

Introduction of Products

Introduction of KOM-LOGI Light, A Komatsu's Equipment Positioning System

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In recent years, a business of positioning information service is widely spreading. It relies on GPS, data communications through a cellular phone network and the Internet. To meet with the time's demand, Komatsu Ltd. has developed what it terms KOMTRAX and mounts it on its line of construction equipment. KOMTRAX now shows a sign of pioneering new businesses. In the application of the KOMTRAX technology, for example, Electronics Division of Komatsu has subsequently developed a transportation vehicle positioning system named KOM-LOGI Light.

KOM-LOGI Light collects information on a specific vehicle's position and the present status of transportation from a vehicle-mounted terminal with a built-in GPS receiver via Dopa network which is a packet transmission network of NTT DoCoMo. It is a compact system which enables you to grasp the present location and the status of equipment while in transport, sitting at a computer terminal in your office. This paper introduces the function and features of this system.

Key words: GPS, Wireless Packet Transmissions Network, Internet, ASP, Server, Database, GIS

1. Introduction

The positioning system using GPS and PHS was put into practical use around 1995. Ever since the infrastructure for wireless communications network has been upgraded as satellite communications network and cellular phone network have made a great stride. In keeping with this trend, there has been an increasing number of enterprises which take part in the business of providing positioning service, which in turn is expanding the market rapidly. Komatsu has been no exception to this development. In 2001 it started to mount *KOMTRAX on its main models like medium-size hydraulic excavators as a standard specification in Japan. As the population of machines with KOMTRAX increased thereafter, KOMTRAX is used for providing Komatsu machine owners with data on their machines and equipment management in the construction equipment renting business.

And then Electronics Division developed KOM-LOGI Light applying the established KOMTRAX technology. As mentioned earlier on, it is an equipment transportation support system to help realize more efficient and economical transport of equipment by grasping the present location of specific equipment en route.

The system narrowed down its potentially wide functions to grasp of the equipment location, equipment operating conditions, transport history and sending a message to the equipment. Thus having realized a low price and easy operation, it was commercialized and successfully introduced in the market in September 2002. Right now there are several contractors which are making use of the system in the domestic market.

* KOMTRAX: Komatsu-developed dynamic control system for construction equipment

2. Basic concept on system

Now let's turn to the basic concept on this system and means with which to have embodied the concept.

(1) Low Price

- To minimize the cost for developing a Truck-mounted terminal by making the most of KOMTRAX technologies fostered in the course of the development (both in software and in hardware)
- To establish commonality of parts with the KOMTRAX terminal (e.g. GPS receiver) and thereby ensure cost reduction
- To lower the office terminal equipment development cost by limiting control functions
- To use a PC with Windows program for the office terminal equipment
- To use a packet transmission for communications with the Truck-mounted terminal equipment

(2) Pursuit of Easy Operability

- To specialize functions to the grasp of the equipment location, equipment conditions, transmission of simple messages from the equipment and transmission of messages from the office terminal equipment

(3) Makeup for use with ASP

- To make up the office terminal equipment with Web server, distributor server, communication server and browser, keeping the ASP* business in prospect.

3. Features of the system

3.1 Makeup of total system

The whole system is illustrated in Fig. 1.

The office terminal equipment and the truck-mounted terminal equipment are portions which Komatsu Ltd. has developed and commercialized. System users are supposed to make a contract with a communications (common) carrier (NTT DoCoMo in this instance) for the use of DoPa transmission network (a packet transmission network of NTT DoCoMo).

3.2 Truck-mounted terminal equipment

(1) Outlines

The truck-mounted terminal equipment has a built-in GPS receiver and is capable of communications via DoPa transmission network. For the display, it has an LCD which shows two lines of 20 letters/figures at a time and is equipped with operation buttons for setting a working condition. Through this system two-way communications are made possible between the truck driver and the administrator in the office. The former informs the latter of the present location of his truck, estimated arrival time and cargo pickup status, etc., and the latter in turn instructs arrangements for a truck to the former or gives him information on pickup cargos. Thus a wide variety of information can be exchanged between the two parties via transmission network. It can also be applied to other business systems in a wide area.

