International Space-Based AIS and Data Extraction Backbone

System Requirements Concept of Operation and Business Model

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CONTENTS

INTRODUCTION

With greater emphasis being placed on global situational awareness, global asset monitoring, and environmental monitoring, maritime and terrestrial sensor and data acquisition systems are critical enabling capabilities that are becoming more ubiquitous. The need is driven by global security and safety initiatives responsive to the new face of conflict, which involves every sector of society and knows no geographic boundaries. Because much of the Earth's surface is "unwired" and governed loosely, if at all, and because illicit activity seems to flourish where transparency is lacking, there may be important gains in collecting data and monitoring activity in just such places: the open seas, jungles, deserts, and the polar regions. We feel that moving data out of these areas, which are not supported by electrical or communications grids, suggests the need for a global space-based data collection and distribution backbone. Furthermore, we feel that creating such a system should be undertaken as an international collaborative effort, with no significant barriers to entry.

A number of national space agencies, consortia, and commercial interests have been active in deploying AIS receivers and data extraction capabilities on satellites; however, there currently exists no global partnership to coordinate and organize all the disparate efforts – especially one that ensures the availability of these capabilities to otherwise underserved countries. To further develop the concept of an internationally shared data collection and distribution backbone in space, CANEUS is organizing a workshop to explore technical, policy, and financial issues, and to frame an implementation plan. The eventual goal is to establish a public/private partnership that would create a low-cost, internationally shared data collection and distribution backbone in space with exceptionally low barriers to entry for participating nations.

To set the stage for the workshop, two separate articles address issues associated with establishing a space-based data extraction and distribution backbone. Existing data streams, notably the ships' Automatic Identification System (AIS) give concrete context to the articles, while thinking about the future will involve data streams with diverse content. The first article already distributed by e-mail and available on the CANEUS web site, canvassed the globe and summarized the presentations, policy statements and end user requirements created by organizations that have an interest in the extraction and distribution of data from "unwired" areas of the world in support of international safety, security, environmental protection, and economic prosperity.

This, the second article, addresses system requirements and a concept of operations framework for an international small satellite communications backbone. Also, segments of the proposed communications backbone are described and reflect the needs and input from all the international stakeholders that was introduced in article 1. Basic tenants for a collaborative framework are proposed including data ownership, value-added services, leveraging of partner resources, cost structures and commercial and private business responsibilities.

This article will also suggest a couple of business models that include an international shared asset framework for a global monitoring system to be used as a base of discussion for the CSSP Workshop. After having reviewed both article 1 and 2, the workshop attendees should be prepared to participate in the system definition, deployment planning and funding identification activities scheduled throughout the 3 days of the "CANEUS – Collective Security, Safety and Prosperity (CSSP)" workshop.

OVERVIEW

Following and throughout the remaining body of this article, are a number of recommendations that the participants at the CSSP Workshop may want to consider as points for discussion during the project definition process. While these recommendations are specific in nature, the reader is encouraged to provide insightful critique and further embellishments that reflect the reader' needs and experience to the CSSP Workshop forum and be prepared to share this input with the group.

Recall from article 1 "International Space-Based AIS and Data Extraction Backbone – High Level Requirements" that the objective of the CSSP Project is to deploy a constellation of satellites and network of ground stations to provide an AIS service and simple data extraction service for the underserved areas of the globe. And an essential characteristic of the system is that it has to be very low cost so that all cooperating nations, large and small, can afford to participate in the contribution and sharing of the information. The intent is for the system cost to cover just enough functionality to support the elemental requirements for international situational awareness (relying on the commercial satellite community for the more expensive data-rich information services) in order to bolster safety and coordinated security of all global maritime assets no matter where they reside or voyage.

One recommendation for the stakeholders to consider is that, in order to mitigate the cost of deploying and operating the CSSP system, the system requirements should be minimalist in constitution and the participating Nation States' existing assets and capabilities should be leveraged against the system needs. Deployment of new assets should only be justified when the coalition of members' collective capabilities cannot satisfy the requirements. In terms of a minimalist approach, for example, analysis from ONR determined that a polar orbit geometry using 30 satellites in five orbital planes is an effective configuration with respect to persistence and cost (assuring coverage at the equator). In addition, by selecting an altitude near 550 km the satellites suffer less AIS co-channel interference and, have reduced comms power requirements relative to satellites in higher orbits, and simultaneously meet a three to five year mission design life (orbit will not decay within five years during the worst-case atmospheric drag environment). The satellites should be purpose-built and small (20 to 30 cm cubed weighing 15 to 25 kg– a popular form factor used by a number of satellite suppliers), and utilize both a low power and thermal budget, small solar panels, minimum maneuvering (deployable flaps for example), VHF/UHF comms links, support for "bent pipe" operation to minimize the duration of comms link activity, and simple antennas. Also, low cost commercial off-the-shelf ground terminal equipment (software and hardware including a simple steerable antenna) can be used in the ground support segment.

In terms of leveraging, for example, piggybacking an AIS and data extraction payload onto a Nation State's already planned polar orbit LEO mission can be more cost effective than a purpose-built satellite. Most likely, the CSSP system will be a combination of piggybacked payloads and purpose-built satellites. Also, by coordinating the launch services of CSSP coalition members most of the extra launch capacity could be used for the needs of the constellation deployment while, at the same time, reducing the overall cost of the primary missions. The ground segment of the CSSP system can be implemented using existing littoral AIS base station or other satellite listening stations that exist throughout the globe simply by adding the low cost hardware, software and antenna previously mentioned and by tapping into the existing data network and regional communications structures. Even the command and control center that includes an enterprise server required by the CSSP system could be collocated in an existing command and data center in order to leverage operational and structural expenses.

