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Canadian Coast Guard
Maritime Services Directorate

Canadian Coast Guard e-Navigation Strategy

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Introduction

As defined by the International Maritime Organization (IMO):

*“e-Navigation is the harmonised collection, integration, exchange and presentation 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”*¹

e-Navigation is not a new type of equipment, but a ‘concept’ that involves a broad range of navigation systems and services. The concept is based on the harmonization of marine navigation systems and supporting shore services to meet identified user needs. Clearly, there is a need to equip both shipborne and shore-based users responsible for safety of shipping with modern proven tools that are optimized for decision-making. The overall goal is to reduce errors by making maritime navigation and communications become more reliable and user-friendly. If current technological advances occur without proper coordination, there is a risk that marine navigation systems of the future could be hampered by a lack of standardization (ashore and shipborne), incompatibility between vessels, and an unnecessary level of complexity.

While the full scope of e-Navigation is not fully known, it is expected that it will be far-reaching and impact the entire maritime navigation domain on a national and international level. As such, the Canadian Coast Guard (CCG) needs to prepare for this important evolution.

Purpose

This document has two main objectives:

1. To define a strategic e-Navigation vision for incorporating the use of new technologies in a structured way, while ensuring that their use is compliant with various navigational and communication technologies/services that are already available.
2. To develop an e-Navigation implementation strategy for Canada that can be the basis for national implementation within the broader context of international conventions and maritime initiatives (e.g., by IMO and IALA).

Background

At the July 2008 meeting of the IMO Sub-Committee on Safety of Navigation (NAV 54), a strategy for the development and implementation of e-Navigation was agreed. A report was prepared that provides a comprehensive description of the vision, scope, objectives, benefits, components, users (ashore and shipborne), and basic requirements for the implementation and operation of e-Navigation.² As a Member State of IMO, there is benefit to Canada in following this guidance. As such, the criteria and factors that appear to be relevant to a Canadian implementation of e-Navigation are addressed in this CCG e-Navigation Strategy document.

This document is based on several earlier drafts that were developed prior to IMO NAV 54. In addition, the outcome of the CCG-organized “E-Navigation Workshop” that was held in Ottawa on 10-11 June 2008 have been incorporated.

¹ IMO NAV54/WP.2, Annex, Section 1, 11 June 2008

² IMO NAV54/WP.7, Section 13, 4 July 2008

e-Navigation Vision

At a basic level, e-Navigation refers to the ability for a ship to access, integrate and present shore-based maritime information onboard, and to transmit key information to shore or to other ships. Its major components include:

- Accurate and reliable electronic positioning. This includes both satellite and land-based radio navigation systems/services.
- Accurate and approved electronic navigational charts, digital broadcast services that provide critical information, such as weather conditions, tide/water level, current flow, ice coverage, status of aids-to-navigation, security zones, and sensitive marine protected areas.
- Reliable and robust transmission of positional and navigational information in several directions: ship-to-shore, shore-to-ship, and ship-to-ship. In particular, this includes information on vessel transits related to course, speed, and manoeuvring parameters, as well as vessel identification and cargo details.

The implementation of the concept of e-Navigation has been enabled due to significant technological advancements, particularly as they relate to the ability to share information electronically on a timely basis between ships and from ship-to-shore and shore-to-ship. Virtually all organizations involved in the world-wide maritime domain— both seagoing (masters/mates, pilots, fishermen and recreational boaters) and shore-based clients and stakeholders (ports, governmental organizations, etc.) will be affected by the increasing use of e-Navigation.

Implementing e-Navigation should result in significant benefits in terms of improvements in safety-of-navigation and increased efficiency in maritime transportation. As the federal maritime service delivery organization, CCG is well-positioned to take a leadership role for Canada on e-Navigation. Over the years, CCG has developed significant technical and operational expertise in a number of key components associated with e-Navigation. This includes:

- Implementation of the Automatic Information System (AIS), expected to be operational by 2009.
- Deployment of the Long Range Identification Tracking (LRIT) system.
- Electronic transmission of strategic maritime information to assist navigation planning on the St. Lawrence River (*Marinfo*).
- e-Navigation Pilot Project for the transmittal of waterway information to pilots using portable computers on the Quebec portion of the St. Lawrence River.
- Active participation at international organizations, such as the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) and the International Maritime Organization (IMO).

