

SYMPOSIUM ON INTEGRATED APPLICATIONS (B5)  
Integrated Applications End-to-End Solutions (2)

Author: Dr. Larry Paxton

The John Hopkins University Applied Physics Laboratory, United States, larry.paxton@jhuapl.edu

HAVOC – HIGH ALTITUDE VEHICLE OBSERVATIONS CONSTELLATION: AN INNOVATIVE  
APPROACH TO GUARDING FRONTIERS**Abstract**

We present a study of a new concept for using small satellites for Earth observation. Small satellites appear to, at least from the commercial market standpoint, to be accepted to a greater degree than ever before. However, the market has failed to develop at the pace one might expect. This is due to the inherent opportunities and limitations of a small spacecraft as an observing platform. There are many challenges associated with observations from space including coverage and persistence. We've examined a different concept; here we use satellites, high altitude balloons and long-duration, high altitude unmanned aerial systems (UAS) to drive down cost and provide a new capability for tracking shipping in the Arctic. HAVOC is a disaggregated, inhomogeneous constellation of stratospheric and space sensors utilizing communications technologies that solve complex surveillance and border protection issues. For our study, we used tracking of Arctic shipping as the *raison d'être* for the creation of a capability because it is a case that is difficult to address otherwise. The Arctic is a region that is becoming more accessible as the area of summer polar ice decreases and as the thickness of the winter ice diminishes as well. While small Earth observing satellites have an important role, their value may be augmented by adding UAS and other groundbased sensors to the solution space.