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[54] **SELECTIVE CALL MESSAGE FORMATTING**

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[73] Assignee: **Motorola, Inc.**, Schaumburg, Ill.

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[51] **Int. Cl.**[7] **G08B 5/22**; H04B 7/26

[52] **U.S. Cl.** **455/38.4**; 455/45; 340/825.44

[58] **Field of Search** 455/38.1, 38.4, 455/45, 566, 575; 340/825.44; 345/141, 143

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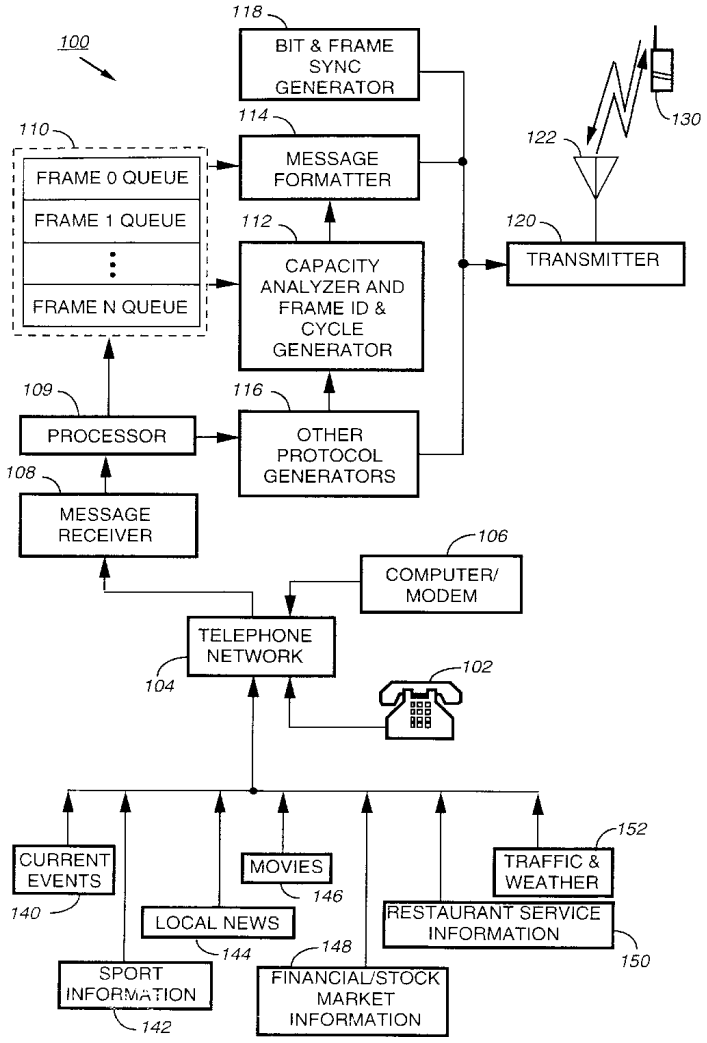
[57] **ABSTRACT**

A selective call device **(130)** having a receiver **(204)** that receives a selective call signal with an address **(312)**, a formatting message **(406)**, and a related message **(408)**. A processor **(214)** correlates a recovered address with a predetermined address in the selective call device **(130)** and determines selection of the selective call device **(130)**. A decoder **(212)** decodes the formatting message **(406)** and the related message **(408)** contained in the selective call signal in response to the processor **(214)** determining selection of the selective call device. An information display **(228)** presents at least a portion of the related message **(408)** in accordance with a format determined at least in part by the formatting message **(406)**.

