In 2006 the Maritime Safety Committee (MSC) of the IMO put a new work programme item on the agenda of the Sub-committee on Safety of Navigation (NAV) and COMSAR to "Develop an E-Navigation Strategy". NAV, the lead Sub-Committee, is due to report back to the MSC in 2008. Details of the consideration of this matter by COMSAR 11 are given in document CPRNW9-3-1 (Report on COMSAR 11). The IMO has taken the lead on this matter with support from the IHO, IALA and other bodies.

NAV 52 in 2006, following a preliminary discussion, established a Correspondence Group (CG) to progress work prior to NAV 53 in 2007. NAV 53 considered the report of the Correspondence Group together with some other input papers. Following a preliminary discussion which concluded that E-navigation must be user driven rather than technology driven as recommended by COMSAR 11. The matter was then referred to a WG for more detailed discussion. The WG's recommendations which were endorsed by the Sub-Committee included:

> A definition: "E-Navigation is the harmonised collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment."
>
> A set of core objectives which includes: "facilitate safe and secure navigation of vessels having regard to hydrographic, meteorological and navigational information and risks".
>
> It was also concluded that it was premature to discuss the system architecture and conduct a gap analysis before finalising the users' requirements.

NAV 53 re-established the CG with new ToR and will report back to NAV 54 in 2008. The full report of NAV 53 on E-navigation is attached to this document.

Addendum to CPRNW9-5-1

Extract from IMO NAV53/22

13 DEVELOPMENT OF AN E-NAVIGATION STRATEGY

13.1 The Sub-Committee recalled that MSC 81 had considered document MSC 81/23/10 (Japan, Marshall Islands, Netherlands, Norway, Singapore, United Kingdom and the United States) proposing to develop a broad strategic vision for incorporating the use of new technologies in a structured way and ensuring that their use was compliant with the various navigational communication technologies and services that were already available, with the aim of developing an overarching accurate, secure and cost-effective system with the potential to provide global coverage for ships of all sizes.

13.2 The Sub-Committee also recalled that following discussion, MSC 81 had decided to include, in the work programmes of the NAV and COMSAR Sub-Committees and the provisional agendas for NAV 53 and COMSAR 11, a high priority item on "Development of an e-navigation strategy", with a target completion date of 2008, and assigned the NAV Sub-Committee as co-ordinator, instructing NAV 52 to give preliminary consideration to the matter. MSC 81 had also agreed that the two Sub-Committees should consider the issues with the aim of developing a strategic vision within their associated work programmes for taking this issue forward and to report to MSC 85, for it to develop the necessary policy direction for further progress of this important work.

13.3 The Sub-Committee further recalled that NAV 52 had considered documents MSC 81/23/10 (Japan, Marshall Islands, Netherlands, Norway, Singapore, United Kingdom and the United States) on the development of an e-navigation strategy and NAV 52/17/4 (Japan) outlining Japan's approach to e-navigation and agreed, to progress the work for NAV 53, to establish an intersessional Correspondence Group under the co-ordination of the United Kingdom. It also instructed the Correspondence Group to submit a document to COMSAR 11, raising specific questions that should be addressed by COMSAR and prepare a comprehensive report for submission to NAV 53.

13.4 The Sub-Committee noted that COMSAR 11 had agreed that the user requirements should be clearly defined by the NAV Sub-Committee before the COMSAR Sub-Committee

could review the technical improvements that might be required if GMDSS equipment was to be utilized as a data communication network for e-navigation; the development of e-navigation should be user-driven and not technology driven; there should be equipment performance standardization, including a standard mode of operation for shipboard equipment; and the software installed in operating systems should follow a formal change control process to ensure that all elements of the e-navigation system would operate efficiently. COMSAR 11 had also agreed that with respect to the potential components of the e-navigation strategy and proposed system architecture, issues connected with search and rescue, data communication links, and operation of the GMDSS were within its remit. COMSAR 11 had further agreed that the existing GMDSS infrastructure supported SAR services and communications; however, with respect to e-navigation, broadband communication on a global basis using satellite technology would be necessary.

13.5 The Sub-Committee also noted that COMSAR 11 had instructed the Secretariat to convey the aforementioned views and conclusions to the NAV Sub-Committee and the Co-ordinator of the Correspondence Group on e-navigation for future work and guidance.

13.6 The Sub-Committee also recalled the Secretary-General's remarks at the opening session of the Sub-Committee underlining the need to make progress on the development of an e-navigation strategy.

13.7 The Sub-Committee briefly discussed document NAV 53/13 (United Kingdom), report of the Correspondence Group outlining the agreed scope of e-navigation and the approach to developing a system architecture, presenting complementary "component" and "descriptive" models including the key issues to be addressed in a future work programme.

