This paper presents an outline of the Marine Electronic Highway (MEH) Project and the current status of developments towards implementation of the Phase 1 MEH Demonstration Project for the Straits of Malacca and Singapore as a joint project of the Global Environment Facility (GEF), the World Bank (WB) and the International Maritime Organization (IMO). The MEH Project was presented to the World Summit on Sustainable Development in Johannesburg as one of IMO’s Partnership Initiatives to strengthen the implementation of Agenda 21.

Concept of the MEH

1. The MEH is one of the most innovative and significant advances in navigational safety and protection of the marine environment, incorporating the latest available technologies. It is a marine information and infrastructure system that integrates marine environmental management and protection systems (EMPS) and state-of-the-art marine navigation technologies.

2. Its backbone is a precision navigation system that utilizes a network of Electronic Navigational Charts (ENCs) in conjunction with Electronic Chart Display and Information Systems (ECDIS), Differential Global Positioning Systems (GPS) and Automatic Identification Systems (AIS).

3. The system allows for an integrated digital navigation, which enables the provision of vital marine information such as tides and current to ships on a "real-time" basis. This in turn would enable ships to navigate accurately under the overall traffic management system of the Straits of Malacca and Singapore. This will significantly improve the safety of navigation and, hence, reduce the risk of accidents that could cause catastrophic environmental pollution.

4. The system will also integrate marine environment protection system (EMPS) which would provide a common basis for the environmental monitoring and protection of the Straits, which will include a 3-dimensional hydrodynamic model; oil and chemical spills trajectory and fate models including spill damage models as well as the linkage to coastal and ocean monitoring systems; environmental impact assessment and sensitivity mapping.

5. The system will further enhance the transparency of navigation and overall traffic control and will provide a basis for intensive monitoring of the real-time situation of navigation, which would help in the efforts of relevant countries to reduce piracy and armed robbery in the Straits and enhance maritime security throughout the region.

Straits of Malacca and Singapore

6. The Straits of Malacca and Singapore were chosen to pilot the concept of the MEH because of their highly congested maritime traffic lanes and environmentally-rich coastal areas, coupled with the strong commitment to navigational safety and environmental management of the three littoral States of Indonesia, Malaysia and Singapore. This commitment was substantiated by their ratification of the 1982 UNCLOS, SOLAS 1974 and MARPOL 73/78 and other IMO Conventions dealing with navigational safety, pollution prevention and control.

7. In 1997, approximately 104,000 vessels transited the Straits, whereas in 2001 vessel arrival in Singapore was over 140,000. In addition, there is a high level of local traffic engaged
in trade and fishing across the Straits. Although the Straits are shallow, hazardous to navigation and characterized by narrow channels, irregular tides and shifting bottom topography, they are the preferred international route for maritime trade due to the presence of services and active ports and the fact that this route provides the shortest one to connect the Far East with the Indian Ocean and the Middle East compared with other routes.

9 For oil tankers trading between the Middle East and the Far East, the transit through the Straits of Malacca and Singapore is shorter by approximately 1,000 miles, or a saving of about three days' steaming if compared with the two alternative routes, i.e., Lombok-Makassar and the Sunda Straits.

10 The Straits of Malacca and Singapore is also a zone of high biodiversity, rich in marine fauna and flora that is characteristic of a tropical estuarine environment. The abundance of seagrass beds, mangrove swamps, coral reefs and wetlands enrich the associated coastal marine environment, which also acts as a stopover point for migratory birds on seasonal transition. This environment serves as a unique heritage to the world.

Current situation of providing navigational aids

11 The coastal and marine natural resources of the Straits of Malacca and Singapore are of enormous value to the littoral States and also contribute to the global economy. The assessment of the net economic value of the Straits is around US$15 billion, putting it among the most valuable international sea lanes in the world. Attached to this economic value are the livelihoods and the future development of more than 30 million people living in the vicinity of the Straits, whose wellbeing is directly or indirectly associated with the state of affairs in the Straits.

12 Activities undertaken by the three littoral States to improve navigational safety have been substantial, with the majority of the funding being borne by the littoral States. In the case of marine pollution prevention and the provision and maintenance of navigational aids, a significant amount of funding has been provided by Japan.