14 Claims, 4 Drawing Sheets



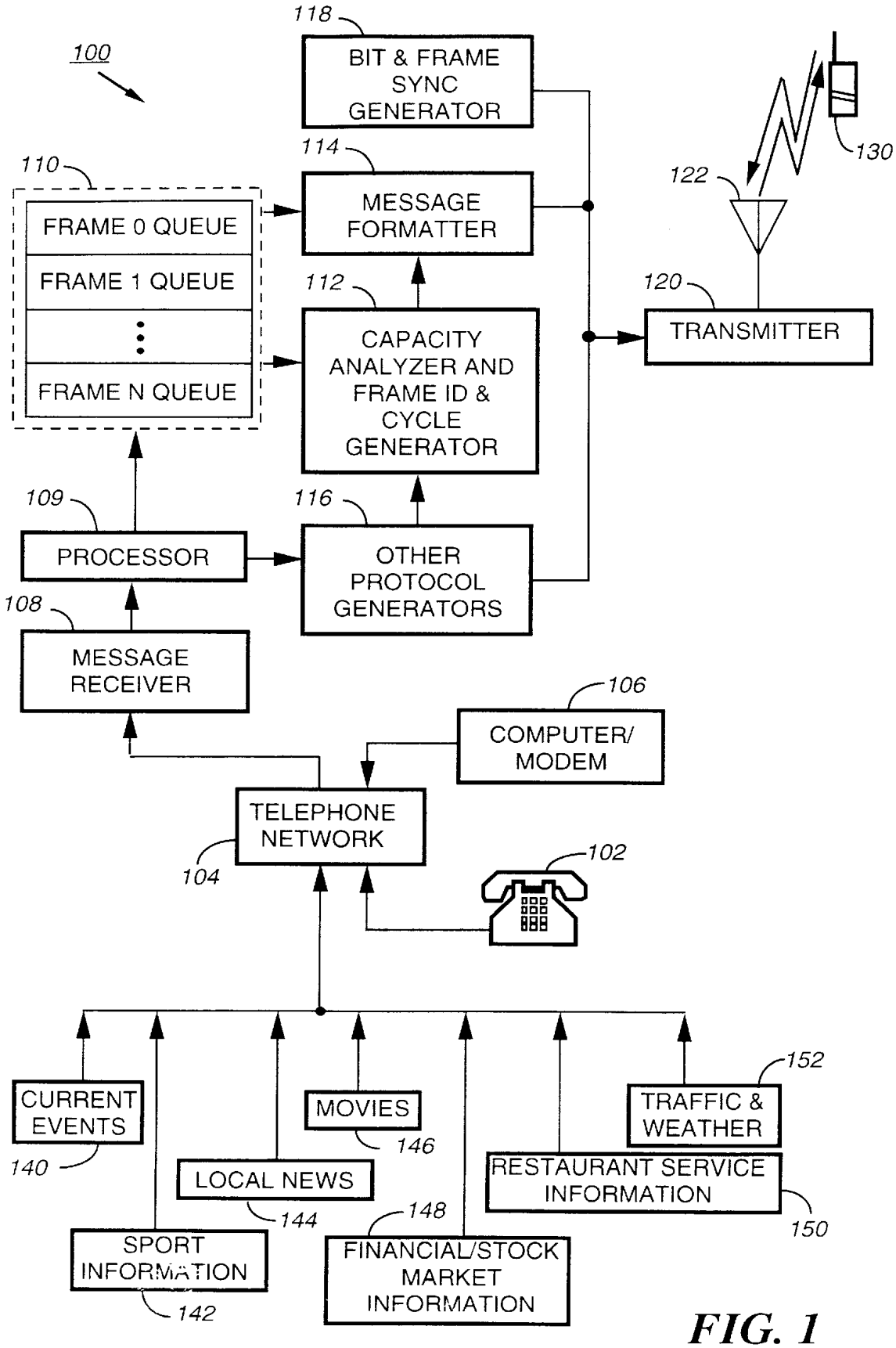

100
118
BIT & FRAME SYNC GENERATOR
114
MESSAGE FORMATTER
110
FRAME 0 QUEUE
FRAME 1 QUEUE
FRAME N QUEUE
112
CAPACITY ANALYZER AND FRAME ID & CYCLE GENERATOR
122
130
120
TRANSMITTER
109
PROCESSOR
116
OTHER PROTOCOL GENERATORS
108
MESSAGE RECEIVER
106
COMPUTER/ MODEM
TELEPHONE NETWORK
104
102
CURRENT EVENTS
140
MOVIES
146
LOCAL NEWS
144
SPORT INFORMATION
142
148
FINANCIAL/STOCK MARKET INFORMATION
152
TRAFFIC & WEATHER
RESTAURANT SERVICE INFORMATION
150

