

On-board Communication Challenges

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ABSTRACT: The main objectives of the MarCom project (Maritime Communication, broadband at sea) are to investigate the main user needs and requirements to communication technologies within the maritime community. An important part of this is providing on board services to the crew, passengers and ship operations. In order to facilitate the MarCom project will propose a Generic Scalable Service Platform to handle the ‘nuts-and-bolts’ of communication. Development of this platform presents a series of challenges and considerations presented in this paper.

In this paper we will indicate what challenges and possibilities this implicates for a solution for On Board LAN (Local Area Network), SOA (a WebService Oriented Architecture), and wireless communication.

1 INTRODUCTION

The main challenge in the MarCom- project will be to find out how to adapt existing and emerging land based communication technology to the limitations that maritime use entails: Enormous areas to cover, poor or no infrastructure on land, low density of users and limited willingness to pay for services.

The solution lies in integrating the different technologies, develop solutions for multi hop and ad hoc networks between stable and mobile units, and an Information and Communication Technology (ICT) architecture (software and network) that allows for variation in service quality.

In addition one must stimulate increased use of communication services on board in order to get a broader base for payment.

This will be done through the development for several new applications for use on board.

We will exploit the synergy between low cost wireless communication ship to shore and ship to installation at sea (oil platforms etc) on one hand, and Wireless Local Area Network (WLAN) on board on the other hand.

Accordingly we have launched the following three R&D priority fields as the most important in the project: (themes of this paper in bold)

- Communication ship to shore
- A generic scalable ICT service platform

- Optimized maritime mobile and wireless LAN-solutions

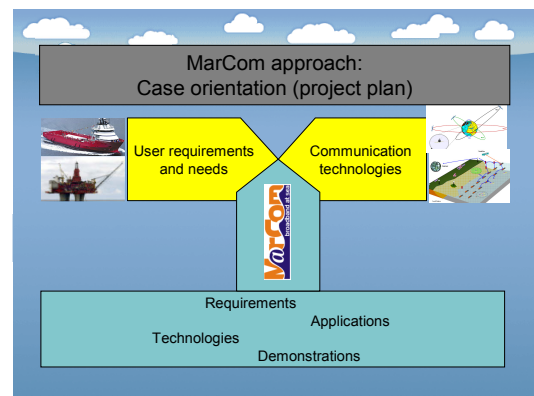


Figure 1. MARINTEK (Norwegian Marine Technical Institute)

1.1 The ICT-Solutions

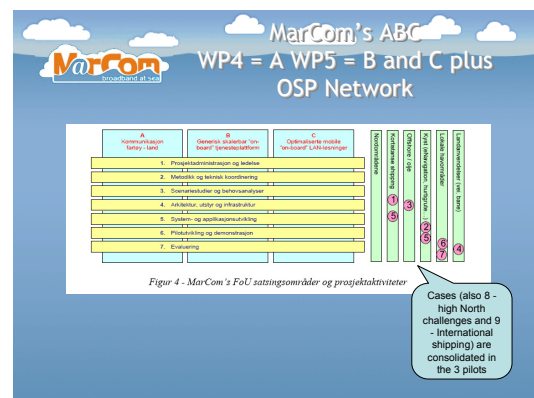


Figure 2.

Focus-areas:

During work in the project, we expanded from 7 cases listed in the proposal to the Norwegian Research Council, to 9 (including High North Challenges, and International Shipping). We then consolidated these cases in 3 pilots. In WP 5 we will focus on B and C in the figure above and below. We will probably also expand the software engineering focus to include the basis for land based networks to work in conjunction with the ones on board.

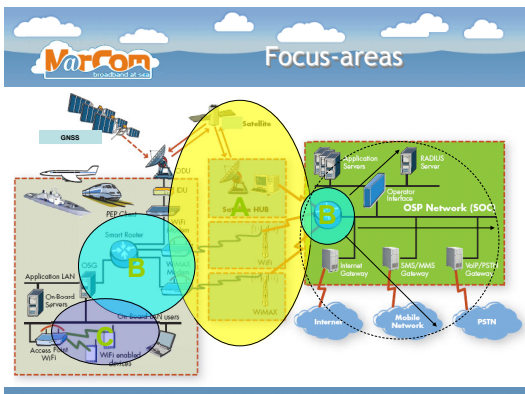


Figure 3. MARINTEK / Mowgly

1.1.1 Requirements from the pilots

We have changed our original project plan and started up the three pilots (1. Remote Diagnosis, 2. Integrated Operations, 3. High Speed Craft Monitoring) ahead and parallel to the integration works in WP4 and 5. This way, we get practical studies and further requirements to the solution(s).

