VTMIS & VTS IMPLEMENTATION IN PORTS
THE HELLENIC EXPERIENCE

by
Apostolos Kountras
Telematics for Transport & Environment
Marketing & Sales Dept.
INTRACOM S.A.

Introduction

Sea borne trade is expected to gain ground against road trade by growing around 2% during the first decade of the 21st century in EU. The European Commission estimates that 90% of the European Community’s external trade is carried by sea. Greece is a country with extended and partly difficult coastlines, more than 3,000 islands, around 100 ports and harbours, areas with lower and higher traffic density including transports of dangerous cargo. Grounding or stranding involves a high risk, because the subsoil and boundaries of navigable waters are rocky in most cases. The commercial traffic is mixed with a considerable amount of pleasure crafts. An accident with environmental pollution could have extraordinary negative results on tourism, which is considered as one of the most important sectors of national economy.

Four (4) years ago the Hellenic Ministry of Merchant Marine (MMM) came with an international call for tender related to the turn-key implementation of the so called “1st phase of the National Vessel Traffic Management & Information System” (VTMIS). This project has been contracted in early 2000 and concerned a wide area spread system of four (4) modern VTSs, a supervisory National centre defined as VTMIS, plus appropriate display equipment on-board five (5) Hellenic Coast Guard (HCG) patrol boats. The definition of this project was part of a two (2) years period study which has been carried out by the MMM as an effort to implement advanced technological solutions that can help its various departments/administrations to face a series of problems in the maritime sector.

User requirements and VTMIS- VTS Goals

Not all VTSs have been planned for the same reasons. Of course a common set of user requirements came out of the constant increase of marine transport, the steam at higher speed of modern marine transport means (fast-ferries) and the increasing amount of hazardous cargo transport. The maritime sector will become more dangerous since these facts are combined with well-known tendencies like the expected expansion of EU Common Market, the promotion of Short Sea Shipping in EU waters, the ever-decreasing seamanship of the EU-vessels’ crews, whose nautical skills are coming more and more from in class training than tradition and experience.
All four (4) VTSs meet the very basic, according to IALA, requirements. Namely:

- The facilitation of vessel traffic,
- The decrement of marine accidents,
- The improvement of offered search and rescue services, and
- The protection of marine environment pollution and shore pollution.

Nevertheless, for each individual VTS a different goal is targeted. For example, in Igoumenitsa Port the main goal is the safe passage of cargo and passengers through a narrow fairway surrounded by swallow waters and the management of this “choke point” especially in view of future traffic demand increase when the port will become part of a major European commercial corridor connecting rest of Europe with Turkey via the “Egnatia Odos” Motorway. In Corfu Island VTS, as far as it concerns facilitation of traffic and safety, one of the main goals was the speed control of high-speed ferries sailing along the beaches, which seasonally are full of swimmers enjoying the natural beauty of the island. Before the VTS implementations, serious incidents, even drownings have been reported due to waves raised by passing by vessels. In Patras VTS the traffic organization deals mainly with the facilitation of navigation in a narrow passage which experience a temporal (4 year long) heavy cross traffic created by numerous barges and construction boats working for a major bridge construction in the Rio-Antirio area. Finally, the Greater Piraeus area faces with all these traffic related problems of a big port which annually serves more than 100 thousand ship arrivals, 16+ millions metric tones of cargo, more than a million TEUs, thus accommodating around 87% of Greek external trade, while in parallel ~14 million people, most of them tourists, are commuting annually through its terminals. Big tankers, giant containerships, every type of freighter sailing among world’s biggest cruising vessels and super fast ferries, dredges, fishing and pleasure boats comprise a dense maritime population which constantly interferes and interacts with the land based facilities and resources like refineries, port utilities, cranes, loading facilities, points of logistic services (agents, offices, banks, etc.).

Figure 1: Central Piraeus Port
Nearby all these marine activities is the city of Piraeus with its fragile air and sea environment and extensive population doing other activities (services, tourism, fishing), which also need to be protected.