With CCG leadership and in close cooperation with e-Navigation “stakeholders” (see Annex A), Canada can seize this opportunity and become a world leader in implementing e-Navigation. At the same time, CCG must ensure that its various maritime services are effectively supporting the direction that is chosen.

e-Navigation Model

A descriptive model related to the “Provision of e-Navigation-related Services” is provided in Annex B. Based on a conceptual model developed by the IALA e-Navigation Committee, it depicts the various information inputs that make up the e-Navigation concept and the resulting outputs (i.e., benefits) once it has been implemented.

The challenges and organizational impacts of implementing e-Navigation should not be underestimated by the government agencies responsible for providing the information inputs. For CCG, it will impact almost all programs to some degree. For instance, the development of new systems supporting the management of vessel traffic will need to take into account e-Navigation. As the digital transmission of information from shore-based to shipborne systems occurs, the service delivery model of the Marine Communications and Traffic Services (MCTS) program will need to be adjusted as users access increased levels of navigation-related information to assist in decision-making process. In turn, this will affect the role of the MCTS officers and the various tools supporting their work, such as those related to risk identification and monitoring. A detailed impact analysis in this area will be required.

Over time, e-Navigation will likely result in changes to service delivery within the Aids-to-Navigation (AToN) program. In particular, larger vessels are expected to transition from a reliance on traditional aids to using electronic navigation services as they become increasingly available in the near future. For smaller vessels, reliance on traditional aids is expected to continue for the foreseeable future, or until affordable, reliable and easy-to-use electronic navigational services are readily available.

The Waterways Management program may experience shifts in operations with increased demand for timely and accurate real-time information about channel status and water levels. In a similar manner, the Ice Breaking program may face demands for timely and accessible ice-related information that can be made available to supplement pilots’ knowledge of ice-related risks.

The Environmental Response program and Search and Rescue operations are expected to benefit from e-Navigation in terms of achieving more comprehensive monitoring of vessel position and movements.

The challenges and impacts of implementing e-Navigation for other information providers such as Environment Canada (e.g., meteorological), the Canadian Hydrographic Service (electronic charts) will need to be assessed as well. As CCG and other organizations move ahead on the e-Navigation implementation, there are two key aspects that will need to be taken into account on a continuous basis:

- 1) the process of reviewing and adjusting services to respond to evolving requirements
- 2) maintaining regular consultation with e-navigation “stakeholders”, including federal government partners, maritime user community, and private sector companies.

Key Considerations

International

By its very nature, e-Navigation requires international harmonization. While vessels operating only in Canadian waters could, theoretically, work with a “made-in-Canada” solution, vessels operating in international waters must conform to international conventions and standards. Therefore, collaboration/cooperation with the international community is essential.

To that end, IMO and IALA have been jointly defining and assessing the implications of e-Navigation, as well as developing strategies to guide its implementation. They have established several working groups at the international level to ensure the smooth transition to e-Navigation technologies and systems. The Canadian Coast Guard is actively participating in these international activities, and must continue to do so.

Impacts on users and regulatory agencies

As e-Navigation progresses, its stakeholders will be affected in various ways. Relevant regulatory agencies such as Transport Canada will need to consider how e-Navigation will affect current regulations. While e-Navigation is expected to be ‘scalable’ (i.e., able to adapt to meet different client needs) its users will be faced with critical decision-making with regards to its use. Implementation costs, training and certification of users are prime examples of factors that will need to be considered. Even smaller scale users such as the recreational boaters are also expected to benefit from the advent of e-Navigation over time.

Impact on CCG operations

CCG operations will be affected, both for fleet operations (e.g., personnel and equipment) and on the technical support side (e.g., ITS). While the long-term impact on ITS will need to be assessed, it is expected that there will be a shift in their staff competency needs profiles as CCG adapts its operations to support the e-Navigation demand.

Most likely, e-Navigation will require greater emphasis on the accuracy, quality, reliability, integrity, and timeliness of information services that are currently being provided.

