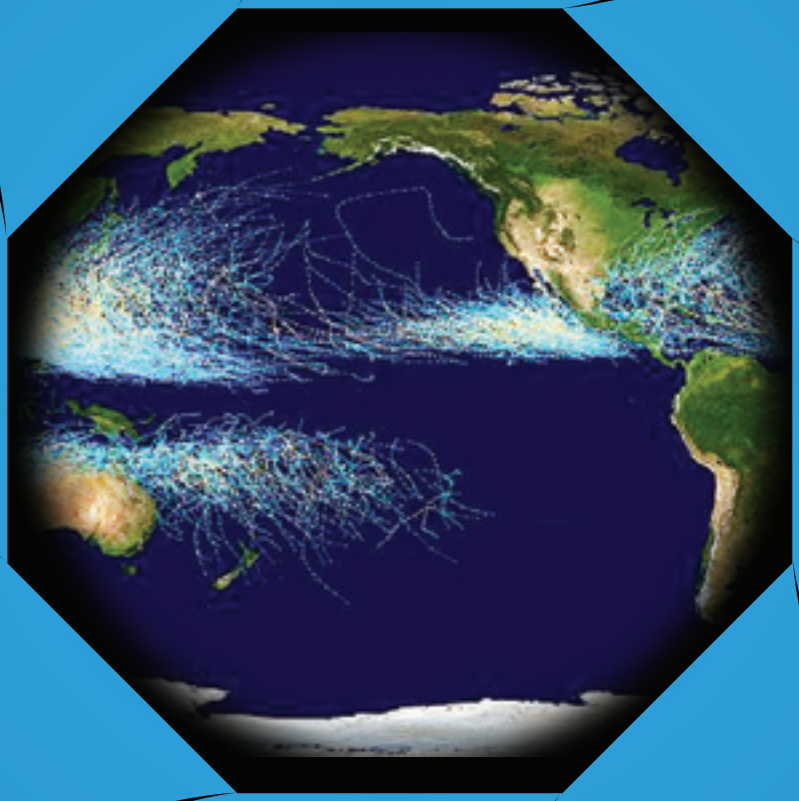
Worldwide Satellite Magazine May 2009

SatMagazine

Earth Observation and Imagery:



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Whenever I attend the National Space Symposium in Colorado Springs, I leave the conference with what feels like a brain 2x larger than when I arrived. There is so much information imparted to attendees that one's brain cells are flooded with new data, new contacts, new technologies — in this case, having a headache is a good thing, as such means a ton of information has been absorbed for current and future synapse processing.

Elliot Pulham offered some thoughts regarding the state of the space industry and its related business environs. *Elliot* happens to be the CEO of **the Space Foundation**, the organization that plans and hosts the **National Space Symposium**.

Mr. *Pulham* believes there may be lag before the full impact of the current economic doldrums are felt, with most business advancement to be seen in the public sector. He definitely feels there will be an increase in collaborations of the international kind, as well as increased integration within the business sector. There is definitely great capacity, not necessarily with transponders, but for growth and advancement in this industry.

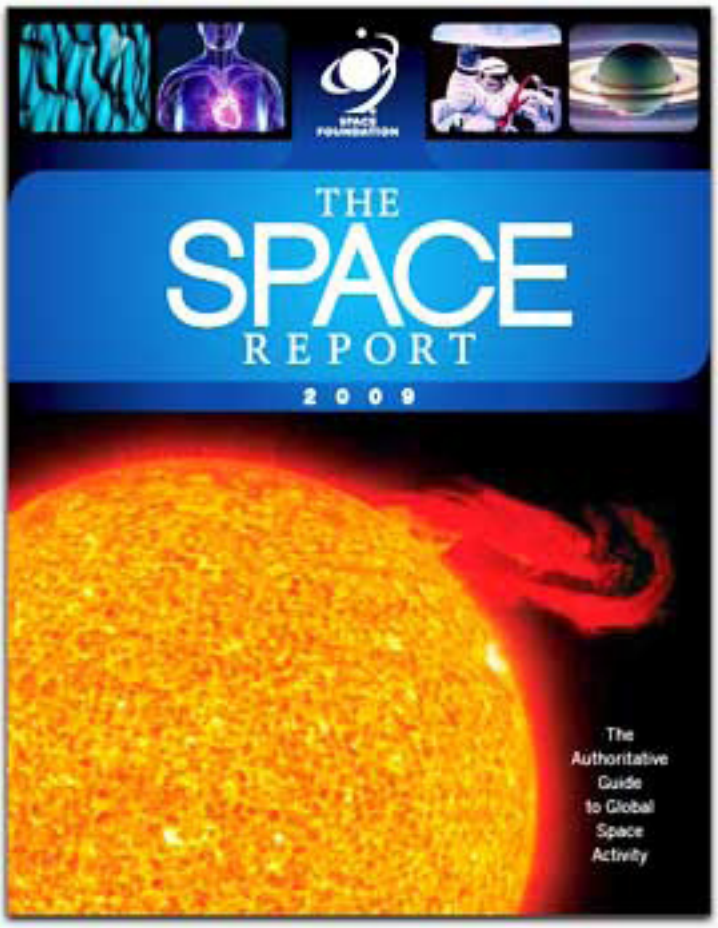
From a personal perspective, when economies are recalcitrant, forging forward with already committed projects, as well as activating aggressive marketing and public relations efforts, makes a great deal of sense. Due to any number of actors withdrawing from such activities, such is an opportunity for those with foresight to cement themselves into place as subject-matter experts. Their voices remain heard — their messages are more easily recognized due to a lack of competitive voices, not a bad thing when attempting to promote your product or message.

As economies improve, those who have weathered the storm and remain in place have no need to start from scratch, and seem to have "always been there," doing what is necessary to instill confidence with prospective customers, and assuring their well-established client base they are in the industry for the long term proving they can accomplish the job. This is also a good time for a new company to launch as more attention is paid to their announcements and products due to less clamor from an over-messaged industry.

I would now like to present excerpts from both the *Executive Summary* and the pages of this magnificently produced annual, ***The Space Report 2009: The Authoritative Guide to Global Space Activity***. For those who are interested in obtaining this publication, the annual is available ***at this direct link***.

Introduction

In 2008, a year when the world's economy was more tumultuous than any other in decades, the space industry experienced a remarkable time of success and inspiration. It weathered the economic crisis while reaching new levels of technical, scientific, and business achievement. Folded within the pages of this annual space story are historic accomplishments by governments, corporations, and entrepreneurs and their ambitious plans for continuing the use and exploration of space. These success stories, detailed throughout ***The Space Report 2009: The Authoritative Guide to Global Space Activity***, demonstrate the resilience and de-



termination of countries eager to reach out into space, and the people and companies desiring to take part in the exploration and expansion of the highest frontier. ***The Space Report 2009*** presents an innovative and energetic chronicle of the previous year in space as well as an outlook on what lies ahead. Space activity spans a vast arena, ranging from locating the family pet with a *global positioning system* (**GPS**) collar to discovering the origins of our universe. In 2009, the space industries that envision, design, build, and operate the systems for space exploration and space-borne commerce, and the governments that direct, and underwrite, sizable portions of global space activity, will confront down-to-earth challenges brought on by a tightening global economy.

Amid these substantial economic reverberations, the breadth of worldwide space activity in the past year is all the more remarkable. Significant space-related developments in 2008 included some potential "game changers" with a collection of scientific, government, commercial, and entrepreneurial firsts. They include the first-ever observation of a supernova at the moment of its explosion and a NASA lander discovering ice on Mars, a sign of the possibility of life on that planet. The United States shot down one of its own satellites to prevent an uncontrolled fall from orbit. *Taikonauts* performed a spacewalk and made China the third nation ever to accomplish this feat. The U.S. Air Force and its steadfast support contractors achieved a record of 59 consecutive successful launches while the first commercially funded and built space booster was successfully launched, propelling its payload into orbit.

Entrepreneurs took steps toward making private spaceflight more affordable, while commercial enterprises made advancements in delivering satellite-borne media services to airplane passengers. Demand grew for satellite transmission of high-definition television signals, and high-tech swimsuits based on space-related technology enabled world re\cords to be broken during the *Summer Olympics* — all of this made 2008 another banner year for space.

Beyond these stories of space success, ***The Space Report 2009*** presents vital economic data about the **$257 billion space industry**, ranging from the launch industry to space-dependent consumer services. The ***Space Foundation Index***, the industry's premier public equity market tracking tool, declined significantly, as did most other market indexes around the world. This year, ***The Space Report 2009*** also includes two new indexes, the *Space Foundation Infrastructure Index* and the *Space Foundation Services Index*. These additions provide more detailed historical financial analysis, tracking, and clarity about two critical segments of the space industry.

The report updates developments in the use and application of space products and services and includes new information about space infrastructure, with greater detail on the global space workforce and the economic impact of the space industry. In addition to updated information on salaries, workforce numbers, and leading space states and metro areas, ***The Space Report 2009*** addresses concerns about scientific and technical education and the future of the U.S. space industry's labor pool. This year's report includes a new subsection analyzing U.S. science, technology, and math performance from kindergarten through the 12th grade, and compares undergraduate and graduate technical degree programs in the United States with

LiveTV offers as many as 36 channels of satellite TV, more than 100 channels of XM radio, and connectivity for email and text messaging. Image Credit: LiveTV

those in several other leading space countries. ***The Space Report 2009*** closely examines, perhaps the single most important factor in the success of the space industry, its people. Education trends may present a recruiting problem for the U.S. space industry in years to come as interest in science, technology, engineering, and mathematics declines in U.S. schools, along with academic performance in those areas. In the technology arena, the hold on the popular imagination enjoyed by the space industry in the early years of the space age has slipped, and young people with a technical interest appear more inclined to focus on computer and software engineering career tracks.

The positive side of the workforce picture is that the space industry, despite the economic downturn, appears poised to continue its role as a major jobs producer, and an engine of economic innovation. Regions such as California, Colorado, and the Washington, D.C., area are likely to continue to attract workers due to the important role played by space employment and wages in their regional economies.

The Space Economy

The detailed financial analysis presented in ***The Space Report 2009*** reveals that, in a troubled financial environment, the space industry managed to maintain and increase its revenues in 2008, with estimated budgets and revenues from public and private sources of **$257 billion**. This represents a growth of more than $6 billion over the previous year. Within that total there was significant growth in individual sectors. At the same time, space industry stock valuations took a severe hit in 2008 according to the *Space Foundation Index*, and the lean times most likely will continue well into 2009.

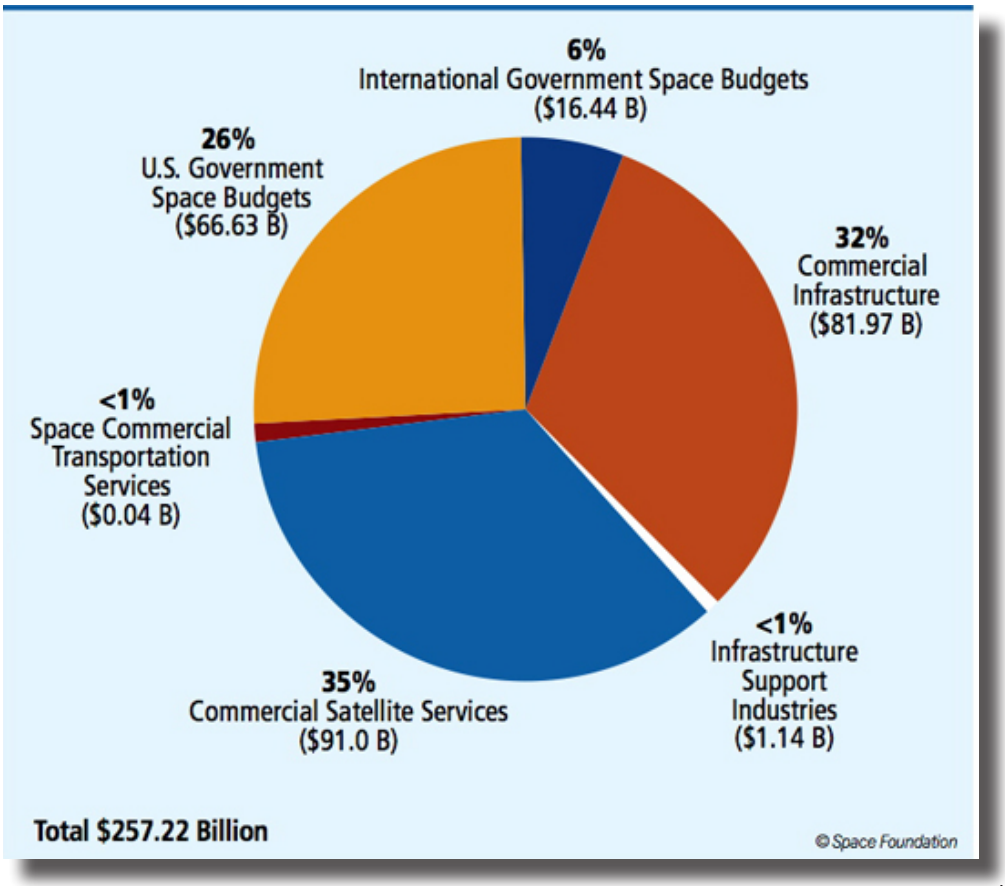


Table 1 — Global Space Activity, 2008

Nevertheless, investment in space activity and economic output resulting from space activity remained substantial in 2008 and continued to provide thousands of jobs at enviable pay scales.