Firewall requirements are being studied in project run by the Norwegian offshore industry network; OLF, and the project has contacts with this.

1.2 Generic Scalable Service Platform

The purpose of this part of the MarCom-project is to demonstrate the benefit of broadband at sea, and land-to-ship ICT-integration through the development of a demonstrator for “The generic scalable service platform” (Integrated platform, GSS). The main requirements for this platform are to provide an integration platform for:

- Several on-board applications
- Integration with systems and utilities onshore (cloud computing, software as a service...)
- Provide seamless roaming of data communication between different communication technologies and infrastructures (WiMAX and likes of it-, 3G/4G mobility, VHF/ UHF, NMT, SatCom etc.) and Multihop networks
- WLAN and data capture/ sensor networks

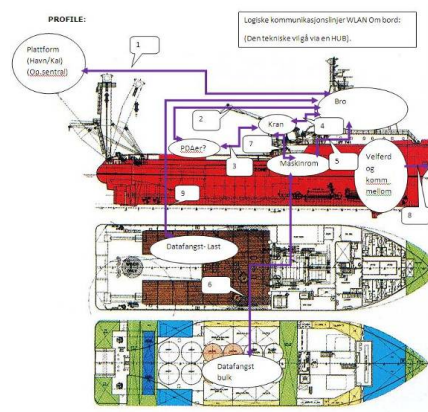


Figure 4. Future logical communication lines on an offshore supply vessel (NG/ Origo Mobikom AS)

- Cope with different communication Service Levels (SL's)
- Sort and prioritize communication with different SL's

The solution must (on a commercial basis) accommodate shared applications/ cooperation technologies; GIS/ planning systems etc. from any 3 party application or content provider, for use in integrated operations and commercial shipping in general.

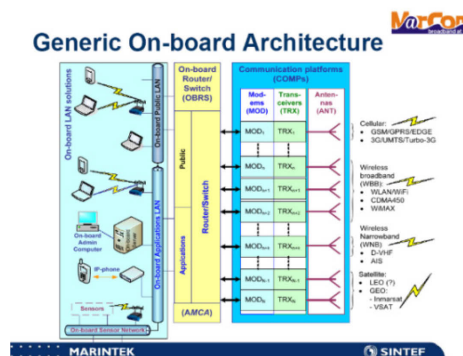


Figure 5. Marintek/ FB jf MarCom Delivery 4.1

One main theory is to build on the CALM-standard; and build a dialect of this (CALMSEA). This can be a topic for a new European R and D project (EuroMarCom), to finance further work.

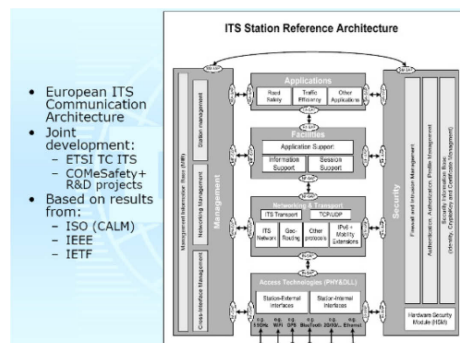


Figure 6. A CALM-solution, courtesy of Q-Free, Trondheim, from: (presentation at) APEC-ISO Joint Workshop Ottawa 12 November 2008

1.3 Application Groups

Analysis of the cases in MarCom resulted in finding six common application groups as shown in the figure below (Figure 1).