13 Singapore's Vessel Traffic Information Services (VTIS) has been in operation since 1990. This is a comprehensive radar and computer-based vessel traffic system covering the Singapore Strait and can show the positions of up to 1,000 vessels at a time. Malaysia also has a radar and vessel traffic monitoring systems, which was commissioned in 1998 and covers the entire Malacca Strait.

14 The Mandatory Ship Reporting System, STRAITREP, which came into effect on 1 December 1998, requires designated vessels to report, via VHF voice radio communications, to the marine authorities of the littoral States when transiting the Straits of Malacca and Singapore. Vessels entering the operational area are required to submit reports containing information such as the name of the ship, its call sign, IMO identification number, position, hazardous cargo and any deficiency of the ship that could affect normal and safe navigation.

15 The current maritime safety infrastructures and regulatory mechanisms in place in the Straits have improved the safety of navigation, flow of vessel traffic and the overall management of the Straits as an international sea lane. However, the volume of international traffic passing through or calling at ports in the Straits has steadily increased throughout the 1990s. Vessel statistics from 1995 to 2001 showed an annual average increase of 5.96% for the Port of Singapore and 10.58% for Port Klang. Also there is a substantial volume of cross-Straits traffic among the three littoral States involving trade and fishing.
16 Notwithstanding the benefits of the above system currently available, the threat of collision as well as groundings is increasing. The biggest concern is the risk of a catastrophic oil spill following a collision with or grounding of a VLCC or any vessel carrying large quantities of bunker oil. The cost of the clean-up operation for a large-scale oil spill is significant. The outlay for clean-up in respect of the Evoikos oil spill incident came to about US$ 7.5 million.

17 Although the three littoral States have oil spill response capabilities, such as oil spill contingency plans and response facilities, the Evoikos incident highlighted the need for a better traffic management system, which would prevent maritime accidents and would cope with the future increase in volume of traffic, including ships carrying hazardous materials.

18 With the increasing volume of maritime traffic and port development in the Straits, the capacity and condition of the Straits to handle such growth whilst ensuring safe and efficient navigation remains a source of concern. Clearly, an innovative approach to improving the management of the maritime traffic and marine environment protection will be required and it is hoped that the Marine Electronic Highway will provide a solution to this question.

Project outline

19 The MEH Project will establish an MEH system in the Straits of Malacca and Singapore through the following phases:

   Phase 1 Demonstration of MEH System: and
   Phase 2 Development of Full-Scale MEH System.

20 The MEH system will be an integrated regional network of marine information technologies, utilizing Electronic Navigational Charts (ENCs), Electronic Chart Display and Information System (ECDIS) and Automatic Identification System (AIS). The system will be designed from the end-users' perspective and requirements and will make full use of new technologies, their applications and management. Other components will include sustainable financing mechanisms, obligations associated with accession and ratification of relevant international conventions, protocols, legal, institutional and administrative arrangements and political and public relations to enhance the utility and acceptability of the MEH system and its long-term sustainability.

21 Phase 1 of the MEH Project will be implemented as the GEF/World Bank/IMO Demonstration Project of the MEH System in the Straits of Malacca and Singapore over five years from 2004/2005, with a total budget of US$16 million. This phase will involve the following four key tasks and challenges:

1. the integration of existing marine information technologies and capacities within the three littoral States with new and innovative technologies, focusing on the specific needs of users within the three countries as well as other users of the Straits;

2. quantification of the socio-economic benefits to the governments, industry, private sector and the coastal communities of the region;
.3 establishment of interagency, intergovernmental and intersectoral partnerships to develop, finance, construct and operate the Full-Scale MEH as a potentially self-sustaining and revenue-generating enterprise;

.4 institutional arrangements, including agreement among participating parties on the administrative, legal, financial and operational aspects of a managing organization, which will be responsible for implementing the Full-Scale MEH system in the Straits.

22 Phase 2 of the Project will extend the pilot MEH System over the entire area of the Straits of Malacca and Singapore as a Full-Scale MEH and monitor and evaluate the expanded MEH's commercial and environmental benefits for the entire sea lane by sharing the results of the evaluation with the relevant States and through advocacy and the provision of technical assistance to establish similar systems at other parts of the sea lane.

