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WO 2008/157770 A2 **US 20020160794 A1**
US 20020080816 A1

(58) Field of Search:
INT CL **H04L, H04W**
Other: **EPODOC, WPI.**

(54) Title of the Invention: **Mobile station for polling or data transfer**
Abstract Title: **MOBILE STATION FOR POLLING OR DATA TRANSFER IN UNUSED MESSAGE FIELD**

(57) A mobile station 2 transmits a message being in a format including a plurality of fields, at least one of the fields being unused but including data, to an authentication server 22 which extracts the data and provides it to a data server. Additionally the authentication server is adapted to process messages from the mobile station by querying the data server to determine if there is data to send to the mobile station. The authentication server 24 generates an IP address for the mobile station and passes this to the data server 26 and the mobile station. The IP address is in a first group or a second group to indicate whether there is data to be sent to the mobile station. If there is data to send then it is sent to the mobile station 2 using the generated IP address.

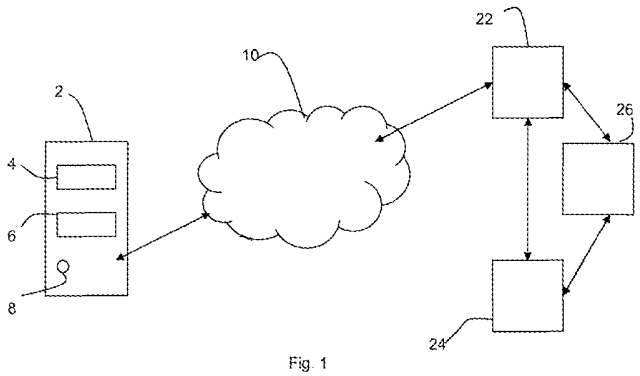

Fig. 1

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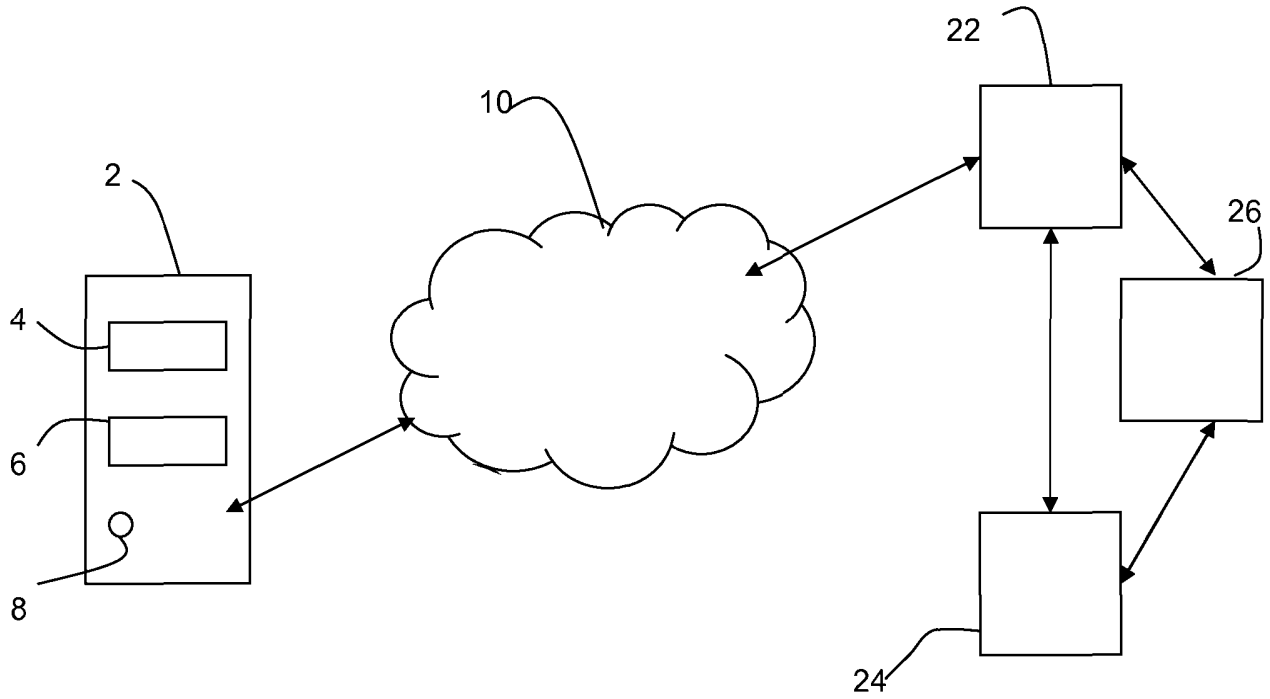

