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Naval Vessel Traffic Services

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NAVAL VESSEL TRAFFIC SERVICES

Enhancing the Safety of Merchant Shipping in Maritime Security Operations

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Vessel traffic services (VTSs) ensure the safe and efficient handling of traffic on busy waterways like the English Channel and the approaches to New York. This technique, wherein electronic sensors and communication systems are used to manage traffic actively, can also be used in maritime security operations (MSOs) to enhance safety in areas with risks related to asymmetric threats.[1] Nowadays a limited form of VTS is deployed for MSO situated in international waters. These services, provided by naval cooperation and guidance for shipping (NCAGS) organizations, are focused on building maritime domain awareness (MDA) and providing naval-related safety information to merchant shipping. Structuring and monitoring of vessel traffic, unfortunately, is supported only poorly, or not at all, by NCAGS.[2] This is a serious omission, as structuring and monitoring vessel traffic make earlier detection of dangerous situations possible, render ships harder to attack, and minimize possible cascading effects to ship traffic from harassment or attack. Moreover, compared to alternatives such as escorts and convoys, there would be less delay to shipping, while the need for military assets may be reduced through improved efficiency.

This idea has led the authors to develop a new concept, which is termed "Naval VTS." This approach combines a voluntary VTS monitoring system with a traffic organization and information service aimed at

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providing military commanders responsible for MSOs a level of vessel safety that makes security tasks easier to plan and perform. Navigational risks and risks related to asymmetric threats cannot always be separated, which means that Naval VTS may have to deal with both risks and that it requires flexibility in how it is established.

As proof of concept, three detailed examples will illustrate how Naval VTS would enhance the safety of merchant shipping and contribute to a more efficient use of military assets. The development of the International Recognized Transit Corridor (IRTC) in the Gulf of Aden is extensively discussed in one of the examples, as it clearly shows the progress in MSO toward the organization of maritime traffic, an important part of Naval VTS. Following the examples, the main findings are discussed and recommendations for further research are presented.

VESSEL TRAFFIC SERVICES AND MARITIME SAFETY OPERATIONS

Merchant shipping today carries an estimated 80 percent of world trade on a fixed number of maritime routes, the sea lines of communication (SLOCs).[3] Areas of heightened shipping density on these SLOCs—like the straits of Bab el-Mandeb, Hormuz, and Gibraltar—form choke points. Merchant ships passing these choke points are vulnerable to collision, piracy, and terrorism.

Collisions between ships could practically close a busy choke point like the Strait of Malacca. Such an accident would necessitate rerouting a significant number of merchant ships through the Lombok or Sunda straits. Rerouting causes delays and raises freight rates. This could affect many countries, as the Strait of Malacca, for instance, is the main SLOC between East Asia and the West.[4] A traffic separation scheme and a mandatory reporting service (called STRAITREP) were implemented in 1981 and 1998, respectively, to enhance the safety of navigation in the Strait of Malacca, but the ever increasing volume of maritime traffic remains a source of concern.[5]

Piracy in the Gulf of Aden has led to higher insurance premiums, crew costs, and security costs for ships sailing through this approach to the Strait of Bab el-Mandeb. The heightened piracy risk has even caused shipping companies to reroute ships around the Cape of Good Hope, despite the distance and expense.[6] Though it occurs on the main SLOC between Asia, Europe, and the east coast of the United States, piracy in the Gulf of Aden did not cause much stir until the roll-on/roll-off ship *Faina,* carrying thirty-three T-72 tanks and other heavy weaponry, was hijacked there. After this incident, which followed a sharp increase in piracy activity, NATO, the European Union (EU), Russia, India, Japan, Korea, Malaysia, and others intensified their naval presence in the region.

In June 2009, an IRTC and a Maritime Security Patrol Area (MSPA) were established by the Combined Maritime Forces in the Gulf of Aden in support of United Nations Security Council resolutions 1814 (2008), 1816 (2008), 1838 (2008), and 1846 (2008).[7] The IRTC enables naval forces to concentrate their resources, while the MSPA is overlaid on the IRTC to coordinate and deconflict the efforts of task forces. EU Naval Force ATALANTA encourages merchant vessels to pass through the IRTC in groups, based on their transit speed. These group transits should enhance mutual protection and optimize the deployment of military assets even further. Unfortunately, however, attacks continue, even on ships in group transits through the IRTC.[8]

Terrorist attacks on the USS *Cole* (DDG 67) in October 2000 and the French oil tanker *Limburg* two years later raised the insurance premiums on ships bound for Yemen.[9] The threat of terrorism also caused international concern over the security of choke points, where ships present easy targets and the consequences could be enormous.[10] Concerned about the possibility of the Strait of Gibraltar becoming a site for terrorist attacks, NATO in March 2003 started escort operations there to ensure the safe transit of nonmilitary ships from alliance member states requesting protection.[11] These escort operations were part of the maritime antiterrorism operation ACTIVE ENDEAVOUR, which covers the Mediterranean. A total of 488 ships took advantage of the NATO escorts before reduced threat levels made it possible to suspend them on May 2004. ACTIVE ENDEAVOUR produced insurance rate reductions of approximately 20 percent for commercial shipping transiting the Mediterranean.[12]