Components of the MEH Demonstration Project

23 The MEH Demonstration Project comprises the following seven strategic components:

Component 1 Establish the Marine Electronic Highway and demonstrate its technical functionalities on navigation safety and marine environment protection for the Straits;

Component 2 Facilitate the integration of marine environment systems and data flow and information exchange through the MEH system;

Component 3 Develop the operational and administrative mechanism for the sustainable management of the MEH system:

Component 4 Evaluate the financial, social and economic benefits and legal issues of the MEH system;

Component 3 Promote awareness and participation of relevant stakeholders to support the MEH system;

Component 6 Strengthen national and regional capacity in maritime safety and marine environment protection of the sustainable management of the MEH system; and

Component 7 Implement transitional activities to develop the MEH Full-Scale System.

Institutional and implementation arrangements

24 At the start of the MEH Demonstration Project in 2004/2005, the Project Steering Committee will be established as the overall regional body to observe the implementation of project activities. The PSC will provide the institutional arrangement for the development of the managing tool, which will operate, administer and manage the MEH system and, furthermore, provide a sustainable basis for co-operative agreement among relevant stakeholders.
25 Four Technical Committees (TCs) and two Working Groups (WGs) will be established in the course of implementing the MEH Demonstration Project:

- TC on Survey and Electronic Navigational Charts (ENCs);
- TC on Shore Base [Shore-Based] Infrastructure and Facilities;
- TC on Shipborne Equipment;
- TC on Environmental System and Information;
- WG on cost sharing for the MEH Full-Scale Development Project; and
- WG on Demonstration Evaluation.

26 A Project Management Office will be established in the region to administer and manage the Project onsite and will have a project team consisting of a Project Manager, technical and administrative staff and experts. The staff of the Project Management Office will work closely with the staff from national agencies assigned to the MEH Data Centres and will oversee the work of consultants as well as provide the secretariat function to the Project Steering Committee, Technical Committees and Working Groups. At the last Provisional Project Steering Committee held in Singapore in December 2003, it was agreed that the Project Management Office should be established at Batam, Indonesia.

**Partners**

27 The littoral States of Indonesia, Malaysia and Singapore are the major players in this Project. Aside from their membership in the Project Steering Committee, Technical Committees and Working Groups, the littoral States will co-finance the implementation of the Demonstration Project by providing in-kind contributions, such as the use of and access to maritime safety facilities, office space, equipment and local experts. The littoral States with their designated National Focal Points and lead agencies will be working with the Project Management Team in partnership with relevant stakeholders, to implement the activities of the seven components of the Demonstration Project, including the development of the MEH Fund and the governing body of the MEH system. The littoral States will also work towards overcoming policy, institutional and legal barriers for the establishment of the MEH system in the Straits.

28 Currently, the Demonstration Project has as its partners the International Association of Independent Tanker Owners (INTERTANKO), International Chamber of Shipping (ICS) and the International Hydrographic Organization (IHO). The partnership with INTERTANKO and ICS will ensure that an adequate number of tankers will be made available for the technical evaluation of the MEH system. INTERTANKO and ICS will assist in monitoring participating ships to ensure that they adhere to the requirements (i.e., ensuring the availability of ECDIS and AIS on board ships) of the project and also in identifying any constraints or problems that may arise onboard ships during their participation. As partners, INTERTANKO and ICS will be member of the Project Steering Committee and also will take part in the review and evaluation of the project and the implementation of its activities as members of the various technical committees and working groups of the Project.

29 As another partner, IHO will also be a member of the Project Steering Committee and also will take part in the review and evaluation of the Project as well as the implementation of its activities as a member of the various technical committees and working groups of the Project. Its major input to the Project will be to provide technical assistance in the development and
production of ENCs, the development of ENC-based ecological or sensitivity maps and the mapping services as well as promoting technical co-operation, e.g., training and expert advice.

30 Private sector partners such as technology providers, especially those engaged in digital technology and telecommunications as well as those in the environmental sector, will be involved in the development of various products and services of the MEH system covering online and real-time communications and data exchange.