(2) Appearance

The appearance of the truck-mounted terminal equipment is shown together with the name of each part in Fig. 2.

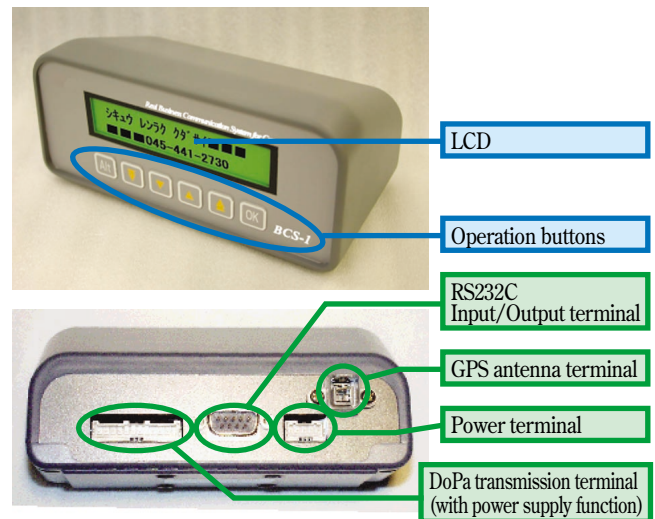


Fig. 2 Appearance of truck-mounted terminal equipment

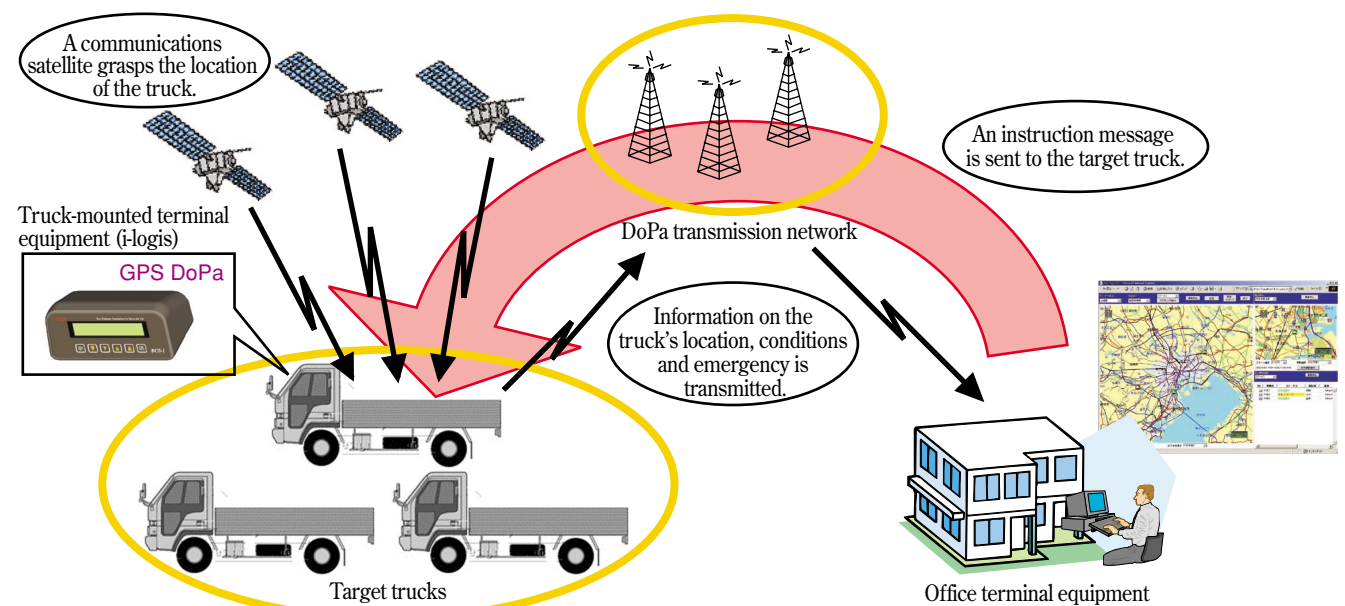


Fig. 1 Makeup of total system

*ASP: Application Service Provider

(3) Makeup of truck-mounted terminal equipment system

As illustrated in **Fig. 3**, the truck-mounted terminal equipment system is made up of terminal equipment, Mobile Ark, Mobile Ark antenna and GPS antenna. Now let's review each component.

