6th International CITIS innovation Award in recognition of outstanding work performed on Managing IT having IP in mind

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Abstract: From the beginning of the new century The **W**orldwide **W**ide **W**eb **(WWW)** is expanding rapidly and exponentially. **Internet** protocol suite (TCP/IP) to link, wired or not wired, devices worldwide was matured enough to be utilized not only from the world of scientists, but for commercial and operational purposes as well. Despite the fact of conservative nature of maritime industry we strongly believe and are highly confident that in near future vessels will be also nodes of WWW. Moreover shipping is the only industry utilized centuries ago[1] , needs and will constantly need an efficient **real** worldwide (sea and shore) data network. In this direction Thenamaris[2] decided proactively to redesign its enterprise information system to take the advantages in monetary and efficiency terms of MPDS (mobile packed data system) announced availability by INMARSAT[3] as earliest as possible assuring that this will be the standard for the new century! The presented then@mail is the first messaging system designed and utilized with a unified approach for ship-shore, instead of ship-to-shore, as well as shore-shore messaging either in real mode or as store and forward process based on INTERNET protocol suite. Then@mail is a part of the ***then@erp*** revised to be web enabled integrated enterprise resources planning system were both shore and ships are nodes of a virtual common information system. The solution was implemented by Thenamaris in house based on creative and innovative thinking of its researchers and their long 15+ year's expertise achieved during the implementation and continuous improvement of the widely recognized of its outstanding information system performance. Design architecture, functional specifications, evaluation and proof of concept will be presented. A relatively extensive background is preceded to prove the continuity in this roadmap.

British Post Office engineers inspect Marconi's radio equipment during demonstration on Flat Holm Island, 13 May 1897. The transmitter is at centre, the coherer receiver below it, the pole supporting the wire antenna is visible at top

Keywords: INMARSAT, TCP/IP, Optimization, Satellite communication

[1] On 13 May 1897, Marconi sent the world's first ever wireless communication over open sea. The experiment, based in Wales, witnessed a message trans versed over the Bristol Channel from Flat Holm Island to Lavernock Point in Penarth, a distance of 6 kilometres (3.7 mi). The message read "Are you ready" The transmitting equipment was almost immediately relocated to Bream down Fort on the Somerset coast, stretching the range to 16 kilometres (9.9 mi).

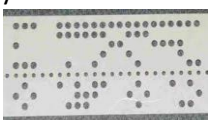
[2] Thenamaris is a high reputable Ships Management company. It manages a fleet of approx. five million DWT. www.thenamaris.com

[3]The International Maritime Satellite Organization (INMARSAT) was established under the auspices of the International Maritime Organization by the *Convention on the International Maritime Satellite Organization*, signed at London on 3 September 1976 and entered into force on 16 July 1979. The organization was modelled after Intelsat, an international consortium which provided satellite communications among the member countries ..

Background

Public worldwide data networks was not something new for shipping industry

Decades ago a worldwide dedicated wired network was established connecting national public telegraphy nodes (PTNs). At the office end, teletype machines are connected to network. Teletypes have a paper tape input/output device, a printer and a keyboard to type messages known as telexes. Each teletype has its own unique number as well an answerback code which was sent whenever for confirmation purposes the receiver is asking for. Typically a shipping management company has several telex lines synoptically connected which are installed in a physical place named *telex room.* Telexes are transmitted either directly from keyboard or using paper tape archived messages while received telexes are classified and distributed from dedicated several telex operators 24 hours per day 7 days per week. Network transfer rate is 50 bps (bits per seconds) and minimum cost presupposed the minimum message length. At the end of nighties Thenamaris had 9 telex lines and equal number of operators and spent on about 1.5 M$/year. Vessel have also obligatory, according to GMDSS[4], a teletype machine, the most known was the INMARSAT Satcom-C[5]. Telexes are exchange between ship and shore over INMARSAT satellite communication link. The maximum size of a message was 32KB.



An alternative method with less usability and availability is known as TOR (Telex over ratio). Messages are modulated as VHF frequencies. A typical TOR machine searches the vessel, establishes connection and message is transmitted without cost!

