EARTH OBSERVATION SYMPOSIUM (B1)
Monitoring Change in the Arctic (6)

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# ROBOTIC ARCHITECTURE FOR CONTINUOUS COMMUNICATIONS, MULTI-SENSOR SIGNAL PROCESSING, VESSEL TRACKING, ORGANIC NAVIGATION, IN-SITU MONITORING OF MIZ, AND SUPPORT OF OPERATIONS AND LOGISTICS IN THE ARCTIC

**Abstract**

We developed and demonstrated the feasibility of an autonomous architecture – ARCTIC – that will deploy the capabilities of continuous reliable communications, organic navigation and vessel tracking, accurate geodetic framework, dynamic support of operations and logistics, and in-situ ice-sea and Marginal Ice Zone research in the Arctic.

ARCTIC is a distributed, dynamic network of autonomous platforms combining sonar, RF, active RFID, laser communication, and power technologies and microsatellite relay. It enables the real-time acoustic and non-acoustic signal processing (image, optic, water properties) and functions from the bottom floor, through the entire water column, on water surface, ground level, and into the atmosphere and beyond.

For the global coverage, a constellation of 30 – 72 microsatellites will support real-time RF communication with intended ground-level assets. The basic system consists of a minimum of 30 microsatellites, in three 530 km, circular, polar orbits whose orbital planes are separated by 120 degrees. With 10 satellites evenly spaced, in each of 3 polar orbits, it is highly likely that at least 2 satellites will be above 5 degrees elevation at any given time. With the basic 30 satellite system, the maximum slant range to any Ground Asset will be 2140 km. The LORAN-type triangulation model is used for determining and dynamic maintenance of the positioning coordinates of the entire architecture and its individual components. The architecture can associate GPS geospatial coordinates with its own organic geospatial reference system. A relay of 3 – 5 microsatellites will enable the real-time communication over any localized region. The relay of microsatellites (iteratively expandable and reconfigurable) in the calculated polar orbits will remain operational for over hundred years.

ARCTIC and most of its platforms will continuously transfer data at 200 – to – 700Kb/s and, discretely, 10GB every 10 minutes using Earth-to-Space Forward Link (Ground Asset) transmit power of 20 Watts at the RF Transmit Frequency of 9750 MHz and Space-to-Earth Return Link (Microsatellite) transmit power of 25 Watts at the RF transmit frequency of 8600 MHz.

In the short run, the proposed architecture will sustain continuous reliable communications in the region. In the long-run, the iteratively deployable dynamic network of autonomous platforms will serve multifunctional and multinational purposes of navigation safety and MIZ research.