The above considerations mainly focused on the traffic safety aspect and measures to reduce risk, while an adequate level of efficiency is maintained. But within the framework of safety also the security aspects of the marine traffic can be improved. Towards this goal an extended network of state of the art VTSs could greatly help for the enforcement of National and International Maritime legislation.

For Greece, the most important problems of this kind are:

- Illegal immigration,
- Drug and gun trafficking, and
- Smuggling.

Today, Europe proves to come near to its limits as far as it concerns the financial and social impact of illegal immigration. According to HCG, during year 2001, one of the worst years indeed, within the Greek territorial waters 370 incidents of illegal immigration have been intercepted, with 6,864 illegal immigrants and 137 traffickers on-board all arrested. Nowadays this phenomenon is immense, and following Seville’s European Council, where all EU Leaders asked for tough measures against the illegal entry of immigrants in EU territory, HCG uses VTSs (especially those of Corfu and Igoumenitsa along with the traffic picture onboard systems) as a coastal surveillance tool to combat these maritime criminals. These law offenders ask for $2,000 to 2,500 per person as an "embarkation fee" to unsanitary tubes. While in case the transportation is carried out with an American or EU flagged sailing vessel the "fee" is somewhat higher ~ 3,000 $.

Greece, beyond being one of the numerous European entry gates for illegal immigrants, locates in a very strategic maritime crossroad related to drug and gun trafficking. Some of the most important East-West drug traffic corridors pass through the Aegean and Ionian seas whilst some of its neighbor countries are used occasionally as a base for mass drug and/or gun transshipments. Again the available VTS centers are used for systematic control of the busy fairways and with the employment of the HCG vessels demonstrating on-board traffic picture, operators are able to locate the perpetrators and guide accurately, silently and safely the equipped patrol crafts to intercept the offending vessel and seize their deadly cargo.

Finally, the state of the art technology employed by the Greek VTS centers allow through their rule-based intelligence to apply different surveillance rules to areas with distinct geographical and traffic characteristics. Thus HCG operators have a flexible surveillance tool to combat smuggling a “black market” which in Greece reaches annually 2,7 billion € (fuel, cigarettes, leather goods and CDs). Using VTS system intelligence, they can identify “illegal en-route transshipments”, “undeclared coastings” or other abnormal traffic behaviors.

Last but not least we should refer to the extensive security requirements emerging from the preparation for 2004 Athens Olympic Games event. These requirements have to do with early identification of “unknown” targets, safeguarding of Safety
Zones around the sites where various maritime contests will take place, temporal ban of all traffic close to the so called “Floating Hotels”. Worth to mention that in Piraeus only, 3 km of new docks are under construction that will be occupied daily by 12 huge cruising vessels hosting 7,000 visitors and members of the Olympic family.

Engaged Technologies

As it has been mentioned in the beginning of this presentation, the first phase of the National VTMIS covers the greater area of Piraeus (Argosaronikos Gulf) along with its three main access corridors (N, SE and S), as well as specific areas of Ionian Sea (figure 2).

The central VTMIS system connects via redundant high-speed data lines and dedicated radio networks with three (3) VTS centers in Piraeus, Patras and Corfu Ports and two (2) RTS (Regional Traffic Service) centers in Antirrio and Igoumenitsa port. The actual technological difference between a VTS and an RTS is the fact that an RTS does not have its own database server, instead uses the server of a nearby VTS center. Every VTS center processes all local data of the vessels moving within its area of responsibility (AOR) and acquires them from a number of unmanned remote sensor sites (RSSs) (figures 3 & 4). The total number of the RSSs is eleven (11). The connection between the VTSs and the RSSs necessitated the employment of five (5) unmanned remote relay stations. All local and wide area networks of the project have been designed in order to be able to carry simultaneously video, voice and traffic data under a worst-case tracking capacity of 1,000+ identified tracks per VTS AOR. The exact positioning of the RSS and the relay sites have been made with the use of state of the art GIS-based software simulating the radio performance of the X-band radar, radio link, RDF, VHF-marine & aero devices. Thus a radio optimization among the available sites has been achieved. Other very valuable sensors are these of daylight, low level light and, in
very “sensitive” areas (i.e. boarder surveillance), infrared cameras (figure 5). Also some RSS sites include meteorological sensors that continuously and accurately forward atmospheric pressure, wind speed, humidity, visibility, and temperature data to the VTS operator. These data are either used by operators for the provision of “Information Service” to mariners or are taken into account whenever marine-weather information should be taken into account during the judgment of a special operation case (oil spill, SAR, etc.).