FIG. 1

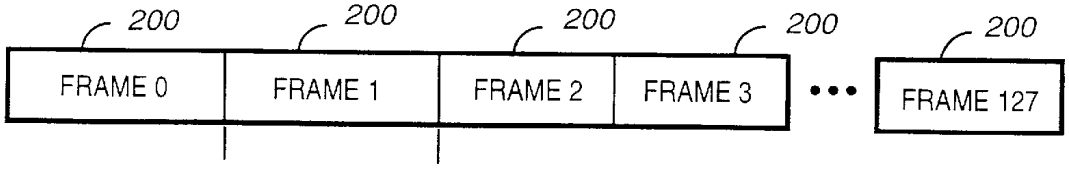


FIG. 2

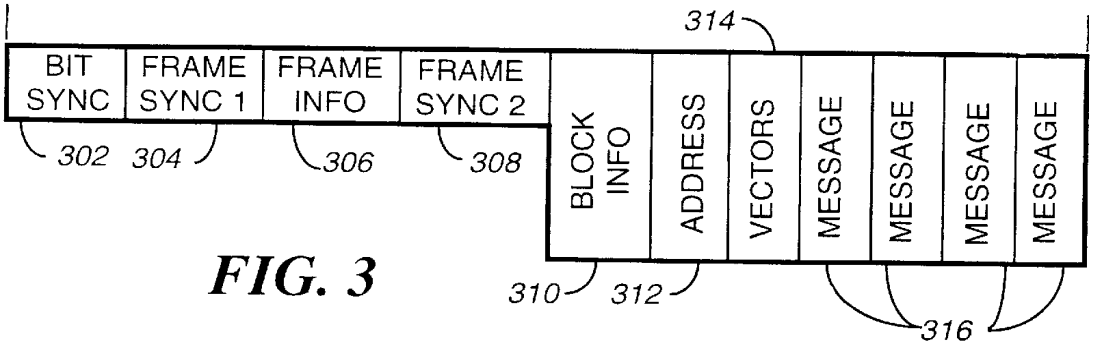


FIG. 3

316

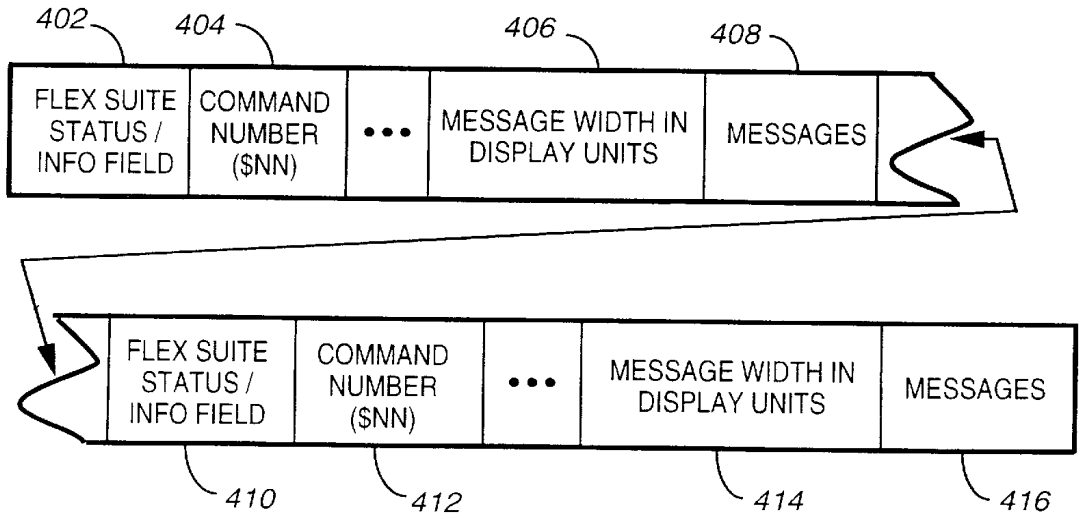


FIG. 4

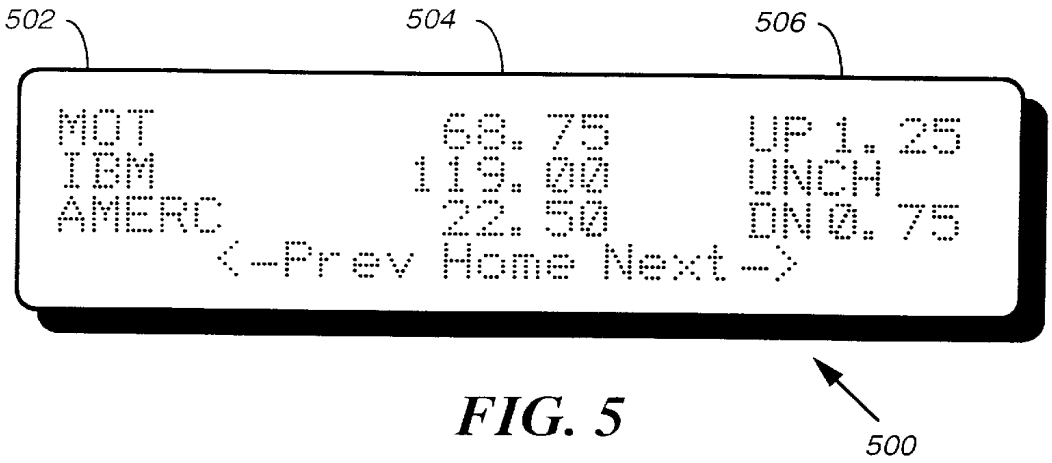


FIG. 5

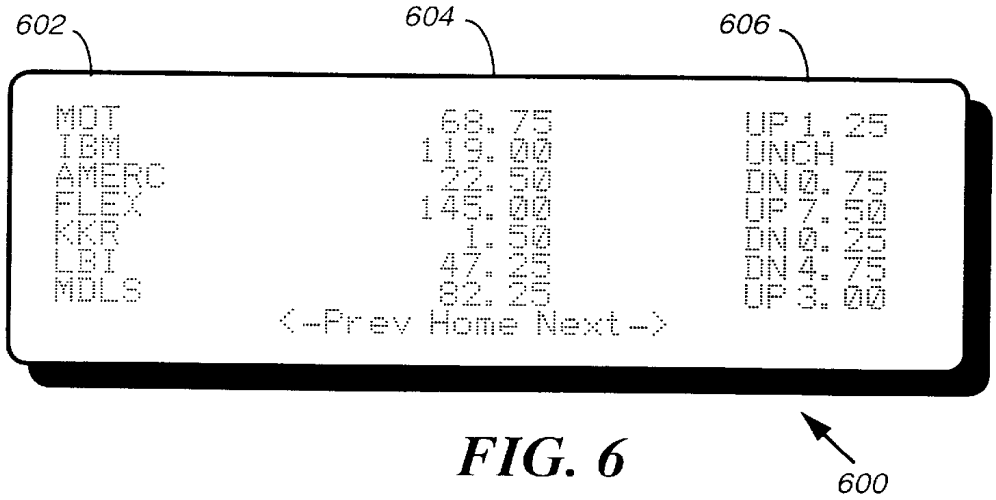


FIG. 6

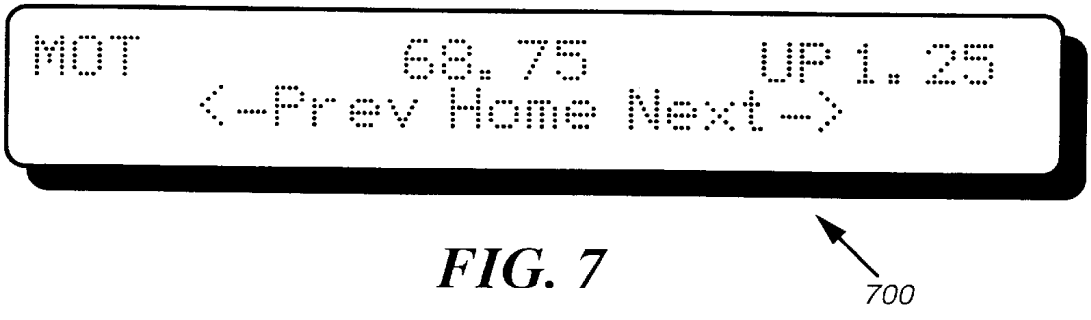


FIG. 7

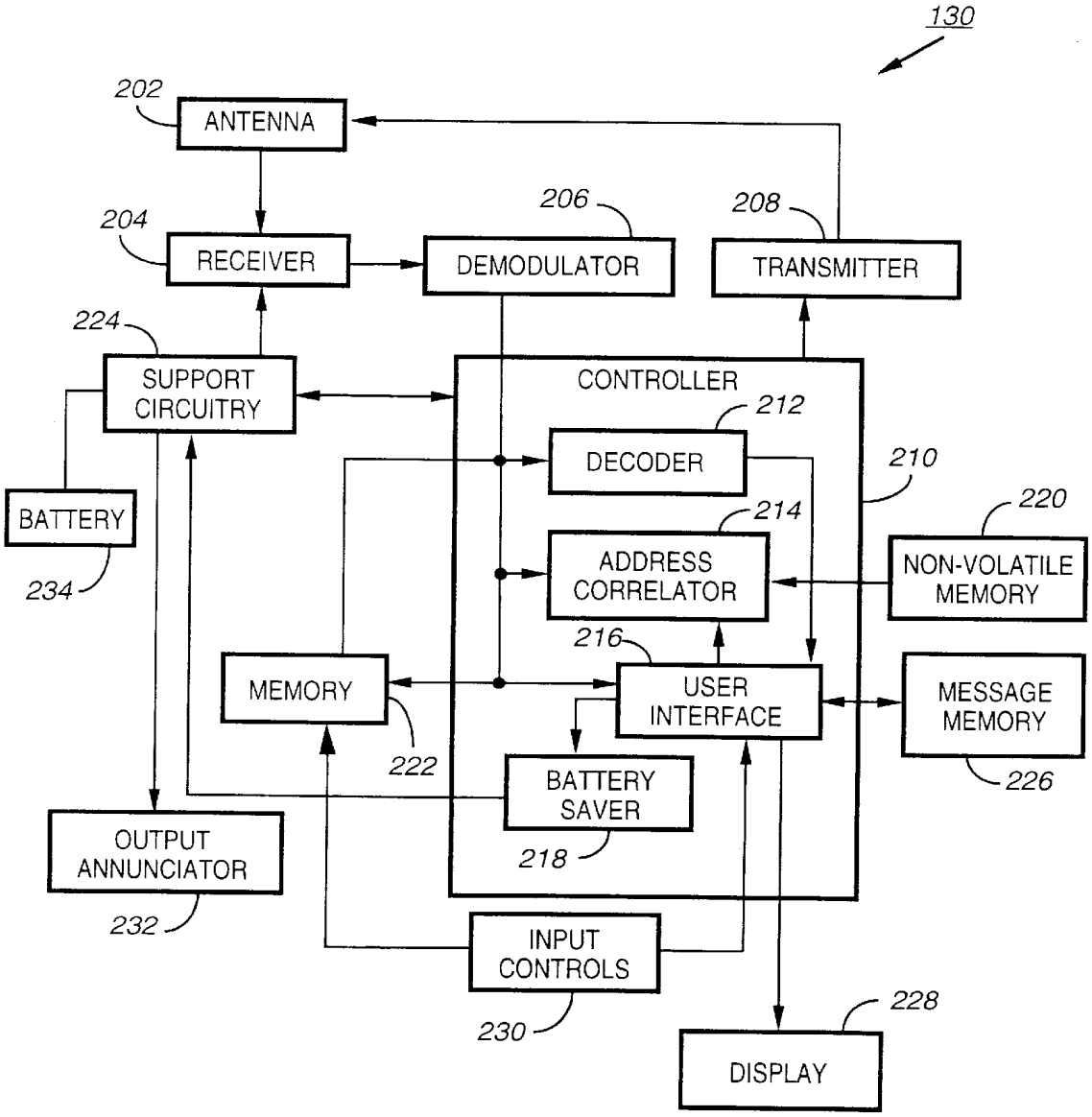

130
202
ANTENNA
204
RECEIVER
206
DEMODULATOR
208
TRANSMITTER
224
SUPPORT CIRCUITRY
CONTROLLER
212
DECODER
210
214
ADDRESS CORRELATOR
220
NON-VOLATILE MEMORY
BATTERY
234
216
MEMORY
222
USER INTERFACE
MESSAGE MEMORY
226
BATTERY SAVER
218
OUTPUT ANNUNCIATOR
232
INPUT CONTROLS
230
228
DISPLAY

FIG. 8

SELECTIVE CALL MESSAGE FORMATTING

FIELD OF THE INVENTION

This invention relates in general to wireless messaging and more particularly to consistently formatting messages received by a wireless messaging receiver.

BACKGROUND OF THE INVENTION

A conventional selective call device, e.g., a receiver and/or transmitter, often can receive messages from more than one sources. Sources are distinguished from each other typically by an address information associated with each message. When the address information correlates, or matches, a predetermined address in the selective call device, the selective call device receives and stores the message from a particular information source.

