. Each 'manual' device type has a unique identifier to
allow the module to send the correct control codes to perform screen formatting for that type device. If the module has no instruction set for that device, then the default 'question/answer' mode will be used. This is most applicable to 'dumb' termination operations.

AUTOMATIC PAGE ENTRY - If the calling device provides an 'automatic flagged' access ID, then the subsequent data will be assumed to be pre-formatted and no prompts will be issued. The calling device may then enter up to sixteen pages in the PAGREC format. The date and time data is not provided by the accessing unit. On completion of the data input, the CSU will disconnect.

PAGE LOOK-UP - Look up of pages previously processed is provided. If the calling device is manual, then the caller will be prompted for the look-up information. If the accessing device is automatic, then the lead-in code will request the look-up of previous pages. The Pager Control Block and all stored pages will be output to the accessing device. If 'manual', then the CSU will pause following each screen of data and await a prompt from the calling party to display the next screen.

OSU - Operator Service Unit

The Operator Service Unit runs in slave with both serial ports connected to 'consoles'. Each port may be connected to a modem for off-site operation at 1200 baud, or to a local console for on-site operation at 9600 baud. The basic functions of the OSU are:
(START-UP) - Local consoles will be assumed if no operator dial number is provided, and default baud rate will be 9600. If an operator dial number is provided, then the module will attempt connection to the operator port until connection is made. Operator port baud rate will default to 1200 baud, but 300 baud may be selected.

MEMU - Once a connection is established, a menu will be displayed, and the operator will be prompted to select one of the following functions:

PAGE ENTRY - Manual Page Entry -

LOOK-UP A PAGER - Looks up and displays the basic control information for any pager on the system. This includes the Cap-Code, the Owner system, the Current Location system, and previous pages to the pager (local or nationwide).

CHANGE PAGER LOCATION - Looks up a Pager Control Block, and allows the destination system address to be changed. This requires only that the operator knows the area code and one exchange of the destination city. The destination system is the determined by the system and the city name is displayed prior to termination of the sequence.

Figure 7 is a further illustration of uplink control processor 7, traffic route processor 6, automatic page generator 10 and central site processor 9 shown in Figure 1. In addition to the above-described functions, the following functions are provided by function CPU's in these computer systems.
VLSU - Voice Line Service Unit

The Voice Line Service Unit is similar to the LSU Line Service Unit. It has the additional capability of voice generation to provide automatic prompting to the accessing customer for Pager Address Location Changes.

Two methods of voice generation may be used. In one, a 'phonetic' voice synthesizer is used, in the other, direct voice storage and recall is used.

The 'phonetic' synthesizer requires much less processor overhead than the direct storage approach. The appropriate 'phonemes' are selected to provide the words, stored in the hard disk, and output at the time required.

In the 'direct' voice storage method, each voice message is recorded locally, stored on a hard disk, and provided to one of eight voice generator circuits. When a voice message is required, the TSU obtains the voice data from the hard disk and outputs it to the voice generator.

SSU - Status Service Unit

The Status Service Unit constantly checks the operation of all other units in the system, and connects to a console for display of the system status. It's console data may be routed to either its local console (default), or on access by the central monitoring facility, it's console data may be routed over the modem line to the central monitoring facility. All function CPUs in the system generate periodic 'ticks' and send a status message to the SSU at a pre-determined interval (e.g., five seconds). If the SSU fails to receive a 'tick' from a particular function CPU, it sends an 'interrogation' to that function CPU, which, if not returned within five seconds, will cause 1) a message to the monitoring site processor that a failure has occurred in the faulty function CPU, and 2) a re-boot (total reset) of the affected function CPU. The SSU also outputs 'ticks' to an external device which is capable of performing a complete local system hardware
reset. If the SSU fails to tickle the hardware device within thirty seconds, the hardware reset is initiated.

The SSU maintains a log of the status of each function CPU. If one function CPU becomes backlogged, it can assign another function CPU to the backlogged function. Any inequity between the function CPUs is flagged and output to the monitoring site processor.

The SSU also monitors the external hardware monitoring device, and periodically generates 'status' pages to the monitoring site processor via the national network.

ASU - Accounting Service Unit

The Accounting Service Unit receives the 'page complete' record from the TSU and updates the appropriate account file. On completion of the update, the ASU sends an 'accounting complete' record to the RSU ACT FIFO for later (polled) transmission to the master system. It is typically multiplexed in with an SSU.

DBU - Data Base Unit (optional)

The Data Base Unit provides complete control of the data records pertaining to each account and pager. It allows up to 255 data bases per logical drive partition, up to 1,048,580 records per data base, up to 255 elements per data data record, and up to 255 data characters per element. High-speed indexing and look-up may be performed based on any of the data elements within the data base.

A page request is processed through the system in the following manner. For numeric only pages, the subscriber places a numeric only call by dialing the local access line assigned to that pager and inputting 1) the desired pager number, then 2) the desired display data (if any).

The local system RCC site processor receives the call request, then determines where the pager is located (station address). If the pager is currently located within range of the local station, the local system processes the call locally, and stores a Page Record for later transmission to the traffic site processor for billing control. If,
however, the pager is not located within range of the local station the local system generates a Page Record for immediate transmission to the traffic route processor.

Pages containing alphanumeric data (letters A-Z, numbers, and punctuation) require a different method of input to the system since this information is not possible to input using a standard 'touch-tone' telephone. Four methods are provided:

Local Operator - The RCC may have one or more 'Operator Consoles' installed at the RCC site. Since most RCC's provide answering service to their customers in conjunction with paging, this should not present a problem. The person placing the page (caller) dials the local number of the answering service and requests a page. The operator places the page by inputting the pager number and the alphanumeric data message via an operator console. The system then processes the call. The local operator is connected to the RCC site processor through the OSU.

Encoder - An Encoder device comprised of a console, modem, and possibly a printer, is supplied to the user for installation in his office. The user's officer personnel would originate the page by typing in the message and pressing the 'send' key. The Encoder then dials the local modem access line of the local RCC, or the 800 service number (if provided), and sends the call request to the local RCC. The system then processes the call. The Encoder connects to the RCC site processor through the CSU Module.

Computer Interconnect - Since many users of the system would already have sophisticated computer systems, word processors, or personal computers, these devices would be allowed access to the system to facilitate page processing. Operation would be similar to operation under 'Encoder'. The interface protocol would be provided to the user so that the user's system could be programmed to communicate with the RCC site processor. The computer interconnect connects to the RCC site processor through the CSU.
Automatic - Automatic pages could be placed by the system itself signalling an 'event occurrence'. The system may be connected to one or more news wire services and stock exchange wire services. The user would request, for instance, a page in the event a word or combination of words appears on the wire service, or in the event of a stock value change in excess of a requested amount, or at a predetermined date and time. When the event occurs, the system places the page. Also, time sensitive events like birthdays could be programmed in advance. On the desired date the pre-programmed page would be placed. The automatic pages are generated in automatic page generator 10 which connects to traffic route processor 6 via an RSU.