13.8 The Sub-Committee also considered the comments by ICS (NAV 53/13/6) on the report of the outcome of the Correspondence Group. The observer from ICS requested that apart from the issues outlined in paragraph 6 of their submission, the E-navigation Working Group, should bear in mind that possible operational and technical developments should not lead but only support the strategy development.

13.9 The Sub-Committee was of the view that the support for the proposed e-navigation strategy should be based on user requirements rather than a system architecture based on possible operational and technological developments. The Sub-Committee further concluded that it could only undertake a gap analysis after the user requirements had been identified, as not to risk negating and constraining the work yet to be done thereon by the Organization.

13.10 With respect to the proposal by the United Kingdom (NAV 53/13/2) that a back-up to GNSS would be required in the event of any failure in the equipment and suggesting that LORAN-C and, in particular eLORAN, would be able to provide that capability, the Sub-Committee was of the view that it would be premature to opt for any particular back-up arrangements for GNSS at this stage of the development. In this context the Sub-Committee also noted the information provided by IALA (NAV 53/13/5) on the necessary redundancy of position fixing systems.

13.11 Furthermore, the Sub-Committee agreed with COMSAR 11, that the e-navigation strategy should be user, rather than technology driven and was of the view that it was first necessary to identify and define the user requirements before considering any technology standards. The Sub-Committee also agreed that it was necessary to determine the present limits of the e-navigation strategy, recognizing that this strategy had to be updated as and when necessary, before embarking on the development of the system architecture.

13.12 The Sub-Committee also briefly discussed documents NAV 53/13/1 (Japan), NAV 53/13/3 (IALA) and NAV 53/13/4 (IALA).

Establishing the E-Navigation Working Group

13.13 After preliminary discussion, as reported in paragraphs 3.1 to 3.12 above, the Sub-Committee established the e-navigation Working Group and instructed it to consider all relevant documents submitted under agenda item 13 (NAV 53/13, NAV 53/13/1, NAV 53/13/2, NAV 53/13/3, NAV 53/13/4, NAV 53/13/5 and NAV 53/13/6) including the outcome of COMSAR 11 and taking into account any decisions of, and comments and proposals made in plenary, undertake the following tasks:

.1 consider the report of the Correspondence Group (NAV 53/13) and, in particular:

.1 finalize at least provisionally the definition of e-navigation (NAV 53/13, paragraph 6 and NAV 53/13/3);

.2 finalize at least provisionally the core objectives of an integrated e-navigation strategy (NAV 53/13, paragraphs 8.1 to 8.15);

.3 provide comments and guidance on the migration from traditional aids to navigation (AtoN) to virtual e-navigation aids (NAV 53/13, paragraphs 9 and 10);

.4 provide comments and guidance on the proposed onboard, shore and communications elements of e-navigation (NAV 53/13, paragraph 11);

.5 provide comments and guidance on the three proposed e-navigation systems architectures in order to further develop such a structure (NAV 53/13, paragraphs 12 to16 and annex 2);

.6 provide comments and guidance on the user requirements to further develop and define such requirements including the need for developing a standard mode (S-mode) for mariners (NAV 53/13, paragraphs 17 to 20); and

.7 provide comments and guidance on the preliminary gap analysis in order to assist further development of a gap analysis on the basis of user requirements (NAV 53/13, paragraphs 21 to 24, annex 3 and NAV 53/13/6); and

.2 consider NAV 53/13/1 and provide comments and guidance on the identification of essential functions of e-navigation by marine accidents analysis;

.3 consider NAV 53/13/2 and NAV 53/13/5 and provide comments and guidance on the issue of necessary redundancy of position fixing systems;

.4 consider NAV 53/13/4 and provide comments and guidance on the introduction and use of AIS and as Aid to Navigation (AtoN);

.5 prepare revised terms of reference for the Correspondence Group on e-navigation to progress work for finalization at NAV 54 (NAV 53/13, paragraphs 28 to 30);

.6 take into account the role of the human element guidance as updated at MSC 75 (MSC 75/24, paragraph 15.7) including the Human Element Analysing Process (HEAP) given in MSC/Circ.878-MEPC/Circ.346 in all aspects of the items considered; and

.7 submit a report to plenary on Thursday, 26 July 2007 for consideration at plenary.

Report of the E-Navigation Working Group

13.14 Having received and considered the e-navigation Working Group's report (NAV 53/WP.4), the Sub-Committee (with reference to paragraphs 3.1 to 7.3), took action as summarized hereunder.

