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Research & Debate—A Maritime Traffic-Tracking System: Cornerstone of Maritime Homeland Defense

Guy Thomas

RESEARCH & DEBATE

A MARITIME TRAFFIC-TRACKING SYSTEM CORNERSTONE OF MARITIME HOMELAND DEFENSE

Guy Thomas

Among the many lessons "9/11" has taught is the one that the United States is a vulnerable nation. This is especially true on its sea frontiers. President Franklin D. Roosevelt understood this; he made a point of it during his first "fireside chat" after Germany invaded Poland, plunging Europe into war in September 1939, twenty-seven months before the U.S. Navy was attacked at Pearl Harbor. American security was, he said, "bound up with the security of the Western Hemisphere and the seas adjacent thereto." It still is. "We seek to keep war from our firesides by keeping war from coming to the Americas." Today, we are engaged in a different war, one that has already come "to our firesides." To help prevent its return Americans must again attend to the security of the seas and their ports. This is doubly true for, despite the emergence of the information age and the decline of the U.S. merchant marine, the United States is still a maritime nation; the security of its harbors and seaports is still of first importance to the well-being of this country. Americans are very dependent on maritime trade, as was recently demonstrated by the significant economic damage done by the short dock strike on the West Coast. It is easy to envision that the economic cost and social impact of simultaneous terrorist attacks on two or more American ports would be huge.

The nation is attempting to grapple with this problem, which is ultimately one of global scope. One part

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of that problem—but a step that is both critical and manageable in the short term—is to maintain the security of its ports. The United States needs to track and identify every ship, along with its cargo, crew, and passengers, well before any of those vessels and what they carry enter any of the country's ports or pass near anything of value to the United States. This article proposes a system that would provide that tracking capability, as well as a means to meet any related emergency with an appropriate response. This proposal—the result of months of war games, conferences, and working groups dealing with the maritime aspects of homeland security—is intended to be a strawman, a thought starter, a means of generating informed debate on how and why the United States might build a maritime counterpart to the flight-following systems of the North American Aerospace Defense Command (NORAD) and the Federal Aviation Administration (FAA).[1]

Not everyone supports this idea. Some believe it is too difficult, or not worthwhile, or both. Admiral Vern Clark, the Chief of Naval Operations, is not one of these; he has twice called for the creation of a "maritime NORAD." He first urged its creation on 26 March 2002 during a conference on homeland security issues sponsored by the Coast Guard and the Institute of Foreign Policy Analysis at Cambridge, Massachusetts. Parts of his speech resemble an early version of the white paper this article is drawn from, written by the author and forwarded to the Navy Staff in November 2001. Other powerful members of the U.S. government also spoke, but it was Admiral Clark's words that the press highlighted. The CNO's second call for a maritime tracking system came on 15 August 2002, at the Naval-Industry R&D Partnership Conference in Washington, D.C. This time the press missed it:

> In conducting homeland defense, forward deployed naval forces will network with other assets of the Navy and the Coast Guard, as well as the intelligence agencies to identify, track and intercept threats long before they threaten this nation.
>
> I said it before and I'll say it again today: I'm convinced we need a NORAD for maritime forces. The effect of these operations will extend the security of the United States far seaward, taking advantage of the time and space purchased by forward deployed assets to protect the United States from impending threats.

What, some ask, does the admiral mean by "forward deployed assets"? If he means units deployed overseas, the problem is significantly more difficult than if he means units under way (in fleet operating areas, for example) a few hundred miles off the U.S. coasts. A maritime NORAD-like system could be built from existing technology to solve the "detect, ID, track and interdict as appropriate in the coastal-belt" problem. That belt could extend from fifty to a thousand miles offshore, or some other similar area, to provide sufficient time for early detection, analysis, and determination of the threat potential or the probability of involvement in illegal activity of vessels en route to the United States. A maritime traffic tracking system as outlined below would require almost no additional tactical assets and would make the ones that are there substantially more effective. The overseas, far-forward problem is a closely related, but separate, issue. Its multinational political dimension alone makes it substantially more difficult. However, it is not significantly more difficult technically, once we get foreign ships in foreign waters to install the proposed transponders, which, it must be admitted, would indeed be a very tough sell. The proposed system would, most assuredly, assist in the forward-deployed situation, but, in any case, the problem of security at home needs to be solved first. It may be possible to expand overseas the tracking capabilities required once they are in place in U.S. coastal waters and economic exclusion zones, but it would be nearly impossible to do the reverse—to establish the required tracking capabilities in foreign seas and then extend them back to the coast of the United States. To attack the overseas environment before the near-home coastal problem would result in a huge waste of time and national resources, both manpower and money, and would leave our ports still vulnerable.