Support from User States

31 From the beginning of discussions on the concept of the MEH Project and, in particular, during the Project Development Fund Block B activities under the fund provided by the Global Environment Facility, the Hydrographic and Oceanographic Department of the Japan Coast Guard has participated in the preparation of the MEH Demonstration Project. The Ship and Ocean Foundation and the Japan Association of Marine Safety have also actively participated in the Project preparatory meetings and provided valuable contributions.

32 The Japanese Government has also been invited to participate in the MEH Demonstration Project and the Japan International Co-operation Agency has also indicated its interest in supporting the Demonstration Project by providing technical expertise for the development of the Electronic Navigational Charts.

33 The Ministry of Maritime Affairs and Fisheries of the Republic of Korea has also participated in the Project preparatory meetings and expressed its willingness to contribute in the operation of the MEH Demonstration Project.

Future

34 The concept of a Marine Electronic Highway (MEH) was initiated in Canada in the early 1990s with the application of digital technology to navigation, particularly in the development of electronic navigational charts and ECDIS. The core of the Canadian version of the MEH was the integration and interconnection of the ECDIS and the Automatic Identification Systems (AIS).

35 The concept of the establishment of MEH in the Straits of Malacca and Singapore was first discussed in the mid 1990s at meetings of the GEF/UNDP/IMO Regional Programme on Partnership in Environmental Management for the Seas of East Asia (PEMSEA), as a pilot project for the Straits.

36 The three littoral States and the International Maritime Organization explored the possibility of realization of the MEH concept and, after three years of intensive consultations in the region and with the World Bank, the MEH Demonstration Project proposal was developed for implementation from 2004/2005 over a 5-year period.

37 Partnership with relevant stakeholders and co-operation and support from the User States are of paramount importance for the successful operation of the MEH Demonstration Project and for the refinement of the MEH Full-Scale System for its development after the evaluation of the Demonstration Project.

38 The MEH Demonstration Project will provide an image of the future system of navigational control and traffic and environment management for international straits.
Article 43 of the United Nations Convention on the Law of the Sea requires that User States and States bordering a strait should, by agreement, co-operate in the establishment and maintenance in that strait of necessary navigational and safety aids or other improvements to aid international navigation and for the prevention, reduction and control of pollution from ships. However, the development of the MEH System would go beyond the scope of the UNCLOS and requires participation and co-operation through partnership arrangements with various stakeholders, including the shipping industry, the private sector and, still, the public sector in agencies in User States. Above all, the commitment on the establishment of the MEH system by the Governments of the three littoral States is a fundamental factor for the success of the Project. Taking into account all these elements and the already expressed firm commitments from Indonesia, Malaysia, Singapore, INTERTANKO, ICS and IHO and, furthermore, taking into account the willingness for co-operation and support expressed by the relevant sectors of some User States, at this stage of development, IMO is preparing an actual implementation process, which is expected to commence in the course of 2004/2005 after the approval of the MEH Project by the World Bank.

Contribution of the MEH Project to the discussion on technology for maritime security

Technology will play a vital role in establishing maritime surveillance systems for navigational safety, environmental protection, efficient management of maritime traffic and ensuring maritime security through the Straits. The MEH System, if established, would definitely play an important role in the overall maritime surveillance system.

The concept of the MEH System and the approach for the MEH Demonstration Project towards the future Full-Scale MEH System have been developed through intensive consultation among relevant authorities of the littoral States and other stakeholders over years based on the strong commitment indicated by all partners towards applications of new technology for future navigation management systems and resolving issues beyond territories by co-operation.