Repeat - In the event that the user feels that he has missed a page for any reason, he may dial into the local RCC and, using a special access code, request that all of his pages be repeated. This would be valuable since the pager would probably be incapable of receiving pages in an aircraft traveling between two service areas. The stored pages would be repeated sequentially in order of occurrence.

After a page request is made as described above, it is processed through the system in the following manner. As also described above, each page request generates a Page Record. The Page Record is standard throughout the system, and contains the necessary information to process the page throughout the system. The Page Record is processed locally for local pages by the RCC site processor.

Nationwide pages are processed through the remotely located traffic route processor. When a page request is made, the local RCC site processor seize one of it's Remote Data Lines and dials into one of the lines connected to the traffic route processor. These lines may be a bank of national and state 800 numbers in rotary configuration, or a series of data lines provided by a data service, such as GTE telenet. The traffic route processor answers the call and inputs the Page Record. Included in the Page Record is the current pager
station address, programmed by the user on the local access lines using a 'touch-tone' telephone. The traffic route processor receives the Page Records, checks and corrects it, stores it, then forwards it to the uplink controller.

The uplink controller assembles the Page Records into a data packet which is transmitted by the Uplink equipment to the satellite along with all other 'current' Page Records. The satellite receives the data packet and repeats it to all RCC Site Processors simultaneously. Each RCC Site Processor extracts the page and data packet(s) intended for it from the data packet stream, converts the received page record(s) into local transmission page format, then forwards the formatted page data to the TSU for output on the local transmitter.

The TSU handshakes with other control equipment working with the local RCC transmitter, and then transmits the local page over the RCC transmitter when a time slot becomes available. Thus, the page is completed.

Where a pager location change is desired, the user dials into the local system operator (if provided) who selects the 'Change Pager' function on the local console of the RCC site processor. The change pager function prompts the operator for the information pertinent to the change and the operator asks the user for the information, then inputs it to the system.

Where the subscriber is already in a remote location and wishes to transfer his pages to another service area, he dials into the central site processor and is prompted for the function he desires. He inputs his pager number and the area code and exchange of someone he is going to visit in the destination city. The central site processor responds with the city name (for handshake) and the level of coverage in the area. The user also is prompted for the pertinent times of service, or an itinerary may be programmed weeks in advance if desired.
The local station address is defined by a number of six digit identifiers, the six digits are the local station's site address and consist of the area code and all exchanges served by that RCC site processor. All local stations have a 'look-up' table of all exchanges where nationwide paging service is provided. This simplifies the system for the user, since he probably knows the number of someone in the city he is going to visit. Ideally, the user would input a 'number where he can be reached' in the city he is going to. If service is not provided in that exchange, then the system can immediately notify the user. The user can then decide whether to 'turn-off' his pager by inputting an area code / exchange of '000000'. This will prevent 'missed pages' from occurring without the user knowing in advance that he will be unable to receive the page, and it will prevent the user being billed for pages he did not receive because of national paging system limitations. In the event that more than one RCC Site Processor serves the same exchanges, the Traffic Route Processor will alternate the transmission between the RCC's to provide equal air time utilization.

Paging receiver 4 shown in Figure 1 is a conventional paging receiver which has been modified in accordance with the present invention to permit scanning of the RCC frequency channels. Such a conventional receiver can be selected from among a number of receivers known in the art including receiver model number D-4-ALPHA manufactured by NEC. The NEC D-4-ALPHA pager is an FM-FSK alpha-numeric pager capable of receiving a single modulated carrier. In order to conserve battery life, certain sections of the pager's subsystems are turn off for a majority of the time and turned on only when absolutely necessary. The turn-off period (hereafter referred to as "sleep") is controlled by a "watchdog" timer resident in the pager's VLSI components. The sleep-awake duty cycle is arranged so that the pager is given ample opportunity to recognize an incoming page while maximizing battery power conservation. An example of a typical page acquisition sequence is shown in Figure 8.
The upper half of Figure 8 represents the signal transmitted by the RCC. Section A is the page preamble (typically a single tone) which precedes all paging messages. The purpose of the preamble is to cause all receiving pagers to awaken and begin looking for the synchronization codeword (B) which identifies uniquely the pager which is being signaled. In addition to this function, the synchronization codeword also specified the time domain location of the message packet C.

The lower half of Figure 8 represents the pager's power save response to the transmitted signal. The two short duration pulses (D, E) represent the normal sleep process the pager uses to conserve battery life. Should the preamble (A) be present while the pager is awake, the RF power save signal maintains the pager in an awake status in synchronous with the synchronization codeword (F) and subsequent message packets (G, etc.). Should the pager fail to recognize the synchronization codeword (as would be the case during periods of heavy radio interferences, a weak signal or an invalid synchronization codeword) or message packet, the pager returns to the normal sleep-long/awake-short battery save status.

Among the pager subsystems which are slaved to the power save awake/sleep cycle is the RF "front end." This section of the pager is shown in Figure 9.

The receiving stages of the pager are implemented as simply as possible while maintaining high selectivity and sensitivity. Low noise amplifier 900 is a single stage RF transistor amplifier. Band pass filter stage 901 is a cascade of factory tuned "tank" circuits. The first IF (21.4 MHz) is obtained from a downconverter made up of band pass filter 901, local oscillator 903 and mixer 902 and band pass filter 904. Mixer 902 is a BJT (bipolar junction transistor) mixer which is biased for nonlinear operation. Local oscillator 903 is a fixed frequency crystal oscillator which supplies the down conversion frequency. It is local oscillator 903 which is replaced by a scanning
local oscillator module in accordance with the present invention. The pager IF is subsequently passed to the FM discriminator (not shown) for demodulation. In order to turn the front end on and off (awake/sleep), the RF power save signal from the NEC VLS1 circuit drives the base of a switching transistor. The transistor switches the DC supply voltage rail to the elements shown in Figure 9.

Modification of the receiver to permit reception of any of a plurality of separate RF signals can be accomplished in accordance with the present invention with little modification to the original pager design. Further, the useful battery life for the modified pager should be no less than 150 hours using a size "AA" alkaline 1.5 volt cell. Lastly, the original design performance specifications of the pager are maintained.

The sleep/awake signature of the modified pager and RCC transmitted signal is discussed in Figure 10. The upper half of Figure 10 represents the signal transmitted by the RCC. Section A is a special preamble unique to the RCC's which support the scanning pager network. This preamble is a single tone (alternating 1, 0 bit pattern) of a duration sufficiently long for a pager to completely scan all frequencies at least once. Sections B, C and D are the page preamble, synchronization codeword, and message packet, respectively. These last 3 sections are the same as their counterparts in Figure 8.