THE PROBLEM

The United States has 185 deepwater ports. Every day over two hundred commercial vessels and twenty-one thousand containers arrive at eighteen of these deepwater ports. The container-carrying ships are largely concentrated in less than a dozen ports that have the proper handling equipment, but most ports can accept a few containers. Additionally, approximately five thousand vessels of all types, pleasure boats, fishermen, tugs with or without tows, oilfield-support vessels, and research ships are active every day in the vast area from fifty to a thousand nautical miles offshore. All of these vessels are large enough to carry significant cargoes. They sail to and from not only the 185 ports mentioned but also an even larger number of smaller moorings and anchorages. Some of these vessels, which are of all sizes and types, are involved in illegal activities, such as drug and immigrant smuggling, illegal fishing, or environmental pollution.

The concern since "9/11" is that there may be other vessels with even more sinister objectives. This concern is heightened by the fact that tens of ocean-crossing-capable commercial vessels disappear every year. Some sink because of weather or unseaworthiness. Others probably "disappear" for insurance purposes. More than a few are attacked by pirates. Additionally, older but serviceable ships of considerable size can be purchased in many places for less than the terrorists probably spent to execute the attacks on the World Trade Center and the Pentagon. Any of these vessels could carry enough explosives to destroy or substantially damage a port's infrastructure, including bridges, chemical and petroleum plants, processing, handling and storage facilities, and such high-value vessels (and thus high-payoff targets) as aircraft carriers and liquid natural gas carriers. Indeed, the easiest way to put a weapon of mass destruction into large urban areas such as New York, Los Angeles, or the Hampton Roads area of Virginia is to send it by ship. A relatively small explosion onboard a small ship with a deck cargo of even a few smallish bags of anthrax or some other evil substance in a major city port might only kill a few thousand or even just a few hundred people, but the terror it would cause would be devastating to our economy, if not our national psyche. The threat to our ports is especially true now that the airport and container security has been significantly enhanced worldwide.[2]

These facts make it apparent that the United States needs a better means than it now has of identifying and tracking all vessels, as well as their cargoes, crew, and passengers, as they approach the coasts of the United States or its territories. The country does not now have a system that will give full "situational awareness" of the surface of the seas surrounding it. It needs to create one now. We need to know the name and ownership, position, course, speed, and intended port of call of every vessel; the identity of everyone onboard; and a description of its cargo or function—just as is required for all aircraft, private and commercial alike. In other words, what is needed is a requirement for a "float plan" (the maritime equivalent of an aviation flight plan) and a means of positively identifying each vessel well before it nears our coasts (e.g., the maritime equivalent of an "identification friend or foe," or IFF, system). Moreover, the float plan and the maritime IFF system must be linked together. Such an infrastructure might be a "North American Maritime Defense Command." Various proposals are under investigation by the governments of the United States and Canada via a Bi-National Maritime Awareness and Warning Working Group based at NORAD. Others have suggested changing NORAD to the "North American Defense Command" (with the same acronym), with air, land, and sea components.

HOW CAN THIS BE DONE?

Once we have a workable long-range maritime IFF, we can use several existing technologies to gather, process, analyze, and fuse data from all useful sources so those who must daily make decisions can reliably make the right ones in a timely manner and take appropriate action. As already noted, the proposal centers on a maritime analog of the FAA and NORAD, as well as the U.S. Customs flight-following systems and the development of a long-range maritime IFF. This is the critical initial step in building a maritime equivalent of NORAD. Though it does not address adequately the very difficult problems of tracking the cargo and the people onboard, this increment will provide an "information backbone" with which data on the contents of a vessel—its cargo, crew, and passengers—can be melded, as it absolutely must be. Though this article focuses primarily on a maritime IFF system and the needed information backbone, it also addresses the other issues, i.e., the gathering, processing, analyzing, fusion, and provision of data, to provide a context and to outline issues to be considered for an end-to-end "system of systems."