13.15 The Sub-Committee noted that the correspondence group (CG) had agreed to adopt the definition developed by IALA's e-NAV Committee (NAV 53/13, paragraph 6 and NAV 53/13/3, paragraph 2) and provisionally finalized the following definition for e-navigation as a concept based on harmonization of marine navigation system and supporting shore services driven by users' needs:

> "E-Navigation is the harmonized collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment."

Core objectives of e-navigation

13.16 The Sub-Committee considered the core objectives identified by the CG (NAV 53/13, paragraphs 8.1 to 8.15) and provisionally agreed that the core objectives of an e-navigation concept using electronic data capture, communication, processing and presentation should:

.1 facilitate safe and secure navigation of vessels having regard to hydrographic, meteorological and navigational information and risks;

.2 facilitate vessel traffic observation and management from shore/coastal facilities, where appropriate;

.3 facilitate communications, including data exchange, among ship to ship, ship to shore, shore to ship, shore to shore and other users;

.4 provide opportunities for improving the efficiency of transport and logistics;

.5 support the effective operation of contingency response, and search and rescue services;

.6 demonstrate defined levels of accuracy, integrity and continuity appropriate to a safety-critical system;

.7 integrate and present information onboard and ashore through a human interface which maximizes navigational safety benefits and minimizes any risks of confusion or misinterpretation on the part of the user;

.8 integrate and present information onboard and ashore to manage the workload of the users, while also motivating and engaging the user and supporting decision-making;

.9 incorporate training and familiarization requirements for the users throughout the development and implementation process;

.10 facilitate global coverage, consistent standards and arrangements, and mutual compatibility and interoperability of equipment, systems, symbology and operational procedures, so as to avoid potential conflicts between users; and

.11 be scalable, to facilitate use by all potential maritime users.

Key outcomes of e-navigation

13.17 The Sub-Committee considered the three key outcomes agreed by the CG (NAV 53/13, paragraph 11) focusing on the onboard, shore and communications elements of e-navigation:

.1 **Onboard**
navigation systems that benefit from the integration of own ship sensors, supporting information, a standard user interface, and a comprehensive system for managing guard zones and alerts. Core elements of such a system will include high integrity electronic positioning, electronic navigational charts (ENCs) and system functionality with analysis reducing human error, actively engaging the mariner in the process of navigation while preventing distraction and overburdening;

.2 **Ashore**
the management of vessel traffic and related services from ashore enhanced through better provision, co-ordination, and exchange of comprehensive data in formats that will be more easily understood and utilized by shore-based operators in support of vessel safety and efficiency; and

.3 **Communications**
an infrastructure providing authorized seamless information transfer onboard ship, between ships, between ship and shore and between shore authorities and other parties with many related benefits, including a reduction of single person error.

13.18 In this context, the Sub-Committee agreed that these were broad expectations rather than outcomes and should be taken into account by the CG as a starting point, when developing the users' requirements.

System architecture

13.19 The Sub-Committee considered the three proposed e-navigation architectures developed by the CG (NAV 53/13, paragraphs 12 to 16 and annex 2) and noted that COMSAR 11 had not opted to formally favour any particular one, but stressed the importance of basing the vision and system architecture on agreed users' requirements. The Sub-Committee agreed that it was premature to agree on any one of the system architectures proposed by the CG before finalizing the users' requirements and that the system architecture should only be considered after MSC 85 had agreed upon the policy direction based on the strategic vision finalized by NAV 54.

User requirements

13.20 The Sub-Committee considered the views of the CG on the users' requirements to further develop and define such requirements including the need for developing a standard mode for mariners (NAV 53/13, paragraphs 17 to 20) and noted that an e-navigation system should reduce some of the basic errors in perception, communication and decision-making that occurs on board and ashore. The Sub-Committee agreed that the E-Navigation strategy should be user driven rather than technology driven. In this context, the Sub-Committee was advised that the United Kingdom, IALA and IFSMA were working on developing a methodology to identify users and their needs and, would be providing the appropriate input to the CG. Accordingly, the Sub-Committee further agreed that the CG should continue its work related to identification of users and their needs.

13.21 The Sub-Committee noted the information provided by IFSMA on the project being undertaken by the Nautical Institute, titled 'S-mode'. The project was aimed at developing a standard presentation of information using a standard menu system for shipboard units. The Sub-Committee welcomed this initiative and invited IFSMA to keep the CG informed of their progress on the project. The Sub-Committee noted the recommendations of COMSAR 11 and agreed that pending further development, it would be premature at this stage to endorse a standard mode (S-mode) for mariners.