Looking for an alternative cost effective alternative network architecture

Early eighties Thenamaris, a leader in innovative solutions and one of the small band companies with ICT development in house, envisaged and designed a network architecture to reduce the data communication cost. Having an affiliate company in London (LND) compared communication tariffs, applied simulation techniques and concluded that the cost of telex transmission to many countries and vessels over satellite or radio link is significantly lower from UK (LND) instead from Greece (ATH). An LCCA model (life cycle cost assessment) incorporating the additional yearly operational cost for a leased line, the setup investment and on the other hand annual cost saving proofed the cost efficiency of network topology change. A **Sperry**

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[4] The **Global Maritime Distress and Safety System** (**GMDSS**) is an internationally agreed-upon set of safety procedures, types of equipment, and communication protocols used to increase safety and make it easier to rescue distressed ships, boats and aircraft.
GMDSS consists of several systems, some of which are new, but many of which have been in operation for many years. The system is intended to perform the following functions: alerting (including position determination of the unit in distress), search and rescue coordination, locating (homing), maritime safety information broadcasts, general communications, and bridge-to-bridge communications. Specific radio carriage requirements depend upon the ship's area of operation, rather than its tonnage. The system also provides redundant means of distress alerting, and emergency sources of power

[5] **Inmarsat-C** is a two-way, packet data service operated by the telecommunications company Inmarsat which operates between mobile earth stations (MES) and land earth stations (LES). It became fully operational after a period of pre-operational trials in January 1991. The advantages of Inmarsat-C compared to Inmarsat-A are low cost, smaller and uses a smaller omni-directional antenna. The disadvantages is that voice communication is not possible with Inmarsat-C.[1] The service is approved for use under the Global Maritime Distress and Safety System (GMDSS), meets the requirements for Ship Security Alert Systems (SSAS) defined by the International Maritime Organization (IMO) and is the most widely used service in fishing Vessel Monitoring Systems (VMS).
The service works with a store-and-forward method which enables interface with data network transfer including; e-mail; SMS; telex; remote monitoring; tracking (position reporting); chart and weather updates; maritime safety information (MSI); maritime security; GMDSS; and SafetyNET and FleetNET services; two-way messaging; data reporting and polling; Safety/Emergency alerting.
The service is operated via an Inmarsat-C Transceiver or a lower-power mini-C Transceiver. Data transfers between MES and LES at a rate of 600 bits/second. The frequencies for transmitting (TX) are 1626.5MHz -1645.5MHz and for receiving (RX) are 1530.0MHz - 1545.0MHz.

message switching system, replaced later by **Case Beeline** in 1987, was installed in London and a phone line between ATH and LND was leased. At both ends of the line a telex over voice simultaneous modem (COHERENT) were connected. Modem provided interfaces for a voice line (4800 bps) and three telex lines with 75 bps rate. In this way conversation over phone and telex exchange between office was cost free but most important a significant cost saving was achieved because of lower UK telex tariffs. Of course telexes to Greece and some other countries sent directly from ATH.

Even data communication was reduced significantly and the setup investment was payback in only one year, the whole messages administration process is remained manual with waste of time and major inefficiencies (reliability, availability, transparency, effectiveness). A message is written on paper and forwarded to telex room. Telex operator types the message, send the telex, cuts the printed telex and places it and copies to appropriate wickets. Several outgoing telexes are sent to wrong recipients and frequently incoming telexes are wrongly distributed and a lot of duplication work is occurred since there is not any central electronic messages repository.