Modern selective call services or service providers are capable of sending multiple types of data including information services, for example, stock market, weather, sports, news or other information, periodically to a subscribing selective call device (receiver or transceiver). Before long, hundreds of information services are likely to be broadcast to selective call devices. Because service providers may pre-format the information into a specific format, e.g., either right of left justified or in aligned columns, a problem results if one selective call device presents this information differently from another due to differing display characteristics such as pixel density, the number of horizontal lines, or vertical lines.

Thus, what is needed is an apparatus that allows messages received from personal sources or information services to be received and presented in a consistent fashion across a number of selective call devices, allowing all users to view messages as intended by the information provider.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an electrical block diagram of a selective call system for providing information services in accordance with a preferred embodiment of the present invention.

FIGS. **2–4** are timing diagrams illustrating the transmission format of an interleaved information signaling protocol utilized by the selective call system of FIG. **1** in accordance with the preferred embodiment of the present invention.

FIG. **5** is a typical four line alphanumeric information display for use with the selective call device in accordance with the present invention.

FIG. **6** is a typical eight line alphanumeric information display for use with the selective call device in accordance with the present invention.

FIG. **7** is a typical two line alphanumeric information display for use with the selective call device in accordance with the present invention.

FIG. **8** is an electrical block diagram of a selective call device in accordance with the preferred embodiment of the present invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. **1** shows an electrical block diagram of a selective call system (or radio frequency communication system) for generating and transmitting (or broadcasting) a selective call signal (or communication signal) including either personal messages or a plurality of information services in accordance with a preferred embodiment of the present invention.

The functions of the selective call system **100** are preferably implemented within software, for example within a MODAX™ 500 Selective Call Terminal which is manufactured by Motorola Inc. Typically, a subscriber can send a message by using a telephone **102** to initiate a transmission of a selective call message. As is well known, the telephone **102** couples to the selective call system **100**, in particularly a base station or base site via a telephone network **104**, the operation of which is well known to one of ordinary skill in the art. Similarly, a computer/modem **106** is also coupled to the telephone network **104** to enter information, for example alphanumeric or numeric messages. The telephone network **104** couples to a message receiver **108** which receives the messages to be transmitted (broadcast) to at least one of a plurality of selective call devices **130** typically from the public switched telephone network **104**.

According to an alternate embodiment, a plurality of information services **140–152** are coupled to the telephone interface network which is coupled to a processor **109** via the message receiver **108**. Those skilled in the art will appreciate that the plurality of information service providers **140–152** can be received as radio frequency signal by an antenna.

When the base site processor (encoder) **109** receives information which is periodically transmitted as updates, the information is encoded as a message in the form of a selective call signal (or communication signal). Specifically, the processor **109**, coupled to the message receiver **108**, determines an appropriate protocol, preferably, the FLEX™ protocol, and address to encode the information service. If the processor **109** determines that the message is to be sent via another signal format, it is passed to one of another protocol generator **116** which can include other protocol generators well known to one of ordinary skill in the art. When the processor has determined that the information services and any messages are to be transmitted on the FLEX™ protocol, the information is encoded and stored in a frame queue buffer **110** which has queues (FRAME O–N QUEUES) for the corresponding frames of the signal, and in this example of the present invention, the corresponding number of frames N is 128. The predetermined frame identification (ID) of the selective call device **130** corresponding to the message is determined and the message is stored in the corresponding frame queue. A capacity analyzer and frame ID/cycle generator **112** determine the sequence of frame IDs to be transmitted and analyze the capacity of each frame to determine the cycle value to be used. The capacity analyzer **112** is also responsive to other protocols being transmitted. For example, if the expected occurrence of a frame is to be replaced by the transmission of one of the other protocols (thereby diminishing the capacity of the frame), the capacity analyzer **112** can account for this with the determined cycle value. A bit and frame sync generator **118** synchronously generates bit and frame synchronization signals. A message formatter **114** determines, in response to the address of selective call devices **130** and the frame queue, the frame which the information is to be included, and a respective message formatting width in display units. The messages are then formatted for transmission. A transmitter **120** accepts signals from blocks **118**, **114** and **116** and modulates and transmits radio frequency selective call signals to selective call devices **130** via antenna **122** in a manner well known to those of ordinary skill in the art.

Referring to FIGS. **2–4**, timing diagrams of a signaling protocol in accordance with the preferred protocol for selective call messages are shown according to FIG. **1**. Referring

to FIG. **2**, the selective call protocol is encoded, preferably according to the FLEX™ protocol, in a number of, preferably one-hundred-twenty-eight (128), message packets or frames **200**. Each frame **200** is preferably 1.875 seconds in duration and has a preferred base data rate of 6400 bits per second. Although, it will be appreciated that other data rates can be used including the ability to use multiple data rates.

Referring to FIG. **3**, each frame is comprised of a bit sync signal **302**, preferably 32 bits of alternating 1,0 patterns, followed by a FRAME SYNC #1 signal **304** preferably having a predetermined thirty-two bit words and its thirty-two bit inverse, and a FRAME INFO signal **306**, preferably one thirty-two bit word having twenty-one variable information bits containing information such as a cycle number and a frame number. The BIT SYNC signal **302** provides bit synchronization to the selective call device(s) **130** while the FRAME SYNC #1 signal **304** provides frame synchronization and includes a signal indicative of the data rate of the message information.

