Possibility of using satellite communication technologies for remote maintenance in marine industry

Review

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ABSTRACT

Use of satellite communication technologies and its development in ship remote maintenance system have been analysed in this review. There were succesfull trials of that kind of maintenance experimented in aircrafts and on the space crafts After that, the experiments were succesfully done on submarine vessels. Projects for ships remote maintenance that have commenced in Japan and France were listed and explained in this review as. It has been analysed robot use for ship remote maintenance in two projects, called Octopus and Justin. Two different maintenance types were explained. The first one was maintenance that alerts and controls ship systems. Another type of maintenance is to use satellite communication technologies for real repairs. Main point of remote maintenance from the land stations is to prevent failures by detection.Wireless connectivity is in use on the newest and biggest cruise ship of the world, Oasis Of The Seas. That project called Digital Seas has been explained in the followed article .

Key words: ships maintenance, satellite communication technologies, wireless connectivity, robot, amount of ship crewmembers

INTRODUCTION

The base of ships remote maintenance is in common technology improvement of this age and that technology enters the life on the ships as well.. Remote maintenance means repairing management and routine remote checks of ship system functionality. Wireless connectivity, computing technology and satellite communications technology in common life is at the highest level of use ever. There are different analyse aspects of the ship remote maintenance. On one side shipowners, on the other side insurers and the ship operators. Ship operators are crewmembers on the ships and remote maintenance team members on the land.
Human factor is always the most important factor in the shipping industry. The last one of the human factors in this chain of maintenance is a crewmember that decides as the latest one. He does avoid collision, prevents or creates pollution and he suffers accidents and injuries. Crewmembers suffer reduced ammount of man power caused by technology improvement. The reason of more and more accidents is lack of people on board the ships today. The other consequencies are increased ammount of jobs per person and worse quality of ship maintenance and ship operations itself. The answer to the requests for the retreival of

crewmembers ammount is appearance of the robots. Robots are already in the marine industry since the beginning of this milenium.

The use of robots improves every day as well. Some scientists have proposed that artificial inteligence will overtake human inteligence for approximately 35 years.. We are living in that future already. Examples are in this review [1]

Possibilities of remote maintenance were experimented in space crafts and air planes, submarines as well. There are some projects of ships maintenance from the land, using satellite communication availabilities. Projects, success of those projects and possibility of that implementation to the whole marine industry are still ongoing and depend on the scientific improval of communication technology.

PROJECTS OF SHIP REMOTE MAINTENANCE

Project JRC (Japan Radio Co.,Ltd.) is based on sale of their products (units in communication chain system) and maintance of those products from the land maintenance stations. Required equipment that JRC obligates the ship to be equipped with is Remote Maintenance Server that operates via Inmarsat satellite. It is necessary to connect only one JRC Fleet product to get into the Remote Maintenance System. Those products are Fleet F77(JUE-410F) i FleetBroadBand (JUE-500) .