Given the vulnerability of merchant shipping in choke points, it is remarkable that VTS is not already included in maritime security operations. VTS traffic organization techniques were used to establish the IRTC in the Gulf of Aden, but in general it has not been given proper thought in connection with MSO. That is a pity, as merchant ships have significantly changed over the past decades; today, the variations in size, speed, and maneuverability are enormous. This diversity within dense traffic flows, in the face of asymmetric threats, demands active traffic management to reduce risks.

In particular, the absence of VTS activities in MSOs causes the following problems in choke points with asymmetric threats and large volumes of traffic:

- Vessel traffic in choke points with no existing VTS center is not organized. The navigational risks inherent to merchant-ship traffic in a confined and congested environment may become unnecessarily high.

- The throughput of merchant ships through a choke point is not optimized. Fast vessels may be exposed to danger longer than necessary.

- Factors affecting the safety of vessels with regard to cascading effects in the event of harassment or attack of other ships are not managed.

It is to overcome these problems that the Naval VTS concept is proposed. Like any vessel traffic service, Naval VTS is a traffic-monitoring system designed to provide support to mariners in busy waterways where risks are deemed greatest. Its main focus, however, would be on the risks related to asymmetric threats.

THE CONCEPT OF NAVAL VTS

As noted above, Naval VTS is a voluntary vessel traffic service designed to enhance the safety of vessel traffic through confined and busy areas at increased risk, of either a general or specific nature (other than war). It comprises a traffic organization service and an information service.[13] It is not, however, envisioned as providing navigational assistance, because of potential liability issues and the fact that the infrastructure that would be required in the Naval VTS area for such a service may be absent or damaged (either by lack of maintenance or by the actions of violent nonstate actors).[14]

The main purposes of Naval VTS are

- To minimize the risk from harassment or attack on merchant ships

- To minimize the cascading effects on ship traffic from harassment or attack

- To optimize the throughput of merchant ships transiting choke points

- To deconflict merchant-ship movements with military operations

- To enhance vessel safety with regard to the risk inherent to traffic in a confined and congested environment.

Secondarily, in meeting these purposes the concept has the potential to stabilize insurance costs and improve the effectiveness of naval patrols and escorts.

All vessels navigating through a Naval VTS area would be encouraged to participate. Participation would be beneficial to vessels, as it would enhance their safety, and it is beneficial to the Naval VTS organization, as it would contribute to the compilation of the traffic picture. Decisions concerning ships' actual navigation and maneuvering remain with their masters. Naval VTS guidance would never relieve them from their responsibility to exercise good seamanship and comply with the Collision Regulations.[15] To minimize the liability element of Naval VTS, each message directed to a vessel would have to state clearly whether it concerned a question, item of information, advice, or a warning and would use International Maritime Organization (IMO) "standard marine communication phrases" where practicable.[16] Nonparticipating vessels would be briefed on dangers that existed and would be monitored.

A Naval VTS organization in a maritime security operation would consist of a commander and one or more units. These units would be teams of military VTS operators, with specialized equipment, possibly cooperating with existing vessel-traffic centers. These units could be ashore or afloat (embarked on either naval or civilian vessels), located at the discretion of the Naval VTS commander. Units would have areas of responsibility, subareas of the Naval VTS area, which are slightly overlapping for contact pass-off and redundancy. All units would have to be equipped with Automatic Identification System (AIS) equipment—receiver, radar, and communications—connected to automated systems to store, update, modify, retrieve, and display collected traffic-picture data. Such equipment, which must be compatible between units and the commander, would give each unit full information about each participating vessel and its intentions. The number of units and level of service provided would depend on the local situation and threat level, and could be adjusted as a situation developed.

Cooperation can be a force multiplier for Naval VTS. Cooperation between the navies participating in MSO could increase the assets and personnel available for Naval VTS. Additionally, cooperation with existing VTS would be particularly valuable when their service areas overlap with that of Naval VTS; use of their surveillance and communication facilities could decrease the assets required to establish Naval VTS. Cooperation with the maritime industry, finally, would make it possible to obtain quickly and cost-effectively all information necessary to maximize maritime domain awareness—such as vessel movements in ports, vessel conditions, hydrographic conditions, and the operational status of aids to navigation.