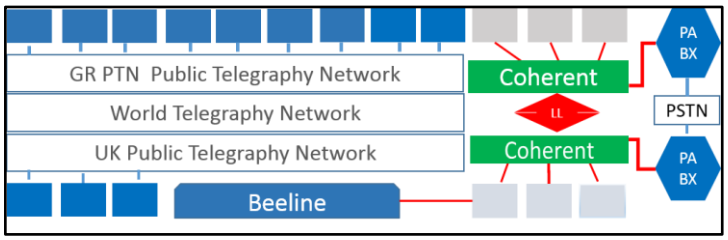


figure 2: Communication architecture redesign: Red lines denote the new links via coherent SVT modem. PBX: Private branch exchange systemV.Graikos CFO and A. Vardakis CIO: 1985

Thenamaris integrated data communication system (TELES) Born

At the end of eighties the revolution of micro-informatics broke out while integrated of digital services networks (ISDN) theories were ad equally matured to be materialized. Thenamaris realized the imperativeness to go ahead toward to a paperless, **integrated data processing and communication system for its operation efficiency maximization.** Request for Interest (RFI) for a related system went bad. So far it decided to carry out the project with its forces but with the minimum investment cost. The project started in

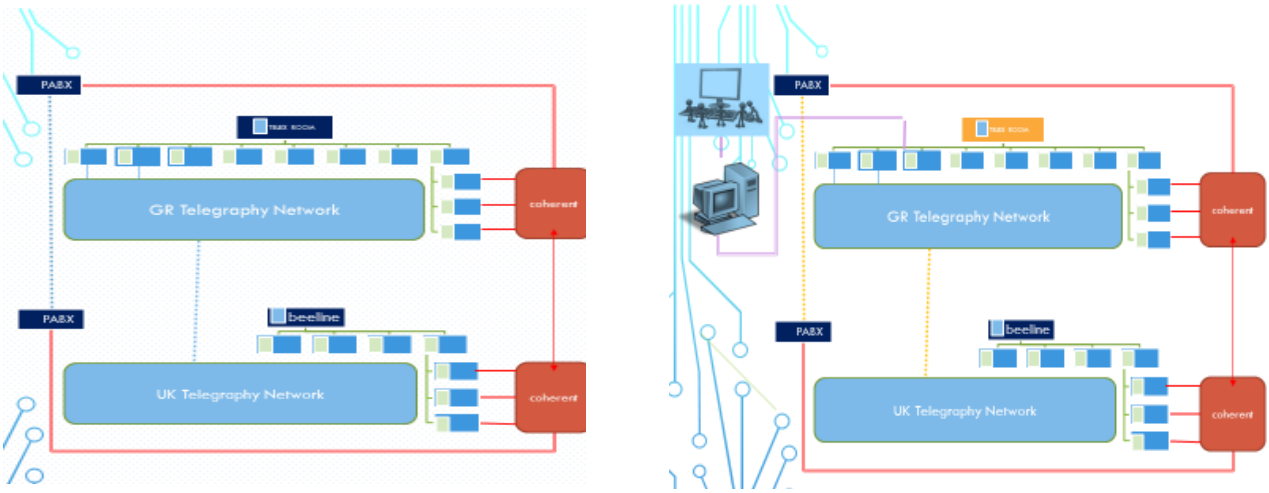


Figure-4 : TELES : From-To : Data processing and communication (telexes) integration
Varelas –A.Englund 1991

1989 and the first version of the system **(TELES**) deployed two years later. The innovative approach and results in figures are presented epigrammatically as follows:

- **Zero hardware investment cost:** The whole messaging system was deployedimplemented in the central Unisys 6065 computer. Nine interfaces (Telex-data modems with memory) programed in CPM-86 by **D. Dafinis** a genius engineer and owner of **"Micro computer applications**" company are

paralleled to seven local telex machines and two to machines linked to Case Beeline over the leased line. Dedicated terminals for telexes management were not required.

- **Zero system software license and maintenance cost**. The TELES deployed over freeware UNIX operating system. All the user shell including telex editor, menu generator, terminal and printers interfaces, workflow and security were developed in house.
- **Zero cost of Communication software development.** Communication drivers (telex, TOR, beeline) developed in house. As development tools C++ and MF COBOL and INFORMIX data base were elected with almost zero cost.