In order for the CSSP system to be effective and provide utility to all international partners, it is essential that the functionality and operation is responsive to the international maritime authorities' existing and evolving policies, the stakeholder's ever-growing requirements and, dovetails into the national and regional frameworks that are beginning to self-organize into the global information networks that are required for effective maritime surveillance. The recently released Wise Pen Final Report for "Maritime Surveillance In Support of CSDP",[1] even though written for the EDA, provides guidelines and recommendations for international maritime awareness capabilities and is a good example of the type of policies being established in each of the major maritime regions around the globe. The specific requirements for the CSSP system should be directly responsive to these guidelines and recommendations. From the Wise Pen report:

> *"SOLAS, IALA, & IMO show that governance models exist for international maritime cooperation without succumbing to deadlock over legal or sovereignty issues. Governance in maritime surveillance can be similarly achieved by agreeing delegated authorities and responsibilities."*

1 The "Wise Pen Team" Final Report to the EDA Steering Board on Maritime Surveillance in Support of the Common Security and Defence Policy (CSDP) was released on 26 April, 2010. The central message of the report is the need for linking national and international military and civilian assets in order to create a federated maritime surveillance network.

The takeaway from this is that the CSSP administration should have a high level interface with each of the maritime policy setting authorities and participate in the development and implementation of the directives. The report also recommends a structure for the data sharing network that has a direct bearing on the space-based segment. From the report:

> *"Thanks to the internet and related developments, distributing and protecting data has made the goal of affordable, COTS-based, service-oriented, loosely-coupled federation of systems readily achievable. Indeed it is already evolving through AIS-LRIT-STIRES: SafeSeatNet-IALANET: EU NAVFOR Atlanta's Mercury and unifying tools like the EDA's Common Standard User Interface (CSUI), which are ideally suited to handling the complexities of information sharing and synthesizing by different authorities for different purposes at different levels."*

Responsive to this federation of systems of low cost technology and information sharing services, the CSSP system should collect and then direct the AIS data to collaborative networks that already exist, such as MSSIS, SafeSeaNet, or Iala-Net – this being the most cost effective and least complicated means to distribute data to the partnering Nations (by taking advantage of existing agreements, security and infrastructure).

An operational implementation of the global surveillance network was also suggested in the recommendations made in the report. From the report:

> *"The preferred approach is regional. Maritime surveillance is a continuous worldwide process whereas action in response to it tends to be local or regional. The global "white picture"[2] network must therefore be capable of more detailed enlargement for regional level mission purposes. Progressive implementation should permit information and intelligence exchange by first connecting National Maritime Coordination Centers (NMCCs) through maritime surveillance (MARSUR) on a by-request basis, second, developing the exchanges at regional level and, in the final phase, the Regional Coordination Center (RRC) would assume the predominant coordinating role."*

2 From the Wise Pen Report: The compilation, by either system, of AIS data, with or without other cooperative detection systems, constitutes what is called the "white picture". Contacts which only appear in non-cooperative sensors, and which do not respond to electronic interrogation constitute the "black picture".

For the CSSP System to be effective, the system should provide services that support the action-oriented activities at the local and regional level, and also feed the global data gathering, synthesis, and data fusion processes taking place at the national level. Support is provided for both the immediately actionable information at the local level and the actionable information from the national level that results from the post processing of the data collected (both from the satellite based AIS-VDL and data extraction services) and forwarded to the NMCCs by the CSSP System. A further discussion of the concept of operation for CSSP System follows.

Regarding the actions taken at the local level, currently the proposed CSSP System focuses on data collection and relies on the regional maritime authority to initiate the required actions after a synthesis and fusion of the information – the CSSP System does not directly affect local actions. However, a potential issue to explore at the workshop is whether a space-based AIS base station should be implemented that would function like a physical shore station (pss) as defined in the IALA Recommendation A-124. With this extended functionality, a CSSP satellite/payload could directly interact with the littoral AIS stations via the AIS VHF data link (AIS-VDL) as a repeater. Thus, the littoral station's coverage could be extended beyond the typical 50NM range, in support of AIS services for all AIS reporting assets within a Nation's exclusive economic zone (EEZ). Furthermore, the CSSP satellite/payload could provide a fully functioning AIS service, for example VTS, aids to navigation, search and rescue, etc. for all AIS reporting assets in international waters. There are many issues to overcome with this concept that need to be discussed at the CSSP Workshop forum but the potential improvement for global maritime safety and security is tremendous.

Another item that must be explored is the CSSP System data policy. Commensurate with the underlying need for globally shared data, the CSSP System policy for space-based data must transcend the regionally restrictive and costly subscription model that most existing commercial satellite data collection services are promoting. Nevertheless, the policy needs to recognize the key role that the commercial satellite providers will have in the implementation and continued operation of the CSSP System and thus be consistent with a viable business case for those suppliers. Also, separate provisions for the handling of proprietary data must be included in the policy. A number of recommendations are touched on in the following sections.

A complimentary issue to the data policy is the CSSP System business model. The cooperative of Nation States interested in the space-based backbone will be organized under an international charter. Further the organization will need to progress through a definition and implementation phase, and a continuing operation phase. Development of the charter, business framework, and phases of maturation will be a focus activity for the CSSP workshop and a few suggestions relative to this subject matter are offered in the following sections of this article.

CONCEPT OF OPERATION

The CSSP System is comprised of a constellation of satellites (Figure 1) in LEO, and ground support services. To reduce cost and to promote international participation, the constellation should be a combination of extremely low cost purpose-built satellites and comms payloads on member's already-planned LEO missions that utilize polar orbits. As mentioned previously, analysis from ONR determined that a polar orbit geometry using 30 small satellites in five orbital planes (6 satellites each) is an effective configuration with respect to persistence and cost to assure coverage at the equator.