The lower half of Figure 10 represents the modified pager's response to the transmitted signal. The awake period E is the period of the preamble search at each frequency. In the above example, the special preamble A is searched for and not found until frequency #7 shown in Table 1 for example is reached by the pager. At this point, the pager remains awake through periods F and G and subsequent message packets. Table 1 is a listing of several frequencies in the VHF band which the pager of the invention can scan. This list is by no means inclusive and is presented by way of example only. Moreover, the pager of the invention may also be used to scan a plurality of frequencies in other bands as well.
In order to scan all twenty-two frequencies, the conventional fixed frequency receiver is modified as shown in Figure 11. The pager's crystal local oscillator is electrically disconnected and replaced with frequency agile local oscillator 950 and associated logic circuitry 951. The local oscillator frequency is chosen so that the difference frequency between the local oscillator and RF is 21.4 MHz when the RF/LO frequency numbers are correlated. Logic circuitry 951 uses the flowchart shown in Figure 12 to control the LO frequency based on the pager's status (i.e., awake, sleep, preamble detect, etc.).

A transmission consists of two preambles followed by a batch of complete codewords, each batch beginning with a synchronization codeword (SC) (see Figure 13). The first preamble allows for frequency synchronization by the receiving pagers. This preamble is a sequence of logic reversals, 101010... repeating for a period of at least 1200 msec. The preamble frequency is, for example, 500 Hz.

The second preamble is transmitted for pager bit synchronization which also allows for word synchronization. This preamble is a pattern of logic reversals, 101010... repeated for a duration of 1125 msec. One example of a preamble frequency is 256 Hz but other frequencies may be used as well.

**TABLE 1**

<table>
<thead>
<tr>
<th>Channel No.</th>
<th>RF Freq. (MHz)</th>
<th>LO Freq. (MHz)</th>
<th>IF Freq. (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>152.03</td>
<td>130.63</td>
<td>21.4</td>
</tr>
<tr>
<td>2</td>
<td>152.06</td>
<td>130.66</td>
<td>21.4</td>
</tr>
<tr>
<td>3</td>
<td>152.09</td>
<td>130.69</td>
<td>21.4</td>
</tr>
<tr>
<td>4</td>
<td>152.12</td>
<td>130.72</td>
<td>21.4</td>
</tr>
<tr>
<td>5</td>
<td>152.15</td>
<td>130.75</td>
<td>21.4</td>
</tr>
<tr>
<td>6</td>
<td>152.18</td>
<td>130.78</td>
<td>21.4</td>
</tr>
<tr>
<td>7</td>
<td>152.21</td>
<td>130.81</td>
<td>21.4</td>
</tr>
<tr>
<td>8</td>
<td>152.24</td>
<td>130.84</td>
<td>21.4</td>
</tr>
<tr>
<td>9</td>
<td>158.70</td>
<td>137.30</td>
<td>21.4</td>
</tr>
</tbody>
</table>

As shown in Figure 14, there are six points of interface between
the module of the present invention and the paging receiver. The scanning receiver module is required to perform the following functions:

1. Receive the RF power save from the pager and determine if the pager is in the battery save mode or receiving messages.
2. Receive the pager discriminator data and determine if a valid preamble-1 has occurred.
3. Provide the necessary control signals to the scanning local oscillator section to set the frequency.

The following tables 2-11 more detaily describe the processing of a page through the paging system of the present invention under various conditions.

**TABLE 2**

**NUMERIC CALL — AUTOMATIC DTMF — LINE — LOCAL**

<table>
<thead>
<tr>
<th>RCC SITE PROCESSOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
</tr>
<tr>
<td>User</td>
</tr>
<tr>
<td>LSU</td>
</tr>
<tr>
<td>LSU</td>
</tr>
<tr>
<td>LSU</td>
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<td>User</td>
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<td>User</td>
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<tr>
<td>LSU</td>
</tr>
<tr>
<td>LSU</td>
</tr>
<tr>
<td>User</td>
</tr>
</tbody>
</table>
User
Is through dialing display data - press '#'

LSU
Gives BEEP - BEEP - BEEP

LSU
Disconnects

LSU
Formats Page Record
   Installs Pager Number
   Installs Data Code
   Looks up Destination Code, installs
   Calculates data blocks required
   Obtains source ID number
   Installs data

LSU
Determines that page destination is one of the local TSU's

LSU
Requests and obtains packet ID number

LSU
Stores PAGREC in CURRENT PAGE BUFFER

LSU
Sends Page Record Holding message to TSU

TSU
WAIT STAGE periodically sends 'tick' to Status Service Unit

TSU
Receives Page Record Ready message

TSU
Loads Page Record into buffer

TSU
Formats Page Record into POCSAG format and installs in
   POCSAG buffer

TSU
Checks Holding Time
   If not started, starts Holding Time

TSU
Awaits Holding Time Time-out or next Page Record Ready
   Message

TSU
Sends Transmitter Time Request to RCC transmitter controller

RCC
Transmitter controller sends 'WAIT' or 'GO'
   If TSU receives WAIT
      TSU starts 'Max Wait Timer'
   If Max Wait Timer times out
      TSU sends error message to RSU
         RSU receives error message
         RSU connects to Monitor Facility
         RSU sends 'RCC Transmitter Controller
         Out-Of-Service Message'
TSU Receives 'GO'
TSU Sends 'Transmitter On Command Sequence'
TSU Starts 'Max Wait Timer'
   If TSU receives 'Transmitter Fault' from RCC Transmitter Controller
   Or if Max Wait Timer times out
       TSU sends 'Transmitter Fault' message to RSU queue
RCC Transmitter Controller sends 'Transmitter On' acknowledgement
TSU Sends POCSAG buffer to RCC Transmitter
TSU Pauses
TSU Sends 'Transmitter Release' message to RCC Transmitter Controller
TSU Starts Max Wait Timer
TSU Starts Repeat Control Burst timer
   If Repeat Control Burst Timer times out
       TSU sends 'Transmitter Release' message again
   If Max Wait Timer times out
       TSU sends 'Transmitter Controller Fault 2' message to RSU Queue
TSU Sends Page Complete message to ASU
TSU Returns to WAIT stage
   — END OF SEQUENCE —

TABLE 3
NUMERIC CALL — AUTOMATIC DTMF — LINE — NATIONWIDE

RCC SITE PROCESSOR
User Dials local line and connects to one of the 'Line n' inputs
LSU Detects ringing on line
   SIEZES line
   Gives dial tone
User Dials first digit of pager account number
LSU Removes Dial Tone
User  Dials next five digits of pager account number
LSU  Gives BEEP
LSU  Gives Dial Tone
User  Dials display data
User  Makes mistake - presses 'a'
LSU  Gives BEEP
LSU  Gives Dial Tone
User  Dials display data
User  Is through dialing display data - press '#'
LSU  Gives BEEP - BEEP - BEEP
LSU  Disconnects
LSU  Formats Page Record
    Installs Pager Number
    Installs Data Code
    Looks up Destination Code, installs
    Calculates data blocks required
    Obtains source ID number
    Installs data
LSU  Determines that page requires National routing
LSU  Requests and obtains packet ID number
LSU  Stores PAGREC in CURRENT PAGE BUFFER
LSU  Sends Page Record Holding message to TSU
RSU  Receives Page Record Holding message
If no Page Records holding
    RSU set page holding time to await additional blocks
If Page Record Holding Time not timed-out, wait
    RSU connects modem to Central RSU Traffic Route Processor
If unable to make connection
    Repeat connection attempt
If five attempts
    Connect to Monitor Facility and report error
RSU Sends all current Holding Records
RSU Awaits handshake for Repeat Request(s)
RSU Resets, awaits next Page Record