Results

So far in 1991 one hundred users communicate directly with TELES. Telexes to one or more recipients (circulars) are routed cost optimally, archived, classified, easily retrieved and printed ad hoc. In monetary terms communication cost decreased dramatically from 2M$ to 450K$ per year, the hardware and software maintenance cost reduced from150 K$ to 10 K$ annually. Another substantial consequence was the significant manpower and consequently operational cost reduction. From **nine** telex operators only **four** were needed and other **five** people indirectly involved were liberated.

- **Non tangible:** The operational efficiency was increased enormously. Workload for duplication work was reduced. Information is sent and received in time by the in charge person(s). The number of missed messages was minimized. Old messages could easily be retrieved, edited and forwarded. Messages by sent directly from data application such as voyage plan and many more.

The market environment: *In 1989 established the LEAGORE Software Company focused on its product the TELIX which is alive until our days. TELIX designed with similar to TELES main characteristics. It used the similar boxes from the same developer (D. Dafinis), deployed also over UNIX and provided a simple interface shell. TELiX did not pay attention for other topology and alternative routes and his architecture was closed enough. TELIX was the dominant player for years until* ***Danaos*** *at the end of the century designed and realized a full integrated communication solution named info@gate, which is currently worldwide leader in the market. It should be emphasized that with the mentioned solutions Greeks won the first place worldwide in message systems in maritime leaving behind the "Uk* ***message manager****" solution based on hassler modems*

Shipping Messages Refilers Networks

During nineties appeared in the market networks for messages COMTEXT and BIMCOM (Livanos idea) were rapidly grew up and dominated in maritime industry. They provided lower prices to telex transmission and, cheap exchange messages among the members with low cost. TELES exploited this opportunity and developed the appropriate gateways to the mentioned networks and developed the algorithm of least cost routing. The results are impressive. Significant saving per year was achieved without additional investment cost. Similarly for ship to shore data communication TELIA the Swedish communication company announced **Maritex**[6], Finally at the end of nineties PSDN (Public switch data networks based on X25 protocol) were alive.

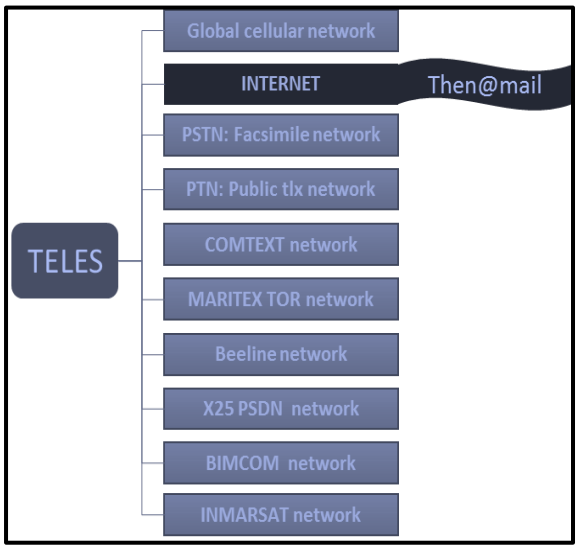
[6] An automatic short-wave radio system for telex traffic used by ship anywhere on earth.. Traffic peaked during the 19990s with some 50000 users. TELES opened a gateway to MARITEX network achieving a 25% saving for shore to ship messages which meant 100K$/year additional cost.

This is another opportunity to send messages with lower cost to LES (Land earth stations such as Thermopylae in Greece) that was exploited by adding the appropriate gateway to TELES system.

Facsimile[7] networks

At the same decade **Fax** was appeared, adopted with enthusiasm and became very popular. The incorporation of faxes in an integrated messaging system was considered imperative. TELES opened gateways to fax machines using the DD86 boxes (Dafinis again) and developing the appropriate software user interface for fax viewing and management overcoming the UNIX obstacle for viewing images (The fax viewing is programmed and carried out by the implemented terminal emulator!)

TELES the integrated messaging system gives his position to then@mail



TELES welcomed millennium as the matured and most integrated messaging system worldwide in maritime industry. TELES utilizes optimally combined all the available communication paths and networks minimizing the communication cost and human intervention. **Millions of $** were saved during its life cycle but now is time to give his position to a new architecture. Thenamaris perceived the INTERNET dominance revolution and decided proactively to reengineer TELES under the light of digital revolution. The life cycle of Refilers, TOR, X25 networks, ship-shore communication over voice was closed or will be closed shortly.