Total revenue for space products and services in 2008 reached an estimated **$91 billion**, 10.4 percent more than the $82.4 billion total in 2007. The largest revenue producer within the commercial satellite service sector was direct-to-home (DTH) television, which generated **$69.61 billion** in 2008. Fixed satellite services constituted the second-largest sector with **$16.79 billion** in 2008. These industry segments together comprise 95 percent of commercial satellite revenues. Fixed satellite services showed the strongest growth rate, increasing 31 percent in 2008 to a sector with revenue of **$16.79 billion** from $12.82 billion in 2007.

Revenue in 2008 for commercial space infrastructure, including launch vehicles, satellites, ground stations, in-space platforms, and infrastructure support industries totaled **$83.11 billion**. The pace of launch industry operations was essentially unchanged in 2008 with 69 orbital launches carrying 106 payloads. Of these 69 launches, 28 carried commercial payloads and 41 carried non-commercial payloads. The level of government spending reflected by those non-commercial launches demonstrates that governments often represent a stabilizing force for the worldwide space industry.

Space Foundation Index

The *Space Foundation Index*, now in its fourth year, tracks the market performance of 29 public companies selected because they derive a significant portion of their revenue from space-related assets and activities. The index, available online ***at this direct link***, enables industry professionals and market analysts to track the performance of the industry against broad market benchmarks such as the **Standard & Poor's** (**S&P**) **500** and the **NASDAQ Composite Index**. Following more than three consecutive years of steady gains where it often outpaced other key indexes, the *Space Foundation Index* fell substantially with the rest of the stock market in 2008. During 2008, the performance of the Space Foundation Index declined from a lifetime gain of approximately 29 percent to a loss of 29 percent by the end of the year. It underperformed both the NASDAQ and the S&P 500 expectations.

This year, the Space Foundation unveils two additional indexes that individually track the two market segments that make up the overall Space Foundation Index. These are space infrastructure, which is directly related to the equipment and software that space systems need to function, and satellite services, which involves the sale of services that depend on space assets.

The *Space Foundation Infrastructure Index* (**SFII**) and the *Space Foundation Services Index* (**SFSI**) are new market measures that have been tracked back to June 30, 2007. The SFI and its two component parts, the SFII and the SFSI, are updated daily.

Space Products and Services

As the space industry becomes a vital part of the general consumer economy with GPS receivers and satellite television, it becomes more susceptible to general economic downturns. During the years when the U.S. space industry relied almost entirely on U.S. government programs, government spending served as a protective buffer from economic down-cycles. For several years prior to 2008, the expansion of the space industry into consumer spheres was the engine of its rapid growth. Last year brought home the risks inherent in participating in these commercial markets.

Satellite systems provide a host of services ranging from intercontinental communication to in-vehicle navigation, and have become as integral to daily life as cell phone towers.

What is changing, and changing rapidly, is the way this basic information can be used. Sometimes in new combinations, it is used to deliver an ever-expanding variety of services. Demand for satellite communications is increasingly driven by consumer applications, most notably video. Carriage of *high-definition television* (**HDTV**) continues to increase in major markets globally. Global positioning services continue to expand in variety, and designers and engineers are coming up with new ways to combine positioning data with other databases as an aide to travelers, tourists, professionals, and soldiers.

A challenge ahead for the expanding global positioning and navigation market lies in the need to develop uniform technical protocols that will eliminate the need for multiple sets of equipment to access the signals provided by satellite constellations deployed by different nations.

How Space Products + Services Are Used

The space industry has surpassed the point where descriptors of space products and services used can be covered in a single publication. The examples in this report represent a small sampling to illustrate the breadth and ingenuity of the space industry in creating new ways to serve governments and the private sector. From private space travel to mobile Internet services to high-tech swimsuits, the space industry is fully engaged in finding new applications for existing technology and in developing new technologies to solve persistent problems.

Common themes around some of these products and services involve making life easier and more interesting. In 2008, **ICO Global Communications** began testing a mobile TV service using a satellite over the United States, designed to deliver up to 15 television channels for entertainment starting in 2010.

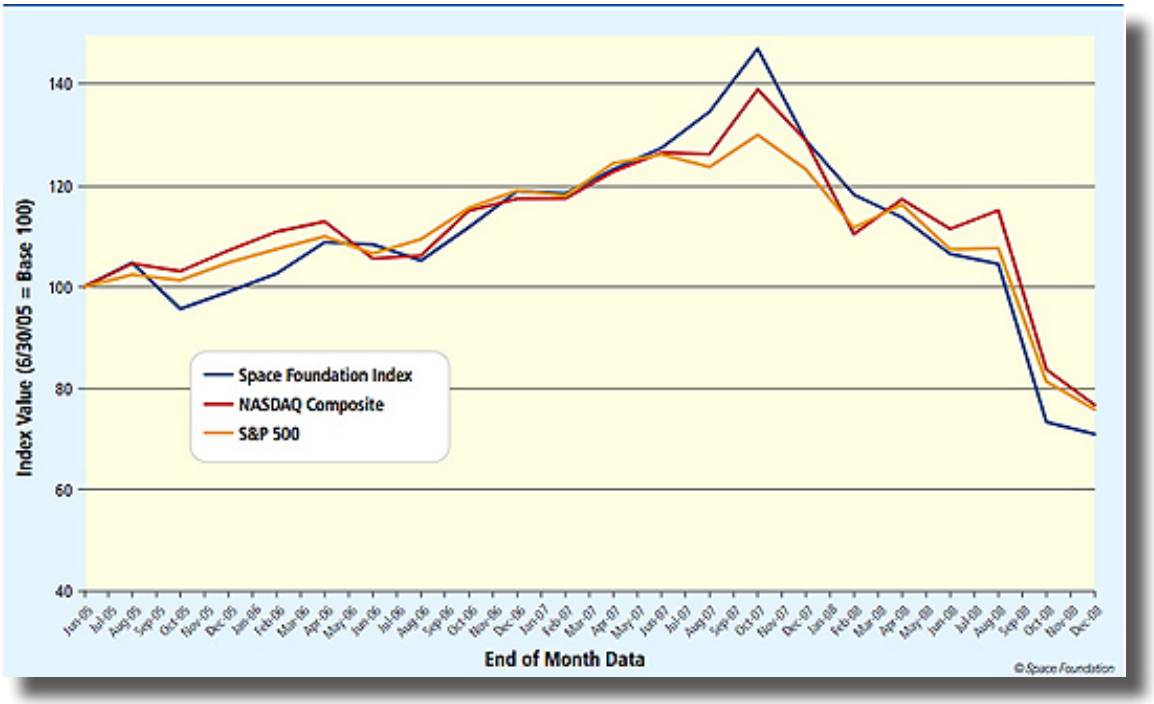


Table 2 — Space Foundation Index vs. Other Market Indexes

Governments as well as individuals are finding new ways to use space products and services. The *Beijing Olympic* organizers relied upon remote sensing data from a U.S. satellite to monitor aerosol levels in and around Beijing before the games. The data helped organizers concentrate their pollution reduction efforts

to make Beijing a more receptive environment for athletic competition. The same research team was also deployed after the *Sichuan* earthquake to provide the governments with disaster damage assessments. Satellite communications serve governments around the world for election monitoring, border security, tax collection, distance learning, disaster relief, and national defense.

As satellites are unaffected by the disruption on Earth caused by natural disasters, satellite services are often the only way for first responders to communicate immediately and consistently. New technology being developed jointly by the United States and the United Kingdom is promising marked improvement in border security by offering more accurate means of detecting smuggled nuclear materials. The list goes on and on as the fusion of technologies creates new products and services for space, and its users, nearly every day.

The Space Report 2009 Data

The Space Report 2009 is the result of extensive research by the Space Foundation and an array of independent research organizations and individuals with expertise in space, policy, financial markets, science, education, and technology. This combined effort involves identifying, gathering, analyzing, and synthesizing publicly available sources including government reports, congressional records, and corporate reports, as well as data provided by industry trade associations and private research firms. The report also draws upon articles in business and industry publications.

Illuminating the text of ***The Space Report 2009*** are scores of exhibits tracking industry sector activity, major sources of space industry revenue, trends in education, employment, government investment in space, and market performance of space industries. Additional exhibits that further illustrate the state of the global space industry can be found at the ***The Space Foundation's website.***

Earth Observation

Broadly defined, the Earth observation market includes revenues from applications as varied as weather forecasting, intelligence-gathering, highway inspections, climate change studies, and commercial uses in agriculture, fishing, mining, construction, and public health.

As the demand for information increases aboard ships at sea, the U.S. Navy is planning to outfit its surface fleet with the latest in bandwidth-increasing commercial satellite communications terminals. In 2008, Harris Corporation was awarded several contracts for its Multi-Band Shipboard Satellite Communication System for a variety of ships, including the Navy's new littoral combat ships (LCS). The LCS program is still in the prototype phase. One of the competing designs is the General Dynamics trimaran, shown here in drydock. Image credit: US NAVY

The primary industries using space-based products and services involve Earth-orbiting satellites used for communication; remote sensing and Earth observation; and position, navigation, and timing.

Based on **BCC Research** revenue data, the estimated total global expenditure for this overall satellite-based Earth observation market in 2008 was **$7.5 billion**, a 3 percent increase from $7.3 billion in 2007. Weather forecasting and intelligence-gathering applications experienced the highest growth rates, approximately 5 percent and 7 percent, respectively. The same study projects that revenue will reach **$9.9 billion** by 2012. In a different study, **Chesapeake Analytics** reported

that world markets for high-resolution land imaging and related value-added services totaled **$3 billion** in 2008, and are projected to reach **$5.2 billion** by 2013. High-resolution satellite imagery is a leading driver for this market with revenues expected to grow from $1.1 billion in 2008 to **$2.5 billion** in 2013. Chesapeake also estimates that satellite-based synthetic aperture radar will grow from $280 million in 2008 to **$780 million** in 2013, as providers seek Earth observation capabilities regardless of cloud cover or darkness.

Remote sensing products and services provide a unique perspective of the Earth, its landmasses, nations, and communities. Growing access to these products and services has expanded our understanding of landforms and structures, made it easier to identify change in natural and fabricated formations, and assisted in rural and urban planning.

More than 80 percent of commercial remote sensing data is produced and purchased by governments with national security as the primary application. Commercial companies and governments operate remote sensing satellites, and a wide range of private companies analyze and integrate imagery with other information such as road maps, store locations, pollution maps, census data, and crime statistics. An increasing mix of military, civil government, and consumer interests drives demand for imagery. Current military operations drive continual U.S. government demand for satellite imagery to address national security and intelligence gathering concerns. Global change, including climate change, human impact, and natural disasters such as the 2008 earthquake in China, floods in Asia and North America, and hurricanes and tsunamis, increasingly drive demand for remote sensing and Earth observation.

Innovative services such as ***Google Earth*** and ***Microsoft Virtual Earth***, among others, are streamlining and enhancing the use of remote sensing products and

This false-color satellite image of vineyards near Heraklion, Crete, was collected by DigitalGlobe's QuickBird satellite. Healthy vegetation appears bright red, and unhealthy or dead vegetation appears brown or green. Man-made materials are generally light blue or cyan. False-color satellite imagery enables farmers to assess the health of entire fields or orchards. Harvest stages and irrigation techniques can also be studied to predict and improve crop yields.

Image credit: DigitalGlobe

services by consumers for such tasks as locating retail stores, gas stations, and restaurants, and getting directions to an office or other destination. The **Microsoft** and **Google** services use imagery from various satellites, aerial, and ground-based platforms to provide a variety of perspectives, melding access to space-based views and bird's-eye views with street-level images.

Environmental monitoring satellites provide decision-makers with critical information on climate change and natural disasters. The loss of a single satellite can cause significant gaps in Earth observation capabilities, as was the case in February 2009 when **NASA**'s *Orbiting Carbon Observatory* (**OCO**) was destroyed in a launch failure. OCO was designed to acquire high-resolution data on the atmosphere, the oceans, and the Earth's surface. The spacecraft was intended to collect carbon dioxide measurements for research into reducing manmade greenhouse gasses. Missions of this type may influence environmental decisions and policies as scientists and policy makers seek to understand atmospheric processes.

***Low Earth Orbit* (LEO)** spacecraft, in addition to their use for communications services, are also used to provide images of the Earth for civil, scientific, and military applications. In 2008, the U.S. National Oceanic and Atmospheric Administration's (NOAA) Advisory Committee on Commercial Remote Sensing reported that there were 88 satellites in use, or in development for this purpose, operated by 27 different countries. The U.S. has been the leader in the commercialization of electro-optical remote sensing technology, but recent years have seen other countries begin to excel in the development of synthetic aperture radar (SAR) systems. SAR combines the echoes from multiple radar pulses and overlaps them into a single radar image. This allows imaging of the Earth during inclement weather, heavy cloud coverage, and nighttime, overcoming constraints that limit other remote sensing systems.

In 2008, there were 19 remote sensing satellites launched on behalf of five countries. Of particular note, in August, the German ***RapidEye*** constellation of five remote sensing satellites was launched. The five RapidEye satellites travel along the same orbital plane and feature identical sensors, allowing large amounts of imagery to be collected, up to 4 million square kilometers (2.5 million square miles) per day. Five satellites in the same orbital plane allow for a higher number of multiple imaging passes over the same spot and quick revisit times. With these capabilities, the RapidEye constellation is capable of imaging any point on Earth every day.