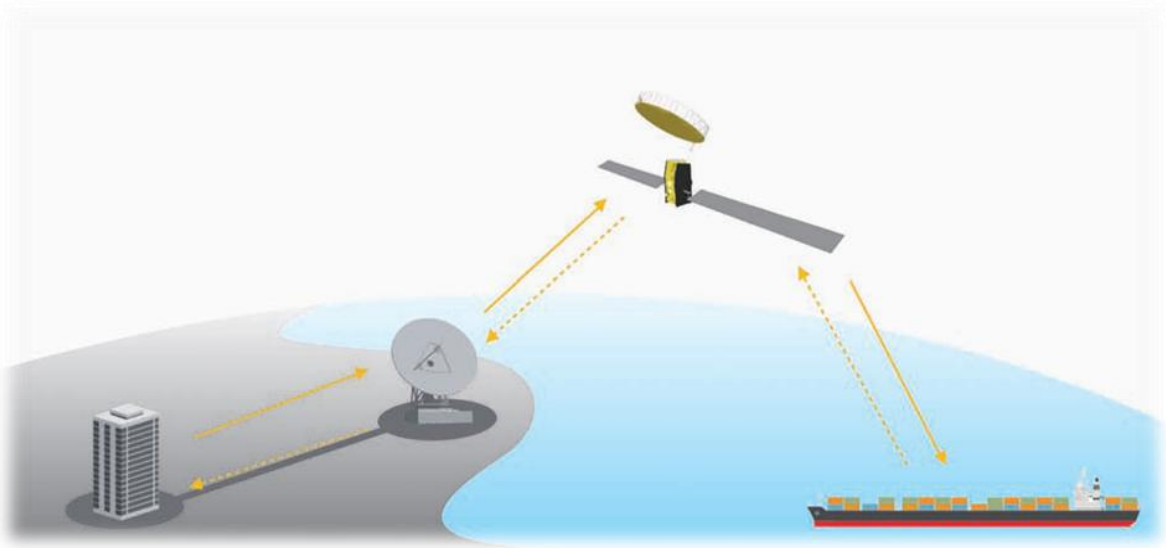

FIGURE 1 Any bandwith connection vision

The educated servis team connects to ship systems using sattelite communication and analyzes failure. Accredited technician can remotely link onboard the vessel to inspect, analyse, resolve and take follow-up action for next port attendance. JEG system is present all over the world and their technicians are able to come to each port and resolve the failure or just to resolve the problem. The strategy of Japan Radio is to keep all of this activity cost effective. For better understanding of this cost effective maintenance system is important to say that remote maintenance teams are located in Canada(2), USA(9), South America(6), Africa(6), Europe(17),Australia and Polynesia(5), and in Asia(18). There is just one emergency phone number to call from anywhere to get their support Today, JRC offers comprehensive assistance through its organisation, in partnership with a worldwide StarNetwork of over 270 fully trained and qualified partners and agents, assisting 24 hours a day and 365 days a year.

The system automatically monitors onboard equipment which allows for quicker repair and maintenance. It is designed to monitor failures, allowing for immediate advice for onboard action. This system provides a highly user protected satellite connection between shore and vessel. The system is highly user protected, preventing un-authorised access by any other person or compeeting company. [2]

Project France Telecom(France Telecom Mobile Satellite Communications) presents in offer Remote control for SkyFile Mailfull with control of the onboard email-configuration and no action or expertise required. Remote maintenance gives full access to the remote PC, connecting remote and land PC into one network and operates via Inmarsat B-HSD, using same equipment as Japan Radio Co. Ltd. offers in their project. [3]

Project ROHMS (submarines project) is the Remote Off-Hull Maintenance Support (ROHMS).That is the "web services" component that enables authorized personnel at an off-hull maintenance location to execute predefined queries for system maintenance related data, retrieve that data through a Secret Internet Protocol Router Network connection, and provide feedback to the on-hull system or system operator. This capability enables shore-based technicians to conduct system assessments and troubleshoot problems reported via casualty reports or through any other means of requesting fleet technical assistance. Additional capabilities include off-hull analysis of system performance to identify degrading trends before any system "down time" is experienced.
The ROHMS experiment demonstrates the potential of applying this capability to supporting the maintenance, manning, repair, and upgrade of the submarine fleet. This project created a system and explored the Concept of Operations needed to apply remote distance support to underway platforms; to enhance undersea maintenance and status information flow. There is a clear need for technologies that enable remote, distance troubleshooting, and assessment. ROHMS leverages advanced technologies to produce a new maintenance, status, and repair capability for submarine Combat Systems. [4]