Commanders of maritime security operations would have authority to activate Naval VTS in their areas. Naval VTS could fit into the normal course of MSO, as participation would be voluntary for all ships and shipmasters would remain responsible for the crews, safe navigation, and handling of their ships. The Naval VTS command-and-control structure and its place within the overall command structure would vary according to the objectives of the operation and the forces participating. Naval VTS commanders, however, would always be responsible for the activities of their organizations.

ESTABLISHING NAVAL VTS

Implementation of this concept requires a Naval VTS area, traffic organization, Naval VTS units, and communication and emergency procedures. Assembly areas might have to be designated as well.

The *Naval VTS area* is a zone within an area where naval forces are operating in which naval vessel traffic services are to be provided. It must be large enough

to cover the waters in which there is an actual threat to shipping, but not so large as to become unmanageable. Factors affecting the size of the area are geographic configuration, the asymmetric attacks expected, and the density and diversity of traffic. The size of a Naval VTS area would be adjustable and could be altered as the situation develops.

To prevent dangerous traffic situations and to provide for the efficient movement of vessels, traffic in the Naval VTS area must be organized. *Traffic organization* can be achieved by a combination of traffic organization and management techniques, including:[17]

- *Geographical division*—to separate traffic streams. This is achieved by using existing "traffic separation schemes," when available and clear of risks. Otherwise, traffic streams can be separated by recommending distinct, noncrossing routes for ships going in opposite directions. Slow and fast traffic moving in the same direction can be separated this way too, so as to minimize transit time.

- *Time separation*—to give a vessel exclusive use of a certain area, or a restricted passage, for a given time. Time slots would be allocated to vessels as part of their sailing plans. Time separation requires advance planning, if the use of (possibly crowded) assembly areas is to be avoided.

- *Distance separation*—to minimize the cascading effects of harassment or attack. Minimum differences between vessels transiting the Naval VTS area would be specified (after consultation with experts) for each type of ship, and cargo carried. The separation distances maintained would be monitored by the Naval VTS.

When overtaking and passing within lanes is not possible, distance separation requires planning so that fast vessels are not exposed to danger longer than necessary due to slower vessels in front of them. When there are no overtaking restrictions, passing distances may be recommended as well.

In deciding the number and location of the *Naval VTS units* to which ships will be requested to report, the size, traffic density, and the geographical configuration of the Naval VTS area must be considered. The key technical factor is the relationship of the radar and communication ranges of the units to the surveillance and communication requirements of the area. A good match is needed, as the quality of accident prevention depends on the units' capability to detect developing situations and their ability to give timely warnings.

Communication procedures are needed for prearrival information, entry of vessels into the Naval VTS area, transit, and departure. Depending on the local situation, other communication arrangements, such as for vessels in berths and

at anchor, may be needed as well.[18] These procedures should stipulate what communications are required and which frequencies should be monitored.

Emergency procedures are needed to deal with incidents that may result from the risks present in the Naval VTS area. These procedures may include alerting the Maritime Rescue Co-ordination Center, promulgating information on the incident to vessels in the Naval VTS area, and restricting traffic. Multiple communications frequencies would be advisable: one for emergencies, a second for standard position checks, and a third on which transiting vessels report suspicious activity. How to deal with high-threat situations with low response times would require advance consideration. In addition, the advantages and disadvantages of having merchant ships restrict or cease transmissions of signals like AIS should be weighed.

Assembly areas may be designated in the Naval VTS area for emergencies, cross-traffic, convoy operations, and so on. When feasible, assembly areas should be situated where the likelihood of asymmetric attacks is remote and disruption of traffic flow is minimal. Assembly areas would have to be large enough to hold all ships expected. Finally, to gain the cooperation of the merchant shipping industry, the coordinates of the Naval VTS area, the services it would provide, and its reporting procedures would be promulgated using the World-Wide Navigational Warning Service. The wording of this notice would require careful thought, so as not to raise concern needlessly in the shipping industry.

HOW NAVAL VTS MIGHT BE USED

Naval VTS offers military commanders responsible for conducting MSOs a broad palette of options to enhance the safety of merchant shipping and improve the effectiveness of military activities. The following examples illustrate how this palette can be used.

Example 1: Terrorism in the Sunda Strait

Consider the following scenario: terrorists block the narrow Strait of Malacca by sinking a very large crude carrier by causing a deliberate collision with a hijacked 25,000-deadweight-ton (dwt.), kerosene-laden product tanker. The collision and the following inferno raise international concern and cause shipping companies to divert their ships through the Lombok and Sunda straits. In the expectation of other terrorist attacks on shipping in the Indonesian archipelago, a multinational maritime force is deployed to conduct MSO in the Java Sea. The Sunda Strait, being the shortest diversion for ships up to 100,000 dwt., becomes heavily used, and fears grow that a similar terrorist attack might occur there (see map 1).[19]