Gap analysis for e-navigation

13.22 The Sub-Committee considered the preliminary gap analysis based on the current understanding of what is likely to be contained within an agreed e-navigation users' requirements and the consequential e-navigation capabilities (NAV 53/13, paragraphs 21 to 24 and annex 3) and the comments of ICS (NAV 53/13/6) thereof. The Sub-Committee noted with appreciation the work done by the CG in carrying the preliminary gap analysis. However, the Sub-Committee agreed that at this stage it was premature and could pre-empt the development of users' requirements, users' services and system architecture and that the gap analysis should be undertaken after development of users' requirements.

Identification of essential functions of E-Navigation by marine accidents analysis

13.23 The Sub-Committee considered the information provided by Japan (NAV 53/13/1) on a method for identifying necessary functions for avoiding collisions with a view to facilitate the development of an E-Navigation strategy and agreed that this information should be considered by the CG when developing the users' requirements.

Redundancy of position fixing systems

13.24 The Sub-Committee considered the information provided by the United Kingdom (NAV 53/13/2) and IALA (NAV 53/13/5) on the need to provide a back-up to the Global Navigation Satellite Systems (GNSS) because of the vulnerabilities of GNSS. The Sub-Committee agreed that there was a need to provide an internationally agreed alternative system for complementing the existing satellite navigation, positioning and timing services to support e-navigation and recognized that potential back up systems could be made available and that it was premature to identify any specific system before the users' requirements for e-navigation had been finalized.

Introduction and use of AIS and as Aid to Navigation (AtoN)

13.25 The Sub-Committee considered the information provided by IALA (NAV 53/13/4) relating to the introduction and use of AIS and as Aid to Navigation (AtoN) and noted that IALA would submit a more detailed proposed to NAV 54.

Migration from traditional aids to navigation (AtoN) to virtual e-navigation aids

13.26 The Sub-Committee noted the views of the CG relating to developing an e-navigation strategy was to reduce navigational errors – from whatever cause – to prevent shipping accidents and ship-source marine pollution and that the traditional aids would not necessarily disappear once e-navigation had been adopted (NAV 53/13, paragraphs 9 and 10). The Sub-Committee agreed that e-navigation should not be viewed as a means to reduce or eliminate existing AtoN and that any decision to employ e-navigation as a means to replace traditional AtoN should only be considered once a full risk assessment had been carried out and the users' requirements had been finalized.

13.27 The delegation of Panama expressed its concern at the reference to possible future replacement of the existing aids to navigation by electronic navigation. In its judgement, that should not be the objective in developing a strategy on electronic navigation.

Revised terms of reference for the Correspondence Group on E-Navigation

13.28 The Sub-Committee agreed that, to progress the work for NAV 54, the intersessional Correspondence Group should be re-established under the co-ordination of the United Kingdom* and approved the draft terms of reference of the proposed Correspondence Group, given below.

13.29 Taking into account documents NAV 53/WP.4 and NAV 53/13/1 (Japan) and, the progress made at NAV 53 relating to the development of an e-navigation strategy and the guidance in MSC/Circ.1091 on Issues to be considered when introducing new technology on board ship and MSC/Circ.878-MEPC/Circ.346 on Human Element Analysing Process (HEAP); the Correspondence Group on e-navigation should:

.1 identify all potential users of e-navigation;

.2 define the user needs for e-navigation;

.3 review the need to consult other maritime agencies and interest groups – navigational practitioners, support agencies, research organizations, equipment manufactures and port managers; and

.4 continue to develop other aspects of the strategic vision for e-navigation.

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* **Co-ordinator:**
Mr. Ian Timpson
Zone 2/27
Department for Transport
Great Minster House
76 Marsham Street
London
SW1P 4DR
Telephone: +44 20 7944 4446
Fax: +44 20 7944 2759
E-mail address: ian.timpson@dft.gsi.gov.uk

In order to structure the task of developing a Strategic vision for e-navigation using a holistic and top-down approach it is essential to provide a methodology and logical phases to define the essential elements of e-navigation. In this context, the Correspondence Group should develop a strategic vision taking into account the logical phases relating to:

- user identification;
- user requirements;
- user services;
- identify existing systems;
- system requirements;
- gap analysis;
- role of cost benefit analysis; and
- system architecture.

The Correspondence Group should note that this is not a comprehensive list of logical phases and that some of the work can be undertaken simultaneously.

The Correspondence Group should submit a document to COMSAR 12 raising specific questions that should be addressed by COMSAR and prepare a final comprehensive report for submission to NAV 54.

13.30 The Sub-Committee instructed the Secretariat to inform COMSAR 12 on the progress made on the development of an e-Navigation strategy.

13.31 Bearing in mind the ongoing work on the development on an e-navigation strategy, the Sub-Committee invited the Committee to endorse the progress made at this session.