

SatMagazine

A satellite in space, featuring a long boom extending from a central body to a rectangular payload. The background is a dark, starry space with a portion of a blue and white planet visible on the right.

In This Issue...

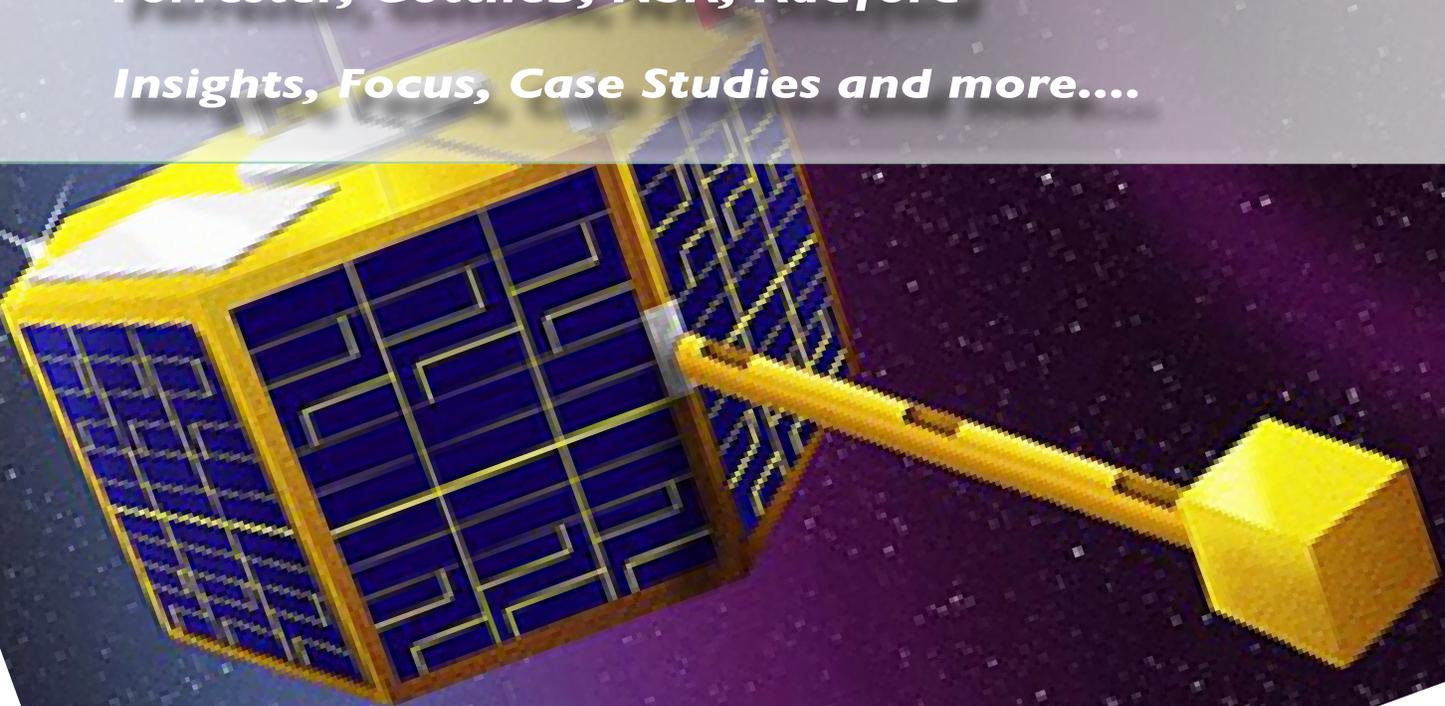
Small Satellites — Small Package, Huge Potential

Executive Interviews

***Sir Martin Sweeting, Surrey Satellite Technology Ltd.
David McCourt, Satellite Holdings, LLC***

Forrester, Gottlieb, NSR, Radford

Insights, Focus, Case Studies and more...



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SatMagazine January 2010

— BEAM — Small Satellites
 The Editors..... 4

— BEAM — The SmallSat Market
 By Phil Davies, SSTL..... 14

— NewsBEAMS —
 The Editors..... 17

InSight — European Pay Radio Begins To Motor!
 by Chris Forrester 32

Executive Spotlight
 Professor Sir Martin Sweeting, SSTL..... 37

InSight — The New Challenge At Sea
 by Alan Gottlieb, Gottlieb International..... 43

InSight — NSR
 North America, The Waning Star..... 48

InSight — Chronicles Of SATCOM
 The Performance Appraisal by Tony Radford 52

Focus — Event
 SatExpo Europe 2010 55

Case Study
 Breaking Down Barriers by Victor Barendse, Wired Ocean 56

Focus — Taurus II
 Rocketing Ahead by Baron Beneski, Orbital Sciences 59

Focus — Event — Bigger + Better Than Ever
 The 26th National Space Symposium 61

Case Study — All Aboard!
 The Kazakhstan Train Connection by SES WORLD SKIES 67

Executive Spotlight
 David McCourt, Skyware Global..... 69

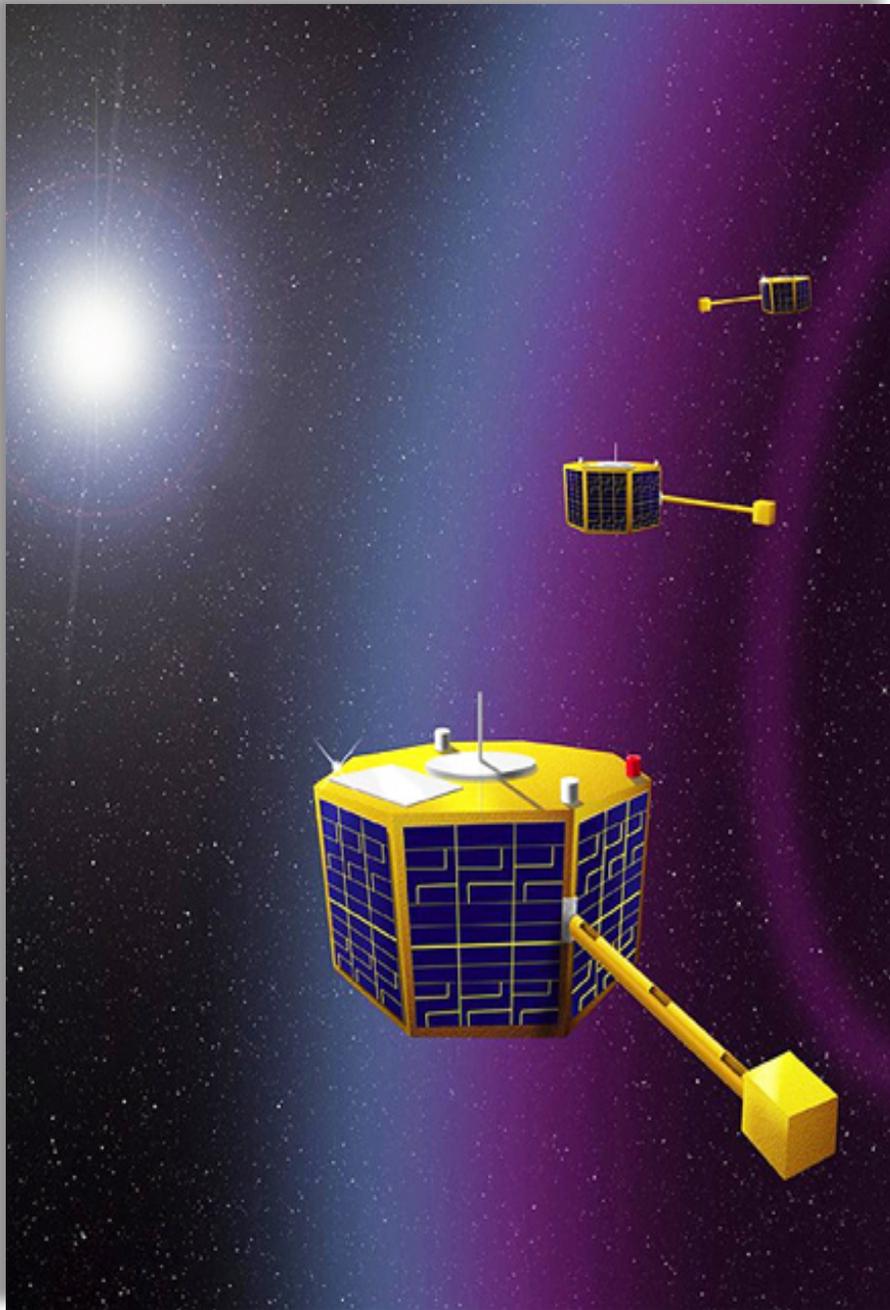
Case Study — Surviving The Deadliest Catch
 With SAILOR Onboard by Thrane & Thrane 72

Focus — Interorbital + TubeSat
 TubeSat Preps For Neptune 30 by Randa Relich Milliron..... 75

Case Study — Matching The Pace Of Aerospace
 by Tim Nichols, Siemens PLM Software..... 81

ADVERTISER INDEX

Advantech 45
 AnaCom, Inc. 7
 AVL Technologies 57
 Comtech EF Data 77
 CPI..... 79
 Futron 29
 GlobalLink 85
 Gottlieb International Group 47
 Intelsat General 3
 MITEQ / MCL 1
 NEWTEC CY 5
 NSR 49
 PacTel International 23
 Paradise Datacom 21
 SatCom 2010 Africa..... 73
 Sat Expo Europe 2010 9
 SAT-GE..... 83
 SMi (Oil & Gas SatCom)..... 19
 SSPI 53
 Thuraya 15
 Wavestream 33



Our wish to you is for a most joyous and fruitful New Year. Our industry, although far from immune to the economic doldrums affecting the global economies, has a resiliency we should all be most thankful for, and to that end, with the proper attitudes and earnest work, all should see a continuing recovery in 2010. SatNews Publishers is most thankful for your continued support and if we can do anything to assist you with your endeavors as far as content is concerned, please contact us and let us know of your interests. Thank you!

With today's extremely cost sensitive market for SATCOM and MILSATCOM, it's no wonder more focus and attention is being afforded to small satellites. Weight is the issue — heavy, multifunction satellites require launch vehicles of significant size to deliver them to their assigned orbits, and such is a most expensive proposition. Due to small satellite's lower weights and smaller size, the cost to launch them is far less as, usually, multiple small satellites can be simultaneously propelled into orbit. Additionally, the piggy back method can also apply to small satellites, allowing them to ride along in launch

vehicles as additional passengers for a large satellite payload. Another factor of significance for smaller satellites is their lower cost for their manufacture. Many times, a variety of smaller satellites can be built using mass production techniques.

There are, basically, four "types" of smaller satellite: mini, micro, nano and pico. The following four classifications are for the satellite's "wet mass," which includes the fuel for the spacecraft, from lightest to heaviest:

Commercial and military/government interests continue to fuel additional developments, with the latter especially interested in smaller satellites due to their ability to become fully operational in a far shorter period of time than larger satellites, a most important condition for warfighters.

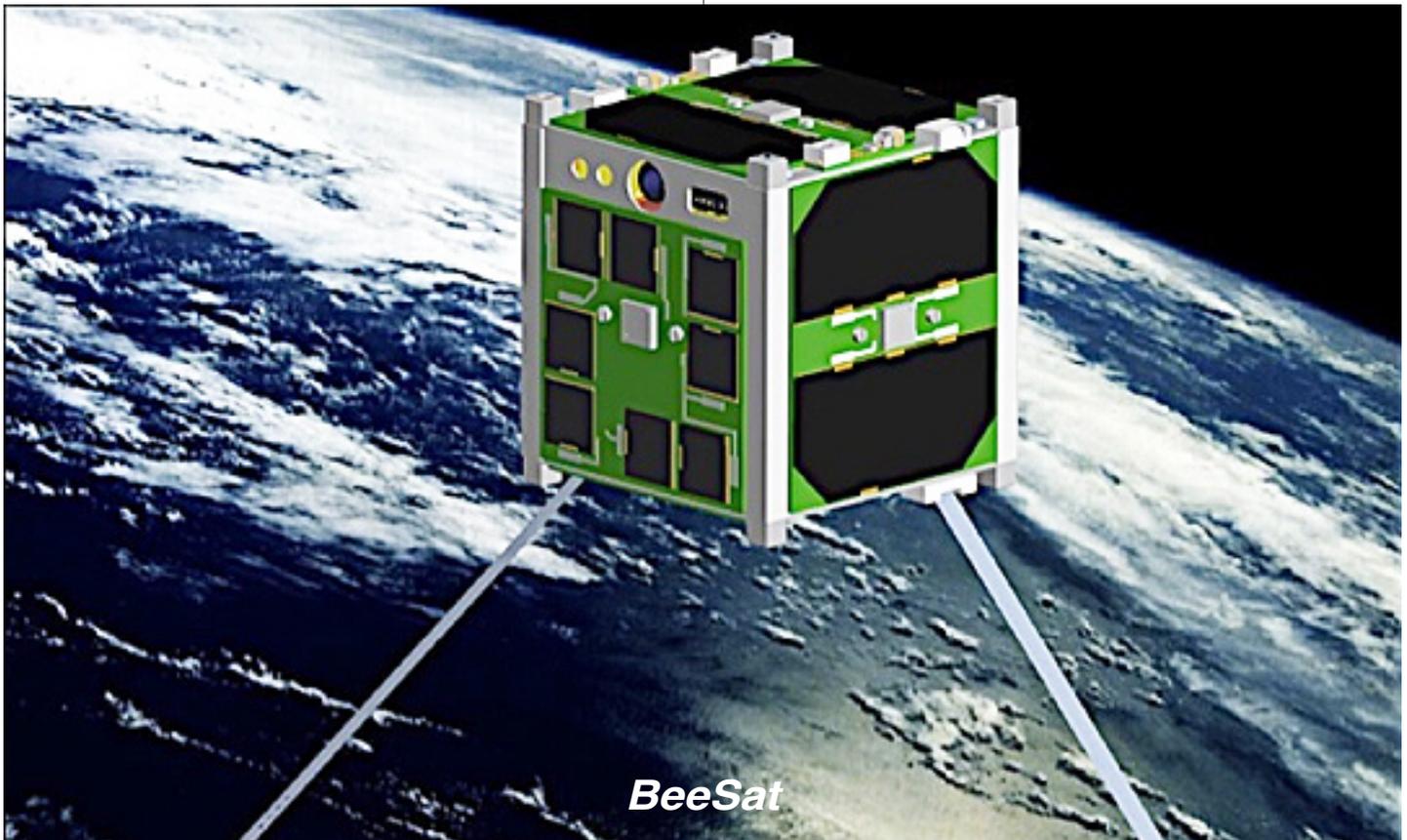
- Between 0.1 and 1 kg (0.22 to 2.2 pounds) — **picosatellite**, which includes its sub-genre, **CUBESAT**, measuring 10x10x10 cm³ and a maximum mass of 1 kg
- Between 1 and 10 kg (2.2 to 22 pounds) — **nanosatellite**
- Between 10 and 100 kg (22 to 220 pounds) — **microsatellite**
- Between 100 to 500 kg (220 to 1,100 pounds) — **minisatellite**

Small satellites also require a great deal of innovation, especially when it comes to the power driving the spacecraft for attitude control, propulsion, instrument use. Typical sources including butane, carbon dioxide (or a liquid that can be safely vaporized to deliver “push”), electric power (solar or battery), with any number of new and unique propulsion systems being currently developed by a number of companies. Commercial and military/government interests continue to fuel additional developments, with the latter especially interested in smaller satellites

due to their ability to become fully operational in a far shorter period of time than larger satellites, a most important condition for warfighters. Smaller satellites can also be replaced in far shorter time and a full constellation (or a “swarm,” when applied to nanos and picos) can be deployed with advanced technologies while maintaining cost restrictive budgets.

Additionally, smaller satellites, once on orbit, present a unifying capability and can work harmoniously together to produce objectives. Where, previously, ground control stations were needed to order the satellites into various formations, now such can be done automatically with the smaller satellite far more responsive, time-wise, to alter an objective’s needs.

Among the latest small satellite missions — **BeeSat**, a pico satellite project of the **Technical University of Berlin**. The main objective of BeeSat was to prove the viability during on orbit verification of newly developed micro reaction wheels for pico satellite applications.



BeeSat



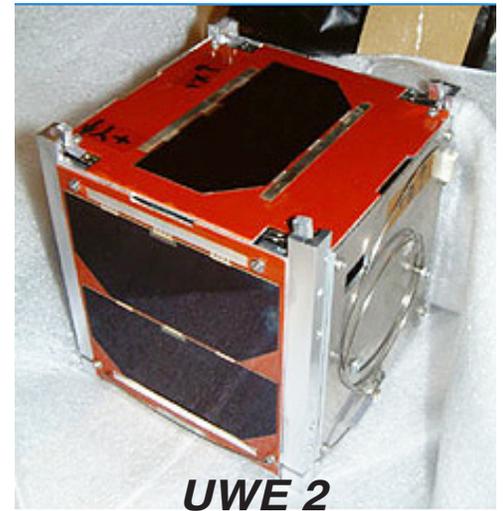
Although there are currently several developers of CUBESATs, many of them lack a precise attitude control system, which is mandatory for more sophisticated applications as pointing capabilities are

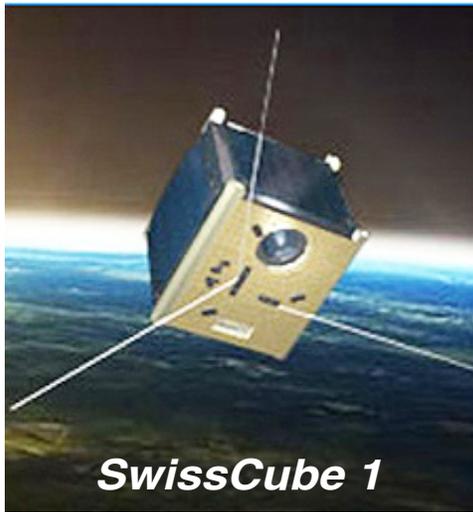
required. Having a precise attitude control system opens the gate to new potential and cost effective applications — such as Earth observation, space science, astronomy, and on orbit verification of new technologies.

The combo of highly sophisticated miniaturized technologies and the advantage of forming swarms

or clusters of pico satellites will result in completely new applications at very low cost. BeeSat will demo the use of coin-sized micro reaction wheels for attitude control of pico satellites in orbit as one of the key elements,

on which **TU Berlin** is currently working. Further missions, with a focus on other key technologies, are also planned for the future. This pico satellite, launched aboard the Indian **PSLV-CA** launch vehicle on September 23rd, 2009, was one of several other small satellites:



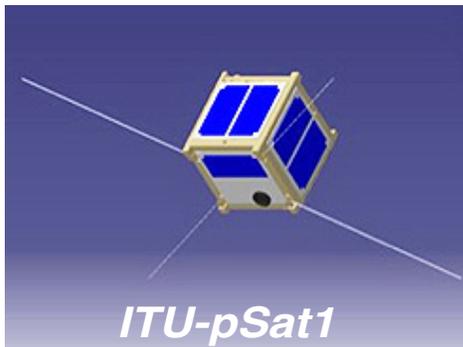


SwissCube 1

Oceansat 2
(Indian Space
Research
Organization's
(ISRO) 952 kg
for EO)

UWE 2
(University of
Würzburg to test
Internet protocols
in space, 1 kg)

SwissCube 1
(oxygen emission observations at 100 km
altitude, 1 kg, Ecole Polytechnique Fédérale
de Lausanne)



ITU-pSat1

ITU-pSat1
(Istanbul Technical
University, 1 kg,
testing of an
on-board passive
stability system
and to download
640x480 photos)

Rubin 9 (ISRO,
with 2 payloads,
used for maritime
AIS, developed by
Luxspace + OHB-
Systems, 16 kg)



Rubin 9

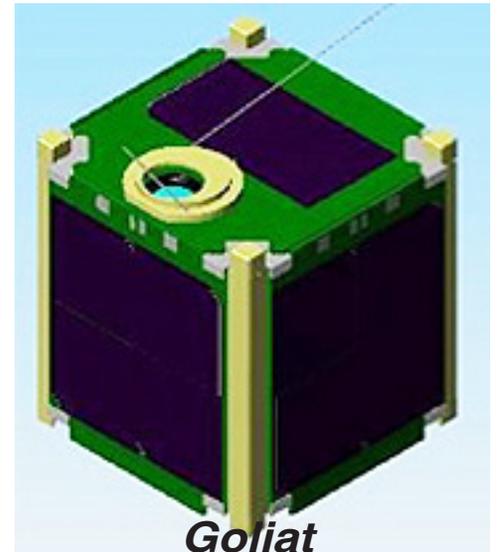
This PSLV-CA
launch aptly
demonstrated the
small satellites
capabilities for
multiple spacecraft
occupancy within a

single rocket. Upcoming in November of 2010 will
be the maiden voyage of **ESA's Vega** solid-fueled
rocket (designed to launch satellites in the 300 to
2,000 kg range) with the following passengers...

AtmoCube,
Trieste
University, to
analyze space
weather, 1 kg

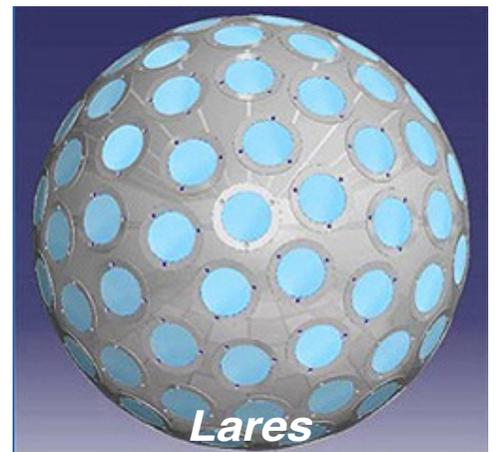
e-st@r,
cubesat
developed by
Politecnico di
Torino, Italy,
1 kg

Goliat, cubesat
developed by
the University
of Bucharest, 1 kg



Goliat

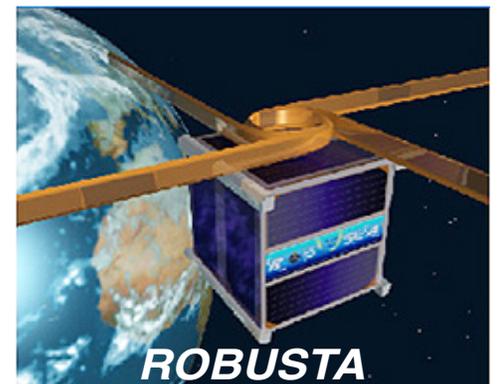
The Laser
Relativity
Satellite
(LARES)
which will
study the
gravitational
field of Earth
and engage
in general
relativity
analysis, from
Carlo Gavazzi
Space, Italy



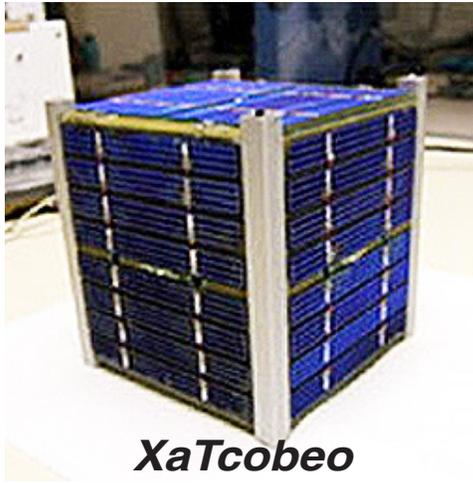
Lares

PW-Sat1, which is a cubesat that is planning on
deploying a solar sail from orbit, the first nano
from Poland,
1 kg

ROBUSTA,
designed by
the University
of Montpellier
II, which
will examine
the effects
of space
radiation
on bipolar
transistors, 1 kg



ROBUSTA



XaTcobeo

SwissCube 2, a cubesat with a ground segment for satellite monitoring and control, 1 kg

XaTcobeo, built by the University of Viga, Spain, with 2 payloads, one to measure ionizing radiation, the other for

a SRAD, with a test of a new solar panel deployment system

OUFTI-1 and UNICubeSat are also planned passengers

You'll readily note the degree of involvement in small satellite development by higher learning institutions, as the lower cost factors allow for universities to engage students and grads in spatial research without incurring enormous research and manufacturing costs.

Government organizations are entering into this arena, as is evidenced by an award just made to Orbital Sciences Corporation, that being a Phase 2 contract, from the Defense Advanced Research Projects Agency (DARPA), Arlington, Virginia. Orbital Sciences is to develop the final design for "System F6" (Future Fast, Flexible, Fractionated, Free-Flying Spacecraft). The Phase 2 award to Orbital came as a result of a down-select by DARPA from among several companies that participated in the program's Phase 1 study contracts in 2008 and 2009. The Phase 2 contract is valued at US\$74.6 million over one-year.

The objective of the System F6 program is to develop and demonstrate the basic building blocks of a radically new space architecture in which traditional large, multi-functional "monolithic" spacecraft are replaced by clusters of wireless interconnected spacecraft modules. Each of these modules performs a subset of the tasks performed by a large classical spacecraft and works

together in a cluster to provide the same overall effective mission capability. By allowing the various functions of a spacecraft to be developed and launched separately, this type of "fractionated" system provides benefits such as reduced overall risk, budgetary and planning flexibility, faster initial deployment, and ultimately greater survivability, including selective replacement of damaged or obsolete elements of a complex spacecraft.

In the next phase of the System F6 program, Orbital will be responsible for the detailed design and ground testing of the new technologies, architectures and programmatic concepts required to successfully fractionate a space system. These include wireless data communications, cluster flight operations, distributed spacecraft computing systems, rapidly relocatable ground systems, and value-centric design methodologies.

The company's program partners include IBM and NASA's Jet Propulsion Laboratory. Phase 2 will include development of the detailed design of the spacecraft modules, ground elements and launch options; a hardware-in-the-loop test-bed ground demonstration with new technology prototypes; and release of an F6 Developer's Kit, which will allow third-parties to design compatible fractionated modules, a new and radical concept in spacecraft systems. All software source code, interfaces, standards and operating systems will be available to everyone, including the public. This will allow any interested third parties to develop modules compatible with the existing spacecraft network. These modules can launch and connect to the already deployed cluster, allowing them to leverage resources available in the network. The eventual goal is to provide an open source compatibility platform where any new satellite launched into space can access and reap the benefits of a worldwide interconnected system, similar in fashion as to how the Internet functions here on Earth.



For additional proof as to the interest in small satellites, let's take a look at **NASA**. The agency has just partnered with **Dynetics** and the **Von Braun Center for Science and Innovation**, or **VCSI**, and has successfully completed environmental testing of the **Fast, Affordable Science and Technology Satellite**, or **FASTSAT- HSV01**.

A NASA team built this small, low-cost satellite called FASTSAT, and it's almost ready to fly. But, why name it FASTSAT?

It's certainly *not* because it travels fast. It's because it was built in a hurry. The FASTSAT team built this prototype in a mere 10-1/2 months for the relatively thrifty sum of US\$4 million dollars.

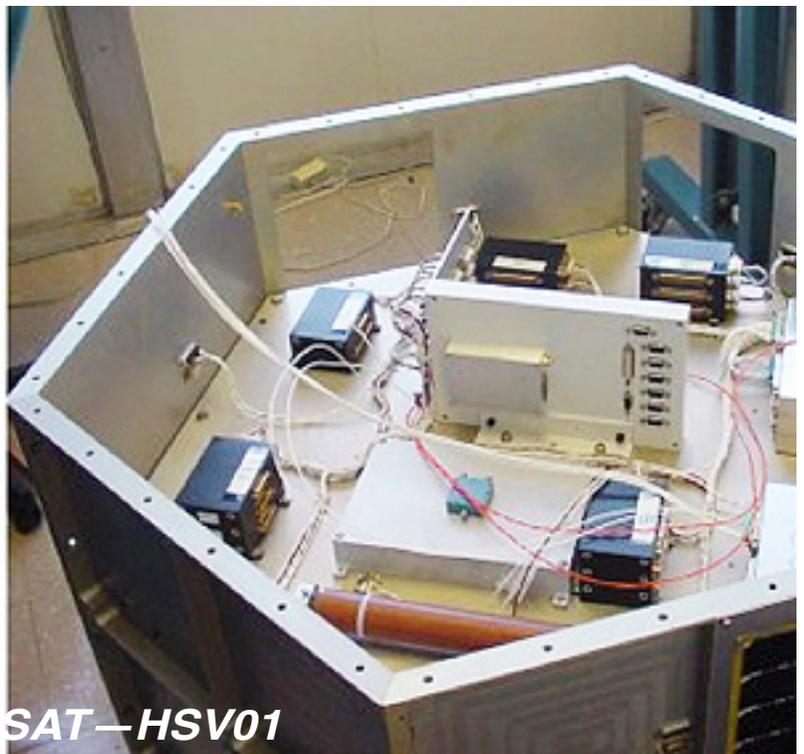
“That’s unheard of,” says Marshall Space Flight Center’s *Edward “Sandy” Montgomery*, “to build something that will fly in space in that short time frame and for that amount of money. But that was part of our experiment — to see if it could be done.” The full name says it all: **Fast, Affordable, Science and Technology SATellite**. FASTSAT- HSV01 is a unique platform that can carry multiple small instruments or experiments to low-Earth

orbit on a wide range of expendable launch vehicles for a fraction of the cost traditionally required for such missions. The satellite or “bus” will carry six small payloads, including three technology demonstration experiments and three atmospheric research instruments.

FASTSAT is 39.5 inches in diameter – not much larger than the dreaded exercise ball. It is hexagonally shaped and weighs 90 kg without a payload. A payload up to 50 kg can hitch a ride. These dimensions place FASTSAT squarely in the microsatellite category.

Recently completed has been the environmental tests that will ensure — before actual flight — the satellite can withstand the rigors of liftoff and the extreme thermal conditions of space. Over the past month, engineers at the **Marshall Center** subjected the spacecraft to the vibration levels resident with a launch, electromagnetic emissions, and thermal vacuum conditions of space.

To be included is **Nanosail D**, a technology experiment that will demo deployment of a compact solar sail boom system from FASTSAT.



FASTSAT—HSV01

Nanosail D was built, and is managed by, the Marshall Center with support from NASA's **Ames Research Center** in Moffett Field, California. The other two technology experiments include the **Threat Detection System** and the **Miniature Star Tracker**, both managed by the **Air Force Research Lab** at Kirtland Air Force Base, New Mexico.

FASTSAT will be flying a total of six instruments, three of which were developed by Goddard scientists. The **Defense Department's** *Science and Experiments Review Board* approved all six.

"It is ironic," said *Michael Collier*, principal investigator on **MINI-ME**, one of the three Goddard-provided instruments. "Usually you use suborbital platforms to prepare instruments for satellites. But we're proving our concepts on a satellite."

The Instruments

The three Goddard-developed instruments each weigh about 3 kg (6.6 lbs.) and are designed to study different processes in Earth's upper atmosphere and the effects of solar activity in this region — an important scientific line of inquiry given the fact that intense solar activity can disrupt communications and navigation satellites and exert an aerodynamic drag on low-Earth-orbiting satellites and other space assets.

"This is an area of intense interest to both NASA and the Defense Department," said *Doug Rowland*, principal investigator on the **PISA** instrument. "Both are seeking a greater scientific understanding of Earth's atmosphere and knowledge on how it affects technological systems like GPS and cell phone networks."

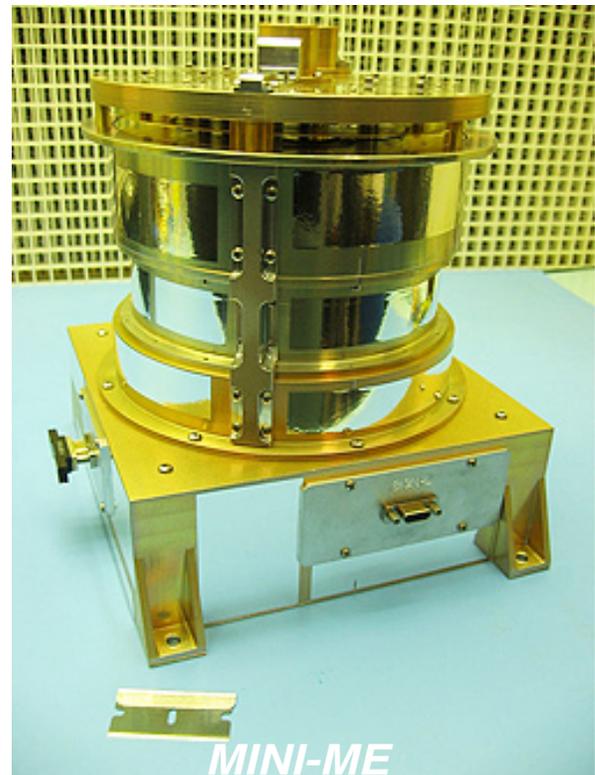
The microsatellite itself is about the size of an exercise ball and was developed to carry Earth-observing and space science missions. And due to its relatively low-cost — at around \$10 million, as compared with hundreds of millions for a traditional satellite — the spacecraft is ideal for carrying technology-demonstration payloads.

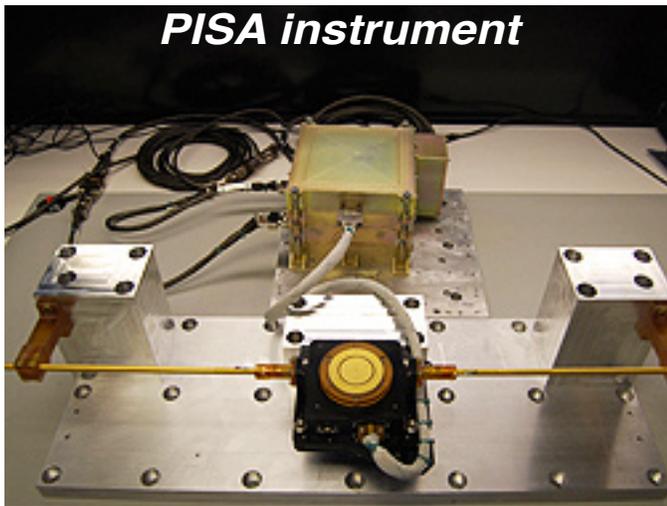
Fortuitous Opportunity

The scientists called hitching a ride on the micro-satellite most fortuitous. When they began work on their IRAD-funded instruments three years ago, they thought they would be flying on **MidSTAR-2**, a follow-on to the successful experimental satellite system developed by students at the **U.S. Naval Academy**. The Academy did not receive funding to build MidSTAR-2, forcing the trio to seek a different platform on which to integrate their instruments.

"The unique confluence of the development of the Goddard instruments, the FASTSAT spacecraft, and the availability of a Defense Department launch opportunity in exchange for experiment results allowed this mission to proceed and become a reality," said *John Sigwarth*, the principal investigator on the **Thermospheric Temperature Imager**.

"Most space physicists don't get this type of opportunity in a career," *Collier* added. "This is a real feel-good success story. We could not have done this without the generosity of a lot of people," he said. "This is the way the IRAD program is supposed to work."





Goddard's FASTSAT Instruments

MINI-ME

(Miniature Imager for Neutral Ionospheric Atoms and Magnetospheric Electrons) — Principal Investigator *Michael Collier*

MINI-ME, which weighs less than 3 kg. and is the smallest of the three Goddard-provided FASTSAT payloads, will look for neutral atoms flowing up from Earth's ionosphere and into the magnetosphere, the magnetic field that surrounds the planet and protects it from the harmful effects of solar wind. In addition to flying on FASTSAT, MINI-ME will fly on a sounding rocket in January 2012 under a US\$1.6 million NASA award. Again, it will measure the ion population in Earth's upper atmosphere. "FASTSAT and the sounding rocket flight are a great start for this instrument concept," *Collier* said.

PISA (Plasma Impedance Spectrum Analyzer) — Principal Investigator *Doug Rowland*

PISA will accurately measure electron density and temperature in Earth's upper atmosphere — data needed to understand the ways that solar wind produce complex structures and turbulence at high altitudes. These structures can scatter radio waves, disrupting communications with low-Earth-orbiting navigation and scientific satellites. The instrument will study what causes the disruptions and whether scientists can predict and monitor them. PISA is a proof-of-concept of a miniaturized instrument that the principal investigator hopes to shrink further

to fit inside an even smaller micro-satellite that is expected to fly in 2012.

TTI (Thermospheric Temperature Imager) — Principal Investigator *John Sigwarth*

This revolutionary imager will measure in near real-time the global temperature of Earth's thermosphere, which can heat up and expand during solar storms. Having an instrument that can provide these measurements is crucial for protecting low-altitude satellites. Skylab, for example, plunged to the Earth earlier than expected after a storm-heated atmosphere expanded and exerted an aerodynamic drag on the low-flying laboratory.

Thanks to a new class of very low cost launch vehicles (such as **SpaceX's *Falcon 1*** and **Kistler's *K-1***), doors have now been opened for inexpensive satellites and instruments.

"You wouldn't put an expensive payload on an inexpensive rocket — it's a risk issue. You'd use an inexpensive bus to fly an inexpensive instrument on an inexpensive rocket," says *Edward Montgomery*.

FASTSAT could be used for test demonstrations of new technologies. "It doesn't make sense to spend several hundred million dollars just to test a technology before a major mission when a FASTSAT can do it for so much less," states *Montgomery*. "That's the impetus driving this project."

Small satellites — they continue to prove that innovation, combined with manufacturing expediency and cost effectiveness, will continue to grow their use within our industry as viable additions to an already powerful array of products.

Editors note

*Our thanks to the following writers and editors who authored the NASA content: **Dauna Coulter, Rob Gutro, Kim Newton, Judy Campbell, First Lt. Robert J. Wilcox and Dr. Tony Phillips.***

THE SMALLSAT MARKET

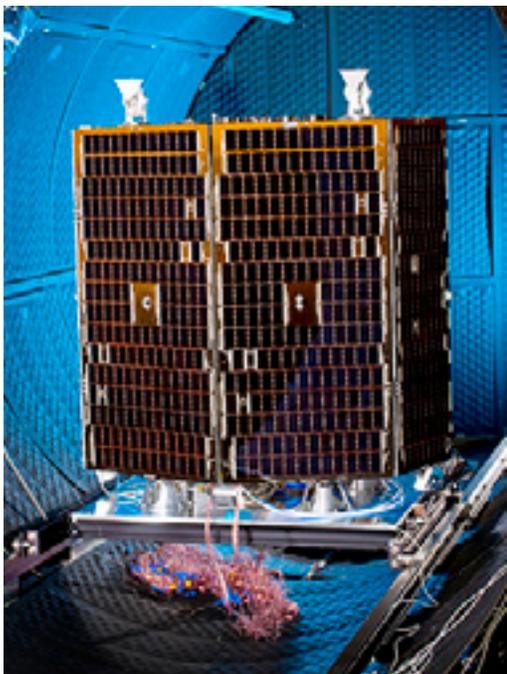
by Phil Davies, Surrey Satellite Technology Limited

Despite the perception that space is a growing market the actual number of satellites launched each year has been falling over the last 20 years from around 140 per year in the early 1990's to around 100 per year in recent years. Whilst the total number of satellites has been falling it's interesting to note that the number of small satellites — defined as less than 500kg — has remained fairly constant at about 30 per year.

It is my belief that the major hurdle to growth in the small satellite market is the availability of cost-effective launch. The converted ICBMs of the former Soviet states have certainly helped the manufacturers located in countries where national policy allows their use. However, there are major users of Space, such as the USA, where the manufacturers find it difficult or impossible to use these launchers and this, in turn, has held back the development of the small satellite market.

There are now several initiatives underway to address the launch problem. The initiatives can broadly be split into two types. Firstly, new launch vehicles are being developed: good examples being the **SpaceX Falcon** and the **Virgin LauncherOne**. What distinguishes these vehicles from most of those developed in the past is the fact that they are being developed by commercial organizations with an entrepreneurial culture and devoid of the politics and subsequent inefficiencies that plague government-inspired programmes.

The second type of initiative can broadly be described as “ride-share,” whereby launch for very small satellites, commonly described as Cubesats, will be provided by some of the governments with large launch vehicles. For example, the U.S. **Atlas-5** and the European **Vega** will be able to offer very low cost launch, typically to educational Cubesat developers.



NigeriaSat being tested

For small satellites, what we expect to see in the coming decade is, therefore, a split in the market into ‘minisatellites’ aimed at operational missions for governments and commercial operators on the one hand, and much smaller ‘micro/nanosatellites’ aimed at educational missions on the other.

As the market leader for development of new small satellite missions, it is illustrative to look at SSTL's product development over the last decade and into the near future as barometer on what's happening in a general sense. For many years, SSTL's core products have been optical imaging satellites. At the start of this decade, SSTL started developing the *disaster monitoring constellation* (DMC) satellites, which were 90 kg satellites with wide swath multispectral imagers with 32 metre ground sample distance. At the time of their launch, in 2002/2003, these satellites were the



Phil Davies, SSTL

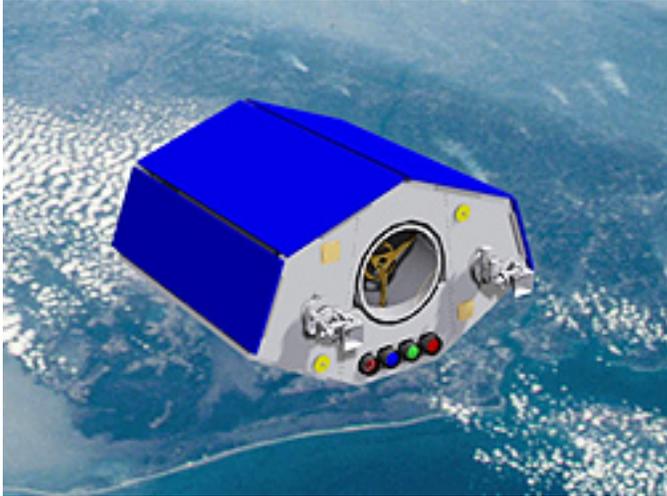


most sophisticated SSTL had built. Over the course of this decade, the capability of SSTL's satellites has improved at such a dramatic rate that all of SSTL's current offerings are of higher performance than the first generation **DMC**.

The principal reason that the performance of small satellites is improving at such a phenomenally fast rate is their use of terrestrial electronics. Terrestrial electronics tend to double their performance at unit cost every two years — a phenomenon known as “Moore's Law” following *Gordon Moore's* observations made in the 1960's that “the number of transistors on a chip doubles about every two years.” Through use of such electronics, small satellite performance is improving at a rate approximating to that of Moore's Law.

The improvements are dramatic — since the start of this decade, we have experienced an order of magnitude improvement in computing power, data storage, and data downlink speeds on small satellites and we now have small Earth observation satellites with bus performance surpassing the largest satellites of the last decade, such as the 8-ton **Envisat**, in many key parameters. When SSTL analysed the improvements in resolution of its own optical imaging satellites, it discovered that between 1990 and 2009, the resolution achievable on our satellites almost

exactly tracked Moore's law. In terms of the key parameter for such missions — the ground sample distance (commonly referred to as the “resolution”) has dropped from 32 meters at the start of the decade to 2.5 meters for **TopSat** launched in 2005 and **NigeriaSat-2** to be launched next year. Ongoing technology development at SSTL now enables the company to offer “Sub-1-metre” small satellites to the market for launch in the 2012+ timeframe.

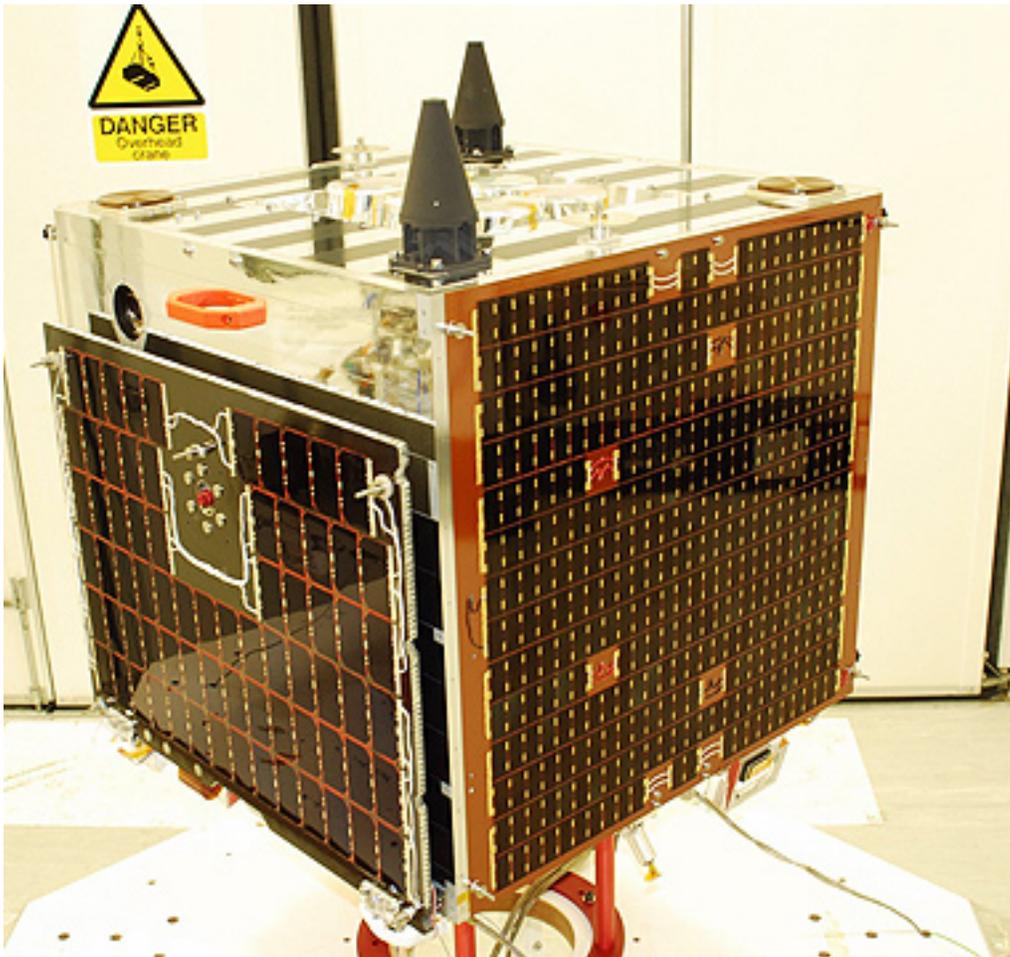


Artistic rendition of NigeriaSat-2 in orbit

Thus, small satellites have become a classic case of the “disruptive technology” referred to by Clayton Christensen in his 1990’s works “**Disruptive Technologies: Catching the Wave**” and “**The**

Innovator’s Dilemma.” The technology being disrupted is the large and exquisite imaging satellite with a price tag measured in \$ billions rather than \$ millions. While such systems produce superb imagery, they are generally unaffordable to all but the richest countries and, even then, are generally too expensive to deploy in multiple numbers limiting the ability of the owners to gather timely imagery.

A constellation of small satellites, at, or below, the price of one large and exquisite satellite, could provide much more imagery in total and much more timely imagery with latency measured in hours rather than days. Such a system would also be inherently fault resilient through redundancy at constellation level and would also allow much simpler service continuity by occasional replacement of one satellite in the constellation rather than the “big bang” approach of replacing a large and expensive satellite with a rebuild every few years.



UK-DMC2

What this implies in terms of launch mass is that operational customers are generally demanding new missions with high capability which translates into masses in the range 100kg to 500kg. For non-operational missions with education or technology demonstration aims the masses are typically sub-50kg. For the operational customers, the market for such satellites would surely expand very rapidly once there is a reliable, low cost and readily available launcher addressing this market. Fingers crossed — **SpaceX** and **Virgin Galactic** achieve that goal in the coming years.

ISRO Earns Respect + Revenue...

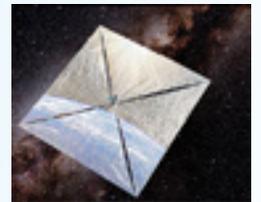
ISRO (Indian Space Research Organization) earned more than Rs 100 crore in the last three years by launching satellites of other countries, Minister of State in PMO *Prithviraj Chavan* told the *Lok Sabha*. The space agency launched 12 foreign satellites during the last three years, including **six nano** satellites at a cost of Rs 101.60 crore, he said. In reply to a separate query, Chavan said ISRO also plans to launch a naval satellite in 2010-11, which would provide a communication facility to various naval vessels. He said the ISRO plans to send human beings in space and undertake planetary exploration within the next decade.



The space program also envisioned enhancing capabilities in the areas of satellite communications, navigation, Earth observation, and human space flight, in addition to pursuing research in space science, astronomy and planetary exploration, he said. ISRO's *Geosynchronous Satellite Launch Vehicle (GSLV)* is capable of putting into orbit a 500 kg payload to undertake a mission to Mars.

The Planetary Society Believes In LightSailing...

The Planetary Society has announced **LightSail**, a plan to sail a spacecraft on sunlight alone by the end of 2010. The new solar sail project, boosted by a US\$1 million anonymous donation, was unveiled on the 75th anniversary of the birth of Planetary Society co-founder *Carl Sagan*, a long-time advocate of solar sailing.



LightSail is an innovative program that will launch three separate spacecraft over the course of several years, beginning with **LightSail-1**, which will demo that sunlight alone can propel a spacecraft in Earth orbit. **LightSails-2** and **3**, more ambitious still, will reach farther into space. Taking advantage of the technological advances in micro- and nano-spacecraft over the past five years, The Planetary Society will build LightSail-1 with three Cubesat spacecraft. One Cubesat will form the central electronics and control module, and two additional Cubesats will house the solar sail module. Cameras, additional sensors, and a control system will be added to the basic Cubesat electronics bus.

LightSail-1 will have four triangular sails, arranged in a diamond shape resembling a giant kite. Constructed of 32 square meters of mylar, LightSail-1 will be placed in an orbit over 800 kilometers above Earth, high enough to escape the drag of Earth's uppermost atmosphere. At that altitude the spacecraft will be subject only to the force of gravity keeping it in orbit and the pressure of sunlight on its sails increasing the orbital energy.

LightSail-2 will demonstrate a longer duration flight to higher Earth orbits. LightSail-3 will go to the Sun-Earth Libration Point, L1, where solar sails could be permanently placed as solar weather stations, monitoring the geomagnetic storms from the Sun that potentially endanger electrical grids and satellite systems around Earth. *James Cantrell*, CEO of **Strategic Space Inc**, is Project Manager of LightSail-1. **Stellar Exploration** will build the spacecraft in San Luis Obispo, California. Other team participants include the Cubesat development group at **California Polytechnic University**, San Luis Obispo, and a team at Russia's **Space Research Institute**.

NTS NanoSat Monitors Illegal Fishing For Canadian Forces

exactEarth Ltd., a subsidiary of **COM DEV International Ltd.**, has successfully used its space-based **AIS** (*Automatic Identification System*) technology, **exactAIS**, to assist the **Canadian Forces** (CF) and **Department of Fisheries and Oceans** (DFO) in monitoring *illegal unregulated unreported* fishing (**IUU**) activity in the Pacific Ocean. For several weeks, the Company has tasked its **NTS** nanosatellite to monitor a targeted region of the northern Pacific Ocean for the AIS signals that are required to be transmitted by several classes of ocean-going vessels.

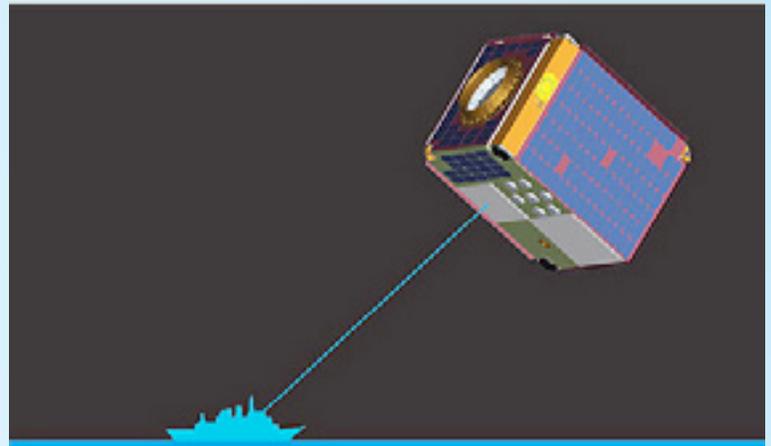
The exactEarth data has been combined with other surveillance information to enable the Canadian Forces and DFO to focus their surveillance and monitoring efforts on specific vessels suspected of IUU fishing.

“We are pleased our technology has been able to contribute to international efforts to ensure sustainable fishing practices,” said *Peter Mabson*, President of exactEarth. “This project illustrates just one of the many applications made possible by the exactAIS capability to detect ships from space rapidly over a wide area.”

IUU fishing, in particular high seas driftnet fishing, has a devastating effect on marine life as nets up to 40-kilometres long catch everything in their path, resulting in depletion of valuable fish stocks. The United Nations has maintained a moratorium on driftnet fishing since 1992, but the problem persists, with many non-compliant fishing vessels actively concealing their violations. Canada through DFO is one of many countries cooperating in an international enforcement effort. The Department of National Defence engaged

exactEarth to supply AIS data to assist in the monitoring and enforcement of IUU practices. The AIS data from NTS was provided on a daily basis over the entire region of the IUU study — a region which spanned more than six million square kilometres in the northern Pacific Ocean. As a result, the CF and DFO were able to target their monitoring efforts, which include aerial surveillance by Aurora maritime patrol aircraft, in a more efficient and cost-effective manner over this wide expanse.

The NTS nanosatellite was launched in April, 2008, to validate COM DEV’s space-based AIS technology. Having successfully completed its original mission, the 8-kilogram spacecraft continues to orbit the Earth every 90 minutes and remains fully functional. IUU monitoring represents the first time exactEarth’s AIS solution, exactAIS, has been deployed for operational, rather than demonstration purposes.



Shrinking Swedish Satellites In Space!

ÅAC Microtec in Sweden tests miniaturized satellite systems in space, and for the second time in 2009, they will fly their revolutionary microsystem-based components in space. On Wednesday, September 23rd, an Indian PSLV launcher brought AAC's miniaturized computers, control systems, and mass memories to test in their real working environment. ÅAC Microtec is the first company in the world to demonstrate a 3D-wafer level packaged (**3D-WLP**) microelectronic and **MEMS** equipped nanosatellite in space. ÅAC Microtec has, together with **RUAG Space** (ex. **Saab Space**), developed an advanced nanosatellite architecture based on a plug-and-play concept for rapid response and scientific satellites on behalf of the German company group, **OHB Systems** in Bremen.

The satellite architecture is called **INOVATOR** ("IN-Orbit Verification of ÅAC Technologies on Rubin") and consists of miniaturized subsystems for data handling, communication, attitude control and mass memories. INOVATOR is an advanced experiment for future small, powerful satellites that can be offered for launch from jet airplanes and by small launchers. The attitude control modules use ÅAC's *thru-silicon-via* (**TSV**) technology **XiVIA**®.

"This is the first time that a nano-satellite system entirely built in a 3D-packaging technology is demonstrated in space. Through INOVATOR, we demonstrate the basis for the small satellites of the future: the total mass of our subsystems is



only 120 grams! This is a revolution which makes it possible in the future to fly very advanced instruments on small satellites since the control electronics becomes so small,” says *Robert Thorslund*, Project Manager at ÅAC Microtec.

ÅAC has, with RUAG Space, built a mass memory that reuses electrical design elements from the **ESA**-satellites *Herschel* and *Planck*, aiming at demonstrating that the ÅAC technology can be used for realizing existing designs.

“RUAG Space has contributed with their long experience of designing space electronics and specifically mass storage memories. It has been of particular interest to see if ÅAC’s technology could be useful in hybrid solutions where parts of existing designs are miniaturized. We have successfully integrated and tested ÅAC’s technology in our labs in Göteborg. It will be exciting to see how the systems will perform in space,” says *Lars Nordfeldt*, Director of Communications at RUAG Space.

The launch of *RubinSat 9.2* was performed as a piggyback service with the research satellite *Ocean-Sat 2*, launched from India on September 23rd. The launcher was a **Polar Launch Service Vehicle (PLSV-C14)**. The INOVATOR-experiment has been financed by the **Swedish National Space Board** and was developed under a three-year schedule. PSLV-C14 also carried the 960 kg indigenous *Oceansat 2* and six other nano satellites, including four Cubesats and two Rubinsats. Oceansat 2 is the 16th Indian remote sensing satellite and is a cuboid with two solar panels projecting from the sides.

ISRO To Receive Nano From Students For Eco Work

In India, **IT Kanpur** has developed a nano-satellite that is expected to provide real-time data on drought, flood, vegetation and forestation.



The satellite, designed and developed by a group of students of the institute, will be handed over to ISRO, which is expected to launch it by the end of the year. “This satellite will have specific function of sending imagery on ground conditions. We will set up a tracking station in our institute where we will get the real-time data on drought, flood, vegetation and forestation,” IIT Kanpur Director Prof. S. G. *Dhande* said. The nanosatellite, which will be named ‘*Jugnu*’ (in English, **Firefly**), will have a mass of less than 10 kg. It will piggyback on larger launches, avoiding the need for a dedicated launch.

Pactel Int'l Mobile Network Launch In Funafuti



Pactel International has launched a new 2.5G Mobile Network in *Funafuti*. To date, this network already has more than 600 subscribers. The existing network was damaged by a storm in 2007, leaving the Island's customers without mobile phone

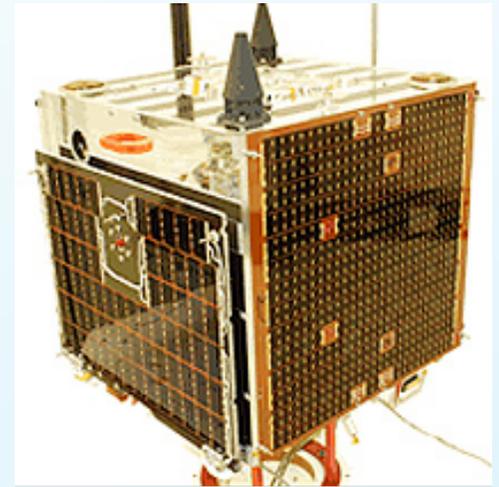
coverage. Pactel International was appointed by Tuvalu Telecom Corporation to install a replacement mobile phone network to operate on the island. This has allowed the Company's customers to access normal mobile services at very competitive rates.

Simeti Lopati, CEO of **Tuvalu Telecom Corporation** expressed his pleasure in Pactel's solution and its tailored ability to serve the needs of the people of Funafuti: "Tuvalu Telecom is grateful to Pactel International for the assistance it provided in restoring our mobile phone service. Despite a number of geographical and environmental challenges, Pactel International managed to design and install a GSM network solution, optimal to our needs. This solution has noticeably improved Tuvalu Telecom's services and financial situations. I believe that this is a beginning of a long and mutually beneficial partnership with Pactel International, which will prosper into the future."

SSTL Launches Satellites x 2 For Disaster Determination

More is better as **SSTL** expands the capability of the only spaced-based disaster monitoring system, the **Disaster Monitoring Constellation (DMC)**, with the successful launch of the **UK-DMC2** and

Deimos-1 satellites. The British built satellites were launched onboard a **Dnepr** rocket from the Baikonur Cosmodrome in Kazakhstan at 18:45 UTC on Wednesday, July 29, 2009. Following confirmation of separation from the launch vehicle, ground stations in Guildford and Spain established contact with UK-DMC2 and Deimos-1, respectively, and both satellites are now commissioned.



Both satellites will bring significant enhancements to the DMC, which provides Earth observation imagery for a range of commercial and environmental applications as well as to the International Charter: Space and Major Disasters. The first satellite in the DMC, **AISAT-1**, was launched in 2002 and with the addition of these further two satellites, the total number of operational DMC “eyes in the sky” has been increased to six.

UK-DMC2 and Deimos-1 were designed and built by SSTL at the Company’s state-of-the-art facilities in Guildford U.K. Deimos-1 was manufactured for Spanish customer, **Deimos Space**, while UK-DMC2 is owned by SSTL and will be operated by the Company’s subsidiary, **DMCii**. The latest spacecraft continue SSTL’s rapid advances in innovative space solutions with each satellite having ten times the capability of the satellites launched just five years ago.

SSTL’s Chairman, *Sir Martin Sweeting*, commented, “These latest two satellites will advance the capability of the DMC, an international constellation conceived and established by SSTL to provide affordable Earth observation space assets to all, and continue to demonstrate the commercial value of space as evidenced by SSTL’s investment in UK-DMC2. The launch is also timely as the U.K. Government has just launched the Space Innovation & Growth Team (IGT) tasked with creating a 20-year strategy for the space industry that will build Britain’s leadership in space. SSTL welcomes the initiative and is represented on the team.”

UK-DMC2 and Deimos-1 were launched alongside four other satellites onboard the Dnepr launch vehicle: **DubaiSat-1**, **AprizeSat-3**, **AprizeSat-4** and **Nanosat-1B**.



SES – Purchase Of Protostar 2

SES S.A. has announced the Company’s **SES Satellite Leasing** business unit in the Isle of Man was selected as the successful bidder in a public auction for the **Protostar 2** satellite with a US \$185 million, all cash offer. Upon conclusion of the transaction, Protostar 2 will be integrated into the global satellite fleet of **SES WORLD SKIES** to provide incremental capacity over Asia. Protostar 2, built by Boeing, carries 22 physical Ku- transponders as well as 10 S-band transponders. The satellite was launched in May this year onboard a Proton rocket and is expected to provide at least 15-years of operational service.



Pactel International focus on satellite telecommunications and broadcast services in the Asia-Pacific Region.

Our services include:

- Internet Backbone connectivity
- VSAT data solutions
- VOIP Gateways
- Broadcast and Streaming Video solutions
- International Private Leased Line
- Equipment Hosting and Satellite Ground System
- Network Design

We pride ourselves on understanding our customers' unique connectivity requirements and providing solutions best suited to each individual need.

Our robust, flexible and cost effective satellite communication solutions are suitable for:

- Carriers
- ISPs
- Government
- Mining, Oil & Gas
- Maritime
- Corporate Entities

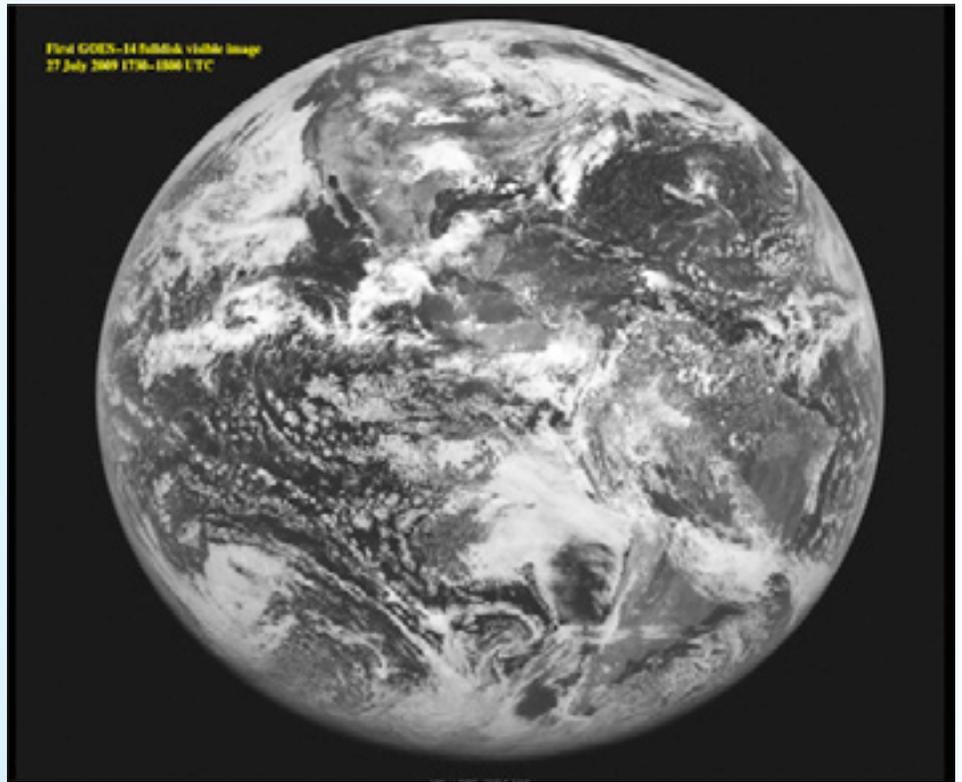
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Boeing – GOES-14 Enters Full Service

Boeing announced **GOES-14** (formerly **GOES-O**), the second satellite in a series of **Geostationary Operational Environmental Satellites** built by Boeing for **NASA** and the **National Oceanic and Atmospheric Administration (NOAA)**, has completed on-orbit testing and been accepted into service. NOAA will use GOES-14 to accurately predict storms and monitor weather conditions across approximately 60 percent of the planet, including the United States. Boeing and NASA conducted approximately five months of on-orbit testing on GOES-14 from the **NOAA Satellite Operations Control Center** in Suitland, Maryland, after the satellite's June 27 launch from Cape Canaveral Air Force Station, Florida. GOES-14 successfully completed a series of postlaunch milestones, including launch and orbit-raising data reviews, a contingency operations readiness review, and testing and verification of the instruments and communications services. GOES-14 now joins **GOES-13**



First full disk image from GOES-14

(formerly **GOES-N**) as a backup satellite for the two-satellite

GOES constellation. The two spacecraft are ready to become NOAA's primary operational satellites. NOAA's current plans call for GOES-13 to become the operational east satellite during spring 2010 and begin providing critical data for the next hurricane season.

On December 16, Boeing shipped the third satellite, **GOES-P**, from the company's satellite integration and test complex in El Segundo to Cape Canaveral, where it will undergo final preparations for launch early next year. GOES-P will be launched aboard a **Delta IV** rocket procured from **United Launch Alliance** through Boeing's commercial launch business, **Boeing Launch Services**. The launch is planned for February 25 from Cape Canaveral's **Space Launch Complex 37**.

Intelsat – Etisalat Signs On With IS-15

Intelsat, S.A. has announced **Etisalat UAE** has signed a multi-year capacity contract on Intelsat's recently launched **Intelsat 15** satellite (**IS-15**), located at 85 **degrees East**. Etisalat will use this capacity to expand its network platform beyond the United Arab Emirates and provide higher-bandwidth broadband services to its enterprise customers throughout the Gulf region.

IS-15 is expected to enter service during 2010. Once on station, IS-15 will replace the *Intelsat 709* satellite. IS-15's Ku-band payload will serve the Middle East, Russia, and the Indian Ocean region to distribute high growth applications that include cellular backhaul for wireless communications to remote locations; broadband networks for enterprise applications; IP Trunking for robust Internet connectivity; and video services for DTH programming.



DigitalGlobe – WorldView-2 Is Engaged

DigitalGlobe's (NYSE: DGI) latest high-resolution satellite, *WorldView-2*, has achieved full operational capability on January 4, 2010. Successfully launched on October 8, 2009, *WorldView-2* produced the first set of images within 11 days of the launch.

The satellite completed its commissioning process, enabling DigitalGlobe to start taking orders for *WorldView-2* imagery from its global resellers, partners, and customers. *WorldView-2* joins DigitalGlobe's existing sub-meter satellites on orbit, *QuickBird* and *WorldView-1*, to enable an annual imaging capacity equivalent to three times the earth's land mass. *WorldView-2* collects multispectral imagery at 1.8 meter resolution and panchromatic imagery at 0.46 meters.



NASA – A Moving Experience To AMC 3

Effective January 16, 2010, **NASA Television's** Public, Education and Media channels will be available for downlink on **Americom's AMC 3** satellite. Additionally, NASA TV has reformatted its online program schedule to improve its readability. Satellite and cable service providers, broadcasters, and educational and scientific institutions will need to re-tune their receiving devices to Americom's AMC 3 to continue accessing NASA TV for distribution. News networks, their reporters and other broadcast media organizations must tune their satellite receivers to the Media Channel to ensure reception of clean feeds for all mission coverage, news conferences, and other agency distributed news and information. News and other media organizations will no longer be able to rely on content from the Public Channel for clean feeds of mission and other agency activities. NASA TV's occasional HD feed and *Live Interactive Media Outlet (LIMO)* Channel also will migrate to AMC 3. For complete downlink information, [select this direct link](#).

SSPI – Significant Survey

The *Society of Satellite Professionals International (SSPI)* has released the results of its first member survey. The report, "The Satellite Industry Workforce 2009," reveals some surprising and a few not so surprising results based on responses from SSPI members around the world.

Key findings of the report, include:

- The satellite industry is not a “graying” business. The age distribution of satellite professionals is remarkably even, with 43 percent of respondents between the ages of 18 and 39 and 80 percent of respondents under the age of 54.
- The industry pays satellite industry employers to invest in training and development. Nearly 65 percent of employees who have 6-15 years in the industry have worked for their current employer 6-15 years.
- The industry suffers from striking gender disparity that is unlikely to improve soon. Approximately 80 percent of industry employees are male, and the proportions hold up across all ages, though not across all job functions.
- People who work in the industry are proud to recognize it as a distinct sector of the global telecom industry. A large majority, when asked what they do for a living, say “I work in the satellite industry.”

“There have been a lot of anecdotal assumptions about the satellite industry workforce, but no hard numbers backing or refuting any of those to date,” said *Tamara Bond*, SSPI Membership Director and author of the report. “In order to better support the professional development needs of the industry, SSPI felt it was imperative to first look at the make-up of the industry and gain insight into those who call themselves ‘satellite professionals’. The survey yielded a wealth of information about the people we work with as well as the apparent health and stability of the industry, at least from the viewpoint of the employees.” The report and a video with the author are available by selecting the above graphic.

TriaGnoSys – Certainly Is Up In The Air

TriaGnoSys has completed its *air traffic management (ATM)* communications suite, a mobile aeronautical communication network based on Internet technologies for cockpit and cabin services, which seamlessly integrates satellite and terrestrial data links. The technology



was developed as part of the EU-funded *Networking the Sky (NEWSKY)* project to manage the huge growth in air traffic, which is forecast to double by 2025 according to the latest **Eurocontrol** figures.

At the conclusion of the NEWSKY project, TriaGnoSys demo'd its communications suite using a simulated flight from Europe to the U.S. Throughout the flight, either a satellite or a terrestrial link was automatically selected, depending on operational preferences and the availability of links, resulting in a seamless handover between the networks ensuring session continuity. TriaGnoSys' ATM communications suite provides both voice and data communications, as well as weather map downloads. A central feature of the suite is the use of IPv6, combined with TriaGnoSys' **VoCeM** compression and optimization technology.

Ariane 5 – Owl Eye Spy In The Sky As French Helios 2B Launches

Arianespace wraps up another successful year of operations with the orbiting of the French **Helios 2B** military very-high-resolution optical imaging observation (spy) satellite, which was produced by **Thales Alenia Space** and launched at the **European Spaceport** at the Guiana Space Center in Kourou, French Guiana, on behalf of the **French Space Agency**. This was the third time in 2009 that Arianespace's launcher carried defense and security payloads. On its year-opening mission in February, Ariane 5 lofted two **Spirale** satellite demonstrators for a French-developed future early warning system, while its October 1 flight deployed the **COMSATBw-1** secure telecommunications platform for Germany's armed forces.

Chairman and CEO *Jean-Yves Le Gall* said these missions “underscore the strategic nature” of Arianespace's role as a launch services provider, and confirms the access to space provided by a system that is backed by European governments and its space industry. During the past 30 years, our company has launched 277 satellites — 32 of which were for the requirements of European defense. We have 10 new contracts signed in 2009 — soon 11 — and we once again lead the pack, and our order book guarantees the launch rate of six to seven Ariane 5s annually for the years to come.”

“Thales Alenia Space has produced all the high-resolution instruments for Helios satellites since 1993,” said *Reynald Seznec*, President and CEO of Thales Alenia Space. “By drawing on our expertise in optical engineering and industrial facilities

that are unrivaled in Europe, we have developed instruments that are increasingly sophisticated and also provide greater and greater precision in terms of both spatial and spectral resolution. Thales Alenia Space has the capabilities needed to remain the trusted partner of the French Ministry of Defence in the coming years, for both observation and communications applications.”



The Ariane 5 GS is tailored for low-Earth orbit payloads such as Helios 2B, and is operated in conjunction with the Ariane 5 ECA on missions to geostationary transfer orbit that carry telecommunications satellite payloads. As a result, Arianespace uses two standardized launcher configurations, ensuring what they describe as high reliability and availability through production repeatability. The Ariane 5 GS launcher carried a total payload of 5,954 kg, including the HELIOS 2B satellite. This bird is the second satellite in a new-generation spaceborn observation system for military applications that has been created by France in conjunction with Belgium, Spain, Italy and Greece. All of the previous Helios 2 and Helios 1 satellites have been launched by Ariane vehicles, starting with *Helios 1A* in July 1995.

Lockheed Martin's GOES-R Gets The Go



Thumbs up for the **Lockheed Martin** team, originally awarded a contract by **NASA** in 2007 to design and build the agency's **Solar Ultraviolet Imager (SUVI)** for the **Geostationary Operational Environmental Satellite (GOES)-R** Series. The team just met the requirements of a *Critical Design Review* at the *Lockheed Martin Space Systems Advanced Technology Center (ATC)* in Palo Alto by a group of multi-disciplinary experts from NASA and NOAA, as well as a number of independent reviewers. The SUVI instrument will be built at the ATC under the management of the company's *Sensing & Exploration Systems* organization.

The Lockheed Martin SUVI instrument meets and exceeds all performance requirements. The design provides over six times more pixels (picture elements) than required, and imaging cadence capability at more than three times the original specification. The SUVI program will now proceed to fabrication of the flight units. The next major review will be the Pre-Environmental Review in November 2011. The team is on track for instrument delivery in October 2012, with six months of schedule margin to meet that date. The first GOES-R launch is scheduled for 2015.

United Launch Alliance – NASA's WISE Wins Its Freedom

United Launch Alliance capped 2009 with the launch of a **Delta II** carrying NASA's **Wide-field Infrared Survey Explorer (WISE)** spacecraft on December the 17th. Rocketing from Space Launch Complex-2, the launch was the eighth Delta II of 2009 and represents the 37th

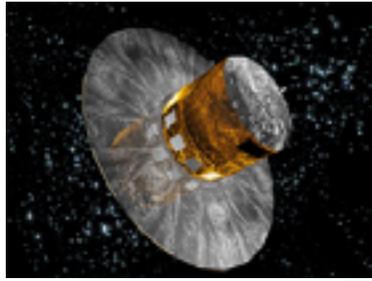


successful mission launched by United Launch Alliance in its first 36 months of operation. WISE will scan the entire sky using an infrared telescope with sensitivity hundreds of times greater than ever before possible, picking up the glow of hundreds of millions of objects and producing millions of images. The mission will uncover objects never seen, including the coolest stars, the universe's most luminous galaxies and some of the darkest near-Earth asteroids and comets. The spacecraft was launched on a Delta II 7320-10C configured vehicle featuring a ULA first stage booster powered by a **Pratt & Whitney Rocketdyne RS-27A** main engine and three **Alliant Techsystems (ATK)** strap-on solid rocket motors. An **Aerojet AJ10-118K** engine powered the second stage. The payload was encased by

a 10-foot-diameter composite payload fairing.

Lockheed Martin – GPS2+ Conveyed To Inmarsat

Lockheed Martin has completed site acceptance testing over the **Inmarsat-4** satellite network and delivered the *Global Satellite Phone Service (GSPS)* gateway in Subic Bay to **Inmarsat**. This is the final major delivery for the GSPS program contract that was awarded to Lockheed Martin in December 2006. In addition, Lockheed Martin successfully implemented and integrated the evolution of the *Global Mobile Radio (GMR2)* standard to **GMR2+**, providing improved performance and features over the prior generation of Lockheed Martin gateway products.



ESA – Gaia To Glean Galaxy Goodies

The *European Space Agency (ESA)* will launch the **Gaia** satellite into space using the **Soyuz-STB/Fregat** launch vehicle from the **Guiana Space Center** (French Guiana) in 2012. Gaia, ESA's nexgen star mapper, will be placed into the deep space beyond the lunar orbit. Gaia is a successor of ESA's **Hipparcos** mission. Built by **EADS Astrium**, it will weigh around 2,100 kg at launch and is equipped with a most sensitive telescope and a latest generation instrument payload. Gaia's mission is to observe more than a billion objects with

magnitude down to 20 and to construct the largest and most precise map of the Galaxy, the Milky Way, extrasolar planets and other galaxies. It will scan the sky for at least five years from the second Lagrangian point (or L2), located at about 1.6 million kms away from the Earth.



NASA | NOAA – GOES-P Enters Post Storage Testing Phase

Just two months after the successful launch of the **GOES-O** spacecraft, now called **GOES-14** in orbit, the **NASA** team removed the **GOES-P** spacecraft from storage and commenced its post storage testing. GOES-P is being prepared for an early March 2010 launch and, if the launch schedule holds, it boasts an unprecedented two launches in approximately 8 months. The latest *Geostationary Operational Environmental Satellite*, GOES, developed by NASA for the *National Oceanic and Atmospheric Administration (NOAA)*, called **GOES-P**, is targeted to launch on February 25 onboard a **United Launch Alliance Delta IV** expendable launch vehicle.

Once in geosynchronous orbit, GOES-P will be designated **GOES-15** and NASA will provide on-orbit checkout and then transfer operational responsibility to NOAA. GOES-P will be placed in on-orbit storage as a replacement for an older GOES satellite. GOES-P is the third and last spacecraft to be launched in the GOES N-P series of geostationary environmental weather satellites. The GOES satellites continuously provide observations of 60 percent of the Earth including the continental United States, providing weather monitoring and forecast operations, as well as a continuous and reliable stream of environmental information and severe weather warnings. GOES-P carries an advanced attitude control system using star trackers and *Hemispherical Inertial Reference Units*. The GOES-P image navigation has an accuracy of about 2 km from an orbit altitude of about 22,300 miles, or 35,700 km and only differs from GOES-O in the channel configuration for the solar Extreme Ultraviolet (EUV) telescope.

Boeing And ILS – Proton Takes Off On A Breeze And Brings TV DIRECTly To U.S.

ILS Proton successfully launched the **DIRECTV 12** satellite for **DIRECTV** on December 29, 2009 from the **Baikonur Cosmodrome**. **International Launch Services (ILS)** and **Boeing** have been working diligently to ensure the successful launch of the DIRECTV 12 satellite into orbit, which occurred from Pad 39 at the Cosmodrome at 6:22 a.m. local time (7:22 p.m. EDT, 00:22 GMT). Boeing received the first on-orbit signals of the satellite, which weighs more than 5.9 metric tons, from the satellite nine hours after its launch into geostationary transfer orbit, indicating that the satellite is healthy and operating normally.

DIRECTV 12 is a Boeing **702** commercial satellite that will provide consumer television programming to millions of U.S. households and will expand DIRECTV's HD capacity by 50 percent with more than 200 national channels and 1,500 local HD and digital channels and more advanced services for its 18 million customers nationwide. The satellite will receive and transmit programming throughout the United States with two Ka-band reflectors, each measuring 2.8 meters in diameter and nine other Ka-band reflectors.

Handover of DIRECTV 12 is scheduled for early 2010. Together with **DIRECTV 10** and **11**, the new satellite will help significantly expand DIRECTV's HDTV broadcasting to consumers across the contiguous United States, Hawaii and Alaska.

This was the seventh and final commercial launch of 2009 for ILS and the 56th ILS Proton launch, overall. ILS Proton launched the **DIRECTV 10** satellite just two years ago, fully demonstrating the enhanced Proton capability, which became the standard configuration for future missions. This was the 351st launch for the Proton, following the landmark 350th Proton launched just two weeks earlier on 14 December. The Proton Breeze M vehicle is developed and built by Khrunichev Research and Production Space Center of Moscow, one of the pillars of the Russian space industry.

"DIRECTV placed their trust and confidence in ILS two years ago with a very significant launch with the DIRECTV 10 satellite. At that time, it was the largest satellite launched by Proton, demonstrating the increased capabilities of the vehicle. Now, with DIRECTV 12, DIRECTV once again entrusted their business to us with the continuation of this successful partnership. We are very proud to play a significant role in the expansion of digital television services in the United States with DIRECTV," said ILS President *Frank McKenna*.

"At DIRECTV, we are proud to say that we have had many successful firsts, including the introduction of HD. We relied on ILS Proton in 2007 to launch DIRECTV 10 and knew that the same professionalism and flawless technical performance would be applied to the launch of DIRECTV 12. We thank the entire mission team from ILS, DIRECTV and Boeing, for their dedication and commitment to this launch," said *Jim Butterworth*, DIRECTV Senior Vice President of Engineering and Operations."





We make no excuses for returning so speedily to the position of Sirius-XM and its would-be European imitator Ondas Media. The news concerning the prospects for an international version of Sirius grew considerably during December as Sirius' CEO Mel Karmazin as well as his 40 percent shareholder Liberty Media confirmed they were looking closely at international options.

Liberty Media CEO *Greg Maffei* said that Liberty would fund any international expansion for **Sirius**, and although he did not specifically state that Liberty would use the **Worldspace** assets, that seems to be the general conclusion.

EUROPEAN PAY-RADIO BEGINS TO MOTOR! by *Chris Forrester*

Indeed, just as *Maffei* was talking to Wall Street analysts, **Ondas Media**, which wants to launch pay-radio services over Europe, was issuing a statement designed to force Liberty to pause with its plans. Ondas announced that radio technology company **Delphi** has signed an exclusive sat-radio agreement with Ondas Media. The deal in effect scuppers any plan that Sirius-XM, Liberty Media and Worldspace might have had for a Europe-wide pay-radio service based on cars with factory-installed radios. The formal statement says "Delphi Corp. has signed an Exclusivity Agreement with Ondas Media confirming that they will only manufacture and sell Ondas satellite radio receivers in Europe."

Muddying the water more than a little is the fact that Delphi had a similar 'exclusive' agreement with Worldspace (announced in 2008 at that year's CES show). Previously, Delphi was committed to developing the Ondas satellite radio reference design, but were also providing the production reference design for manufacturers supplying Worldspace kit for Italy's Fiat vehicles. At that time Worldspace promised a service would be introduced in Italy during 2009.

Despite Worldspace's Chapter 11 bankruptcy, the Fiat/Worldspace agreement remains in force (although is the subject of separate legal squabbles), although now not with a Delphi supply package included.

"This new arrangement ensures that Delphi, the leading satellite radio supplier to car companies in the U.S., will only supply Ondas radios in the European market. Delphi will still supply the reference technology of Ondas reception systems to all Ondas OEM radio manufacturers as per the original agreement," the statement continues.

Delphi's now exclusive focus on Ondas is a significant indicator of the credibility Ondas is establishing based on their achievements with OEM customers, radio broadcasters, regulators, and infrastructure partners. "Delphi was and still is the 'first-to-market' leader in all types of satellite reception systems, and have integrated their radios into 200 different models of automobiles for both Sirius and XM



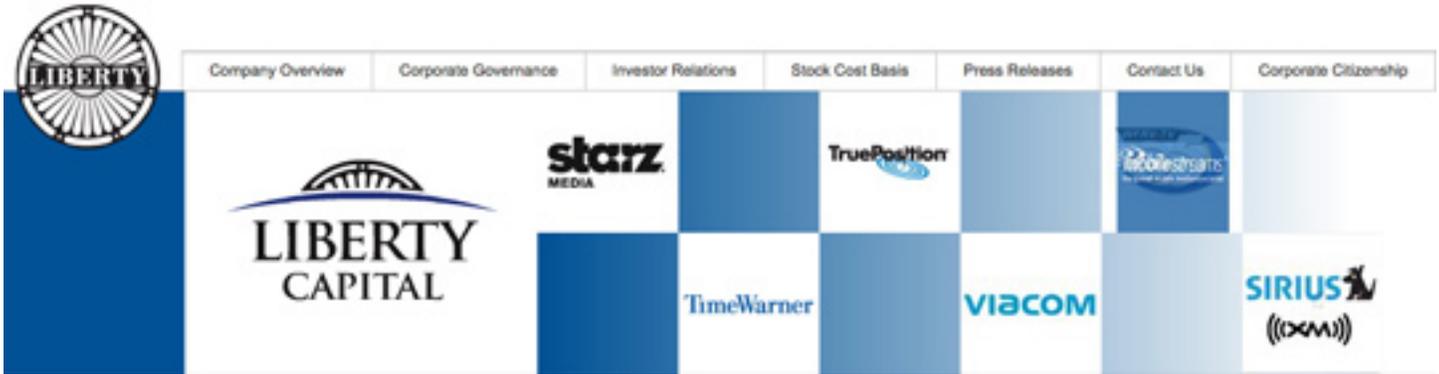
technologies. This commitment gives Ondas a significant operational advantage over competitors,” said their statement.

What this deal means is that Worldspace (either as a revived company, or with Liberty and/or Sirius-XM as active participants) cannot use Delphi-supplied or patented components in Europe. There are certain other suppliers of satellite radios (notably **Kenwood**). Another company, New Jersey-based **‘Consumer Satellite Radio LLC’** (CSL), filed certain patent infringement claims earlier this year against Sirius, XM, and U.S. retailers such as **Radio Shack** alleging that CSL’s patents within the technology had been used without permission.

However, as far as the Delphi/Ondas contract is concerned, this is a major step forward for Ondas. Building a car is itself a hugely complex process, and the supply of radio units into upscale and mass-market vehicles is a major undertaking especially when one considers the ‘behind the fascia trim’ options available to buyers. The Delphi agreement means it will be even more challenging for Worldspace (or its associates) to now get factory-installed sat-radios into European vehicles. It isn’t impossible, of course, and listeners might be happy to have a separate Worldspace receiver bolted onto a dashboard somewhere.

But it won’t be pretty!

Indeed, it is a widely-held misunderstanding to consider that Sirius-XM “integrate” their own satellite reception technology into a vehicle. This is always done with certified suppliers. Delphi was the first and most successful Tier 1 automobile supplier for both Sirius and XM in the early days, and were often called upon to get other manufacturers technology working. Delphi was instrumental in



the early success of XM in time to market, and also aided Sirius during its many challenges to get to service launch (recall that early Sirius CEO *David Margolese* was let go for failing to hit service launch

advice based on the many mistakes they made (but survived), the fact is that to get this sort of technology into a car requires quite a bit more than a simple cheat sheet of tick-box options. Without Delphi, many believe it is inconceivable that Italy's Fiat cars will have factory installed radios anytime in the near future. Sirius XM certainly can't do it themselves from their New York offices in the Avenue of Americas.



Sirius satellite

dates and during his tenure experienced up to 30 months of technology integration delays. Delphi were brought in to rescue that schedule). Therefore while Sirius XM can offer Worldspace lots of

Meanwhile the satellite technology that Ondas will probably use is coming back to life. **Solaris Mobile** is the joint-venture between **Eutelsat** and **SES Astra** that had hoped by now to be transmitting S-band signals from a giant **Harris**-supplied transmitter fixed to the Eutelsat **W2A** satellite. The antenna suffered an 'anomaly' and isn't working as specified. However, this hasn't stopped Solaris Mobile from announcing a technical trial with **Alcatel-Lucent** and French transmission company **TowerCast** to test DVB-SH radio to demonstration vehicles in and around Paris.

We can also confirm that the Solaris Mobile satellite-to-terrestrial trial, which uses the special S-band payload on Eutelsat's W2A orbiting satellite, is very definitely targeting Ondas as a customer, despite Solaris having to dramatically amend its business plan. However, the S-band payload is the subject of a major insurance claim, and Solaris CEO *Steve Maine* says the craft's insurers have agreed to pay 100 percent of the claim. It is known that the Solaris Mobile payload's problems are one of capacity and scale and not operability. Maine has said that Solaris can offer all its planned services,





although not necessarily in the scale that would make a fully-fledged business.

The upcoming trial/test is designed to demonstrate the commercial possibilities still available from W2A's S-band cargo. Any revenues received on a future commercial deployment would be shared with the craft's insurers. *Maine* says that a potential service to cars — of the type being planned by Ondas — could be deployed to Paris “and another territory”. A third service could be offered on a much wider basis, but would need to consume less capacity.

It is known that Ondas Media is looking closely at France and Germany. It has carmaker deals in place with **Renault**, **BMW**, and **Nissan**. It is already a matter of record that Solaris Mobile and its shareholders are weighing the options of how to replace the damaged S-band payload. Solaris is under certain EU obligations to ‘use the capacity, or lose it’. The bandwidth is required to be in use by May 2011. Inmarsat has a similar obligation on its 30 MHz of S-Band licence.

Maine admits that a radio deployment is now unlikely this coming year (2010). When Solaris Mobile was first mooted there was considerable (apparent) enthusiasm for DVB-SH services to mobile phones and similar devices in cars. Those schemes have all but evaporated. However, *Maine* remains optimistic saying that while the pure DVB-H/DVB-SH telco-market may have vanished there remained more, not less, opportunities for the S-Band payload and video in general.

However, here's a strange thing. Despite the very public support from Sirius and Liberty

Media for their international pay-radio plans, their stockholding investors seem not to be that impressed. As this is written, the Sirius share price is flat. Sirius CEO *Mel Karmazin* (speaking at a recent **Reuters Global Media Forum**) stated that Liberty and Sirius XM are indeed in talks about the Worldspace. This could mean that coverage in Europe, India, and other foreign markets might now be opened to Sirius XM's satellite coverage possibilities, as well as technology sharing, and content distribution deals. As Liberty is seemingly putting up all the costs, Sirius XM can receive cash directly to their bottom line, which is already going to show profits in Q4 of 2009, from their domestic endeavors solely. This — one would think — is good news for Sirius.

Sirius (SIRI) has traded at around 60 to 70 cents since September, and while every one cent moves up or down makes a meaningful difference to the pay-radio broadcaster's market capitalization (currently US\$2.4bn, and with trading at 62 to 63c), it would seem fair to say that Sirius' shareholders seem not to be that impressed by any thoughts of an international roll-out for Sirius. *Karmazin* has fairly stated that he didn't see any international investment plans for Sirius other than there could be opportunities on the revenue side of the balance sheet.

Meanwhile, there's the question of wrapping up Worldspace's Chapter 11 bankruptcy, which is ongoing. A meeting that was originally scheduled to take place at the **Delaware Bankruptcy Court** on December 2 was scrubbed. Worldspace now has until January 31st to file a restructuring plan and has until April 1st to — hopefully — wrap its bankruptcy protection up although it is worth stressing that these dates can be extended.



EMPOWERING
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DELPHI



However, it would seem from a reading of the various Court filings by the assorted lawyers to Worldspace that Liberty is firmly in the driving seat for the failed radio broadcaster and in effect controls the two somewhat tired Worldspace satellites (*AfriStar* and *AsiaStar*), both now nearing the end of their working lives. Afristar was launched in October 1998 and has solar-panel problems, and with an operational design life of just 12 years — which is close — although it could stay on station (+/- 1 deg) for a further 3 years or so. Asiastar was launched in March 2000, again with a 12-year lifespan, so this craft has a slightly longer “use by” date.

Worldspace also has an ‘asset’ in the shape of *Worldspace 3*, a craft that’s sitting in a satellite warehouse in Toulouse. It would be unfair to call it *DustSat*, given that it is carefully stored in a temperature and humidity-controlled clean



AfriStar satellite

environment, but by any measure the satellite now has some tired components that would need replacement.

This third Worldspace satellite will also need technical modification to permit it to more aggressively target Europe. Finally, a new owner needs to stump up the launch and insurance costs for WS3 — and this means real money measured in the tens of millions of dollars. Liberty Media’s satellite arm is going to have to fund this if it hopes to launch a real L-band service across greater Europe.

To summarise, Worldspace has to emerge from Chapter 11, staff hired, and battered relationships rebuilt. Cash must then be paid to fund the modifications of Worldspace 3, then a launch slot booked (and this is not easy) and insurance taken out. This summarized list is but the tip of an iceberg of challenges, and is by no means a pushover even for Dr. *John Malone*.

About the author

London-based Chris Forrester is a well-known entertainment and broadcasting journalist. He reports on all aspects of the TV industry with special emphasis on content, the business of film, television and emerging technologies. This includes interactive multi-media and the growing importance of web-streamed and digitized content over all delivery platforms including cable, satellite and digital terrestrial TV as well as cellular and 3G mobile. Chris has been investigating, researching and reporting on the so-called ‘broadband explosion’ for 25 years.



Executive Spotlight

**PROFESSOR SIR MARTIN SWEETING
CHAIRMAN + DIRECTOR
SURREY SATELLITE TECHNOLOGY LTD.**



Sir Martin Sweeting



Serving as both the Chairman and as a Director of Surrey Satellite Technology Ltd. (SSTL), as well as Director of the Surrey Space Centre (SSC), Sir Martin Sweeting has been honored on numerous occasions for his work that pioneered the concept of rapid-response, low-cost and highly-capable small satellites using modern terrestrial COTS (commercial off the shelf) devices to ‘change the economics of space’.

In 1985, after building and launching the U.K.’s first two research microsattellites at the **University of Surrey**, he formed **SSTL — Surrey Satellite Technology Ltd.** — which has now designed, built, launched and operates in orbit a total of 27 nano, micro, and minisatellites — including the international **Disaster Monitoring Constellation** (with Algeria, China, Nigeria, Turkey and U.K.) and the **GIOVE-A**

Galileo satellite for ESA.

SSTL has also developed a highly successful satellite know-how transfer and training program and has worked with 12 countries — particularly enabling emerging space nations to achieve their first space missions and thus to access space directly to benefit their environment and economies. During the 1990s, as the capabilities of small satellites rapidly increased, they moved from being a research activity to meeting real applications for Earth observation, communications and space science. In 2004, SSTL formed a company — **DMC International Imaging (DMCii)** — to coordinate the DMC and to exploit the commercial applications of the DMC EO data. Working in partnership with the **U.K. British National Space Centre** and **DMC Consortium** members, the constellation is providing services and imagery to the International Charter: “Space and Major Disasters”. DMCii provides 24-hour emergency on call officer services and, in the event of a major disaster, tasks the global fleet of satellites made available by the world’s space agencies. Images from the DMC are used in a wide variety of commercial and government applications including agriculture, forestry and environmental mapping, and have been supplied to organizations such as the United Nations and the U.S. Geological Survey during disasters such as the Asian Tsunami and Hurricane Katrina.

The main advantage of small satellites are the speed with which they can be developed and the cost savings that ensue.

The growth in company size and the capability delivered to customers has continued to accelerate for SSTL. Today, SSTL employs almost 300 staff, has launched 34 spacecraft, with seven more under

Executive Spotlight

manufacture, and is delivering missions that provide critical and valuable services to customers across the globe. In 2008 the Company established a U.S. subsidiary, **Surrey Satellite Technology LLC**, with offices in Denver, Colorado. At the end of that year, **EADS Astrium NV** bought a 99 percent shareholding in SSTL from the University of Surrey, allowing the Company to fulfil its growth potential.

Sir *Martin* is also Director of the **Surrey Space Centre**, leading a team of 60 faculty and doctoral researchers investigating advanced small satellite concepts and techniques, which acts as the research laboratory for SSTL: real academic-commercial synergy. In 1995, Sir *Martin* was awarded the **OBE** in *HM Queen's Birthday Honours* and the *Royal Academy of Engineering Silver Medal*, both in recognition of his pioneering work in small satellites. In 1996, he was elected a *Fellow of the Royal Academy of Engineering* and in 2000 was elected a *Fellow of the Royal Society* (the U.K.'s national academy) and also awarded the *Royal Society's Mullard Prize*. Sir *Martin* was knighted by HM Queen in the *2002 British New Year Honours* for services to the small satellite industry.

In 2006, he was appointed a *Distinguished Professor* at the **University of Surrey**, invited to sit on the *BNSC Space Advisory Council*, and to join the *ESA Advisory Committee on Human Spaceflight Microgravity*

& *Exploration*. He was awarded the *Royal Institute of Navigation Gold Medal* in recognition of the successful GIOVE-A mission for the European Galileo system and featured in the U.K.'s "Top Ten Great Britons" and received the *Times Higher Education Supplement Award for Innovation* for the *Disaster Monitoring Constellation (DMC)*.

We were delighted to have the opportunity to learn more about Sir *Martin's* exceptional career.

SatMagazine (SM)

Sir *Martin*, you have just received the Faraday Award, what exactly is this honour and what does the bestowment of the Faraday mean to you? Plus, your Faraday award is especially notable in that it commemorates the organization's 50th anniversary, making it a double compliment — do you interpret it as such?

Sir Martin Sweeting

The Faraday Medal is the highest award made by the IET and, as a radio engineer by training, it is particularly special to be recognised by this award named after Michael Faraday — a great experimentalist.

SM

How was SSTL originally formed, and when? What was the company's original charter? And, what was SSTL's connection with NASA?

Sir Martin Sweeting

Space at Surrey started in 1979 and grew initially as a research group pioneering the then unheard-of 'microsatellites' using commercial off-the-shelf technologies and components to achieve small but highly capable satellites at a fraction of the conventional cost. SSTL was formed in 1985 after the launch of our second satellite and its remit was to commercialise the research experience gathered thus far and to attract funding for continued satellite missions. SSTL's only connection with NASA was through the provision of launch opportunities for our first two satellites 'piggy-back' on-board NASA



Photo courtesy of Leroy Sanchez

Executive Spotlight

rockets carrying NASA payloads and with the help of AMSAT.

SM

Can you tell us about the first satellite/project from SSTL? And how were off the shelf components used in its manufacture? You were certainly well ahead of the times, earning your PhD in the late 70's designing and building this small, 50 kg satellite. You successfully launched the satellite and communicated through amateur radio bands back to a ground station at the Surrey campus. Was this a difficult time for you, with many thinking 'no way' this can be accomplished?

Sir Martin Sweeting

The first two satellites were built at the University and used many 'COTS' components — some early microprocessors, some of the first 2D CCD arrays that formed the basis of later digital cameras, and a speech synthesiser chip that was used in a 'speak-&-spell' children's toy, which the satellite used to 'speak' telemetry from orbit that could be listened to using a simple FM hand-held receiver on the amateur radio bands. My PhD was in nothing to do with satellites — it was researching shortwave radio antennas — satellites were my hobby!

Designing, building, testing and launching the first satellites was a very demanding task — then operating them in orbit proved just as difficult, but I learned a lot the hard way... there were many sceptics as to the feasibility of us building satellites at a small university lab, and also as to whether they could ever do anything useful in such a small size!

SM

Just recently, your company was acquired by EADS Astrium NV. Prior to this change of ownership, the University of Surrey played a hugely important role with SSTL. How has the EADS Astrium acquisition changed the University of Surrey relationship with SSTL?

Sir Martin Sweeting

The acquisition by EADS has been important to enable SSTL to grow and realise its potential — the links with the University remain very strong since the Surrey Space Centre academic research team act as the 'R&D labs' for the Company through a formal IP relationship — and this is strongly supported by ASTRIUM.

SM

Given how busy you are as an engineer, with your work at the University of Surrey, and with your management of SSTL, how do you manage to ensure your family time remains your personal time? How has the family handled your continual rise within the satellite community?

Sir Martin Sweeting

You are correct, running two organisation is very demanding in both time and energy, but it is stimulating and enjoyable (99 percent of the time!) — I am very lucky that my hobby turned into my job! My family is proud of what has been achieved at Surrey and the recognition it has brought, but always bring me back down to Earth by reminding me of what needs to be fixed at home as well as in space!

SM

How difficult/frustrating or complicated is it for you, representing a University, to be interfacing with huge government entities such as NASA? Are the turn-around times for answers to questions and other collaborative efforts daunting?

Sir Martin Sweeting

I represent both the University and also the Company and most of my dealings are with ESA and the U.K. BNSC and international customers, rather than with NASA (although we hope to do more with NASA ...!). Large organisations (both institutional and industrial) have inevitable inertia that can, at times, be frustrating, but increasingly our customers come to Surrey and SSTL because we can offer an alternative, more rapid, more

Executive Spotlight

flexible and lower cost solutions to their space requirements or aspirations.

SM

In 2008, SSTL initiated a subsidiary firm in the U.S. in Denver, Colorado. What was the purpose of that new subsidiary, its goals, and is the unit well on its way to meeting those milestones?

Sir Martin Sweeting

The USA is the largest space market in the world currently but it is difficult to access it fully from outside the U.S. We have completed several satellite projects successfully with U.S. organisations but it is clearly easier from 'inside the fence' and so we took the decision to establish an SST-US in Colorado so that the small satellite expertise and experience could be transferred into the U.S. and projects carried out on U.S. soil by U.S. personnel.

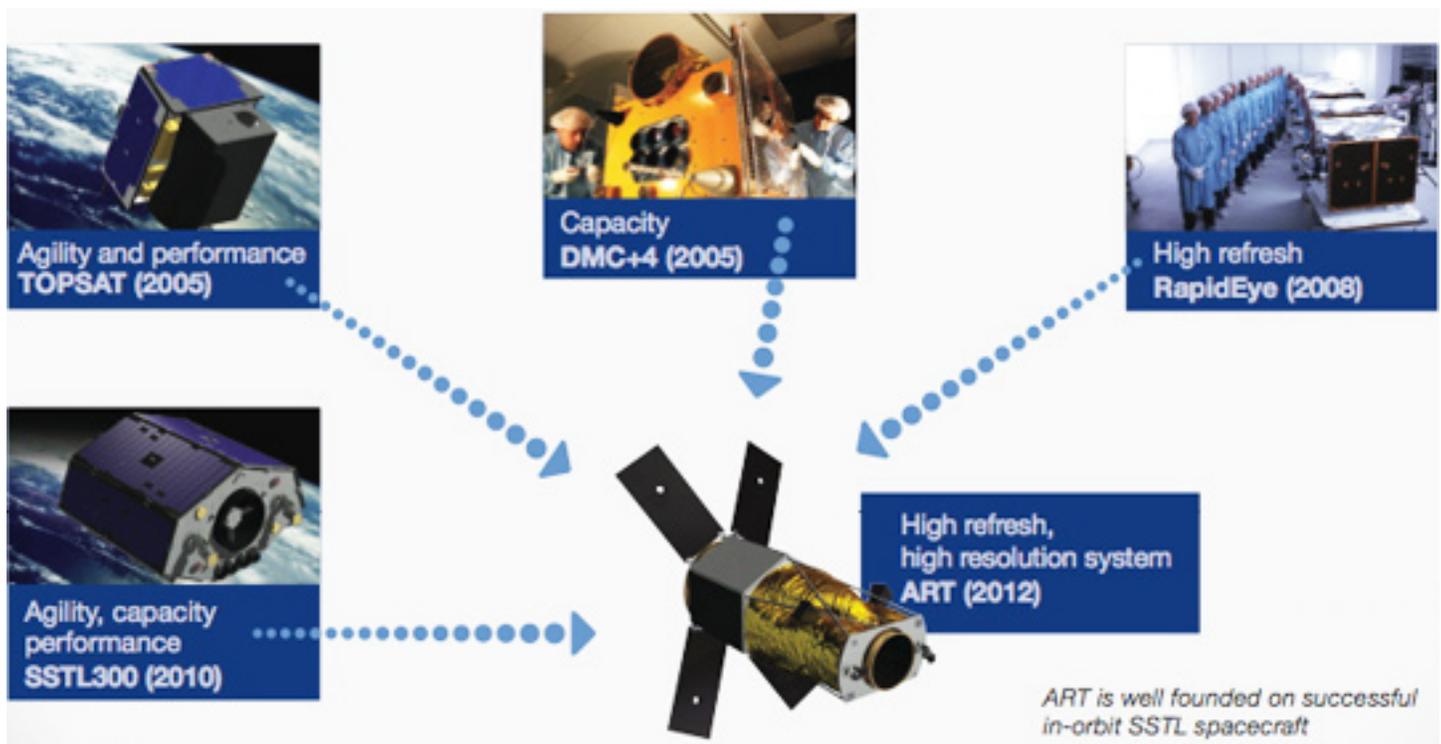
SM

What are the advantages and disadvantages of smaller satellites?

Sir Martin Sweeting

The main advantages of small satellites are the speed with which they can be developed and the cost savings that ensue. A typical SSTL satellite can be designed, built, tested and made ready for launch in less than two years. This is in contrast to the 5-10 years that is now common for larger satellites. In terms of costs, there are savings to be made by the use of small satellites in three main areas. Firstly, the satellite is generally dedicated to more focussed tasks and, when coupled with a rapid development schedule, this brings considerable cost saving.

Secondly, the cost of launching a smaller and lighter satellite is much lower than that of a large satellite. Finally, the cost of operating small satellites is greatly reduced due to the automation that is generally possible through the use of latest COTS technologies, for example removing the need for 24/7 manned facilities. Whilst the capability of small satellites is rapidly growing, there are still areas where larger satellites can offer better ultimate performance — but at a much



SSTL's ART (Accuracy, Reach, Timeliness) diagram

Executive Spotlight

higher price. After all, the laws of Physics still apply and large telescopes will always be able to outperform smaller ones.

However, through clever use of technology we can make small satellites give a “good enough” performance. Some people refer to the “80/20 rule” ... 80 percent of the performance for 20 percent of the price — and this is what SSTL aims to achieve.

SM

Sir Martin, how do you classify the various categories of the smaller satellites... micros, nanos, picos and so on? What are the delineation points for these classifications?

Sir Martin Sweeting

Satellites < 1kg are “picosatellites”, 1-10kg are “nanosatellites”, 10-100kg are “microsatellites”, 100-500kg are “minisatellites”.

SM

In the 80’s you pursued research funding to develop this now proven concept to a system capable of responding to the growing application areas that space can facilitate, and developed the research group working around small satellites. This was the impetus for you to initiate the Surrey’s Know-How transfer program where your group provided technical training to engineers from countries who placed an order for a small satellite with Surrey. Working together as a team enabled the engineers to master the complex and diverse skills required to operate a satellite. Did you continue with this program?

Sir Martin Sweeting

The impetus to start the ‘know-how transfer and training programs’ was primarily business but also a personal interest in working with international partners. We have now completed 12 such programs with different countries — and continue it currently with Nigeria, Algeria and most recently Sri Lanka.

SM

Do you agree with Warren Leary, writing in the New York Times, who described the promise of microelectromechanical systems (MEMS) as applied to satellite technology and hinted at the possibility of a satellite-on-a-chip. He discussed the work of Siegfried Janson and colleagues at The Aerospace Corporation, in El Segundo, California, and quoted him as describing, ‘Fully integrated satellites that could be mass produced cheaply by the hundreds and sent into space in groups to perform a variety of tasks.’

Sir Martin Sweeting

We are currently developing prototypes at the Surrey Space Centre of ‘satellite systems on a chip’ and this will lead soon to a ‘satellite-on-a-chip’.

SM

Will Femto-satellites be the next new class of satellites, due to the a possibility of shrinking the capabilities of a typical pico-satellite bus (attitude control, imaging missions, communications, and so on) onto a single chip?

Sir Martin Sweeting

It is technically feasible to build ‘satellites-on-a-chip’ now, however their utility is the question — how can such a tiny satellite (with tiny amounts of power) do anything useful? I believe that the answer is in flying them in swarms working together and forming sparse area arrays, but this is a very demanding challenge — as yet unproven.

SM

SSTL received a contract award from the European Space Agency early last month that deals with the management of a student-built mission to the Moon. Can you tell us about this contract and what is hoped to be accomplished?

Sir Martin Sweeting

The ESA mission is the European Student Moon Orbiter mission or ESMO. It comes out of the

Executive Spotlight



Education Office at ESA where for a number of years a European team of students have been developing the concept of a lunar orbiting vehicle. SSTL's role as prime on this mission is to lead the universities in the technical and programmatic challenges of concluding the design, building, testing, launching and operating the orbiter. The launch is planned for 2013/14 with a view to operating a number of payloads around the Moon for a subsequent minimum of six months.

There are some interesting challenges inherent to this program in ensuring that the educational objectives of the program are met in concert with achieving the demanding technical objectives. As a company, we're very excited to be taking on this mission as it leverages our strong background in know-how transfer and designing space hardware in a low cost and pragmatic manner.

In addition, this mission allows us to strengthen our existing relationships with both European

academia and the European Space Agency — and prepare for a future U.K.-led lunar orbiter 'MoonLITE' which will carry penetrators to explore the surface of the Moon.

SM

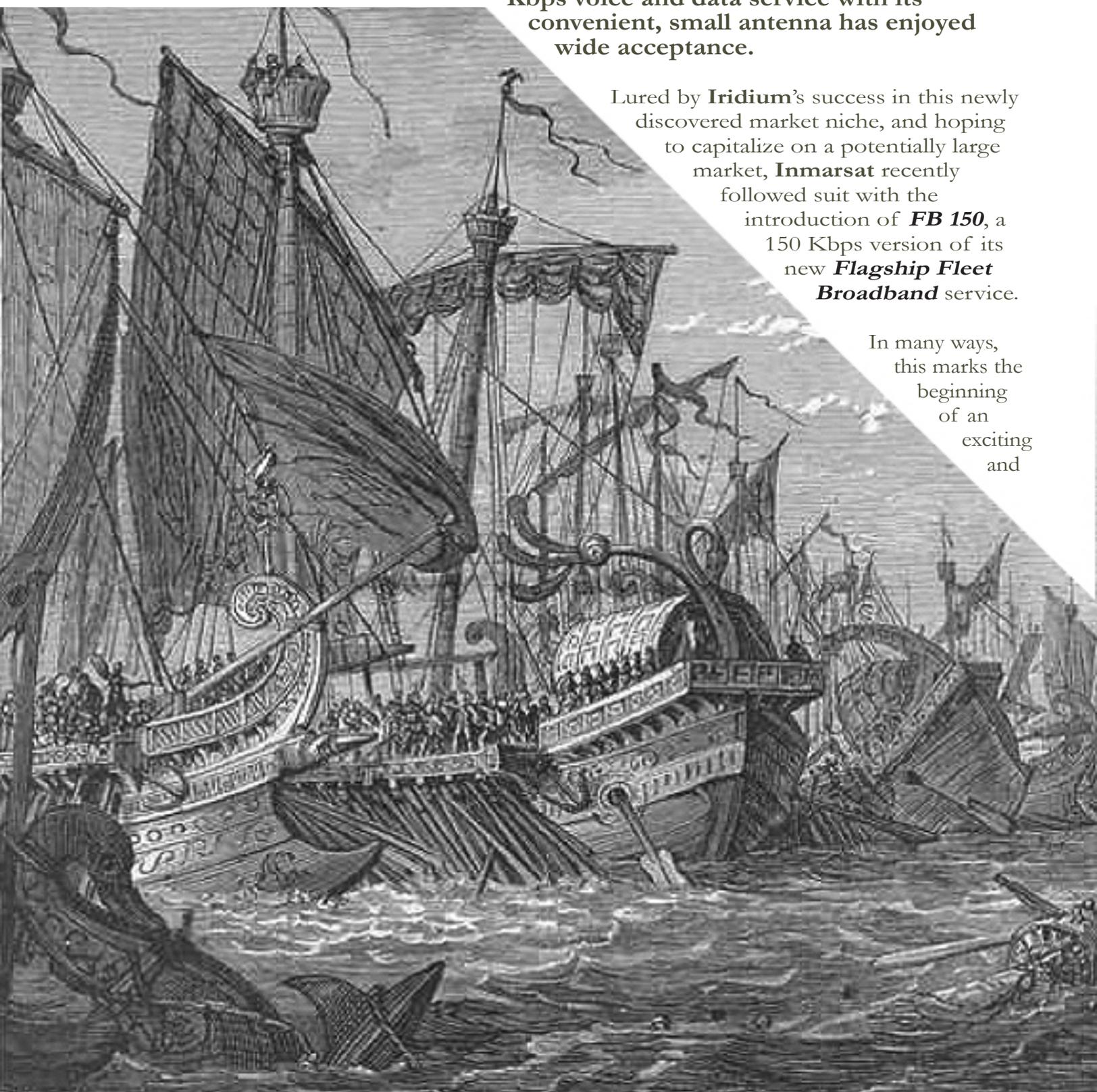
Thank you, Sir Martin, for your talk with us and we wish you and your company well with your highly interesting projects.

CAN FB 150 UNSEAT OPENPORT?—THE NEW CHALLENGE AT SEA —
by Alan Gottlieb

Iridium just announced the sale of its 1,000th OpenPort system, making it the de facto leader in the 128 Kbps targeted segment of the maritime communications market. Since its introduction, the inexpensive 9.6/32/64/128 Kbps voice and data service with its convenient, small antenna has enjoyed wide acceptance.

Lured by **Iridium's** success in this newly discovered market niche, and hoping to capitalize on a potentially large market, **Inmarsat** recently followed suit with the introduction of **FB 150**, a 150 Kbps version of its new **Flagship Fleet Broadband** service.

In many ways, this marks the beginning of an exciting and



complex contest as Inmarsat, the traditional master of maritime communication, attempts to unseat a nimble upstart who has beaten them to market. Can **OpenPort**, an early winner in the up to 128 Kbps maritime communications market, maintain its lead against Inmarsat's new FB 150 service?

To find out how these services compare, **Gottlieb International Group** queried end users and providers, and what we found astonished us. Unlike FB 150, OpenPort user satisfaction was found to be largely dependent on the chosen service provider with satisfaction varying considerably among those who bought from Tier 1 providers versus those who purchased from sub-distributors at the bottom of the distribution chain.

Users who purchased the OpenPort service from the Top Tier providers enjoyed a relatively good quality of service and significant discounts from list pricing while those who bought from the sub

distributors were more likely to pay higher prices and complained more often about service quality. As we dug deeper, reasons for the disparity began to emerge.

- **Pricing:** Iridium has a multi-level distribution scheme that can often result in significantly higher prices for those users who purchase from a sub distributor versus a Tier 1 provider. Furthermore, until May of 2009, OpenPort had no real competition resulting in very limited discounting. Distributors published price lists and generally adhered to list prices. Despite the fact that times have changed, many of these price lists still exist and circulate creating the false impression that the service is considerably more expensive than FB 150. In fact, we found the opposite to be true. Very significant discounts are available, especially for those users who buy from the Tier 1 distributors.

- **Service Quality:** To assure service quality, proper placement of the OpenPort antenna is critical since the antenna is highly sensitive to bursts from Inmarsat C, radar and other types of interference. Top Tier distributors usually perform a careful Site Survey to determine the optimal location for antenna placement and either perform or supervise installation themselves. Sub distributors are much more likely to limit involvement with installation to providing a set of written instructions for user self install, resulting in poor antenna placement and/or less than optimal installation. In addition, vendors at the edge of the distribution network are much less likely to assure that software and firmware upgrades are installed as required. As Iridium has labored constantly to improve its service, upgrading is critical and vendors need to make sure their customers actually install the updates.

- **Managing Data Costs:** As both OpenPort and FB 150 offer expensive, pay-by-the-byte data services, usage control is essential. While e-mail and SMS consume relatively minimal amounts of data, unrestricted use of the Internet on either service can result in thousands,

or even tens of thousands, of dollars in unexpected billings. Tier 1 providers generally provide sophisticated, Web based portals that allow users to set limits on data usage, and they teach their customers how to use them. Stratos, AND, Globe Wireless, Satcom Group and Sea Mobile have especially good usage management packages.

Incredibly, we found that some Second Tier distributors had no such packages at all and were relying on analysis of after-the-fact call records from Iridium to control customer usage. Without real time usage management, some customers were reported to have run up tens of thousands of dollars in data charges.

The result of our survey suggests that, despite being a reasonably good service, product perception in the market has been infected by the inconsistent performance of sub distributors and, in many cases, their failure to provide the appropriate cost control software and the other value added services necessary to properly support the product. Consequently, potential purchasers need to carefully shop around and buy directly from the best Tier 1 vendors. Having detailed the importance of choosing a proper distributor when buying OpenPort, we can now look more closely at the features and performance of both services.

OpenPort + FB 150 Compared

In comparing OpenPort and FB 150, it is critical to understand that either service could certainly meet your voice and data communications requirements. In reality, as both of these services charge data on a pay-by-the-byte basis, neither is cost effective in applications such as web surfing, streaming video, or transmission of email attachments larger than 500 Kb. These services are principally for voice, e-mail, SMS, transmission of low-density photos, and small files and can be suitable for remote PC Management (at speeds of 128 Kbps or greater). If you are planning to give crew access to the Internet, you are going to definitely need a VSAT service. Considering these limitations, here's how the services compare in that regard.

1. **Voice Quality:** Voice quality with the OpenPort service can be compared to the Iridium phone service. Most users reported quality to be adequate but demonstrated a slight preference for FB 150. While some OpenPort users have reported dropped calls, careful analysis appears to reveal that such problems are either a result of poor antenna placement or failure to install the required software and firmware updates.
2. **Crew Calling:** OpenPort has a significant advantage over FB 150 in the Crew calling application since it allows three simultaneous voice calls versus only one call for FB 150. OpenPort can also be employed with pre-paid scratch cards to facilitate pre-paid calling. Also, we understand that some providers offer the crew calling service for as little as \$.50 to \$.60 per/minute, much lower than FB 150.
3. **Email and Data Pricing:** We found no significant differences in terms of functionality. We believe OpenPort to be significantly less expensive than FB 150. However, as we mentioned, printed price lists are totally unreliable and substantial discounts are available from many OpenPort distributors. So, you need to shop around and get quotes from distributors. Don't rely on the printed price lists for comparisons.
4. **Transmission Speed:** In terms of transmission speed Inmarsat FB 150 enjoys a slight advantage with its standard 150 Kbps offering. However, until recently to obtain 128 Kbps services on OpenPort required users to commit to a high-end expensive pricing package and pay a premium for either 64 Kbps service or 128 Kbps. However, Iridium has just announced that the need to subscribe to a high-end plan for 128 Kbps service has been eliminated along with any surcharges while, unlike Inmarsat, slower speeds will be available at discounted pricing.
5. **Antenna Infrastructure:** The OpenPort antenna has no moving parts and is small

and inexpensive making ideally suited to small and mid sized vessels. Because it has no moving parts, it enjoys a distinct advantage on smaller yachts and other vessels subject to intense vibration. Furthermore, the fact that the service relies on a continuously orbiting constellation of LEOs means it is more apt to retain connectivity in far North latitudes where look angles are low for geosynchronous satellites such as those employed by Inmarsat.

6. **Polar Access:** Obviously, if you intend to sail North or South of 73 degrees latitude, OpenPort is the only functional service.

In conclusion, we believe these services compare favorably and are confident our research conclusively indicates that much of the negative commentary surrounding OpenPort is a result of poor service by vendors at the lower end of the distribution chain, not a significant deficiency in the service itself. In comparison, both of these services have attractive features and the secret of success in employing them is to accurately match them to your own specific requirements.

About the author

Mr. Gottlieb is CEO of Gottlieb International Group. His firm, Gottlieb International Group Inc., specializes in assisting ship owners and managers with evaluation of satellite service offerings and helping service providers structure appropriate service offerings. He is recognized expert in the field, has extensive contacts in the global shipping industry and VSAT vendor community and is a frequent published author and speaker at satellite and maritime conferences.



Established in 2002, Gottlieb International Group has worked with ship owners and managers VSAT vendors around the globe, His clients have included such major vendors as Inmarsat, Iridium, Globecom Systems, KVH Industries and Intelsat. His new E-Book, *The First Independent Guide to Maritime VSAT* is now available through his Company's website.

Mr. Gottlieb is a native of Washington, D.C. and holds a Masters Degree in International Business from Thunderbird Graduate School and a B.A. from Stetson University.

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Illustration credit:

Naval drawing courtesy of Ridpath from *The History Of The World*.

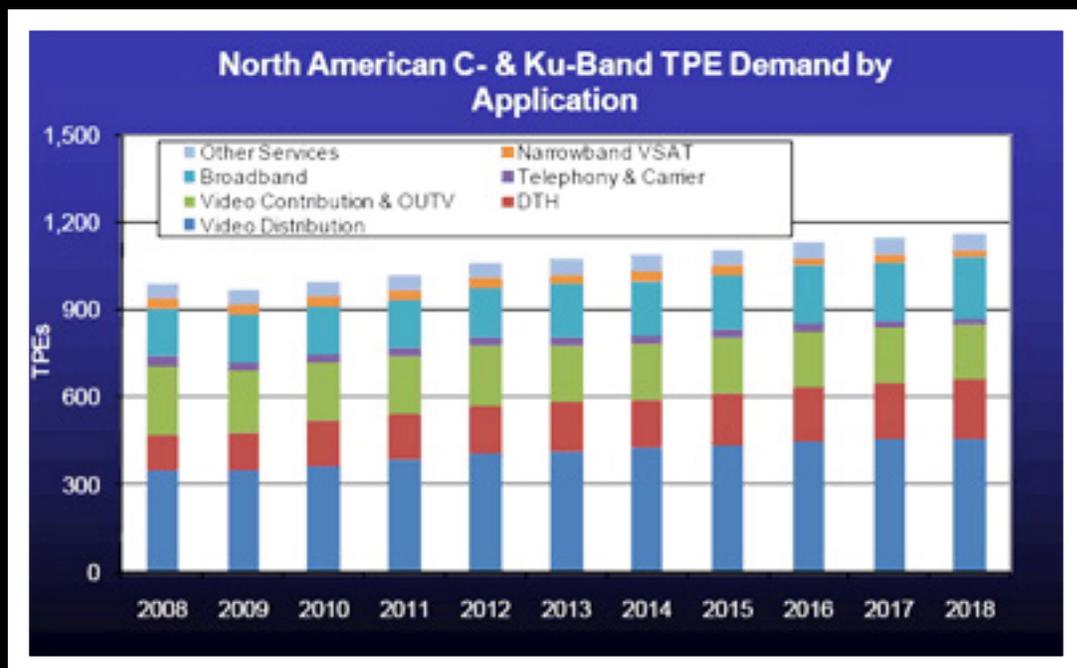
NORTH AMERICA, THE WANING STAR IN THE SATELLITE OPERATOR CONSTELLATION

The satellite industry, NSR included, has not been shy in recent months about trumpeting the relative success the sector has had in sliding through the recent global economic turmoil relatively unscathed. It is certainly true that the satellite industry as a whole has managed continued strong growth in the face of the worst economic crisis since the Great Depression of the 1930s. Still, the world “relative” is key because there have been some signs of weakness in a few key markets with North America, interestingly, seeing perhaps the greatest negative impact of any region from the point of view of commercial satellite operators operating therein.

A perfunctory scan of quarterly report press releases from the two major satellite operators in the North American market, SES and Intelsat, does not appear on the surface to indicate any weakness in the region. However, comments and detailed reading of SEC quarterly reports does reveal some of the softness being seen in North America. For example, SES Chief Financial Officer *Mark Rigolle* commented in the July 31st, 2009, conference call presenting his company’s Q2 2009 results that North America “has been the most difficult and lowest-growth market we have”. And buried well down in both of Intelsat’s Q1 and Q2 SEC quarterly reports were notes regarding a “decline in revenue from media customers primarily in the North America and the Latin America and Caribbean regions” despite earlier reassuring statements in the same reports that “all regions reported revenue increases, with the North America, the Asia-Pacific and the Africa and Middle East regions showing the strongest gains”.

Where lays the truth in these at times contradictory statements? As is usual, there is no simple explanation, and instead the North American market is subject to a number of both positive and negative trends. On the C-band side of the business, video distribution and contribution services by far dominate, and it is here that NSR sees probably the weakest, at least in the short-term, area for North America.

While greatly diminished in recent years, there still remains a fairly substantial number of analog channels and feeds serving the North American market. Even as both SES and Intelsat announced new SD and HD channel



launches over the course of 2009, it must be remembered that the conversion of the analog channels and feeds to digital often frees up capacity to accommodate this channel growth, and this implies that a new channel launch does not necessarily translate directly to a net gain in leased capacity. This analog conversion may well be at the core of Intelsat's comment on declining revenues from media clients in North America.

Further, both SES and Intelsat (with just about every other operator the world over) have been using the issue of relatively tight supply in many markets as a means to increase capacity pricing. In fact, a fair share of the revenue growth reported over 2009 has not come from new capacity leasing but for higher prices that are utilized in capacity renewal contracts.

Yet, supply in North America (especially C-band supply) is not nearly as tight as it is elsewhere in

the world. It is true that a number of key cable headend satellites serving North America are full or nearly so. Yet, there are also a number of C-band payloads in North America with relatively low fill rates. Further, the shuttering of the **IP Prime** service in North America probably released a substantial amount of free C-band capacity into the North American market, and this was likely in part what Mr. *Rigolle* was alluding to for the region. It is much harder to push up capacity pricing in a market where there is still available capacity and many broadcasters are launching new channels on already existing capacity they have under contract by simply taking advantage of their analog migration.

The chart on the previous page is from NSR's ***Global Assessment of Satellite Supply and Demand 6th Edition*** study clearly shows the dip in demand in 2009 that is mainly coming about due to the end of the IP Prime service,

plus the analog conversion issue that was accelerated by the analog terrestrial TV switch-off in North America in the middle of the year. Nonetheless, NSR remains positive over the longer-term for growth potential in the North American C-band market for a number of reasons. First, the analog conversion process is slowing as there are fewer and fewer analog channels or feeds to convert, and this means that any new channel launch in the future will likely lead more directly to the need for media clients to lease additional capacity. Additionally, as the economy in North America recovers in 2010 and 2011, NSR expects a spurt of new channels to go on air as delayed channels are rolled out and new players seek to enter the media market in North America.

Turning to the North American Ku-band market, the leading markets here are broadband and networking services, DTH and video distribution and contribution. Leased Ku-band transponders for broadband Internet access services have declined in 2009 for North America as Hughes has been slowly returning capacity to satellite operators as it grows its *HughesNet* subscriber base on its *Spaceway-3* satellite, plus the major corporate VSAT networking market slowed considerably in 2009 as many companies have put off plans related to new VSAT networks or upgrades/expansion of existing VSAT networks. Fortunately, the corporate VSAT market will likely see a turnaround in 2010 and 2011, as with C-band video distribution and contribution, as economic conditions in the region improve.

While broadband and networking were the weakest Ku-band markets in North America in 2009, DTH is the strongest, and this segment has seen little impact from the global economic issues. Ciel Satellite saw its completely leased *Ciel-2* satellite enter into service in 2009, and Telesat has pre-sold the entire capacity on its upcoming *Nimiq-5* satellite. Plus, farther into the future, the *QuetzSat-1* satellite is also entirely presold. However, much of the DTH market in North America is “pre-baked”, and the economy one way or another would have little impact on expected growth here.

Falling in between DTH and broadband and networking markets are Ku-band video distribution and contribution services. There are no Ku-band analog channels being carried in North America, though a few analog feeds still remain. NSR expects some analog feed migration within the Ku-band market in North America for 2009, and this could cause a short-term decline in Ku-band demand, though it is likely that much of this capacity will be reused for carriage of new SD and HD channels for ethnic and specialty services in the region. And, as with C-band, as the analog migration process completes itself in the coming few years, any new channel or occasional use demand will translate straight into new Ku-band leasing.

Yes, the North American satellite market has dimmed somewhat in 2009, and this has no doubt had a real impact on players in the market. Yet, as described above and detailed in greater depth in NSR’s *6th Edition* study, some of the market issues in North America are independent of the overall economic conditions and would have occurred even if times were good everywhere. NSR is quite confident there are no real systemic, long-term issues in the North American commercial capacity leasing market. Within a few quarters, the North American region will likely wax bright again for satellite operators serving the region.

About NSR

Northern Sky Research (NSR) is an international market research and consulting firm specializing in telecommunications technology and applications.

NSR primary areas of expertise include satellite and wireless networks, emerging technology, and media applications. Their services and clients cover the entire globe. With extensive expertise in all geographic regions and a number of telecommunications sectors, NSR is a leading provider of in-depth market insight and analyses. Since each NSR product is based on future perspectives, our analyses allow our clients to stay a step ahead of the competition.

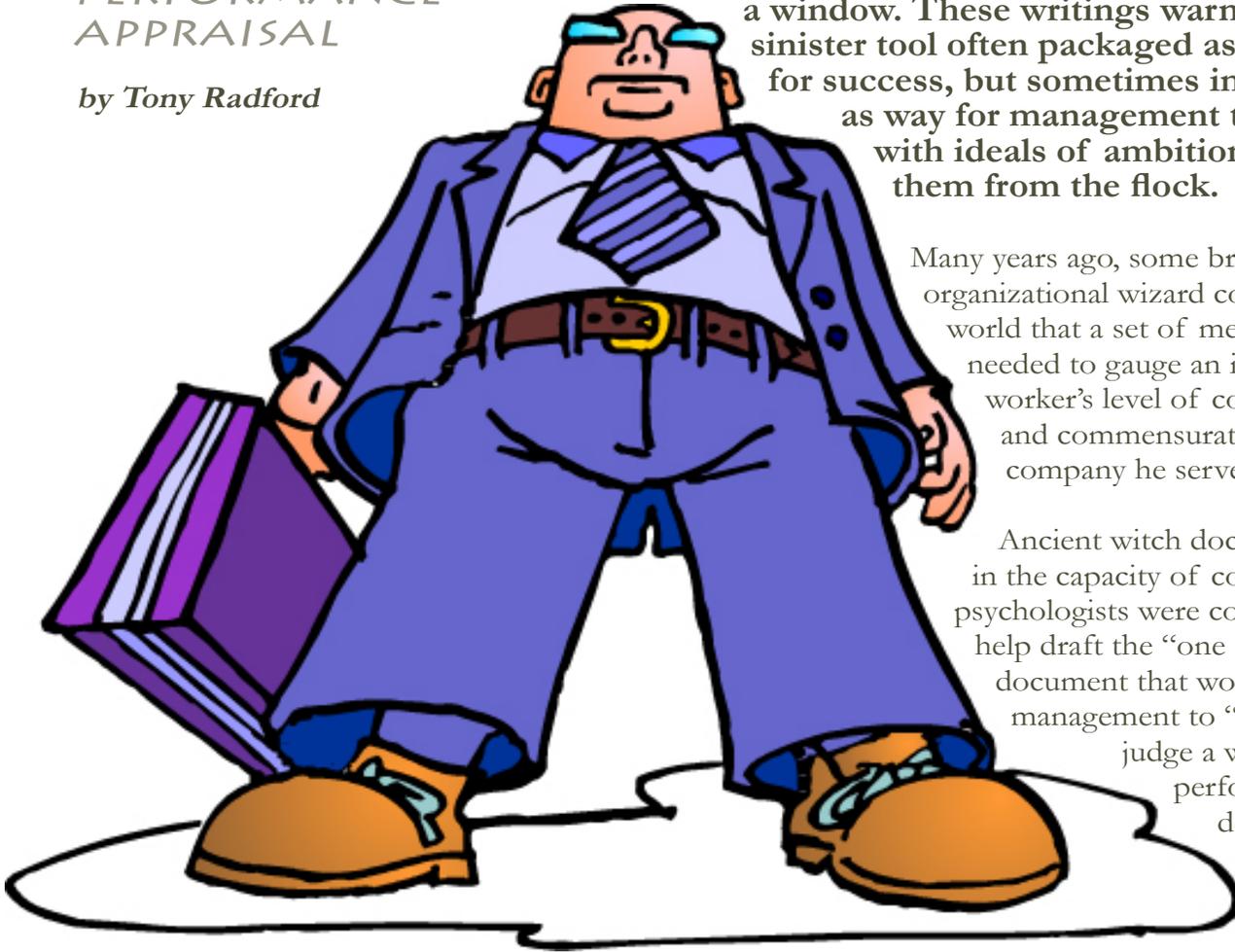


CHRONICLES OF
SATCOM

THE
PERFORMANCE
APPRAISAL

by Tony Radford

As is the case for many writings of wisdom, the *Satcom Chronicles* contain a section designed to prepare one for the treacherous trek from entry-level obscurity to a higher position of prosperity and perhaps even an office with a window. These writings warn us of a sinister tool often packaged as a vehicle for success, but sometimes implemented as way for management to trap those with ideals of ambition and weed them from the flock.



Many years ago, some brilliant, organizational wizard convinced the world that a set of metrics was needed to gauge an individual worker's level of contributions and commensurate worth to the company he served.

Ancient witch doctors operating in the capacity of corporate psychologists were consulted to help draft the "one size fits all" document that would allow management to "objectively" judge a worker's performance and determine his or her occupational fate — and so was born the

Performance Appraisal.

This new, scientifically-crafted tool spread throughout the land like wildfire, mutating in form along the way, becoming as much a weapon as a tool. This tool permeated organizations large and small and, akin to the most prolific of viruses, the ***Performance Appraisal*** struck defenseless workers during its annual outbreaks like clockwork, all suspiciously synchronized with the fiscal calendar.

The Performance Appraisal — with its dull, bone-crushing ability to send a wave of crippling fear into the hearts and minds of those in reflection of the past year, who wondered if their actions would invoke respect or disdain from the ivory-tower inhabitants who would ultimately decide whether this year's performance review would bear the ripe fruits of appreciation or a fast track to the firing squad. Or, even worse, would result in exposure to a humiliating stump speech highlighting your less-than-mediocre performance and commensurate sentence to continue service. In your present

The Performance Appraisal is an insidious document with the power to shape even the most powerful corporations.

capacity — though graced with probationary oversight that all but insures financial stagnation, or your eventual replacement, by some incompetent dweeb.

Carving the organizational chart with the artful precision wielded by *Michelangelo* himself, corporate managers would use the **Performance Appraisal** to mould their teams in their likeness by rewarding those whose noses could mimic the finger of the most skilled proctologist with enviable positions of power, while routing out dissidents whose hard work and valuable contributions might one day overshadow the paltry performance of the departmental leader and topple him or her from their throne.

Such is the course that was set eons ago and continues to this day. **The Performance Appraisal** is an insidious document with the power to shape even the most powerful corporations. Power, that left in the wrong hands, could have a devastating effect on the spirits of high achievers who lack prowess in the theater of company politics.

Many books have been written on the science of **Performance Appraisals** and how they might be capitalized upon to help forward one's career. They're often riddled with inspirational meanderings of *Confucius*-grade philosophy and examples of successes that stand as testaments of proof that their principles actually work.

Of course, the viability of their suggested tactics and strategies assumes the appraisal will be conducted with complete objectivity referenced to an accurate accounting of one's personal contributions and a sincere objective to see that he or she is recognized for dedication and loyalty to the logo. But, surprisingly, this is not always the case.

My performance reviews were often less than inspiring. I know the appraisal forms were not designed to capture and reflect my devotion and unrelenting desire to carry my corporate colors across the mined battlefield and onto the stage of market dominance. So I decided long ago that the **Performance Appraisal** was not likely to be a springboard to my success. Only by positioning myself on the front lines was I granted the opportunity to step on every mine and to eventually gain some notoriety from the resulting explosions, complete with dust clouds and flying debris.

Thanks to years of dedication, a bit of luck, and some help from the *Peter Principle*, I am now responsible for the perpetuation of this annual ritual. Thanks to the wounds I've sustained from the many **Performance Appraisals**

I've endured, I see this sacred event in a different light. I actually wrote my own form and invite my staff to grade me.



Tony Radford undertaking a task all good managers can accomplish... writing his own Performance Appraisal.

You see, I learned long ago the best strategy for success is to surround oneself with people who are more resourceful, clever, and ambitious than myself and to become a part of a successful, inspired team.



Now my challenge is to remain worthy of a position of influence and member of a team of staunch professionals passionately dedicated to the cause. There's nothing more inspirational than that — and to think I can credit all of it to the **Performance Appraisal**.



As we enter the New Year satellite industry event calendars quickly fill up with the most promising and business-enriching trade exhibitions such as **SAT EXPO EUROPE 2010** at Fiera Roma (Rome Fair) from February 4th through February 6th.

Professional participants will have expo access on the fourth and fifth, and on the sixth, the general public may also enjoy the exhibition. Exhibitors from around the globe will be present, including NASA (who will also conduct a panel session in the Mediterranean Center), and the latest technologies will afford attendees important information and connections to assist them in today's international satellite markets.

The conferences

- **Mediterranean Space Conference, 1st EGNOS European Conference**
- **European Earth observation systems**
- **Agricultural satellite**
- **Aerospace market and its new professions**
- **S Band and its new services**
- **3D Cinema via satellite**
- **European Installer Meeting**
- **Space applications and services: seminars and workshops**

Thematic areas

- **Navigation Satellite System**
- **Earth Observation**
- **UAV and USV**
- **Remote Sensing**
- **Advanced Telecommunication**
- **Satellite New Services**
- **Sat HD and Sat 3D**

Each admission ticket to **SAT EXPO EUROPE 2010** includes a free copy of the *SAT Expo 2010* catalog. Italy is a member of the European Union — visitors to the country will have to possess a valid passport, and for those attending from a non-EU country, possibly a tourist visa, as well. Rome Fair is less than 5 km from **Leonardo Da Vinci International Airport**, and there is regular bus and taxi service available during this event. Special rates for show attendees are available at the 4-star **Sheraton Golf Parco De'Medici Hotel & Resort** (*select the hotel graphic to the right for special rates and additional details*).



BREAKING DOWN BARRIERS

by Victor Barendse, *Wired Ocean*

The cost implication of the broadband communication of volumes of data is well known as a most important issue for ship owners and operators. Applications such as Internet browsing, downloading email with attachments, obtaining electronic manuals, and weather and navigation data for bridge and other critical systems are all shore to ship (download) intensive applications crucial to operational efficiency and important elements of crew morale.

The expensive nature of SATCOM equipment and satellite airtime, especially with the move to next generation per MB broadband systems, can prove prohibitive in allowing for the common use of such applications. However, by taking into account the fact that many of the applications are weighted towards downloaded data (*i.e.*, browsing), it's possible to reduce airtime costs and increase speed in a simple and effective manner.

As use of broadband data increases at sea, so too does the cost to vessels.

Using capacity on Ku-band broadcast satellites, **Wired Ocean** sends data to vessels via the boat's *satellite television antenna (TVRO)*. These satellites have much greater bandwidth than mobile satellite systems, thereby allowing for faster transmission speeds and lower usage costs. Data from the vessel is sent via the onboard SATCOM system or cellular terminal. As vessels using Wired Ocean are typically receiving much more information than they are sending, the majority of the broadband communication is at far more economical, fixed prices and superior speed. These lower and fixed costs enable ships/crew/shipowners to take advantage of broadband data volumes while maintaining their existing communications budgets. The reduction in costs can actually pay for the equipment installation within just a month or two.



Although reduced costs are usually the driving factor in the uptake of Wired Ocean, the **S-Box** (the heart of the Wired Ocean system) hardware and software also offers strong functionality as a communications hub and through various performance enhancing technologies can actually increase data speed. With always-on 512kbps downlinks (shore-to-ship-data), Wired Ocean's services are much faster than mobile satellite services. That's up to 50 times faster than some existing marine services, almost 10 times faster than Inmarsat Fleet, and almost twice as fast as Inmarsat FB250. Wired Ocean is also almost 10 times faster than the GPRS cellular service. To complement this outright speed, Wired Ocean has also incorporated state of the art performance enhancement systems at its network operations hub and in the S-Box to minimize latency (processing lag, or time, delay), remove unnecessary handshaking, and to compress transferred data. The S-Box can also be used as a switching device for a vessel's entire communications network and a unique caching system means that only new

content of previously viewed web pages needs to be downloaded for faster and more economical Internet browsing.

The Wired Ocean S-Box uses a robust **Linux** operating system and incorporates a firewall and communications encryption. It connects the ship's computers or network to the Wired Ocean service and seamlessly initiates, manages, and terminates connections as well as simplifying access of the ship computers or network to the Internet, without installing any software on the computers, using a user friendly web-based interface.

When considering the limited technical support aboard most merchant vessels, the simplicity of setting up and using Wired Ocean is not to be underestimated as an important driver in the system's growing acceptance.

The online experience for a Wired Ocean user is effectively the same as that of a broadband user on shore. Browsing, emailing, and so on, are completed using standard applications with no additional software needed. Behind the scenes, however, the Wired Ocean System is providing sophisticated data management:

1. The user enters a web address, accesses a database or email system, etc. The data request is sent from the computer through the Wired Ocean S-Box, which optimizes the data request for efficient transmission, and then transmits it via the SATCOM or cellular system on board to Wired Ocean's network operations hub (at normal airtime costs for the specific service).
2. Wired Ocean's network operations hub retrieves the requested data from the Internet and applies optimization techniques to the data before transmitting it through the selected satellite.
3. The data is received by the S-Box via the ship's satellite TV antenna. The S-Box ensures that the data is correctly received and delivers it to the requesting computer. This downlink part of the process is billed as Wired Ocean cost, hence the savings can be made.

Case study — wired ocean

The S-Box caches previously accessed webpages, and future requests for this data will be served directly from the cache, meaning that they do not become part of billable volume. When outside Wired Ocean's coverage (currently European and Scandinavian waters, but an expansion to the USA is planned), the S-Box falls back to using the vessel's dedicated SATCOM to receive data sent to the vessel as well as to send data from the vessel. Using the SATCOM equipment in this mode still makes use of various performance enhancement systems even when not within Wired Ocean's coverage, so the S-Box still provides value as part of the vessel's communications network.

As use of broadband data increases at sea, so too does the cost to vessels. Per megabyte pricing is notoriously difficult to predict, especially when considering multiple users and large downloads, which may include unplanned automatic updates to operating systems or anti virus software. Unexpected downloads could cost \$1,000s extra per month, but with Wired Ocean's fixed pricing, the cost will not fluctuate. By heavily reducing the cost of shore-to-ship data per megabyte Wired Ocean has already enabled vessels to maximise

their communications budget. The next step was to provide fixed pricing plans so that in addition to making broadband usage more affordable, there are no surprises in the form of unexpected, prohibitively high bills for downloaded data at the end of the month.

Five fixed price plans, designated *Beaufort 1-5*, have been introduced to the Wired Ocean service, ensuring that vessels can select the usage profile that best fits their needs. The plans, which are differentiated by the volume of priority data downloaded, start at less than \$300 per month. Gigabytes of data can be downloaded for less than \$1,000 per month.

All fixed price plans feature a maximum shore-to-ship data rate of 500 kbps, which is faster than many existing maritime broadband services. The new fixed price plans are also available with the cost of the Wired Ocean S-Box, the heart of the Wired Ocean system, included. The benefits of Wired Ocean, such as lower broadband usage costs, faster speeds, and greatly enhanced management of cost, could be achieved without any capital expenditure whatsoever.

Wired Ocean's new fixed pricing plans are available now. Visit www.wiredocean.com to learn more.



The successful test firing of the CASTOR® 30 second stage motor for Orbital Science Corporation's Taurus® II space launch vehicle on December 9th marked the beginning of a year-long systems testing campaign that will lead to the rocket's first flight in early 2011. The solid-fuel second stage motor, which is supplied to Orbital by ATK Space Systems of Magna, Utah, was test fired for approximately 150 seconds, producing 72,000 lbs. of maximum thrust. In order to accurately test the motor performance in flight conditions, the static fire test was conducted in a vacuum chamber at the U.S. Air Force's Arnold Engineering Development Center (AEDC) which simulated the upper atmospheric conditions at altitudes in excess of 100,000 feet where the motor is designed to ignite.

Taurus II is a two-stage launch vehicle designed to provide reliable and affordable access to space for medium-class payloads weighing up to 12,000 lbs. Orbital currently has a backlog of nine Taurus II launches that support NASA's cargo transportation requirements for the International Space Station.



The first launch of the Taurus II rocket is scheduled for March 2011 to demonstrate the capabilities of the cargo delivery system the company is developing for NASA under the Commercial Orbital Transportation Services (COTS) research and development project. NASA has also selected Orbital for an eight-mission, \$1.9 billion Commercial Resupply Services (CRS) contract, with operational missions to the ISS scheduled to begin in late 2011.

“We are very pleased with the results of the ground test of the Castor 30 motor, which performed according to the specifications built into the design of the Taurus II rocket,” said Mr. Brent Collins, Orbital’s Taurus II Program Manager. “The ground test of the Castor 30 motor is the first major event in the testing phase of the Taurus II development program, having completed the engineering design and procurement work over the past year and a half.

“In addition to the second stage testing, we will soon begin the testing process for the rocket’s liquid fuel first stage at NASA’s Stennis Space Center in Mississippi.”

TAURUS® II — ROCKETING AHEAD

by Baron Beneski, Vice President, Orbital Sciences Corporation



The **Taurus II** will use twin **Aerojet AJ26-62** engines with a combined thrust of more than 775,000 pounds to

power the first stage. These engines, originally designed and produced by **Samara State Scientific Production Enterprises**, have an extensive test history. They have been upgraded by **Aerojet** of Sacramento, California, to add *Thrust Vector Control*, modern mechanical and electrical actuation components, and U.S. sourced feedline components. In addition, significant progress has been made in the construction of a new facility at Stennis to perform the qualification and subsequent hot-fire acceptance tests of the main engine system. The facility is expected to be in operation and ready for testing to commence in March of next year.

Similarly, **Orbital Sciences** has made significant development progress in just a few short years by leveraging other key system components and suppliers with significant flight heritage and launch vehicle experience. These include:

- First stage tankage and associated components designed and built by Yuzhnoye / Yuzhmash of the Ukraine
- Avionics and Guidance systems derived from other Orbital successful launch vehicle programs
- Ground systems infrastructure designed and produced by a consortium of companies with extensive launch vehicle systems experience.

This “re-integration” approach of existing components and infrastructure enables Orbital to not only reduce the time typically needed to bring a new launch vehicle on line, but also significantly mitigates development risks.

In addition to the main engine test firing, Orbital has aggressive plans to accomplish other significant development milestones in 2010 including:

- Completion and activation of a new integration and launch facility at the Mid-Atlantic Regional Spaceport (MARS) on Wallops Island, Virginia
- Completion of 1st stage booster structural testing
- Component delivery, integration and static fire test of the 1st stage booster
- Completion and test of proto-flight payload fairing and other payload accommodations elements

While the company’s current backlog of nine flights is dedicated to supporting NASA commercial International Space Station resupply requirements, the Taurus II will be easily adaptable and a cost effective solution for other payloads, including mid-class satellites for civil government (*i.e.*, NASA and NOAA), military and commercial customers.

Through a systematic, detailed approach that builds on major proven systems, state-of-the art avionics and control elements and new launch and test facilities, Orbital is bringing the Taurus II launch system on line to meet the medium lift launch demands of the next decade.



The Space Foundation's *26th National Space Symposium*, set for April 12-15 at The Broadmoor Hotel in Colorado Springs, Colorado, is where all sectors of the space industry gather together to share perspectives and get down to business.

For four days in April, you can witness the largest gathering of space professionals in the world. Visit the *AMERICOM Government Services Exhibit Center*, which will be teeming with activity and overflowing with the latest in space technology. You can hear from the leaders who are shaping today's global space agenda — and meet the ones who will shape tomorrows. You can witness a spectacular opening ceremony featuring the eclectic and energetic musical group, *Barrage*. You can applaud as the **Space Foundation** recognizes organizations and individuals who have advanced space exploration, discovery, awareness, and commerce.

And, if you hurry, you can get a great deal.

Register for the *26th National Space Symposium* by February 5, 2010, and receive \$425 off the regular industry rate.

For details => www.NationalSpaceSymposium.org.

This year's **National Space Symposium** continues the tradition of excellence that the premier gathering of the global space community has established over the years. And, it mixes it up with two exciting new programs: a separate **Cyber 1.0 Conference** on Monday, April 12, immediately before the *Symposium* kick-off; and special programs and events for up-and-coming **New Generation** space professionals woven throughout the four-day event.



Cyber 1.0 Conference

Conducted by the Space Foundation, the **Cyber 1.0 Conference** will clarify **Air Force Space Command (AFSPC)**'s newly acquired cyberspace mission, which is the direct responsibility of the **24th Air Force**. It will feature AFSPC, government, and industry leaders who will provide an overview of the cyberspace mission and discuss the influence of the cyber domain on modern life, the **Department of Defense**'s cyber perspective, and cyber acquisition policies and procedures. Interactive AFSPC and industry demonstrations and a luncheon that looks at the domain from "inside the beltway" round out the program. The speakers include

- AFSPC Commander General **C. Robert Kehler**
- USAF Lieutenant General **Larry James, USAF**, Commander, Joint Functional Component Command (JFCC) — Space, United States Strategic Command, and Commander, 14th Air Force (Air Forces Strategic), AFSPC
- Major General **Richard Webber, USAF**, Commander, 24th Air Force.

The **Cyber 1.0 Conference** is a complementary event to the **26th National Space Symposium**, with a separate registration fee. There is a significant discount for *Symposium* attendees and space is extremely limited. For registration and more details, go to www.SpaceFoundation.org.

New Generation

Building on an initiative launched at the **25th National Space Symposium** in 2009, this year's event is offering expanded programs aimed directly at the younger generation of space professionals. The **New Generation** program will allow attendees to both be involved in the mainstream **26th National Space Symposium** program and to spend highly focused time concentrating on issues specific to new entrants to the burgeoning space industry. Program elements include mentoring opportunities that provide quality exposure to industry leaders, workshops for professionals in the early stages of their space careers — both commercial and military, representation on a wider range of main program panels and as master moderators, and a New Generation reception following at the close of the **Symposium**.



Main Agenda

The **26th National Space Symposium** program looks at opportunities and issues facing the global space community today, addressing all aspects of space, including civil, commercial, national security, ‘new space,’ international and its many related components. It includes presentations, panels, forums, and workshops featuring high-level space leaders, including:

- **Dr. William F. Ballhaus, Jr.**, Vice Chairman, Space Foundation Board of Directors, and former president and chief executive officer, The Aerospace Corporation
- **Steve Boehinger**, Director of Institutional Affairs, Euroconsult, and managing director, Euroconsult North America
- **Major General Charles F. Bolden, Jr., USMC (Retired)**, Administrator, National Aeronautics and Space Administration (NASA)
- **General Bruce Carlson, USAF (Retired)**, Director, National Reconnaissance Office
- **Ariane Cornell**, Executive Director, Space Generation Advisory Council
- **Lieutenant General Larry D. James, USAF**, Commander, Joint Functional

Component Command — Space, United States Strategic Command, and Commander, 14th Air Force (Air Forces Strategic), Air Force Space Command

- **General C. Robert Kehler, USAF**, Commander, Air Force Space Command
- **Dennis A. Muilenburg**, Executive Vice President, The Boeing Company, and President and Chief Executive Officer, Integrated Defense Systems



- **Major General Richard E. Webber, USAF**, Commander, 24th Air Force

The *Symposium* will also feature a panel representing three decades of **National Reconnaissance Office** leadership, moderated by **General Thomas Moorman, USAF (Retired)**, Chairman, Space Foundation Board of Directors, and former Commander, Air Force Space Command. Speakers will include:

- **Hans Mark, Ph.D.**, Under Secretary of the Air Force/Secretary of the Air Force and NRO director, 1977-1979
- **Edward C. Aldridge, Jr.**, Under Secretary of the Air Force/Secretary of the Air Force and NRO director, 1981-1988
- **Martin C. Faga**, Assistant Secretary of the Air Force for Space and NRO director, 1989-1993
- **Jeffrey K. Harris**, Assistant Secretary of the Air Force for Space and NRO director, 1994-1996
- **Keith R. Hall**, Assistant secretary of the Air Force for Space and NRO director, 1997-2001

- **Peter B. Teets**, Under Secretary of the Air Force and NRO director, 2001-2005

- **Donald M. Kerr, Ph.D.**, Assistant to the Secretary of the Air Force (Intelligence Space Technology) and NRO director, 2005-2007

- **Scott F. Large**, Assistant to the Secretary of the Air Force (Intelligence and Space Technology) and NRO director, 2007-2009

Special Programs

The **26th National Symposium** also features a number of special events:

- The invitation-only **Congressional Luncheon**
- The **Corporate Partnership Dinner** (additional fee for non-military registrants; included in Active Military/Government rate)
- The **General James E. Hill Lifetime Space Achievement Award Luncheon** (additional fee for non-military registrants; included in Active Military/Government rate)



- The *Space Technology Hall of Fame® Dinner*, featuring actor/director and space icon *Leonard Nimoy* (additional fee for non-military registrants; included in Active Military/Government rate)
- Special events geared for selected teachers and students (invitation-only)

Corporate Involvement

The *26th National Space Symposium* is made possible by the generous support of the following major sponsors:

- *AMERICOM Government Services* — the sold out Exhibit Center
- *AVIATION WEEK* — Media partner
- *Ball Aerospace & Technologies Corp.* — *Congressional Luncheon*
- *The Boeing Company* — *Corporate Partnership Dinner*
- *General Dynamics* — *Cyber 1.0 Luncheon*
- *Lockheed Martin* — *Space Technology Hall of Fame® Dinner* and space education activities for teachers
- *Northrop Grumman* — *Opening Ceremony*
- *Raytheon* — *General James E. Hill Lifetime Space Achievement Award Luncheon*

Other sponsors include *ATK, Cisco Systems, Inc., GMV, International Space University, Pratt & Whitney Rocketdyne, SAIC, Space News,* and *United Space Alliance.*



Additional sponsorship opportunities are available; interested companies should contact Sponsorships@SpaceFoundation.org. More than 140 companies are exhibiting in the sold-out AMERICOM Government Services Exhibit Center. To be put on the waiting list, companies should contact Exhibitor@SpaceFoundation.org.

The *26th National Space Symposium* promises to be informative, inspirational, and an excellent venue for making connections and conducting business.

For more information, including online registration, agenda, speakers, exhibitors, and sponsors, go to www.NationalSpaceSymposium.org



SPECTACULAR SYMPOSIUM BACKDROP — THE BROADMOOR HOTEL

The **National Space Symposium** has been at **The Broadmoor Hotel** in Colorado Springs, Colorado, since the **Space Foundation** first launched the gathering of space professionals 26 years ago. The Symposium has grown since

Located on 3,000 lush acres under the shadow of Cheyenne Mountain, The Broadmoor offers the spa; fitness center; two swimming pools; three outdoor hot tubs; one lap pool; 54 holes of championship

that time to become the premier meeting of all sectors of the space community — now encompassing more than 8,000 attendees, two exhibit halls, three full days of educational events, and new and exciting programs for up-and-coming space leaders.

Although it has grown along with the **National Space Symposium**, **The Broadmoor Hotel** has retained its position as one of America's finest grand hotels — so much so that last month **Forbes Travel Guide Five Star Awards** (formerly *Mobil Five-Star Award by Mobil Travel Guide*) honored The Broadmoor as a **Five Star** winner for 2010 — **for a record 50th consecutive year**.

The Broadmoor is the *only* property to ever achieve this status and is also the longest-running consecutive winner of both the **AAA Five-Diamond** and **Forbes Travel Guide Five-Star** awards. Additionally, the historic resort has the distinction in 2010 of becoming a triple Five Star winner with the addition of Five-Star ratings for both the **Penrose Room** restaurant and **The Spa at Broadmoor**.



golf, six tennis courts with tennis camps; children's programs; 24-hour room service; valet parking; pet-friendly accommodations; 24 specialty retail shops; and superb meeting, exhibition, and hospitality facilities. Even *National Space Symposium* attendees who aren't staying on property are able to enjoy the ambiance, the service, the tradition for excellence, and the spectacular view.

With a history dating back to 1891, The Broadmoor was built by entrepreneur *Spencer Penrose* to rival Europe's finest hotels, and its grounds include a museum of vintage carriages and automobiles. In addition, some *26th National Space Symposium* events are held at the adjacent **Penrose House**, Spencer Penrose's gracious antique-filled home and gardens.

"The beauty, elegance, and history of the The Broadmoor create a fascinating backdrop for discussing global space endeavors," said Space Foundation CEO **Elliot Pulham**. "This is just one of the reasons there's no other event like the *National Space Symposium* anywhere in the world."



THE KAZAKHSTAN TRAIN CONNECTION — ALL ABOARD —

It's early Sunday evening in Almaty, Kazakhstan's biggest city. Hundreds of commuters, mostly business people, board a train at the National Railway Station for the overnight journey to the capital metropolis of Astana.

It's a twelve-hour trip north that has long kept company executives and government workers painfully out of touch. Determined to add Internet access, email, and reliable phone services to its most popular commuter rail, the National Railway Company and its telecom arm, Transtelecom, turned to Astel, one of Kazakhstan's leading telecommunications providers. Connectivity can be fleeting, especially at speeds of up to 140 kilometers per hour over vast stretches of diverse countryside. However, Astel had a plan and a technology partner to make reliable high-speed broadband a reality aboard the high-speed train.

Reach and Reliability

A seasoned telecom services innovator, Astel relies heavily on satellite to meet the communications needs of companies, consumers and government agencies throughout the Asian country. The firm has a long-term agreement with SES WORLD SKIES for more than 100 MHz of transponder capacity to support VSAT networks and a wide range of other connectivity services. Part of that capacity has been tapped to provide groundbreaking communications capabilities to National Railway passengers traveling the 1,300 kilometer route between Almaty and Astana.

As part of the historic deployment, Astel is using the Middle East beam on SES WORLD SKIES' NSS-6 satellite to deliver the trio of Internet access, email and VoIP telephony services onboard the train. The mobile communications, featuring transmission speeds of up to 2048 Kbps, are being offered free of charge to passengers along Kazakhstan's busiest rail line. Other trains and rail routes are expected to be added in the near future.

"Our delivery of The National Railway Company's broadband and telephony service marks a significant first in Kazakhstan," said *Vladimir Breusov*, President of Astel. "The expertise of SES WORLD SKIES people and the reliability and reach of its satellites have enabled Astel to provide this innovative service that is keeping commuters connected and driving economic growth across the region."

From the Drawing Board to the Tracks

The Kazakhstan milestone represented a big technical challenge. The railway wanted quality services for its passengers on the go. No interruptions for this discerning crowd. Using a 5.6



meter antenna aimed at **NSS-6**, fiber-optic backhaul, a robust telephone network plus a 0.5 meter dish and Wi-Fi network on the train, Astel had the platform in place for the reliable service delivery.

Early tests revealed the downloading of web content and access to the Internet and email services were consistently good, as long as the duration of satellite **NLOS** (*non line-of-sight*) remained under 18 seconds. The 12-hour commuter route never posed NLOS issues. Likewise, the VoIP telephony works from start to finish and provided higher quality phone service over GSM. The first train offering the new, free services rolled out of the station in August 2009. Response has been positive, usage rates increasing and expansion plans already in the making.

A Moving Success

“By delivering connectivity to one of the busiest and longest commuter routes in Kazakhstan, Astel is contributing to the country’s business productivity in ways not possible before,” said *Scott Sprague*, Senior Vice President of Global Sales at **SES WORLD SKIES**. “We’re honored that SES WORLD SKIES’ knowhow and satellite capacity is making Astel’s vision and ambition a

historic reality for The National Railway Company and its passengers.”

“It was absolutely essential that we develop accurate transmission parameters. That was certainly one of the biggest challenges facing the engineering teams,” explained Astel’s *Breusov*, noting Transtelecom played a vital role in the rollout. “Astel and SES WORLD SKIES technicians collaborated to calculate the optimal satellite link necessary for the reliability and quality service levels behind the National Railway Company’s successful launch.”

The pilot phase of Kazakhstan’s first connected commuter rail “has exceeded all expectations,” *Breusov* said of the emerging service. “The NSS-6 satellite provides the best coverage over Kazakhstan and SES WORLD SKIES has the local, Russian-speaking staff capable of solving our challenges on the fly with knowledgeable and effective solutions,” *Breusov* added.

More National Railway trains will be equipped early next year, as the service goes commercial aimed at keeping thousands more commuters in touch on the go.

Executive Spotlight

**DAVID MCCOURT, CHAIRMAN + CEO
SKYWARE GLOBAL**

In 2008, David C. McCourt formed Satellite Holdings, LLC, a partnership between private investment firms McCourt Capital, LLC and The Edgewater Funds. Since then he has begun a series of high-profile acquisitions to found Skyware Global — the world's first total solutions provider of antenna systems. Here he gives us his industry predictions and explains why Skyware Global is well-positioned to support future growth.



SatMagazine (SM)

Mr. McCourt, can you give us a bit more background to your founding Skyware Global?

David McCourt

Of course. Satellite Holdings, LLC was founded in late 2008 with a view to forming a company that could fill a gap in the market for an all-round antenna systems provider that would take responsibility for the overall product. Having over 30 years of experience in the cable and telecoms industries I knew that it was important to take niche players seriously and get a full understanding of where the

opportunities lie. I had spoken to satellite providers, who told me that they would welcome a company that took responsibility for the entire outdoor unit.

We acquired the Raven Group, the leading provider of consumer satellite broadband antennas, on New Year's Day of last year, and shortly merged it with nearly half of ASC Signal Corporation's total business. This included: the DTH, VSAT and RF business units, as well as Germany-based Skyware Radio Systems, a unit previously owned by Philips Electronics, and ASC PRC, the operating entity located in China.

The Raven Group had existing operations in Illinois, USA, Accrington, U.K. and China. However the acquisition has added manufacturing facilities in North Carolina, USA, and Zhuhai, China, as well as R&D and engineering offices in England, Scotland, and Germany. With one of the world's leading research and development divisions, we believe the companies have merged to fill the gap that we identified in the market to form the only global total solutions provider of integrated outdoor units and associated electronics and equipment.

Executive Spotlight

SM

Why did you consider the Raven Group to be an attractive investment?

David McCourt

Raven's strong microwave business first caught our attention. Their RF microwave engineers are among the very best in the industry and they know how to design and manufacture equipment to perform a certain task at a certain price point. The company already had a reputation as a leader in the design, manufacture and distribution of components for the global consumer satellite industry, and had proven itself to be an attractive investment, demonstrating growth of over 50 percent per annum for the past four years.

Their customers provide direct-to-home satellite services in remote regions around the world that can't access cost-effective services via cable. This market is expected to expand thanks to the growth in worldwide demand for high-bandwidth and video applications.

SM

What was the motivation behind the subsequent mergers with ASC business units, including Skyware Radio Systems?

David McCourt

In much the same way that Raven is at the forefront of the design and manufacture of components for the consumer satellite industry, ASC holds a leading position in the enterprise market. Besides the markets that they operate in, the acquisition has created a lot of synergies, for instance the product materials and global reach of both companies differ so that together we have created a company that offers the full suite of products to any territory, for any application.

Thanks to investment in expansive countries such as India, China and across the continent of Africa, the concentration of high-growth companies in these regions have and will continue to deliver significant opportunities in the enterprise market.

Skyware Radio Systems was part of the same private equity group as ASC, so we acquired them as part of the merger. Raven is more of a mechanical company and Skyware Radio Systems is more of an electronics specialist, so the companies brought capabilities together that complemented and improved each other.

We must not overlook the electronics units though as they form a major part of Skyware Global's offering. Electronics enable us to offer an end-to-end package, meaning that we are the only company accountable for the entire system.

All parts of the business work together to deliver complete outdoor systems. This means that Skyware Global can optimize systems, properly developing and designing units to work together right from the concept stage.

SM

What are your predictions for the global satellite equipment markets in 2010 and beyond?

David McCourt

As we make the move from Ku- to Ka-band frequencies we will see a transformational change in the industry and a marked improvement in the bandwidth capabilities of broadband via satellite.

Raven was the first to develop consumer Ka-band two-way antennas and the first contract with WildBlue was signed in 2003, and rolled out the following year. Raven was the first to develop and provide large volumes of consumer broadband products to the market at an attractive price. Using existing DTH technology, Raven developed and improved on the designs, to offer Ka-band products that were economical on price, enabling our customers in turn to offer a very attractive and competitive offering.

Up until now, Ka-band has remained very much specific to the North American market. Currently, in the USA for example, Ka-band accounts for around 80 percent of satellite broadband provision.

Executive Spotlight

Interestingly there has been a huge take-up in cities as well as rural areas in the USA. However, with two major satellite launches scheduled for this year and next, the door will be opened for satellite broadband provision in Europe.

SM

Which satellite launches are you referring to?

David McCourt

Avanti Communications is due to launch the Hylas satellite in 2010, which is expected to serve several hundred thousand people in the UK alone, whilst Eutelsat's KA-SAT in 2011 will target 15 million homes across Europe. With the launches of these satellites and reasonable rates for consumers, we foresee the consumer broadband market expanding in a similar way to the U.S.

Demand for content over the Internet is expanding faster than ever before and the advent of higher broadband speeds via satellite will enable satellite broadband providers to supply high-bandwidth and video applications to consumers. For the first time in Europe, satellite providers will be able to seriously compete with the level of broadband services delivered by cable and fiber providers.

In the U.K., the government's Digital Britain initiative, which has a minimum target of 2mbps broadband provision for all, will only happen in time via satellite. Digital Britain echoes Obama's pledge for investment in the broadband infrastructure in the U.S., and other similar schemes are being developed in countries all around the world. Satellite can offer close to 100 percent geographic coverage, allows rapid and flexible deployment and has a low carbon footprint. It is the single, most effective route to achieving these goals.

SM

You've spoken a lot about consumer broadband. Do you see opportunities in the enterprise broadband market as well?

David McCourt

Absolutely. The enterprise broadband market is very well-positioned for growth in the coming months. Large demand for VSAT terminals in India, Africa and South-East Asia in particular, coupled with the speed and ease of deploying broadband via satellite for high-growth businesses — it is far cheaper and easier to add an extra customer via satellite than via a wire-based product — put it in a strong position for the future.

The geography of these regions is such that cable and fiber services often can't reach businesses so the provision of services via satellite will become paramount to their everyday activities. Being a global company, with manufacturing in U.S., Europe and in the Far East, puts us in the happy position of being able to provide our systems at low cost and from multiple locations.

SM

In summary, what is your overall strategy for 2010?

David McCourt

Our total focus is on delivering consistency, quality and efficient worldwide logistics to ensure that our partners can offer a quality service at a reasonable price. We are continuing to invest heavily in our R&D, to offer cutting-edge products to our customers. As Skyware Global continues to grow we will be able to extend our worldwide presence even further to offer an ever more tailored and cost-effective offering to each of our clients around the world.



SURVIVING THE DEADLIEST CATCH
WITH SAILOR® ONBOARD

Northwestern is one of the featured boats in the Discovery Channel's smash hit show, *Deadliest Catch*, which documents the king crab fishing industry in the Bering Sea, and airs in over 150 countries. The show has made Skipper *Sig Hansen* famous, but fame doesn't make time at sea any safer, easier or more profitable.

Northwestern has one of the best safety records of any fishing vessel in the Bering Sea and *Sig*, like many fishermen, believes that safety success is derived from experience. He also believes technology can play an important, non-direct, supporting role, helping him to make decisions and communicate with his crew and the land-based operations.

"It's all about experience but technology can make it safer. I think technology is improving, but then it's up to the people that use it to know what to do with the information at hand. Especially with weather reports," explains *Sig*.

Communications Package

In May of 2009, *Sig* had the entire communications system on **Northwestern** replaced with a brand new **SAILOR** SATCOM system, VHF, and GMDSS communications package, all headed-up by the flagship **SAILOR 500 FleetBroadband**, which, according to *Sig*, will be used for operational applications and the crew's personal use.

“We have had the same SAILOR VHF at the helm of **Northwestern** since 1987. I was thinking to myself, ‘how many times have I hit those buttons?’ And it’s still going strong. So SAILOR is obviously high quality stuff and we’ll make sure we put the gear through its paces,” says *Sig*.

Extreme Conditions

Trusted and reliable communications equipment is important to *Sig*, especially when he describes 60 foot waves, terrifying gusts of wind and ice building up to more than a foot thick — all conditions the **Northwestern** and her crew must

cope with on a regular basis. Having access to the Internet on board, delivered by the SAILOR 500 FleetBroadband system, has enabled *Sig* to have far greater control of where **Northwestern** should be and what she should be doing.

“My wife would get weather reports from the Internet for me early in the morning. The stations would get the weather but not transmit until later in the day so I was always a few hours ahead. Sometimes a three-quarter hour period is enough time for you to get the hell out of town and get to where you need to be going. So that was a big deal,” according to *Sig*. “Now though, I just get online myself in the morning, which means I don’t have to wake my wife up at 4 am. That’s an even bigger deal.”

“We still fight the weatherman though, because, let’s face it, time is money. You want to stay out as long as you can, until you feel that you absolutely have to go in. Which was the case on a recent trip,

CASE STUDY — THRANE & THRANE

when the weather was closing in on our last day of fishing. I kept pushing it and pushing it. Those 2 or 3 hours extra, then we got around the island before she really blew. Most of the other boats left several hours prior to me leaving, but I knew I had an 80 or 90 mile run, 8 or 9 hours and sometimes staying a little bit longer can really count, but you have to know that you are safe.”

Crew Morale

Sig is highly enthusiastic about the state-of-the-art SATCOMs he now has onboard as he experiences how many different ways the communication system can help to improve safety and efficiency, from regular maintenance and equipment malfunctions to accidents and emergencies. However, just as important to *Sig* is the fact that his crew now has a reliable link to home, which is vital for maintaining high morale.

“I really enjoy the fact that the crew can contact their loved ones. What could be more therapeutic than that? I have no problem with the guys using it. I tell them, ‘hey, call home, you need to call home.’ It’s like therapy for them, and then they are much better,” *Sig* said.

About Thrane & Thrane

Thrane & Thrane is a leading manufacturer of equipment and systems for global mobile communication based on sophisticated satellite and radio technology.

Since its incorporation in 1981, the company has established a strong position within global mobile communication

solutions based on the Inmarsat system, and today Thrane &

Thrane provides equipment for maritime, land-based and aeronautical use. The company’s products are sold throughout the world under the brands Thrane & Thrane, EXPLORER® and SAILOR® through distributors and partners and as OEM products.

Thrane & Thrane has approximately 650 employees and is listed on the OMX Nordic Stock Exchange in Copenhagen.

The logo for Thrane & Thrane, featuring the company name in white serif font on a dark blue rectangular background.

TUBESAT PREPS FOR NEPTUNE 30

by Randa Relich Milliron, CEO, Interorbital Systems



Interorbital Systems (IOS), based in Mojave, California, is a rocket manufacturer as well as a small satellite developer. The Company recently announced the names of the teams and experiments slated to fly on the first orbital launch of the company’s new modular rocket, the NEPTUNE 30.