The successful developments towards the MEH Demonstration Project should be considered as a good model of international co-operation for establishing a maritime surveillance and information system for maritime security. Sharing chart information by the three littoral States and providing ENCs through the established common information mechanism of the MEH System have not been considered without involving such difficult and sensitive issues as sovereignty over the territorial waters; joint operation for the hydrographic and waterway survey; information sharing and arrangement for co-operation. Furthermore, the role and responsibility of the shipping industry and contribution from other States in the context of Article 43 of UNCLOS have been intensively discussed. These issues will be further considered during the MEH Demonstration Project over the five years when details of hydrographic survey and ENC development, mechanism of information centres would be decided and the prototype of the MEH System would be actually constructed. The IMO Secretariat is of the firm opinion that co-operation among littoral States and the shipping industries as well as other relevant stakeholders has been the characteristic of the Project and this spirit of co-operation will prevail over the Demonstration Project, resolving any difficulty involved in establishing the system over the five years of project implementation.

The MEH Demonstration Project will be implemented in the coming five years, but the follow-on Full-Scale MEH Project cannot be expected for the immediate future. However, the way through which the MEH Project and the MEH Concept have been developed would provide useful information on what technology would be available now for any maritime surveillance
systems, how such a system would be established and how important international co-operation would be for any attempt to achieve the intended goals.
The MEH Project was *presented* to the World Summit on Sustainable Development in Johannesburg as one of IMO's Partnership Initiatives to strengthen the implementation of Agenda 21.

**Concept of the MEH**

*Marine Electronic Highway (MEH)*

- one of the most innovative and significant advances in navigational safety and protection of the marine environment;
- a marine information and infrastructure system that integrates marine environmental management and protection systems (EMPS) and state-of-the-art marine navigation technologies.

**Precision Navigation System**

*Backbone of the MEH System* which interlinks a network of Electronic Navigational Charts (ENCs) in conjunction with Electronic Chart Display and Information Systems (ECDIS), Differential Global Positioning Systems (DGPS) and Automatic Identification Systems (AIS).

**Additional Specifications of MEH**

- Electronic Chart Display Information System
- Electronic Navigation Chart
- Differential Global Positioning System
- Automatic Identification System
- Vessel Traffic Management Information System
- Tides and Currents
- Wind and Weather
The MEH system will further enhance the transparency of navigation and overall traffic control. It will provide a basis for intensive monitoring of the real-time situation of navigation. It will enhance maritime security throughout the region.

In 1997, approximately 109,000 vessels transited the Straits, whereas in 2001 vessel arrivals in Singapore was over 140,000.

High level of local traffic engaged in trade and fishing across the Straits.

Provides the shortest route to connect the Far East with the Indian Ocean and the Middle East compared with other routes.

Straits of Malacca and Singapore is shorter by approximately 1,000 miles, a saving of about three days' steaming if compared with the two alternative routes, i.e., Lombok-Makassar and the Sunda Straits.

Zone of biodiversity, rich in marine fauna and flora that is characteristic of tropical estuarine environments.

Stopover points for migratory birds on seasonal transition.

Strait of Malacca and Singapore

- Coastal and marine natural resources - enormous value to littoral States, contribute to global economy.
- Estimated at US$15 billion net economic value
- Livelihood of 30 million people living in the vicinity
- Improving navigational safety - littoral States
- Marine pollution prevention and navigational aids maintenance - Japan - significant donor

Current Situation of Providing Navigational Aids

- Singapore's Vessel Traffic Information Services (VTIS)
- Malaysia also has a radar and vessel traffic monitoring systems and AIS stations
- Mandatory Ship Reporting System, STRAITREP, came into effect on 1 December 1998, requires designated vessels to report, via VHF voice radio communications, to the marine authorities of the littoral States when transiting the Straits of Malacca and Singapore.
Current maritime safety infrastructure and regulatory mechanisms in place in the Straits have improved the safety of navigation, flow of vessel traffic and the overall management of the Straits as an international sea lane.

Vessel statistics from 1995 to 2001 showed an annual average increase of 5.9% for the Port of Singapore and 10.58% for Port Klang.

Also there is a substantial volume of cross-Straits traffic among the three littoral States involving trade and fishing.

The biggest concern is the risk of a catastrophic oil spill following a collision with or a grounding of a VLCC or any vessel carrying large quantities of bunker oil.

Outlay for the EVOIKOS oil spill incident came to about US $7.5 million.

With the increasing volume of maritime traffic and port development in the Straits, the capacity and condition of the Straits to handle such growth whilst ensuring safe and efficient navigation remains a source of concern.

