Design of Rapidly Deployable Mast Mounting Assembly with GSM Antenna for the Provision of Mobile Coverage for a Moving Convoy Using Satellite - BTS-To-BSC Link

Abstract: The invention refers to a design of rapidly deployable mast mounting assembly with GSM antenna for the provision of mobile coverage for a moving convoy using satellite - BTS-to-BSC link.
wo 2012/164352


Published:

— with international search report (Art. 21(3))
DESIGN OF RAPIDLY DEPLOYABLE MAST MOUNTING ASSEMBLY WITH GSM ANTENNA FOR THE PROVISION OF MOBILE COVERAGE FOR A MOVING CONVOY USING SATELLITE - BTS- TO- BSC LINK.

5 DESCRIPTION

TECHNICAL FIELD

The present invention relates to Design of Rapidly Deployable Mast Mounting Assembly With GSM Antenna for the provision of Mobile Coverage for a moving Convoy using Satellite - BTS- to- BSC link.

BACKGROUND ART

Mobile communication Service is provided all over the world by Global System for Mobile Communication (GSM). This Service allows both speech and Data to be communicated across the interconnected network. It is made possible through a chain of Base Transceiver Station (BTS) and a Base Station Controller (BSC). The BTS consists of communication equipment for providing Wireless communication between Mobile Station (customer handset) and the GSM Network. BTS is normally having a huge tower mounted with Communication antenna and associated Transmit /Receive equipments in an enclosure. Each BTS covers certain fixed cell area only. In order to have wide coverage, the number of BTS has to be increased. It is not economical to provide more BTS to cover the entire area; hence coverage is designed only for more populated area. When the customer is in the vicinity of this coverage area communication is possible. The signal transmitted by the handset (Mobile station) is picked up by the BTS and transmitted back to the GSM network, so as to reach the desired customer at the distant end. Similarly the signal transmitted back from the BTS is received at the handset and the communication link with the distant customer is established.

When a subscriber is in need of mobile communication out side this coverage area, the existing system fails to provide communication. Then the only way to provide communication under this condition is either to move the BTS along with the traveler or establish more BTS or Roaming arrangement with other operators. In this set up BTS
moving is not possible due to its fixed nature. In the prior art BTS is not moveable from its fixed position. Hence the GSM antenna and its mounting were not moved. To provide a moving coverage, the GSM antenna with its mount has to be moved along with the traveler.

Some of the problems and drawbacks in connection with the prior art are hereinafter briefly summarized.

BTS (Base Transceiver Station) is operated in fixed location and is not movable in the conventional system. Hence the coverage limited to defined cell area only. In order to provide uninterrupted communication, large network of BTS are required all over the area to be covered. This is economically not viable. If the subscriber goes out of the coverage area, communication using GSM is impossible. To keep the subscriber connected, the BTS with its coverage has to be moved along with the traveler.

In the prior art movement was not possible due to fixed nature of GSM mast and the Antenna mounting. So the main defect is the GSM Mast cannot be used for moving environment.

BRIEF SUMMARY OF THE INVENTION

The existing Global System Mobile communication provides the means of communication to people on the move locally and internationally by way of roaming arrangement with different mobile operators across the globe. Coverage is also limited with the individual operator. In the new invention, Mobile communication is provided to the subscriber through the same domestic operator either from local or international destination. No roaming arrangement is required with any other operator. The convoys moving to various locations can access his domestic network by using this system. Coverage is always made available by moving BTS simultaneously with the convoy. To create a moving cell coverage pattern radiating Omni antenna has to move as part of the moving BTS.

The new in this invention is the simplicity of Mast mounting. Mast can be easily assembled and disassembled without using any external tools. Mast with GSM antenna
deployment on top of the vehicle is possible with in short time. Mast balancing & holding in vertical position is achieved using two tie rods. The entire system can be folded back and stored on the vehicle top with simple locking and unlocking mechanism.

