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CONTRIBUTION TO CROSS-PLATFORM PROGRAMMING IN INTEGRATED SHIP'S SYSTEMS

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ABSTRACT
Integration between maritime industry and ships' current operation is increasing. It can be seen as on-line access of on-shore company's monitoring team to all ships' systems. It is enabled by satellite link and modern communications. This paper deals with advances in integration of all ship's systems, which leads to Internet of things aboard and Internet of everything when linking to land through integrated communication systems. We propose Ship's Internet of Everything (SIoE) and usage of RFID technology to identify who is giving and who has to execute commands. In order to implement such systems and enable access from any point, cross-platform programming should be used, which is discussed further.
Keywords: object programming, integrated information systems, cross-platform compatibility, Internet of things, cyber-physical systems (CPS)

1. INTRODUCTION
Advancements in cloud storage and computing as well as in communication technology, as support, lead to tremendous opportunities in information technology for maritime applications. However, such opportunities need planning. Since various services could be on various platforms, there is possibility of incompatibility. Hence, integration of such services into large compact virtual system could be a challenge. This is obvious that this could not be accomplished without multiplatform approach.
When dealing with software requirements, ability to function in different environments should be normal in future. This could be obtained by cross-platform code. Hence, it is important that students/trainees develop such skills. Of course, these skills are not necessary for people, which will work onboard freighters or passenger ships. Developers in biros, offices, shipyards and military should be interested in such skills. These skills will also help in finding jobs in onshore and IT businesses. There are many possible/ongoing applications, which could be integrated on board ships, shipbuilding and maritime R&D sectors, maritime companies, as well as in education of engineers in maritime field (machine, electrical, nautical).
This paper is organized as follows. The second section overviews some references in the field and close related and similar areas. The third section describes the proposed SIoE. Finally, conclusions are given.

2. LITERATURE OVERVIEW

Ships' systems are mostly integrated nowadays. However, there is a lack of specific literature in topic of this paper, which is application of Internet of things/everything in maritime application with cross-platform approach. Although, there are many references dealing with some areas or solution, there are not much relevant references in integrated ship's solutions for cross-platform integration and automatization with respect to giving commands from different platforms to different executing control systems. Importance of web based development is shown in [1] and archiving in [2].

A study of key technologies of shipbuilding virtual enterprise information integration oriented agile manufacturing is given in [3]. It proposes usage of XML (eXtensible Markup Language) technology (interchange data in the form of objects between application programs according to SOAP (Simple Object Access Protocol) agreement and to use WSDL (Web Service Description Language) to define a standard representation mechanism of components based on XML). In [4], authors proposed usage of XML, but also JAVA VM (Virtual Machine) and API (Application Programming Interface), and cross-platform kits. Agent-based development strategy is choosen to model busniess process [5] in general and fusion integration based on enterprise engineering. However, it is not specific for maritime industry / applications. Model driven engineering is proposed in [6]. Of course, it is also not specific for maritime enerprises. Prevericiation and prevalidation requirements were considered in [7]. They proposed a framework for these actions in project stage before integration. It was derived from increasing need for selfgoverned assistance in geographically distant maritime activities. On the conutratry, our proposal in the next section proposes cross-link of various systems when there are already installed. Integration of advanced communication and cyber systems with physical systems leads to CPS in maritime applications. Maritime CPS incorporates wireless communications, control, and information technologies [8] in real-time mode for distributing sensing, computation and control of physical systems by cyber module. Security and sensitivity to cyber attacks is discussed in [9], where ZigBee security platform is considered.

Table 1. Some tools for cross-platform programming and comments.

Tool	Based on	Application field
MoSync (www.mosync.com)	Native (also C++, PHP, Python, Ruby, Java)	Cross-platoform mobile apps (windows, lynux mobile, android, iOS, iPad)
Whoop (www.whoop.com)	WYSYWIG interface	Windows Mobile, Symbian Blackberry, Android, iPhone, and other major mobile OS's
Appcelerator (www.appcelerator.com)	Web technology to allow cross platform compatibility between platforms (Java based). The native apps are derived from technologies such as HTML5, CSS3, JavaScript, PHP, Python and Ruby	Rendered on the mobile via browsers.
Widgetpad (widgetpad.ndl.cc)	web-based platform	Some problems in Andriod. New version overcomed these problems
RhoMobile (www.rhomobile.com)	Ruby	Windows Mobile, Symbian, Android, iOS and RIM. Noe offers RFID and bar code scanning APIs. Open source
PhoneGap (phonegap.com)	Distributed systems technologies and web shortcuts, i.e. JavaScript, HTML, CSS3	Android, Symbian, Palm, Blackberry, iPhone, and iPads
Xmarin (www.xamarin.com)	C++	iOS, Android, Windows, open source
Haxe (http://haxe.org/)	Haxe programming language (similar components as C++, Java, PHP)	All platforms and systems, open source
JDeveloper Studio (www.oracle.com/technetwork/developer-tools/jdev/downloads/index.html)	Java	All platforms and systems
Gtk+ (www.gtk.org)	C++	All platforms and systems
Qt (https://www.qt.io/download)	C++	All platforms and systems

In order to implement cross-platform approach to the paper's topic, several tools were considered. Table 1 presents these tools, foundation of tools (the second column), and com ments regarding platforms, problems and open source for development (the third column).
Finally, we should mention reasons for IoT usage (www.microsoft.com):

- start with your things,
- get more out of your existing assets,
- make small changes (see a big impact),
- improve efficiency,
- connect any asset,
- enable innovation,
- increase agility,
- build the ability to scale,
- transform your business, and finally,
- choose an enterprise-proven IoT partner.

