

DESCRIPTION

METHOD OF, AND SYSTEM FOR, TRANSMITTING MESSAGES

5 Technical Field

The present invention relates to a method of, and system for, transmitting messages and also to a primary station and a secondary station for use in the system. An example of such a system is an answer back paging system and for convenience reference will be made to an answer back paging
10 system but it is to be understood that the teachings of the present invention can be applied to other 2-way messaging systems.

Background Art

Answer back paging systems have been disclosed for example in
15 WO96/14716. In an elementary form such a system requires a paging network controller (PNC) to arrange for a message to be transmitted to a predetermined addressee. The addressee on receiving a call is able to transmit a simple reply by way of a low power transmitter incorporated into the pager. The above mentioned Patent Specification discloses a system in which a series of
20 messages are transmitted to respective addressees and the PNC then transmits invitations for the addressees to transmit their replies substantially simultaneously as pseudo random data sequences which are de-spread at the PNC and the replies forwarded to the respective party requiring the reply. In order to avoid having to apply power control techniques in the pagers to ensure
25 that replies are received by the PNC at comparable power levels, the PNC transmits its invitations at stepwise increasing (or decreasing) power levels and only those pagers just able to receive a respective one of the invitations transmit their replies. A feature of this known method is that relatively strict control of the received power is necessary.

30 PCT Patent Application IB97/00492 discloses a variant of the above mentioned method which for convenience of description will be referred to as

progressive elimination. In this technique the PNC transmits a series of messages on a downlink to individually addressed pagers. The PNC then transmits a control signal on the down-link inviting those pagers wishing to make an up-link transmission, for example a reply to a message, request for
5 service or a registration request, to transmit them substantially simultaneously as pseudo-random data sequences. The PNC analyses those of the up-link transmissions which are intelligible and then repeats the invitation which includes acknowledgements of those up-link transmissions that have been analysed successfully, consequently only those pagers who had responded the
10 first time but had not received an acknowledgement need retry.

There are situations in which a subscriber wishes to make either an up-link transmission in a system which is not operating an invitation to reply protocol or a second or subsequent up-link transmission following a first up-link transmission responding to an invitation to reply.

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Disclosure of Invention

An object of the present invention is to introduce more flexibility into the operation of answer back messaging systems.

According to one aspect of the present invention there is provided a
20 method of operating a message transmission system comprising at least one primary station for transmitting signals on a down-link and at least one secondary station for making transmissions on an up-link, characterised in that the at least one secondary station derives a time reference from a signal transmitted on the down-link and times its up-link transmission to begin at a
25 multiple of a unit of time referred to said time reference.

According to a second aspect of the present invention there is provided a message transmission system comprising at least one primary station having means for transmitting signals on a down-link and at least one secondary station having means for making transmissions on an up-link, characterised in
30 that the at least one secondary station has means for deriving a time reference from a signal transmitted on the down-link and for timing its up-link

transmission to begin at a multiple of a unit of time referred to said derived time reference.

According to a third aspect of the present invention there is provided a secondary station for use in a message transmission system in which at least one primary station transmits signals on a down-link to addressed secondary stations, each of said secondary stations having means for making transmissions on an up-link, characterised in that each of said secondary stations has means for deriving a time reference from a signal transmitted on the down-link and for timing its up-link transmission to begin at a multiple of a unit of time referred to said derived time reference.

According to a fourth aspect of the present invention there is provided an answer-back paging system having a primary station for transmitting down-link messages, at least one of which requires two successive up-link responses, to a plurality of secondary stations, characterised in that at least one of said secondary stations utilises the transmission of a first of said two responses as a time reference for the transmission of the second of said two responses.

Brief Description of Drawings

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

Figure 1 is a block schematic diagram of a message transmission system,

Figure 2 is a diagram showing the transmission of invitation signals, reception of CDMA responses and the analyses of the responses

Figure 3 is a diagram showing the interlaced operation of a pseudo random data sequence response type of system,

Figures 4A and 4B illustrate how acknowledgements are combined with an invitation signal transmitted on the down-link,

Figure 5 is a block schematic diagram of the PNC 10,

Figure 6 is a flow chart showing the sequence of operations,

Figure 7 is a block schematic diagram of a pager,

Figure 8 illustrates a sequence timing rule for use with a system issuing invitations for reply,

Figure 9 illustrates a chip - timing sequence; and

Figure 10 illustrates multiple response sequence timing rules.