The tracking of ships bound for the United States is a task for the U.S. Navy, U.S. Coast Guard, and U.S. Customs Service. Whereas ship tracking is now undertaken only by exception, when extraordinary circumstances warrant, this article proposes that it be done on a routine basis. Indeed, given today's technology, its comparative low cost and substantial capabilities, it would not be excessively expensive to put a transceiver or transponder on every ship and track it (as will be discussed below). However, even if a transponder could be placed, at a reasonable unit price, in every container bound for the United States, the aggregate cost could well prove prohibitive. But the payoffs of even just vessel tracking for the struggle against terrorist threats (as well as drug and illegal-immigrant smugglers and polluters) could be substantial, far outweighing its cost.

Surveillance under the proposed system would be focused on the belt from fifty to a thousand miles offshore, or some other similar zone. (Vessels on voyages originating and terminating within U.S. waters would be of interest only if they ventured more than fifty miles offshore.) Vessels in that belt would be forbidden to approach U.S. shores closer than twelve nautical miles (the international recognized limit of territorial waters) without having switched on and operated a maritime IFF system for at least the previous ninety-six hours. A ship departing a foreign port less than ninety-six hours from the coastal waters of the United States would have to have the system operating as it gets under way.

Also, all vessels bound for U.S. waters would be required to file a float plan (with the information detailed in the sidebar) and have a registration receipt from the U.S. Coast Guard before reaching a point ninety-six hours (about a thousand miles, at ten knots) out. Those who did not comply would risk being stopped, searched, and denied entry to U.S. ports for a minimum of two days. The float plan could be forwarded via e-mail or any other record-producing communications system. Most shipping companies already do something similar to this internally to keep track of assets and maintain business flow. This is an expansion of the field of vessels for the Advanced Notification of Arrival (ANOA) now required by the Coast Guard for large vessels entering our ports. It is in any case a good idea from a safety view, as a float plan tells someone ashore where a vessel is headed and when it expects to get there; if the vessel does not arrive on schedule, a search can be initiated. (In two recent cases, men sailing alone spent more than three months adrift in disabled boats because no one knew to look for them.) Many smaller ships operating offshore already have communications devices that support e-mail; those that do not could use a marina's e-mail before departure. It would, in any case, be the operators' responsibility to make the necessary reports and to obtain the necessary documents. Given the widespread availability of communications systems, however, this requirement should not be arduous. The cost of the transponders and the minimum monthly fee for U.S. citizens could be funded with an income tax credit. In that most of the proposed transponders would also have at least e-mail capability, additional usage of the system would be the vessel operators' responsibility, like exceeding a monthly allocation of cell-phone minutes.

These reporting requirements are consistent with international practice regarding freedom of navigation on the high seas. Indeed, the U.S. Coast Guard already has a ninety-six-hour Advanced Notification of Arrival requirement in effect, dictating that large commercial vessels broadcast their intentions well before they cross the thousand-mile line. Once within a thousand miles the proposed maritime IFF system would update a vessel's position at specified intervals as it closed the coast. The fifty-nautical-mile inner boundary eliminates from surveillance the vast majority of pleasure and fishing boats and other coastal commercial vessels that normally do not routinely venture far offshore. The boundaries, both far and near, could be easily adjusted as needs and experience dictate.

Those areas that abut neighboring countries' borders will need special attention, including the establishment of radar identification zones. The areas include where the coasts of Texas and California meet Mexico; where Washington State and Maine meet the Canadian coast; the Strait of Florida, which abuts the territorial waters of Cuba; and the vicinity of Puerto Rico and the U.S. Virgin Islands. Radar surveillance in these high-interest, potential high-threat areas would greatly facilitate the positive identification of all maritime traffic, especially if very-long-range (110 nautical miles–plus) high-frequency surface-wave (HFSW) radar is employed. Indeed, means are already at hand in most of those places to provide the close surveillance required. The one thing they are lacking is the means to identify positively the many tracks they now have. This proposal solves that problem for the tracking of all law-abiding citizens. The others would become much more conspicuous. Where adequate radar surveillance is not now available, a few well-placed aerostats, like those used in counterdrug operations, would provide sufficient coverage. However, experience indicates that radar tracking is not enough—satellite communications transponders onboard ships, serving an IFF function, are key to solving the ship-traffic management system.

