C-SIGMA

Collaboration in Space for International Global Maritime Awareness

Cornerstone of Global Maritime Awareness &
Pathway to Global Maritime Cooperation for Safety, Environmental Protection, Resource Conservation, and Security

Maritime Security is very important to the world. It has many different dimensions, including but not limited to maritime law enforcement, maritime safety, maritime environment protection, maritime science & technology, maritime trade & economy, maritime law, trade sanctions enforcement, and public health. However, there can be no Maritime Security without Maritime Situational Awareness (MSA) and Global MSA can only be achieved by a global approach involving all the above stakeholders plus industry and academia on a truly global scale.

Many new, highly capable space systems are either here now or will be here in the next few years. Advances in the cyber world including "big data" mining, artificial intelligence and machine learning are allowing more complete processing of the data provided by these new systems. The expansions in both Earth observation space and in data handling provides us with a unique, epoch-making opportunity.

C-SIGMA envisions seizing that opportunity by linking together existing and planned unclassified space system capabilities in a worldwide collaborative network via coordinated regional centers for international GLOBAL MARITIME AWARENESS to provide substantially improved security, safety, environmental protection, resource conservation, as well as disaster mitigation and recovery. It would be a huge step toward GLOBAL MARITIME SECURITY.

Background:

In the 21st century it is well known that the cyber world has expanded exponentially but unnoticed by many, since 2004 and increasing steadily since then, there has also been an on-going revolution in space-based Earth observation systems and, led by space-based AIS, which provides the needed common frame of reference, their utility over the world's waterways has increased dramatically. These capabilities not only support safety and security at sea but can also significantly assist in economic and environmental stewardship and resource protection, as well as disaster mitigation and recovery. This is especially true of the remote areas of the world such as the Arctic, and the resource rich areas in the underdeveloped world such as the Gulf of Guinea, the South China Sea, Micronesia, the Indian Ocean as well as both the South Atlantic and Pacific coasts of South America. The potential contributions of space-based Earth observation systems to maritime awareness is of growing interest to the world's naval and law enforcement forces, as well as to environmental preservationists, and commerce, maritime, environmental protection, and disaster preparedness governmental ministries, in addition to ship brokers, and others with an interest in the marine domain, its environment, and the protection of its resources; however, coordination to maximize these capabilities is lacking.

Ongoing research started just after 9/11 (September 2001) shows that no single country or international organization has the ability and resources to fully support the safe, secure and efficient use of the maritime domain as well as the conservation and protection of the marine environment with its finite resources of fish, minerals and oil, as well as to substantially assist oceanic commerce. In that no one country has sufficient resources, including spacecraft, substantial

international collaboration is essential to achieving these objectives in a balanced manner. Indeed, this effort may need to be managed by an agency of the United Nations.

Among the greatest need, as well as the greatest opportunities for international collaboration are presented by the multiple national and regional efforts to develop the doctrine and concept of operations to coordinate the use of the space technologies now available for detecting, identifying and tracking vessels well offshore, on a global scale. These systems are especially suited in areas with shared international interests such as the Arctic, or in pirate infested waters, or in areas known to support smuggling or resource theft of all types.

As of mid-2022 there was a virtual tidal wave of new space-systems with earth observations capabilities being launched with more being planned and built. Additionally, as indicated above, the cyber world is also enjoying a similar expansion, with artificial intelligence and machine learning leading the way. The time to take advantage of these significant opportunities that are on the horizon and rapidly bearing down on the world is now, as this tide of technology rises. Catch the wave! Seize the moment!

System Description

There are nine elements that must be integrated for effective results. (Seven in space, two on the ground.)

Two of the seven different satellite types employ passive RF sensors :

1. Automatic Identification System (AIS), an automated short message system designed for collision avoidance and traffic control in congested waters but is now also used globally as a primary ship identification and tracking system. It is the key component of this concept. It is what makes this concept feasible.
2. Unclassified Signals Intelligence satellites (ELINTSats AKA RFgeoSats) (New Capability as of late 2019)

Another three of the seven different satellite types employ imaging sensors :

3. Synthetic aperture radar satellites (SARsats)
4. Electro-optical (EO) imaging satellites
5. Video optical satellites

The sixth element are the communications satellites

6. Machine-to-Machine (M2M) communication satellites. Individual transponders sending short, formatted status reports to communications satellites

The seventh stands by itself.

