Safety Confirmation of Ship's Crew Using Cell-phone with GPS Receiver and Wireless LAN.

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Abstract

Ships and their cargos have been managed safely by positioning report system. However, little attention has been paid to safety of crew's works with danger. The attempt that used PHS inboard was before by the present authors. However, the functions were just voice call and mail exchange. The data acquisition from the terminal by proper control was not possible. Thus the position of the terminal was not available. As for the cell phone of next generation, GPS receiver and wireless LAN are installed by manufacturers. Therefore, we propose a system which uses a cell-phone with GPS receiver on a ship in order to promote the safety of ship's crew. We checked the availability of cell-phone GPS receiver at thirty different points inboard. The positioning was not possible in the areas further than 4m from the window. Then, we proposed the system which follows the positions of the crews and confirms their safety inboard by using the VoIP (Voice over Internet Protocol) function by wireless LAN.

Keywords: GPS, GPS built in the cell phone, positioning accuracy, Voice over Internet Protocol, Internet Protocol, Asterisk, Session Initiation Protocol, Access Point

1. Introduction

The VoIP (Voice over Internet Protocol) function by GPS and wireless LAN is installed in next generation's cell phone. Then, crew's safety inboard was confirmed by using the terminal of the IP telephone for the GPS cell phone and the voice call to acquire the location information in this research.

Navigation of ship is conducted by the information that exists in bridge at present. GPS receivers are usually used as a powerful tool to find their positions. However, positioning information is just used for the navigation of the ship and not for the safety of crew individual. Then, we propose the usage of a handy-type GPS receiver built in cell phone GPS receiver on a ship for safety of ship's crew. It is portable and works even inside the room. We also investigate be possibility usage of a Cell Phone GPS. And, personal communications and the positional detection between crew were done with wireless LAN terminal that was able to use inboard anywhere.

In the present paper, we examine the performances of cell phone which equip GPS receiver (CASIO A5403CA) and a Wireless VoIP terminal (ICOM VP-43) and discuss their possibilities to be a tool to secure the crew's safety.

2. Positioning experiment

2.1 Cell phone GPS receiver

Figure 1 shows the view of a cell phone GPS receiver evaluated in the experiment. Cell Phone GPS is easy to use, portable, and available for any persons. A carrier in Japan, KDDI cooperation began GPS positioning service by a cell phone in December, 2001.

The interesting feature of Cell Phone GPS is that necessary information can be obtained such as the position of base station under using, electric field intensity and positioning mode by arranging the JAVA program. It is possible to obtain the positioning information continuously with a fixed interval or fixed times by arranging the JAVA program on the Cell Phone GPS receiver. The seven positioning modes of Cell Phone GPS are defined as follows.

1. GPS: More than 4 GPS satellites are used.
2. AFLT (Advanced Forward Link Trilateration): Only base stations of cell phone are used.
3. HYBRID: Combination of GPS satellites and base stations is used.
4. FAIL: Positioning is not possible.
5. FREE: The positioning is not specified.
6. PREFIX: BTS (Base Transceiver Station) is used.
7. SECTOR CENTER: Sector Center is used.

Cell Phone GPS can be used even in a poor environment of radio wave. Thus it may be effective because we are able to acquire the location information even in the place where the electric field from the satellite does not reach.

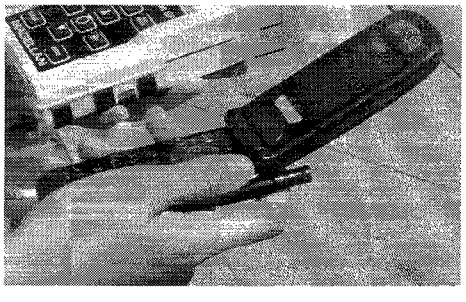

Fig.1 Cell Phone GPS receiver.