5 In the drawings the same reference numerals have been used to indicate corresponding features.

Modes for Carrying Out the Invention

Referring to Figure 1, the message transmission system comprises a
10 paging network controller (PNC) 10 having a message entry port 12 which receives pager addresses and associated messages from an operator equipped with a personal computer (PC) or directly from a subscriber having a PC and a modem. The PNC 10, which comprises directories containing information such as pager radio identity codes (RICs), areas to be paged, frequencies,
15 pager types, prevailing protocols, for example POCSAG (or CCIR Radiopaging Code No 1) and ERMES, and status of the pagers, assembles the messages and their associated RICs together with other relevant information into data packets which are forwarded to a paging area controller (PAC) 14 which formats the RICs and associated messages into a format which can be
20 transmitted by base station transmitters (or transmitter section of a base station transceiver) 16 to two-way pagers 18,20 respectively, by way of a down-link.

If a two-way pager 20 identifies that a message is being transmitted having its RIC, it receives the message and decodes it. If the user wishes to send a brief response then, by means of an integral key pad, he selects a pre-
25 stored response and when invited by the PAC 14 it transmits its response by way of an up-link. The response signals may be sent simultaneously as pseudo-random data sequences (PRDS).

One or more receivers (or receiver sections of a transceiver) 22 are provided for receiving the responses and for relaying them to the PAC 14 in
30 which they are decoded and sent as data packets to the PNC 10. The PNC 10 comprises means for analysing the signals and for matching the responses with

the messages transmitted on the down-link.

Those responses which are matched are relayed to the respective users in any suitable form, for example by e-mail or by transmission as one-way paging messages. Alternatively the responses are sent to a message answering service operated by the paging network. In either case an
5 acknowledgement is sent to the respective 2-way pager 20. However, not all the responses are matched because for example strong responses smother the weak responses as a result of the near-far effect. If the PNC 10 determines that only a small proportion of the messages transmitted on the down-link have
10 received responses then it issues a general invitation to those pagers which have not responded to the messages or have not received an acknowledgement, to transmit or re-transmit their responses on the up-link. The newly received responses are analysed, matched where possible and acknowledgements are transmitted. If it is determined that the total number of
15 successful responses is still below a statistically determined threshold level, the cycle is repeated by transmitting another invitation signal on the down-link. The process is repeated until either a predetermined number of cycles have elapsed or the threshold level has been exceeded and it is evident that no more intelligible responses to the batch of messages are recoverable.

20 In the case of substantially simultaneously transmitted PRDS response signals, each time a batch of response signals is received, those response signals which are analysed successfully will generally have the greatest power levels at the antenna of the receiver 22. Thus as they will be eliminated from the pool of response signals, then when the next invitation signal is transmitted,
25 signals from weaker sources, that is, the more distant pagers, will be decoded and matched. This sequence of operations is referred to herein as Progressive Elimination.

Figure 2 illustrates an example of a system in which responses comprise PRDS signals which are transmitted simultaneously in response to an invitation
30 signal on the down-link. In Figure 2 messages (not shown) already have been transmitted on the down-link. A first invitation INV1 is transmitted on the down-

link. The pagers which have detected a message addressed to them respond to the invitation signal INV1 by transmitting a code sequence within a defined time slot RES1. A search routine SCH is initiated following expiry of the time slot. In the search routine, codes stored in the PNC 10 (Figure 1) are successively compared with the response data sequences and one by one the responses to particular ones of the messages are identified. However, due to the near/far problem only the strongest of the response signals are detected and these are eliminated from the next search by acknowledgement signals being transmitted on a down-link to inform those pagers which have been successful not to respond to the subsequent invitation signals INV2 and INV3 in the sequence.