TRAFFIC ROUTE PROCESSOR
RSU (From RCC Site) receives Page Records from RCC site
RSU Checks Source Record ID Number
If not sequential
RSU sends 'Repeat nnnn Request' to RCC Site Processor
RSU receives repeated Records
RSU Checks Destination Code Address
If Destination inaccurate, generates 'New Destination Code' Record for transmission to RCC Site Processor
RSU Assigns Destination Packet ID number to each Page Record
RSU Sends Page Record Ready message to Uplink RSU

UPLINK PROCESSOR
RSU (To Uplink) receives Page Records Ready message
RSU Loads Page Records into Page Record Block Queue
RSU Sends Page Records Ready message to next USU
USU Receives Page Records Ready message from RSU
USU Loads Page Records
USU Awaits Transmission Time loop
USU Output Page Records in Block format

SATELLITE SYSTEM SENDS TO DOWNLINK
DESTINATION RCC SITE PROCESSOR
DSU Detects record block with correct Destination ID
DSU Signals next DSU to prepare for input
DSU Finishes input of Page Record
DSU Signals 'GO' to next DSU
DSU Checks and corrects received Page Record
DSU Requests and obtains a Packet ID from the local SSU
DSU Loads Page Record to TSU queue
DSU Sends Page Record Ready to TSU
DSU Awaits next 'Prepare to Receive Data' from other DSU(s)
TSU 'WAIT STATE periodically sends 'tick' to Status Service Unit
TSU Receives Page Record Ready message
TSU Loads Page Record into buffer
TSU Formats Page Record into POCSAG format and installs in POCSAG buffer
TSU Checks Holding Time
   If not started, starts Holding Time
TSU Awaits Holding Time Time-out or next Page Record Ready message
TSU Sends Transmitter Time Request to RCC transmitter controller
RCC Transmitter controller sends 'WAIT' or 'GO'
   If TSU receives WAIT
      TSU starts 'Max Wait Timer'
      If Max Wait timer times out
         TSU sends error message to RSU
         RSU receives error message
         RSU connects to Monitor Facility
         RSU sends 'RCC Transmitter Controller Out-of-Service Message'
TSU Receives 'GO'
TSU Sends 'Transmitter On Command Sequence'
TSU Starts 'Max Wait Timer'
   If TSU receives 'Transmitter Fault' from RCC Transmitter Control
   Or if Max Wait Timer times out
      TSU sends 'Transmitter Fault' message to RSU queue
RCC Transmitter Controller sends 'Transmitter On' acknowledgement
TSU Sends POCSAG buffer to RCC Transmitter
TSU Pauses
TSU Sends 'Transmitter Release' message top RCC Transmitter Controller
TSU Starts Max Wait Timer
TSU Starts Repeat Control Burst timer
If Repeat Control Burst Timer times out
 TSU sends 'Transmitter Release' message again
If Max Wait Timer times out
 TSU sends 'Transmitter Controller Fault 2' message to RSU Queue
TSU Sends Page Complete message to ASU
TSU Returns to WAIT stage

— END OF SEQUENCE —

TABLE 4

ALPHANUMERIC INPUT — OPERATOR — LOCAL

OSU Initialization
If modem connection required
 If DIAL NUMBER contains data
 OSU prompts modem for connection
 If five tries with no modem response
 OSU sends 'Modem Fault Detect' to SSU

Modem Responds
Sends Dial Data to Modem
Modem dials number
Modem sends 'Waiting for Carrier' message to OSU
If modem does not detect carrier
 Modem sends 'No Data Carrier message to OSU
 OSU retries
 Every fifth try OSU sends 'Line Fault Detect' to SSU
 Modem sends 'Data Carrier Detect'

OSU Sends 'Console Type Request' to remote terminal
If console does not respond to type select
 OSU selects 'dumb console' default parameters
If console responds with type
OSU selects appropriate control code commands based on received console type

OSU Displays Operator Menu
OSU Enters WAIT STATE
OSU WAIT STATE periodically sends 'tick' to SSU

--- End OSU initialization

Operator selects desired function (PLACE A PAGE)

OSU Prompts for Pager Number
If Operator press CR without data
    OSU re-displays menu

Operator enter pager number, using backspace and delete for edits

Operator presses CR

OSU Looks up page number, sets control block
If pager number is not valid
    OSU sends 'Invalid Pager Number Error' message to Operator
    OSU re-prompts for Pager Number

OSU Prompts for Display Data
If Operator presses CR without data
    Tone Only Page, proceed to OSU formats Page Record
Operator types in Display Data, using backspace and delete for edits

Operator presses CR

OSU Formats Page Record
    Installs Pager Number
    Installs Data Code
    Looks up Destination Code, Installs
    Calculates data blocks required
    Obtains source ID number
    Installs data

OSU Determines that the page is to be placed locally
OSU Requests and obtains Packet ID number
OSU Stores PAGREC in CURRENT PAGE BUFFER
OSU Sends Page Record Holding message to TSU
TSU WAIT STATE periodically sends 'tick' to Status Service Unit
TSU Receives Page Record Ready message
TSU Loads Page Record into buffer
TSU Formats Page Record into POCSAG format and installs in POCSAG buffer
TSU Checks Holding Time
   If not started, starts Holding Time
TSU Awaits Holding Time time-out or next Page Record Ready message
TSU Sends Transmitter Time Request to RCC Transmitter Controller
RCC Transmitter Controller sends 'WAIT' or 'GO'
   If TSU receives WAIT
      TSU starts 'Max Wait Timer'
   If Max Wait Timer times out
      TSU sends error message to RSU
         RSU receives error message
         RSU connects to Monitor Facility
         RSU sends 'RCC Transmitter Controller Out-of-Service Message'
TSU Receives 'GO'
TSU Sends 'Transmitter On Command Sequence'
TSU Starts 'Max Wait Timer'
   If TSU receives 'Transmitter Fault' from RCC Transmitter Controller
   Or if Max Wait Timer times out
      TSU sends 'Transmitter Fault' message to RSU queue
RCC Transmitter Controller sends 'Transmitter On' acknowledged
TSU Sends POCSAG buffer to RCC Transmitter
TSU Pauses
TSU Sends 'Transmitter Release' message to RCC Transmitter Controller
TSU Starts Max Wait Timer
TSU Starts Repeat Control Burst timer
   If Repeat Control Burst Timer times out
      TSU sends 'Transmitter Release' message again
   If Max Wait Timer Times out
      TSU sends 'Transmitter Controller Fault 2' message to
      RSU Queue
TSU Sends Page Complete message to ASU
TSU Returns to WAIT stage

