A Development of Controlling System of Harbor Terminal using on the Commercial Network

Yong Ho Kim¹ and In Cheal Yoon²*

¹Department of Self-designed and Open Majors, Gwangju University, Gwangju, Korea, 503-703; multi_kyh@gwangju.ac.kr
²Department of Logistics and Distribution Management, Gwangju University, Gwangju, Korea, 503-703; yic1218@gwangju.ac.kr

Abstract
This study researched on the operational management system of harbor based on the commercial network. In order to improve a work efficiency and to save operational costs of harbors, a superintendent who manages every working operations at harbor is able to conform rapidly and cope with circumstances that is required supporting equipment in case of working delay through this system. The confirmation of location information with the help of real-time GPS makes it possible to provide accurate location of yard working equipments compared to the existing way that is used on input information of start and finish working conditions based on real-time location information of GPS system. It is possible to think about existing Y/T Pooling and monitoring system together and it will be anticipated to improve more productive capacity of harbor. The input method of conventional wireless terminal is just used by pressure sensitive touch. The operational management of harbor is a considerable improvement on those currently use because the introduction of electrostatic touch interface and the usage of vast application of tablet are able to change the method of communication as well as the method of work process. The harbor operational system differs from its building environment and the method of supplying information according to its operational system. But the introduction of operational system based on tablet using commercial network make it possible to anticipate to improve the quality of harbor service due to the way that the external information such as a shipping and cargo company as well as shipper is easily accessible to PC or tablet.

Keywords: Commercial Network, Crane, GATE, Port Operation

1. Introduction
The quantity of goods transported all over the world is being increased continuously due to globalization, multinational production center, rapid economic growth, and newly rising Chinese market. The 97% of it is relay on marine transport. The container transported by sea is being stored temporarily and being controlled at a harbor yard before sending to other areas. The conventional harbor system is composed of Berth, Yard, Gate, Gantry crane, Trailer, Yard crane, Reach stacker, Top handler, and Fork lift. Their communication system between operation system manager and workers is used by the built in industrial PDA with connectivity of Terminal Operating System. According to gathering the information of work result through the industrial PDA, a operation system manager is monitoring the working schedule the planner established. In case of working delay and supporting equipments, he can also cope with the situation to provide required equipments at the spot. But the communication system is sometimes unstable due to so many shadow areas because of the containers blocks even though there have already installed wireless network inside the yard¹².

A operation system manager uses industrial PDA which is provided with information that is collected data of final work results. It is very difficult for him to make a decision of changing the working schedule as well as to supply the required equipment properly in case of supporting equipments and working delay. Also the industrial PDA which is used in harbor areas is not proper because the cost for
maintenance and its fixed software specification including user interfaces have so many inconveniences. In this study, the relatively small terminal which is more cheaper than the present industrial PDA is developed and used for the purpose of reducing the harbor operating costs.

2. Related Research

In stead of existing PDA used in harbors and ships, the technology which is using a smart phone is developed. The Dongle for smart phone only is adapted to control and manage a communication to the managing server through the Wi-Fi and 3G network. But the information which is being deal with the reliability improvement of container’s information and its monitoring conveniences is confined. The loading and unloading of existing transportation service system in harbors are started when the vehicles get through the gate. The outside vehicles are received the working information which is confined at a block-bay inside yard that is occurred loading and unloading. The limitation of these information makes the outside drivers difficult to predict preceding time of loading and unloading. And it causes them a complaint because they have to stay there as a consequence of traffic congestion without any notice.

3. The Development of Harbor Terminal of Container

3.1 Exiting PORT System

In order to communicate the wireless network built to communicate between harbor automation equipments and the control system at the existing container terminal, the wireless communication network of 802.11(a/g/n/ac) is setting up. This method differentiates among coverage according to frequency range. There are under many restrictions to build fast speed wireless network because the hindrance there such as many containers and buildings makes it difficult to communicate due to using a high frequency range of transmission bandwidth. Also an additional antenna covering 2.4GHz and 5GHz is necessarily installed in order to improve a sensitivity of receiver. Sea breeze and rain is really bad for a lot of electrical devices and it will corrode and destroy circuit boards gradually. A roaming is inevitable among the access points when a communication is being out of service area that makes the shadow of radio at shown in Figure 1.

For the purpose of the computer processing of harbor automation equipments, the installation of optical fiber cable of yard and C/Y and the setting up a wireless AP as well as industrial PC are necessary. Managing the separate system independently requires manpower and operating cost. A discontinued model of equipment is bound to happen. In order to improve such problems, the managing system based on tablet using optical fiber communication system is necessary.