In addition, in September, the ***GeoEye-1*** satellite was launched. Funded in large part by the **National Geospatial-Intelligence Agency** (**NGA**), GeoEye-1 provides 0.4-meter (1.3-foot) high-resolution panchromatic and 1.6-meter (5.2-foot) multicolor images to be marketed to the Department of Defense as well as city and state planners. GeoEye-1 provided imagery of the

System	Operator	Manufacturer	Satellites	Mass kg (lbm)	Highest Resolution (m)	Launch Year	Status
EROS	ImageSat International	Israel Aircraft Industries	EROS EROS B EROS C	280 (617) 350 (771) 350 (771)	1.5 0.7 0.7	2000 2006 2009	EROS-C will replace EROS-A, and provide higher resolution and imagery in additional spectral bands.
IKONOS	GeoEye	Lockheed Martin	IKONOS	816 (1,800)	0.82	1999	IKONOS will eventually be replaced by GeoEye-1.
OrbView	GeoEye	Orbital Sciences	OrbView-2	372 (819)	1,000	1997	Focuses on oceanographic conditions.
QuickBird	DigitalGlobe	Ball Aerospace	QuickBird-2	909 (2,004)	0.6	2001	Two previous QuickBird satellites failed to become operational.
RADARSAT	MacDonald, Dettwiler and Associates (Telesat Canada)	MacDonald, Dettwiler and Associates	Radarsat-1 Radarsat-2 RCM-1 RCM-2 RCM-3	2,750 (6,050) 2,195 (4,840) 1,200 (2,645) 1,200 (2,645) 1,200 (2,645)	8 0.8 TBD TBD TBD	1995 2007 2012 2013 2014	RADARSAT-1 and -2 are operational. RCM is the RADARSAT Constellation Mission which will be able to provide wider coverage and quicker data analysis.
TerraSAR	Infoterra Group	Astrium	TerraSAR-X TanDEM-X TerraSAR-X2	1,023 (2,255) 1,023 (2,255) 2,060 (4,540)	3 3 5	2007 2009 2012	TerraSAR-X is currently operational. TanDEM-X will fly in formation with TerraSAR-X. TerraSAR-X2 is the proposed replacement for X2.
WorldView	DigitalGlobe	Ball Aerospace	WorldView-1 WorldView-2	2,500 (5,510) 2,800 (6,175)	0.5 0.5	2007 2009	WorldView-1 is operational. WorldView-2 will operate in a higher orbit and provide imagery in additional spectral bands.
GeoEye	GeoEye	General Dynamics Advanced Information Systems	GeoEye-1 GeoEye-2	907 (2,000) TBD	0.41 TBD	2008 2011	GeoEye-1 launched in 2008. GeoEye-2 could potentially have 0.25 meters resolution.
RapidEye	RapidEye AG	Surrey Satellite Technology Ltd.	RapidEye 1-5	150 (330)	6.5	2008	String of five satellites provides high temporal frequency and redundancy.

Source: Various

Table 3 — Unclassified Remote Sensing Satellites In Operation, 2008

January 20, 2009, U.S. presidential inauguration on the National Mall in Washington, D.C., to media outlets worldwide.

Thanks to the **Space Foundation**'s *Elliot Pulham* and *Janet Stevens* as well as the editors and writers of the publication: *Marty Hauser*, *Micah Walter-Range* and *Mariel John*, with contributions from: *Andrea Maléter*, the Technical Director at **Futron** — *Christopher Novak*, Partner, **Content First, LLC** — *Charlies Liu*, Ph.D., of the **City University of New York** — *Anita Antenucci*, the Managing Director of **Houlihan Lokey** — and *Kevin W. Leclaire*, Managing Partner of **ISDR Consulting, LLC**. The Editor of the report is *John M. Diamond* and to **brandt ronat + co** for the superb design of the report.

All have managed an exceptional job in presenting this annual. Believe me, there's so much more deep information and analysis within these pages that anyone involved in our various industries owes themselves a copy of ***The Space Report 2009***.

For further information, select the following graphic for the report's website. All images used in this article are located in the ***Space Foundation***'s book.

— Hartley G. Lesser, Editorial Director

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Insight — The Forrester Focus

Over-Expansion In Middle East Satellite?

by Chris Forrester, Columnist

The Middle East's two indigenous satellite operators are both building new satellites for their region. ArabSat is on a set of more aggressive expansion plans, which in essence sees Arabsat launching a new craft every year until 2012. Nilesat is also busy, and its 201 craft will launch early in 2010. "If new capacity were limited to just these pair, then there would not be a problem," argues *Nabil Kazan*, **a well-known name in Arab broadcasting.**

Mr. *Kazan*, speaking at the recent **MIPtv** programming market conference, said that while the number of channels had grown from just 15 to more than 500 in the past 12 years or so, the end result of "channel overload" was causing damage to the local TV environment. We'll return to this challenging problem in a moment — but there's more than just **Arabsat** and **Nilesat** expanding their capacity (*panel*).

Mid-East Audience Share

	2002	2008
Total number of channels	70	450
MBC	22 percent	43 percent
Saudi TV	3 percent	11 percent
LBC (now LBC-Rotana)	15 percent	11 percent
Abu Dhabi TV	12 percent	2 percent
Al Jazeera	5 percent	5 percent
Dubai Media	4 percent	3 percent
Others	40 percent	25 percent

Source: IPSOS, Booz & Co, April 12 2009

Two years from now there's going to be an excess of supply over demand. This excess supply may be soaked up by the expansion of HDTV services. But this is by no means certain.

There is a huge legacy problem of *MPEG-2* set-top boxes (STBs) in the Middle East/North Africa (MENA), and until someone launches *MPEG-4*-based HDTV, there is little or no reason to shift to advanced compression.

Indeed, most local observers see the growth of channels as being inevitable. **Euroconsult** suggests 1000+ digital channels covering the region by 2010, and around 1200 channels by 2015. Few see much risk to this level of expansion, nor is there much threat to this level of expansion from HDTV. Any investment in HDTV will need to include the mainstream commercial channels, and the local argument — expressed with some justification — is that there's no financial incentive to launch HD.

Nevertheless, Nilesat says it will launch a showcase HD channel with help from some of the region's major players. *Gabriel Chahine*, Vice President at **Booz & Co**'s Beirut office, argued at the MIPtv presentation in March that there's growing signs of maturity amongst the region's free-to-air broadcasters. "The industry structure in the region is unique. The ad-spend on TV is low by any international measure. Yet pan-regional broadcasters are spending a great deal of money on their [programming] grids in order to win audiences over. The major broadcasters show all the signs of growing stronger, while smaller players are struggling."

However, the cost of programming — at least by 'western' standards — is miniscule. Chahine gave, as examples, the top four broadcasters, which had annual programming budgets of $63m, $51m, $40m, and $33m, or an average of much less than $1m per week on programming. There are European broadcasters spending more than this per hour of TV and winning smaller audiences!

Chahine explained that five broadcasting groups now controlled 70 to 80 percent of pan-Arab viewing, with **MBC** dominating the region with a 43 percent audience share from its bouquet of nine channels. There are some strong regional differences, with **Egypt**'s **Nile TV** cluster doing well in Egypt, and **Saudi Arabia**'s TV output winning a greater audience in its local market. "There are very few groups which have been able to increase their audience share during the last half-dozen

Most recent channel closures

General

AEN – KSA
Al Madina TV – Egypt
Al Hadaf TV – Egypt
Al Hekayat – UAE
Al Mirbad TV – Iraq

Variety/ Entertainment

Al Ganadria – KSA
Fun Satellite – Egypt
Maktoob TV – Jordan
Al Shashah – UAE
Kullouna Al Kuwait – Kuwait

Music

Venus TV – Egypt
Escape TV – Jordan
Shahrazad – Lebanon
M Live – UAE
Kunouz – UAE

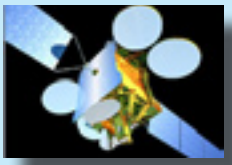
Data: PARC, Booz & Co

years. MBC is the clear leader. Other channels which were leading the market back in 2002 (for example, **LBC**) have almost disappeared from the radar screen by 2007-8. The 'one-size fits all' model that used to work so well, now doesn't work at all. Almost all of the major broadcasters are attempting to diversify their offerings, trying to come up with more targeted offerings. The larger groups now have 10 to 12 channels under their umbrellas, with the most recent restructuring taking place in Egypt, which has seen re-launches of all of their channels. However, right across the board it is fair to say that not all are succeeding effectively."

Over the past four years, about 81 free-to-air channels have closed, 24 of which were best described as 'general' channels, plus another 17 in the variety/entertainment category, 10 music channels, 7 that covered news/current affairs, 4 sports channels and 3 movie channels.

Gabriel Chahine argues that there *IS* space for some channel expansion, but the over-riding need is to raise the quality of local productions, especially drama series. Currently dubbed Turkish melodrama outperforms locally produced (Arab) content. *Nabil Kazan* says that channel numbers should reduce, not expand. "Almost everyone in the region have dishes that can look at

Promised capacity growth for Mid-East



Arabsat 5A

Arabsat
A new satellite every year until 2012, adding spot-beams, and Ka-band. Some will replace existing capacity.

Nilesat 201

Nilesat
Nilesat 201 will launch in Q2/2010. Currently 100 percent full. 201 will replace Nilesat 101, and add transponders.

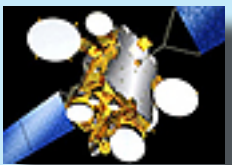
Eutelsat W2

Eutelsat
Already a major Mid-East player, providing extra capacity to Nilesat and Arabsat, and reluctant to leave its new-found market. (see Noorsat).

Noorsat 3

Noorsat
A clever use of Eutelsat excess capacity. Noorsat is a 'virtual' satellite operator that's carved out a very nice niche for itself while piggy-backing on — or adjacent to — Arabsat and Nilesat's key hot spots.

SmartSat
Financed by a $500m Kuwait- Jordanian consortium, SmartSat was highly visible at the recent Dubai CabSat show, and is behind the plan to build what they describe as the Mid-East's first privately-financed satellite, which will be orbited in 2011.



YahSat 1A

YahSat
YahSat is Abu Dhabi's entry into the Middle East capacity scene. Part military/part commercial, its first (1A, of two planned satellites) will launch later next year. 1B in 1H/2011. Backed ultimately by Abu Dhabi Royal Family via their Mubadala investment company. Will operate Ka, Ku and C-band capacity from 52.5 degrees East.

SES NEW SKIES NSS-7

SES Astra
The Middle East is the 'missing link' for SES. Of course, Astra have a growing number of transponders covering Africa, and SES New Skies' NSS-703, NSS-6 and NSS-7 each do a good job of covering Africa and the Asia region, but where the Middle East is not central to its primary mission.

SmartSat's plan

Khaled Derbas, Chairman and MD, **SmartSat**, says, "The MENA region offers unlimited growth potential for the satellite industry as a rapidly growing number of companies in the region such as Internet service providers, GSM providers, broadband technology solutions providers and television stations are now taking full advantage of the groundbreaking capabilities being delivered by satellite technology. Furthermore, being a private company, SmartSat enjoys greater flexibility in offering various innovative service packages, which enables us to address more specific client requirements and subsequently benefit a vast majority of consumers in the region."

SmartSat is a UAE-based firm created by a joint venture between **Smartlink**, a Jordanian private shareholding company that operates as a global broadband satellite services provider in the Middle East, North Africa and Eastern Europe regions with offices in Jordan and the UAE; and **Al Jawhara Holding**, a Kuwaiti investment holding company that serves as SmartSat's financial manager. The company's new satellite, which will be orbited in 2011, is now in the design stage while RFP's have been short listed to two satellite builders.

SmartSat says it will enable clients to tailor broadband packages that satisfy specific market segment demands and subsequently optimise revenue potential. With the satellite's powerful signals and two-way links, "SmartSat can also support the MENA's satellite broadcasters, home satellite providers, news organisations, satellite conference centres and other content providers with regular programming or on-demand requirements, enabling high-definition viewing at home or for live, in-studio broadcasts. Another strategic advantage of SmartSat, being a private entity, is its ability to offer a broader price range that is a lot more competitive and delivers greater product value." ...we'll see.

NileSat (98 percent penetration), ArabSat (94 percent penetration), and Eutelsat Hot Bird at **13 degrees East**, with 70 percent coverage." He praised local production, citing Egypt ($180m of local production last year), Syria ($50m in 2008), the Lebanon, Jordan, and the Gulf States ($25m), but says the cake is now spread much too thinly. The proliferation of channels has reduced the average audience per programme, reduced the ad-spend per channel per hour, and reduced profits on a per-channel basis.

Kazan says that last year's total spend, by all channels, on local non-sport original programming (including variety shows and comedy as well as factual, kids and tele-novellas) was no more than $250m-$300m. "On sport it is a different story. Fierce buying rights for key events have sent the bidding amounts for soccer alone to more than $300m, and it might be $350m."

"I'd like to strongly recommend to the channel owners to spend more on research, marketing and acquiring and producing content that's relevant for the Arab world" stated *Kazan*. He added that the economic downturn had not affected Middle East broadcasting.

"Something like 50 percent of the channels on air don't need advertising. They are either wholly subsidized by their governments, or religious backers. Out of the remaining 250 or so channels, then the top 10 or 20 are getting more than 85 percent of the total advertising spend in the region. The remaining channels, many of then owned by individuals who wished to brag about the fact that they own a TV station, they should not be able to go much further. And it isn't just these 500 channels. There's another 500-600 on Hot Bird."

These experts, keen to protect the local industry, were unanimous in suggesting that the region doesn't need new TV channels. However, if this is true then where does this leave the planned capacity expansion for the region?

About the author

Chris Forrester is a well-known entertainment and broadcasting journalist. He reports on all aspects of the TV industry with an emphasis on content, the business of film, television, and emerging technologies, including interactive multimedia, web-streamed and digitized content over cable, satellite and digital terrestrial TV, and cellular and 3G mobile. Chris has been investigating, researching and reporting on the 'broadband explosion' for 25 years.

Executive Spotlight On...

Dr. Jesus Villasenor, M.I.T. and Mr. Luke Volpe, Dynamics Research Corp.

When one wishes to learn about a specific program, the best way to proceed is to contact the subject-matter experts who are responsible for much of the work surrounding the project. This certainly holds true for NASA's HETE mission.

Dr. Villasenor is a Research Scientist at the **Kavli Institute for Astrophysics and Space Research (KIASR)** of the **Massachusetts Institute of Technology**. He joined the KIASR as a postdoctoral fellow in 1996 in the search for Gamma Ray Bursts with the ***High Energy Transient Explorer*** (***HETE-1*** and ***HETE-2***) program. He was the Instrument Scientist who led the development of the ***Soft X-ray Camera*** flown on HETE-2. Currently, Dr. Villasenor is a Research Scientist at the Massachusetts Institute of Technology (MIT) and is the *SXC Instrument Scientist*, **NASA HETE** mission.

Dr. Villasenor

Luke Volpe is the Director of Engineering, ***Metrigraphics Division***, **Dynamics Research Corporation** (**DRC**) and has worked with that Company for more than 25 years, serving in positions such as the Research & Development Manager. Prior to joining DRC, Luke held the position of *Manager of Photolithography* at **Analog Devices Semiconductor** and at **Transitron Electronic Corporation**. Luke has a Bachelor of Science degree in Industrial Engineering from **Boston University** and is a field expert in semiconductor photolithography.

Luke Volpe

SatMagazine

What, exactly, is the purpose of the HETE-2 satellite?

Dr. Villasenor

HETE was designed to solve, what was until a few years ago, one of nature's most enigmatic puzzles, the *Gamma-Ray Burst* (**GRB)**.

SatMagazine

When and how were GBRs first discovered?

Dr. Villasenor

First discovered in the late 60's by the ***Vela*** satellites which were designed to detect nuclear explosions, GRBs are short, intense bursts of gamma ray radiation emitted randomly anywhere in the sky. They eluded any explanation because they never repeated, and there were no preferred places to look. Follow up observations taken hours later did not reveal any trace of this phenomenon. Thus, decades after they were first detected no one was even sure whether they originated from our solar system, our galaxy or from distant galaxies.

SatMagazine

Would you describe the problem solving approach?

Dr. Villasenor

HETE's approach to the problem was to detect and localize GRB occurrences to high precision, so that deep looking telescopes could be brought to bear on the search. Of equal importance, HETE also promptly disseminated these positions to all observatories within seconds. Prior to HETE, follow up observations could only be carried out hours after the GRB, and the searches were in relatively large areas of sky because the positions were not as accurate. Consequently, as it was later discovered, the GRBs optical afterglow had faded by orders of magnitude before any telescope could undertake any search.

SatMagazine

Would you please tell us what were the critical components of the HETE satellite system?

HETE-2 satellite

Dr. Villasenor

An important part of the HETE mission was the **SXC** (*Soft X-Ray Camera*), which would pin point the locations of GRBs to within an arc minute, as well as send out its position almost instantly to observation centers around the globe.

SatMagazine

How does the Soft X-ray Camera work?

Dr. Villasenor

The Soft X-ray Camera works both as an X-ray detector, and imager. It uses as detectors CCDs (charge coupled devices), the same ones you find in digital cameras but modified for sensitivity in the **1-10 keV** X-ray band. To reveal spatial locations in the sky, a *fine-coded mask* (**FCM**) is positioned above the CCDs. X-rays from point sources cast shadows on the CCD, which can be checked against the mask pattern to reveal the angle of arrival. Our mask pattern only gives a one-dimensional direction, hence there are two modules which comprise the complete Soft X-ray Camera unit to give a singular point in the sky.

This was done to take advantage of the significantly lower computational load of 2, 1-D systems versus a 2-D system. The strength of this instrument lies in the very small pixel size of the CCDs, along with the fine features of the mask, and the precise alignment of the two, to yield accurate locations in the sky with as few as a dozen X-ray photons!

SatMagazine
How did Metrigraphics and MIT collaborate to create this satellite?

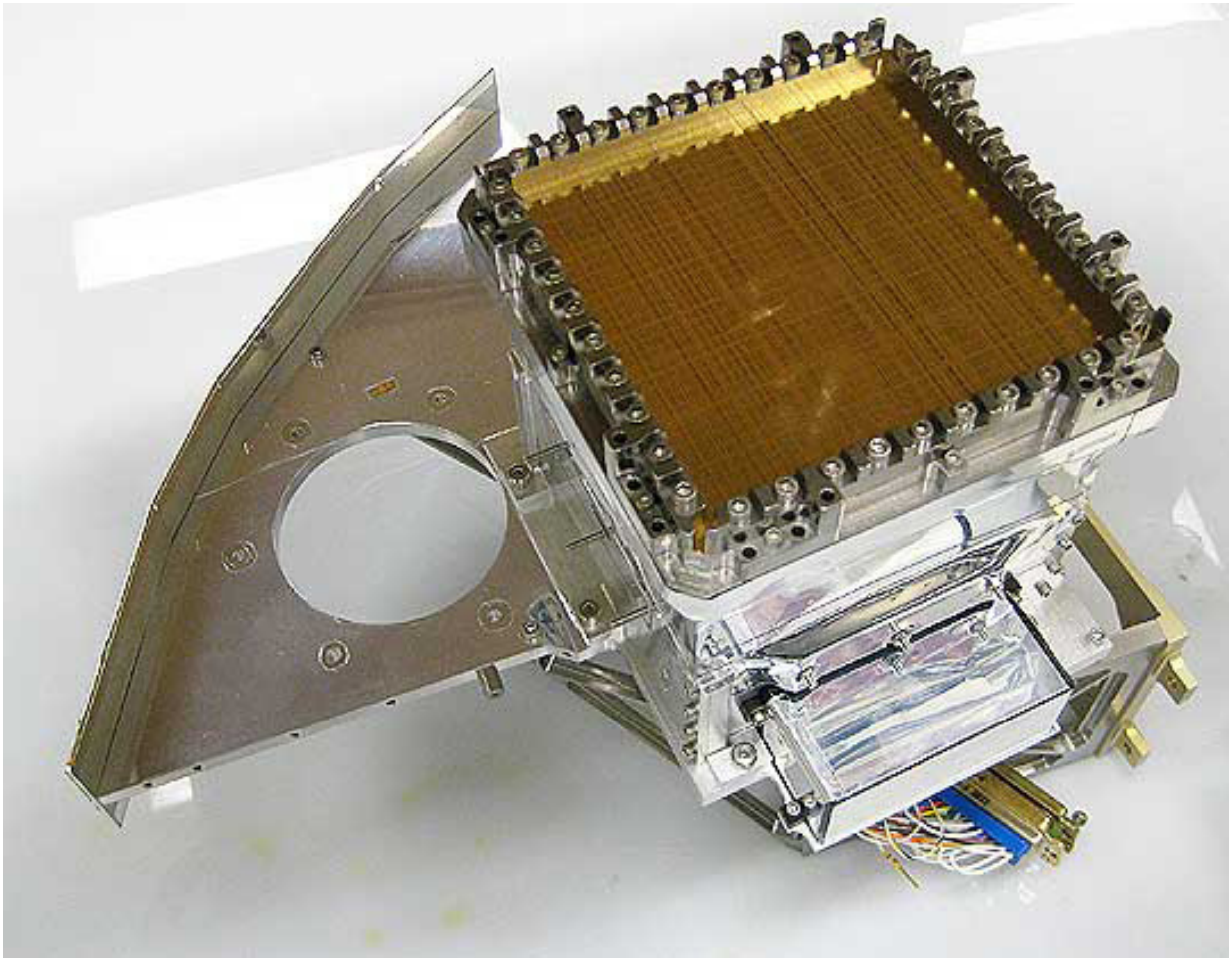
Luke Volpe
DRC's **Metrigraphics** was selected to build the fine-coded mask (FCM) elements due to their experience in forming precise apertures in metal foils. The HETE application in particular had several critical requirements that exceeded the technology's state of the art at the time of manufacture. These requirements included slit width uniformity, sidewall perpendicularity, foil thickness control, and foil flatness control after being removed from the ultra flat glass base.

The FCMs are 127mm square and contain 10,250 precisely positioned rectangular slits. The slit widths, FCM thickness, and material were designed and specified by the MIT HETE team to filter out all but the GRB soft X-ray bandwidth. Gold was selected for the material because it is opaque to x-rays.

For the SXC to function properly, slit widths had to be uniform to within **+/-0.001mm** and perpendicular to the plane of the foil to within **+/-1 degree**. Any variation from the design specifications over the entire active area could reduce accuracy of the SXC and consequently reduce the system's ability to yield accurate locations in the sky.

SatMagazine
Can you describe, in general terms, the FCM manufacturing process?

Luke Volpe
The manufacturing process is based on semiconductor level photolithography, thin film processing (sputter deposition/ion milling) and electrochemical metal deposition, (electroplating). The FCM foil structure



The Soft X-Ray Camera (SCX)

is built on an ultra flat glass substrate that has been sputter coated with a 3000-angstrom layer of conductive seed metal. A precise plating mold is formed over the seed metal in UV sensitive photoresist. Using the pre-deposited, electrically conductive seed metal buss, gold is electroplated into the photoresist mold. Once the electroplating process is completed, the photoresist mold is dissolved away and the FCM is separated from the glass carrier.

SatMagazine

Please describe the successes of the HETE-2 satellite.

Dr. Villasenor

HETE-2 contributed greatly to solving the GRB mystery. It was the first satellite to rapidly disseminate an accurate GRB position within seconds of its actual detection, and subsequently allowed telescopes to observe the afterglow of GRBs, which among other things revealed the distance of these objects. They come from distant galaxies, and are now known to be very powerful occurrences.

On March 29, 2003, it detected a "nearby" GRB, which allowed us to conclusively tie GRBs with supernova explosions, or the death of massive stars. Three years later, on July 9, 2005, it detected a fainter type of short GRB, for which the first optical afterglow was found thus establishing cosmic origin as well.

This class of GRBs is now thought to occur from the merger of two neutron stars. Between these two discoveries, the range of GRBs was spanned, which led NASA to declare the mystery "solved." Of course, GRB research is continuing and much more needs to be learned and discovered.

SatMagazine

Thank you for your work and the information you've given us regarding the NASA HETE mission.

Insight: Near Earth Executive Briefing

Positive Communications Opportunities During Turbulent Economic Times

by Patrick K. Brant

The financial results are in for the year 2008 and they are very positive! The global FSS (Fixed Satellite Services) operators all reported annual revenue growth in the 8 percent-12 percent range and EBITDA margins from 78 percent to 82 percent. Certainly, this is good news for the operators and it should trickle down to some extent to the larger integrators such as Caprock, Artel, Globecomm, and others. Smaller integrators however, are struggling under the pressure of tight credit, high capacity utilization, and costs associated with creating support infrastructure. New satellites have been launched successfully and there are more under construction. Overall, 2008 was a good year in the industry.

Most organizations in the industry are proceeding cautiously in 2009 and managing their businesses based on the key performance indicators of revenue, EBITDA, capacity utilization, new sales contracts and contract renewals. Increasing productivity per employee, responding effectively to regional trends, as well as understanding key 'demand drivers' will be essential to continuing industry health. The global economy is presenting a challenging environment and will require solid management analysis, evaluation and actions. The FSS industry's financial performance has historically lagged recoveries from economic downturns. The industry's greatest challenge will be to dig below the high level indicators and exercise strategies that can change some of the underlying dynamics in the industry and provide a foundation that will grow regardless of the global economic climate. Improving the underpinnings of the business rather than simply sustaining the improved operating efficiencies created over the past decade means 2009 can be the year

when the industry drives its performance and energizes the global economy.

The current economic climate creates an opportunity for companies that can focus on action and implementing strategies for change while others are focusing on 'maintaining the status quo" in these difficult conditions. An outline of differentiating strategies are listed and several critical differentiators for sustained success could include:

- **Energize the industry by taking stock of the benefits and advantages of the services you offer and actively promoting those solutions to target markets that are looking to improve efficiencies:**
  - ◊ *Broadband solutions can provide a positive impetus to the global economy*
  - ◊ *"Sell what is in the wagon"— The satellite industry owns assets that have been fully paid for and operate at less than 80 percent capacity use*
  - ◊ *20 percent underutilized capacity equals sales opportunity without significant capital costs*
    - » *Unused capacity is not always in the most attractive areas, but still presents opportunities*
    - » *New satellite construction has NOT been stopped. Business plans and projections have to have NEW perspectives*
    - » *Ground segment is significantly underused and overbuilt, providing opportunities for cost-effective solutions*
- **Develop and provide applications that will make a difference. Innovation has always been important, but coming out of this global economic downturn, fresh and interesting applications will give you an immediate advantage over competitors that spent the last few years "hunkered down." Now is not the time to eliminate new product planning and development.**
  - ◊ *Opportunities to drive the advantages of reach, speed, and cost*
  - ◊ *Technology solutions for security, IP*
  - ◊ *Market analysis*
    - » *Distance learning is now a concept that is 20 years old and still very limited in actual usage*
    - » *Business continuity has been discussed but nothing new has been introduced*
    - » *Emergency response and management interoperability still have few accepted standards*
    - » *Improve Industry employment demographics*
    - » *Average age of Industry employees is near 50 years of age*
    - » *Need more energetic, 'new Idea' engineers directly out of college to be mentored by the veteran engineers in the industry*
    - » *Attract newcomers to sales with high activity thresholds*
  - ◊ *'If all you do is what you've done, all you'll get is what you've got.'*
- **Improve the relationship between Operators and Integrators**
  - ◊ *Integrators and service providers should be viewed as partners*
- **A distribution channel for the operators rather than as customers**
  - ◊ *Operators should partially share the enormous margins they receive by reducing the capacity cost.*
    - » *This would result in greater capacity use, a more motivated distribution channel, and more hard dollar profit with a slightly lower percent of profit over revenue.*
- **Develop a mix between Commercial and Government customer targets**
  - ◊ *Fortune 1000 accounts are multinational, require security, desire control of communications*
  - ◊ *Government has requirements in Defense (military), Diplomacy (State), and Trade (commerce). Knowledge of contracting process required*

The news for 2008 was very positive and the outlook for 2009 is solid, but there are opportunities for those who seize the moment to drive the industry to new levels of excellence in the years ahead. The development and execution of operational plans that can step outside of "the way it has always been done" will position the industry to come out of the global economic downturn with credible growth strategies in place. These companies will not only avoid that lag and grow throughout the downturn but excel as the recession recedes.

About the author

Patrick K. Brant formerly served as President and CEO of Loral Skynet as well as the COO of Loral CyberStar, Loral's former data services company, and he played a crucial role in the integration of CyberStar with Skynet in 2003. Pat served as president of Controlsat and as a senior director for Orbital Communications, the first provider of global data services via low earth orbit (LEO) satellites.

Focal Point: C2SAT

Technology For The Future

by Susanne Sundqvist, ***C2SAT***

The broadband and Internet revolution has finally reached the maritime sector. The Internet generation is no longer a land-based only system. Users at sea expect similar network performance as they receive at home. Access to communications you have come to depend upon is just as much a necessity at sea, whether it is for contacting headquarters, family and friends, or for entertainment purposes. Suddenly, crew welfare is at the top of the agenda for many ship owners and most crews are likely to apply for work on vessels offering the best broadband service. Enormous bandwidth is needed to satisfy passenger and crew voice and Internet links as well as a wide range of value-added services.

The market is currently divided into **VSAT** (***Very Small Aperture Terminals***) and the **Inmarsat** and **Iridium** segments. The difference between these communication systems is a VSAT solution that is customer designed. Granted, the equipment investment is probably higher — however, traffic fees are much lower. There are many communication systems available on the market that result in a constant decision struggle for ITC managers who operate within the offshore business environs.

More than 70 percent of the Earth's surface is covered with oceans — that's an enormous area to cover with a communications' blanket. Then, there are weather conditions to counter, as well. One second, the sea is calm and, one minute later, there is stormy weather of Titanic proportions. Under these circumstances and over long distances, there is but one method to communicate effectively and reliably, and that is via satellite.

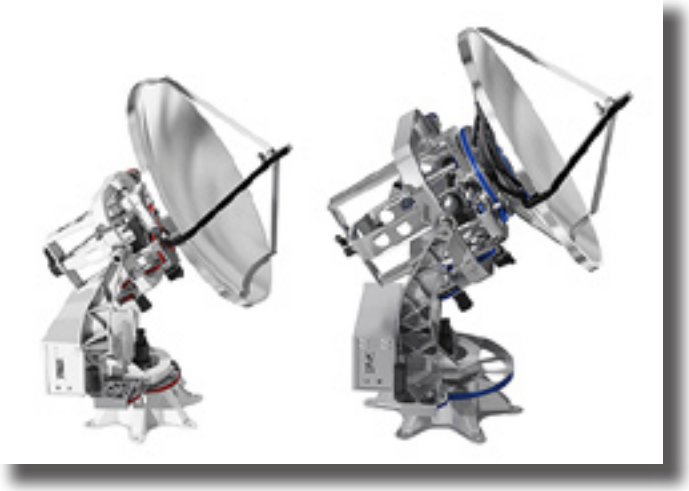
Unpredictable dynamic weather conditions call for a specific kind of VSAT, one that is robust and, above all, reliable for all vessels, such as seismic boats, container ships, cruise ships, fishing boats, and military vessels requiring constant, always-on communication. The upstream oil and gas industry increasingly relies on *satellite communications* (**SATCOM**) for their needs in remote offshore operations, as well as for reliable backup services on their offshore platforms.

The VSAT antennas on board these vessels must, therefore, be stabilized to track satellites effectively, and to eliminate that detested loss of signal. When a vessel rolls back and forth due to wind and wave action, and the satellite is located in the area between the antenna's extreme positions, the zenith paradox occurs. This leads to loss of signal and is a problem with three axes and various communication systems normally associated with maritime VSATs.

Stability With Four Axis

C2SAT, established in 2000 and headquartered in Stockholm, Sweden, is raising reliability, precision, and accuracy a step ahead by using four axis on their antennas. The Company has introduced a series of four axis military and commercial high performance stabilized antenna systems for always-on mobile broadband connectivity. The C2SAT stabilized antenna systems feature optional reflector sizes up to 2.4m for all frequency bands, including Ku-, Ka-, C-, X- and S-band, fitting the same mechanical rig. The flexibility of the present, patented, four axis stabilized mechanical robot allows for a tailored solution based on a customer's requirements. The object is to provide reliable high speed satellite communication, reduce costs in investments, and to reduce the traffic fees, making the bandwidth that's actually been paid for by the customer available for a wide range of applications without reduction in quality.

The C2SAT system achieves a high tracking accuracy (with only a loss of 0,1 dB) — and that takes into account both the losses due to pointing and the losses due to polarization misalignments. The high tracking



C2SAT 1.2m Ku- versus 4m Ku-

C2SAT 1.3m

accuracy is a result of the system's gradient tracking method, a predetermination tracking parameter and the four axis design, where the fourth axis refers to the cross level elevation. The patented stabilized antenna system helps to predict the next position needed. The forth axis enables shorter geometric paths and less rotation torque for each axis. Adding the forth axis also solves the zenith paradox at high reflector elevations during dynamic conditions such vessel roll — the satellite is seen alternatively from the north and the south.

The technologies applied are proprietary and protected by a series of global patents for two-way broadband satellite communication, making as full a use of bandwidth as is possible. The system permits always-on services such as Internet access, SCADA, Wi-Fi, voice over IP, GSM onboard, ATM, credit card validation, video conferencing, video telephony, live video transmission, email, TV, as well as customer tailored services, all available simultaneously in a single system.

A Range Of Products

Based on the original 1.2m Ku-band stabilized antenna platform, C2SAT has expanded the portfolio to include a new lightweight version, the **C2SAT 1.2m Ku-4M** and also the **C2SAT 2.4m C-band**, which includes a larger reflector built of low weight fiber carbon which gives the unit an overall weight of 170kg. The new lightweight version was officially launched in February of last year and the C-band antenna was introduced in June last year at the ***CommunicAsia*** show in Singapore.

Antenna customers range from fishing boats, merchant vessels, seismological marine laboratories, military vessels to yachts. C2SAT does not sell to the end-consumer but through a distribution net with global coverage. In April of last year, a follow up order was received from an offshore customer in the Middle East. This order was for the **C2SAT 1.2m Ku-band** system, which followed the initial pilot installation in 2007 on a drilling ship.

A Radio Link Point-To-Point System

One of C2SAT's partners is **Trac-ID Systems AS** (Trac-ID), based in Stavanger and Bergen, Norway, with **StatoilHydro Venture** as a major owner. Trac-ID is a technology provider specializing in wireless applications for the oil and gas industry. That company aims to contribute to increased safety and profits in oil and gas field operations and other harsh environment operations by supplying high quality wireless solutions for tracking, monitoring, and communication.

The cooperation between C2SAT and Trac-ID has resulted in the development of ***TracLink***, a stabilized radio link, point-to-point solution, which makes it possible to transfer 155 Mbps/sec. of data — yes, even offshore. The system is a combination of the C2SAT four axis stabilized antenna system, microwave point-to-point radio and sophisticated traffic routing (***TracSwitch***).

This TracLink system-solution can use as many as four antennas, two positioned at the bow and two at the stern, to ensure always-on communication with the opposite fixed radio link installation. Each pair of antennas (at bow and stern) automatically compensates for multipath fading. If, for instance, a drilling derrick is shadowing the microwave signal from the bow system, the TracLink system automatically transfers the data traffic to the stern system to maintain the wireless link.

The microwave radio used in the TracLink system is the latest generation of **Ericsson**'s ***Point-to-Point*** radio and includes 155Mbit/sec modems. The TracLink system solution makes it possible for the system to automatically control which of the four antennas is active. The TracSwitch, an integrated part of the TracLink system, operates without interrupting traffic.

The TracLink 1.2m antenna solution is comprised of the C2SAT-patented gimbals system with four stabilized axes. Each axis adjusts the direction of the antenna by using a predicting device to ensure the antenna is looking toward the opposite radio link installation.

When fiber optic cables are installed, the communication systems used today provide high capacity transmission between fixed installations. However, there is no provision for communication to floating rigs operating offshore. These wireless link systems will be the preferred solution for communication between floating offshore installations and fixed platforms (or onshore sites), as the system makes it possible to transfer larger volumes of data from offshore operations and associated systems. The TracLink solution can also be a component of an automatic backup system for existing fiber optical links.

The cooperation between C2SAT and Trac-ID has also resulted in a communication solution, ***TracSat***. In September of last year, TRAC-ID and seismic company **Wavefield Inseis ASA** announced the successful implementation of the TracSat system on ***M/V Malene Ostervold***, which is used in seismic operations around the globe. The TracSat system is based on C2SAT 1.2m Ku-band unit.

The offshore industry's demand for asymmetric satellite services providing higher bandwidth ship-to-shore, transmitting large volumes of information between

M/V Malene Ostervold

remote sites and headquarters, offers a strong financial forecast. Wavefield purchased the TracSat system after extensive testing to verify the systems satellite coverage capabilities as well as global functionality.

Antenna Answers

With traffic fees based on maximum bandwidth, C2SAT stabilized antenna systems make it possible to increase the number of terminals in the offshore network, using the same satellite link. The systems gradient tracking system identifies any selected satellite within six seconds — DVB or DVB-S2 is optional. The C2SAT antenna system was developed with a ruggedized construction to meet military standards, including shock, vibrations, and EMC. The systems' high reliability makes it suitable for use as the main communication connection point. C2SAT systems provide higher bandwidth ship-to-shore, and large volumes of information may be transmitted without frustrating interruptions.

About the author

Susanne Sundqvist works as the Marketing manager and has been with C2SAT since 2004.

Finding The NexGen Aerospace Workers For The U.S. Satellite Industry

by Marion Blakey, President and CEO
Aerospace Industries Association

The U.S. satellite industry has a great deal to worry about these days — lost opportunities due to outdated export control rules, global competition from more and more countries every day, the various technical challenges of providing new services — but there's another issue out there affecting the entire aerospace industry that demands attention in the satellite sector — a looming workforce crisis.

The U.S. aerospace industry workforce is currently dominated by aging workers — baby boomers who were enthralled with space travel and answered our nation's call to win the Space Race and put Americans on the moon. Today, nearly 60 percent of aerospace workers were age 45 or older in 2007, with retirement eligibility either imminent or already reached.

There is a growing need to replace these experienced workers, especially the engineer talent pool, with capable new talent to ensure that the United States continues to be the world's leader in satellite technology and other important aerospace applications. But there are not sufficient numbers of young people studying ***Science, Technology, Engineering and Mathematics*** — the **STEM** disciplines — that would put them on the path to enter aerospace careers and replace our retiring workers.

There is very strong competition for our nation's brightest math- and science-oriented students. Aerospace companies are forced to share talent with a variety of high-tech industries that were not even around when baby boomers were selecting their careers. For example, more than half of those who graduate with bachelor's degrees in engineering go into totally unrelated fields for employment. And the numbers earning advanced degrees in STEM subject areas lag other fields by huge margins.

An estimated 70,000 engineering bachelor's degrees are awarded in the United States each year, but only 44,000 of those graduates are compatible for aerospace careers when you subtract other engineering

disciplines and foreign nationals ineligible for security clearances. About 40 percent of STEM master's degrees and 50 percent of doctoral degrees go to non-citizens also not eligible for security clearances. Many jobs in the national security and space sections of the industry — a significant portion of overall employment — require the clearances. Even with the economic decline, many aerospace companies are still hiring, especially engineers. So the shortfall is evident.

In addition, our future workforce is not being prepared for STEM careers even before they reach college. Approximately 70 percent of our eighth graders are below "proficient" in mathematics and science and our 15 year olds rank 21st in science and 25th in math when compared to other nations.

The **U.S. Labor Department** projects 2.5 million STEM-related jobs will be vacant by 2014, a clear disconnect with the amount of available talent as aging workers start to retire at a faster pace. **NASA** and the **Defense Department** predict that the shortage could affect national security and limit commercial product development.

