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[54] **METHOD FOR EFFICIENT BANDWIDTH UTILIZATION WHEN TRANSCEIVING VARYING BANDWIDTH MESSAGES**

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[58] Field of Search 455/38.1, 38.4, 54.1, 455/54.2, 455/56.1, 220, 228; 340/825.44

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Primary Examiner—Edward F. Urban
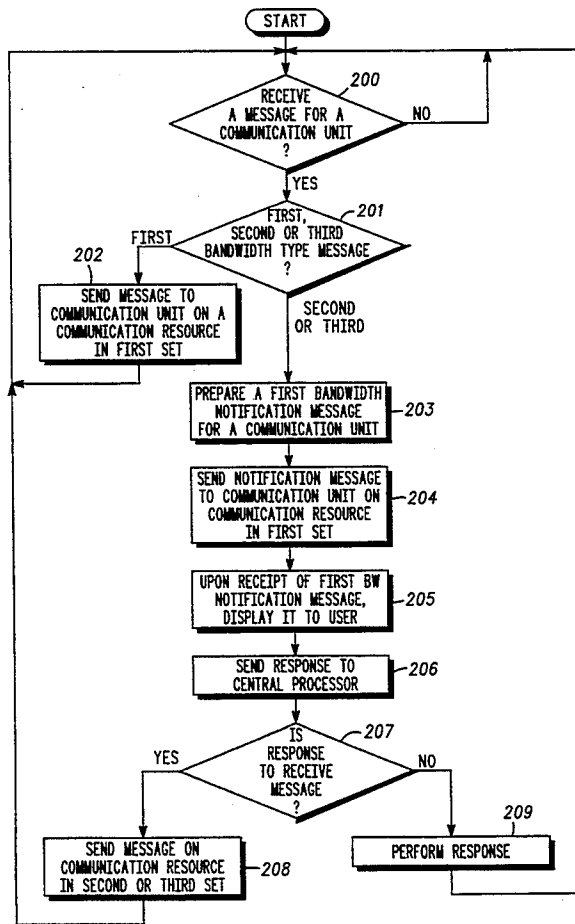*Assistant Examiner*—Mary M. Lin
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[57] **ABSTRACT**