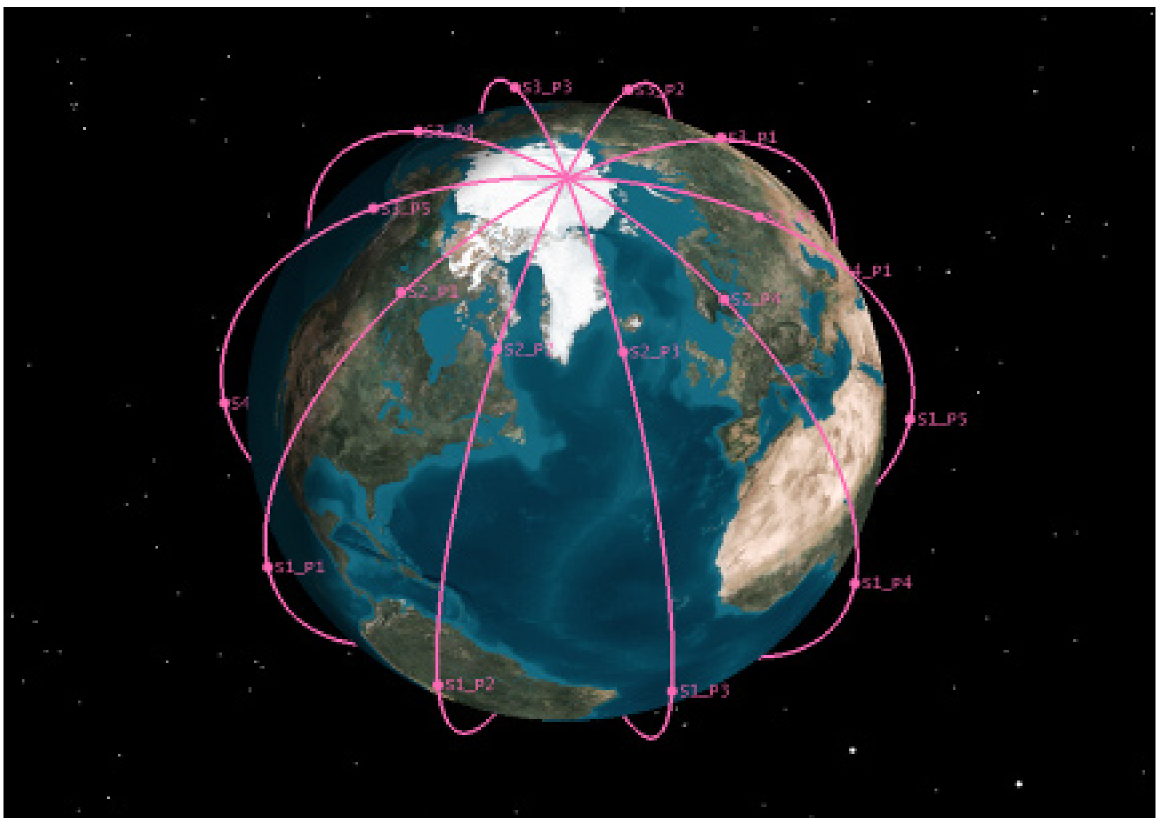

Figure 1. CSSP System Constellation – 5 Polar Orbits with 6 Satellites Each

And, deploying the satellites at an altitude near 550 km would reduce AIS co-channel interference, reduce the comms power requirements, and simultaneously meet a optimal three to five year mission design life. The 550 km altitude was deemed to be the lowest initial altitude at which the orbit would not decay within five years during the worst-case atmospheric drag environment.

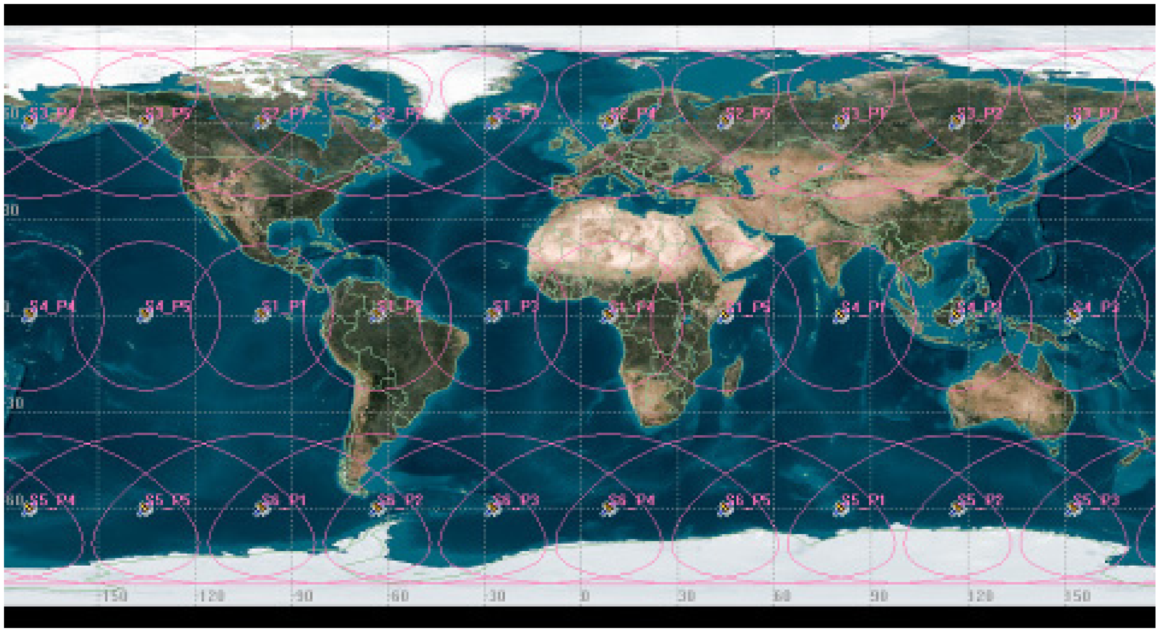

Figure 2. CSSP System Constellation Service Coverage

At a 550 km altitude, the geometric field of view (Figure 2) is approximately 45 degrees in longitude at the equator. The full 360 degrees of longitude can be covered by approximately eight, 45-degree fields of view. Thus, the ascending and descending nodes of four orbital planes would just cover the equator. For redundancy, five planes were selected to assure persistent coverage at the equator.

To support both an AIS and data extraction service, the satellite comms hardware package includes 4 VHF channels for the AIS-VDL, 2 UHF bidirectional channels for short burst data extraction (able to pole assets and sensors for data and then collect the information), and an L band up-link and S band down-link for command and control and high speed data handling. Both “bent pipe” and “store and forward” modes of data handling are supported; however, as the network of ground terminals is expanded, there will be less of a need for “store and forward” operation.

In order to save cost and promote international participation, the ground segment of the CSSP system will rely as much as possible on the member’s existing satellite listening stations that exist throughout the globe. A simple hardware/software and antenna package can be made available for any member to interface to the constellation’s UHF based data extraction service. Data collected by the CSSP System will be ported to an enterprise server and subsequently distributed to existing data network and regional communications structures supported by the Maritime National and Regional Authorities. Even the CSSP command and control center and enterprise server required by the CSSP system can be collocated in a member’s existing command and data center in order to leverage operational and structural budgets.