— END OF SEQUENCE —

TABLE 5

ALPHANUMERIC INPUT — OPERATOR — NATIONWIDE

OSU Initialization
   If modem connection required
      If DIAL NUMBER contains data
         OSU prompts modem for connection
      If five tries with no modem response
         OSU sends 'Modem Fault Detect' to SSU
   Modem response
      OSU sends Dial Data to Modem
      Modem dials number
      Modem sends 'Waiting for Carrier' message to OSU
      If modem does not detect carrier
         Modem sends 'No Data Carrier' message to OSU
         OSU retries
         Every fifty try OSU sends 'Line Fault Detect' to
         SSU
         Modem sends 'Data Carrier Detect'
      OSU sends 'Console Type Request' to remote terminal
If console does not respond to type select
  OSU selects 'dumb console' default parameters
If console responds with type
  OSU selects appropriate control code commands based on
  received console type
OSU Displays Operator Menu
OSU Enters WAIT STATE
OSU WAIT STATE periodically sends 'tick' to SSU
    — End OSU initialization
Operator selects desired function (PLACE A PAGE)
OSU Prompts for Pager Number
If Operator press CR without data
    OSU re-displays menu
Operator enter pager number, using backspace and delete for edits
Operator presses CR
OSU Looks-up page number, gets control block
If pager number is not valid
    OSU sends 'Invalid Pager Number Error' message to Operator
    OSU re-prompts for Pager Number
OSU Prompts for Display Data
If Operator presses CR without data
    Tone Only Page, proceed to OSU formats Page Record
Operator types in Display Data, using backspace and delete for edits
Operator presses CR
OSU Formats Page Record
  Installs Pager Number
  Installs Data Code
  Looks up Destination Code, Installs
  Calculates data blocks required
Obtains source ID number
Installs data
OSU Determines that the call is to be routed National system
OSU Requests and obtains Packet ID number
OSU Stores PAGREC in CURRENT PAGE BUFFER
OSU Sends Page Record Holding message to RSU
RSU Receives Page Record Holding message
If no Page Records Holding
  RSU set page holding time to await additional blocks
If Page Record Holding Time Not timed out, wait
  RSU connects modem to Central RSU Traffic Route Processor
If unable to make connection
  Repeat connection attempt
  If five attempts
    Connect to Monitor Facility and report Error
RSU Sends all current Holding Records
RSU Awaits handshake for Repeat Request(s)
RSU Resets, awaits next Page Record
  TRAFFIC ROUT PROCESSOR
RSU (From RCC Site) receives Page Records from RCC SITE
RSU Checks Source Record ID Number
If not sequential
  RSU sends 'Repeat nnnn Request' to RCC Site Processor
  RSU receives repeated Records
RSU Checks Destination Code Address
If Destination inaccurate, generates 'New Destination Code'
  Record for transmission to RCC Site Processor
RSU Assigns Destination Packet ID Number to each Page Record
RSU Sends Page Record Ready message to Uplink RSU
UPLINK PROCESSOR
RSU (To Uplink) receives Page Records Ready message
RSU Loads Page Records into Page Record Block Queue
RSU Sends Page Records Ready message to next USU
USU Receives Page Records Ready message from RSU
USU Loads Page Records into ram buffer
USU Awaits Transmission Time loop
USU Output Page Records in Block format

DESTINATION RCC SITE PROCESSOR
DSU Detects record block with correct Destination ID
DSU Signals next DSU to prepare for input
DSU Finishes input of Page Record
DSU Signals 'GO' to next DSU
DSU Checks and corrects received Page Record
DSU Requests and obtains a Packet ID from the local SSU
DSU Loads Page Record to TSU queue
DSU Sends Page Record Ready to TSU
DSU Awaits next 'Prepare to Receive Data' from other DSU(s)
TSU WAIT STATE periodically sends 'tick' to Status Service Unit
TSU Receive Page Record Ready message
TSU Loads Page Record into buffer
TSU Formats Page Record into POCSAG format and installs in POCSAG buffer
TSU Checks Holding Time
   If not started, starts Holding Time
TSU Awaits Holding Time time out or next Page Record Ready Message
TSU Sends Transmitter Time Request to RCC Transmitter Controller
RCC Transmitter Controller sends 'WAIT' or 'GO'
If TSU receives WAIT
   TSU starts 'Max Wait Timer'
If Max Wait Timer times out
   TSU sends error message to RSU
      RSU receives error message
      RSU connects to Monitor Facility
      RSU sends 'RCC Transmitter Controller Out-of-Service Message'
TSU Receives 'GO'
TSU Sends 'Transmitter On Command Sequence'
TSU Starts 'Max Wait Timer'
   If TSU receives 'Transmitter Fault' from RCC Transmitter Controller
   Or if Max Wait Timer times out
      TSU sends 'Transmitter Fault' message to RSU queue
RCC Transmitter Controller sends 'Transmitter On' acknowledgement
TSU Sends POCSAG buffer to RCC Transmitter
TSU Pauses
TSU Sends 'Transmitter Release' message to RCC Transmitter Controller
TSU Starts Max Wait Timer
TSU Starts Repeat Control Burst timer
   If Repeat Control Burst Timer times out
      TSU sends 'Transmitter Release' message again
If Max Wait Timer times out
   TSU sends 'Transmitter Controller Fault 2' message to RSU Queue
TSU Send Page Complete message to ASU
TSU Returns to WAIT state

— END OF SEQUENCE —
<table>
<thead>
<tr>
<th>CSU</th>
<th>WAIT STATE periodically sends 'tick' to SSU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calling party dials line number</td>
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<tr>
<td></td>
<td>Modem Detects ring signal</td>
</tr>
<tr>
<td></td>
<td>Modem answers</td>
</tr>
<tr>
<td></td>
<td>Calling party presses or sends CR</td>
</tr>
<tr>
<td></td>
<td>Requests logon ID (which contains type specification)</td>
</tr>
<tr>
<td></td>
<td>If calling party sends invalid logon ID</td>
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<tr>
<td></td>
<td>CSU sends 'Invalid Logon ID'</td>
</tr>
<tr>
<td></td>
<td>CSU disconnects modem</td>
</tr>
<tr>
<td></td>
<td>CSU returns to WAIT STATE</td>
</tr>
<tr>
<td></td>
<td>Calling party responds with valid logon ID</td>
</tr>
<tr>
<td></td>
<td>CSU selects appropriate console command codes based on type specification in Logon ID</td>
</tr>
<tr>
<td></td>
<td>Sends appropriate Customer Service Menu</td>
</tr>
<tr>
<td></td>
<td>Resets 'Dead Console' timer</td>
</tr>
<tr>
<td></td>
<td>If 'Dead Console' Timer times out</td>
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<tr>
<td></td>
<td>CSU sends 'No Activity Time out Error'</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>Customer enter pager number using backspace and delete for edits</td>
</tr>
<tr>
<td></td>
<td>Customer presses CR</td>
</tr>
<tr>
<td></td>
<td>Looks up page number, gets control block</td>
</tr>
<tr>
<td></td>
<td>If pager number is not valid</td>
</tr>
<tr>
<td></td>
<td>CSU sends 'Invalid Pager Number Error' message to Customer</td>
</tr>
</tbody>
</table>