All VTS and RTS centers have been developed by MMM with the purpose to facilitate marine traffic, improve the safety and security of mariners and protect the marine environment. These centers provide their services on a continuous 24-hour basis from the local HCG facilities, and their role is characterized as administrative and operational within their AOR. These services are performed in the following three
steps, which repeat continuously in time, as long as the VTS is considered operational:

- Data collection to build a traffic image,
- Data evaluation of the traffic image to ascertain the need of interaction, and
- Data dissemination to respond to traffic situation.

This iteration does not run automatically, but usually includes specific activities/participation by the VTS operators. The first step corresponds to external verbal communication via VHF and/or telephone calls from ashore. In the second step two or more operators from the same or adjacent VTSs communicate and agree upon specific actions or evaluations to be made. Finally step three again includes external communication with vessels to respond to traffic situations developing in the VTS area (figures 6 & 7).

Figure 6: Corfu VTS

Figure 7: Patras VTS
The VTMIS center locates in the central HCG Headquarters in Piraeus and is the National supervisory body that receives on constant basis information from all VTSs, processes the data centrally, composes a “National Traffic Picture”, evaluates it, assists in special or multiple operations and finally distributes relevant information to other competent authorities like the Police or the Port Authorities (figure 8).

Thus VTMIS has a rather strategic role, offering a valuable tool for collectively analyzing national traffic data, performing strategic planning of maritime developments and helping in the establishment of new traffic rules and regulations. Also in the future will be the main participant to other peer National or European agencies of the same nature. Surely the above-mentioned safety orientated services to a large extent also contribute to the security of traffic. The aforementioned function can be enhanced still by co-operation and action agreement with different maritime and security services, which become active in the same or adjacent areas. As such an example we refer to possible communication of the central VTMIS database to external databases like the Siren one employed by all Shengen Treaty countries or alternatively the interconnection of the National VTMIS with national vessels’ black lists. The latter falls into the category of “Co-operation with allied Services” supporting the whole community of maritime organizations.

Figure 8: National VTMIS & VTS of Piraeus

Figure 9: VTMIS Traffic Picture onboard application
Last but not least, a very innovative part of the project is the installation on-board five (5) HCG vessels of the appropriate radar, marinized computer, and radio data- communication devices in order to automatically exchange dynamic traffic picture and other data base queries with the National VTMIS center. Since past year, these vessels are carrying AIS transponders serving as a test bed for the HCG authority that wanted to test and evaluate this technology both as a target tracking and data transmission device (figure 9).

The intrinsic characteristics of all the subsystems employed in the project are as follows:

- Full compatibility with all relevant recommendations of international organizations such as IMO, IALA, ICAO, IEC, CIRM and ITU and of course the national standards established by Greek authorities/ associations;
- Fully automatic and integrated system, which presents and compares all data from different sources to the operator console. For example: traffic picture, resource management and network management data can be provided in the same workstation, according to user authorization;
- Capability to exchange information via widely spread technologies such as the internet with third interested parties (Maritime Agents, Customs, Pilots e.t.c);
- Data fusion to allow integration of multiple and different vessel monitoring sensors (i.e. radar, RDF, AIS transponder) on the same operator console;
- Accurate time stamping of all events using a sophisticated data process, supporting accurate back tracing in case of hardware failure, or record and replay of operational instances;
- Remote control and remote diagnostic capability of all peripheral devices, allowing the unmanned operation of the RSSs;
- Decentralized data processing where each VTS has its own database server, whilst at the same time unequivocal data are maintained in the central VTMIS database. All databases are aligned regularly in near real- time fashion and according to internationally accepted data formats (i.e. ECDIS chart data, Lloyd’s vessel records, etc.);
- MIL-spec type system reliability resulting from the redundancy of all critical system components (VHF units, radar transceivers, target extractors, correlators, database servers, etc), being one in prime and the other in hot-standby state;
- Commercial of the self, software and computing/ networking equipment that facilitates system maintenance and its remote management while guarantees the low cost and easy extension of the project.