Following the FRAME INFO word **306** is a FRAME SYNC #2 **308**. Following the FRAME SYNC #2 **308** is a block info word signal **310** including information such as the number of priority addresses, end of block information field, and vector start field. The code word of each frames **200** is preferably encoded as 31,21 Bose-Chaudhuri-Hocquenghem (BCH) code words having twenty-one information bits and ten parity bits generated according to the well known BCH algorithm. An additional even parity bit extends the word to a 32,21 code word. The addresses are located in block **312** and the vectors pointing to the messages are located in block **314** and the messages are located in the remaining blocks **316**. Generally, all of the address signals within the frame are located in a first portion **312** and the information or message signals are located in a subsequent portion of the block **316**. It is well known to those skilled in the art how to locate addresses **312** in a first portion and message information **316** in a second portion of the frame **200**. Words **310–316** are shown in a vertical orientation to indicate that these words may be interleaved in order to improve the immunity of the transmission to burst errors. It is understood by one of ordinary skill in the art that interleaving may be modified or eliminated.

Referring to FIG. **4**, the message information words **316** are illustrated in more details according to the preferred embodiment of the present invention.

The timing diagram further explodes the block **316** containing the address, command, and information data. This message block contains an information/status field **402**, an optional command code **404**, a formatting message **406**, and a related message **408**. The formatting message **406**, and related message **408** may be repeated as shown in the secondary information/status field **410**, an optional command code **412**, a formatting message **414**, and a related message **416** to accommodate a number individual selective call messages or related messages corresponding with a specific topic or subtopic address, thus allowing a unique format for each message or information service subscribed. This permits a service provider to pre-format information at a processing location only once, and generate a corresponding formatting message **406**, **414** that is sent to selected subscribers. Since the selective call device uses the formatting message(s) **406** to re-format a received message **408** with respect to the display capability of the particular selective call device, all selective call devices can present the related message **408** in a manner that substantially resembles the format intended by the information service provider.

When used in conjunction with information services, the messages are encoded in message information words **316** for transmission to enabled selective call devices **130**. In particular, an FLEX™ suite status/information field **402**, **410** identifies the type of information, e.g., in this case, an information service, as opposed to individual numeric or alphanumeric selective call messages, is being transmitted. The status/information field **402**, **410** can also identify an application other than information services. Alternatively, the absence of the status/information field **402**, **410** can indicate that the information or message is a regular selective call message without formatting.

Following the status/information field **402**, **410** is a command number **404**, **410**. The command number **404**, **410** identifies (or describes) the function associated with the messages that will follow. In the case of an information service receiver, the command number describes how the topics of the information services are being transmitted. For example, the command number identifies whether the topics of the information services are transmitted according to one of two preferred methods, (1) a range of topics method designated, e.g., by a command number of "000", where the range of the information topics are included, e.g., as the first and last topics (or offset from the first topic to the last topic); or (2) an itemized topic method, designated by e.g., by a command number of "001", where each topic of a particular transmission is included.

Referring to FIG. **5**, the display **500** shown is a typical four line alphanumeric information display for use with the selective call device in accordance with the present invention. The display **500** shown is presenting at least a portion (four lines) of a related message **408** including stock market information. The actual message may be any number of lines, some of which are not immediately presented on the display **500**, but maintained in the memory **222**. Note that the ticker symbols **502**, e.g., MOT, IBM, AMERC, are left aligned, while the stock prices **504** are right aligned, and the trend indicators **506** are left aligned. If every display **500** had the same number of horizontal picture elements (pixels), and the characters or symbols were monospaced, then all messages could be presented in the same format on such displays without requiring the formatting message **406**. However, as is illustrated in FIG. **6**, a display **600** with a higher vertical and horizontal pixel density effectively maintains the relative spacing between the ticker symbols **602**, stock prices **604**, and the trend indicators **606**, to align the fields as shown in FIG. **6**.

By example, the display **500** is capable of presenting **26** alphanumeric characters in cells of 6×8 pixels, the character being formed in the inner 5×7 pixels. The density of the display **500** is approximately 20 pixels/cm, or 156 horizontal pixels by 32 vertical pixels. Thus, if a formatting message **406** specifies a screen size of 150 display units (e.g., pixels in this example) for the related message **408**, using default values of 6 pixels for alphanumeric characters; 16 pixels for ideographic characters, a character or symbol representing an idea or a thing without expressing the pronunciation of a particular word or words for it, as in a traffic sign, Chinese, or Japanese graphic symbols; and 8 pixels for an ideo-alpha character cell, one can calculate the number of displayable characters per line as follows:

$$DC=\text{INT}(\text{Screen size} / \text{default character width}) \quad [1]$$

Using the preceding values, the number of display characters (DC) are 25 alphanumeric characters, 9 ideographic characters, and 18 ideo-alpha characters. Note that equation

[1] never yields a non-integer result, thus only full character cells are presented. If the screen size in display units read from the formatting message **406** exceeds the actual number of horizontal display units or pixels available on the information display, the value DC will default to the screen size.

Referring to FIG. **6**, this display **600** is approximately 40% denser than the display shown in FIG. **5**. Thus, the related message is "expanded" or scaled to fit in an area approximately the same as that shown in the display **500** shown in FIG. **5**. Scaling is performed by the selective messaging device in response to the number of display units recovered from the formatting message **406**. Accordingly, the related message **406** is presented in a fashion that display unit for display unit, substantially resembles a mode of presentation intended by the service provider.