An important issue that must be addressed for the proposed CSSP System concept of operation to be realized is frequency allocation. The comms links used to support the AIS data collection (the four VHF channels) are globally defined by the ITU and the assumtion is that the recommendation of ITU-R WP5B will be implemented. Namely, channels 75 and 76 are approved for satellite-based AIS activity and a new message 27 for space-based coordination accepted into AIS-VDL messaging. The status of the approval process should be reviewed at the CSSP workshop and action items identified for any outstanding issues. Relative to the other comms links and, of even greater concern, is that the bidirectional UHF data extraction channels and the L- and S- band commands and control channels currently have no frequency reserved for their use internationally. Even if a request for a frequency allocation were filed today, it would potentially take a number of years before CSSP System frequencies would be assigned, most probably delaying the deployment of the constellation. One solution is to establish a unique business relationship with an existing satellite operator that already owns an appropriate frequency allocation that could be used in the CSSP System comms links. Whatever the potential solutions are, the issue must be explored at the CSSP Workshop.

The concept of operation for the CSSP System can be separated into 2 sectors; International AIS Data Collection Service (Figure 3) and Data Extraction Service (Figure 4). As shown in the **International AIS Data Collection Service** illustration, each satellite is able to interact with AIS-equipped ships and navigational aids through the AIS-VDL. Also, the satellite can interact with the CSSP Command and Control Center through the L and S band channels.

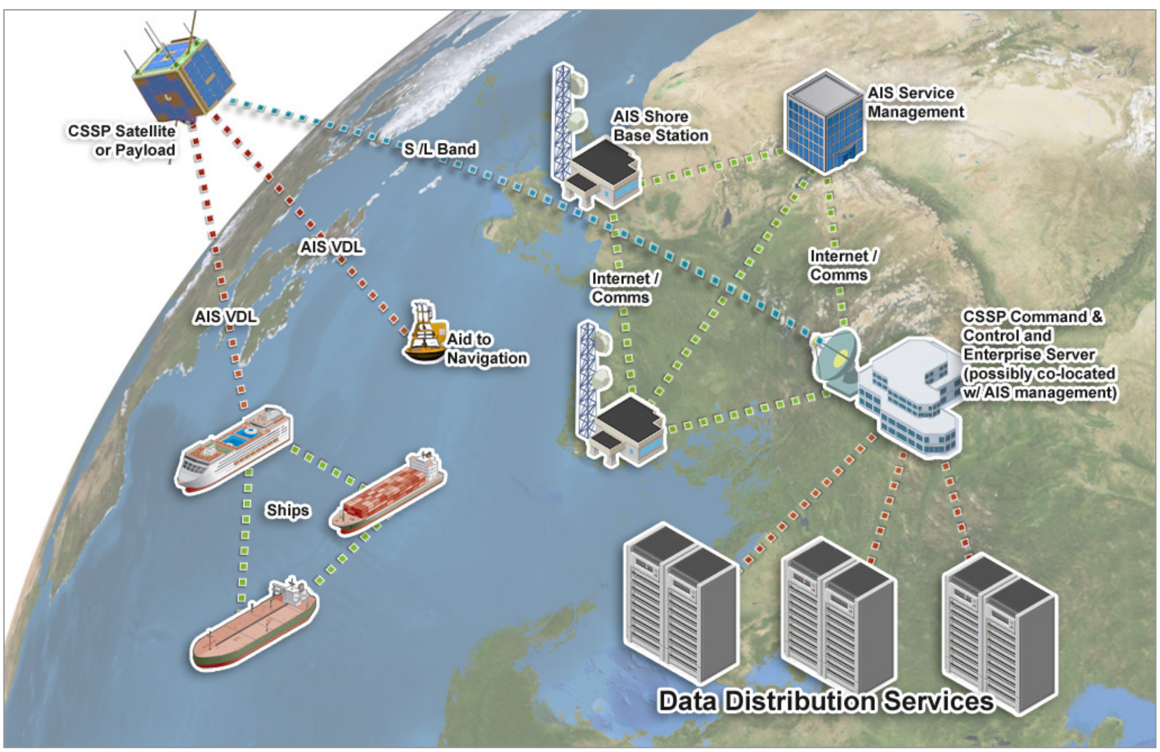

Figure 3. International AIS Data Collection Concept of Operation

Relative to AIS services, the CSSP satellite/payload collect vessel tracking data from the AIS-VDL. However, by employing the mechanisms recommended by the ITU-R WP5B the CSSP coverage is primarily focused on only the AIS reporting vessels that are not currently part of an AIS group that includes an AIS base station. In this way, co-channel interference is drastically reduced and duplicate data is not burdening the AIS networks.

CSSP System command and control, and data management functions are handled over the S- and L- bands - direct communications between the satellite and the CSSP Command and Control Center is possible when the satellite passes over the Center. Also all data on the S band down-link is encrypted and is directly ported to the enterprise server in the CSSP Command and Control Center. Basic AIS data (vessel id, position, time, speed and direction) is received at the Center and then forwarded to the CSSP System's enterprise server and subsequently to the data distribution