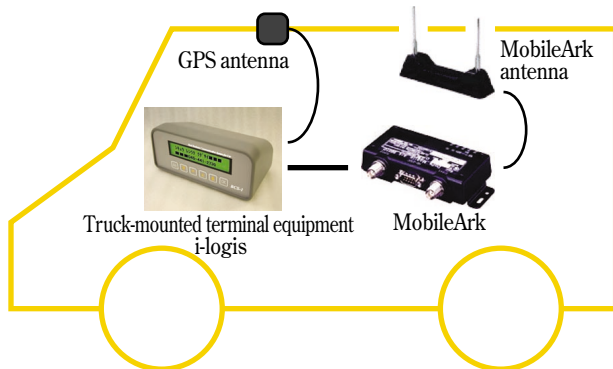


Fig. 3 Makeup of truck-mounted terminal equipment

① Terminal equipment

A built-in GPS receiver enables the equipment to grasp the present location of the truck. Furthermore, truck Work status can be set by operating buttons on the equipment.

② Mobile ark

This is a terminal for DoPa transmission of NTT DoCoMo. It acts like a modem and carries out data communications.

③ Mobile ark antenna

This is an antenna for PDC 800 MHz band. An NTT DoCoMo-made antenna or one that Komatsu has developed for KOMTRAX can be used for this application.

④ GPS antenna

This is a water-proof antenna which may be installed externally e.g. on the truck roof. It is of a magnet type for easy installation.

(4) Features of truck-mounted terminal equipment

The following can be enumerated as features of this terminal equipment.

① It is a compact type truck-mounted terminal equipment with a built-in GPS receiver, and can be readily installed on the instrument panel with an accessory stand.

② Equipped with an LCD, work instructions or any other messages from the office can be visually displayed.

③ The truck driver can transmit Work status by operating operation buttons.

④ It can be connected to external equipment and tools like a sensor or car navigation system, as it is equipped with RS232C input and output terminal as a standard specification.

(5) Specifications for truck-mounted terminal equipment

Table 1 shows the basic specifications for the truck-mounted terminal equipment and **Table 2** shows conditions for the installation.

Table 1 Basic specifications

Spec. item		Specifications
Display	Display device	Character LCD of 20 letters and 2 lines
	Letter size	5.5 × 3.2
	Resolution	5 × 8 dot / letter
	Backlight	LED
Button		6 tact switches (PET film embossed)
Interface	Serial	RS232C 1 ch. (for DoPa transmission)
	Serial	RS232C 1 ch. (Non-procedure)
	Antenna	GPS antenna 1 ch.
CPU		SH7047 (SH2 core, 50 MHz max.)
Memory		Flash ROM with built-in CPU 256 KB RAM with built-in CPU 12 KB OVD SRAM 256 KB (Backup possible with super capacitor, less than 48 h) OVD EEPROM 2 KB
Power	Rated voltage	DC10 through 30 V
	Power consumption	Below 7.2 W
	Grounding	Negative grounding method
Output power	Voltage	DC5 V ± 0.25 V
	Output for DoPa	Below 320 mA
Weight		Below 0.5 kg
Eternal dimensions (W × H × D)		141.5 × 63.5 × 88 mm (including connector)
Mounting method		Screwed from underside (M3 nut at 4 spots)