Table 6
ALPHANUMERIC INPUT — MANUAL — CUSTOMER SERVICE UNIT — LOCAL
CSU re-prompts for Pager Number

CSU
Prompts for Display Data

If Customer presses CR without data
Tone Only Page, proceed to CSU formats Page Record
Customer types in Display Data, using backspace and delete for edits
Customer presses CR

CSU
Formats Page Record
Installs Pager Number
Installs Date Code
Looks up Destination Code, Installs
Calculates data blocks required
Obtains source ID number
Installs data

CSU
Determines that page should be processed locally
CSU
Requests and obtains Packet ID Number
CSU
Stores PAGREC in CURRENT PAGE BUFFER
CSU
Sends Page Record holding message to TSU
CSU
Disconnects modem
TSU
WAIT STATE periodically sends 'tick' to Status Service Unit
TSU
Receives Page Record Ready message
TSU
Loads Page Record into buffer
TSU
Formats Page Record into POCSAG format and installs in POCSAG buffer
TSU
checks Holding Time
If not started, starts Holding Time
TSU
Awaits Holding Time time out or Next Page Record Ready message
TSU
Sends Transmitter Time Request to RCC Transmitter Controller
RCC
Transmitter Controller sends 'WAIT' or 'GO'
If TSU receives WAIT
TSU starts 'Max Wait Timer'
If Max Wait Timer times out
TSU sends error message to RSU
   RSU receives error message
   RSU connects to Monitor Facility
   RSU sends 'RCC Transmitter Controller Out-of-Service Message'
TSU Receives 'GO'
TSU Sends 'Transmitter On Command Sequence'
TSU Starts 'Max Wait Timer'
If TSU receives 'Transmitter Fault' from RCC Transmitter Controller
Or if Max Wait Timer times out
   TSU sends 'Transmitter Fault' message to RSU Queue
RCC Transmitter Controller sends 'Transmitter On' acknowledgement
TSU Sends POCSAG buffer to RCC Transmitter
TSU Pauses
TSU Sends 'Transmitter Release' message to RCC Transmitter Controller
TSU Starts Max Wait Timer
TSU Starts Repeat Control Burst timer
If Repeat Control Burst timer times out
   TSU sends 'Transmitter Release' message again
If Max Wait Timer times out
   TSU sends 'Transmitter Control Fault 2' message to RSU Queue
TSU Sends Page Complete message to ASU
TSU Returns to WAIT STATE

— END OF SEQUENCE —


<table>
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<td>CSU returns to WAIT STATE</td>
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    Customer types in Display Data, using backspace and delete for edits
    Customer presses CR
CSU  Formats Page Record
    Installs Pager Number
    Installs Date Code
    Looks up Destination Code, Installs
    Calculates data blocks required
    Obtains source ID number
    Installs data
CSU  Determines that page should be placed on the National System
CSU  Requests and obtains Packet ID Number
CSU  Stores PAGREC in CURRENT PAGE BUFFER
CSU  Sends Page Record holding message to TSU
CSU  Disconnects modem
RSU  Receives Page Record Holding message
    If no Page Records Holding
        RSU set page holding time to await additional blocks
    If Page Record Holding Time not timed out, wait
RSU  Connects modem to Central RSU Traffic Rout Processor
    If unable to make connection
        Repeat connection attempt
    If five attempts
        Connect to Monitor Facility and report Error
RSU  Sends all current Holding Records
RSU  Awaits handshake for Repeat Request(s)
RSU  Resets, await next Page Record
TRAFFIC ROUTE PROCESSOR

RSU (From RCC Site) receives Page Records from RCC SITE
RSU Checks Source Record ID Number
   If not sequential
      RSU sends 'Repeat mmmn Request' to RCC Site Processor
      RSU receives repeated records
RSU Checks Destination Code Address
   If Destination inaccurate, generates 'New Destination Code'
      Record for transmission to RCC Site Processor
RSU Assigns Destination Packet ID Number to each Page Record
RSU Sends Page Record Ready message to Uplink RSU

UPLINK PROCESSOR

RSU (To Uplink) receives Page Records Ready message
RSU Loads Page Records into Page Record Block Queue
RSU Sends Page Records Ready message to next USU
USU Receives Page Records Ready message from RSU
USU Loads Page Records into ram buffer
USU Awaits Transmission Time loop
USU Output Page Records in Block format

SATELLITE SYSTEM SENDS TO DOWNLINK

DESTINATION RCC SITE PROCESSOR

DSU Detects record block with correct Destination ID
DSU Signals next DSU to prepare for input
DSU Finishes input of Page Record
DSU Signals 'GO' to next DSU
DSU Checks and corrects received Page Record
DSU Requests and obtains a Packet ID from the local SSU
DSU Loads Page Record to TSU queue
DSU Sends Page Record Ready to TSU
DSU Awaits next 'Prepare to Receive Data' from other DSU(s)
TSU WAIT STATE periodically sends 'tick' to Status Service Unit
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      RSU receives error message
      RSU connects to Monitor Facility
      RSU sends 'RCC Transmitter Controller Out-of-Service Message'
TSU Receives 'GO'
TSU Sends 'Transmitter On Command Sequence'
TSU Starts 'Max Wait Timer'
If TSU receives 'Transmitter Fault' from RCC Transmitter Controller
   Or if Max Wait Timer times out
      TSU sends 'Transmitter Fault' message to RSU Queue
RCC Transmitter Controller sends 'Transmitter On' acknowledgement
TSU Sends POCSAG buffer to RCC Transmitter
TSU Pauses
TSU Sends 'Transmitter Release' message to RCC Transmitter Controller
TSU Starts Max Wait Timer
TSU Starts Repeat Control Burst timer
If Repeat Control Burst Timer times out
    TSU sends 'Transmitter Release' message again
If Max Wait Timer times out
    TSU sends 'Transmitter Control Fault 2' message to RSU Queue
TSU Sends Page Complete message to ASU
TSU Returns to WAIT STATE
    — END OF SEQUENCE —

<table>
<thead>
<tr>
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<tbody>
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Obtains source ID number
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CSU Determines that page should be processed locally
CSU Requests and obtains Packet ID Number
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CSU Sends Page Record holding message to TSU
CSU Disconnects modem
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TSU sends 'Transmitter Fault' message to RSU Queue
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If Repeat Control Burst Timer times out
TSU sends 'Transmitter Release' message again
If Max Wait Timer times out
TSU sends 'Transmitter Control Fault 2' message to RSU Queue
TSU  Sends Page Complete message to ASU
TSU  Returns to WAIT STATE