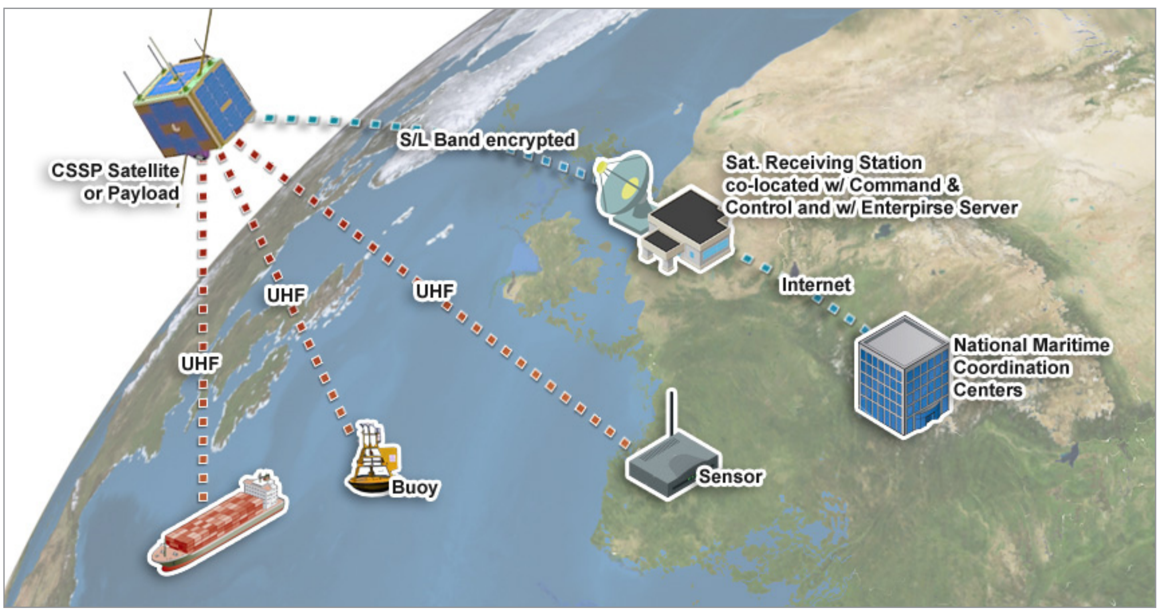

Figure 4. Data Extraction Service Concept of Operation

services such as MSSIS, SafeSeaNet and IALA-Net.

In addition to the comms hardware used for space-based AIS data collection service, the CSSP satellite/payload concept incorporates a UHF channel for short burst data in support of a complementary **data extraction service** that is used to collect data from assets and unattended ground or maritime sensors (Figure 4). The received message packets are encrypted aboard the satellite then down-linked over the UHF channel to partnering nation's ground terminals distributed around the world or down-linked over the S band channel directly to the CSSP Command and Control Center where the enterprise server is collocated. From the ground terminals the protected data stream is also routed to a CSSP enterprise server. The CSSP Command and Control Center along with the enterprise server is the central point of control for all the CSSP satellites/payloads and in most instances will be collocated with a partnering nation's assets in order to leverage costs. It accepts requests from the end users/owners of the data for communications service and tasks the satellites and ground terminals to collect the data and distribute the information based on distribution rules established by the end user/owner; typically a National Maritime Coordination Center. An issue that should be explored at the CSSP Workshop is capacity. In other words, based on the needs of the stakeholder at the forum, how many sensors and assets need to be monitored at any one time and how much data will each sensor/asset report?

PURPOSE BUILT SATELLITE AND COMMS PAYLOAD

Recall from the overview section that in order to mitigate the cost of deploying and operating the CSSP system, the system requirements should be minimalist in constitution and the participating Nation State's existing assets and capabilities should be leveraged against the system needs. Deployment of new assets should only be justified when the coalition of member's collective capabilities cannot satisfy the requirements. Also recall from the section that piggy backing an AIS and data extraction payload onto a Nation State's already planned polar orbit LEO mission (or for that matter, a commercial satellite LEO service deployment) can be more cost effective than a purpose-built satellite. Most likely, the CSSP system will be a combination of piggybacked payloads and purpose-built satellites. Also, by coordinating the launch services of CSSP coalition members most of the extra launch capacity could be used for the needs of the constellation deployment while, at the same time, reducing the overall cost of the primary missions. Implied from this then is the need for the CSSP International Collaborative to design and procure an AIS and data extraction comms hardware set for the opportunities where a payload can be accommodated on a member's or commercial services planned mission – and – to design, procure and deploy an elegantly low cost purpose built satellite to provide data collection coverage to "fill in the gap" as it were, where currently planned member services do not exist.

AIS and Data Extraction Payload: There are a number of commercial satellite suppliers that design and fabricate their own AIS transceiver and data extraction satellite hardware sets (Orbcomm, Com Dev, SpaceQuest, and KSAT for instance). Indeed, each of them have demonstrated the ability to acquire AIS data and ground sensor data from space, with SpaceQuest providing the most comprehensive acquisition of global AIS data. Orbcomm has been the most aggressive of the satellite builders in deploying services in space for monitoring AIS equipped assets and the project with the US Coast Guard (USCG) can be used as a model for the CSSP System implementation. The USCG commissioned the development of an AIS payload that was added to a planned deployment. In addition, the USCG supported the cost of monitoring the satellites with some supplemental funding. Nevertheless, none of these organizations have implemented the new provisions proposed by ITU-R Working Party 5B for space base AIS which should be approved in the near future. The provisions, which include the utilization of channel 75 and channel 76 and, and implementation of a new VDL message 27 for space applications, will make the space-based acquisition of AIS data more effective and reliable. The next generation of transceiver needs to be developed and the CSSP stakeholders may also choose to extend the functionality of the transceiver beyond simple data collection. This subject of generation 2 requirements and the process for commissioning further development relating to: frequency allocation; throughput; revisit intervals; antennas; power consumption; improved capacity; standard interfaces (external and internal); comms protocols; encryption methods; cost containment strategies; etc. should be thoroughly discussed at the CSSP Workshop and list of actions items identified. Demonstration projects comprised of commercial suppliers and national agencies should be created to support the development and validation of a 2nd generation AIS and Data Extraction comms package that is based on CSSP member defined international requirements.