Table 2 Terminal equipment installation conditions

Condition		Specifications
Resistance to vibration		5 through 100 Hz, 21.57 m/s ² in X, Y and Z directions (applicable only to main body)
Resistance to shock		Below 490 m/s ² , 12 ms (applicable only to main body)
Range of tolerable ambient temperature		0 through 50°C
Range of tolerable ambient humidity		15 through 85% RH, No condensation
Range of tolerable ambient temperature during storage		-20 through 70°C
Surrounding atmosphere when in use		No corrosive gas around
Resistance to noise	Power	1000 Vpp Pulse Length 1000 ns
	Transmission	400 Vpp Pulse Length 1000 ns capacity coupling

(6) Function of truck-mounted terminal equipment

Table 3 shows various functions the terminal equipment is equipped with.

(7) Example for display on truck-mounted terminal equipment

Fig. 4 shows an example for the display on the truck-mounted terminal equipment.

Table 3 Basic specifications

Function item	Function
Display function	Data transmitted from the office terminal equipment or in-store data called up by operating a button are displayed in letters, numerals and marks.
Button function	Setting Work status, switching a mode and inputting data are carried out by button operation.
DoPa communications function	Two-way communications can be carried out between the truck-mounted terminal equipment and the office terminal equipment by way of DoPa terminal equipment. Protocol: TCP/IP
Positioning function	The truck's present position is located by GPS.
Function of communications with external tools & equipment	Communications with an external tool or equipment can be carried out by way of RS232C.
ON/OFF contact signal input function	A signal from an ON/OFF contact type sensor or switch is inputted.
ON/OFF signal output function	An instruction from the office terminal equipment turns a signal output ON or OFF whereby an alarm buzzer is sounded or a relay is activated.
Data backup function	Data are stored in a built-in SRAM and EEPROM.
FLASH ROM writing function	Data in the FLASH ROM built in CPU are rewritten by a switch on the circuit board or an output signal from CPU.
Power self-hold function	Power supply is controlled by turning ACC power ON or OFF. Thanks to this function, it becomes possible to turn off power supply, when ACC power has been shut down and after the shutdown process in CPU. Consequently spurious data are checked from being written in the SRAM or EEPROM.
LCD contrast adjustment	Contrast of LCD can be adjusted on the setting mode display.

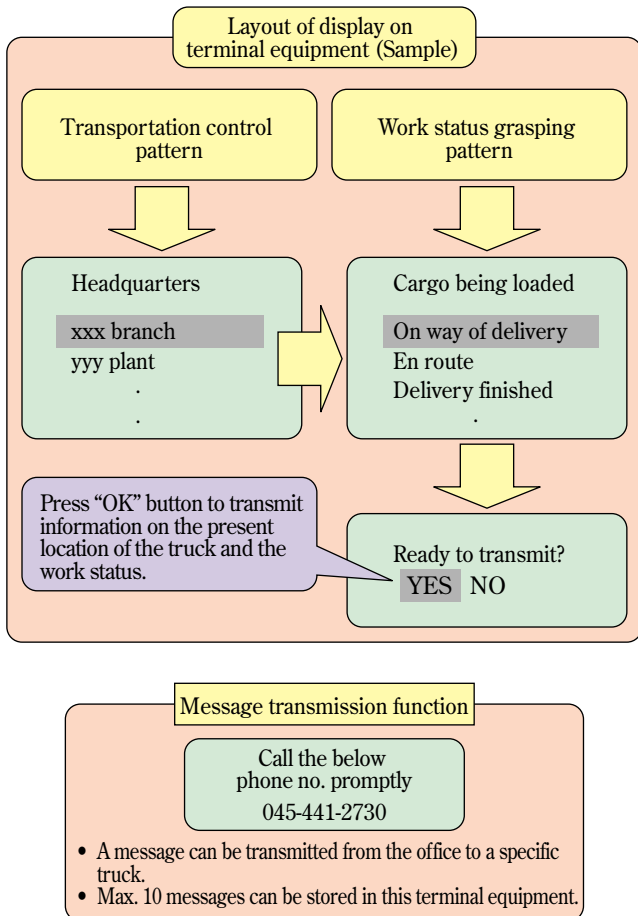


Fig. 4 Display on truck-mounted terminal equipment

3.3 Office terminal equipment

(1) Makeup

(1-1) Makeup of hardware

The hardware in the office terminal equipment consists of a personal computer with software in store and a router connected to the router in a DoPa network station with a common carrier leased line. HDD in the personal computer is of RAID 1 structure (dual HDD) for enhancing the stability. (See Fig. 5)