There are a number of aggressive initiatives, both on the company level and industry-wide, to encourage young people to pursue math and science careers and ignite excitement in aerospace. The one **AIA** is most directly involved in is the **Team America Rocketry Challenge**, the world's largest model rocket competition.

Now in its seventh year, **TARC** is a collaborative effort between **AIA** and the ***National Association of Rocketry***, with support from NASA, the Defense Department, the ***American Association***

of Physics Teachers and more than 30 AIA member companies.

Created as a one-time event to mark the 100th anniversary of the Wright brothers' first flight, TARC received such a positive reaction from students, teachers and parents, AIA made it an annual event. The national, hands-on competition challenges middle and high-school students to demonstrate their math and science skills, work together in a team environment, and design a real aerospace product, which is put through the rigors of testing and evaluation.

The specifics of the challenge change each year so students must solve a new problem and build an original rocket. This year, future engineers from across the country are charged with the task to design and build a model rocket that will climb to 750 feet and stay aloft for 45 seconds.

Teams must also return a payload of one raw egg — lying horizontally to mimic the position of an actual astronaut — to the ground unharmed.

Out of the more than **650 TARC** teams that submit qualifying scores, 100 finalist teams are invited to compete for **$60,000** in prizes and scholarships at the final "fly-off" to be held on May 16th, at **Great Meadow in The Plains**, Virginia, outside of Washington, D.C. At the finals, scores are compiled after two rounds of launches and the winning team earns a trip to the **International Paris Air Show** in June, among other accolades.

TARC team members consider the competition to be a fun way to apply math and science and also an engaging activity to do with their friends. At the same time, sponsoring companies see the value in exposing these students to hands-on learning that will hopefully propel them to pursue aerospace careers.

Since the first TARC, almost **50,000 students** have participated, and there is strong evidence that TARC successfully encourages its participants to pursue careers in the aerospace industry. For instance, each of the eight graduating seniors from the 2008 winning TARC team from **Enloe High School** in Raleigh, North Carolina, is currently enrolled in a college engineering

program. Also, in a 2008 survey of TARC participants conducted by AIA, 67 percent of respondents said TARC increased the likelihood they would enter into an aerospace career.

David Adelman is just one example of a TARC alumni now working in the aerospace field. Already aware that engineering interested him as a career path, Adelman participated in the inaugural TARC competition and asserts that the hands-on exposure to rockets increased his interest in the aerospace sector. But TARC delivered more than just passion for aerospace. After being introduced to **Aerojet**, his team's sponsoring company, the major space and defense contractor followed *Adelman* through college, offering him internships, a scholarship and even a job upon graduation as a mechanical engineer designing missiles.

"I never would have known about Aerojet if it wasn't for TARC," *Adelman* said.

For more information about this year's Team America Rocketry Challenge, visit

http://www.rocketcontest.org.

About the author

Marion C. Blakey is president and chief executive officer of the Aerospace Industries Association. AIA represents the nation's leading manufacturers and suppliers of civil, military, and business aircraft, helicopters, unmanned aerial systems, space systems, aircraft engines, missiles, materiel and related components, equipment services and information technology. Visit www.aia-aerospace.org for more information.

Executive Spotlight On...

Rob Bednarek, President + CEO, SES AMERICOM-NEW SKIES

Rob Bednarek heads up global satellite services company SES AMERICOM-NEW SKIES, a newly combined division of SES that brings together SES AMERICOM, the leading supplier of satellite solutions in the U.S., with the strategic global satellite services of SES NEW SKIES.

His company's fleet has grown overnight from eight to 24 spacecraft. The 25-year industry vet leads the newly formed organization of 400 employees worldwide from two offices a world apart — in The Hague, Netherlands and Princeton, New Jersey. The organization's global span is perfectly aligned with the daily global coverage needs of his company's media, enterprise and government customers.

Television networks and programming producers, the biggest names and innovators in business, and some of the largest network operators and government agencies in the world are among a growing roster of clients that depend on **SES AMERICOM-NEW SKIES** for reliable content delivery and communications connectivity anywhere, anytime.

Taking the reins at SES AMERICOM-NEW SKIES was a natural for *Bednarek*, whose impressive career includes a series of senior posts, including his continued participation on the Executive Committee of SES (the parent of SES AMERICOM-NEW SKIES as well as SES ASTRA in Europe). *Bednarek* also oversees the company's participation in satellite operators Ciel in Canada, and QuetzSat in Mexico. He has previously served as President and CEO at SES New Skies, Executive Vice President of Corporate Development at SES, and as Executive Vice President and Chief Technology Officer at **PanAmSat**. Early in his career, he was the Deputy Chief Scientist for the **U.S. Corporation for Public Broadcasting**.

SatMagazine caught up with him **in** Washington, DC, where he unveiled his vision for the new satellite powerhouse that combine the two complementary satellite networks.

SatMagazine

Rob, you're a busy man. You've taken two industry leaders in SES AMERICOM and SES NEW SKIES and formed a global giant. What is the goal behind the combination of two leading firms?

Rob Bednarek

Our goal is to develop and deliver the global satellite services and support systems that enable our customers to realize, and even exceed, their ambitions. SES stands for industry innovation, reliability, stability and a long-term commitment to the satellite business and our customers' networks. Combine those strengths with the complete global coverage provided by our 24 satellites accessible anywhere, anytime and we think SES AMERICOM-NEW SKIES is well positioned to serve customers around the world.

NEW SKIES and AMERICOM have both earned customer trust and established strong reputations over the years. AMERICOM has a 30-plus year tradition of reliability and operational excellence serving North America with innovation, expertise and state-of-the-art solutions. NEW SKIES has excelled at breaking into new markets and putting capacity in places where we can help customers thrive by developing and evolving exciting new markets and services.

Together, the two companies combined will further change the satellite landscape. SES AMERICOM-NEW SKIES will challenge our competitors and serve customers with both choice capacity and deep knowledge and experience in media distribution and telecom connectivity.

We will be announcing a new name for the newly combined division later this year, so stay tuned.

SatMagazine

What are the biggest benefits SES AMERICOM-NEW SKIES offers to the global marketplace?

Rob Bednarek

Clearly, the top benefit is presenting global scale capacity suited to customer needs, either locally or across continents. When you join customers' ambitions with our satellites, there really are no limits to what we will accomplish together.

We're strongly positioned to better share insights gained in one part of the world with those who may be able to benefit elsewhere. For example, the rapid growth of HDTV in the U.S. is just beginning in other markets. Our history and leadership in HD delivery is valuable to customers contemplating the need for high-def programming.

Likewise, our vast networking and broadband experience allows us to tailor our capacity and services to a wide variety of needs irrespective of location. We can alert customers to developments we believe will improve their business prospects. Last, but perhaps most importantly, the scale achieved by our newly combined entities supports even further improvements in our customer service — from expanded teams to enhanced tools.

SatMagazine

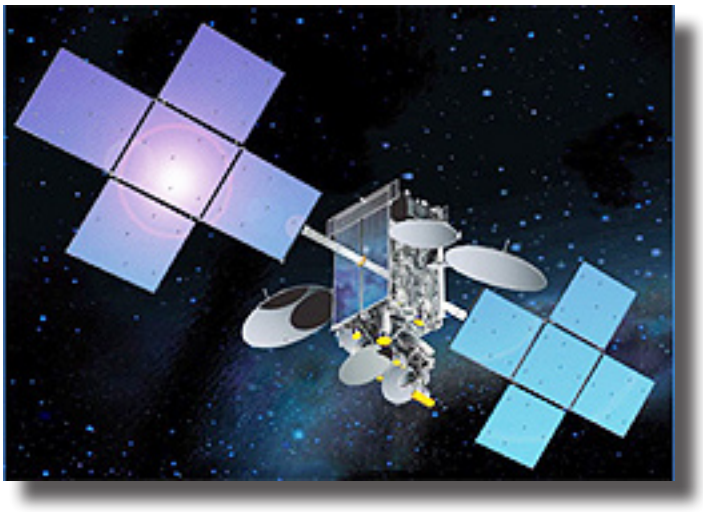
Where are your most promising growth hotspots geographically speaking? And has the economic downturn affected any major customer initiatives?

Rob Bednarek

SES AMERICOM-NEW SKIES' global opportunities are as varied, diverse and exciting as the markets we serve and the solutions we offer to media, enterprise and government markets.

India, Africa and Middle East markets continue to grow, and industry investments in these regions that drive communications and media developments, remain on track.

Our NSS-12 satellite, slated for launch in Q3 this year, is another great illustration of demand. That platform will deliver a great mix of DTH, VSAT, and telecom applications with Africa, Middle East, and AOR coverage. And it's nearly sold out.



NSS-12 satellite

The U.S. and North America remain solid as well, where bandwidth for HD advancements is required. ION Media Networks, for example, just launched its flagship network in HD on one of our HD-PRIME birds, AMC-1. We've just surpassed the 65 HD channel mark on the HD-PRIME platform, which is home to HD leaders such as Discovery HD Theater, Showtime HD, Food Network HD, and HGTV HD.

SatMagazine

On the *subject of your combined fleet, SES AMERICOM-NEW SKIES has 24 spacecraft. What is your overall fleet strategy going forward?*

Rob Bednarek

The entire SES fleet counts 40 spacecraft today, and with nine satellites currently under construction SES is pursuing one of the industries most ambitious expansion programs. Satellite capacity is the key ingredient that allows us to enable the continued growth of our customers in markets around the world. That's no secret.

SES AMERICOM-NEW SKIES is dedicated to maintaining and expanding the capacity we need to meet the near and long term needs of our global customers. NSS-9, launched in February, is located over the Pacific Ocean region with a broad distribution range. It can reached from Australia, Indonesia, the Philippines, Japan, China and Korea to the U.S. mainland, Hawaii, and Polynesia. Customers can also tap the global beam on board NSS-9 for coverage of the entire Earth.

It replaced NSS-5, which is now free to support a wide range of missions with its flexible C- and Ku-band capacity. We will certainly leverage our legacy satellites, as they are replaced, to provide expanded coverage and redundancy.

Over the U.S., AMC-21 has done extremely well supporting anchor tenant PBS and its 356 public television stations and the delivery of mobile broadband services to the oil and gas industry, the U.S. government, and maritime broadband users across the Gulf of Mexico and Caribbean.

Our capacity strategy also ensures strong inventory and online access to our global occasional solutions as well. We have a tradition of carrying the biggest breaking news stories, political campaigns and conventions, national weather coverage, and sporting events in the world — from the Olympics and the Super Bowl to March Madness. We are clearly a leader in sports content distribution worldwide and we look forward to growing that role with our global platform.

A quick view of upcoming fleet activity has NSS-12 scheduled for launch in Q3 and NSS-14 on the fast track for 2010. Overall, the near term net gain is 200 transponders soon to be supporting everything from

NSS-9 launch

broadcast to broadband delivery to just about anywhere you can imagine.

SatMagazine

You have always been one to put your imagination and visionary skills to good use for the companies you lead. Can you share with us what the future holds for SES AMERICOM-NEW SKIES and your customers?

Rob Bednarek

I think it's safe to say the future looks very bright. I'm pleased with where we are today and with the support and encouragement we receive from SES regarding our continued growth and development. Our business today is built on great relationships with a wonderful set of customers.

Our account teams know their business and thoroughly understand our customers' challenges and opportunities. We have dedicated ourselves to further improve service, including increased technical support and more flexibility and creativity in an ever-changing market environment.

In addition to our strong operating focus, we continue to support future development of our capacity and services. We have plans for additional satellites and we are fully involving our customers in the design of those spacecraft to support their needs five to 10 years out.

We are also working to ensure that our capacity is suitable for an increasing array of applications in new areas, including the mobile and government sectors.

Advanced HD and IP encapsulated video are certainly exciting, and SES AMERICOM-NEW SKIES is well positioned to support these evolving developments and the rollout of networks around the world.

Wavelets — "Beyond Comparison"

by D. Lee Fugal

Wavelets are used extensively in Signal and Image Processing, Medicine, Finance, Radar, Sonar, Geology and many other varied fields. They are usually presented in mathematical formulae, but can actually be understood in terms of simple comparisons with your data.

As a background, we first look at the ***Discrete Fourier Transform*** (**DFT**) or it's faster and more famous cousin, the ***Fast Fourier Transform*** (**FFT**). These transforms can be thought of as a series of comparisons with your data, which we will call for now a "signal" for consistency. Signals that are simple waves of constant frequencies can be processed with ordinary DFT/FFT methods.

Real-world signals, however, often have frequencies that can change over time or have pulses, anomalies, or other "events" at certain specific times. This type of signal can tell us where something is located on the planet, the health of a human heart, the position and velocity of a "blip" on a Radar screen, stock market behavior, or the location of underground oil deposits. For these signals, we will often do better with wavelets. We now demonstrate both the **Fourier** and **Wavelet** Transforms of a simple pulse signal.

The Discrete Fourier Transform/Fast Fourier Transform (DFT/FFT)

We start with a point-by-point comparison of the pulse signal (**D**) with a high frequency wave or "sinusoid" of constant frequency (**A**) as shown in *Figure 1* below. We obtain a single "goodness" value from this comparison (a correlation value) which indicates how much of that particular sinusoid is found in our own pulse signal.

We can observe that the pulse has 5 cycles in 1/4 of a second. This means that it has a frequency of 20

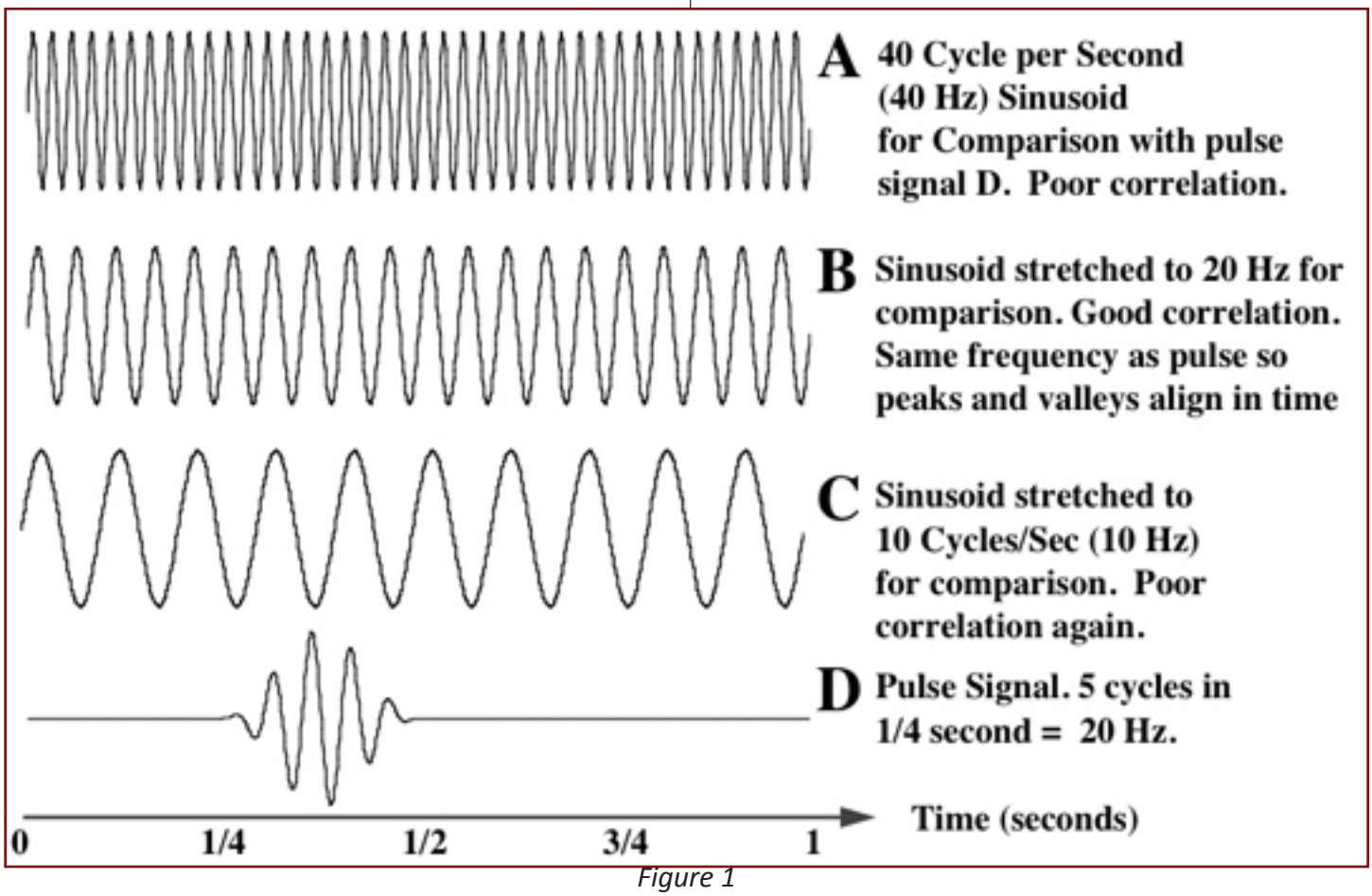


Figure 1

FFT-type comparison of Pulse Signal with several stretched sinusoids.

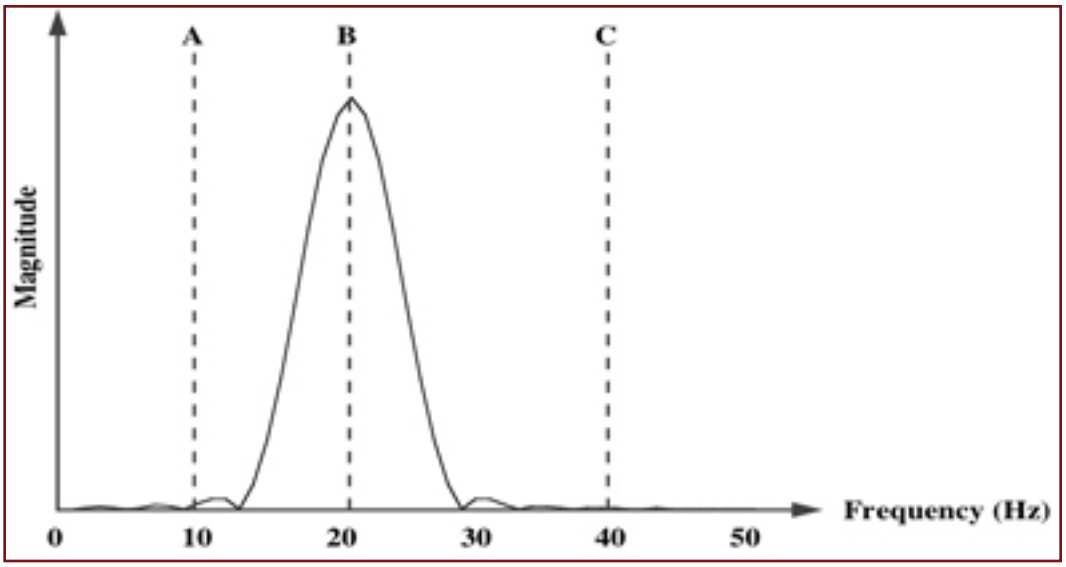


Figure 2

Actual FFT plot of above pulse signal with the three sinusoids indicated

cycles in one second or "20 Hz." The comparison sinusoid, A, has twice the frequency or 40 Hz. Even in the area where the signal is non-zero (the pulse) the comparison is not very good.

By lowering the frequency of A from 40 to 20 Hz (**waveform B**) we are effectively "stretching" the sinusoid (**A**) by 2 so it has only 20 cycles in 1 second. We compare point-by-point again over the 1-second interval with the pulse (**D**). This next correlation gives us another value indicating how much of this lower frequency sinusoid (now the same frequency as our pulse) is contained in our signal. This time the correlation of the pulse with the comparison sinusoid is very good. The peaks and valleys of B and the pulse portion of D align (or can be easily shifted to align) and thus we have a large correlation value.

Figure 1 on Page 35 shows us one more comparison of our original sinusoid (**A**) stretched by 4 and trimmed so it has only 10 cycles in the 1 second interval (**C**). This comparison with **D** is poor again. We could continue stretching and trimming until the sinusoid becomes a straight line having zero frequency or "DC" (named for the zero frequency of Direct Current) but all these comparisons will be increasingly poor.

An actual DFT (or functionally equivalent FFT) compares many "stretched" sinusoids ("analysis signals") to the pulse rather than just the three shown here. The best correlation is found when the sinusoid frequency best matches that of the pulse. *Figure 2* shows the first part of an actual FFT of our pulse signal **D**. The locations of our sample comparison sinusoids **A**, **B**, and **C** are indicated. Notice that the FFT tells us correctly that the pulse has primarily a frequency of 20 Hz, but does *NOT* tell us where the pulse is located in time!

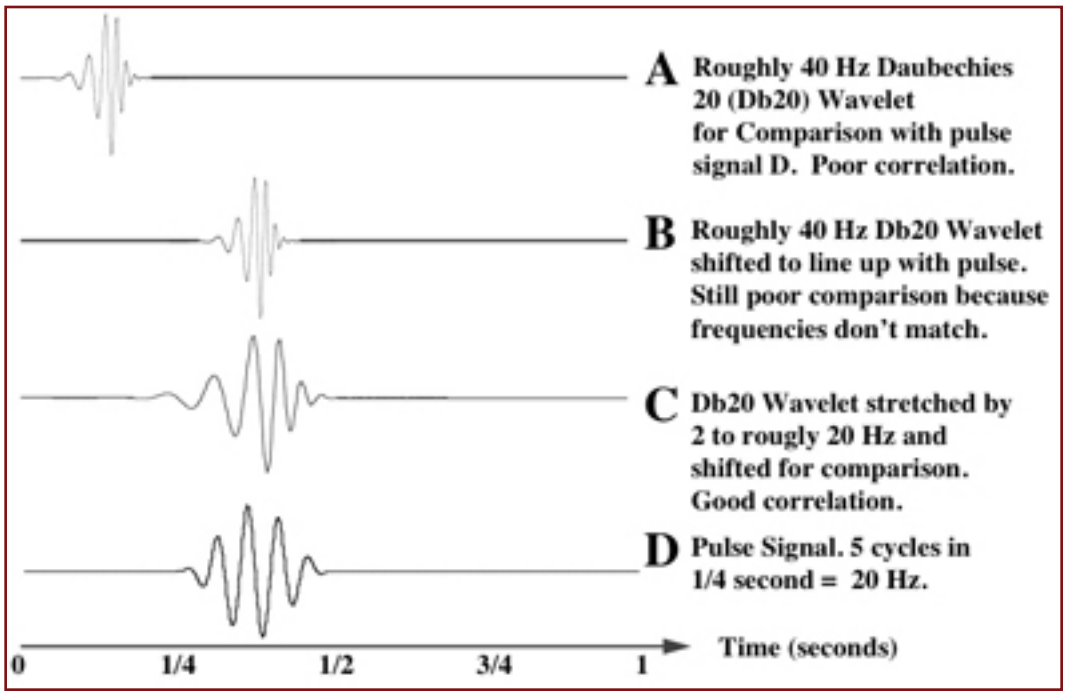


Figure 3

CWT-type comparison of Pulse Signal with several stretched and shifted wavelets

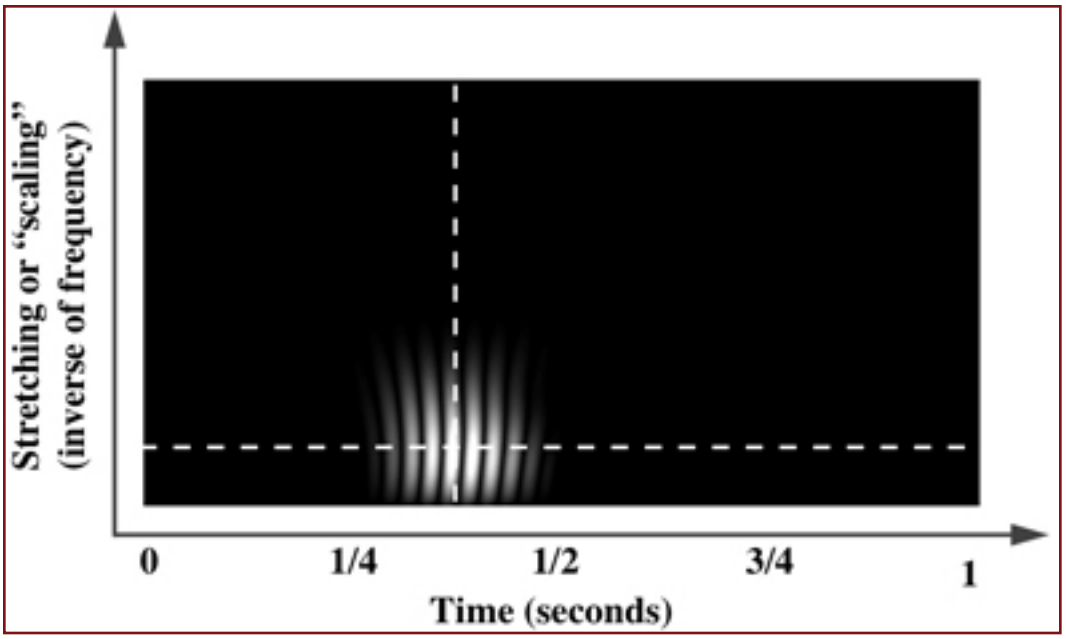


Figure 4

Actual CWT display indicating the time and frequency of the Pulse Signal

The Continuous Wavelet Transform (CWT)

Wavelets are exciting because they too are comparisons, but instead of cor-relating with various stretched, infinite length unchanging sinusoids, they use smaller or shorter waveforms ("wave–lets") that can start and stop where we wish.

By stretching and shifting the wavelet numerous times we get numerous correlations. If our signal has some interesting events embedded, we will get the best correlation when the stretched wavelet is similar in frequency to the event and is shifted to line up with it in time. Knowing the amounts of stretching and shifting we can determine both location and frequency.

Figure 3 on Page 36 demonstrates the process. Instead of sinusoids for our comparisons, we will use wavelets. **Waveform A** shows a ***Daubechies 20*** (**Db20**) wavelet about 1/8 second long that starts at the beginning (t = 0) and effectively ends well before 1/4 second. The zero values are extended to the full 1 second. The point-by-point comparison with our pulse signal **D** will be very poor and we will obtain a very small correlation value.

In the previous FFT/DFT discussion we proceeded directly to stretching. In the **Wavelet Transforms** we shift the wavelet slightly to the right and per-form another comparison with this new waveform to get another correlation value. We continue to shift until the **Db20** wavelet is in the position shown in **B**. We get a little better comparison than **A**, but still very poor because **B** and **D** are different frequencies.