Purpose-built Satellite: As the CSSP International Collaborative endeavors to deploy the 30 satellite

Figure 5. AprizeSat 3 and 4

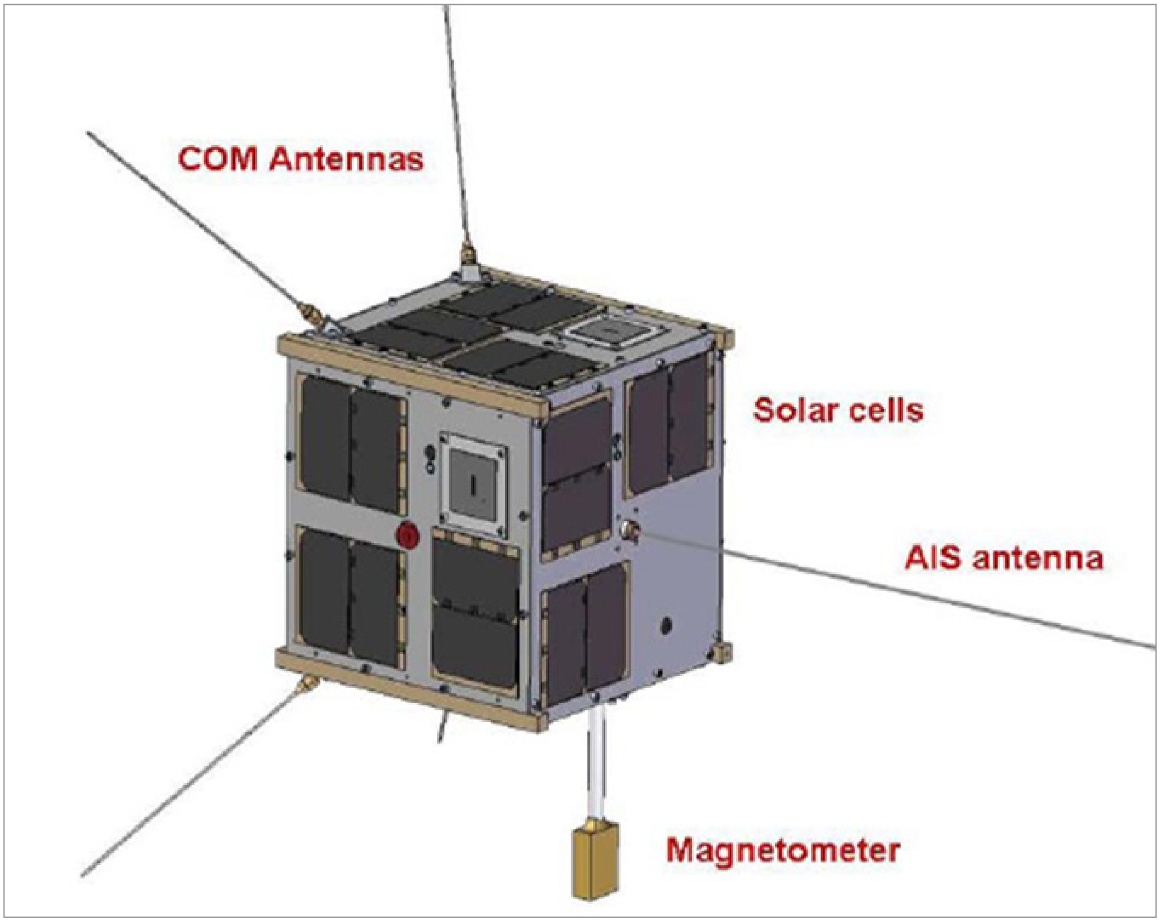

Figure 6. AISsat-1

constellation of satellites and finds an underserved area of the globe not covered by other member assets, then the case for deploying a purpose-built satellite can be made. As previously mentioned, there are a number of commercial satellite builders that have built, deployed and demonstrated small satellites capable of AIS and data collection (Orbcomm, Com Dev, SpaceQuest, KSAT and OHB to name a few). By general observation, the most popular bus structure for these cost sensitive applications seems to be the 20 cm^3 form factor weighing in the range of 15 to 25 kg. Figure 5 shows SpaceQuest's AprizeSats 3 and 4. Both satellites have been successfully deployed and have been effectively collecting data for over a year. Figure 6 is a pictorial of the AISsat-1 which was built by the Space Flight Laboratory at the University of Toronto (UTIAS) under direction of FFI and deployed in space this summer. Figure 7 is a pictorial of the proposed GLADIS satellite which is part of a USN Joint Capability Technical Demonstration program. This platform is to be used to validate the different components of a low cost and improve performance strategy in support a of global AIS and data extraction service. For example, the application of COTS type components, low cost maneuverability, improved bipolar antenna, power management concepts, etc. will all be tested and the resulting improvements would be shared with the international community.