MAP 1
THE SUNDA STRAIT
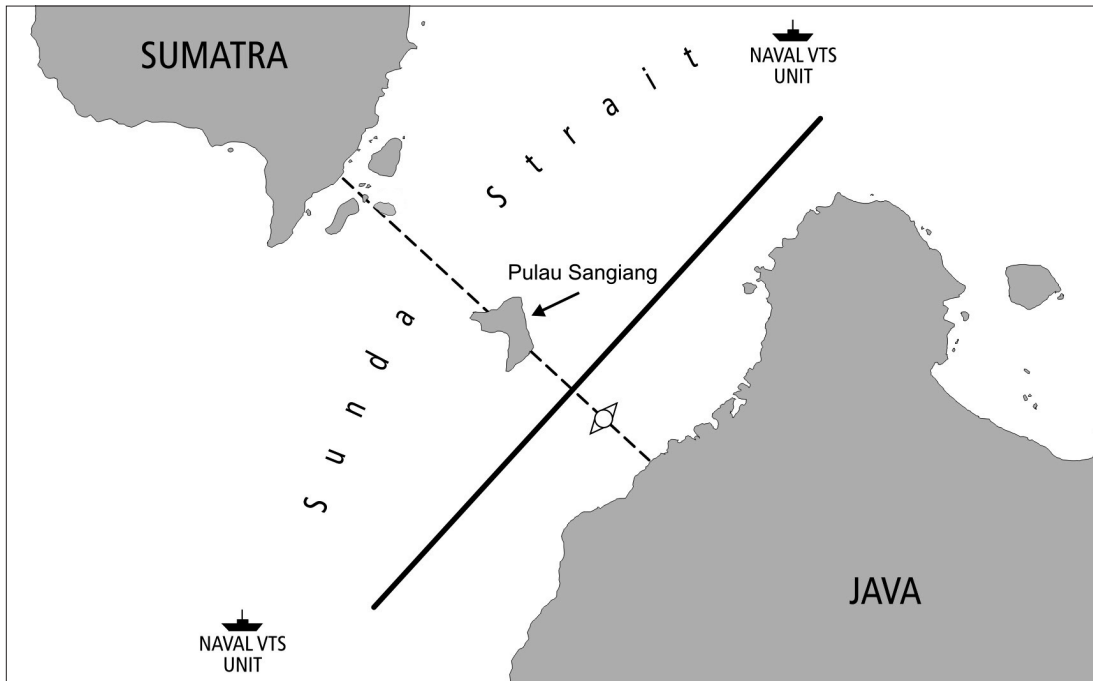
In response, Naval VTS is activated in the Sunda Strait. The site where most congestion is expected and that is most vulnerable to deliberate collisions is the passage between Sumatra and Java, where the small island of Pulau Sangiang lies; this zone needs radar surveillance and must be included in the Naval VTS area. There are no existing VTS centers in the Sunda Strait, and according to the en route sailing directions for Borneo, Java, Sulawesi, and Nusa Tenggara, there is only one track through the risk area.[20] To reduce liability and gain the cooperation of the merchant shipping industry, this track is endorsed. This decision excludes the use of geographic-division traffic-organization techniques.

The deliberate ramming in the Malacca Strait had been possible because of the poor maneuvering qualities of the victim, a large tanker. Naval VTS can apply time-separation techniques to enhance the safety of such ships in the Sunda Strait—for example, giving all tankers over 60,000 dwt. going in the same direction the exclusive use of the risk area for a certain time. This prevents the dangerous situations with more maneuverable vessels (like the hijacked product tanker) and minimizes the time the larger participating tankers are exposed. Terrorists, however, can be expected to adapt their modus operandi as their targets become harder to attack. In anticipation of such changes, Naval VTS can apply distance separation, further contributing to the prevention of dangerous

maritime situations and minimizing cascading effects to ship traffic in case of attack.

The risk area stretches approximately twenty-two nautical miles. Radar surveillance of this area is achieved by two Naval VTS units afloat, embarked on chartered civilian ships, one in the north and one in the south (see map 1). Vessels are requested to report to and maintain very-high-frequency (VHF) radio watch with the nearer of these units thirty minutes prior to entering the risk area. The areas of responsibility of these two units overlap along a line drawn from Java to Sumatra, over Pulau Sangiang. At this point participating vessels shift their reports and VHF watch to the other unit.

As some ninety ships a day are expected to be diverted through the Sunda Strait, time separation could cause severe congestion in the approaches; in addition, assembly areas cannot be used, due to the threat of deliberate collisions. Therefore, advance planning of vessel movements is imposed. To obtain the necessary data, the Naval VTS organization—that is, the Naval VTS commander— requests vessels to send prearrival reports confirming their participation, as soon as practicable. Position updates are also requested, at prescribed times and locations. The Naval VTS commander intends, if traffic flow without congestion cannot be achieved by planning, to give priority to ships in the northern approaches, as maneuvering space there is restricted by islands, reefs, rocks, oil fields, and shallows exposed at low tide.