(1-2) Makeup of software module

The software in the office terminal equipment consists of a communications server, Web server and database server as well as a browser. The communications server carries out communications with truck-mounted terminal equipment, while the Web server transmits contents to the browser. The

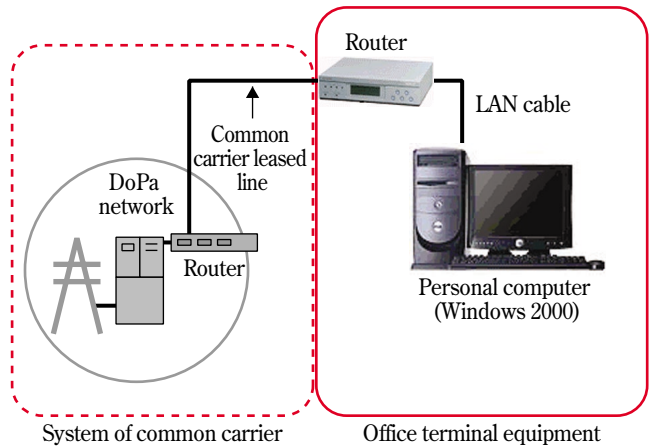
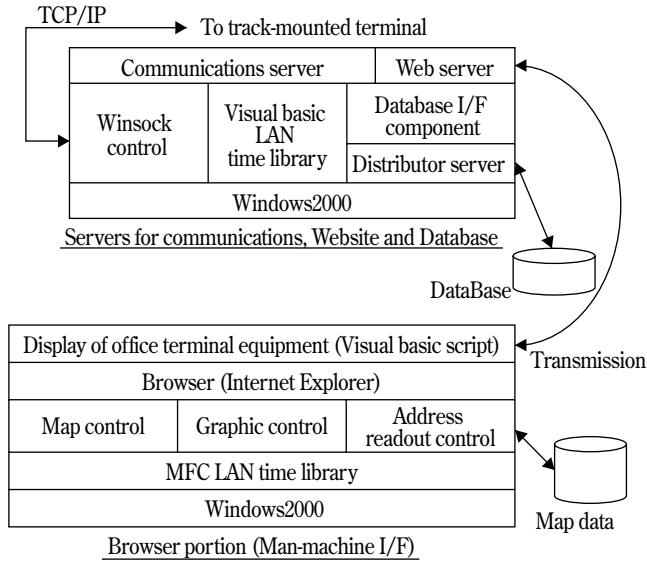


Fig. 5 Makeup of hardware of office terminal equipment

database server controls information on the truck's location and work status. (See Fig. 6)

In the KOM-LOGI Light system, all these servers are housed in a single personal computer. On the other hand, a browser can be mounted in a separate personal computer, to which a Web server transmits contents by way of the Internet. It makes easier for the system to become an application service provider (ASP) that way.



Browser portion (Man-machine I/F)

(Note) The actual makeup may partially differ from the above due to a mounting reason.

Fig. 6 Makeup of software module

(2) Features

The features of the KOM-LOGI Light system are as enumerated hereunder.

(2-1) Multi-display

Plural displays are presented to a viewer at a time, which enables him to instantly grasp the truck's location as well as work status at a glance. (See Fig. 7) It is also possible to

show all of the displays one by one, or to turn a specific display into a small one and retain it as an independent sub-window.

- ① Main map domain
This is the main display to show map data. To call it up, select either a map for the truck at work or a map for tracking a specific truck.
- ② Sub-map domain
To call it up, select either a map for showing truck at work or a map showing tracking a specific truck.
- ③ Information domain
This is a display to show history of communications and information on the truck's up-to-date work status (that selected by operating a button on the truck-mounted terminal equipment).