Meeting Client Demand

CCG will also have to consider the “information push and pull” that will be caused by e-Navigation. At present, there is only moderate demand for electronic maritime-related information to be automatically provided by a government organization (i.e., push). But, e-Navigation may force a technological turn that places users in the role/position of demanding the provision of electronic/digital services (i.e., pull). Demands for harmonized, real-time information that meets international standards such as water depth and level, buoy status, ice conditions, tides, and weather forecast may be expected for many waterways in Canada. Government agencies including CCG, the Canadian Hydrographic Service, the Canadian Ice Center, the Canadian Hydraulics Center, Environment Canada, and others will need to ensure

that their internal operations can meet these demands in a continuous, reliable, accessible and fail-safe environment. Taking this technological turn could become an expensive and time-consuming process. The costs associated with e-Navigation, and determining who is responsible for the costs, will quickly become an issue. As such, user fees introduced for a portion of marine navigation services will need to be re-assessed as reliance on e-Navigation increases.

Key Policy Issues

1. Critical decisions on public vs. private benefits regarding the information to be provided through e-Navigation will need to be made if CCG is to avoid long-term complications.

This includes what are (or should be) e-Navigation related systems/services -- as well as what are not. If CCG shifts its operations to provide a full fledged e-Navigation service for some users, it will be hard-pressed to implement a cost-recovery system years later unless the current cost-recovery system is amended to reflect a lesser reliance on traditional navigation aids. At present, the provision of AtoN services is a significant cost-driver for the current fee schedule.

2. Migration from traditional navigational systems to e-Navigation is expected to be gradual and occur over a long period.

For some users, CCG will be pressured to continue supporting both traditional and newer technologies. Similarly, since e-Navigation will have an impact in all navigation waters -- including in the Arctic -- its implementation should be done in conjunction with a review of the current/future levels of service provided by CCG.

3. Accountability for e-Navigation will become an important consideration for CCG. Private entities may expect Government to act as an “enabler” to “make it happen”. However, federal e-Navigation stakeholders need to agree on a shared vision about e-Navigation, and to determine who will lead this initiative. This includes a pragmatic assessment of what is the expected product and time-frame. If CCG is to play a lead role, it must convey its position on the various e-Navigation components, to all stakeholders.

Implementation Strategy

As described in the Vision section, e-Navigation has many facets and will require the involvement of various key players. However, CCG is well positioned to take a leadership role in this area because of its significant experience in modernizing its operations under such initiatives as AToN 21, the St-Lawrence e-Navigation Pilot Project and the implementation of AIS. Pressure from industry for increased e-Navigation capabilities is expected to increase in the near future. CCG must position itself to respond to this expected demand, and be willing to work with other federal partners, maritime users, and the private sector.

The Implementation Strategy includes four main components (i.e., streams):

1. User Interaction should be focused on the need for e-Navigation services, and should serve as the driver for any future investment. Under this stream, CCG has an opportunity to engage the maritime user community in a dialogue on the full scope and implementation of e-Navigation. To do this:

- Relevant users should be identified and invited to participate in an e-Navigation forum.
- A common understanding of e-Navigation must be fostered and agreed to by all.
- Key milestones necessary to successfully implement e-Navigation in Canada according to the international conventions/mandates should be established.
- Accountabilities, roles and responsibilities on the various e-Navigation components should be specified and agreed.
- User requirements and expectations should be identified.

2. **Stakeholder Coordination** relates to the cross-departmental nature of e-Navigation, and the need to work together for a seamless service to meet the needs of users. CCG should take the leadership role and raise awareness among its federal government partners so that they too are prepared and the Government of Canada can provide an integrated service of e-Navigation when users are ready and willing to embrace it. CCG should seek a confirmed mandate to lead and implement e-Navigation in Canada. This mandate would also define where and under what conditions the provision of e-Navigation services should be offered. This is particularly important for the arctic as current resources in that area are far from being able to support e-Navigation operations.