In a communication system, a method that efficiently utilizes bandwidth of communication resources when transmitting first and second bandwidth messages to a communication unit may be accomplished in the following manner. When a central processor receives a message for the communication unit, it determines whether the message is of a first bandwidth message type or a second bandwidth message type. When the message is of the first bandwidth message type, the central processor transmits the message to the communication unit via a communication resource that is used primarily for transceiving first bandwidth type messages. When the message is of the second bandwidth message type, the central processor prepares a first bandwidth notification message and transmits it to the communication unit via the communication resource. The first bandwidth notification message informs a user of the communication unit that the central processor has the second bandwidth type message for it. When the user desires to receive the message, a request is sent to the central processor, which subsequently transmits the message on a communication resource that is primarily used for transceiving second bandwidth type messages.
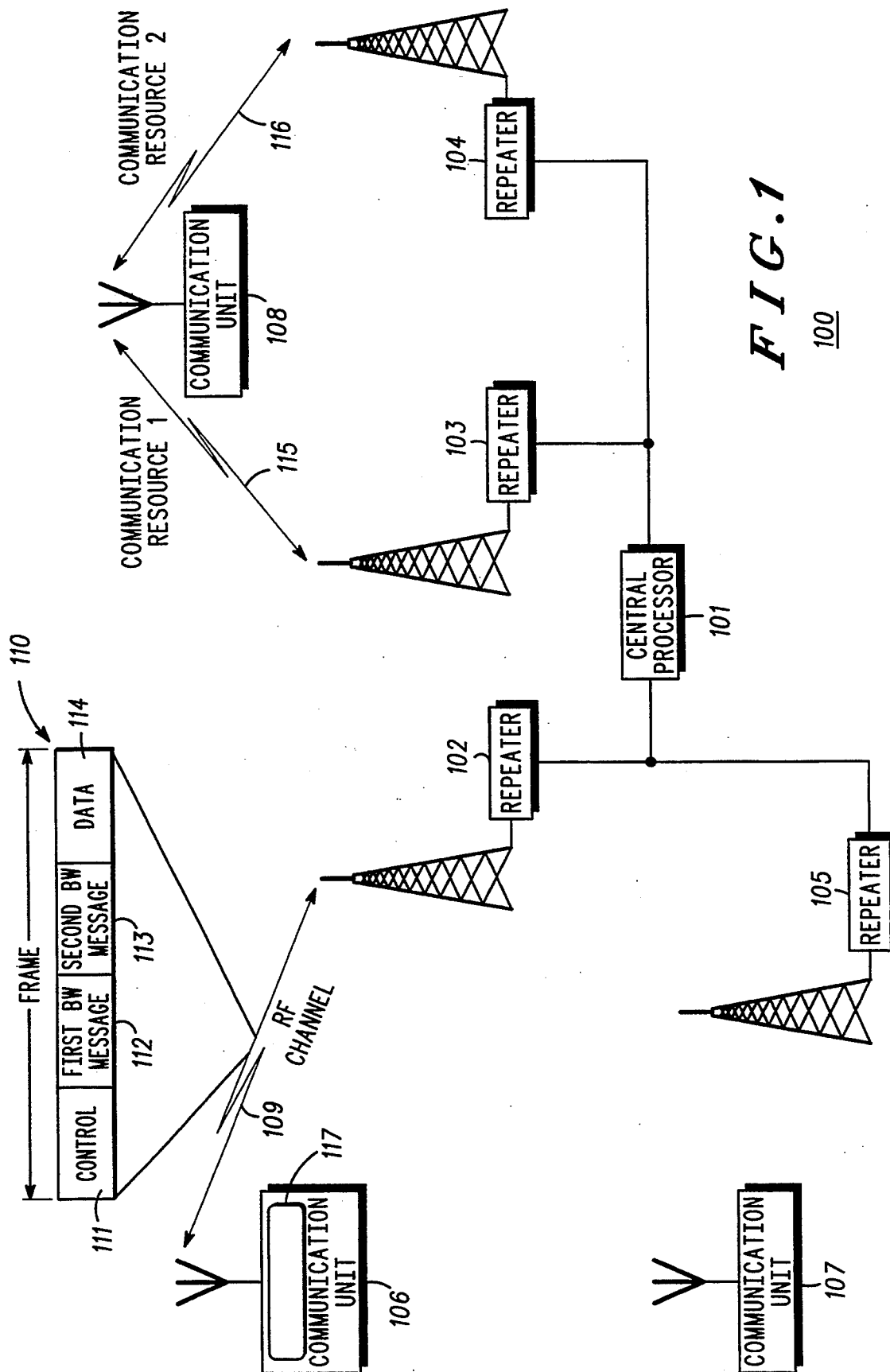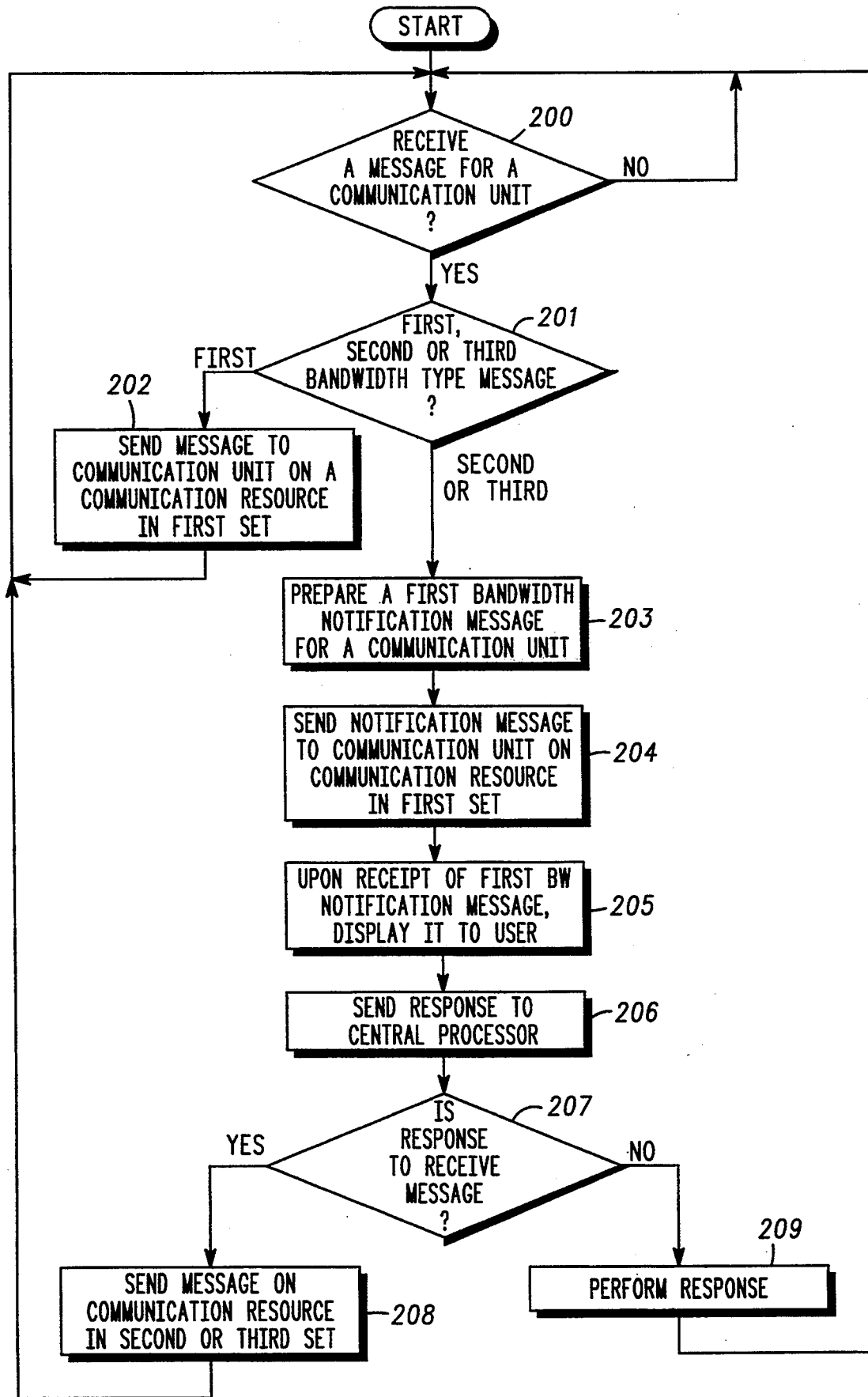
6 Claims, 2 Drawing Sheets