5 DETAILED DESCRIPTION OF THE INVENTION

Global System Mobile communication (GSM) is used all over the world as the means of communication to people on the move. Roaming arrangement is made with other operators across the globe to provide communication to the travelers who are out of their domestic network. This is also limited to a predefined territory decided by the particular mobile operator. Communication is lost when the subscriber is out of this particular territory. To make it more clear, GSM service is provided all over the world, from fixed BTS. Base Transceiver Stations (BTS) are controlled by Base Station Controllers (BSC). The BTS covers only predefined location. Handover between BTS is carried out when the customer moves out from one location to other. This is because of the limited cell coverage. But when there is no BTS cell coverage, communication is lost practically.

The new invention provides an effective solution for the above problem and communication is made possible while moving anywhere. The idea is conceived for providing mobile communication solution for the convoy moving to various destinations. The convoy is always linked to their domestic network operator through Satellite - BTS-to- BSC link. This idea can be utilized to meet the requirement of any potential customer.

The technique adopted for providing mobile coverage is based on our expertise in Satellite communication and GSM applications. It is decided to combine these technologies together to provide a viable solution on the move. The basic idea is to provide uninterrupted coverage, creating a coverage pattern using a single BTS which is moving with the traveler. This BTS is always linked through satellite to the assigned BSC at the home destination.

By incorporating the technology of Satellite Communication, BTS- to- BSC link and technique of satellite tracking, achieved a practical solution to implement the above idea successfully.
Mobile coverage is provided to the customer irrespective of his location. The system is capable of transmitting voice/data to the public network through Satellite-BTS-to-BSC link. In order to create a moving coverage pattern to follow the convoy, a moving BTS with the traveler is designed in a transportable vehicle. A 4-Wheel drive vehicle is selected for implementing the design so that it can move easily in any uneven terrain.

The basic principle of implementing mobile coverage moving with convoy is shown in Figure 1. The BTS is housing the radio transceivers which transmits and receives signal on the cells allocated frequencies. This in-turn communicates with its BSC at the home location through the satellite link as shown in Figure 1. The BSC Manages the radio resource of the BTS and also the connection between the Mobile station (MS) and the external network subsystem. The BSC is interconnected to the Mobile Switching Center (MSC). It acts as the normal switching node for the mobile subscriber or land line telephone in the home network. The detailed description of the schematic in Figure 1 is provided in the subsequent section.

The signal transmitted from the Mobile station (MS) 101 is picked up by the GSM Omni Antenna 102 as shown in Figure 1. The signal is processed by the Micro BTS 103 and is passed to the satellite modem 104. The modem output, the Intermediate Frequency (IF) signal is up converted and amplified by the Block Up Converter (BUC) in TX System 105 to the desired satellite communication frequency band. The signal is transmitted through the Satellite communication Antenna 106 inside the radome 205. The antenna automatically tracks and lock to the satellite to maintain the communication link. The Signal received at the distant Earth station 107, is fed to Earth Station receive system 108, where it is down converted and demodulated to the desired base band frequency. The base band signal is transmitted to its base station controller (BSC) 109. There the signal is processed and switched to the Public network 110, so as to reach the desired subscriber 111. The reverse process takes place for receiving the signal by the transportable vehicle. Received signal is retransmitted by the Omni antenna to the customer handset 101, who is within the radiating range of the Micro BTS.

The signal transmission and reception from the handset is achieved through an omni antenna mounted on a GSM mast, which acts as the interface between the BTS and customer handset. The coverage area depends on the height of the mast and the antenna. So the mounting of the GSM mast and Antenna has great importance. In normal situation The
GSM Antenna is mounted on a GSM tower. In the case of a moving vehicle, it is not possible to mount such a tower for fixing the Antenna. It is necessary to have an alternate solution to solve this problem. So a mast with light weight and good stiffness has been selected. This is mounted on top of the vehicle.