The basic intent of the format feature as implemented using the formatting message **408** and the intrinsic capability of the display device in the selective call device comprises maintaining relative vertical alignment between proximate horizontally arranged display rows. The procedure, as discussed by example in the preceding text, operates to project the related message into a virtual display space corresponding with an actual horizontal display unit density of the information display associated with the selective call device. In doing so, the intended vertical alignment between proximate horizontally arranged display rows is preserved. This is evident when comparing the displays shown in FIG. **5**, **6**, and **7**, as the columns are substantially in vertical alignment for different display sizes and horizontal densities. Finally, as described by equation [1], the projection is achieved by dividing a display unit density contained in the formatting message **408** by the actual horizontal display unit density of the information display associated with the selective call device, e.g., the default values of 6 pixels for alphanumeric characters, 16 pixels for ideographic characters, and 8 pixels for the ideo-alpha character cell. In this way, the information is normalized for correct presentation on any display device, and occupies the maximum viewable area, thus fully utilizing the capability of a particular display device.

FIG. **7** is a typical two line alphanumeric information display **700** for use with the selective call device in accordance with the present invention. This figure illustrates the fact that the present invention is backward compatible with conventional information service systems. In FIG. **9**, the displayed message has been conventionally formatted for reception by a selective call device enabled with the present invention. The related message **408** was formatted by the service provider at 24 alphanumeric characters in width, and the two line display **700** has a horizontal pixel density of 144 pixels. The selective call system then generates a formatting message **406** which specifies a screen size of 144 pixels, the lowest common horizontal screen size of conventional selective call devices that don't support the present invention. Accordingly, the enabled devices, which displays are shown in FIGS. **5**, **6** and **7**, will present information in exactly the same format as non-enabled conventional selective call devices. However, when using the instant invention, the enabled devices realize a significant advantage over the conventional devices since the service provider need not reformat messages specially for each selective call device based on the horizontal display capability of the device(s).

FIG. **8** shows an electrical block diagram of a selective call device according to the preferred embodiment of the present invention. The selective call device (e.g., transceiver or receiver) **130** is powered by a battery **234** and operates to receive and to transmit radio frequency signals via an antenna **202**. A receiver **204** is coupled to the antenna **202** to receive the radio frequency signals. A demodulator **206** is coupled to the receiver **204** to recover any information signal present in the radio frequency signals using conventional techniques. The recovered information signal from the demodulator **206** is coupled to a controller **210** that decodes the recovered information in a manner well known to those skilled in the art.

In the preferred embodiment, the controller **210** comprises a microcomputer, such as a Motorola, Inc. manufactured microcomputer, e.g., 68HC11K4 or MC68HC11PH8, and has or comprises a signal processor performing the functions of a decoder which is normally implemented in both hardware and software. The signal processor comprises an address correlator **214** and a decoder **212**, using methods and techniques known to those skilled in the art. The address correlator **214** checks the recovered information signal from the output of the demodulator **206** for address information and correlates a recovered address with one of a plurality of predetermined addresses that are stored in the selective call device's non-volatile memory **220**. After the address correlator **214** determines that the received signal is directed to the selective call device **130**, e.g., by correlating the address in the received signal to one of the predetermined addresses in the memory **220**, the decoder **212** decodes the signal for the status/information field **402** to determine if the message contains individual selective call messages or information services data. Absence of the status/information field **402** (FIG. **4**) typically indicates that the message being decoded is an individual selective call message. However, in the instant invention, the content of the status/information field **402** may signal a following format message or information that is formatted relative to a previously received and stored format message. The status/information field **402**, the command number **404**, the format message, related information service topic addresses, and information addresses are preferably stored in the memory **222**.

When the user of the selective call device **130** has subscribed to at least one information service, the memory **222** is programmed, e.g., via over-the-air techniques or other appropriate methods of programming, with the information service addresses and associated topic addresses (or sub-addresses) and the associated topic addresses (or topic sub-addresses). The topic sub-addresses are associated with information services. Therefore, each information service has a unique topic address that allows the selective call device **130** to determine when the information service is present within a particular transmission or message. The topic address can be a short form of the information service sub-address or can be unique and different from the information sub-addresses while still being able to identify the presence of the information service within a particular transmission.

Status information are also stored in memory **222**, for example, memory **222** is a non-volatile memory or electrically erasable memory indicating the information relating to the information service that the selective call device **130** is programmed to receive. Subsequent to the decoder decoding the presence of the status/information field **402**, the decoder decodes the command number **404**, and the format message **406** (if indicated), the topic addresses (if indicated) and the information service addresses (if indicated) and the message information in block **408**.

After receiving, decoding, and storing an individual selective call message or a selected information service in a memory **226**, the selective call device **130** typically presents at least a portion of the stored message to a user, such as by a display **228**, e.g., a liquid crystal display. Additionally,

along with receiving, decoding, and storing the information, an alert is presented to the user via an output annunciator **232**. The alert can include an audible alert, a visual alert, a vibratory or silent alert, or a combination of the aforementioned alerts, using known methods and techniques.

The support circuit **224** preferably comprises a conventional signal multiplexing integrated circuit, a voltage regulator and control mechanism, a current regulator and control mechanism, audio power amplifier circuitry, control interface circuitry, and display illumination circuitry. These elements are arranged to provide support for the functions of the selective call device **130** as requested by a user.