SHIP AND CONTAINER TRACKING

Monitoring the contents and tracking the location of containers are at the heart of shipping security. Many people believe containers, whether arriving by land or sea, represent the greatest potential for security breaches and entry of contraband. The tracking of containers bound for the United States is an important responsibility of the U.S. Customs Service. The U.S. Border Patrol, Drug Enforcement Agency, and Federal Bureau of Investigation, plus other law enforcement agencies, support Customs in this effort. The people-vetting and tracking problem is even more difficult, and these agencies also assist the Immigration and Naturalization Service (INS) in vetting and tracking the people arriving in the United States via all modes of transportation, including ships. (For some of the currently available technologies, see the appendix, available online at www.nwc.navy.mil/press/Review/2003/autumn/rd1-a03.htm.)

DRAFT NOTICE TO MARINERS

Be advised: All vessels intending to enter or transit the territorial waters of the United States or its protectorates (Guam, Puerto Rico, Virgin Islands, Samoa) must file the Advanced Notification of Arrival (ANOA), as required by pertinent U.S. Coast Guard regulations, or a float plan as described below with the U.S. Coast Guard, prior to arriving within one thousand nautical miles of the coast of the United States or its protectorates. If the point of departure is within [to be specified] nautical miles, the float plan must be filed a minimum of twenty-four hours prior to leaving the foreign port. The float plan will include:

1. The names and nationalities of all persons onboard
2. List of all Maritime Mobile Service Identifiers (MMSIs) to be used on the voyage
3. Description of any and all cargo
4. Point of last departure
5. Destination
6. Estimated time of arrival
7. Estimated time and location of arrival at a point fifty nautical miles from the coast of the United States or its protectorates.

Additionally, all vessels must also have one of the following systems on and transmitting its identification (MMSI) and location. It must be reporting the vessel's position and MMSI not less than once an hour when in international waters within [to be specified] nautical miles from the United States or its protectorates. When in international waters within [to be specified] hundred miles of the United States or its protectorates and planning on entering U.S. territorial waters the vessel must broadcast its identification and position four times an hour. Vessels not complying with this directive will be subject to interception and detention for a minimum of twenty-four hours at the limits of U.S. territorial waters.

Potential solutions to these two problems will not be addressed here other than to note that the float plan, systems, databases, and procedures developed to track ships would assist the INS in its people-tracking efforts and the U.S. Customs Service in its cargo-tracking mission as well. In fact, the system proposed here would have much wider applications than port security, or even counterterrorism generally. As a start, it would also greatly assist in the war on drugs, help curb illegal immigration, assist in fisheries protection, and support antipollution operations.

Most of the civilian agencies named above already have at least limited maritime surveillance capabilities to cope with such problems. As an example, the Customs Service has an excellent facility at March Air Reserve Base, near Riverside, California—the Air and Marine Interdiction Coordination Center (AMICC). It is primarily focused on countering air smugglers and tracks all aircraft crossing any border in North America. The coverage of the remote radars (displayed at AMICC via live video feeds) extends far across North America and well into South America. AMICC currently makes only a minimal effort against marine smugglers, due to manpower and equipment limitations, but Customs would like to see that capability expanded. The agency clearly understands what needs to be done and, given the resources, is ready to do it or to help whatever other organization gets the job.

At any one moment there are about five thousand aircraft airborne either over the United States or in its immediate vicinity. The Customs Service's system for coordinating multiple reporting entities and the tools it has developed for its air surveillance task are especially instructive. In the course of a day, seven to eleven AMICC watch standers routinely select an average of 2,900 tracks (out of tens of thousands) for special, detailed examination. To assist in that examination AMICC has developed an excellent set of software tools that allow surveillance system operators to access databases that contain the current flight plan data and the flight tracks of all flights of the aircraft under special scrutiny in the past two years, as well as data on anyone of special interest who has been associated with that particular aircraft. Interestingly enough, the Coast Guard has much of this same data on over six hundred thousand vessels of U.S. registry in its Maritime Information for Safety and Law Enforcement (MISLE) database. It also has many of the same types of interfaces to a host of other organizations, such as commercial insurance databases and international police organizations as does the AMICC. The AMICC is also a major participant in the Domestic Events Network (linking the Federal Aviation Administration, NORAD, law enforcement agencies, and air traffic control facilities). AMICC's experience should prove very valuable in developing a maritime counterpart. If the maritime surveillance organization is not collocated at the AMICC, it would need to have a close interface with AMICC and be a major participant on the Domestic Events Network. The maritime tracking center would need to be linked to the MISLE database, which would need in turn to be interfaced to the Global Command and Control System, which is now under consideration, in order to approximate what is now in operation at the AMICC.

