

# SmartBay

Moving from Demonstration Project to Information Service



by Bill Carter

## Introduction

SmartBay ([www.smartbay.ca](http://www.smartbay.ca)) is a user-driven ocean observing system, driven by the specific information needs of the users of Placentia Bay, Newfoundland. Though funded as a two-year demonstration project, it has rapidly become part of the seascape of Placentia Bay – utilized to varying extents by practically every component of the Placentia Bay user community, including fishermen, the oil industry, the marine transportation sector, as well as the general populous. The applications of SmartBay have been just as varied, ranging from safety and marine efficiency, to industrial development, to community socio-economics. In response to this overwhelming positive reaction of the user community, the SmartBay team has strived to maintain

SmartBay as a 24/7/365 operation, facing significant financial and technical challenges along the way.

## Background

The SmartBay vision is “to provide simple access by all stakeholders to data and information in support of effective management and sustainable development of coastal ocean areas and the safety and security of life at sea.” Accordingly, SmartBay has been implemented as a user-driven ocean observing system, serving the information needs of the users of Placentia Bay, Newfoundland (Figure 1). This expanding user community includes numerous fishing enterprises, an operating oil refinery with a second refinery currently in the development phase, an oil transshipment facility, an approved LNG



Figure 1: Placentia Bay, Newfoundland.

facility, as well as various provincial and federal government departments and agencies including the Canadian Coast Guard and the Placentia Bay Vessel Traffic Centre. The user community also includes bodies such as the Placentia Bay Integrated Management Committee and the Placentia Bay Traffic Committee, as well as private individuals living in the numerous communities surrounding Placentia Bay whose day to day lives are influenced in a multitude of ways by the waters at their doorstep. The applications of SmartBay have been just as varied, ranging from safety and marine efficiency, to industrial development, to community socio-economics and environmental protection. Hence the motto: "Better Information – Better Decisions."

The basic premise of SmartBay is to integrate and deliver information created from both static and dynamic data in a manner best suited to the particular needs of a broad base of users. The incidental or non-professional user can access the information through a web portal requiring no special hardware or services. The mariner is able to access and display information on an electronic chart using standard bridge hardware and communications systems. SmartBay also supports the interests of a third class of user, "the professional," engaged in roles ranging from fisheries management to

oceanographic research to environmental protection to sovereignty and security. This class of user (typically a government department or agency, academic institution or industry service provider) requires access to archived data to support the development of specialized, and in some cases, proprietary information products.

As a demonstration project, SmartBay has been successful. In fact, the project has been so successful that the community, both in and beyond Placentia Bay, has come to rely on SmartBay to serve a broad range of data and information needs. Based solely on the utility and timeliness of the basic information services currently provided over a limited geographical area, feedback indicates that SmartBay is already regarded by many as an essential service to support maritime operations and planning.

**SmartBay: From Concept to Reality**

On August 18, 2006, SmartBay was effectively placed in service with the deployment of the first meteorological/oceanographic (met/ocean) buoy, followed shortly by unveiling of the SmartBay portal ([www.SmartBay.ca](http://www.SmartBay.ca)). This culminated an accelerated and successful design and implementation phase spanning some six months. Although funded as a two-year demonstration project, within the first year of 'going live'

SmartBay was being utilized daily by many members of the Placentia Bay maritime community and beyond. This user community includes numerous fishing enterprises, Newfoundland and Labrador Refining Corp., Newfoundland Transshipment, North Atlantic Petroleum, the Department of Fisheries and Aquaculture, Environment Canada and Canadian Coast Guard. Other bodies include the Placentia Bay Integrated Management Planning Committee and the Placentia Bay Traffic Committee, as well as private individuals living in the numerous communities surrounding Placentia Bay whose day to day lives are influenced in a multitude of ways by the waters at their doorstep. In response to the overwhelming positive reaction of the user community, the project team has strived to serve the information needs of the community, while at the same time continuing with the development effort associated with the original project scope. This level of interest, while exciting for the School of Ocean Technology (SOT) and its SmartBay team, has not been without its share of technical and financial challenges.