The Design is made in such a way that it has a center pole 201 holding the GSM Omni antenna 102 with two supporting movable tie rods 205 on a sliding mechanism 202 which holds the antenna in vertical position and prevents swinging and swaying while on the move. The design of the Mast assembly is so simple that no extra tool is required for the mast deployment. It is operated manually. Locking and unlocking 204 can be carried without any additional tool. Tie rod is fixed on a mounting plate 203. The mast mounting is designed for quick deployment with minimum integration time. It is easy to fold back with the help of tie rods when the system is not in use. Adequate care is taken to with stand wind force, shock and vibration. The hollow design of the center pole 201 allows the antenna cable routing to the communication equipment. GSM antenna is mounted on the top of the mast with an additional fixing arrangement as shown in Figure 3 and the connecting cable terminated in an attached junction box 206. The sliding tie rod can be unscrewed and the entire assembly including the mast, antenna and supporting rod can be folded on the top of the vehicle under non deployed condition as shown in Figure 4.

An Omni Antenna 102 is selected to have coverage in all direction which is mounted on top of the Mast for signal pickup. The design implementation is shown in the Figure 2. An efficient and effective positioned omni antenna is essential to cover the designated Area. So the antenna is vertically mounted which picks up the GSM signal from the Mobile Station and fed to the Micro BTS for onward transmission. Similarly the received signal from Micro BTS is transmitted back to the subscriber. So the Antenna mounted on a mast with appropriate supporting mechanism is shown in Figure 3. This is essential for effective communication between the subscriber and moving BTS.

It will be hereinafter described how to use the invention.

This is a self-contained Communication solution for providing mobile connectivity irrespective of conventional GSM Coverage, extremely useful for convoy moving to different destinations without depending on any local mobile operator for their immediate use. This compliments the absence of GSM coverage and provides instant communication
facility to any motorable locations using the cell coverage area of the BTS on the vehicle. Provision of mobile coverage for the moving convoy is achieved using Satellite- BTS to BSC link. This is highly useful to provide communication to the desired destination with the same domestic operator. This provides the roaming facility with out any other service provider. Since All the Communication equipments are accommodated compactly in a transportable vehicle, it can be easily transported anywhere to establish communication link with short notice.

The Mount can be easily assembled on moving platform to fix the Communication Antenna. The mechanism is very simple and light weight. Balancing is achieved by using two tie rods which supports the main pole. The tie rod together with main pole forms a balanced tripod. No external tool is required for assembling and disassembly. It can be easily integrated to any vehicle roof top with in short time and can be deployed very quickly. It takes only very little space due to elegant design. This is useful for any moving platform to fix antenna and keep it in upright condition to withstand wind force, shock and vibration.

Mobile coverage is provided to the customer irrespective of his location. The system is capable of transmitting voice/data to the public network through Satellite -BTS- to- BSC link. In order to create a moving coverage pattern to follow the convoy, a moving BTS with the traveler is designed in a transportable vehicle. A 4-Wheel drive vehicle is selected for implementing the design so that it can move easily in any uneven terrain.

The basic principle of implementing mobile coverage moving with convoy is shown in Figure 1. The BTS is housing the radio transceivers which transmits and receives signal on the cells allocated frequencies. This in-turn communicates with its BSC at the home location through the satellite link as shown in Figure 1. The BSC Manages the radio resource of the BTS and also the connection between the Mobile station (MS) and the external network subsystem. The BSC is interconnected to the Mobile Switching Center (MSC). It acts as the normal switching node for the mobile subscriber or land line telephone in the home network. The detailed description of the schematic in Figure 1 is provided in the subsequent section.
The signal transmitted from the Mobile station (MS) 101 is picked up by the GSM Omni Antenna 102 as shown in Figure 1. The signal is processed by the Micro BTS 103 and is passed to the satellite modem 104. The modem output, the Intermediate Frequency (IF) signal is up converted and amplified by the Block Up Converter (BUC) in TX System 105 to the desired satellite communication frequency band. The signal is transmitted through the Satellite communication Antenna 106 inside the radome 205. The antenna automatically tracks and lock to the satellite to maintain the communication link. The Signal received at the distant Earth station 107, is fed to Earth Station receive system 108, where it is down converted and demodulated to the desired base band frequency. The base band signal is transmitted to its base station controller (BSC) 109. There the signal is processed and switched to the Public network 110, so as to reach the desired subscriber 111. The reverse process takes place for receiving the signal by the transportable vehicle. Received signal is retransmitted by the Omni antenna to the customer handset 101, who is with in the radiating range of the Micro BTS.