— END OF SEQUENCE —

TABLE 9

ALPHANUMERIC INPUT — ENCODER — CUSTOMER SERVICE UNIT — NATIONW

CSU  WAIT STATE periodically sends 'tick' to SSU
Calling device dials line number
Modem Detects ring signal
Modem answers
Calling device presses or sends CR
CSU  Requests logon ID (which contains type specification)
If calling device sends invalid logon ID
CSU sends 'Invalid Logon ID'
CSU disconnects modem
CSU returns to WAIT STATE
If calling device responds valid ID and Automatic Encoder
CSU selects no echo, no prompt
Calling device sends Pager Number, CR
CSU looks up Pager Number
If Pager Number not valid
   CSU sends 'Error Response Message'
   CSU disconnects
CSU returns to WAIT STATE
Calling device inputs Display Data
Calling device inputs CR
CSU Formats Page Record
   Installs Pager Number
   Installs Date Code
   Looks up Destination Code, Installs
   Calculates data blocks required
   Obtains source ID number
   Installs data
CSU Determines that page should be placed on the National System
CSU Requests and obtains Packet ID Number
CSU Stores PAGREC in CURRENT PAGE BUFFER
CSU Sends Page Record holding message to TSU
CSU Disconnects modem
RSU Receives Page Record Holding message
If no Page Records Holding
   RSU sets page holding time to await additional blocks
If Page Record Holding Time not timed out, wait
RSU Connects modem to Central RSU Traffic Route Processor
If unable to make connection
   Repeat connection attempt
   If five attempts
      Connect to Monitor Facility and report Error
RSU Sends all current Holding Records
RSU Awaits handshake for Repeat Request(s)
RSU Resets, await next Page Record

**TRAFFIC ROUTE PROCESSOR**

RSU (From RCC Site) receives Page Records from RCC site
RSU Checks Source Record ID Number
If not sequential
    RSU sends 'Repeat nnnn Request' to RCC Site Processor
    RSU receives repeated records
RSU Checks Destination Code Address
If Destination inaccurate, generates 'New Destination Code' Record for transmission to RCC Site Processor
RSU Assigns Destination Packet ID Number to each Page Record
RSU Sends Page Record Ready message to Uplink RSU

**UPLINK PROCESSOR**

RSU (To Uplink) receives Page Records Ready message
RSU Loads Page Records into Page Record Block Queue
RSU Sends Page Records Ready message to next USU
USU Receives Page Records Ready message from RSU
USU Loads Page Records into ram buffer
USU Awaits Transmission Time loop
USU Output Page Records in Block format

**SATELLITE SYSTEM SENDS TO DOWNLINK**

**DESTINATION RCC SITE PROCESSOR**

DSU Detects record block with correct Destination ID
DSU Signals next DSU to prepare for input
DSU Finishes input of Page Record
DSU Signals 'GO' to next DSU
DSU Checks and corrects received Page Record
DSU Requests and obtains a Packet ID from the local SSU
DSU Loads Page Record to TSU queue
DSU Sends Page Record Ready to TSU
DSU Awaits next 'Prepare to Receive Data' from other DSU(s)
TSU WAIT STATE periodically sends 'tick' to Status Service Unit
TSU Receives Page Record Ready message
TSU Loads Page Record into buffer
TSU Formats Page Record into POCSAG format and installs in
    POCSAG buffer
TSU Checks Holding Time
    If not started, starts Holding Time
TSU Awaits Holding Time time out or Next Page Record Ready
    message
TSU Sends Transmitter Time Request to RCC Transmitter Con-
    troller
RCC Transmitter Controller sends 'WAIT' or 'GO'
    If TSU receives WAIT
        TSU starts 'Max Wait Timer'
    If Max Wait Timer times out
        TSU sends error message to RSU
            RSU receives error message
            RSU connects to Monitor Facility
            RSU sends 'RCC Transmitter Controller
                Out-of-Service Message'
TSU Receives 'GO'
TSU Sends 'Transmitter On Command Sequence'
TSU Starts 'Max Wait Timer'
    If TSU receives 'Transmitter Fault' from RCC Transmitter
        Controller
        Or if Max Wait Timer times out
            TSU sends 'Transmitter Fault' message to RSU Queue
RCC Transmitter Controller sends 'Transmitter On' acknowledgement
TSU Sends POCSAG buffer to RCC Transmitter
TSU Pauses
TSU Sends 'Transmitter Release' message to RCC Transmitter
    Controller
TSU
Starts Max Wait Timer
TSU
Starts Repeat Control Burst timer
If Repeat Control Burst Timer times out
TSU sends 'Transmitter Release' message again
If Max Wait Timer times out
TSU sends 'Transmitter Control Fault 2' message to RSU Queue
TSU
Sends Page Complete message to ASU
TSU
Returns to WAIT STATE
— END OF SEQUENCE —

ADDITIONAL OPERATOR FUNCTIONS

OSU
In Wait State, periodically sends 'tick' to SSU
Operator presses 'D' for Display a Pager Control Block
OSU prompts for Pager Account Number
Operator made mistake, pressed 'D' key by mistake
Operator presses RETURN without pager number
OSU re-displays Menu
OSU returns to Wait State
Operator enters Pager Account Number
OSU converts account number to binary record number
OSU obtains Pager Control Block from hard disk data file
OSU displays current Pager Control Block contents

OSU
Prompts for 'Change of Menu' command
Operator selects Menu
OSU re-displays Menu
OSU returns to Wait State
Operator selects Change

OSU
Prompts for new Pager Cap-Code
Operator does not want to change Pager Cap Code
Operator presses RETURN with no data
OSU proceeds to 'Owner System' selection
Operator enters new Pager Cap Code
OSU stores Pager Cap Code in Data File (Owner Selection)

OSU Checks Owner System
If Owner System is '000' (new pager on system)
   OSU installs local system ID as Owner System
   OSU installs 'New Pager' page type in PAGREC
If Owner System is not '000' (update existing pager)
   OSU installs 'Update' page type in PAGREC

OSU Prompts for Current Location telephone number of 'L' if local
Operator presses RETURN with no data
   OSU proceeds to 'Current Status' section
Operator presses 'L' key
   OSU installs current system ID as Current Location
Operator enters an Area Code and Exchange of Location City
   OSU calculates record position in Service Area File
   OSU obtains destination system ID
   OSU installs destination system ID in PAGREC (Current Status)

OSC Prompts for current status of pager
Operator presses RETURN with no data
   OSU proceeds to 'PAGREC' section
Operator enters new Status Code
   OSU installs new status code in PAGREC (PAGREC)

OSU Checks PAGREC to see if any changes have been made
If any changes made
   OSU formats Page record
      Installs Pager Number
      Installs Data Code
      Obtains Source ID Number
      Installs data

OSU Requests and obtains Packet ID Number
OSU Stores PAGREC in CURRENT PAGE BUFFER
OSC Sends Page Record Holding message to RSU

RSU Receives Page Record Holding Message
If no Page Records holding
    RSU set page holding time to await additional blocks
If Page Record Holding Time not timed out, wait
RSU Connects modem to Central RSU Traffic Route Processor
If unable to make connection
    Repeat connection attempt
    If five attempts
        Connect to Monitor Facility and report error
RSU Sends all current Holding Records
RSU Awaits handshake for Repeat Request(s)
RSU Resets, Awaits next Page Record