2.2 Positioning by Cell Phone GPS at sea.

The experiment was conducted on the experimental ship SHIOJI-MARU (425GT, Length 49m) shown by figure 2

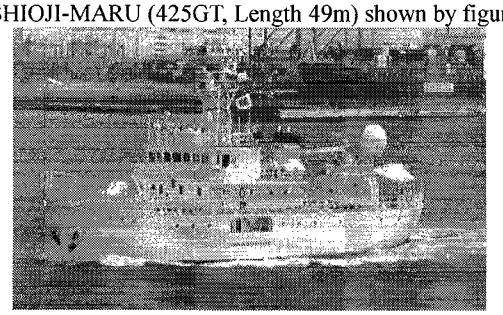

Fig.2 Experimental ship SHIOJI-MARU (425GT, Length 49m) used for evaluating Cell Phone-GPS.

We check the availability of Cell Phone GPS at thirty various points inboard. The operation of data acquisition was repeated twice. The places surveyed inboard are shown in Fig.3. The distance, the measurement accuracy from the window, and the difference of the measurement mode were investigated by this experiment. Figure 4 shows the appearance of the experiment.

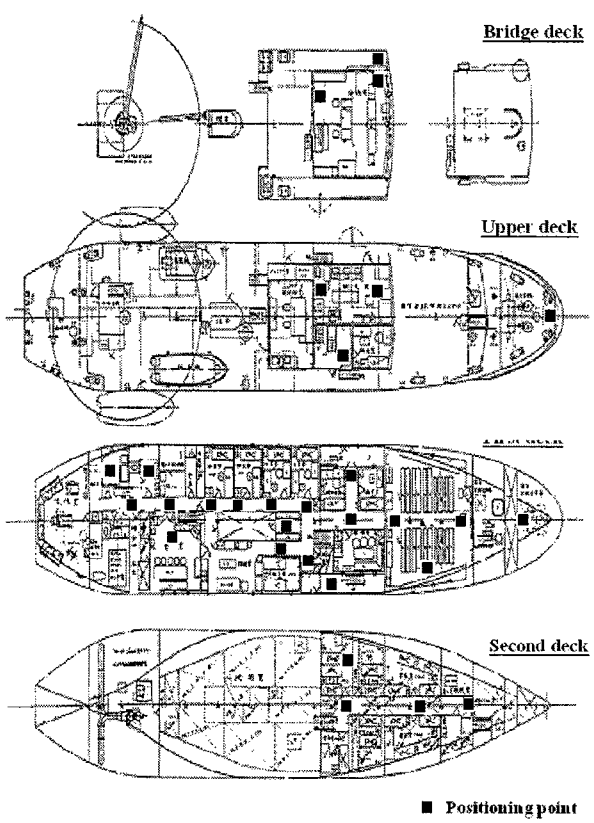

Fig.3 Positions where the data were acquired.

Figure 5 shows the positioning modes and errors of positioning by Cell Phone-GPS in reference to the distance to the window. The mode changes automatically so as to fix the position as often as possible. The error is defined as the difference from the position estimated by the fixed position by DGPS receiver (NAVICOM SF-2050G) installed at the bridge. It was possible to fix the position within 1m from the window with a fairy well accuracy by GPS mode. But any data were not available at the place further than from 4.0 m to the window.

Table.1 Position fixed rate with different positioning mode at the place distance from the window. Total is 100 % at each place

	GPS	Base stations	Not possible
Within 1m	66.7%	30%	3.3%
Within 2m	8.0%	76%	16%
Within 3m	6.7%	90%	3.3%
Deeper	0%	68.6%	31.4%

Table 1 is the position fixed rate with different positioning mode at the place distance from the window. Total is 100 % at each place. GPS worked at the places close to the window. But the rate of fixed position decreased by GPS when the distance increased up to 3 m from the window. The rate of the AFLT which uses the base stations of the cell phone increased there. And, GPS did not work at all at the places further than 3 m from the window and the rate of non-fixed increased. The positioning accuracy of the autonomous GPS mode was 67.8 m in 2drms with in 1 m from the window deduced from the fixed positions there.