The signal transmission and reception from the handset is achieved through an omni antenna mounted on a GSM mast, which acts as the interface between the BTS and customer handset. The coverage area depends on the height of the mast and the antenna. So the mounting of the GSM mast and Antenna has great importance. In normal situation The GSM Antenna is mounted on a GSM tower. In the case of a moving vehicle, it is not possible to mount such a tower for fixing the Antenna. It is necessary to have an alternate solution to solve this problem. So a mast with light weight and good stiffness has been selected. This is mounted on top of the vehicle.

The Design is made in such a way that it has a center pole 201 holding the GSM Omni antenna 102 with two supporting movable tie rods 205 on a sliding mechanism 202 which holds the antenna in vertical position and prevents swinging and swaying while on the move. The design of the Mast assembly is so simple that no extra tool is required for the mast deployment. It is operated manually. Locking and unlocking 204 can be carried with out any additional tool. Tie rod is fixed on a mounting plate 203. The mast mounting is designed for quick deployment with minimum integration time. It is easy to fold back with the help of tie rods when the system is not in use. Adequate care is taken to with stand wind force, shock and vibration. The hollow design of the center pole 201 allows the antenna cable routing to the communication equipment. GSM antenna is mounted on the
top of the mast with an additional fixing arrangement as shown in Figure 3 and the connecting cable terminated in an attached junction box 206. The sliding tie rod can be unscrewed and the entire assembly including the mast, antenna and supporting rod can be folded on the top of the vehicle under non deployed condition as shown in Figure 4.

An Omini Antenna 102 is selected to have coverage in all direction which is mounted on top of the Mast for signal pickup. The design implementation is shown in the Figure 2. An efficient and effective positioned omni antenna is essential to cover the designated Area. So the antenna is vertically mounted which picks up the GSM signal from the Mobile Station and fed to the Micro BTS for onward transmission. Similarly the received signal from Micro BTS is transmitted back to the subscriber. So the Antenna mounted on a mast with appropriate supporting mechanism is shown in Figure 4. This is essential for effective communication between the subscriber and moving BTS.

Naturally, without altering the principle of the invention, the embodiments and constructional details may be widely varied with respect to what has been described and illustrated, purely by way of a non-limiting example, without thereby departing from the scope of the invention which is defined in the accompanying claims.
CLAIMS

1. Designing of mounting arrangement for the mast with GSM Antenna on top of a vehicle to provide mobile coverage for a moving convoy using Satellite -BTS -to -BSC link.

2. Designing of mounting arrangement for the mast with GSM antenna of claim 1 where in the mast is fitted with two tie rods which will slide over the mast up to predefined position to keep the mast in upright position.

3. Designing of mounting arrangement for the mast with GSM antenna of claim 1 where in the mast with tie rods designed as a tripod to balance the mast on top of the vehicle.

4. Designing of mounting arrangement for the mast with GSM antenna of claim 1 wherein the mast deployment is rapid without additional tools.