Naval VTS activated in the Sunda Strait in this scenario enhances the safety of merchant shipping without drawing upon military assets. Participation is seen as a matter of common sense and, having been properly announced, is recommended by the various maritime-industry bodies. No liability is assumed, as Naval VTS participation is voluntary and participation does not compromise the responsibility or authority of masters for the safe navigation and handling of their ships.

*Example 2: Piracy in the Gulf of Aden*

On 22 August 2008, to discourage piracy attacks on commercial vessels in the Gulf of Aden, an International Recognized Transit Corridor (IRTC) was established. This corridor (depicted on map 2) originally ran through the northern part of the gulf, as far from the Somali coast as possible.[21] That route enabled naval forces to concentrate their resources but had three flaws: it allowed the pirates to use the Yemeni coast in their operations; it crossed fishing areas, where pirate skiffs and fishing boats are hard to tell apart; and it did nothing to prevent collisions between eastbound and westbound traffic. To overcome these problems the IRTC was moved south, and traffic streams were separated. A revised IRTC came into effect on 1 February 2009, consisting of two lanes (eastbound

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and westbound) separated by a buffer zone.[22] This corridor, which is generally (but not entirely) clear from known fishing areas, separates traffic but is not a formal traffic-separation scheme, where vessels would have to comply with Rule 10 of the Collision Regulations. (Rule 10 makes special provisions for vessels transiting, operating in, and crossing such schemes.) The geographic shape of the revised IRTC is shown in map 2, indicating the eastbound and westbound lanes. Neither the original nor the revised IRTC is marked or defined by visual navigational aids.

Aside from the traffic organization imposed by the IRTC, a voluntary reporting scheme has been established for commercial vessels transiting the Gulf of Aden.[23] Owners, operators, and managers of vessels planning to transit or enter it are requested to register the details and intended movements of their vessels on the Maritime Security Centre Horn of Africa website.[24] This registration, which should be completed as soon as possible, allows vessels to be signed up for group transits through the IRTC. In addition, masters of vessels transiting or entering the region are requested to send position updates to both the UK Maritime Trade Operations office in Dubai and the U.S. Maritime Liaison Office in Bahrain. These updates and reports are beneficial to vessels as they will receive guidance, recommended routing, and updated threat assessments, and they are beneficial as well to the Combined Maritime Forces.

Naval VTS is designed for confined areas, where direct interaction with vessels is possible. That is not the case in the Gulf of Aden, which is too large for the surveillance and communication requirements of Naval VTS to be met

**MAP 2
THE GULF OF ADEN**

YEMEN

G U L F   O F   A D E N

SOMALIA
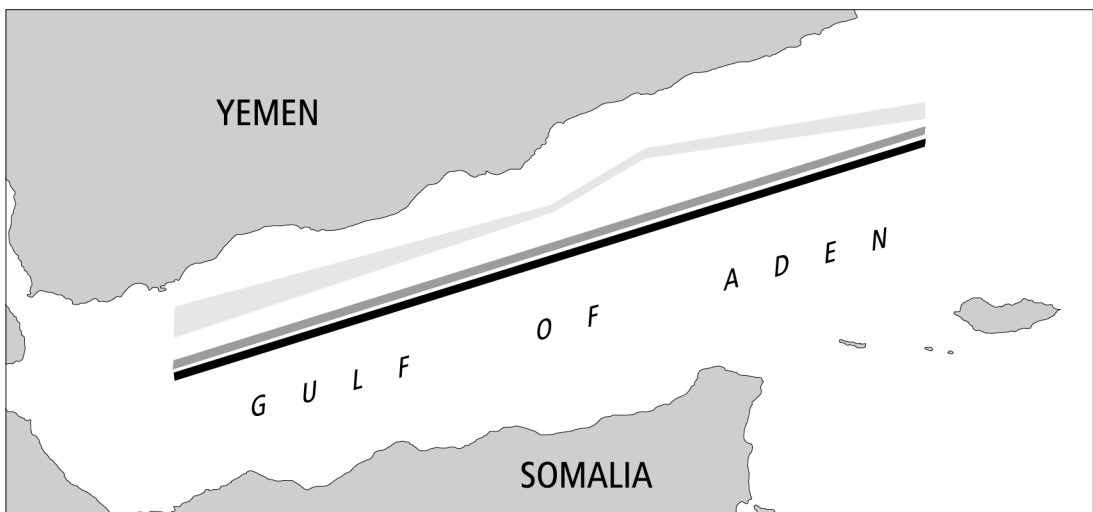
cost-effectively. Even here, however, activation of Naval VTS offers options to enhance the safety of merchant shipping and improve the effectiveness of military activities. In particular, it can improve information services and collect the identifications and intentions of vessels in fishing areas crossed by the revised IRTC. This would allow early detection of dangerous situations and therefore timely warnings. Active traffic management in such fishing areas can be achieved by a limited number of Naval VTS units. These units may be deployed on chartered civil ships carrying armed security detachments for protection.

Alternatively, Naval VTS could improve the traffic organization service. Somali pirates typically lie in wait along shipping lanes for targets of opportunity.[25] Therefore, while the IRTC enables naval forces to concentrate their resources, it also assists pirates in finding their targets.[26] To overcome this undesirable side effect, Naval VTS could establish two or three corridors through the Gulf of Aden, together with a corridor-rotation scheme. The coordinates of these corridors (which should include separate eastbound and westbound transit lanes to prevent collisions) could be promulgated via the World-Wide Navigational Warning Service, but the corridor-rotation scheme would be known to the naval forces only. On entering the Gulf of Aden, participating vessels would receive electronically a sailing plan from a Naval VTS unit ashore. This plan would include the corridor through which individual ships are advised to conduct their transits and the recommendation to switch the AIS off and maintain radio silence so as to deny pirates information as to which corridor is being used. Assuming sufficient distance between the corridors and an appropriate rotation scheme, naval forces would be able to concentrate their resources on the one corridor currently in use, while pirates would have to spread their efforts over them all. This traffic organization would be likely to reduce the number of attacks. Moreover, more predictable attack patterns could arise from corridor rotation, leading to earlier detection and military intervention.

### Example 3: A Terrorist Threat in the Strait of Gibraltar

Consider a further scenario: a terrorist threat against merchant shipping transiting the Strait of Gibraltar in both directions. Intelligence reports are warning that terrorists might use explosive-laden dinghies to commit suicide attacks off Morocco and Spain. The NATO-led antiterrorism operation ACTIVE ENDEAVOUR has been tasked to provide an appropriate response.

Activation of Naval VTS in the Strait of Gibraltar is that response, an especially appropriate one since a high throughput of merchant ships is to be maintained. As suicide attacks are likely to occur close to the coast, the safety of the vessel traffic through the traffic-separation scheme in the Strait of Gibraltar and the precautionary areas on the eastern side and off the Moroccan cargo port of

Tanger-Med needs to be enhanced. (The port of Tanger-Med is about twenty-five miles from Tangier and has been operational since 2007.) This area of higher risk, which must be included in the Naval VTS area, is under the radar surveillance of Tarifa VTS in Spain, a mandatory VTS whose cooperation is sought for the present contingency.

Because a dinghy has more time to approach a slow-moving ship than a fast-moving one, slow-moving ships are more vulnerable to suicide attacks. Hence, Naval VTS divides each lane of the traffic separation scheme into an outside lane (depicted in map 3) for vessels operating at speeds above sixteen knots and an inside lane for slower vessels. This traffic organization is beneficial to slow-moving vessels, as it minimizes the window of opportunity of the terrorists, who have to cross the outside lane first before a slow-moving vessel can be approached. It is also beneficial to fast-moving ships, which do not have to reduce speed for, or overtake and pass, slower vessels, lessening their exposure to danger. To minimize delays in the precautionary areas, where cross-traffic must be expected, Naval VTS also uses distance separation. This provides cross-traffic

MAP 3
THE STRAIT OF GIBRALTAR
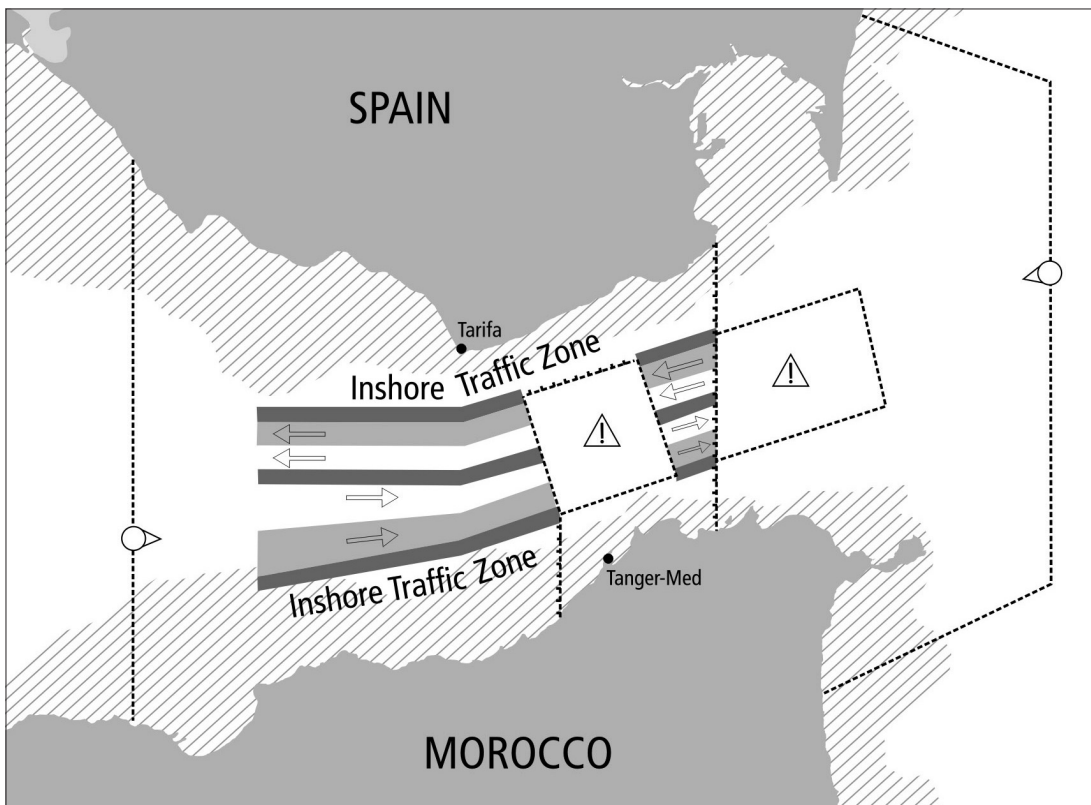
more opportunities to cross safely the traffic flow between the Mediterranean and the Atlantic Ocean, and it gives vessels more space for evasive maneuvering in case of attack. The border between the inside and outside lanes is not marked or defined by navigational aids.