MODELS AND FRAMEWORKS

Fundamentally, the maritime homeland security/defense mission involves a *detect-assess-act* cycle. These cycles can be approached in several ways. The most famous model is the "OODA loop," which consists of the elements *observe, orient, decide,* and *act.* Another widely employed model is the "sensor to shooter" paradigm. A third, more recent breakdown of this cycle is the "find, fix, track, target, engage, assess" model. Though each of these models is useful, none fully describes what actually happens in a systems sense. Let us use a slightly different model to describe a vessel-tracking system and its interfaces with a decision-making apparatus so as to produce a system able to take timely action against potentially hostile vessels and to apprehend others engaged in illegal activities.

This model, called "Warfare in the Fourth Dimension," was developed more than twenty years ago to describe and analyze the importance of time for decisions in combat.[3] It was first used to equate the battle for control of the electromagnetic spectrum with the battle for time, the fourth dimension in physics. The model's components are the sensors (S), the processors (P), the fusion system (F), the decision maker (DM), and the action taker (AT), as well as the communications links that tie each of those components together. The paradigm closely mirrors what actually happens in all forms of combat, be it an infantryman fighting in very close combat or a ballistic-missile-defense action on the edge of space.

Sensors detect phenomena given off by potential targets and forward data to processors, which feed information to the fusion system. The fusion system provides knowledge to the decision maker. He, in turn, takes all other factors of the environment, including rules of engagement, force status, strategic situation, political alignments, and so on, into account and develops as clear a tactical picture as possible and (ideally) the wisdom applied to it. On this basis the decision maker issues orders to the action taker. The sensors detect the results, or lack thereof, and the cycle starts all over again. A shorthand of the model's operation is S-P-F-D-A.

In close ground combat, eyes and ears (and hands and noses, if the conflict is very close indeed) are the primary sensors. The processors, fusion system, decision maker, and action taker are all represented within soldiers, and the communications systems are the synapses in their brains. At the other extreme, on the edge of space, the sensors might be infrared or electronic intelligence satellites, linked to their processing centers on the ground by high-capacity data links that are in turn linked to the fusion system via military satellite communications or fiber-optic cable. The fusion systems might, or might not, be collocated with the decision maker. Most likely the decision maker would be linked to action takers via a separate military satellite communication system. Battle damage assessment uses exactly the same systems, tasked to look for confirming phenomena, after which the S-P-F-D-A process starts all over again.

The requirements for an enhanced tracking system are being widely discussed within the Navy, Coast Guard, and Customs. The basic requirement for overall situation awareness is “maritime domain awareness,” analogous to the airspace awareness afforded by the FAA’s, NORAD’s, and Customs’s flight-following systems. Numerous war games and conferences indicate that various existing systems could be modified to provide the basic building blocks for a system to provide the necessary awareness; this would be the first step in building a North American Maritime Defense Command. Stepping through each of the segments of the S-P-F-D-A model, let us examine how this could be done.

Sense

The first step in this chain is to select specific phenomena that can be detected by sensors and processed by the rest of the cycle in a timely manner. This is the heart of the proposal. Beyond the traditional sensors, such as radars, signals intelligence, and acoustic devices, there already exists a set of cooperative reporting systems, communications satellite–based identity and position reporting systems—the InMarSat, ARGOS, and OrbComm, communications satellite systems with midocean coverage—each of which could be adapted for use as a primary sensor for maritime domain awareness. GlobalStar and Iridium communications satellite systems, the only two other systems with similar coverage, are also developing similar transceiving or transponding systems. Yet other companies, Comtech Mobile DataComm and Boatrac as examples, have developed transceiver-based unit-tracking systems that could possibly participate in the envisioned system. Other satellite communications–associated companies and systems probably would also be able to provide basic components of a maritime IFF system.

These systems would need a common vessel-identification scheme, and one is readily available. Several of them already use the Maritime Mobile Service Identifier (MMSI), assigned by the International Telecommunications Union. Discussions with developers of most of the other systems indicate that their systems could be relatively easily modified to broadcast an MMSI as well.