5. GSM antenna signal cable is terminated on junction box which is mounted on the mast.

6. The mast with GSM Antenna is stowed and secured with foldable and supporting mechanism on top of the vehicle when system is not in use.
INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2011/052444

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.
H01Q 1/27 (2006.01) H01Q 1/32 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Internet, USPTO, EPDOC, WPI using keywords such as: antenna, aerial, satellite, vehicle, car, truck, mount, support, mast, tower, BTS, BSC, GSM, junction box, connection box

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2009/01 21950 A1 (DALKE) 14 May 2009 See whole document, in particular: Fig 2, Item 26</td>
<td>5</td>
</tr>
<tr>
<td>X</td>
<td>US 2008/01 82624 A1 (NEWMAN) 31 July 2008 See whole document, in particular: Abstract; Figs 1, 4, 5</td>
<td>6</td>
</tr>
<tr>
<td>Y</td>
<td>See whole document, in particular: Abstract; Fig 2; Para 0007</td>
<td>1 - 4</td>
</tr>
</tbody>
</table>

* Further documents are listed in the continuation of Box C

X See patent family annex

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

Date of the actual completion of the international search 25 August 2011
Date of mailing of the international search report 25.08.2011

Name and mailing address of the ISA/AU
AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
Facsimile No. +61 2 6283 7999

Authorized officer
JONTY GOLDIN
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No.: +61 3 9935 9618

Form PCT/ISA/210 (second sheet) (July 2009)
## INTERNATIONAL SEARCH REPORT

**International application No.**

PCT/IB20 11/052444

---

### DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
</table>
| **Y**     | US 2002/01 233 44 A1 (CR1QUI et al.) 5 September 2002  
            See whole document, in particular: Abstract; Fig 1, Paras 001 8 - 0026 | 1 - 4                 |
            See whole document, in particular: Paras 0001, 0023 - 0025, 0048 | 1 - 4                 |
| **Y**     | JP 2001 - 1192 17 A (FUJITSU LTD) 27 April 2001  
            See whole document, in particular: Abstract; Fig 5, Items 32 & 38 | 1 - 4                 |

---

Form PCT/ISA/210 (continuation of second sheet) (July 2009)
INTERNATIONAL SEARCH REPORT

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

This International Searching Authority found multiple inventions in this international application, as follows:

*See Supplemental Box 1*

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. X As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 

**Remark on Protest**

□ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

□ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

□ No protest accompanied the payment of additional search fees.
Supplemental Box 1

(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No: Box III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1 - 4 are directed to a mounting arrangement for a GSM antenna mast. The feature of providing a mounting arrangement for mounting a GSM antenna on top of a vehicle to provide mobile coverage for a moving convoy using a satellite-BTS-to-BSC link is specific to this group of claims.
- Claim 5 is directed to a GSM antenna signal cable. The feature of terminating the cable on a junction box mounted on an antenna mast is specific to this group of claims.
- Claim 6 is directed to a GSM antenna mast. The feature of stowing and securing the antenna and mast using a foldable mechanism is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claims and therefore cannot provide the required technical relationship. Therefore there is no special technical feature present in the claims and the requirements for unity of invention are consequently not satisfied a priori.
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>US 200912 1950</td>
<td>NONE</td>
</tr>
<tr>
<td>US 2008 182624</td>
<td>NONE</td>
</tr>
<tr>
<td>US 2005 181783</td>
<td>WO 2005034374</td>
</tr>
<tr>
<td>US 2002123344</td>
<td>EP 123738 1</td>
</tr>
<tr>
<td></td>
<td>FR 282 1707</td>
</tr>
<tr>
<td></td>
<td>US 68 13493</td>
</tr>
<tr>
<td>EP 1634391</td>
<td>AU 2003304220</td>
</tr>
<tr>
<td></td>
<td>CA 253561 7</td>
</tr>
<tr>
<td></td>
<td>CA 2545500</td>
</tr>
<tr>
<td>EP 1634476</td>
<td>FI 20030929</td>
</tr>
<tr>
<td></td>
<td>JP 2006527926</td>
</tr>
<tr>
<td>JP 2006527943</td>
<td>US 2007202802</td>
</tr>
<tr>
<td></td>
<td>US 7486927</td>
</tr>
<tr>
<td>JP 2001 1192 17</td>
<td>WO 2004 112280</td>
</tr>
<tr>
<td></td>
<td>WO 2004 124 18</td>
</tr>
</tbody>
</table>

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX