SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

Author: Dr. Chris Verhoeven
Delft University of Technology (TU Delft), The Netherlands

Dr. Bert Monna
Systematic, The Netherlands
Mr. Steven Engelen
Delft University of Technology (TU Delft), The Netherlands
Dr. Arash Noroozi
Delft University of Technology (TU Delft), The Netherlands
Mr. Prem Sundaramoorthy
Delft University of Technology (TU Delft), The Netherlands
Dr. Mark Bentum
University of Twente, The Netherlands
Prof. Robert J. Meijer
TNO and University of Amsterdam, The Netherlands

EMERGING ECO-SYSTEM: NANO-SATELLITE SWARMS AND LARGE SATELLITES

Abstract

Nano-satellites are small (less than 10 kg) and low cost satellites. Generally the resolution and accuracy of the instruments which can be flown on a nano-satellite are not comparable to those of larger satellites. With current technology a nano-satellite would therefore perform quite different tasks compared to a large satellite. However, a cluster of nano-satellites cooperating to form a spacecraft swarm, can form a large area sensor network, increasing either the coverage or time resolution. In contrast, a large high-cost satellite can accommodate a high performance payload but suffers from very limited time resolution and coverage. Therefore, an architecture which integrates the two concepts into a single eco-system will combine more of the benefits of both satellite types. This paper discusses in detail aspects of an eco-system consisting of larger satellites and a swarm of nano-satellites which cooperate in order to realize high return scientific and commercial applications. The paper also addresses potential sensor technology which can be accommodated on nano-satellite platforms.

One important feature of a swarm which is clearly not available for larger satellites is its "omni-presence". It is possible to deploy a swarm of nano-satellites that can simultaneously observe large areas of the Earth, or even provide constant global coverage. A large Earth observing satellite can identify targets in great detail, but is bound to lose track of them when continuing its orbit. Since the target could be mobile, and there aren't enough large dedicated satellites to continuously track them, it will be difficult to re-acquire the target. A swarm, however, would be able to continuously track e.g. large metal objects at sea, but it most likely won't be able to observe it at a level of detail that leads to identification. In cooperation with a larger satellite which can easily perform such identification, the combined system would simply have to remember what it is tracking and then even when the larger satellite is temporarily not available for identification the system is still able to track the target uninterruptedly. In this way a nano-satellite swarm can increase the effectiveness of a large observation satellite.

It is even imaginable that a large observation satellite takes a few nano-satellites in launch pods into space. With self-propelled nano-satellites, this would be a convenient and economical way to deploy this

"eco-system" in space. Such eco-systems in space will be a great asset to Earth observation and global security and surveillance.