It is anticipated that in a practical system the majority of the pagers 18, 20 (Figure 1) will be some distance from the antenna(s) of the receiver(s) 22 which means that they will have a low power at the antenna. Accordingly, although the durations of the time slots RES1, RES2 and RES3 may be equal, as shown, it is preferable that variable slot lengths be allocated according to the anticipated number of responses, for example a low number of relatively high powered responses and a high number of relatively low powered responses. Short slots are allocated initially so that the few, strong powers contending against low noise and interference can be eliminated efficiently. Longer slots are then allocated to accommodate the weak received powers contending against significant levels of noise and interference.

If desired the pagers 18, 20 may have power control on their transmitters in order to vary the strength of their response signals and in so doing reduce the number of invitation/response cycles.

In a refinement of the embodiment described with reference to Figure 2, Figure 3 shows dividing the population of the pagers into two groups and interleaving the transmission of messages and invitations for one group Gp1 on the down-link with analysing the responses on the up-link from the other group Gp2.

One method of dividing the pager population is to assign the odd

numbered pagers to one group, say Gp1, and the even numbered pagers to a second group, say Gp2. An alternative method is for the pagers to measure the strength (RSSI) of the received down-link signal and by using a pre-set threshold determine to which one of say two groups they belong.

5 One method of issuing an invitation message whilst simultaneously informing those pagers whose responses have been analysed successfully is to send the messages M1 to M14 in an ordered sequence as shown in Figure 4A and in the invitation signal, Figure 4B, providing a field FD with a corresponding number of time slots on a 1 to 1 basis, thus slot 3 corresponds
10 to message M3. When the first invitation signal INV1 is transmitted, say all the bits in the field FD are zero indicating that no responses have been received. However, after the first round of analyses, acknowledgements are transmitted to say the pagers to which the messages M1, M3, M4, M9, M11 and M13 were addressed by changing the bits in slots 1, 3, 4, 9, 11 and 13 of the field FD
15 from "0" to "1". Further bits are changed as more of the messages are acknowledged.

 The number of cycles in which invitations are transmitted may be fixed. However, if it is determined that the number of successfully decoded responses exceeds a statistically determined threshold value, then further iterations are
20 stopped.

 Figure 5 shows in block schematic form a PNC 10 coupled to a PAC 14 and a base station transmitter 16 and a receiver 22. The entry port 12 is coupled to a microcontroller 24 to which are connected directories 26 to 36 relating respectively to RICs, paging areas, frequencies, pager types, prevailing
25 protocols and status. A message store 38 is coupled to the microcontroller 24 for storing messages as they are received at the entry port 12. The store 38 has an area 40 for storing indications confirming that a response to a respective message has been received and acknowledged. An output 42 from the microcontroller 24 is coupled to the PAC 14 to supply data packets to be
30 formatted prior to being transmitted by the transmitter 16.

 Responses received by the receiver 22 are relayed to a signal analyser

44 by way of the PAC 14. As each response is analysed successfully, it is forwarded to the microcontroller 24 for matching with the messages in the store 38. Once matched, the microcontroller arranges for an acknowledgement to be transmitted when sending the next invitation signal on the down-link. At the appropriate moment the recipients of the responses are informed, for example by e-mail or a one-way paging message, or the responses are stored together with the respective pager number so that a subscriber can interrogate the store at his or her convenience. Once the microcontroller 24 has decided that for all practical purposes all the responses have been received, it erases the messages in message store 38 in readiness for receiving more messages by way of the entry port 12. More conveniently the store 38 can comprise two halves with one half handling the acknowledgements of the messages already sent on the down-link and the other half storing messages to be sent.

Figure 6 is a flow chart showing the sequence of operations involved in transmitting messages, receiving responses and acknowledging responses. Block 50 represents start. Block 52 relates to the transmission of a sequence of messages and this is followed in block 54 by the transmission of an invitation signal. Block 56 relates to the reception of the PRDS responses which are then analysed and matched with their respective messages, block 58. Block 60 relates to the transmission of the acknowledgements. In block 62 a check is made to see if the number of successful responses exceeds a threshold value indicating that as many as possible responses have been received. If the answer is No(N) the flow chart proceeds to block 64 in which a check is made to see if the predetermined maximum number of invitations has been exceeded. If the answer is No(N) the flow chart reverts to the block 54. A Yes(Y) answer from the blocks 62 and 64 causes the flow chart to revert to the block 52 and the cycle is repeated.