Fig. 1

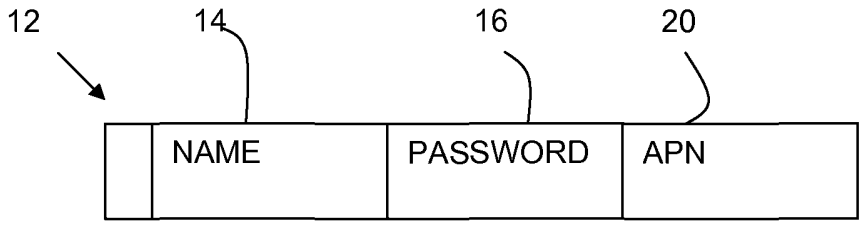

Fig. 2

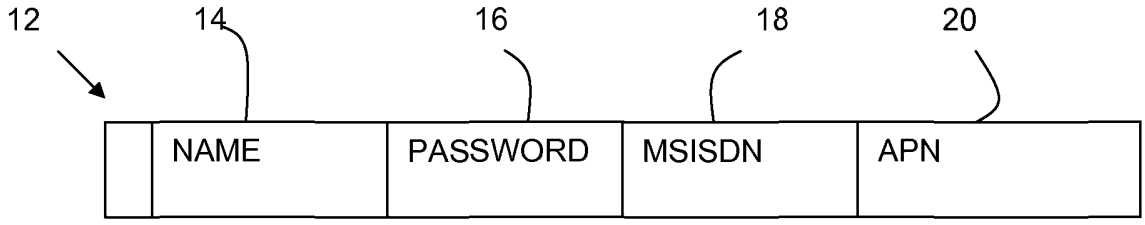

Fig. 3

The following terms are registered trademarks and should be read as such wherever they occur in this document:

GSM

MOBILE STATION FOR POLLING OR DATA TRANSFER

Field of Invention

The invention relates to a method and apparatus for mobile stations that may be used for data transfer, polling or both.

Background Art

A number of different types of cellular devices exist, often referred to as mobile stations, which communicate through cellular networks such as GSM and 3G. Other countries and territories may use different systems. The commonest type of cellular device is a cellular telephone or mobile telephone, though other devices exist, which need not in fact be mobile - GSM and 3G networks can also be used in fixed installations.

Data telephony is increasingly available using GSM and similar networks. A problem however is that the cost of data transfer through such mobile networks is often quite high, especially when using a network abroad. This is in particular a problem when there is only a small amount of data to send, since the minimum charging unit can be very large. This may not be a problem for high value applications, but does restrict the utility of mobile telephony or cellular networks.

An application where the high minimum cost of data transfer might be a problem would be, for example, to track an international shipment by attaching a GSM device which reports back to a home base the location of the shipment. The cost of data transfer when roaming on a network in a foreign country may be quite prohibitive. In particular, the minimum chargeable unit for data transfer may be 10 Kbyte or 100 Kbyte which can be a very large amount of data in some applications. Thus, an application on a mobile station which connects every few minutes to a data server with a brief request of a few bytes can incur very low costs when operating on its home network, since the number of bytes transmitted is very low. However very high costs can be incurred when roaming if a connection is regularly made to send a small amount of data and then broken (e.g. to power down the modem for power saving) The user may be billed for 100Kbyte of data transfer for each connection even if only a few byte of data are to be sent.

Another application where the cost of data transfer may be an issue is for remote devices which receive almost no data, but need low latency. In order to save power, the communications section of the device may be powered off and only enabled to poll a server at regular intervals to see if there is any data to be retrieved. Each poll of the server may cost a significant amount. Accordingly, it may be impracticable to use a cellular network for such remote devices, since the cost of a frequent poll for data may be too high, but polling less frequently results in unacceptable latencies in the system.

A further aspect when using public networks is the need to authenticate users. One widely used way of authenticating a user is a so-called authentication server. A common implementation of an authentication server is a RADIUS server which uses a protocol such as described in RFC2865 or modifications or earlier versions of this protocol. In brief, a user machine, known as a client, contacts a network access server (NAS) and the NAS contacts the authentication server.

In an application using a cellular network, the client typically provides a number of pieces of information, normally a user id, a password, and a unique MSISDN number, essentially the telephone number, in a message sent through the cellular network. The MSISDN number is the conventional representation of the cellular telephone number. MSISDN is sometimes considered to be an abbreviation of mobile subscriber ISDN number and sometimes an abbreviation of mobile station (or subscriber) international ISDN number. ISDN stands for Integrated Services Digital Network.