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Figure 7. MARINTEK/ MarCom Delivery 3.1

1.3.1 Technical Maintenance

These applications deal with reporting condition of the ship or platform, and (remotely) updating data and software. This group of applications includes:

- State monitoring and analysis: This is technical monitoring system, detection tools, information system, remote control system for monitoring of oil, gas, water tanks and sewerage system. This updates of FDV systems
- Online SW updates and maintenance, such as new SW versions on applications monitoring e.g. the propulsion machinery
- Online data updates, such as online updates of ENC's (both for ECDIS/other chart systems onboard and for pilot laptops), online updates of meteorological and hydrological data, technical drawings, sea maps/3D seabed topology, updates of documents and regulations following a vessel

1.3.2 Reporting

These applications are related to the (onshore) management's need for tracking and status reports from their ships. This can include operational and technical information about the ship and its cargo, but also navigational reports and data needed by government regulations fit within this group.

1.3.3 Bandwidth and Quality of Service

The bandwidth and integrity (quality of service and uplink time) requirements are summarised in the following figure.

1.3.4 Security requirements

The security requirements on the communication channel differ from application to application. The main threats on the communication channel level are denial of service and traffic analysis attacks. Hence, protection of important user data can be implemented on higher layers (the network, transport or application layer).

Seen from a user point of view, a division in low, medium and high security requirements have been provided for each group of applications. Low means

that losing some of the data to unauthorised persons is not crucial.

Medium means that losing some of the data to unauthorised persons is not desirable, but still not crucial.

High means that losing data to unauthorised persons is crucial and one should secure the communication channels.

In addition to Tripple –A data-security in the applications (ref. Cisco IOS Security Configuration Guide, Release 12.2), which is especially critical in safety and special purpose applications, we will also demonstrate how to meet standards and safety requirements in equipment, especially for explosion safety demands in different shipzones (0-2 where 0 indicates the highest demands)

Application group	Security requirement	Comments
Technical maintenance	Low	Losing status data and images of machinery to unauthorised persons is not crucial.
Reporting	Medium	Losing reports to unauthorised persons could be very undesirable if the reports contain sensitive information. Still, it is not crucial.
Safety &	High	Losing images and pictures of e.g. passengers monitoring to unauthorised persons due to e.g. laws and regulations from the Data Inspectorate is crucial and should by all means be avoided.
Training & qualification	Low	Losing training instructions and certificates to unauthorised persons is not considered very crucial.
Infotainment	Low Medium, High,	Losing TV-signals and e-mails might be undesirable and unpleasant however this is not crucial. However, eavesdropping of personal information like social security number or credit card information will be highly undesirable
Special Purpose	High	The requirements here will vary depending on data transmitted and business policy of the company. However it is likely that the data transmitted will be important for business purposes and should be shielded against unauthorized access

1.4 Protocols and message formats

The messages and protocols used in the applications should be based on open standards as much as possible. The exact protocols and formats to be used have to be decided when more work is done in MarCom, later parts of project. Some examples of possible standards are:

1.4.1 Protocols

- VHF data link (VDL) for transfer of AIS messages.
- SMS for transfer of small status messages via GSM.
- Internet Protocol (IP) for transfer of larger data packages such as large reports, documents, experimental data, images and pictures. This can be TCP/IP (point to point communication) or UDP/IP (broadcast).
- SMTP for transfer of e-mails

1.4.2 Messages

- NMEA message format for messages transferred on AIS network and for communication with navigational onboard equipment.
- XML format for reports and services to the crew/passengers (infotainment)
- JPEG, GIF, BMP, PDF, WMF for transfer of images and pictures
- E.g. AVI for transfer of live video from web cameras

Application group	Input	Output
Technical maintenance	Sensor data Status data from equipment Software updates	Status data Status reports Deviation reports Alarms/notifications Time-for-service messages
Reporting	Status data from applications within the 'technical maintenance' and 'Safety and monitoring' application groups	Status reports (to management) Deviation reports (to management) Mandatory reports to authorities
Safety & monitoring	Images and sound from cameras Counting systems	Real-time image/sound combined with necessary data Alarms and notifications
Training & qualification	Course documents and instructions Web-seminars Certificates/diplomas	Qualified crew
Infotainment	TV /Film Local information E-mail Internet Advertisements	Infotainment to crew and passengers
Special Purpose	Analyses data from crew and systems onboard	Analyses data to experts on land

2 APPLICATION REQUIREMENTS (A GENERAL APPROACH)

2.1 Service platform

One of the greatest challenges is of course getting the signal to the ship with high enough bandwidth and integrity. This is the main focus of the MarCom project and is described in another TransNav paper. Another major challenge is how to make use of the signal, maintaining the needs of all the partners (crew, captain, ship owner, government etc) involved. To ascertain this, there is a need to develop a common platform that handles the nuts-and-bolts of the communication.