F I G . 1
100

START

200
RECEIVE A MESSAGE FOR A COMMUNICATION UNIT ? — NO

YES

201
FIRST, SECOND OR THIRD BANDWIDTH TYPE MESSAGE ?

FIRST

202
SEND MESSAGE TO COMMUNICATION UNIT ON A COMMUNICATION RESOURCE IN FIRST SET

SECOND OR THIRD

PREPARE A FIRST BANDWIDTH NOTIFICATION MESSAGE FOR A COMMUNICATION UNIT — *203*

SEND NOTIFICATION MESSAGE TO COMMUNICATION UNIT ON COMMUNICATION RESOURCE IN FIRST SET — *204*

UPON RECEIPT OF FIRST BW NOTIFICATION MESSAGE, DISPLAY IT TO USER — *205*

SEND RESPONSE TO CENTRAL PROCESSOR — *206*

207
IS RESPONSE TO RECEIVE MESSAGE ?

YES   NO

209

SEND MESSAGE ON COMMUNICATION RESOURCE IN SECOND OR THIRD SET — *208*

PERFORM RESPONSE

FIG. 2

METHOD FOR EFFICIENT BANDWIDTH UTILIZATION WHEN TRANSCEIVING VARYING BANDWIDTH MESSAGES

FIELD OF THE INVENTION

This invention relates generally to radio communication systems and, in particular, to a radio communication system that utilizes communication resources to transceive varying bandwidth messages.

BACKGROUND OF THE INVENTION

As is known, radio communication systems typically include communication units that communicate via communication resources. Communication resources are defined by the multiplexing scheme utilized in the particular communication system. For example, with frequency division multiplexing (FDM), the communication resource may be a frequency carrier or pair of frequency carriers; whereas, with time division multiplexing (TDM), the communication resource may be a time slot or pair of time slots in one or more time frames. To control allocation of the communication resources, the communication system employs a central controller to allocate and maintain the communication resources. In addition, the central processor generally provides access to a telephone switching network when a communication unit's user desires to converse with a telephone service subscriber.