Radar surveillance is achieved with one Naval VTS unit. Depending on the level of cooperation, there are two options to locate that unit. One is to station it on a ship in the vicinity of the precaution area off Tanger-Med; the other option is to deploy it at Tarifa VTS. Vessels are requested to send electronic prearrival reports to the Naval VTS organization confirming their participation, well before entering the Naval VTS area, to allow timely data processing and planning. In addition, vessels are requested to report to the Naval VTS unit and maintain a VHF watch with it. This is to be done at the reporting points shown on map 3 and when leaving ports or anchorages in the Naval VTS area. It allows the military VTS operators to interact directly with the participating vessels, which is of vital importance in this potentially dangerous situation.

In this way Naval VTS is able to enhance the safety of merchant ships transiting the Strait of Gibraltar without seriously reducing its throughput. This implementation of Naval VTS in the Strait of Gibraltar requires very few naval assets, if any. Participation by merchant vessels is voluntary and may be declined at any time.

CLOSING THE RESOURCE GAP

The foregoing introduction to, and outline for implementation of, the Naval VTS concept clearly illustrates how, by structuring and monitoring vessel traffic, it could enhance the safety of merchant shipping and improve the effectiveness of military activity. To minimize liability, participation in Naval VTS would have to be voluntary. This has the disadvantage that not all vessels in the Naval VTS area might cooperate, which could cause irregularities in traffic flow. These irregularities, however, would affect safety only minimally—sound traffic organization and direct interaction with participating vessels in critical zones should provide enough robustness.

Naval VTS could play an important role in the international MDA security effort.[27] MDA strengthens the ability of nations to conduct search and rescue and to disrupt crimes at sea by collecting data on shared networks. Unfortunately, this sharing of maritime domain awareness has its risks.[28] Coastal states with excessive maritime claims, as well as violent nonstate actors, may be able to access and misuse MDA data. Moreover, economic interests may be affected when commercially sensitive information is compromised (such as the positions of oil tankers, in the context of spot-market energy prices). Hence military commanders responsible for conducting maritime security operations must carefully

weigh the positive and negative aspects of Naval VTS involvement. Vessels may not want to participate in Naval VTS when the commercial sensitivity of the information supplied by the merchant shipping community is not respected and protected.

All the same, through close liaison with intelligence Naval VTS could make a significant contribution to the detection, identification, classification, and monitoring of possible threats. Additional staffing would be needed to cope with these intelligence tasks, as the main responsibility of the Naval VTS operators themselves would be to interact with ships and respond to traffic situations developing. Additional sensors may be needed as well, as AIS and radar alone cannot, for instance, detect small, fast attack craft in an accurate and timely way. Such additional sensors can be obtained through cooperation efforts. A final caveat is that all attention should not be focused on vessels that are not participating in Naval VTS—the threat could be the vessel that is *more* compliant than others.

Aside from maritime security operations, Naval VTS could be activated for any situation in which vessel traffic needs to be managed quickly, such as in disaster areas. In such a context, the use of AIS virtual aids to navigation would be recommended.

Naval VTS has the potential to close the significant gap between the resources required for MSO and the resources available to violent nonstate actors. As such it merits further investigation and elaboration. Naval VTS tactics, techniques, and procedures would need to be developed into guidance and doctrine for Naval VTS support in maritime security operations. In addition, simulations, training, and exercises will be needed to improve procedures and gain experience and insight in the possibilities and limitations of Naval VTS.