Fig.4 Acquiring the data inboard

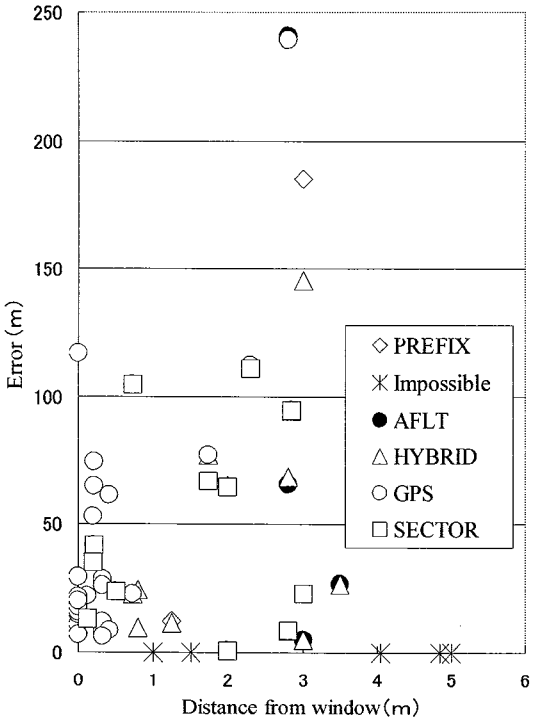

Fig.5 Positioning Error in reference to the distance from the window inboard.

It is possible to acquire other person's location for those who stay on land automatically by the mail function of the cell phone with the service of KDDI.
The personal location information of the crew is very effectively fixed by Cell Phone-GPS, though the error is tens of meters inboard, as it is not available inboard so far at all inboard.

However, there is a fault that positioning is not available at the places 4 m or further from the window. Thus we propose the system which confirms the crew's safety whether he stays inside any division inboard. It can be realized by new wireless LAN system to be installed in the advanced cell phone near future.

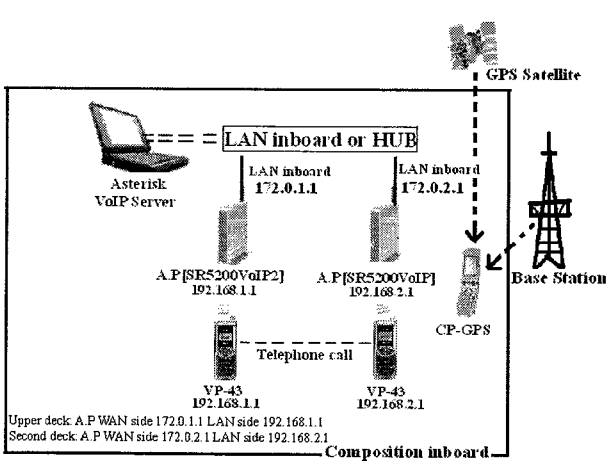

Fig.6 Block diagram of new wireless LAN system, VoIP

2.3 Block diagram of VoIP system

The VOIP (Voice over Internet Protocol) function (so called IP telephone) by wireless LAN is installed in next generation's cell phone. We thought that we were able to acquire and exchange the information between the crews easily besides the voice communication. Then their positions can be followed to enhance the safety.

Then, we propose to use the VOIP terminal equipped with wireless LAN and the Internet Protocol address inboard, where the position is not available with GPS, in order to communicate personally between crew and detect the approximate positions (division where they are). Figure 6 shows the block diagram of new wireless LAN system.
This system uses the function named Asterisk that can provide service by the operation synchronized with the IP telephone device. 2.4 GHz radio is used to communicate between access point at some division and terminals.

Asterisk offers the function of telephone exchange service for the users themselves. The function that seems, "It is in only having the supply of such a function" it about almost becomes complete for Asterisk.

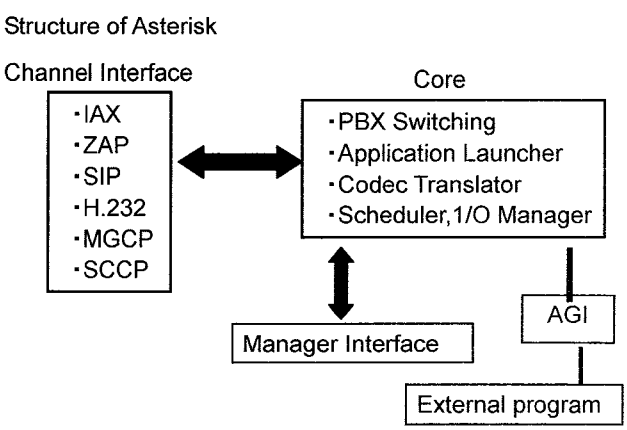

Fig.7 Structure of Asterisk

Figure 7 shows the structure of the asterisk.