Communications in wireless communication systems generally necessitate communication resources with bandwidths appropriate for the type of communication. For example, voice and long data messages, such as file transfers or facsimile transmissions, require wider bandwidths than short data messages, such as pages. Present day wireless communication systems are constructed to support either wide bandwidth (long) messages or narrow bandwidth (short) messages, but not both. The decision to utilize separate systems for long and short messages is based on spectral, or bandwidth, efficiency since transceiving long messages on a short message system requires multiple short messages and transceiving short messages on a long message system results in unused, or wasted, bandwidth. Therefore, users that utilize both wide and narrow bandwidth messages are currently required to access two separate messaging systems.

In contrast, wireline communication systems, such as public telephone and computer networks, do provide means for transceiving both long and short data messages. However, these systems do not allow simultaneous reception of both message types. Therefore, when a computer user is receiving a long message, or large file, over a computer network, the user cannot receive a short electronic mail message without an interruption in the reception of the long message. Alternatively, in a telephone network with "call waiting", a telephone subscriber's current conversation is interrupted with a "clicking" sound while being notified of another incoming call.

Therefore, a need exists for a more efficient method of transceiving varying bandwidth messages in a single wireless communication system without introducing the service interruptions present in wireline communication systems.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a communication system in accordance with the present invention.

FIG. 2 illustrates a flow diagram of steps executed by a central processor and a communication unit in accordance with the present invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Generally, the present invention provides a method for efficient communication resource bandwidth utilization when transmitting first (short) and second (long) bandwidth messages to a communication unit. This is accomplished when a central processor receives a message for the communication unit and determines whether the message is of a first bandwidth message type or a second bandwidth message type. When the message is of the first bandwidth message type, the central processor transmits the message to the communication unit via a communication resource that is used primarily for transceiving first bandwidth type messages. When the message is of the second bandwidth message type, the central processor prepares a first bandwidth notification message and transmits it to the communication unit via the communication resource, which can be done without interruption of current services. The first bandwidth notification message informs a user of the communication unit that the central processor has the second bandwidth type message for it, which the user can access at the user's convenience. When the user desires to receive the message, a request is sent to the central processor, which subsequently transmits the message on a communication resource that is primarily used for transceiving second bandwidth type messages. With such a method, the communication system more efficiently utilizes communication resource bandwidth by deferring transmission of the second bandwidth type message until the communication unit requests to receive it.

The present invention can be more fully described with reference to FIGS. 1 and 2. FIG. 1 illustrates a communication system 100 that includes a central processor 101, a plurality of repeaters or paging broadcast units 102–105 that transceive a limited number of communication resources 111–116, and a plurality of communication units 106–108 each having a display 117. The central processor may comprise a central controller and a data processing element that includes communication protocols, data storage (memory), queuing means, a communication unit data base, and message scheduling algorithms. Alternatively, the data processing element may comprise multiple processing elements which may be centrally located or distributed on a computer network.

The communication resources 111–114 are preferably time slots or portions of time slots in a time division multiple access (TDMA) time frame 110, while communication resources 114–115 are radio frequency (RF) channels. Messages and other communications are transmitted over the RF channels 114–115 using known TDMA channelization and access methodology. TDMA, as utilized in the present invention, uses combinations of data transmitted in discrete time slots to form the communication resources 111–114. These communication resources 111–114 may support a variety of message bandwidths (data transmission capacity) by periodically interleaving the messages at different rates.

First and second bandwidth messages **112–113** are transmitted via their respective communication resources using different interleaving rates. First bandwidth messages **112** are preferably transmitted at a twelve to one interleaving rate. That is, every twelfth time slot is used to transmit the first bandwidth messages **112**. The time slots used to transmit first bandwidth messages **112** are only allocated for the duration of the first bandwidth message transmission. Upon conclusion of the first bandwidth message **112**, the previously allocated time slots are deallocated and made available for other communications. Alternatively, the first bandwidth messages **112** may be transmitted in the same time slots as other communication messages, such as digitized voice, facsimile, or various types of data, by substituting redundancy bits from the other communication messages with data bits of the first bandwidth messages **112**. This alternative transmission scheme allows the first bandwidth messages **112** to be simultaneously transmitted with the other communication messages. The previously described techniques for transmitting first bandwidth messages **112** are suitable for short messages of at most **140** ASCII characters, but are less efficient for delivering longer messages. On the other hand, second bandwidth messages **113** are transmitted at lower interleaving rates, such as four to one or six to one, which accommodate long messages and provide faster transfer times than higher rates, but use more system bandwidth and, accordingly, have higher transmission costs than first bandwidth messages **112**.