The SmartBay approach of building information products in response to user needs has been received extremely well by the Placentia Bay user community. The information products currently provided are based on user consultation during the concept development stage and the information gleaned from these consultations directly influenced the design and implementation of SmartBay services. Although the concept of filling practical information voids appears logical, this has not been the approach used in the development of many ocean observation systems. In many situations the initial approach has been primarily science/research driven with the practical side of the equation playing catch-up in an effort to align with operational funding opportunities. Common to both approaches is that they largely rely on the same sensors, the same acquisition and processing expertise and the

same communications mediums – the difference lies in the ‘value-added’ exercise of listening to the user and ensuring that the data collected is relevant and can be transformed into information products that make sense and have value to that user. Following this approach, the researcher has the raw data to work with and manipulate while the practical user receives a valuable information product to assist in the decision making process.

After approximately one year of operation, SmartBay has become a prominent feature of the Placentia Bay seascape. There are currently four SmartBay buoys positioned in the bay (Figure 1). An AXYS 3-metre met/ocean buoy near the mouth of the bay provides critical data to support weather and sea state forecasts; a customized Satlantic water quality buoy off Come by Chance Point provides met/ocean as well as water quality information for this high traffic area; and a second Satlantic water quality buoy fitted with meteorological sensors off Rushoon on the western side of the bay supports an emerging aquaculture industry in the area. In addition, SmartBay has been very fortunate to partner with the St. John’s based Institute of Ocean Technology to gain temporary access to their Tri-AXYS wave buoy for term



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Figure 2: There are currently four SmartBay buoys positioned in Placentia Bay.

deployments at the pilot boarding station just south of Red Island Shoal along the bay’s eastern side. The buoy data are used to enhance four regional forecasts and four site-specific forecasts generated daily by project partner AMEC. The buoy locations, near-real time data feeds and custom forecasts can be accessed via the SmartBay portal ([www.SmartBay.ca](http://www.SmartBay.ca)). The portal itself has been built to Canadian Geospatial Data Infrastructure (CGDI) and Open Geospatial Consortium (OGC) standards, thereby ensuring that it is open, extensible and interoperable with similar portals. In this way, SmartBay is well positioned to play a long term part in the Global Earth Observing System of Systems.

SmartBay is about making better information available in support of better decision-making by all Placentia Bay users. Logically, situational awareness plays a major part in this process. An initial thrust of SmartBay was to demonstrate to users available technologies that could assist smaller vessels to carry out their business in unison with increasing tanker traffic. In support of such, seven Placentia Bay vessels (five fishing vessels, an RCMP patrol boat, and a privately owned work/crew transfer boat), as well as a 34-foot Narwhal rigid hull inflatable support vessel contributed in-kind by the Marine Institute have been equipped with SmartBay partner ICAN Ltd.'s Aldebaran II electronic charting systems and integrated with Automatic Identification System (AIS) transponders. This technology allows users to track the movement of similarly equipped vessels via continuous broadcast of vessel transit information including vessel name, speed, heading and destination. The AIS information is displayed in real time on the electronic chart systems. Consistent with SOLAS regulations, all international vessels over 300 Gross Registered Tons (GRT) and all domestic vessels over 500 GRT, including all tankers entering Placentia Bay, are required to carry AIS. This regulation provides the SmartBay demonstration vessels and the tanker traffic with improved situational awareness regarding other vessels operating in the area. The SmartBay buoys are also equipped with Aids to Navigation Information System (ATONIS) transponders allowing any AIS equipped vessel within radio range to access, on a real-time basis, meteorological and sea state data collected by each SmartBay buoy. These data can then be applied directly by each vessel master to the decision-making equation.

Along with water quality information provided via the SmartBay buoys located at Come by Chance Point and Rushoon (see Figure 2), SmartBay, in cooperation with the Newfoundland Department of Fisheries and Aquaculture (DFA), also serves as the primary information

dissemination site for time-series water quality data from 2001 to present acquired at 11 potential aquaculture sites scattered throughout the bay. Measurements of temperature, salinity, chlorophyll and dissolved solids are manually downloaded from moored sensors maintained by DFA and provided to SmartBay for integration. Initially this data was only available on request and knowledge that it even existed was limited. However, through SmartBay, the historical data and all updates are readily accessible to anyone with web access via [www.SmartBay.ca](http://www.SmartBay.ca).

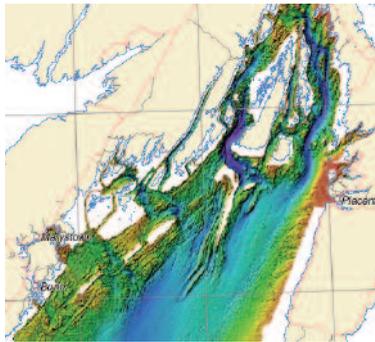


Figure 3: High-resolution coverage of the seafloor.