In case of harbor working at the point of border that occurs roaming, the connected terminal is automatically search the access point according to the quality of signal and other conditions. This makes it happen to delay the working information and reduce the productive capacity of harbor. There are installed multiple wireless access points at an existing system of container terminal shown in Figure 2. The area of shadow of radio is occurred when the signal is out of the access point that is provided.

The occurrence of hindrance in the wireless network shown in Figure 3 makes it possible to have the phenomenon of disconnected communication against a certain area or whole area. In other words, the recovery delay is occurred until access point that happens hindrance is changed and its problem is solved. When the equipments of L2 switch is something wrong such as hindrance the entire wireless network may occur problems. The yard truck for supporting unload working of Ganty crane is to move to Wi-Fi zone due to the difficulty of access Wi-Fi zone.

For the purpose of the computer processing of harbor automation equipments, the installation of optical fiber cable and building wireless AP as well as industrial PC are necessary. Managing the separate system independently requires manpower and operating cost. A discontinued model of equipments is bound to happen. In order to improve such
problems, the managing system based on tablet using optical fiber communication system is necessary.

The existing system of container terminal is composed of control system and automation equipments of harbor yard. As shown in Figure 4, their networks are largely relying on wireless communication. Those equipments are supposed to acquire the information of working accomplishment or store its results to the control system through Wi-Fi zone that is forming multiple access points. There are automation equipments for harbor yard such as T/C (Transfer Crane), Y/T (Yard Truck), R/S (Reach Stacker), T/H (Top Handler), F/L (Fork Lift), and G/C (Gantry Crane) as shown in Figure 5.

### 3.2 A Operating Management System Based on the Commercial Network

A operating management system based on the commercial network that is described in this study is shown in Figure 6.
A Development of Controlling System of Harbor Terminal Using on the Commercial Network

circuit-switched base. This network is provided with distinguished QoS for the real time and non real time service so as to strengthen the managing function of QoS.

Thanks to adapting the technology of smart antenna, a bandwidth expansion for radio communication is being provided. LTE-A commercial network can support the broad bandwidth up to 100MHz. The technology to achieve broad bandwidth which is adapted multiple frequency block is used for carrier aggregation or bandwidth aggregation.

In this study, the built in industrial PDA with connectivity of Terminal Operating System is properly converted to Android operating system. And the additional software which is needed to deal with working information such as loading and unloading, taking in and out of containers throughout the gate including the working information of a mother ship is developed.

4. Conclusion

With the help of harbor operational method of container terminal system using the commercial network, the problems of self-built wireless network at the existing container terminals would be able to improve in this study. Firstly, the phenomenon of process delay could be improved. Roaming is inevitably occurred between the points of wireless access in case of out of wireless service. The connected terminal device searches access point automatically again and again according to signal quality and its environment when the harbor operational works are being processed at the boarder of occurring roaming. This process makes the occurrence of the phenomenon of working process delay. After all, this can cause reducing the productive capacity of harbor.

But the harbor operation will be stabilized at the area of wireless shadow in case of using commercial network which can be roaming freely and providing more larger coverage at 3G/LTE/LTE-A shown at this study. There is no worry about occurring of roaming.

Secondly, it is possible to cope with problems actively. When the problems were occurred in the existing wireless system the interruption of communication may happened all areas or some. But in this research, it makes possible to cope with interruption flexibly using commercial network for the purpose of immediately conversion of communication network (3G->LTE or LTE->3G) according to the condition such as direct connection of terminal device from other base station or the support of communication method of terminal device.

Therefore, due to build the virtual private network and use the terminal device at the working of harbor in this study, the work for a mother ship as well as loading and unloading of container including taking in and out of it are capable of increasing the efficiency of working because of not only building the equipment of virtual private network but also applying and using the terminal at harbor. The basic features of terminal such as providing GPS information are transmitting and receiving text message including push alarm message. These functions help to increase the work efficiency. Instead of using the existing industrial PDA which is expensive for purchase and maintenance, a relatively cost effective terminal makes it possible to reduce the operating cost at harbor.

5. Acknowledgment

This Study was conducted by research funds from Gwangju University in 2015, Korea

6. References

1. U.S. Department of Energy, Solid-State Lighting: Brilliant Solutions for America’s Energy Future. 2011; Available from: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_brochure_june2011.pdf
2. Schwarz FC. Time Domin Analysis of the Power Factor for rectifier Filter System with Overand Subcritical Inductance. IEEE Transactions on Industrial Electronics and Control Instrumentation. 1973; 20(2):61–68.
3. Kelley AW, Yadusky WF. Rectifier Design for Minimum Line Current Harmonics and Maximum Power Factor. IEEE Applied Power Electronics Conference (APEC) Proceedings; 1989. p. 13–22.
4. Dewan SB. Optimum Input and Output Filters for a Single-Phase Rectifier Power Supply. IEEE Transactions on Industry Applications. 1981; IA-17(3):282–88.