Additionally, the controller **210** determines from the enabled or disabled status information in the memory **222** whether to conserve power upon detection of an address information. That is, when a received and recovered address information correlates with a predetermined address in the non-volatile memory **220**, the controller **210** checks the status information corresponding to the correlated predetermined address information to determine whether that address is enabled. If the controller **210** determines that the correlated predetermined address is not enabled then the decoder **212** is not invoked. Further, the controller **210** instructs the battery saver **218** to begin conserving the power of the selective call device **130**. The battery saver **218** signals the support circuit **224** to enter a low power mode (battery save mode). A number of power consuming circuits may be directed to a low power or standby mode of operation. Additionally, the signal from the battery saver **218** signals, or strobes, the receiver circuitry **204** to a low power mode to conserve power.

In this way, when a correlated address is not enabled, as indicated by the associated status information, the selective call device **130** conserves power immediately, while not decoding an associated message and also not storing the message in message memory **226**. Of course, the battery saver **218** will re-enable the receiver and other circuits at some later time. Methods of power conservation strobing in selective call devices are known to those skilled in the art. Further, the controller **210** inhibits any alerts to the user via the output annunciator **232**. By not alerting again, power conservation is maximized. The status information, corresponding to each predetermined address information stored in the memory **222**, allow the controller **210** to disable functions in the selective call device **130**, and to conserve power when a correlated address is disabled, e.g., when no information service is selected for the address port. Input controls **230** are coupled to the memory **222** and the user interface **216** for receiving user inputs, including but not limited to programming, manipulating data and sending commands to the selective call device **130**.

In summary, the encoder generates the selective call signal comprising the address corresponding with the selective call device, the formatting message, and the related message. A transmitter then broadcasts the selective call signal to at least one of a plurality of selective call devices subscribing to an information service provider.

The selective call device uses a receiver to receive the selective call signal. The processor correlates the recovered address with the predetermined address stored in the selective call device, and determines selection of the device. The decoder operates to decode the formatting message and the related message contained in the selective call signal in response to the processor determining selection of the selective call device. Finally, the information display presents at least a portion of the related message in accordance with a format determined at least in part by the formatting message.

What is claimed is:

1. A selective call device, comprising:

a receiver for receiving a selective call signal comprising an address, a formatting message, and a related message;

a processor for correlating a recovered with a predetermined address in the selective call device to determine selection of the selective call device;

a decoder that decodes the formatting message and the related message contained in the selective call signal in response to the processor determining selection of the selective call device; and

an information display that presents at least a portion of the related message in accordance with a format determined at least in part by the formatting message, wherein the formatting message comprises a horizontal screen size in display units and wherein the format further comprises projecting related message into a virtual display space corresponding with an actual horizontal display unit density of the information display associated with the selective call device by dividing a display density contained in the formatting message by the actual horizontal display unit density of the information display accociated with the selective call device, thus preserving an intended vertical alignment between proximate horizontally arranged display rows.

2. The selective call device according to claim **1** wherein the formatting message is retained in a memory, and subsequent received related messages are presented in accordance with the format determined at least in part by the formatting message.

3. The selective call device according to claim **1** wherein the related message contained in the selective call signal comprises information that represents textual information.

4. The selective call device according to claim **1** wherein the related message contained in the selective call signal comprises information that represents alphanumeric information.

5. The selective call device according to claim **1** wherein the related message contained in the selective call signal comprises information that represents numeric information.

6. The selective call device according to claim **1** wherein the related message contained in the selective call signal comprises information that represents ideographic information.

7. The selective call device according to claim **1** wherein the format comprises maintaining relative vertical alignment between proximate horizontally arranged display rows.

8. A selective call system comprising:

a base site processor comprising:

an encoder that generates a selective call signal comprising an address corresponding with a selective call device, a formatting message, and a related message;

a transmitter that broadcasts the selective call signal to a plurality of selective call devices subscribing to an information service provider; and

a selective call device comprising:

a receiver for receiving the selective call signal;

a processor for correlating a recovered address with a predetermined address in the selective call device to determine selection of the selective call device;

a decoder that decodes the formatting message and the related message contained in the selective call signal in response to the processor determining selection of the selective call device; and

an information display that presents at least a portion of the related message in accordance with a format

determined at least in part by the formatting message, wherein the formatting message comprises a horizontal screen size in display units and wherein the format further comprises projecting related message into a virtual display space corresponding with an actual horizontal display unit density of the information display associated with the selective call device by dividing a display density contained in the formatting message by the actual horizontal display unit density of the information display associated with the selective call device, thus preserving an intended vertical alignment between proximate horizontally arranged display rows.

9. The selective call system according to claim **8** wherein the formatting message is retained in a memory in the selective call device, and subsequent received related messages are presented in accordance with the format determined at least in part by the formatting message.

10. The selective call system according to claim **8** wherein the related message contained in the selective call signal comprises information that represents textual information.

11. The selective call system according to claim **8** wherein the related message contained in the selective call signal comprises information that represents alphanumeric information.

12. The selective call system according to claim **8** wherein the related message contained in the selective call signal comprises information that represents numeric information.

13. The selective call system according to claim **8** wherein the related message contained in the selective call signal comprises information that represents ideographic information.

14. The selective call system according to claim **8** wherein the format comprises maintaining relative vertical alignment between proximate horizontally arranged display rows.

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