Similarly, SmartBay serves as a convenient access point for other relevant external databases and on-line services provided by various federal and provincial agencies. For example, SmartBay has implemented a comprehensive interactive map and facilities catalogue of all Small Craft Harbours in Placentia Bay, using information and support provided by the Small Craft Harbours

Branch of Fisheries and Oceans Canada. This application allows mariners to quickly review and compare facilities listings (e.g. electrical service, waste-oil storage, wharf condition, fish-handling equipment, etc.) and provides aerial photographs for 39 Small Craft Harbours in Placentia Bay. Likewise, in support of regional economic development and as a means of providing general information about living, working and doing business in Placentia Bay, SmartBay provides an interactive map and convenient links to extensive demographic and socio-economic information compiled for all Placentia Bay communities, as provided through the Community Accounts web information system of the Province of Newfoundland and Labrador Statistics Agency.

SmartBay is not solely about providing real time information in support of tactical decision-making. It is also a source of a vast amount of information ranging from available shore-side services to fisheries research. Though previously existing, much of this information was difficult to find or stored in disparate information "silos"



that didn't necessarily have the ability to communicate with each other. For example, as part of the SmartBay demonstration project, all Placentia Bay data holdings resident within DFO were compiled into a metadata catalogue that is now available online via the SmartBay portal. For the first time, those with a need for such data are no longer stymied by challenges such as "I didn't know where to find the data" or worse "I didn't know the data existed, so I didn't look for it."

Similarly, as part of the SmartBay project, the Geological Survey of Canada-Atlantic, in cooperation with the Canadian Hydrographic Service, committed to undertake hydrographic resurveying of Placentia Bay using multibeam sonar technology. The result is high-resolution coverage of the seafloor outside the 10 metre contour (Figure 3). Interactive map (GIS) applications including colour rendering depictions of this data are available via the SmartBay portal. This multibeam sonar data set contributes to a number of practical applications ranging from development of new hydrographic charts in support of safe navigation to improved seafloor definition and fish habitat information for fishers.

An important aspect of SmartBay is its spin-off effect in the Newfoundland and Canadian ocean technology sector. The development of new ocean technology products typically requires significant field-testing. The data collected are subsequently used for product refinement or in support of the product certification process. The SmartBay infrastructure represents a cost effective alternative for product developers. Rather than having to ramp up and deploy infrastructure to carry out testing, the developer is able to work in a turnkey testing environment. The SmartBay buoys and support infrastructure have been engineered with the size, power and data capacity to carry and support 'project tenants.' New products can be tested in the actual harsh marine environment and test data can be collected and delivered to the developer. Similarly, a dilemma that often faces small product developers is securing the first deployment of a new product or system. The ability for prospective buyers to observe and evaluate a new product in a real-world operational environment can be a valuable

**Figure 4: Buoy deployments and recoveries are expensive and time consuming.**

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resource for the developer in securing early product sales. Newfoundland-based companies Lotek, Compusult and Northern Radar are examples of companies currently availing of or planning to use SmartBay facilities for new product evaluation.

## **The Trials and Tribulations of Operating an Ocean Observation System**

Anyone who assumes that ocean observation is easy, cheap, straightforward or predictable has never dealt with the practicalities of establishing and maintaining met/ocean infrastructure in an operational scenario. The evolution of SmartBay and the feeling of 'pride of ownership' as the user community embraces the concept is tempered by the harsh realities of "keeping it all going" while meeting user-community expectations on a day to day basis. The past two years have been an eye opener for the SmartBay team, providing an addictive concoction of frustration, satisfaction, anxiety and accomplishment. Within weeks of the deployment of the first buoy in Placentia Bay, the area was hit by the tail-end of a hurricane bringing 60 knot winds and 10 metre seas to the area – the AXYS buoy survived unscathed though the team was left with a far greater appreciation for the environment in which it was working.