Project ICAS remote monitoring has commenced on year 2003, installing monitoring softwares on the ships to detect failures of the engines before the failures make damages. The Integrated Condition Assessment System (ICAS) is a Commercial Off the Shelf (COTS) software product for which the U.S. Navy holds License Rights. It is a shell type architecture to allow for varied implementation of machinery monitoring andcondition based maintenance. Presently, ICAS is installed on approximately 100 U.S. Navy ships. At first, the monitoring programs were installed on submarines and aircrafts, then on the ships. integration with Distance Support has enabled and promoted the ability to remotely monitor systems from shore side. The ship may have no knowledge of the problem and the shore infrastructure informs the ship of the problem. The Maintenance Engineering Library Server (MELS) is a common shore side database where statistical analysis can be accomplished to further maintenance savings and to gain a better knowledge of equipment operation. Integrated Performance Analysis Reports (IPARs) is part of projected plan of getting the data to the Regional Maintenance Center's (RMC's). Regional Maintenance routinely provide feedback to the ships via the Integrated Performance Analysis Reports. Data automatically collected on these ships has saved thousands of man-hours through the automation of performance monitoring as well as time saved through the automated diagnostic features of the software. [5]

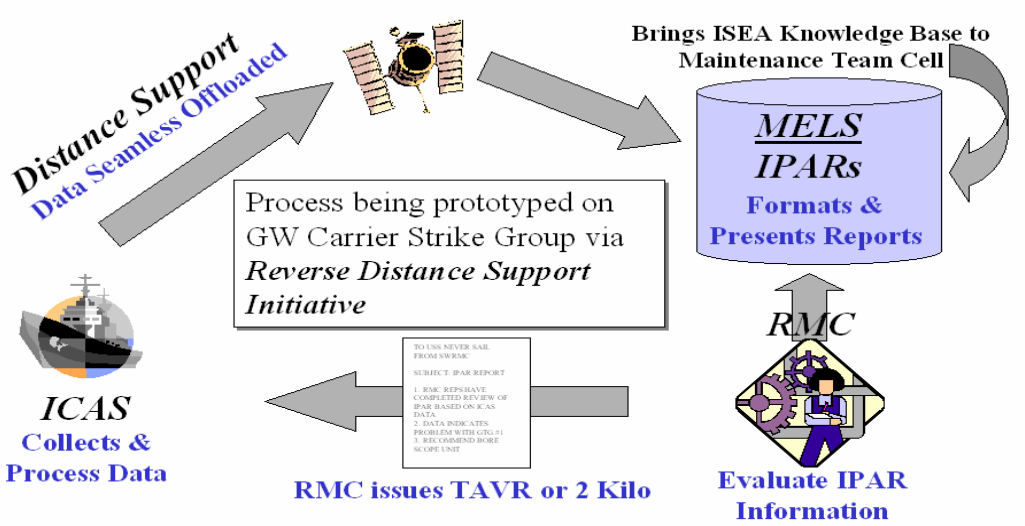

FIGURE 2 ICAS Remote monitoring vision

The case of the US Navy M/V ″0DDG-91″ offers a perspective of cost savings. The vibration problem (2004.) was identified approximately one month after the engine's (new construction) warranty had lapsed. Because ICAS was installed on the ship collecting data, it was discovered that the problem was actually present almost twelve months prior. Figure 3 shows the historical details of the vibration issue on the M/V ″DDG-91″:

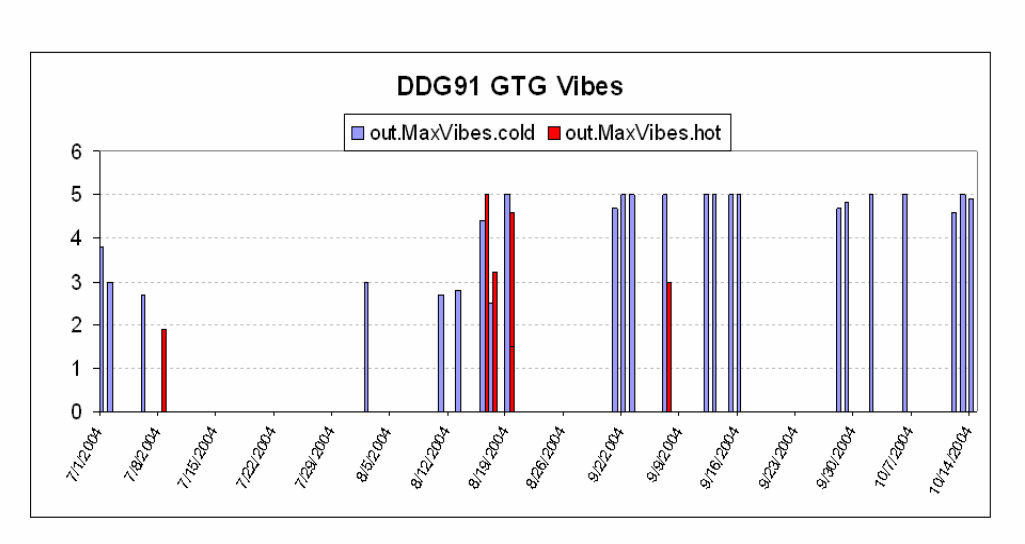

FIGURE 3 Vibration History (problem discovered 12 months prior)

The future goal of this project is to be able to find and fix 100 percent of all ship's capable repairs. Another goal of researches is to find and fix as many off-ship repairs as possible, also to identify and document necessary repairs for next planned dry dock maintenance. [5]

Project Digital Seas (communication project, 2010.) is ongoing project of Mobile Telecommunication Network(MTN) and AT&T telecommunications company on a newest and largest cruise ship today. There , for *massive communication*, is in use a bandwidth with 10 Megabites per second for the internet, 1.5 Mbps for mobile phones, 2 Mbps for video

streaming and 3 Mbps for voice and corporate data. Gateways can support more than 40 simultaneous satellite phone calls. This allows guests and crew to make calls directly from their cabin phones. Not only is full mobile phone coverage provided, but the coverage from Wireless Maritime Services (WMS) – a joint venture between MTN Satellite Communications and AT&T Mobility – relays voice and data traffic from phones, Blackberrys and iPhones via the satellite network. MTN has also provided ongoing supervision and maintenance of the system. A ship's movement on the sea creates a high level of multipath fading as radio signals reflect off the water. To counteract this, the antenna must be stabilised with reference to the horizon as well as the heading of the ship, to ensure it remains pointed at the satellite transmitting and receiving the signal. Installing MTN's satellite communications aboard the Oasis of the Seas provided the highest bandwidth ever used on a single ship in the history of the cruise industry, the total bandwidth was over 26.6 Mbps, while a communications system was installed that uses two separate stabilised C-band satellite antennas.These dual antennas boast automatic beam switching technology supported by MTN's global shore network infrastructure. This prevents outages from satellite blockage, because the antennas can simultaneously track two different satellites on this global C-band network, enabling the ship to transition seamlessly from one satellite footprint to another without any disruption to the service.
According to MTN, the teleport will offer better network efficiency and reliability, thereby improving the firm's customer service offering to the cruise industry.Clearly, customer service is driving innovation when it comes to connectivity aboard luxury cruise liners. Service providers continue to push the technical boundaries, while ensuring that their offerings justify themselves in terms of recouping financial outlay. [6]

FIGURE 4 Digital seas project (2010) with the highest bandwith ever

Project Octopus is an example of a remote control maintenance of ship's hull and topside. That is an outcome of the industrial research project funded by European Union from 1998 till 2001. It is an fully automated remote controlled robot dedicated to ships' hull and topside mostly used for hydro-blasting in dry dock environments. The developed robot is cost effective with a concept specifically adapted to large and vertical surface cleaning tasks. The Octopus robot can crawl along vertical surfaces of the ship through the adoption of advanced software and hardware. Adherence to vertical surface by magnetic force is to ensure the absence of hazard in case of power breakdown. It has been in use in Lisnave shipyard in Lisboa, Portugal and in Genoa, Italy. [7]

The future research of this project would take off the electric cable and improve the solar energy use. Telepresence from an drydock control room or from Chief Officer's Office on the ship should make this robot more effective in derusting of hull surfaces. Hopefully, this

could become a cheap robot in the future, but reducement of the crewmembers ammount is to be expertized before the race for profit would overtake those decisions.