- Channel Interface: It is called Asterisk Channel. It executes the various connections. Both the traditional and IP phone lines use this channel.
- PBX Switching: Private Branch exchange Switching
- Application Launcher: It programs by offering a range of services, and, for instance, the application such as voice mails is started.
- Codec Translator: Translate the data between various codecs.
- Scheduler and I/O Manager: Optimize the operation and schedule of low-level processing.
- Manager Interface: Offer PBX management interface.
- AGI (Asterisk Gateway Interface): Support the execution of the external program through Asterisk as CGI does.

SIP function, included in Channel Interface, was used here.

It is a server that mediates the processing of necessary session establishment for the SIP telephone call in the IP network etc. as an element that composes SIP, and the kind includes three kinds the Proxy server, Redirect server, and the Registrar server.

The experiment received the request that registered present location in the user terminal with a registration server, and used the server function to update information registered in the location server etc. And, it experimented on the base that recorded the possibility of the communication from each terminal.

The two VP-43 terminals were given the IP addresses of (@192.168.10, @192.168.11), respectively and access point was (@192.168.1.102). The state of the registration procedure to the SIP server was output to Asterisk every 30 seconds. Figure 8 shows the example of the time series of the registration procedure from an actual terminal to the server. It is defined that which access point is used by a terminal. Thus, it can be judged which access point a crew who has the VP-43 terminal is. Crew's safety can be confirmed by setting up A.P inboard, turning on the VP-43 terminal, and informing of turning off automatically.

time	端末番号
Jul 25 142956 chan_sip.c: Auto destroying call	*****@192.168.1.102 →A.P
Jul 25 142958 chan_sip.c: Auto destroying call	*****@192.168.1.10' →VP-43
Jul 25 142959 chan_sip.c: Auto destroying call	*****@192.168.1.11' →VP-43
Jul 25 143028 chan_sip.c: Auto destroying call	*****@192.168.1.10'
Jul 25 143029 chan_sip.c: Auto destroying call	*****@192.168.1.11'
Jul 25 143056 chan_sip.c: Auto destroying call	*****@192.168.1.102'
Jul 25 143058 chan_sip.c: Auto destroying call	*****@192.168.1.10'
Jul 25 143100 chan_sip.c: Auto destroying call	*****@192.168.1.11'

Fig.8 Data displayed on the screen of Asterisk

The communication distance is about 30m in the room, and is about 70m possible from the access point usually by outdoor.

It was possible to talk over the telephone by setting up two access points in each deck when experimenting on the SHIOJIMARU aboard and inboard.

3. Summary

The possibility is investigated to adopt Cell phone GPS and VoIP as a tool of the location report system for ship's crew.

Acknowledgement

We thank all the crew of SHIOJI-MARU for their helping us to acquire the data sincerely.

Reference

1. Masaaki WADA (2004). A Rescue System for Man Overboard-III,-A Fusion of the Rescue System and the Monitoring System-. The Journal of Japan institute of navigation. March, No,110, pp.51-58
2. Norikazu OKADA (2000).Applications of GPS,ECDIS, etc NAVIGATION, No,143,pp.145-151
3. Yukio Ito (2001). Communication, protocol, NATUME Company P.223.
4. Masako URAKAMI (2004). Construction of wireless LAN system for navigating small craft with safety. The Journal of Japan institute of navigation. September, No, 111, pp.173-180.
5. Takashi MIWA (2006). Constructing shipboard LAN system using wireless LAN technology and its Application to the ship monitoring system. The Journal of Japan institute of navigation. March, No, 114, pp.243-250.
6. Nobukazu WAKABAYASHI (2001). Data Acquisition and Transfer System for Ship Navigation using IP Network –Implementation on T.S. Fukae-maru-. The Journal of Japan institute of navigation. October, No, 106, pp. 29-37.