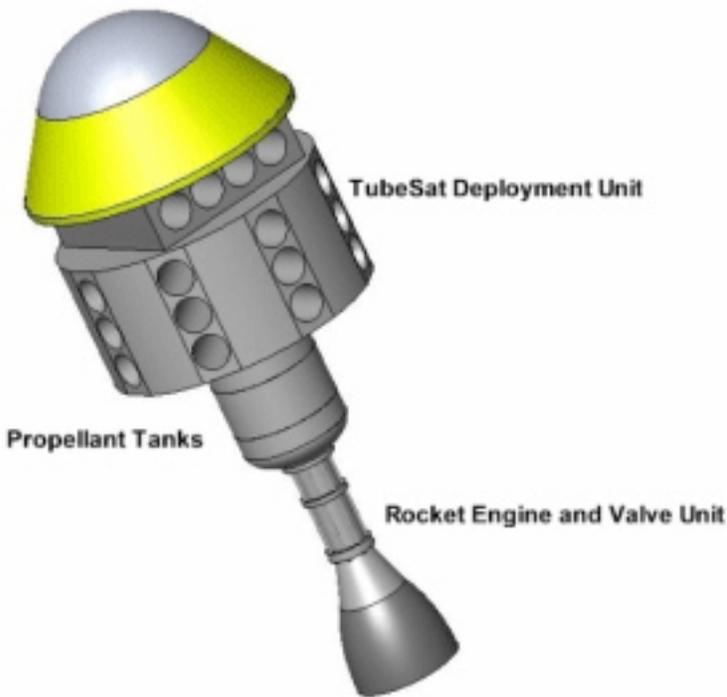


The rocket and its payload represent technological and price breakthroughs. By combining Interorbital’s ultra low-cost, new cylindrical picosatellite — the TubeSat — in combo with their dedicated small satellite launcher — the N30 — IOS has become an industry gamechanger. The Company offers Personal Satellite Kits plus launches for only \$8,000. The first N30 mission will carry a manifest of as many as 32 TubeSats, or two traditional standard CubeSats and 29 TubeSats in a mixed launch.

The current list of satellites set to fly includes those of Kentucky’s **Morehead State University Space Science** (MoSU) program, led by CubeSat inventor *Bob Twiggs*, who joined the **TubeSat** mission with the desire “to enhance the practical hands-on engineering experience” his evolving curriculum at MoSU offers. He sees the TubeSat Kit as “the perfect educational tool.” Bob and his students will collaborate with what may be the youngest team to launch a satellite, the students of the **Aslan Academy**, a private southern California high school team, led by *Talbot Jaeger*. The Aslan group will develop a propulsion system for the spacecraft, which will be built as a double TubeSat. The **Morehead-Aslan** project has a secondary function: to run as a testbed and proof of concept demonstration for applications to be used on a future grand-scale mission, the **QB-50**.



N30 Satellite Module



From the Arts sector comes **Project Calliope**, a cross-discipline music experiment described by program director *Sandy Antunes* as “an ionospheric detector transmitting sonifiable data back to Earth for web streaming and remixing. Conceptually, it’s a musical instrument in space, played by space rather than just after-the-fact sonified. We like the idea of flying something in space whose purpose is to make music until it dies — music from science.”

The **InterAmerican University of Puerto Rico’s** orbital experiment, led by Dr. *Hien Vo*, will represent the first group from a U.S. Territory to launch a science payload using the new TubeSat form-factor. The **University of California Irvine’s UCISAT-1** project, managed by students *Allen Giragosian* and *Anabita Sidhma*, signed on as the first CubeSat in the mix. The primary mission objective of UCISAT-1 is to capture images of Earth and transmit them to the **K6UCI** ground station located on campus. The secondary mission objective is to record and transmit angular

velocity data taken from UCISAT-1’s passive inertial sensor.

The most recent addition to the luminaries flying on the N30’s maiden voyage includes the **Naval Postgraduate School**. NPS has signed on for three TubeSat orbital launches and two test flights. Principal Investigator Dr. *Alex Bordetsky* commented, “We plan to use TubeSats as ad hoc orbital nodes in the TNT (Tactical Network Topology) testbed experiments, to forward tagging and tracking data globally. These small satellites are perfect for use in testbed development.”

NPS has also signed on for two of the N30’s **CPM** (*Common Propulsion Module*) low-altitude test flights, joining Morehead State as IOS’ first suborbital payload customers. The first launch (scheduled for the end of February) will test equipment and telemetry. During the second launch in May, another CPM — the basic building block of the 5-module **NEPTUNE 30** orbital rocket — and TubeSat hardware will play an active role in a worldwide **Maritime Interdiction** exercise involving NPS and **Lawrence Livermore National Laboratory** as leads, with partners including the **Homeland Security Office of Science and Technology**, and **USOCCOM**. IOS’ TubeSat platform will perform an important task in data forwarding — a precursor to the picosat’s future role as the orbital component in a complex realtime communication web.



In addition to those already signed on, 20 additional experimental teams have reserved payload space with sales pending (satellites are added to the manifest only after full payment is made). The NEPTUNE 30 was originally designed to launch a 32-TubeSat payload, or 15 CubeSats, but the customer base began to demand CubeSat launches and double or triple TubeSat placement. To keep the costs at affordable, academically accessible levels, no more than four Cubesats will be flown on the specially priced academic launches, leaving space for 26 TubeSats to launch at the original \$8,000 rate. The base price per standard TubeSat Kit, including launch, is \$8,000. The cost per Cubesat launch (no kit) on a mixed manifest flight is \$12,500. The price per satellite aboard an all-CubeSat NEPTUNE 30 launch will be \$18,000.

Four low-altitude (15km/10mi) suborbital test launches of the NEPTUNE 30 components are scheduled throughout 2010 prior to the first orbital launch. The first three pre-orbital testflights will

evaluate the performance of a single CPM and related launch systems. The last testflight will be conducted with an all-up 5-CPM NEPTUNE 30. Payload space is still available for all suborbital flights on the NEPTUNE CPM launches. Prices start at a minimum of \$500/kg.

The Technology

Two technologies make **Interorbital Systems'** low-cost space program possible: the **TubeSat** and the **NEPTUNE 30 Modular Rocket**, both developed in-house. After studying the small satellite market for the last two years, and seeing the need for low-cost alternatives to existing small sat sources and launch options, IOS invented the **TubeSat Personal Satellite (PS) Kit** and offered it to the space community with a launch to orbit on the IOS NEPTUNE 30 rocket at the combined price of \$8,000. Interorbital's co-founder and CEO *Randa Milliron* commented, "Starting now, private ownership of a piece of space real estate is possible — and at an irresistibly affordable

cost. Planet Earth has just entered the age of the Personal Satellite.”

With its low cost and flexibility of use, the TubeSat Personal Satellite Kit offers endless possibilities. What exactly can one do with one’s own spacecraft? For the general public, it’s an opportunity to send a loved-one’s ashes or mementos to orbit in a tiny private mausoleum. For tekkies, artists, scientists, or hobbyists, this is a chance to broadcast personal messages from space, track migrating animals, photograph and chronicle climate change, conduct sustained zero-G science, send private email, play

Debus), the NEPTUNE 30 is an evolved OTRAG ‘tank bundle’ vehicle, enhanced with modern updates and innovations.

The basic building block of the NEPTUNE Modular Series rockets is the **Common Propulsion Module (CPM)**. A single Common Propulsion Module’s primary components include an oxidizer and fuel tank, a pair of propellant valves, a choice of two liquid rocket engines, and a secondary fluid injection roll and ACS system. The length of the CPM propellant tanks is varied according to the launch application.

Common Propulsion Module (CPM)



a new musical release from orbit, study cosmic ray activity, space-qualify hardware, or advertise a product, company, or cause — all from one’s own orbiting platform that is tearing through space at over 17,500 miles-per-hour.

“The TubeSat was originally designed as an academic program, made for the scientific community as a way of actually flying the backlog of hundreds of small satellites that were gathering dust on lab shelves for lack of a launch. I designed the satellite, and its 32-pack deployment system in the same way I designed the rocket that launches the TubeSats — by achieving ultra low cost through a radical simplification of systems. The TubeSat program could not be possible without the NEPTUNE 30 Rocket.” IOS co-founder, President, and Chief Technology Officer, *Roderick Milliron*, stated. “It’s the NEPTUNE 30 and the use of identical modules that make this type of low-cost rocket manufacturing and affordable satellite launch possible.”

Based on a common-unit, modular launch vehicle concept first explored in the 1970s by *Lutz Kayser*’s **OTRAG** team (the world’s first commercial launch company that included *Wernher von Braun* and *Kurt*

By clustering the CPMs, several launch vehicles can be configured for specific space mission requirements. The most basic cluster, consisting of five (5) Common Propulsion Modules, is designated the NEPTUNE 30. The number 30 is the mass in kilograms the launch vehicle can place in a 192.2-mile (310-km) polar orbit. Other configurations include the NEPTUNE 1000 with 33 CPMs and the NEPTUNE 4000 with 84 CPMs.

Many of the CPM components, such as the propellant valves, the propellant valve control hardware, and some rocket engine components are available off-the-shelf. The application of COTS components drastically reduces the cost of each CPM by decreasing the manufacturing time and labor requirements (man-hours).

Two production models of engine are used in the NEPTUNE launchers: a **Booster Rocket Engine** and an **Altitude Rocket Engine**. These bipropellant liquid rocket engines are designed, manufactured, and tested in-house at IOS, and are the result of a 14-year private-sector research and development program.

Orbital Tourism and Lunar Missions

As the common-unit rocket system is so flexible, launch vehicles for more demanding missions can be easily customized and enhanced by adding additional identical modules. The 33-module **NEPTUNE 1000** is designed to place a 132-pound (60-kg) payload on the surface of the Moon or a 200-pound (91-kg) payload into Lunar Orbit.

Interorbital Systems is also the launch provider for its **Google Lunar X PRIZE Team SYNERGY MOON**, using the N1000 as its Moon rocket. The Stage-Four CPM of the NEPTUNE 1000 is the rocket's **Translunar Injection Stage**. Following the **GLXP** flight, IOS plans to conduct a number of **Lunar Sample Return Missions**. Pre-sales of Lunar Material are already in progress.

The NEPTUNE-series rockets will carry IOS' orbital tourists on true spaceflight adventures consisting of long-term orbital experience. The

NEPTUNE 1000's two-person Crew Module is designed to carry two orbital explorers into Low-Earth-Orbit. It is equipped to stay in orbit for a little more than half-a-day or eight orbits. Safety features include a launch escape tower.

The Crew Module will be launched into a self-decaying orbit for assured reentry. Two test pilots, *Miroslav Ambrus-Kis* and *Nebojsa Stanojevic*, members of the SYNERGY MOON GLXP Team, will fly on the rocket from IOS' private spaceport in the South Pacific Kingdom of *Tonga* in 2011. The cost will be \$800,000 per astronaut (a maximum of two in number). The base cost for a single customer will be \$1,600,000. For space tourism or cargo purposes, launch costs will vary according to the orbital mission vehicle configuration.

The **NEPTUNE 4000** is an orbital tourism rocket with a six-crew member capsule designed for LEO expeditions lasting up to seven days. These



flights are scheduled to begin in 2012 at a cost of \$5 million per ticket, or for a limited time, at \$250,000 for each of eight remaining 'Free Tickets to Space' promotional fare tickets. *Tim Pennington Reed* purchased IOS' first multiple-day orbital flight ticket. Another customer has placed a deposit on the second ticket for the N4000's maiden voyage. Only through complete vertical integration could a Commercial Space program such as Interorbital Systems' exist. It hinges upon three mutually dependent factors: the creation of rocket engines and launch vehicles evolved and constructed via radical simplification of systems; operating independently at a private spaceport (either land or sea-based); and offering the world's lowest-cost satellite and launch package.

No other company can currently match this mix of practicality and innovation — no other company can offer orbital access in the same price range as IOS. This means... A new day in spacelaunch!

TubeSats and NEPTUNE 30 launchers open space to everyone. Public and private-sector space enthusiasts can now seize these new tools that Interorbital Systems has made available to them — to access space, and to do such affordably.



Interorbital's new vertical static test stand

About Interorbital Systems (IOS)

The Company is located at the Mojave Airport and Spaceport in Mojave, California. The company carries out its operations at facilities consisting of a 6,000-square-foot office and manufacturing center, and two private rocket engine test sites. IOS conducts test launches at the Mojave Test Area (MTA) in the desert North of Mojave and at Delamar Dry Lake in Nevada, where it is authorized by the FAA to launch rockets to a maximum altitude of 10 miles — ideal for flight-testing hardware. The Mojave Airport and Spaceport offers easy aircraft access for business and general use. For more info, email ios@interorbital.com

MATCHING THE PACE OF AEROSPACE

by Tim Nichols, Managing Director, Siemens PLM Software

Femap enables more accurate and comprehensive analyses of satellite mechanisms, this in spite of development cycles that have been sliced in half.

400 Satellites Launched Into Orbit

RUAG Aerospace Sweden supplies a variety of equipment for satellites and launch operations for companies around the world. Its customer roster includes satellite companies in the U.S., Japan, Europe, and Russia, and its product line includes computers and data handling equipment, antennas, microwave electronics, satellite structures, rocket guidance systems, ground support equipment, payload adapters and payload separation systems.

Payload separation systems keep satellites safely attached to the launch vehicle during the tough journey toward outer space. Then, at a precise moment in the launch sequence, these systems activate to deliver the highly valuable cargo (the satellite) into the desired orbit with the correct amount of velocity, roll, and spin.

RUAG Aerospace Sweden is the commercial market-leading supplier of payload separation systems, with a history encompassing more than 400 in-orbit separations — all of them successful. These systems, along with the adapter structures that connect the launcher with the satellite, are designed and built at the **RUAG Aerospace Sweden Mechanical Products Division** in Linköping, which is about 200 kilometers south of Stockholm in Sweden.

Three Months For New Designs

As separation systems and adapter structures are some of the last equipment to be built, there is pressure on the team at Linköping to work very quickly. In fact, over the last decade, the cycle times for its products have dropped significantly.

“The majority of that time is spent in manufacturing, which means that today we have about three months to design a new separation system. This is very fast,” explains *Leif Håkansson*, head of engineering in the **Mechanical Products Division**.

The design effort includes the creation of vast amounts of documentation, which weigh more than the hardware itself, according to *Håkansson*. In addition to the documentation, another deliverable is a validated finite element model of the adapter and separation system. *Finite element analysis (FEA)* plays a huge role in the design process for payload separation systems, allowing engineers to observe the performance of their designs at an early stage and to optimize them (to reduce weight, for example). Engineers at RUAG Aerospace Sweden’s Mechanical Products Division use the **Femap®** pre- and post-processor from **Siemens PLM Software** to prepare finite element models for analysis and to visualize the results.

FEA Software Addresses Multiple Needs

The division selected **Femap** for a number of reasons. One was its “excellent performance-to-cost ratio,” according to *Jan-Erik Larsson*, who is lead engineer at RUAG Aerospace Sweden’s Mechanical Products Division. “This ties in with our corporate goal to reduce overhead costs,” *Larsson* explains. “With Femap, we get what we need at a very reasonable price.”

Another reason for the selection of Femap was its ease of use. “A user-friendly environment was important to us because the engineering work at RUAG Aerospace Sweden involves different duties and we don’t work 100 percent of the time with one single software,” *Larsson* says. “It is possible to come back to Femap after weeks of not using it and work very efficiently with it again.”

Femap’s ability to interface with other CAD and analysis formats is very important to the division. “We frequently exchange models with customers. The ability to import geometric data instead of recreating it saves time and costs,” *Larsson* explains. “With other pre- and postprocessors, this is an option you must pay for,” he continues. “You have to request the license and then wait a few days. It is a lot of money for a simple thing and we appreciate the fact that this ability comes free with Femap.” In addition to saving time and costs, the ability to import geometry enhances the quality of the analysis that the division performs. “In many cases, if you couldn’t import that geometry you wouldn’t add it to your model because it would take too long or result in a reduction of details,” says *Håkansson*. “This feature of Femap lets us add more detail to the models so we get more accurate results.”

Finally, the division appreciates the fact that Femap is reliable and robust. “We are quite satisfied with its performance,” says *Larsson*. “We also appreciate that Femap is always fully backward compatible so that when we get a new version we can still import old files. We need to do this sometimes for various reasons, and we appreciate that Femap has a strategy that allows this.”

Faster, And Yet More Accurate Analysis

Building analysis models with Femap is sometimes done by importing CAD geometry (usually in **STEP** format) and then using the software’s automatic meshing capability to generate the finite element mesh. This works very well, according to *Larsson*, and has reduced the time for creating complex finite element models from one week, when engineers worked from drawings, to less than one day today.

In other situations, engineers use Femap's modeling tools to create their own geometry. This is done for some thin-walled structures and for graphite components such as the adapters that connect the launcher with the satellite. "Femap's ability to model these structures, particularly those with laminate properties, is very important to us," Larsson notes. "It's easy to use and having this capability in Femap eliminates the need for additional laminate software, which reduces the analysis effort and improves the results."

These qualities of Femap have helped speed analysis turnaround time, which is important now that the division has seen its development cycles essentially cut in half. But analyses are not only done faster, they are more accurate as well. Because the analysis models can be prepared so quickly, engineers use some of the time that's saved to make them more detailed. And with the ability to import customers' FEA models regardless of format, engineers can more easily include adjacent structures in their analysis models. "We import

complete models of satellites and other adjacent structures, something that was more difficult to do before," says *Håkansson*. "It's a benefit to all parties to analyze a complete system rather than one thing in isolation."

About the author

Tim Nichols is responsible for coordinating the efforts of a worldwide cross-functional group that is dedicated to the Global Aerospace & Defense Industry, including commercial and general aviation, defense and space systems, as well as shipbuilding, and related government agencies across the globe.



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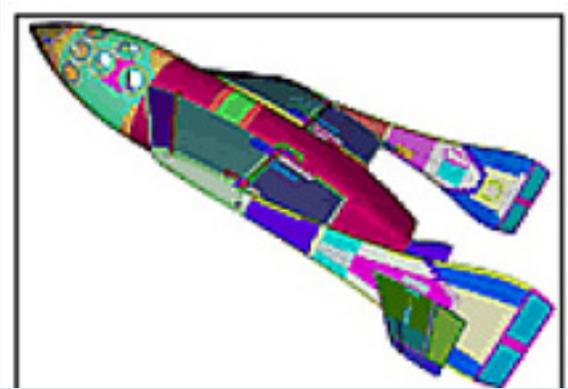
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WHAT IS FEMAP?

Femap is an advanced engineering simulation software program that creates finite element analysis models of complex engineering products and systems, and displays solution results. Femap can virtually model components, assemblies or systems and determine the behavioral response for a given operating environment.



Using Femap's digital simulation capabilities you can:

- Predict and improve product performance and reliability
- Reduce time-consuming and costly physical prototyping and testing
- Evaluate different designs and materials
- Optimize your designs and reduce material usage

CAD-Independent

Femap is CAD-independent and can access geometry data from all major CAD systems including CATIA, Pro/Engineer, NX, Solid Edge, SolidWorks and AutoCAD. Once imported you can prepare the model for analysis using the geometry locator to identify and display potentially troublesome entities, such as slivers, and either remove them completely with the geometry cleanup tools or suppress them. Femap also offers a wealth of geometry creation and modification functions so you can make necessary model changes in preparation for finite element model creation.

Finite Element Modeling

The full finite element model with underlying data is fully exposed by Femap, allowing you to view,

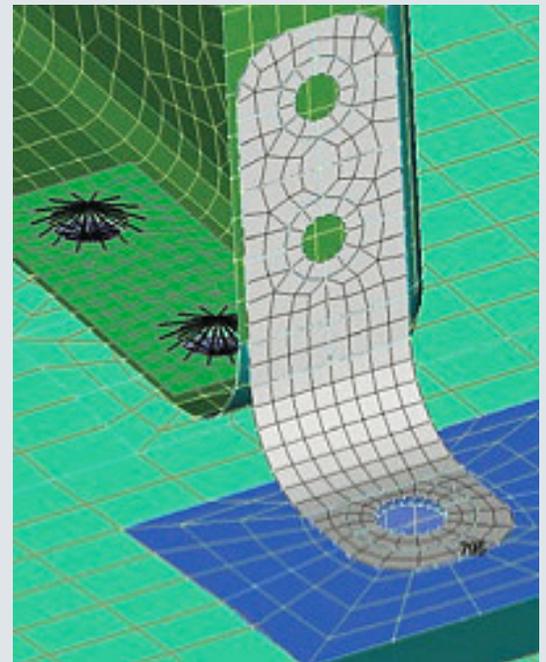
create or modify entities directly. Femap's grouping, layering and visualization tools help you to manage model display while creating and setting up the finite element model.

Femap includes specialized capabilities to help with modeling tasks including:

- Mid-plane extraction of thin-walled structures to aid creation of more efficient and accurate shell models
- Weldment modeling that connects discrete solid welded parts together into a contiguous model
- Data surfaces that allow you to create complex loading conditions based on prior analysis output for multi-physics applications

Finite Element Meshing

Femap's 3D solid and surface meshers are tuned to generate high-quality meshes, providing well-shaped elements to ensure accurate results. Femap gives you full control over all mesh generation parameters including mesh sizing, meshing of small features, growth factors, short edge suppression, etc.



With complex geometry, modification of the mesh is often required in areas where greater accuracy is desired. For this situation Femap's Meshing Toolbox allows you to interactively modify mesh sizing parameters on the underlying geometry, and see the mesh update automatically. You can also

view element quality feedback live while modifying the mesh, to ensure that a high-quality finite element model is created.

Assembly Modeling

Femap with **NX Nastran** supports assembly modeling, including automatic contact detection that determines the components initially in contact. The contact regions can be set to be simply in contact (with or without friction) or glued together. The contact calculations performed by NX Nastran are iterative and update during the solution, to take into account deformation changes representing the true contact condition in the final results.

Other types of component assembly modeling techniques also supported include spot-weld, fastener elements, and bolted joints with optional pre-loading.

Beam Modeling

In addition to solid and shell element models Femap also supports beam modeling and meshing. This technique allows models comprising long, slender components (for which a solid meshing approach would create a large, unwieldy model) to be represented by one-dimensional elements with associated properties.

Model visualization is key to beam modeling, and with Femap you can view these elements as solid components and include offsets. Femap features a section property editor which includes a library of standard cross-section shapes. You can also define your own sections, and the built-in section property calculator automatically determines the required properties.

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Also available are full beam visualization and results display options including shear and bending moment diagrams.

Composite Modeling

The use of composite materials in designs has increased significantly in recent years, and Femap can help you model and postprocess results on composite structures. With Femap's laminate editor and viewer, you can update the laminate properties interactively as you create and modify plies in the laminate.

You can also postprocess composite laminate results using Femap's global composite ply feature, which allows you to view results on continuous plies through the structural model.

Solver Neutral

Femap is solver-neutral and provides in-depth pre- and postprocessing support for all of the main commercial solvers on the market, including **NX Nastran**, **Ansys**, **LS-DYNA**, **Abaqus**, and **TMG**. You can take full advantage of the advanced analysis capabilities of these solvers using Femap's comprehensive modeling and analysis support, particularly for dynamic, geometric and material nonlinear, heat transfer and fluid flow analyses.

Postprocessing

A wealth of visualization capabilities help you view and interpret the results to quickly understand the model behavior. You'll find everything you need to view and interpret the output data, including:

- Contour and criteria plots
- Deformed shape animations
- Dynamic cutting plane and iso-surfaces
- Full output selection
- XY plots
- Free body diagrams and grid point force balance output
- Time and frequency domain animations

Complete access to results data is provided through the Data Table pane, which you can use to gather, sort and control the amount and type of data that is visible, to compile an analysis report.

Scalable Simulation Solutions

The **Velocity Series CAE** products offer scalable solutions for design engineers in the form of the CAD-embedded Solid Edge Simulation program, and Femap with NX Nastran for CAE analysts.

The Femap with NX Nastran product line itself offers solution scalability, from the more general simulation capabilities available in the base module to more advanced applications including dynamics, optimization, advanced nonlinear, rotor dynamics, heat transfer and fluid flow in add-on modules.

Customization

Femap's open customization capability allows complete access to all Femap functions through an OLE/COM object-oriented Application Programming Interface (API), which employs standard, non-proprietary programming languages. Access to the API is through a development environment within the user interface where you can create custom programs that automate workflows and processes, and which can interact and exchange data with third-party programs such as Microsoft® Word and Excel.

Usability

Femap is an intuitive Windows®-native application. Femap's support of multiple graphics windows and specialized panes, such as the Model Info Tree and Data Table, allow complete access to the finite element model and results data and help promote efficient work flows. You can modify the appearance of the interface to suit your requirements, including repositioning panes, modifying the level of functionality exposed, and complete toolbar and icon customization.