TRAFFIC ROUTE PROCESSOR
RSU (From RCC Site) receives Page Records from RCC SITE
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UPLINK PROCESSOR
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RSU Sends Page Records Ready message to next USU
USU Receives Page Records Ready message from RSU
USU Loads Page Records into ram buffer
USU Awaits Transmission Time loop
USU Output Page Records in Block format
SATELLITE SYSTEM SENDS TO DOWNLINK

DESTINATION RCC SITE PROCESSOR

DSU Detects record block with correct Destination ID
DSU Signals next DSU to prepare for input
DSU Finishes input of Page Record
DSU Signals 'GO' to next DSU
DSU Checks and corrects received Page Record
DSU Requests and obtains a Packet ID from the local SSU
DSU Stores PAGREC in CURRENT PAGE BUFFER
DSU Determines that PAGREC is not a Page but an update
DSU Sends Pager Update Record Holding to ASU

ACCOUNTING SERVICE UNIT

ASU Receives Pager Update Record Holding from DSU
ASU Looks up Pager Account Number in Pager Control Block File
ASU Installs Pager Cap Code in Pager Control Block
ASU Installs Owner Service in Pager Control Block
ASU Installs Current Location in Pager Control Block
ASU Installs Current Status in Pager Control Block
ASU Writes Pager Control Block to File
ASU Returns to Wait State

TABLE 11

PROCESS LEVEL BACKGROUND FUNCTIONS

System operation requires a number of background functions, and functions which have not been previously discussed. These functions are transparent to the system.

SSU - Status Service Unit - The SSU performs monitoring of all processes in the system and attempts to correct errors if they occur. The process failure detection sequence depends upon each process in the system 'reporting' to the SSU periodically by sending a 'tick'. The timers used to determine when a process has failed are dependent upon an RTC interrupt.
The SSU also maintains a data table which can be interrogated by a local process. The SSU normally runs in the Utility Processor, therefore the STATUS utility program is capable of displaying the SYSTEM status.

SSU Receives 'tick' from external process
  SSU resets process timer to max value
SSU Receives timer interrupt
  SSU decrements all timers
  If process timer times out
    SSU requests 'reset' by master of faulty process
    SSU updates status table showing reset
  If environment status timer times out
    SSU interrogates the external Status Monitor Device
    SSU fills in status form
    SSU checks for out-of-range condition
    If condition out-of-range
      SSU initiates Service Request via Page Record

SSU Receives Packet ID request
  SSU sends packet ID to requesting process
  SSU increments Packet ID counter
  If Packet ID counter exceeds 4096
    SSU reset Packet ID counter to 0

END

DSU - Downlink Service Unit - The DSU also looks for page records from the downlink which match the local "Owner System." When one is detected, the record is stored and the ASU is notified.

DSU Detects Page Record with correct 'Woner System'
DSU Requests and receives a Packet ID number from the SSU
DSU Stores the Page Record
DSU Sends 'Page Record Holding Message' to ASU

END

ASU - Accounting Service Unit - The ASU is responsible for
posting pages to local pager accounts. The DSU will send a Page Record each time it detects one on the downlink.

The ASU is also the local system whenever a Pager Update is received (see Additional Operator Functions).

ASU Receives 'Page Record Holding Message' from DSU
ASU Locates the account record in the local account file
If the page was local
  ASU increments the Local Page Counter
If the page was National
  ASU increments the National Page Counter
END

The present invention has been described in detail in connection with preferred embodiments. These embodiments, however, are merely examples and the invention is not restricted thereto. It will be understood by those skilled in the art from a reading of the specification that variations and modifications can be made within the scope of the present invention as defined by the appended claims.
CLAIMS

1. A scanning radio paging receiver for a paging system, said receiver comprising:
   antenna means for receiving a paging signal;
   mixer means coupled to said antenna means for mixing said paging signal with a local oscillator signal to produce an IF signal;
   oscillator means coupled to said mixer means for generating said local oscillator signal;
   logic means connected to said oscillator means for controlling said oscillator means to generate said local oscillator signal at a plurality of predetermined frequencies, wherein said paging receiver is caused to scan a corresponding plurality of paging signal frequencies; and
   detector means coupled to the output of said mixer means for detecting the paging signal on each of said scanned frequencies.

2. The scanning radio paging receiver of claim 1 wherein said logic means is a microprocessor.

3. The scanning radio paging receiver of claim 1 further comprising energy save means coupled to said logic means for repetitively switching said paging receiver between a first energy consumption level and a lower energy consumption level, said paging signal being detected when said paging receiver is operating at said first energy consumption level.

4. The scanning radio paging receiver of claim 3 wherein said paging signal includes a first preamble code and a second preamble code, said logic means causing said paging receiver to operate at said first energy consumption level for repetitive predetermined periods of time, said logic means causing said paging receiver to remain at said first energy consumption level when said first preamble code is detected and to return to repetitive operation between said first energy consumption level and said lower energy consumption level if said second preamble code is not detected within a predetermined time after said first preamble code is detected.
FIG. 4

1 2
CSID.RID.SID.DATE H M

--- MINUTE CODE LETTER ('e'-'r')
--- HOUR CODE LETTER
--- DATE CODE (HEX)
--- DESTINATION SYSTEM CODE (HEX)
--- SOURCE SYSTEM CODE (HEX)
--- REPEAT TO DEST. PACKET ID CODE
--- ORIGINATING PACKET ID CODE
--- CONTROL/DATA RECORD FLAG

2 3 4 5 6 7 8
2345678901234567890123456789012345678901234567890...
NNNNNN PPPPPXXS T THM B [------------------------2-----------------]...

--- FIRST DATA BLOCK
--- NUMBER OF DATA BLOCKS
--- SPARE BYTES
--- MINUTE TRANSMITTED
--- HOUR TRANSMITTED
--- PAGE TYPE
--- THREAD LIST
--- SOURCE SYSTEM
--- PAGER STATUS
--- PAGER CAP-CODE
--- PAGER ACCOUNT NUMBER
FIG. 6

FIG. 8

PAGING SIGNAL FROM
RCC TRANSMITTER

ON

OFF

A

B

C

TIME

POWER POWER SAVE

AWAKE

D

E

F

G

TIME

TYPICAL PAGE ACQUISITION SEQUENCE

SIGNATURE

BATTERY SAVE MODE
INTERNATIONAL SEARCH REPORT

International Application No PCT/US86/01368

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL. 4  H04Q 7/00
U.S. CL. 340/825.44

II. FIELDS SEARCHED

Minimum Documentation Searched 4

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III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

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<th>Citation of Document, 16 with indication, where appropriate, of the relevant passages 17</th>
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<td>U.S., A, 4,434,504, (FREDRICKSON) 28 February 1984, See column 3, lines 15-20, and 38-42.</td>
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* Special categories of cited documents: 15

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"G" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search 7

29 October 1986

International Searching Authority 1

ISA/US

Date of Mailing of this International Search Report 8

14 NOV 1986

Signature of Authorized Officer 9c

Donald J. Yusko