(2-2) Display of map showing truck at work

The display indicates the present location of each truck with an icon together with the name of a truck driver and the truck number. (See Fig. 8) At that time, the truck's work status is also shown on the same display.

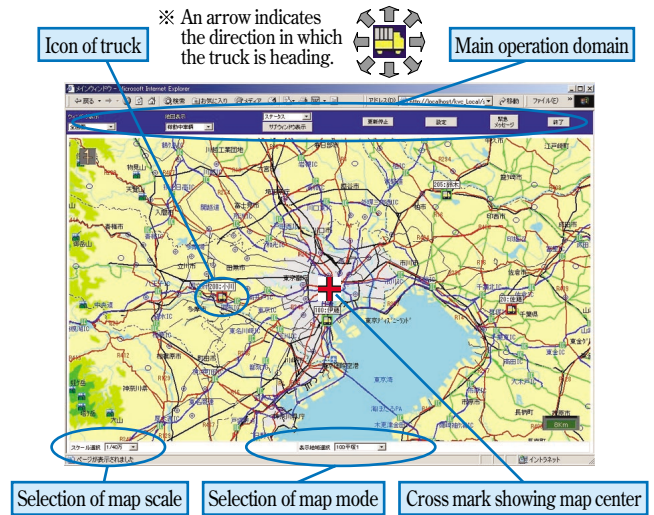


Fig. 8 Map showing truck at work

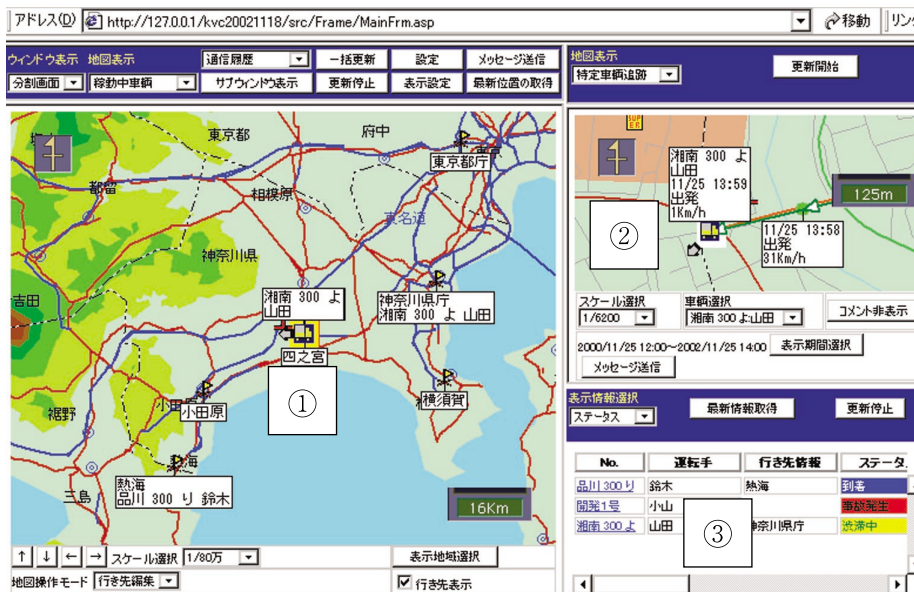


Fig. 7 An Example for multi-display

(2-3) Display of map tracking specific truck

The display indicates the truck's location in succession with an icon and arrow. (See Fig. 9) The display makes it possible for a viewer to track and monitor a specific truck and the route it has taken.