The authentication server responds to a request by sending a return message to the network access server, either "access reject" to indicate that the user is denied access, "access accept" to indicate that the user is allowed access, or "Access Challenge" to indicate that further information is required.

Summary of Invention

According to a first aspect of the invention there is provided a method according to claim 1.

By using unused fields in a message that, in some circumstances, is sent without charge, data may be transferred without incurring a charge.

The method may further include generating an IP address for the mobile station in the authentication server, and passing the IP address to the data server. The data server may respond by checking whether the data server has data to send to the mobile station; and if the data server has data to send to the mobile station, sending the data to the mobile station by sending the data to the generated IP address over the mobile network.

In embodiments, the IP address selected by the authentication server may be selected to indicate a status to the mobile station.

For example, the IP address may be an odd number if there is no data to send to the mobile station and an even number if there is data to send. The mobile station may then switch off quickly if there is no data to send to the mobile station and the mobile station also has no data to send back. If the mobile station does have data to send, this can be sent using the IP address. If the IP address is even, the mobile station does not switch off whether or not the mobile station has data to send, since there is data to send to the mobile station.

In embodiments, the data server may instruct the authentication server to simply reject the request for an IP address if there is no data to send to the mobile station.

In a second aspect of the invention, the invention relates to a method according to claim 5.

By using the activation message as an implicit poll the mobile station can poll for data without incurring a data transfer charge. The data transfer charge is only incurred when data is actually transferred.

In other aspects, the invention relates to an authentication server arranged to carry out the methods above, as set out in claim 8 and 9, and a mobile station as set out in claims 10 and 11.

Brief Description of Drawings

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

Figure 1 shows a cellular device and network according to a first embodiment of the invention; and

Figure 2 is a schematic of a message used in the first embodiment; and

Figure 3 is a schematic of a modified message used in the first embodiment.

The drawings are schematic and not to scale.

Detailed Description

Referring to Figures 1 and 2, in a first embodiment of the invention a mobile station 2 is a tracking device with a GPS location system 4 and a GSM/GPRS/3G cellular modem 6 for connecting to a cellular network 10 and reporting the location of the mobile station. Other sensors 8 may be provided to measure temperature, for example. The mobile station is typically battery operated.

The mobile station is programmed to take data from the GPS location system 4 together with data from other sensors and to generate a first string and a second string, the first string no longer than the maximum length of the username field, and the second string no longer than the password field. Both strings encode the data. Thus, the maximum number of bytes that may be transmitted in a single message is equal to the sum of the number of characters in the username field, and the number of characters in the password field. Typically, the first and second strings can both carry 64 bytes.

The mobile station 2 then sends an Authentication Request 12 (Figure 2) in a message format including a name field 14 and a password field 16, in an attempt to make a connection to the internet using a particular access point name (APN) in an APN field 20. However, in this embodiment, the name field 14 and the password field 16 are unused by the mobile network.

The message is received by NAS 22 which processes the message 12. The cellular telephone number of the mobile station 2 is added in an MSISDN field 18 by a lower level process in the NAS thereby resulting in the complete message illustrated in Figure 3.

The reason that the name field 14 and password field 16 are not required to be used is that the MSISDN 18 is sufficient information to identify the calling mobile station and the APN field is sufficient to identify the destination of the message.

The NAS processes the APN field and routes the Authentication request to an appropriate server. The first and second strings are extracted and replaced by a predefined Username and password. In the embodiment, the server is authentication server 24, though an additional server could be used for this step if required.

The message 12 in this modified form is then processed further by the authentication server 24. In the embodiment, the authentication server 24 is a RADIUS server. The authentication server 24 assigns an internet protocol (IP) address to the mobile station, which is passed back to the mobile station and also sent as an indication to the data server 26 confirming that the mobile station is online.

The extracted first and second strings are now available in the data server, where they may be stored and reviewed, to track the location of the mobile station 2 and any further data collected without incurring any data transfer costs.

The receipt of the IP address by the data server 26 acts as an implicit poll confirming to the data server 26 that the mobile station 2 is on line. If the data server has data which should be sent to the mobile station, this can then be sent over the data network to the ip address of the mobile station. Although this may be a chargeable data transfer, it is achieved without incurring any costs for the poll message from the mobile station 2 to the data server 26 through the cellular network 10. Thus, regular polling from the mobile station 2 to the data server 26 is possible without incurring costs.

After a certain time, the mobile station 2 disconnects from the network and powers down to save power, particularly important to save battery life in this application since the mobile station may not be available for a considerable time.

Note that the allocated IP address may be on a subnet. Those skilled in the art will realize that to exchange data between the data server 26 and mobile station 2, either the data server 26 and mobile station 2 need to be on a common subnet, or the data needs to be routed by a router. Accordingly, those skilled in the art will provide routers as required to route the data.

The mobile station 2 powers up at regular intervals and repeats the steps described above so that the data server builds up a log of the movement of the mobile station.

In a further enhancement, the RADIUS server 24 may modify the ip address that is returned to indicate to the mobile station that it may power down immediately, or if it is required to stay awake (or some other signaling information) For example it may be configured such that on receipt of an Authentication Request, the RADIUS server 24 interrogates the data server 26 to determine if there is any data pending, and allocates an IP address depending on the result.

This requires that ip addresses are divided into two groups of addresses, a first group of addresses being used if there is data to send and a second group of addresses being used if there is no data pending. For example, all even IP addresses (ip addresses with the final digit even) may be assigned to the first group used if there is data to be sent and all odd IP addresses (ip addresses with the final digit odd) may be assigned to the second group used if there is no data to be sent.

The mobile station 2 can then use the ip address to determine what action is required. If the ip address is odd, the mobile station 2 can then power itself down or at least power down the data connection to the data server 26 unless the mobile station 2 has data to send back to the data server 26. In this latter case, the mobile station sends that data to the data server before powering down

Alternatively, if the ip address is even, then the mobile station waits for the data from the data server 26, and also sends its own data (if any) to the data server, before powering down the data connection.

Those skilled in the art can see that other information may be imparted through the use of ip address pools or other ways of allocating the number.

In a second embodiment, the mobile station 2 is attached to a pump installed in a remote location. The mobile station 2 acts as a controller to control the pump. The pump needs to poll the data server 26 for commands every few minutes to check if there are any commands to turn the pump off or on.

In this second embodiment, the message 12 sent by the mobile station does not include any data, i.e. the message does not include the first and second strings which revert to the traditional use as username and password. Thus, no processing to remove these strings is carried out in data server 26.

Instead, the data server 26 simply uses the transfer of the ip address from the authentication server 24 as a poll. If there are any commands to send to the mobile station 2 to cause the pump to start or stop, these are then sent to the ip address and hence to the mobile 2 through cellular network 10. A user activates the remote pump by sending an appropriate message to data server 26 which activates the remote pump by sending an appropriate command the next time the data server receives the IP address from the authentication server 24.

If the mobile station 2 does not receive any commands for a predetermined time, it switches off. The mobile station then switches on again automatically after a further predetermined time, typically every 1 minute to 1 day. In this way, the mobile station 2 may conserve power, which may be very useful in battery operated applications. Nevertheless, the regular polling is not charged - the only data charge occurs when data is sent to the pump.

The further enhancement mentioned above in which the IP address is selected based on whether or not there is data to send from data server 26 is particularly useful in this embodiment. In this way, the mobile station may switch off more rapidly if the IP address indicates that there is no data to send from data server to the mobile station.

The invention is not limited to the embodiments above.

For example, although the embodiments described use separate NAS 22, authentication server 24 and data server 26, the functions of these may be spread around more or fewer servers. For example, the functions of the authentication server 24 and data server 26 may be combined.

Although the applications above relate to a tracking device and a pump, i.e. sensing and control applications, the same approach may be used in any application of a mobile station, including conventional mobile stations such as mobile telephones, portable digital assistants (PDAs) and laptops connected through a modem.

Further, although in the embodiments above the receipt of the message by the data server is regarded as implying a poll for data, the receipt of this message may be used to indicate something else, for example an indication that the device status is OK.

Also, the data sent by the data server may be replaced by data sent by another server, and this may be based on information contained in the activation message, or anything else such as user control.

Nor is the invention limited to the use of the specific strings to transport data highlighted in the first embodiment. Different mobile networks may have slightly different message formats, and indeed mobile networks may vary as to which of the data fields in a message are actually used and which are ignored. The invention may use any field that is not absolutely required to transmit small amounts of data, not just the user id and password fields highlighted above.

Further, although the term "mobile station" is used, this is not intended to imply anything more than that the station operates on a mobile network. In particular, the mobile station may be fixed or permanently installed and need not be handheld or portable.

CLAIMS:

1. A method of operating a mobile network, comprising:

transmitting a message from a mobile station (2) to an authentication server (24) using a mobile network (10), the message being in a message format including a plurality of fields, at least one of the fields being unused by the authentication server but including data;

pre-processing the message in the authentication server (24) to extract the data from the unused field or fields and providing this data and the number field identifying the mobile station to a data server (26).