This service platform can be described as having three layers. First, the Middleware receives the signals and makes it available to the recipients. The service platform performs common tasks, like usage tracking for billing, deciding bandwidth need for each request and performing authorization and validation. Finally, there are applications, as described below.

2.1.1 Administrative systems

There is a range of administrative systems on board a modern ship. One of the main challenges is to integrate the different systems, so that information is easily available to crew and ship owner.

2.1.2 Wellbeing of crew

An important, but easily overlooked part of onboard information systems, is applications available to the crew when not on duty. In order to attract and keep highly qualified personnel, the ship owners are trying to narrow the gap between being on board and onshore. Applications range from full blown video conferencing (with family) to email and chat.

2.1.3 Special Purposes

These are core ship operation information, like alarm systems including search and rescue, navigational systems and propulsion systems. Being top priority data transmission, this requires special attention, but will not be addressed in further detail in this paper.

2.2 Coverage on board

A special challenge on board a ship is determining the availability of wireless access. Walls, bulkheads and other metal structures create radio shadows. In addition, the presence of explosive or flammable substances e.g. in Ex zones, requires use of radio equipment approved for such environments.

2.3 Other demand, research and innovation, commercial implications

One also has to think of:

- Research and innovation; how and where to push state-of-the-art ahead (MarCom is a usability study with intermodal/ maritime transport and supply systems, so it is not necessarily within ICT one wishes to push the state of the art further ahead, rather the use of it.)
- Business models. Without a good business model around the new infrastructure, there will be no incentive to provide it. So the technology must provide for business models; content billing etc.
- IPR considerations.

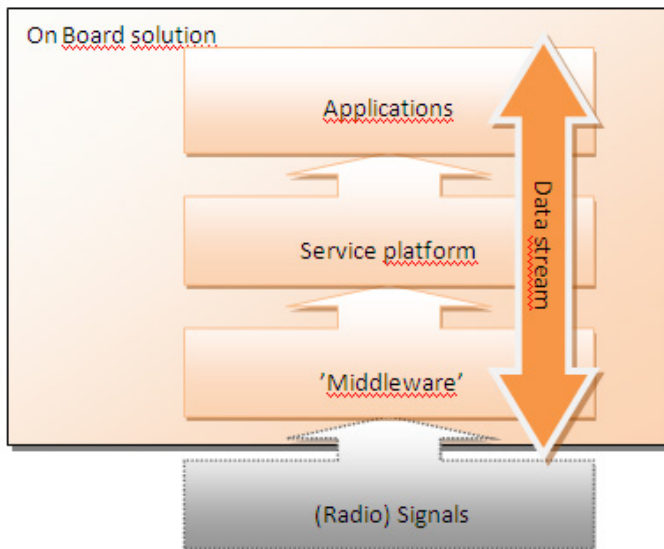


Figure 8. The figure shows a high level overview of the software being developed in MarCom. Note that the data stream will go both ways.

Signals

These are the signals received on board and transmitted from the ship. How the signal transfer is done is the topic for other work packages in MarCom. The signals could also be from on-board entities such as sensors etc.

Middleware

The middleware receives different signals (GPRS, WiMax, UMTS, AIS etc) and makes the da-

ta stream available for the upper layers. This layer will also translate the data stream from the upper layers into appropriate and available formats for transport out of the ship.

Service platform

The service platform will provide services (API) to the applications for easy use of the broadband available. The functions provided by the service platform will typically be related to security, billing and notification services.

Applications

This layer represents the actual applications; e-mail, maintenance surveillance, video etc.

3 SUMMARY AND CONCLUSIONS

Terrestrial communication can supplement satellite communication and provide for wireless broadband at sea in growing areas. This opens for a whole new range of online applications, and new ways of organizing maritime transport and operations, and cooperation between onshore and offshore co-workers. The long term implications for efficiency and welfare on board are tremendous.

The building of infrastructure and implementation of such systems will off course have to be stepwise. As there is not connectivity all over yet, the less crucial applications (for welfare, maintenance, planning and administration etc.) will probably be the “first movers”?

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