NOTES

1. Maritime security operations are military operations other than war conducted to ensure freedom of navigation, the flow of commerce, and the protection of the ocean.

2. NCAGS procedures support real-time monitoring and interaction of vessel traffic poorly, and traffic organization not at all. See also North Atlantic Treaty Organization [NATO], *The Naval Co-operation and Guidance for Shipping Manual (NCAGS)*, ATP-2(B) (unclassified).

3. United Nations, *Review of Maritime Transport 2008* (New York: United Nations Conference of Trade and Development [UNCTAD], 2008).

4. Mokhzani Zubir, *The Strategic Value of the Strait of Malacca* (Kuala Lumpur: Maritime Institute of Malaysia, 2004); U.S. Energy Dept., *World Oil Transit Chokepoints* (Washington, D.C.: Energy Information Administration, January 2008).

5. Marcus Hand, "Malaysia Calls for Limits on Strait Traffic," *Lloyd's List,* 22 October 2008, www.lloydslist.com.

6. The hijacking of the very large crude carrier *Sirius Star* on 15 November 2008 showed that even on the longer route around the Cape of Good Hope, pirate attacks cannot be avoided.

7. Jim Wilson, "Warships for Piracy Patrol," *Safety at Sea International* 42, no. 476 (October 2008).

8. The bulk carrier *Victoria* was hijacked 5 May 2009 in the Gulf of Aden at lat. 13° 22' N, long. 049° 23' E. It was sailing in the IRTC and was picked out of a group transit within only a few minutes. The helicopter from the closest warship (some ninety nautical miles away) was too late to prevent the hijacking.

9. Ali M. Koknar, "Terror on the High Seas," *Security Management* 48, no. 6 (June 2004), p. 75.

10. U.S. Energy Dept., *World Oil Transit Chokepoints;* Jean-Paul Rodrigue, "Straits, Passages and Chokepoints: A Maritime Geostrategy of Petroleum Distribution," *Cahiers de Géographie du Québec* 48, no. 135 (December 2004).

11. "NATO to Escort Shipping in Straits of Gibraltar," NATO Press Release, 4 February 2003.

12. Gen. James L. Jones, press conference at SHAPE following the Allied Command Europe Commanders Conference, 18 June 2003.

13. VTS services are defined in *Guidelines for Vessel Traffic Services,* IMO Resolution A.857(20), adopted 27 November 1997.

14. A navigational assistance service assists the decision-making process on board.

15. See International Maritime Organization, *Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs),* adopted 20 October 1972, entered into force 15 July 1977.

16. *Standard Marine Communication Phrases (SMCP),* IMO Resolution A.918(22), adopted 29 November 2001.

17. International Association of Marine Aids to Navigation and Lighthouse Authorities [IALA], *IALA VTS Manual* (St.-Germain-en-Laye, Fr.: 2002), p. 35.

18. Ships at anchor are very vulnerable to asymmetric attacks, but anchoring cannot always be avoided at ports in the Naval VTS area with limited quay capacities. The security of anchorage areas in the Naval VTS area therefore deserves attention.

19. The figure of 100,000 dwt. is taken from *Sailing Directions (Enroute): Borneo, Jawa, Sulawesi, and Nusa Tenggara,* Publication 163 (Bethesda, Md.: National Geospatial-Intelligence Agency, 2007), p. 97.

20. Ibid., pp. 97–98. There is also an archipelagic sea lane (ASL) through the Naval VTS area. The axis line of the ASL, however, does not indicate the deepest water or any recommended route or track.

21. Maritime Administration, "Gulf of Aden Suggested Waypoints for Transit," MARAD Advisory 2008-05, U.S. Transportation Dept.

22. Maritime Administration, "Indian Ocean: Gulf of Aden: Piracy Countermeasures," MARAD Advisory 2009-04, U.S. Transportation Dept.

23. Hydrographic Department, "Navarea IX (Persian Gulf, Red Sea, NW Arabian Sea) Navigational Warning 092/2009," Pakistan Navy.

24. The Maritime Security Centre Horn of Africa website (www.mschoa.org) consists of a public-access area and a registered-users area. The former offers press releases and general information on Operation ATALANTA. The latter, which can be accessed only after registration and verification, contains more sensitive content, like alerts and transit guidance.

25. *Sailing Directions (Planning Guide): South Atlantic Ocean and Indian Ocean,* Publication 160 (Bethesda, Md.: National Geospatial-Intelligence Agency, 2008), p. 294.

26. This idea is supported by map 1 in UN Institute for Training and Research, *Analysis of Somali Pirate Activity in 2009* (New York: Operational Satellite Applications Programme, 23 April 2009).

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