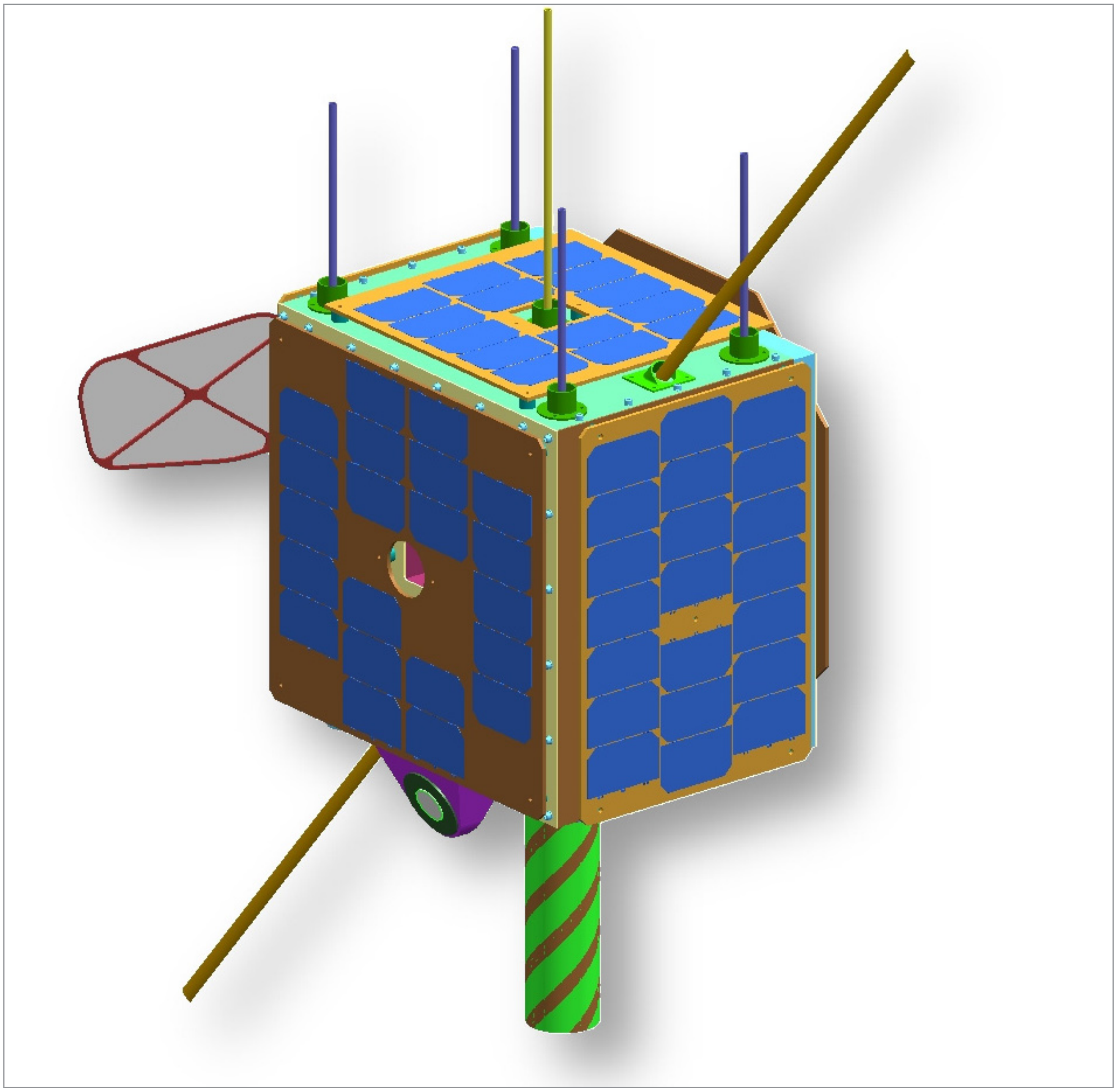

Figure 7. GLADIS Concept

Each of these satellite concepts have best in class contributions that could be combined into a single internationally sponsored design that would be the basis of the CSSP System. Again, as with the comms payload, demonstration projects comprised of commercial suppliers and national agencies should be created to support the development and validation of an internationally sponsored purpose built AIS and Data Extraction satellite that supports the low cost targets of the members and provides a platform for the open sharing of data.

DATA AND COST OF SERVICE MODEL

As mentioned previously, a new CSSP data policy which includes an economical cost structure needs to be created for the collaborative and should be a subject for much discussion at the CSSP Workshop. Following are 2 recommendations for an international data policy framework that the reader might want to consider when preparing their input for the workshop forum. to consider Recall that a candidate data policy must be commensurate with the underlying need for globally shared data, must transcend the regionally restrictive and costly subscription model that most existing commercial satellite data collection services currently use and, be consistent with a viable business case for the commercial suppliers of satellite hardware and services. And remember provisions for the handling of proprietary data must be included in the policy.

Potential CSSP System Data Policy – 1: In this policy it is assumed that the CSSP System is supported by a membership organization made up Nation State Maritime Authorities. Each national partner contributes to a pool of funds to cover the cost of operations the amount of which is based solely on the partner's usage, much the way an electric utility provides service (except the CSSP International Collaborative is a not-for-profit based operation). Ownership of the data is recognized as that of the entity that first makes the information available. The subsequent value added steps associated with collection, synthesis and distribution are also recognized and assigned a rate that is used as a basis for assessing the cost of usage for the partnering nations. Each participant in the supply chain will have an agreement with CSSP International Collaborative that will allow for unrestricted use of non-proprietary data for the members of the collaboration. Space-based AIS services will be handled much the same way as littoral based AIS where in the end user purchases the vessel based equipment and the Nation State Maritime Authority supports the operation of the shore based station, but in the case of the CSSP System, 30 satellites are used. The salient points of this framework are then:

- The sensor/asset owner/operator that transforms the parameter from a physical phenomenon into data is owner of the data. The owners of AIS data afford the same license to space-based data collection services that they give to the shore based monitoring services;
- Owner/operators must be sponsored by a Nation State Maritime Authority to use the CSSP System;
- Each transfer step in the communication link and data synthesis step represents a point of added value to the information. Each step will be assigned a price as recognized by the partners (in consultation with service providers) based on the actual cost of providing that value added service. The end users will be responsible for paying for each subsequent step in the information service that is used by the end user;

- Each Nation State will pay for its annual usage (estimated at beginning of year and adjusted for actual usage at the end of year);
- Nation States with low per/capita GNP will be subsidized with contributions from all members;
- The charge for annual usage will include: the cost of usage for each transmission within the EEZ and any ordered inquiries outside the member's EEZ; a proportionate share of the cost for infrastructure and support; a proportionate share of the subsidy for low per/capita GNP countries; a proportionate share (based on Nation State's GNP) of the cost for all transmissions in international water;
- The total charge can be mitigated by the value of a Nation State assets that are contributed to the operation of the space and/or ground segments of the CSSP System;
- Proprietary data can be collected and securely distributed (through an encrypted link) e according to end user requests. The end user/requestor is directly responsible for the cost of proprietary data collection and distribution unless a Nation State Maritime Authority chooses to pick up the tab.

Potential CSSP System Data Policy – 2: This policy concept is much the same as the first proposed policy except that a commission of members sets a rate for a cost per bit of CSSP data based on annual estimated cost of operation. The CSSP System would keep track of all data collection and distribution transmissions both within a Nation State's EEZ and associated with vessels that sail through international waters under the Nation State's flag. The salient point here being:

- Based on cost per bit of data – collected and distributed. The rate is determined by a commission of members and covers all cost associated with the continuing operation of the CSSP System.

BUSINESS / IMPLEMENTATION MODEL

A framework needs to be established that provides for the planning, implementation and management of the continuing operations associated with the CSSP System. The cooperative of Nation States interested in the space-based backbone should organized under an international charter and subsequently provide the administration for the organization's transition through each building phase of the CSSP International Collaborative. Development of the charter, business framework, and phases of maturation will be a focus activity for the CSSP workshop and a few suggestions relative to this subject matter are offered here. Following are 3 recommendations for a business framework that the reader should consider when preparing their input for the workshop forum.