Thenamaris entering in the new millenium decided proactively to redesign its enterprise information system to take the advantages in monetary and efficiency terms of MPDS (mobile packed data system) announced availability by INMARSAT[8] as earliest as possible assuring that this will be the standard for the new century! The system was implemented on the innovative web development framework[9] with the powerful server-side script engine for dynamically generated web pages. So far only **one system version** was required to be utilized from user either at shore, or on board either over internet or intranet whenever is needed wherever he is.

Ship-shore data communication cost is significant, importance is vital and volume is high. So far then@mail is designed to optimise the data exchange over satellite link. Until now this communication was based on traditional methods. Dial-up connections with significant handshaking time and batch mode session resulted

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[7] (Short for **facsimile**), sometimes called **tele copying** or **telefax** (the latter short for **tele facsimile**), is the telephonic transmission of scanned printed material (both text and images), normally to a telephone number connected to a printer or other output device. The original document is scanned with a **fax machine** (or a **tele copier**), which processes the contents (text or images) as a single fixed graphic image, converting it into a bitmap, and then transmitting it through the telephone system in the form of audio-frequency tones.

[8]The International Maritime Satellite Organization (INMARSAT) was established under the auspices of the International Maritime Organization by the *Convention on the International Maritime Satellite Organization*, signed at London on 3 September 1976 and entered into force on 16 July 1979. The organization was modelled after Intelsat, an international consortium which provided satellite communications among the member countries The Communications Satellite Corporation (COMSAT), a founding member of Intelsat, took the lead in the founding of Inmarsat[] In coordination with the International Civil Aviation Organization in the 1980s, the convention governing INMARSAT was amended to include improvements aeronautical communications, notably for public safety.

[9] A **web framework** (**WF**) or **web application framework** (**WAF**) is a software framework that is designed to support the development of web applications including web services, web resources, and web APIs. Web frameworks provide a standard way to build and deploy web applications on the World Wide Web. Web frameworks aim to automate the overhead associated with common activities performed in web development. For example, many web frameworks provide libraries for database access, templating frameworks, and session management, and they often promote code reuse although they often target development of dynamic web sites, they are also applicable to static websites

in high cost and limited use of data exchange. The aforementioned procedure was carried out from several software solution having advantages and disadvantages but more or less the same characteristics. In almost all cases the connection was activated from the one end and is known as ship-to-shore communication were the word “to” denote the vessel triggers the connection.
Modem is the innovative build in ship shore data synchronization based in *“before and after images principle”* enabling uninterruptible communication link with vessels with eventually different versions with program to program interface layer incorporating alternatively APIs over internet.

Conclusions

The limitations of ship – shore data communication (over voice or standard-C), the obstacle of proprietary operating systems, and the info-space fragmentation in individual applications may be overcome now exploiting the revolutionary internet protocol connection in worldwide network networks (WAN).
The then@erp , the first worldwide maritime integrated enterprise information and communication system including as nodes shore and, ships as well accessible whenever and wherever needed, is designed , implemented , deployed and is alive and for sure will be the prototype model for the next years The main characteristics are summarized in the following ERP attributes table.
In monetary terms the development and development cost is extremely lower compared with outsourcing cost while the efficiency and maritime operation performance is extremely higher.

Future work

This outstanding work of integration of ship and shore in one enterprise resources planning system thanks to INTERNET wired and non-wired network should be continuous. In next future with the perceived tools of coming 4th generation revolution the current WAF (worldwide application framework) should be extended with an Internet of thinks network and beyond to be integrated to one Internet of everything!