3. **Organizational Preparedness** deals with the requirement for CCG to take the technological turn so that its operations shift/adjust to naturally feed the e-Navigation information requirements. CCG could identify best practices of services that have embedded the concept of e-Navigation within their operations, and then replicate them nationally. Where best practices do not exist, they must be created and implemented as quickly as possible. A successful implementation of the AIS technology coast-to-coast will also be critical to moving forward.

4. **Strategic Directions** refers to the need to plan and deal with the impacts created by increasing the information knowledge -- hence autonomy-- of the mariners. As maritime users take up the flow of information provided on-board, CCG must be in a position to adapt its business to the new reality of better informed mariners. In this regard, many aspects of CCG operations will need to be revised/adapted such as the leadership role of MCTS in vessel traffic management and the functions of Waterways Management. A constant re-assessment of the need for traditional aids (e.g., type of, number, and placement) given the capabilities of e-Navigation, will be needed so that CCG can re-direct its investments in areas of most demand. CCG will also have to re-assess the various systems that support the provision of operational information both in the present and in the near future. A specific analysis and assessment will be needed, and a strategy to deal with the looming impacts on current user fee schedule will be required.

Guiding Principles

As CCG implements e-Navigation, clearly-stated guiding principles are needed to support future investments and decision-making. Some of these include:

- 1) *People are the number one priority.* Even the best most technically advanced systems will not replace the need for people to be the most important part of the process. They must be kept informed about the challenges and opportunities, and afforded the possibility to thrive in the new e-Navigation environment.
 - 2) *Cooperation with the international community.* While it is clear that CCG can move ahead to start implementing the concept of e-Navigation in Canada, it must do so recognizing that requirement to do it in cooperation with other countries and international entities. In particular, this includes IMO and IALA.
 - 3) *Different users have different requirements.* CCG has three distinct clients (commercial, fishing, and recreational vessels). Each has specific and different needs. CCG must recognize this varied clientele.
 - 4) *Partnership is essential to success.* CCG is not alone in this journey. For Canada to succeed efficiently, active partnering with all stakeholders should be established and maintained.
 - 5) *e-Navigation is a shared responsibility.* While CCG must play a leadership role to implement e-Navigation, it does so for the benefits of all stakeholders. However, it should not have to bear all responsibilities alone.
 - 6) *Integration is key.* Unnecessary redundancy or duplication of systems processes or information is both costly and counter-productive. Nor does it support the objectives of a reliable and efficient e-Navigation service.
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e-Navigation Stakeholders in Canada: Who are they?

One of the outcomes of the CCG-organized e-Navigation Workshop that was held in Ottawa on 10-11 June 2008, was the need to designate more specifically who are the various types of e-Navigation players and participants in Canada. Currently, there are a number of terms and designations that are used. There is a need to be more precise, and to avoid overlap.

The following is a proposed designation (classification scheme).

Stakeholder – This is the broadest designation and applies to any player or participant who is either involved or has a stake in the development/implementation of e-Navigation. Under this broad designation there are three main categories:

1. **Federal Government** – This applies to any federal government entity that has a role/responsibility to provide e-Navigation related data or information services. This includes individual agencies and agency partners such as:

- Canadian Coast Guard
- Transport Canada
- Canadian Hydrographic Service
- Environment Canada
- [others?]

2. **Maritime User Community** – This designation applies to the customers, users, and clients of e-navigation-related equipment, systems and services. This grouping includes commercial shipping, fishing fleet, and recreational boating. The Maritime User Community can also be divided into those who work at shore-based facilities and those serving onboard vessels. Within each user group there are additional sub-categories. For instance, commercial users could include:

- shipping companies/organizations
- masters and mates
- maritime pilots

3. **Private Sector Companies** – This designation applies to any equipment/hardware, software or system integration company that is involved in the provision and/or use of e-Navigation. This can include:

- navigation equipment manufacturers
- integrated system developers
- valued-added service providers

Ideally, these three groups are all inclusive. In addition, any e-navigation “stakeholder” (i.e., player/participant) should fall under one of the three main groups.

If so, the next step would be to define the **role and responsibility** for each in regard to e-Navigation. Ideally, this can be verified/refined by the CCG e-Navigation Steering Committee.

A Descriptive Model for E-Navigation