Potential Framework – 1: Self Governed International Membership Organization: With this business model, the administration, deployment and continuing operations of the CSSP System will be governed by a not-for-profit cooperative of Nation States organized under an international charter. A Board of Governors appointed by member Nations and populated with representatives from each stakeholder group, will be responsible for all activities associated with the cooperative. Member nations will pay for cost of operation and deployment of assets by contributing to a pool of funds, the amount of which is based on membership usage and those usage fees can be mitigated by member's assignment of National assets and services rendered in support of the CSSP System. The organization will mature through a system definition/deployment phase and a continuing operation phase. Working groups will be established for the space segment (satellites, up-link, down-link, deployment, etc.) and ground segment (command and control, AIS base station network, comms hardware/software, etc.) of the CSSP System and will be populated by all stakeholders with subject matter expertise. The salient points of this framework are:

- Administration, deployment and continuing operations governed by a not-for-profit cooperative of Nation States organized under an international charter;
- Board of Governors appointed by member Nations and populated by representatives of the stakeholders;
- Member nations will pay for cost of operation and deployment of assets by contributing to a pool of funds - based on membership usage
- Usage fees can be mitigated by member's leverage of their assets and services rendered in support of the CSSP System;
- Two phased approach to maturation - system definition/deployment phase and a continuing operation phase;
- Working Groups will be created for space segment (satellites, up-link, down-link, deployment, etc.) and ground segment (command and control, AIS base station network, comms hardware/software, etc.);
- Working Groups populated with all stakeholders having subject matter expertise;
- Working Groups will be responsible for design, research and development, procurement, interface standards and policy recommendations for each section of the CSSP System – subject to oversight from the Board of Governors;
- Board Level liaisons with international maritime authorities – both civilian and military.

Potential Framework – 2: Fractional Ownership Model: In this framework[3], Partnership is provided in return for direct investment in the CSSP System. Investment may be monetary or in-kind contributions such as launch services. Fractional ownership models have been successful in providing previously unaffordable capabilities to partner nations who cooperatively share and manage assets. Two examples are the Strategic Airlift Capability (SAC) by NATO and the Disaster Monitoring Constellation (DMC) managed by DMC International Imaging. Within the SAC agreement, 10 NATO countries plus two partner countries agreed to acquire and operate three Boeing C-17 transport aircraft. Each nation agreed to support a certain number of flight hours for these aircraft and corresponding share of maintenance and operations cost. A central coordination activity was established and jointly funded to manage SAC aircraft according to the Memorandum of Understanding between the partner countries. The DMC consists of six countries that agreed to cooperatively manage 8 imaging satellites. DMC International Imaging, a wholly owned subsidiary of SSTL, manages the tasking and operations of the satellites on behalf of the countries for commercial purposes and some percentage of hours (revolutions are provided for emergency, scientific, and disaster support.

Potential Framework – 3: International Maritime Safety and Security Exchange (IMSSE): With this concept, the CSSP activities would become an integral part of an international safety and security initiative proposed by Admiral Henry G. Ulrich, USN (Ret.)[4]. This concept brings together members that are willing to exchange maritime information in support of their own safety, security and commercial needs. The IMSSE would take on a revolving door approach that allows members to consume and/or provide maritime information thus, permitting consumers and providers to realize the symbiotic relationship on which long-term global maritime commerce and security depends, in spite of differing self-interests. The characteristics of this concept are:

- **Value of Safety and Security:** Maritime safety and security is viewed differently by various participants. Thus, the overriding driver for the IMSSE would be the interpreted value of the safety, security and speed of cargo delivery achieved. The challenge for the IMSSE will be in understanding how to provide and measure this value across the full spectrum of participants.
- **Governance:** The IMSSE's organizational and governance structure would provide policies and procedures that govern the collection, aggregation, analyses, and dissemination of information. Both governments and commercial interests would be represented in the governance structure.

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3 Excerpted from "Concept for an International Small Satellite Constellation to Monitor Unattended Ground Sensors", Naval Research Laboratory, JTM & Associates, Inc., Office of Naval Research, Mandex, Inc.

4 Description of the IMSEE is taken from a presentation prepared by Admiral Henry G. Ulrich USN (Ret.) and provided to the Atlantic Council; http://acus.org/files/publication_pdfs/3/International-Maritime-Security-Atlantic-Council-Issue-Brief.pdf

- **Architecture:** The IMSSE's architecture would be framed around the information, security, and technical aspects that enable the exchange to operate.
- **Resources:** A sustainable IMSSE would rely on both governmental and commercial member financial contributions for development, operations, sustainment and capital investments.

The IMSSE would leverage ad hoc, informal and temporary partnerships to overcome any disruptive perceptions. The IMSSE would build on these efforts, adapt best practices and work towards a business model that satisfies both commercial and governmental needs. Specifically, the IMSSE would:

- **Align Incentives and Expectations:** To attract and retain participants, the IMSSE would align the incentives of the exchange to participants' self interests. Governments will expect the information to be the vital link for actionable and preventive assurances to confidently ensure ships and cargo on inland waters are safe. Commercial enterprises favor enhancements that promote the safe and expedient delivery of cargo. Bottom line: Everyone wants safety.
- **Foster International Government Leadership and Oversight:** Governments, the final arbiters of travel within their exclusive economic zones, must be committed to the IMSSE.
  - Countries, regions and ports have unique needs. While the IMSSE would be universal in what information is exchanged, it would also accommodate geo-specific requirements to the maximum extent practical.
  - One of the more apparent yet daunting challenges will be the development of common governance protocols. The IMSSE would take on an international, commercial-friendly, government-led, coordinated, transparent and low cost approach when developing these protocols.
  - The IMSSE would have international legitimacy. This could be conferred by aligning the IMSSE with an existing international organization(s) such as the United Nations.
- **Identify or Create Data Standards:** The IMSSE would use a common taxonomy and information protection system. There would be concise definitions and clear understanding of data standards and protection among all members in order to rapidly obtain, dynamically transfer and securely store data from a variety of disparate systems and initiatives. Data warehousing is a promising mechanism.

PREPARATION FOR THE WORKSHOP

In order to be prepared for the planned activities of the Workshop, the reader is strongly encouraged to read both article 1 and 2 and to prepare a list of needs and recommendations that can be used as input for the definition and planning exercises that constitute the workshop. If you have any questions or need further clarification on any of the concepts presented in this article you may contact Rick Earles at CANEUS International.

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