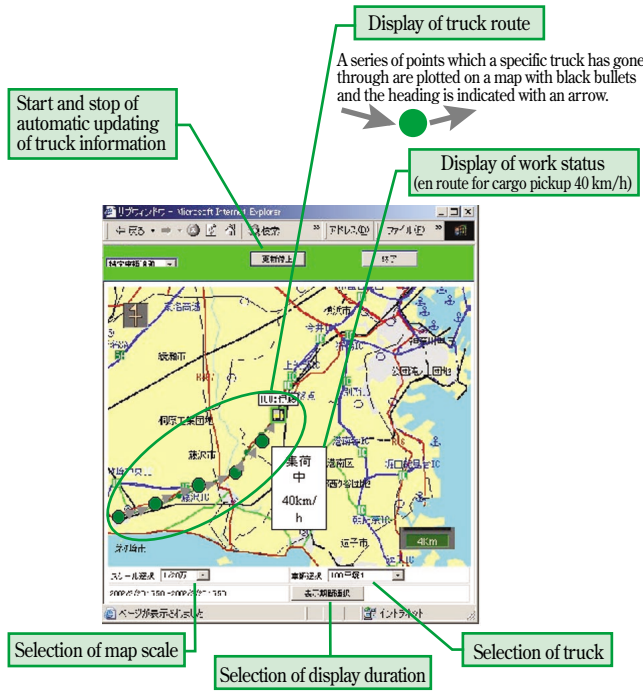


Fig. 9 Map for Tracking Specific Truck

(2-4) Display of truck's work status

The up-to-date status of each truck (the truck's number, truck driver's name, current work status, running speed, communications, point at which communications took place, etc.) is displayed in a table (See Fig. 10). This table is effective particularly when trying to find out an idling truck.

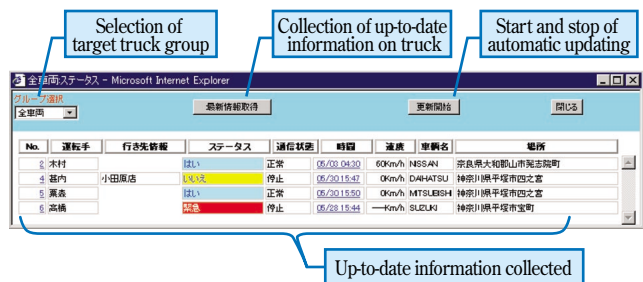


Fig. 10 Display of truck status

(2-5) Display of history of communications

History of communications with each truck (time of communication, truck's number, running speed, working status, point of communications, etc.) is shown in a table. It is possible to set the display in such way that it appears only when there has been a change in any of the contents. (See Fig. 11) It is also possible to download the history into a file and utilize as a source data for a daily report.

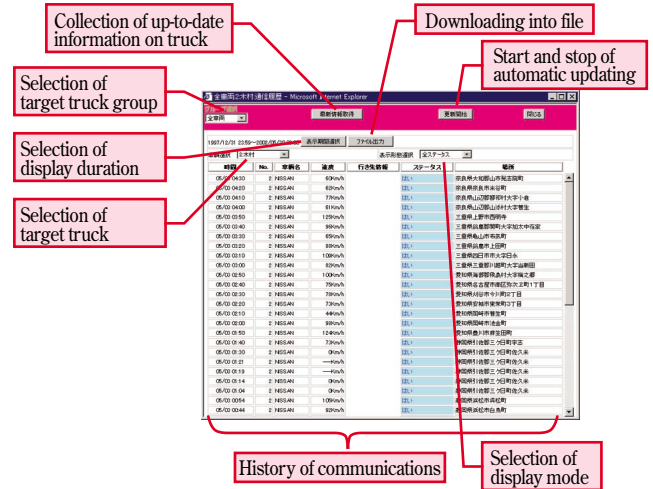


Fig. 11 History of communications

(2-6) Transmission of message to trucks

The office terminal equipment transmits a message to each truck, and it is displayed on the LCD of the truck-mounted terminal equipment. (It is also possible to transmit a message to all the trucks across the board.) Meanwhile, the same terminal equipment receives a response from each truck and shows it on the display.