Acknowledgments

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Table 1 ERP ATTRIBUTES AND VALUES

Attribute	value	comments
System software		
Back office	Unix	Unisys 6065 1994
Front end	Windows	150 workstations
Development tools		
Integrated development environment	PowerBuilder MS.net framework INFORMIX	
programming	XML, Java, C++	In house
ERP design		
Common tools	Editor, menu, portal generator	In house – open source
Users management	User customized c-shell	In house
Network topology		
Structure cabling	Mult-layer bus technology	In house
IPX/SPX TCP/IP	Multiple network protocols	
Data communication		
Gateways	GSM, IP, PABX, IoT, PTN, TOR	In house
Application layer	Messaging, workflow, documents	In house
Application software	All operational, tactical and strategic needs	In house
Optimization models	Chartering, crewing, voyage modeling	In house – open source
Ship-shore data communication		
layers	Application, File transfer, messaging, upgrade maintenance	In house
Mode	On line Real time Store and forward Bi- directional	In house
Pros and cons		
pros	ARM: Maximize availability, reliability minimize development time improve efficiency minimize outsourcing cost	
cons	Significant risk if authors leave	

Managing IT for shipping having IP in mind

by Professor Takis Varelas*, Chief Information Officer, Thenamaris Shipmanagement

Thenamaris the well-known Greek based company manages a fleet of 55 ocean-going vessels. Modern leadership, innovative thinking and quality of services are hallmarks of Thenamaris business culture. An integrated management information system has been developed to support decision making for operational, tactical and strategic activities on board and at shore as well. The system evolved dynamically adopting cutting edge technologies like cost-effective, high bandwidth for terrestrial and mobile packet data services.

MIS accessible worldwide

IT at Thenamaris anticipated at an early stage the radical changes that would result from an explosion in the commercial use of the INTERNET. Furthermore the dominance of IP, MPDS protocols, Windows OS, thin-client services had also been perceived. Its proactive response was to reengineer the company's IT system. A key driver was to leverage the resources provided by the WEB to support new intra-organizational and inter-company processes via Internet.

Winner of the award for innovative use of IP at the 6th international CITIS for its model then@mail materializes the vision of a worldwide information system a needful presupposition for the efficient operation of a shipping management company were people need to manage information **wherever they are whenever they want.** Moreover since shipping companies are organized in a managerial grid based on teamwork structure data must not be considered as personal but they concern teams or departments or projects or whole enterprise members.

The importance of this innovative approach is invaluable in the case of shipping business having a network of offices were people move around the world since is ready to use and because of installation, maintenance and training cost elimination. Superintended engineer at airport, Technical Director from his hotel, colleagues from London office, Technical Director from his hotel may access their applications cost free.

Solution: A web-enabled interface providing users access to the total information system as long as have an Internet connection without any client program and without reprogramming of the existed applications!

• MPDS the revolution for ships shore data communication.

Undoubtedly the most unique element of data communication systems in shipping industry is the ship shore data exchange. A wireless communication where cost is significant, importance is vital ad volume is high.

However, until now data communication between ship and shore was still based on traditional methods. Dial-up connections with significant handshaking time and batch-mode session resulted in high costs and a limited use of data exchange. The above procedure is carried out from several software solutions having advantages and disadvantages but more or less the same characteristics. In almost all cases **the connection is activated from the one end** and is known as ship-to-shore communication were the word 'to' denote that the vessel triggers the connection. In our days there are new data that enforce this data communication revision. The satellite cost per minute has been reduced significantly, satcom provide data communication ports and communication computer on board may act as client and as server as well. Therefore ship shore communication may be transformed from batch mode to "send now or later" dual mode enabling **a cost effectiveness conversational communication.**

Undoubtedly the most unique element of data communication systems in shipping industry is the ship shore data exchange

Furthermore the recent introduction from Inmarsat of the crucial MPDS (the mobile packed data service) revolutionizes the way shipping companies operate providing a permanent high-capacity, always-online connection to every vessel.

Thenamaris has developed a high sophisticated module (then@com) for data exchange over MPDS, ISDN or dialup connections for minimize the transfer amount of data and therefore communication cost. Additionally a platform for instant transition of all applications running on board in the new environment has already developed as well.

Solution: web-enabled interface providing vessels access to the total information system as long as have an MPDS connection without any client program!