Referring to Figure 7, the pager 20 comprises a receiver 68 connected to a decoder 70 which in turn is coupled to a control processor 72. The processor 72 operates in accordance with a program stored in a read-only memory 74. The processor also includes an address store (not shown) which

contains the unique addresses of that pager. In the event of the pager receiving a message then this is stored in a random access memory 76. The messages can be displayed subsequently on a LCD panel 80 which has its associated driver 78 coupled to the control processor 72. A clock 77 is coupled to the processor 72 and provides various timing functions associated with the operation of the pager 20. Annunciating devices which may comprise an acoustic transducer 82, a light emitting transducer 84 and a vibrator 86 are coupled to the control processor 72. A keypad 88 provides a man machine interface whereby a user can instruct the processor to carry out various functions, for example to display a stored message on the panel 80. A transmitter 90 is coupled to an output of the processor 72 and to an antenna 92. A receiver power control stage 94 is coupled between the processor 72 and the receiver 68 in order to practice battery power conservation in accordance with the provisions of the paging protocol being followed. In the event of the pager sending response signals as PRDS signals then the control processor 72 comprises means for determining the sequence to be transmitted having regard the identity of the pager and/or information in the original down-link message. The PRDS is then relayed to the transmitter 90 for onward transmission. If as an option power control is to be applied to the transmitter 90 then a power control signal is supplied by the processor 72 through a control line 96.

Further the signals transmitted on the up-link may also comprise requests for services, such as registration, and accordingly the present invention is equally applicable to processing such requests for services in the same way as a response with the exception there will be no match with an outgoing message.

Two - way messaging allows an originator of a down -link message to be informed automatically for example not only that a message has been received but also that the pager user has displayed the message which has been stored in the RAM 76. Further by means of the keypad 88, a reply to the down - link message can be sent as an up-link transmission. Since some of

these operations will take place subsequent to the original response to an invitation signal then it is necessary for the paging network controller 10 to associate the subsequent up-link transmissions with the original down - link message.

5 Referring to Figures 8, 9 and 10, when an up - link transmission is required, a sequence generator in the control processor 72 (Figure 7) is clocked to generate a PRDS which is indicative of the response or message being sent, for example a registration message, message received, message displayed or an answer to a down - link message. In the presently described
10 embodiment the point in time where clocking is required to start shall be in accordance with the following rules:

(a) Pagers only respond after the receipt of an invitation message. Such messages contain special characters which identify the message as an invitation message; and

15 (b) the up - link PRDS transmission shall start at a predetermined time relative to the end of the batch in which the invitation signal was transmitted, for example at the beginning of the second synchronisation code word S following the end, or completion, of the invitation message INV, or when it is due if it is not actually transmitted this instant being determined by the clock 77.

20 Three examples A, B and C are shown in Figure 8. In example, A, the invitation message INV straddles a synchronisation code word SO. The pager 20 waits until the beginning of the second synchronisation code word S2 and then transmits the appropriate PRDS.

25 In the examples B and C of Figure 8, the invitation message INV occurs in the middle of a batch B and towards the end of a batch B, respectively. In each example the PRDS is transmitted at the occurrence of the second synchronisation code word S2.

30 Figure 9 illustrates in greater detail the generation of the first chip C1 of the PRDS relative the occurrence of the first bit of the second synchronisation code word S2. A typical chip rate for the PRDS is 5625 chips per second.

It should be noted that the data and synchronisation code words

following an invitation message need not be broadcast by the paging system, such as when the transmitters power down due to time sharing, low traffic, or when the same frequency is being used for both the down - link and up - link. In such cases the transmitters 16 (Figure 1) remain powered down until pager
5 transmission ceases. As mentioned above, the clock 77 (Figure 7) synchronises the pager 20 with the invitation message and is able following the detection of the first synchronisation code word S1 to determine when S2 should start.