Clearly, an innovative approach to improving the management of the maritime traffic and marine environment protection will be required and it is hoped that the marine environment protection will provide a solution to this question.

Financing Plan (in USSM)

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<th>GEF Project</th>
<th>Local</th>
<th>Foreign</th>
<th>Total</th>
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Financing Plan (in USSM):

- GEF Project: 8,300,000
- PDF-B: 473,000
- Sub-total GEF: 8,773,000
- Other Source: 6,040,000
- Total: 14,813,000

TOTAL Project financing: 14,813,000
Phase 1 (MEH Demonstration Project):

1. Integration of existing maritime information technologies and capacities within the three littoral States with new and innovative technologies;
2. Quantification of social-economic benefits to the governments, industry, private sector and coastal communities in the region;
3. Establishment of interagency, intergovernmental and intersectoral partnerships to develop, finance, construct and operate the full-scale MEH;
4. Institutional arrangements and agreements on administrative, legal, financial and operational aspects of a managing organization.

The MEH Demonstration Project has 7 strategic components:

1. Establish the Marine Electronic Highway and demonstrate its technical functionalities of navigation safety and marine environmental protection;
2. Facilitate the integration of marine environment protection and information exchange through the MEH system;
3. Develop operational and administrative environment for the sustainable management of the MEH system;
4. Evaluate the financial, social and economic benefits and risks;
5. Promote awareness and participation of relevant stakeholders;
6. Strengthen national and regional capacity in safety and marine environmental protection and
7. Initiate transitional activities to develop the MEH Full Scale Deployment Project and assess the feasibility of establishing the second phase MEH system extending to other sea areas in the East and West of the Straits.

Institutional and Implementation Arrangements

Project Management

- Project Steering Committee
- Four Technical Committees
  a. Survey and Electronic Navigation Chart Production
  b. Shore Based Infrastructures and Facilities
  c. Ship Borne Equipment
  d. Environmental System and Information
- Two Working Groups
  a. Cost Sharing for the Full Scale Project
  b. Demonstration Evaluation/Full Scale MEH
- Project Management Team to be based in Indonesia or Malaysia
- Data Centres in Indonesia/Malaysia/Singapore

Support from User States

- Indonesian Hydrographic and Oceanographic Department
- Japan Coast Guard participated in the preparation of the MEH Demonstration Project
- The Ship and Ocean Foundation and the Japan Association of Marine Safety have also actively participated in the Project preparatory meetings and provided valuable contributions.
- Japan International Co-operation Agency has also indicated its interest in supporting the Demonstration Project
- Ministry of Maritime Affairs and Fisheries of the Republic of Korea has also participated in (he Project preparatory and expressed its willingness to contribute in the operation of the MEH Demonstration Project.

Stakeholders/Partners

- Indonesia - Recipient Country
- Malaysia - Recipient Country
- Singapore - Participating Country
- IMO - Partner
- INTERLUNKI - Partner
- ICS - Partner
- World Bank - Implementing Agency
- IMO - Executive Agency
Future

- Concept of MEH was initiated by Canada in the early 1990s with the application of digital technology to navigation, particularly in the development of electronic navigational charts and ECDIS.
- GEF/UNDP/IMO Regional Programme on Partnership in Environmental Management for the Seas of East Asia (PEMSEA) initiated the MEH PDF Block B proposal.
- Article 43 of the UNCLOS requires that User States and States bordering on a strait should, by agreement, cooperate in the establishment and maintenance of that Strait.

Commitment on the establishment of the MEH System by Governments of the three littoral States is a fundamental factor for the success of the Project.

- Firm Commitments from Indonesia, Malaysia, Singapore, INTERTANKO, ICS and IHO
- Willingness for cooperation and support expressed by the relevant sectors of some User States, MEH Demonstration Project proposal implementation from 2004/2005 over a 5-year period

The MEH Demonstrations Projects for implementation in the succeeding years:

- A Pilot-Scale MEH System planned for establishment in the immediate future
- The MEH System would provide useful information on what technology would be available now for any maritime surveillance system for maritime security.
- How such a system would be established.
- How important international cooperation would be for any attempt to install the final system.