If the envisioned MTTS transponder system is the maritime equivalent of the aircraft system’s IFF, the MMSI is the specific entity’s identification (“squawk”) code. It would become an “electronic license plate.” Aviation IFF was originally interrogated solely by military radar systems, but now it is the primary electronic means of identification of radar tracks for both civilian and military uses. Radar is the vital part of the IFF system, interrogating unit-based transponders and reading responses. However, a ship-tracking system such as would be required for a maritime defense command would need to track ships well out beyond land-based radar ranges; communications satellite transceivers and transponders would serve in its place. Of the five communications satellite systems that either now or would soon be able to meet the reporting requirements over a broad ocean area, InMarSat and OrbComm appear able to provide timely position reporting with oceanic coverage. As of early 2003, two other satellite communications systems, GlobalStar and Iridium, were on the threshold of the needed capability. The fifth system, ARGOS, has an oceanic communicating and reporting capability but has significant built-in time-lateness. Additionally, once a firm market and a known requirement exist, other satellite companies may well decide to provide the required services, either by adapting existing satellite systems or by including oceanic capability in new ones. (Brief descriptions of the MMSI and the several satellite tracking systems suitable for maritime use are in the online appendix.)

Process

The signals containing the unit's identification and location would be broadcast via a transceiver or transponder onboard every ship desiring to enter the coastal waters of the United States. The signal would be received by one of several communications satellite systems, depending on which transceiver/transponder was installed. Overall course and speed would be calculated at the terrestrial tracking station.

Eventually, the effort could include the Automatic Identification System (AIS)—an excellent, high-fidelity collision-avoidance and traffic management system now coming into use (see the online appendix)—if its transponders were placed in orbit, as has been suggested, or a method were found to route the AIS signal through one of the existing communication satellite systems. The advantages to global shipping control would be significant. However, no satellites now in orbit can receive or process the AIS signal, and it is unclear when, or even if, AIS transponders themselves will be put in space. Manned or unmanned aircraft and aerostats could also be equipped to monitor AIS and used in a surveillance/patrol role, but a space-based approach might well be significantly less expensive.

Earth stations receiving the downlink transmitted by whatever satellite system would forward the generated ship-position data to both the National Maritime Intelligence Center and Coast Guard regional reporting centers of some type.

The functions of regional reporting centers could be served by the two Maritime Intelligence Fusion Centers (MIFCs), one on each coast, recently created by the Coast Guard with assistance from the Office of Naval Intelligence. Also, the Defense Information Systems Agency is experimenting with a concept it calls "Area Security Operations Command and Control" (ASOC), by which a communications and software suite would link many of the organizations involved in homeland security. The MIFC will be linked to Joint Harbor Operations Centers (JHOCs), which will use the ASOC to link to military and other government agencies—for instance, the Coast Guard, the Customs Service, the Drug Enforcement Agency, the Border Patrol—in its area of responsibility. It would be responsible for tracking all vessels in its area, assisting in assessing all contacts and deciding whether a response is required, and orchestrating any tactical response required. It would be assisted by NMIC's civilian merchant ship section, which is the organization responsible for performing long-term trend analysis as well as maintaining a daily maritime intelligence watch worldwide.

Fuse

All-source intelligence fusion would primarily take place at the NMIC, but the MIFCs and battle watch organizations maintained at numbered fleet headquarters would assist. Coordination would be over SIPRNET (the U.S. government secure Internet), but because much of the data is not classified, the World Wide Web could also be used. Data from national collection means, including signals intelligence and acoustic systems, over-the-horizon radars such as the ROTHR* and HFSW systems, sighting reports by Navy, Coast Guard, and Customs vessels and aircraft, human intelligence, and acoustic sensors would be melded with the transponder-supplied positions to determine the presence of nonreporting vessels or tracks displaying abnormal behavior or with suspicious histories.

This is not an insurmountable task. As mentioned above, the Customs Service's Air and Marine Interdiction Coordination Center investigates an average of 2,900 anomalous tracks daily. Careful analysis and prompt information exchange with other governmental agencies and with private entities clears the vast majority of unusual tracks, but almost every day the AMICC initiates intercepts by Customs aircraft. Similarly, in a maritime defense system, Coast Guard or Navy assets, either air or surface, could be dispatched to interdict, interrogate, and determine the status and intentions of the few entities judged sufficiently suspicious by the regional reporting center—vessels not reporting or reporting in anomalous ways (such as using the MMSI of a ship known to have been recently in another part of the world). The patrol units would be linked via UHF satellite communications to the MIFC, which in turn could access the vessel's "master file" (probably at the National Maritime Intelligence Center). The master file would contain everything known about the vessel and its owners, including type, the current float plan and all previous ones, associated MMSIs, history of ownership, and cargoes and crews, plus any special notes that have been appended in the past, such as association with suspicious entities or activities.