As far as it concerns the issue of computer security that becomes more pressing in nowadays as vastly more computers and networks have been linked to the Internet. HCG chose the way of the total isolation of all VTSs from the outside world. Only for the VTMIS centre there are plans to interface to the Maritime Community through high security encrypted connections and/or with the use of Firewall. This comes as a necessity since many public and private computers still have not been properly configured to block outsiders, and security components of operating software often are left set on the lowest default level to ease installation.
Preliminary Results

Currently the first phase of the Hellenic VTMIS project is under completion. Corfu, Patras and Piraeus VTSS and RTS of Igoumenitsa are operational; their personnel finished the in class and on the job training successfully according to IALA-V103 recommendation and local vessels started on a voluntary basis to report to the centres. Since mid-summer 2002, the National VTMIS centre is in place with all its connections to peripheral VTSSs. Furthermore, all the display and communications systems on-board the five HCG high-speed patrol boats are in place and used by the officers on a daily basis. Three (3) RSS stations belonging to Piraeus VTS, are still under construction experiencing some delays from the early site acquisition phase of the project. It is expected that in early 2003 the project will finish and the six (6) year warranty and maintenance period will start. By that time HCG plans to issue all relevant notices to mariners and to International bodies in order to start the official operation of the systems.

As of today the operation of the three (3) VTS centres exhibit the following tangible results:

- Efficiency in fairways like the Traffic Separation Scheme in the entrance of Piraeus port increased up to 50% during peak periods without endangering the safe passage of vessels;
- A better management of the shore-based resources has been achieved through the accurate in advance knowledge of all ships’ ETA. This greatly helped delay avoidance in the overall cargo loading & unloading process while facilitated the entirety of port operations;
- VTS centres, with their automatic monitoring surveillance rules, increased HCG personnel awareness of the Maritime Domain (Vessels, Cargo, Crew on board), making them in this way more competent to cope with special safety operations;
- The traffic picture on-board application assisted positively and in a timely manner to intercept a variety of illegal actions (contraband, illegal entry to security zones, illegal en-route transhipments, etc.). This pilot application should be further developed and enhanced towards two directions:
  - New state of the art communications technologies should be employed that provide encrypted high bandwidth mobile transmissions of traffic picture (i.e. TETRA system), and
  - The minor problems related to multiple target positioning due to the simultaneous multiple sensor sources (shore based VTS, on-board radar, AIS) correlation should be solved;
- A VTS centre with clear operational procedures and highly trained personnel according to IALA recommendations can play the role of a Command & Control centre able to respond to a variety of incidents and enforce the local and international law.

Finally, we should mention that there is an emerging need for all players involved in the maritime sector as well as their national (i.e. MMM for Greece) and international (like IMO and IALA) supervising organizations, to reconsider current practices and procedures towards operational controls that directly address maritime security. Possibly this could be achieved through a top down approach something like a
“Security Convention” that could be developed in a similar fashion to the “SOLAS Safety Convention”. This could possibly instruct a new enhanced ISM Code resulting to new “Security Controls” that eventually should be incorporated in the VTS operation procedures.

The Hellenic Ministry of Merchant Marine considers the development of the 1st phase of the National VTMIS as a “success story” for its every day operations in sea and land. Given the fact that the current system met successfully the numerous user requirements stated in previous paragraphs the authorities plan to proceed with project extensions in order to cover the extended and partly difficult for navigation coastlines of Greece.