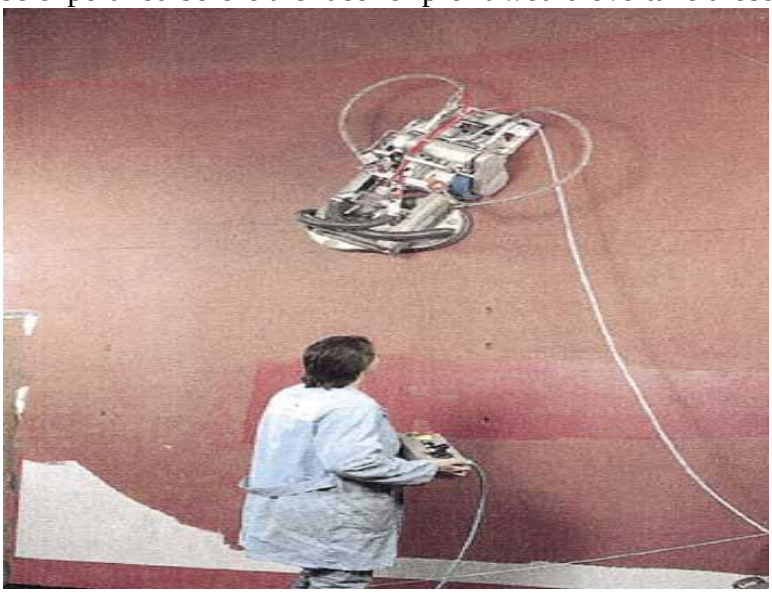

FIGURE 5 Robot Octopus on the ship's hull

Project Justin is about the telepresence robot. Justin is an interesting robot that was manufactured by the German Aerospace Center, where he was specially designed to repair satellites. He can't do this alone since he will need to be controlled by a human hand via telepresence. Justin boasts stereoscopic vision as well as highly sensitive mechanical fingers that lets the user benefit from a high degree of control dexterity where technical repairs are concerned. No annoncements of pricing or launch date just yet. That performance of this robot could be in use for any industry, shipping industry as well.[9]

[8]

[9]

FIGURE 6 Telepresence robot Justin

CONCLUSION

There is evidently remote ships maintenance possibility. It can be done from the shore side supervision maintenance centers. Projects in this review confirm it. Project Digital seas has shown that video link in 40 canals is already possible today.

Project ICAS proved that all data could be sent off the ship with no user intervention, enabling a steady flow of data. Analisys Reports from the ships are being already automatically created, and reviewed by human experts in Regional Maintenance Centers (RMC) and provided back to the ship with recommended maintenance actions. Maintenance actions based upon an evidence of need. The centers use these processes and tools as part of their daily task to support and maintain the Fleet. There is no longer a need for the people from RMC to physically visit the ship, or even be in the same location as the ship, to determine the health and readiness of a system.. If an expert is not available at one maintenance center for the review, the analyses report could be reviewed by the other center across the country. Maximum benefits can be obtained from the ever-changing field of technology and the continuous advances. [5]

The use of the remote maintenance thru satellite communication could (if well implemented) solve failures on the navigational bridges of the ships. There could be overtaken failure(or detected prior) in loto f remote commanding pannels with graphical indication : remote fire door closing pannel, remote bulkhead valves pannel, remote ballast operations pannel and many other systems that sometimes get stack, frozen, not in function and short-circuited.

For sure next crucial advance will be using telepresence thru a robot for better derusting and painting surfaces(Octopus) by commanding and telepresentation of ship's or drydock crew. Telepresence of experts on shore side for repair of failures and to change broken parts. Off course, remote monitoring system is not existing to allow any damage that could be repaired by telepresence robot. It exists to remotely detect failures even 12 months in advance, as it has been shown in this review.

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