Every ocean observation location has its complexities; for Placentia Bay, it is the harsh environmental conditions combined with communications limitations. As with the vast majority of ocean observing systems, the SmartBay buoys rely on solar energy. Placentia Bay is situated approximately 47 degrees north and, when combined with the reality that Placentia Bay is shrouded in fog for about half the year, places significant strain on solar charging systems, especially during the winter months. Not only is the limited sunlight an issue but we are also forced to deal with the build-up of freezing spray on the solar panels resulting in both charging inefficiency and occasionally in instability or damage to the buoys. With limited options, the situation is currently being address by adjusting the sampling and reporting periods based on available power; however, with ever available wave energy playing on the hulls, it appears logical to explore how to utilize this energy to improve efficiency and

robustness. Similarly, the abundance of wind leaves one considering how to reliably capture this energy within the reality of the Placentia Bay environment.

Buoy deployments and recoveries are expensive and time consuming yet in the majority of scenarios are unavoidable in order to address maintenance and calibration (Figure 4). Without entering into a 'better mousetrap' discussion, there needs to be consideration given to how we design, populate and interface oceanographic systems to better accommodate on-site maintenance and replacement of individual sensors. Similarly, interoperability of sensors and systems and common data standards present themselves as ripe opportunities for technical advancement. Once we have these issues resolved there is still plenty of work to be done addressing reliable, cost efficient communications, sensor robustness and remote data acquisition to name but a few.

Defining a sustainable operating model is an issue shared by many ocean observing initiatives. The SmartBay experience in Placentia Bay has demonstrated that focusing on the needs of the users and making the system easy to use results in a system that is widely accepted, used and supported. Mechanisms to translate community interest into financial support remain to be determined, but our discussions to date with various members of the Placentia Bay maritime community indicate recognition of the need to do so, and a commitment to make it happen. As with all such 'infrastructures' (consider power, transportation and telecommunications), a blend of public and private support will be required, with public support proportionately higher in the early stages. Industry, in particular, has been a strong supporter of SmartBay and has, to that end, indicated its desire to work with the SmartBay team to find an acceptable financing model. Lump sum infusions by discrete industry interests are not conducive to long term planning and stability yet is considered essential in the early stages. A levy or fee on users of the bay, including the optimal solution of accessing a small percentage of existing fees, is seen to be achievable; however, it will take time, patience and continuation of some level of public support.

## Looking Forward

Placentia Bay is rapidly becoming the industrial heartland of Newfoundland and Labrador and with this comes the challenges and complexities of mixing traditional and non-traditional users and uses, as well as a host of safety, environmental and regulatory concerns. With appropriate ongoing support, the existing SmartBay infrastructure is well positioned to serve the information requirements of the Placentia Bay community as a whole, thereby helping to ensure sustainable development of this important coastal and marine area. “Better information – better decisions” has evolved from a project motto to a reflection of user expectation.

Evolving from demonstration mode to information service entails significant challenges; however, the SmartBay team has committed to working with industrial, regulatory and academic interests in the community to continue to service what, based on feedback to date, has been a long standing information vacuum. Key to transitioning into operational gear is the maintenance and operational solidification of the existing SmartBay infrastructure and services, including strengthening of capacity to repair instrumentation and the capacity to restore operational status in a timely and operationally acceptable time frame. User feedback over the past approximately two years stresses that enhancement of the existing baseline infrastructure is necessary if SmartBay is to address specific user information needs on an operational basis. Primary enhancements include the acquisition of additional buoys to the SmartBay buoy network, development and operational implementation of surface current and spill trajectory models, as well as improved communication of data and forecasts to the small-boat mariner. There is also a need for ongoing work with local industry and other developers to facilitate and support their use of the existing infrastructure for new technology and applications development and scientific investigations.

Interest from other areas of Newfoundland forces one to consider the concept of incremental expansion. Local systems would contribute to and enhance the broader picture by increasing the resolution of observations and the number of parameters measured and analyzed based

on locally identified priorities for data and information. Under such a scenario local groups would be responsible for the design, implementation, operation, and improvement of local nodes that conform to the high-level architecture and accepted minimum service offering. This step-wise, incremental approach is practical in both fiscal and operational terms. The infrastructure grows according to local needs and priorities. Expenditures are made according to local economics and agendas. Investments accrue over time. Innovation is encouraged and rewarded. ~

## Acknowledgments

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SmartBay is led by the Marine Institute School of Ocean Technology, located in St. John’s, Newfoundland. The SmartBay team includes industry partners AMEC Earth & Environmental, International Communications and Navigation Limited (ICAN) and Earth Information Technologies (NL) Limited.



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