Figure 10 illustrates the situation when the message invitation INV
10 permits a pager to transmit additional responses, for example down - link message displayed or an answer is to be sent to a displayed down - link message, without requiring additional invitations. In order for the PNC to associate these additional responses with the original down - link message, the generation of the PRDS associated with a pager commences at an instant
15 which is an exact multiple, for example integer multiple, of a predetermined unit time interval, for example 60 seconds, from the start of the transmission of the first response or PRDS which as stated above coincides with the start of the second synchronisation code word S2. Figure 10 illustrates an example of a batch structure having 15 seconds for each batch and the first PRDS, PRDS
20 1, commencing with the start of S2. Exactly 4 batch periods or 60 seconds later a second PRDS, PRDS2, is transmitted without being preceded by an invitation message. A third PRDS, PRDS 3, is transmitted exactly 4 batch periods later.

The present invention may be adapted to operate with a system not
25 having invitation messages. In such a system, the start of the second synchronisation code word following the end of a batch of down - link messages can be used for sending the first responses on the up - link and any subsequent responses can be transmitted an integer multiple of the batch period later.

30 From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other

features which are already known in the design, manufacture and use of message transmission systems or component parts thereof and which may be used instead of or in addition to features already described herein.

5 **Industrial Applicability**

Two-way message transmission systems such as answer back paging systems.



CLAIMS

1. A method of operating a message transmission system comprising at least one primary station for transmitting signals on a down-link and at least one secondary station for making transmissions on an up-link, characterised in that the at least one secondary station derives a time reference from a signal transmitted on the down-link and times its up-link transmission to begin at a multiple of a unit of time referred to said time reference.
2. A method as claimed in Claim 1, characterised in that the primary station transmits a series of point-to-point messages on the down-link followed by an invitation message inviting addressees of said point-to-point messages to make transmissions on said up-link, in that said transmissions are pseudo random data sequences commencing at a first multiple of said unit of time and in that a second transmission from any one of said addressees commences at a second multiple of said unit of time.
3. A method as claimed in Claim 2, characterised in that said point-to-point messages are transmitted in batches of substantially constant duration, in that each batch includes a batch synchronisation code word and in that said unit of time is the duration of a batch.
4. A method as claimed in Claim 3, characterised in that said time reference is the commencement of the synchronisation code word of the batch following the batch in which the invitation message terminates.
5. A message transmission system comprising at least one primary station having means for transmitting signals on a down-link and at least one secondary station having means for making transmissions on an up-link, characterised in that the at least one secondary station has means for deriving a time reference from a signal transmitted on the down-link and for timing its



up-link transmission to begin at a multiple of a unit of time referred to said derived time reference.

6. A system as claimed in Claim 5, characterised in that the means
5 in said primary station transmits point-to-point messages to respective ones of
a plurality of secondary stations and further transmits an invitation signal
inviting at least said plurality of secondary stations to make response
transmissions on said up-link, in that said means in the secondary stations
generates response transmissions as pseudo-random data sequences which
10 commence at a first multiple of said unit of time and in that said means in any
one of said secondary stations generates another response transmission which
commence at a second multiple of said unit of time.

7. A system as claimed in Claim 6, characterised in that said means
15 in the primary station transmits the point-to-point messages in batches of
substantially constant duration, each said batch including a synchronisation
code word, and in that said means in said secondary stations treat the duration
of a batch as said unit of time.

8. A system as claimed in Claim 7, characterised in that the time
20 reference is the commencement of the synchronisation code word of the batch
following the batch in which the invitation signal terminates.

9. A secondary station for use in a message transmission system in
25 which at least one primary station transmits signals on a down-link to
addressed secondary stations, each of said secondary stations having means
for making transmissions on an up-link, characterised in that each of said
secondary stations has means for deriving a time reference from a signal
transmitted on the down-link and for timing its up-link transmission to begin at
30 a multiple of a unit of time referred to said derived time reference.



10. A secondary station as claimed in Claim 9 for use in a system in which a primary station transmits an invitation signal inviting said secondary stations to make response transmissions on said up-link, characterised in that the means in the secondary station generates a response transmission as a
5 pseudo-random data sequence commencing at a first multiple of said unit of time and in that said means optionally generates another response transmission commencing at a second multiple of said unit of time.

11. An answer-back paging system having a primary station for
10 transmitting down-link messages, at least one of which requires two successive up-link responses, to a plurality of secondary stations, characterised in that at least one of said secondary stations utilises the transmission of a first of said two responses as a time reference for the transmission of the second of said two responses.