7. Visible Light detecting Satellites (VIIRS)

The last two elements deal with the tasking of the satellites and analysis of their collected data

8. The ground infrastructure, (terminals), software tools and licenses to allow users of the system to determine which spacecraft to task when to obtain the desired results, and to so act.
9. The software tools to correlate, fuse and analyze the information generated by the space systems, including S-AIS and SigSat track data, the basis for all analysis, along with all other pertinent data resident in all reachable data sources such as port, financial, shipping and broker records. Theses Static & Dynamic Data Analysis (SDDA) tools are a critical part of the effort.

While C-SIGMA would go a long way toward satisfying many of the world's varied needs for maritime situational awareness, it would also have the added benefit of providing a focal point for the creation of the global maritime security system envisioned in "A Cooperative Strategy for 21st Century Seapower," a major policy statement of the US military maritime services. The coordination needed to implement C-SIGMA would provide a focus for the efforts to achieve a common goal of protecting the maritime environment as stated in that document and would go far in bringing the lawlessness of such places as the Gulf of Guinea under control. Space-based earth observation does not replace terrestrial systems but does make them substantially more effective and is a significant start to fulfilling the core need of

[1] (the first four conferences were called **TEXAS** (**T**echnical **EX**change on **A**is via **S**atellite)

knowing who is where on the world's waterways. C-SIGMA also directly supports the Presidential Policy DIRECTIVE Four (PPD-4), US National Space Policy (NSP), 28 June 2010, and could be the international mechanism to satisfy its Implementation Task #1. PPD-4 emphasized U.S. leadership in space and directs international collaboration on mutually beneficial space activities for the purpose of broadening and extending the benefits of space to all mankind.

PPD-4, which is unclassified, has a classified Implementation Directive. However, Task Directive #1 is unclassified. It ordered the Secretaries of Defense, Homeland Security, Transportation, State and Commerce, to develop an unclassified, international available **program** to foster international collaboration using civil and commercial space systems to enhance global maritime domain awareness to provide: enhanced safety of life at sea; increased mutual security of all users of the maritime domain; improved protection of the maritime environment and the resources of the sea. It also orders them to address the better monitoring of the condition and performance of the Marine Transportation System. It was thought at the time that the same system could be used both as tool to improve the international and national aspects of the maritime domain. (Guy Thomas wrote all but the first and last sentence of that task and spent nine months selling the idea to his fellow White House Team members. It is no coincidence it was Task #1.)

The implementation of that directive has been held in abeyance for some unknown reason but implementing C-SIGMA could well be the key to building the envisioned, truly global, maritime security system, and would substantially assist in many tasks including detection of illegal smuggling of all types, of goods, arms, drugs, and people; much improved maritime pollution control and resource protection, such as illegal fishing and stealing of oil, as well as dramatically assisting humanitarian assistance and disaster recovery operations. Remote ocean surveillance in such areas as the Arctic, the southern oceans, and the western Pacific would clearly immediately benefit many people both in and out of those regions. C-SIGMA basically already exists in Europe via FRONTEX and the European Maritime Safety Agency (EMSA). Implementing C-SIGMA in the Arctic and a few other locales such as the Gulf of Guinea and the western Pacific could be the needed steppingstone to the implementation of truly **Global Maritime Awareness** for the betterment of the entire world.

Since April 2005 what is now C-SIGMA[1] has held 11 highly successful international conferences at locales such as:
2005-6 USCG HQ., Washington, DC; (TEXAS 1-2)
2007-9 the Canadian Embassy, Washington, DC; (TEXAS 3-4)
2010 ESA Earth Observation Centre, Frascati, Italy; (C-SIGMA I)
2011 NATO's Centre for Maritime Research and Evaluation, La Spezia, Italy; (C-SIGMA II)
2012 the Canadian Embassy, Washington, DC (C-SIGMA III)
2013 the Irish National Space Center, Cork, Ireland; (C-SIGMA IV)
2014 JAXA with the Japanese Coast Guard, Tokyo, Japan; (C-SIGMA V)
2015 InMarSat HQ, London (hosted by England's Space Catapult). (C-SIGMA VI)
2017 European Maritime Safety Agency, Lisbon Portugal. (C-SIGMA VII)

These conferences have been attended by most, if not all of the major Earth observation and AIS satellite builders and operators, and most if not all, of the builders of dynamic data analysis software focused on Earth observation. Many users of this data from all corners of the globe have also participated.

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