2. A method according to claim 1 wherein the fields unused by the mobile network include a name field and a password field.

3. A method according to claim 1 or 2, further comprising

generating an Internet Protocol (IP) address for the mobile station (2) in the authentication server (24);

passing the IP address to the data server (26) and to the mobile station (2);

checking in the data server (26) if the data server has data to send to the mobile station; and

if the data server (26) has data to send to the mobile station, sending the data to the mobile station over the mobile network using the IP address.

4. A method according to claim 3, wherein:

the step of generating an IP address includes checking in the data server (26) whether there is any data to send to the mobile station, and generating an IP address selected from a first group of IP addresses if there is data to send to the mobile station, and from a second group of IP addresses if there is no data to send to the mobile station;

the method further comprises determining in the mobile station whether the generated IP address is in the first group or the second group of IP

addresses, and closing the data connection if the IP address is in the second group of IP addresses indicating that there is no data to send to the mobile station if additionally there is no data to send from the mobile station.

5. A method of operating a mobile station, comprising:

transmitting a message from a mobile station (2) to an authentication server (24) through a mobile network (10);

determining in a data server (26) if there is data to be sent to the mobile station (2);

generating an Internet Protocol (IP) address for the mobile station in the authentication server;

passing the IP address to mobile station (2) and to the data server (26);

and, if the data server has data to send to the mobile station, sending the data to the mobile station by sending the data to the generated IP address over the mobile network.

6. A method according to any previous claim, further comprising:

periodically activate the mobile station for data transfer before the step of transmitting the message from a first mobile station; and

deactivating the mobile station for data transfer after a predetermined time.

7. A method according to claim 5 or 6, wherein:

the step of generating an IP address includes generating an IP address selected from a first group of IP addresses if there is data to send to the mobile station from the data server (26), and from a second group of IP addresses if there is no data to send to the mobile station from the data server (26);

the method further comprises determining in the mobile station (2) whether the generated IP address is in the first group or the second group of IP addresses to determine whether or not there is data waiting to be sent to the mobile station (2) from the data server (26).

8. An authentication server for use with a mobile network having at least one mobile station, and a data server which exchanges data with the mobile station,

wherein the authentication server is adapted to process an incoming message from the mobile station by:

querying the data server to determine whether the data server has data to send to the mobile station and receiving the result of the query; and

generating an Internet Protocol (IP) address depending on the result of the query and transmitting it to the data server and to the mobile station.

9. An authentication server (24) for use with a mobile network having at least one mobile station (2), and a data server (26) which exchanges data with the mobile station,

wherein the authentication server (24) is adapted to process an incoming message (12) in a message format including a plurality of fields, at least one of the fields being unused by the authentication server but including data from the mobile station by:

pre-processing the message in the authentication server (24) to extract the data from the unused field or fields and sending this data and the number field identifying the mobile station to the data server (26).

10. A mobile station (2) for use with a mobile network and a data server (26) which exchanges data with the mobile station;

wherein the mobile station (2) is adapted to periodically activate the mobile station for data transfer before transmitting an activation message though the mobile network;

to receive an IP address through the mobile network in response to the activation message; and

to determine whether the received IP address is in a first group or a second group of IP addresses to determine whether or not there is data waiting to be sent to the mobile station (2) from the data server (26).

11. A mobile station for use with a mobile network having an authentication server and a data server which exchanges data with the mobile

station, the mobile network having a predetermined Authentication Request message format including a plurality of fields, including a name and password field;

wherein the mobile station is adapted to periodically generate data for transmittal to the data server;

to generate a message in the form of the predetermined Authentication Request including some of the data for transmittal in the name and/or password field instead of the name and/or password; and

to send the Authentication Request message including the data to an authentication server through the mobile network.

Application No:	GB0908198.5	**Examiner:**	Mr Peter Stevens
Claims searched:	1 to 4, 9 and 11	**Date of search:**	26 June 2009

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1 at least	US2002/0160794 A1 TISSERAND BRUNO See whole document.
X	1 at least	WO2008/157770 A2 INTERDIGITAL TECH CORP See whole document esp. para. 0042 to 0044 and fig. 4a and 4b.
X	1 at least	US2002/0080816 A1 WI LAN INC See whole document esp. para. 0114-0115.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H04L; H04W

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI.

International Classification:

Subclass	Subgroup	Valid From
H04L	0012/56	01/01/2006