(2-7) Pop-up display of emergency message from truck-mounted terminal equipment

The office terminal equipment makes a pop-up display of an emergency message (as defined in the work status) received from a truck on duty. (See Fig. 12)

(2-8) Setting of land mark on map

A land mark can be set on the stored map. It is free whether to display the land mark or not.

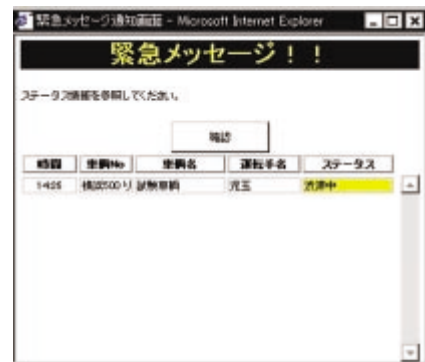


Fig. 12 Pop-up display of emergency message

(2-9) Selection of travel route

It is possible with the office terminal equipment to identify a desirable route between Point A and B on the map for a truck to take by designating a passage point and other retrieval conditions. (See Fig. 13)



Fig. 13 Display of result of travel route checking

4. Example for application

As an example for application, We would introduce a combination of the truck-mounted terminal equipment with a car navigation system. In addition to the ordinary functions of determining the truck's present position and control of work status, this combination system is capable of automatically deciding a route to the destination on behalf of a truck driver. This should contribute to enhancing efficiency in the cargo transportation. Incidentally, a message from the truck-mounted terminal equipment is shown on the display of a car navigation system, which allows the driver an access to a richer source of information. (See Fig. 14)

Besides the combination with a car navigation system, the truck-mounted terminal equipment may well be applied to a cargo delivery control system combined with a barcode reader or to a truck search system combined with CTI (Computer Telephone Integration).

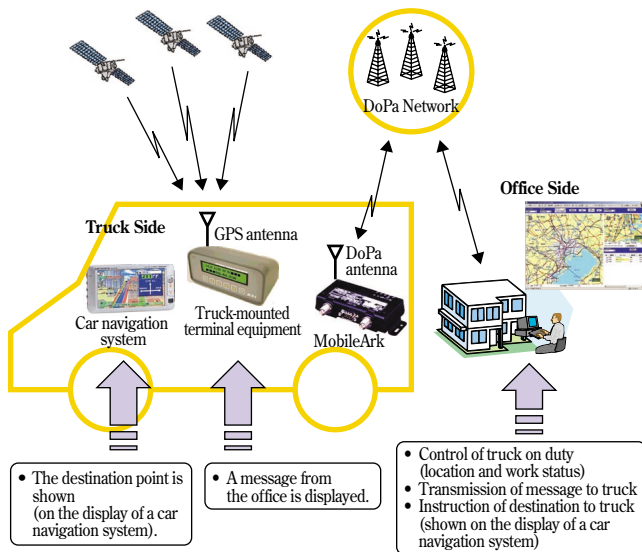


Fig. 14 Example for application

5. Conclusion

The KOM-LOGI Light system has been developed as one of the freight forwarding management systems, intending to take up customers' requirements in this area. While belonging to the freight forwarding management system, it has limited the function primarily to the control of truck's location. As a result, it is a compact system of an affordable price and should be a stepping stone to the ASP business which is going to be a new business to Komatsu. In fact, several requirements have already reached us from our customers and have been integrated into the next version of KOM-LOGI Light system, keeping the ASP business in sight.

Currently, we are pressing ahead with development of the new KOM-LOGI System of an ASP version so that its reliability and functionality are still more enhanced. Hopefully it will soon be commercialized and grow to be a pillar of our application service providing business.

Introduction of the writers



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[A few words from the writers]

The KOM-LOGI System and its successor of an ASP version are system products including servers that we at Information Control System Div. have developed for the first time. In course of the development, we encountered necessity for revising the specifications and software-related troubles more frequently than we had originally anticipated, and frankly we are having a great trouble even now. But at the same time we are sure that the system will grow to be a pillar of the corporate business that will make a big contribution to the increment of sales and profit. We will push forward with the development with a bright vision until our dream comes true.