*ROTHR: Relocatable Over-the-Horizon Radar (AN/TPS-71), a high-frequency radar system.

The patrol unit, which could, in many cases, also determine a vessel's Maritime Mobile Service Identifier via a standard marine VHF radio equipped for Digital Selective Calling, would query the vessel database using the MMSI, much as a highway patrol officer runs a license plate check. A query to a Department of Motor Vehicles database can tell a patrol officer if a suspicious car should be pulled over; an MMSI check would provide the same benefit to maritime forces. Establishing the MMSI as an IFF-equivalent, an electronic license plate, would be of substantial benefit to Navy, Coast Guard, and Customs patrol units. Of course, complications arise when a Navy unit has to check out a suspicious entity and "pull it over"; the Posse Comitatus Act of 1877 constrains the Navy's actions in such a situation. That whole issue is under review, however, and in any case legal means can be found to halt a suspicious ship on the high seas. The USA Patriot Act of 2002 at least allows military platforms to collect intelligence on civilian entities in the manner described here.

Establishing the MMSI as electronic license plates and developing the means to track them would be important steps and would fill a substantial void in the nation's maritime defenses. Getting all units approaching the coast of the United States and its territories to broadcast their MMSIs and position is a different matter, one that would require cooperation. However, the U.S. government can require all vessels desiring to enter U.S. ports to commence broadcasting their MMSIs, within either a specified distance of the coast or time of entering port. Vessels complying would enjoy the greater safety that accrues from track following. Any ship not filing a float plan or broadcasting its identifier and location (which should be immediately obvious to patrolling units) would be subject to interception, inspection, and the likelihood of significant delays in entering port, if indeed they were allowed to enter port at all. Thus the incentive to comply would be substantial. Delay costs all vessel owners, especially shippers, money—more money than acquiring communicating systems (that their ships should already have anyway, for safety, as discussed below) would cost them.

The processing system outlined above is an expansion of capabilities already in place at the Joint Inter Agency Task Force facilities on both the east and west coasts of the United States and at the AMICC. Fortunately, software tools in use at the AMICC and at other government agencies such as the National Security Agency and the National Reconnaissance Office have shown that the manning requirements for a full maritime watch can be quite small. New-generation display and decision technology—such as the Anti-Air Defense Commander (AADC) system developed at Johns Hopkins University's Applied Physics Laboratory, with easily understood symbology and embedded reasoning and data manipulation capabilities, now being deployed on Navy command ships and cruisers—could be used to help the regional reporting center gain and maintain situational awareness. The reporting center's display and decision system would be the focus of the data fusion efforts, such as "smart agents" (see the online appendix), software that would sort the huge amount of data flowing in. The envisioned system could also manage communications links into and out of the several reporting and analysis centers.

Decide

A correct decision requires a sufficient quality and quantity of information and enough time to fuse that information so as to develop knowledge and thence wisdom. Timeliness dictates that decision makers be able to know when they have the information—from all sources and addressing all aspects of the problem at hand, such as status of own forces, rules of engagement, and the political, strategic, operational, and tactical situations—needed to develop wisdom and issue the appropriate orders. This is by no means a trivial task; indeed, integrating vast amounts of data from heterogeneous sources is daunting for the human mind; fortunately, however, several software tools are now available to help the decision maker.

One of these is the Architecture for Distributed Information Access (ADINA) tool developed at the Johns Hopkins University Applied Physics Laboratory—an agent-based architecture for seamless access to and aggregation of heterogeneous information sources. Maritime defense regional reporting centers would use smart-agent tools like ADINA (and Control of Agent-Based Systems, or CoABS, grids, described in the online appendix) both to fuse the data, including the crucial MMSI reports, and to formulate decisions and courses of action, all in close coordination with the U.S. military command structure in the appropriate area.

Act

Once the decision is made to interdict a specific vessel, an on-scene commander would be designated; rules of engagement need to be in place and clearly spell out which federal agencies would take the lead in anticipated cases. Forces, possibly including surface and air elements of the Coast Guard, Navy, or Air Force, would be assigned to take appropriate action. Rapid response would be crucial in some situations; for that reason interdiction forces should include such regular and reserve assets as Air Force A-10s and Navy P-3s, equipped and trained for antishipping attack. Their weapons should include optically guided missiles such as Penguin and Hellfire, to allow disabling fire to be focused on the bridges and rudders of rogue ships attempting to enter port with clearly hostile intentions. In extremis, such as the need to stop a ship known or strongly suspected of carrying weapons of mass destruction, larger weapons, such as Maverick or Harpoon, must be readily available to sink it. If more time is available and forces are in position, surface units could effect the interdiction. Helicopter insertion of special operations forces or specially trained units is also a possibility.