3. PROPOSED SIoE/SIoT

In this paper, we propose implementation of Ship's Internet of Things (SIoT) and SIoE to integrate all ship's operations. Figure 1 illustrates such a system. Ship's systems are integrated, which means connected via LAN, nowadays. There are: sensor networks, integrated bridge systems, integrated engine room systems, etc. Interconnection of such systems is not novel. Crew members and passengers possess smart phones nowadays, but there are almost useless far away from land (short range of base stations – no signal at sea during voyage). But, people still have theirs phones. If we install a local wireless network, smart phones can be useful for ship operations. Crewmembers can use smart phones to access controls of various systems or to monitor operations in progress. Furthermore, smart phones can access smart sensors data to check important parameters necessary in making decisions, such as in emergency situations.

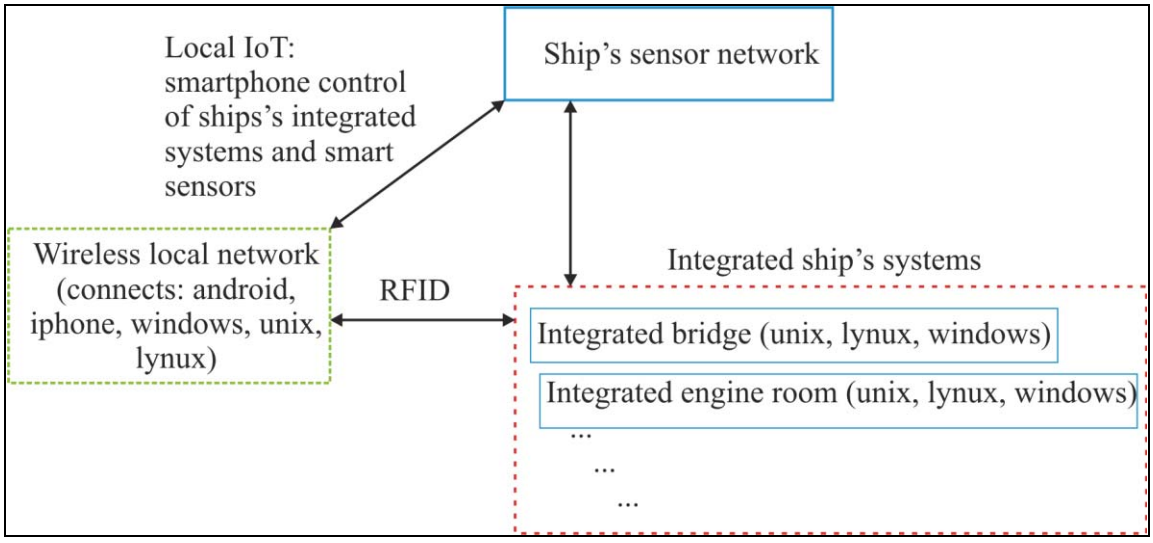

Figure 1. Ship's local Internet of Things and interaction with integrated systems.

Such application of smart phones over ship's local wireless network can be limited due to incompatibility of various phones with specific agent smart apps. Therefore, it is vitally important to use cross-platform applications, which could be developed by cross-platform tools (see Table 1 for some examples). In order to archive history of commands, and also to restrict rights to those who are allowed to command, all systems should use RFID (radio-frequency identification). Every crewmember should have his/her unique RFID code, which will be used to identify if such person can give command to specific device/system.
Benefits of such system are obvious. For example, flow of cargo can be monitored and controlled by scanning bar codes (in case of containers, cans, pallets, barrels or similar cargo or even in case of

scanning tickets). Read parameters can be input to monitoring cargo station. However, it could be downloaded to smart application of the responsible crew member (i.e. executive officer). Furthermore, a ship's company and/or customer can monitor a progress of passenger/cargo embark/load or disembark/unload.
Future programming of Ship's Internet of Everything (SIoE) should include privacy and security through cross-platform software support.

4. CONCLUSIONS AND DISCUSSION

Multiplatform programming has additional issues in security of applications and users. For example, some code can be virtually safe in one platform, but not in another. This opens holes for security breaches. Since maritime systems connect computers and real physical systems, it could present risk to use real systems to make intentional damage or casualties by adversary of any kind.
This schematic implies that cross-platform programing should be used, because various crew members do not have same types of smart phone and OS. However, a company can give official smart phones of the same type to crew for the official use, which would make problem less complex. Cross-platform programing is still important, but it is reduced to operating system (OS) of the ship's systems (which could be design to be the same) and to the OS of smart phones. This means only cross-platform programing to two OSs. This is more secure, because there are fewer places for breaches.

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