Control **111** and additional data information **114** are transmitted in time slots which are not typically used for first or second bandwidth messages **112–113**. Control information **111** is generally used to allocate and deallocate the time slots used for the first and second bandwidth messages **112–113** and is transmitted in its own time slot. However, as previously discussed, the first bandwidth messages **112** and the additional data **114** may share time slots to provide simultaneous transmission of their respective information.

FIG. **2** illustrates a logic flow diagram of steps executed to implement the present invention. Entering the flow diagram at the START block, logic flow proceeds to decision block **200** where the central processor determines whether it received a message for an operable communication unit. An operable communication unit is a communication unit that is currently registered with the central processor. The communication unit registers with the central processor by sending a registration packet to the central processor when its power is activated by its user. Upon registering, the central processor authorizes the communication unit to be on the communication network and communicates, via control information, with the communication unit while the communication unit is within the network's coverage area. The central processor continuously monitors the communication unit's operational status, such as attachment or detachment from the network, location updates, authentication, and service requests.

When a message is not received for the operable communication unit, the central processor continues to check for other received messages. When the message is received or generated by the central processor, the central processor determines whether the message is of a first bandwidth message type, a second bandwidth message type, or a third bandwidth message type **201**. As briefly mentioned above with reference to FIG. **1**, first bandwidth messages are short messages of at most

140 ASCII characters. Second bandwidth messages are longer messages than first bandwidth messages, but shorter than third bandwidth messages. For example, a first bandwidth message may be a phone number or a command entered from a computer keyboard, a second bandwidth message may be a single page facsimile or a long data file, and a third bandwidth message may be multiple data files or a multiple page facsimile. Thus, first bandwidth messages have narrower bandwidths than second bandwidth messages which, in turn, have narrower bandwidths than third bandwidth messages. In the most general case, the communication system only utilizes first and second bandwidth messages.

The varying bandwidth messages generally originate from wireline or wireless communication system users, but may also be generated by the central processor. For example, in a wireline system, a message may originate from a telephone subscriber or a computer that is interconnected with the telephone network. Alternatively, in a wireless system, the message may originate from a communication unit or a peripheral device that is interconnected to a communication unit. Further, the central processor may generate its own message, such as a system maintenance schedule, for a particular communication unit.

Regardless of the origin of the message, the central processor selects the type of bandwidth message based on the message size and user preferences. Messages that are less then 140 bytes long are transmitted using the first bandwidth message type since they can be entirely delivered via a communication resource that is primarily used for transmitting first bandwidth messages. Messages containing more than 140 bytes are queued in the central processor's memory for delivery by either second or third bandwidth message types. The type of message bandwidth with which to transmit the long message is selected based on service criteria such as cost or time required to deliver the message.

When the message is of the first bandwidth message type, the central processor transmits the message to the operable communication unit, via a repeater, on a communication resource in a first set **202**. Communication resources in the first set are primarily used for transmitting short messages (under 140 characters) and may be either time slots or portions of time slots in a TDMA time frame or RF channels. Note that only one communication resource may comprise the first set. The central processor transmits received first bandwidth messages immediately since they have the narrowest bandwidth, cost the least to transceive, and insure maximum system efficiency. Upon transmitting the message, the central processor continues monitoring for other received messages.

When the message is either of the second bandwidth message type or the third bandwidth message type, the central processor prepares a first bandwidth notification message for the operable communication unit **203**. The first bandwidth notification message is a first bandwidth message that notifies the operable communication unit of the second or third bandwidth message resident for it in the central processor's memory. The first bandwidth notification message typically contains the originator of the message, a summary of the message, the date sent, the length of the message, priority, and cost to retrieve the entire message over the network. Upon preparing the first bandwidth notification message, the central processor transmits, or sends, the first bandwidth notification message to the operable communication unit, via

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