Navy, Coast Guard, and Customs vessels and aircraft routinely operating off U.S. shores would not only report all surface vessels in their areas but act as “first responders.” Their reports would be fed into vessel master files and automatically matched with the pertinent float plan. Nonreporting or suspicious vessels would be marked for follow-up.

Because other systems, such as InMarSat-C, AIS, and DSC (described in the online appendix), broadcast position and identification information, it would be beneficial if maritime patrol forces could monitor them. Any vessel in a patrol unit’s vicinity broadcasting on these internationally mandated systems could be quickly and accurately identified, by MMSI. Indeed, all units of the U.S. government assigned to surveillance and interdiction roles should also be equipped to monitor them, if not fully participate.

WHAT WOULD BE REQUIRED?

Putting this proposal into practice would require prenotification of the International Maritime Organization (IMO) but not necessarily its approval. The initial implementation of this system would require the wide promulgation of a notice to mariners directing all vessels out to a thousand nautical miles off a U.S. coast and desiring to enter American territorial waters to broadcast their identification and location at set intervals over one of the approved systems. It would further direct every vessel to broadcast its location as soon as within ninety-six hours of arrival in an American port or whichever happens first. A vessel departing a port less than ninety-six hours out would operate the system as soon as it is under way.

One final word on available technology. The International Maritime Organization already requires units above three hundred gross tons to carry InMarSat-C, as part of the Global Maritime Distress and Safety System and in accordance with the Safety of Life at Sea Convention. InMarSat-C has a built-in ship-polling capability that meets the requirements for a maritime IFF system. The proposed system would provide that capability, all the way down to the smallest vessel capable of open-ocean navigation. These vessels will also be required to have the more expensive and more sophisticated Automatic Identification System by 2004. The purposes of this proposal could be met by either system; in any case, AIS, once it is capable of being monitored from beyond line of sight, may well become the specified system. However, AIS is significantly more expensive than the transponders of the low-earth orbiting satellite communications systems. Those other satellite communications reporting systems that would be suitable include OrbComm, GlobalStar, and Iridium. In any case, installation could be encouraged via a tax credit for American vessel owners. For foreign owners the cost of entering U.S. waters will indeed increase, but not by an unbearable amount. Operational tests would be needed on each of these systems to ensure they are sufficiently timely and compatible with a national reporting standard. The task is clearly feasible from a technology viewpoint.

A two-tiered tracking system could be quickly emplaced, in which a combined automatic identification and satellite transceiver system sends tracking output via the AMICC or other tracking center to national and regional intelligence centers for further analysis and threat/law violation/encroachment determination, in much the same way as a Federal Aviation Agency regional center tracks aircraft. Regulations would be needed requiring all oceangoing vessels to install satellite communications reporting systems and operate them within a certain distance from the United States if the vessels intend to enter its territorial waters.

It would be very much to the benefit of U.S. security, maritime and otherwise, if the system and legal requirements outlined above were enacted immediately. This proposal is intended as a point of departure for building the maritime portion of the homeland security mission capabilities package. It names specific systems, but if more capable systems become available or a more beneficial alignment of existing systems can be made, so much the better. One way or the other, let's get on with it. We are at war, and this is a known vulnerability.

NOTES

1. Drafts of this article have been circulated since November 2001 to stimulate focused, informed debate and information exchange. That information exchange has resulted in several major revisions of this article. However, more informed discussion, war games, both technically focused and policy focused, and operational experiments are needed until the concept and procedures outlined here are fully implemented. One disclaimer is appropriate: though this article identifies specific systems to provide points of departure for further investigation, it is not intended to champion any specific system or systems. If there are better, more useful systems available either now or in the near future, then those should be used.
2. For a detailed study of the piracy problem see John S. Burnett, *Dangerous Waters: Modern Piracy and Terror on the High Seas* (New York: E. P. Dutton, 2002).
3. The model was developed by the author, as a research fellow at the Naval War College, in Newport, Rhode Island.