After we have shifted the wavelet all the way to the end of the 1 second time interval we start over with a slightly stretched wavelet at the beginning and repeatedly shift to the right to obtain another full set of these correlation values. **C** shows the **Db20** wavelet stretched to where the frequency is roughly the same as the pulse (**D**) and shifted to the right until the peaks and valleys line up fairly well. At this particular shifting and stretching we should obtain a very good comparison and large correlation value. Further shifting to the right, however, even at this same stretching will yield increasingly poor correlations.

In the CWT we thus have one correlation value for every shift of every stretched wavelet. To show the data for all these stretches and shifts, we use a 3-D display with the stretching (roughly inverse of frequency) as the vertical axis, the shifting in time as the horizontal axis, and brightness (or color) to indicate the strength of the correlation. *Figure 4 above* shows a ***Continuous Wavelet Transform*** (**CWT**) display for this particular pulse signal (**D**). Note the strong correlation of the three larger peaks and valleys of the pulse with the Db20 wavelet, the strongest being where all the peaks and valleys best align.

The display shows that the best correlation occurs at the brightest point or at about 3/8 second. This agrees with what we already know about the pulse, **D**. The display also tells us how much the wavelet had to be stretched (or "scaled") and this indicates the approximate frequency of the pulse. Thus we know not only the frequency of the pulse, but also the time of it's occurrence!

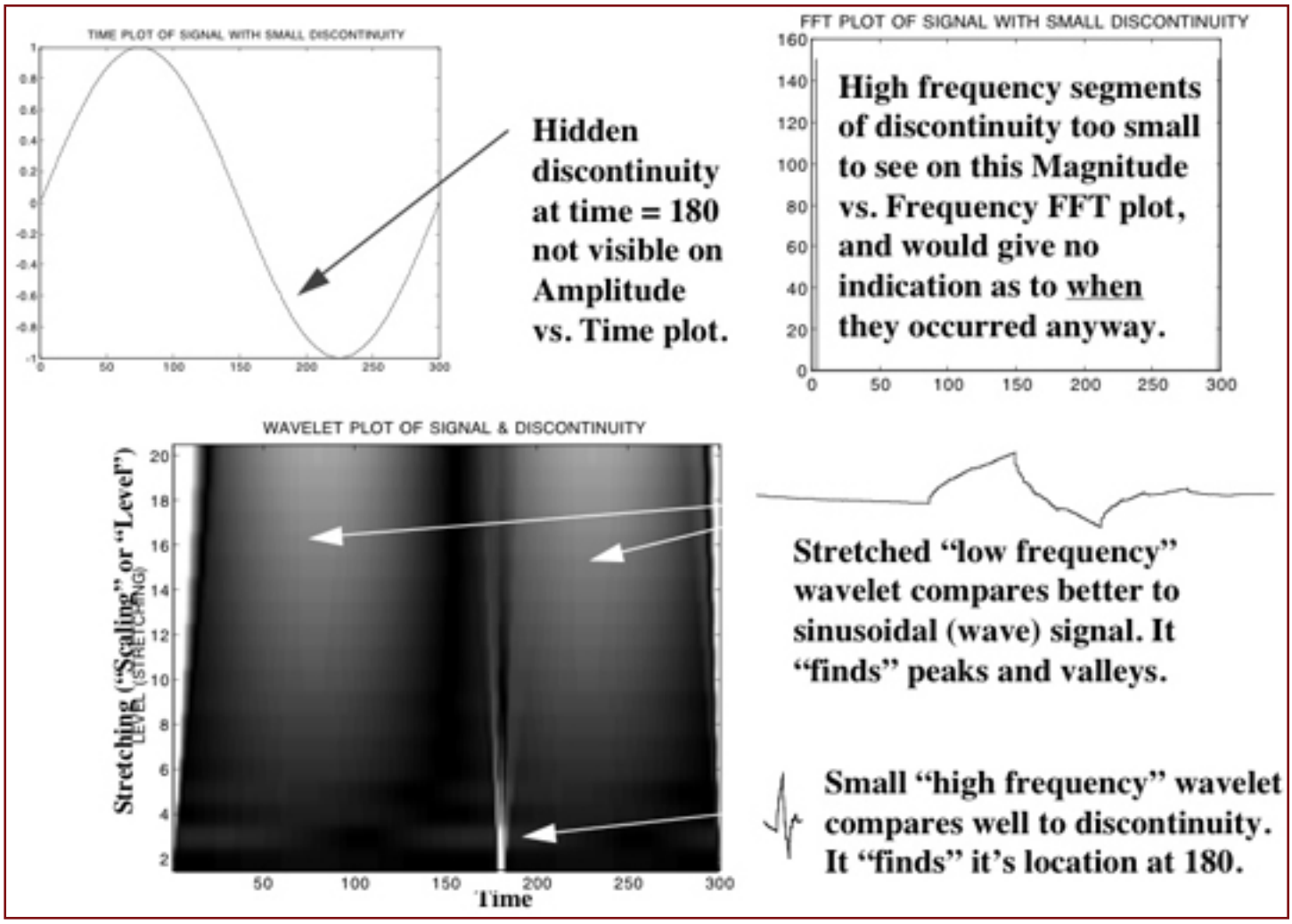


Figure 5

Comparison of Time Plot, Frequency Plot (FFT), and Wavelet Plot (CWT) of a signal with a hidden discontinuity

We run into this simultaneous time/frequency concept in everyday life. For example, a bar of sheet music may tell the pianist to play a C-chord of three different frequencies at exactly the same time on the first beat of the measure.

For the simple example above we could have just looked at the pulse (**D**) to see its location and frequency. The next example is more representative of wavelets in the real world.

Figure 5 above shows a signal with a very small, very short discontinuity at time 180. The Amplitude vs. Time plot of the signal is shown at the upper left but does not show the tiny "event". The Magnitude vs. Frequency FFT plot tells what frequencies are present but does not indicate the time associated with those frequencies.

With the wavelet display, however, we can clearly see a vertical line at **180** at low scales when the wavelet has very little stretching, indicating a very high frequency. The CWT display also "finds" the large oscillating wave at the higher scales where the wavelet has been stretched and compares well with the lower frequencies. For this short discontinuity we used a short wavelet (a **Db4**) for best comparison.

This is an example of why wavelets have been referred to as a "mathematical microscope" for their ability to find interesting events of various lengths and frequencies hidden in data.

Besides acting as a "microscope" to find hidden events in our data, wavelets can also separate the data into various frequency components, as does the FFT. The FFT/DFT is used extensively to remove unwanted noise that is prevalent throughout the entire signal such as a 60 Hz hum. Unlike the FFT, however, the wavelet transform allows us to remove frequency components at specific times in the data. This allows us a powerful capability to throw out the "bad" and keep the "good" part of the data in that frequency range.

These types of transforms are called "Discrete Wavelet Transforms" (DWT). They also have easily computed inverse transforms (IDWT) that allow us to reconstruct the signal after we have identified and removed the noise or superfluous data for denoising or compression.

Undecimated or "Redundant" Discrete Wavelet Transforms (UDWT/RDWT)

In one type of DWT, the Redundant Discrete Wavelet Transform, or RDWT, we first compare (correlate) the Wavelet "filter" with itself. This produces a "Highpass Halfband Filter" or "superfilter." When we compare or correlate our signal with this superfilter we extract the highest half of the frequencies. For a very simple denoising, we could just discard these high frequencies (for whatever time period we choose) and then reconstruct a denoised signal.

Multi-level RDWT's allow us to stretch the wavelet, similar to what we did in the CWT, except that it is done by factors of 2 (twice as long, 4 times as long, etc.). This allows us stretched superfilters that can be halfband, quarter-band, eighth-band and so forth.

Figure 6

If you look closely at the top of the Ferris Wheel, you will see compression "noise" on the right image and NONE on the left

Conventional (Decimated) Discrete Conventional Transforms (DWT)

We stretched the wavelet in the CWT and the RDWT. In the conventional DWT, we shrink the signal instead and compare it to the unchanged wavelet. We do this by "downsampling by 2." Every other point in the signal is discarded. We have to deal with "aliasing" (not having enough samples left to represent the high frequency components and thus producing a false signal). We must also be concerned with "shift invariance" (do we throw away the odd or the even values? — it matters!).

If we are careful, we can deal with these concerns. One amazing capability of the filters in the conventional DWT is alias cancellation where the basic wavelet and 3 similar "filters" combine to allow us to reconstruct the original signal perfectly. The stringent requirements on the wavelets to be able to do this is part of why they often look so strange (see *Figure 8 on Page 41*).

As with the RDWT, we can denoise our signal by discarding portions of the frequency spectrum — as long as we are careful not to throw away vital parts of the alias cancellation capability. Correct and careful downsampling also aids with compression of the signal. Modern JPEG compression uses wavelets. *Figure 6* shows JPEG image compression. The image on the right was compressed by a ratio of 157:1 using a Biorthogonal 9/7 set of wavelets.

There are many types of Wavelets. Some come from mathematical expressions. Others are built from basic Wavelet Filters having as little as 2 points. The Db4, Db20, and Biorthogonal wavelets shown earlier are examples of this 2nd type. *Figure 7* shows a 768 point approximation of a continuous Db4 wavelet with the 4 filter points (plus 2 zeros) superimposed.

Some wavelets have symmetry (valuable in human vision perception) such as the Biorthogonal Wavelet pairs. Shannon or "Sinc" Wavelets can find events with specific frequencies (these are similar to the Sinc Function filters found in traditional DSP). Haar Wavelets (the shortest) are good for edge detection and reconstructing binary pulses. Coiflets Wavelets are good

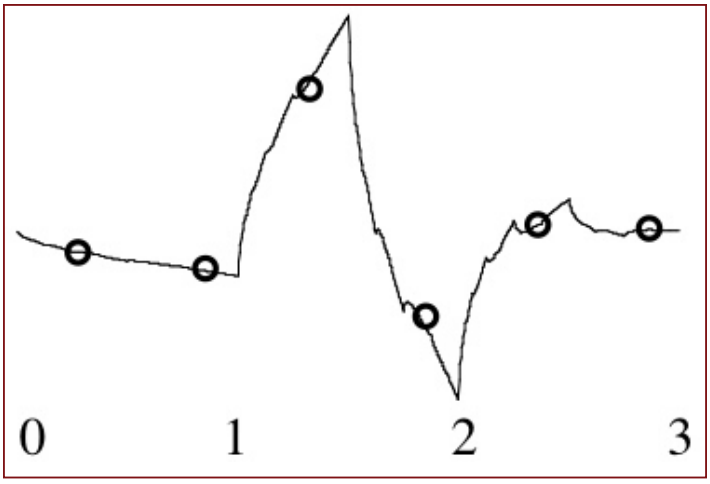


Figure 7

Daubechies 4 wavelet with 4 original filter points and 2 end zeros

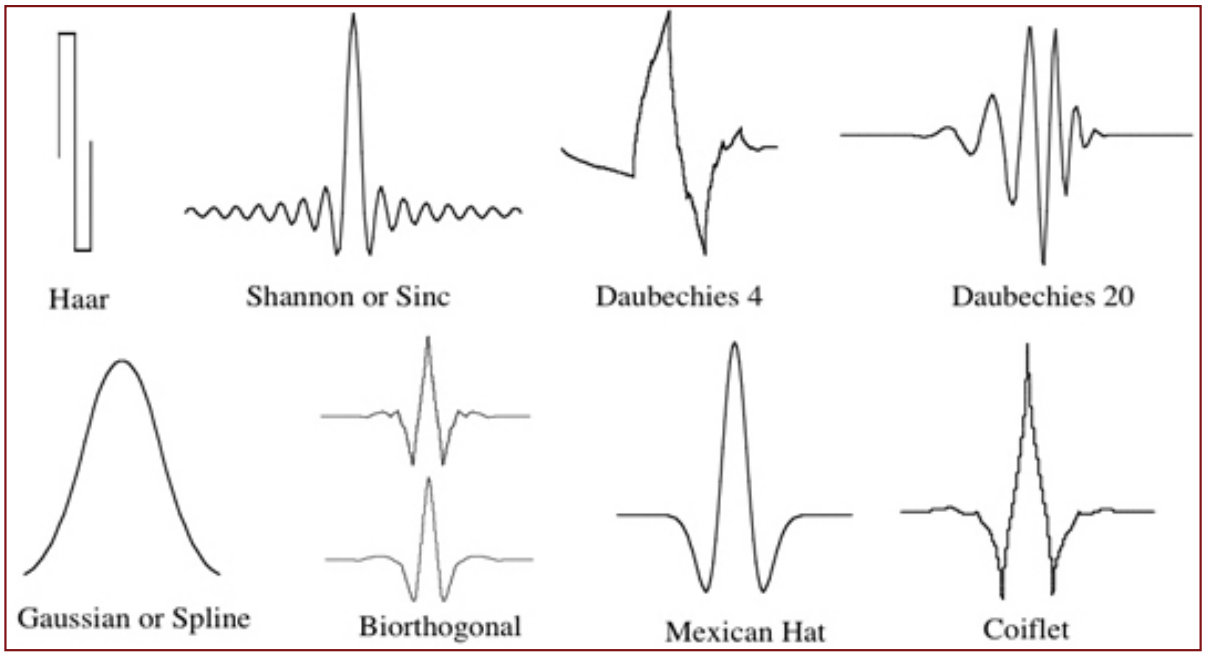


Figure 8

Examples of types of wavelets

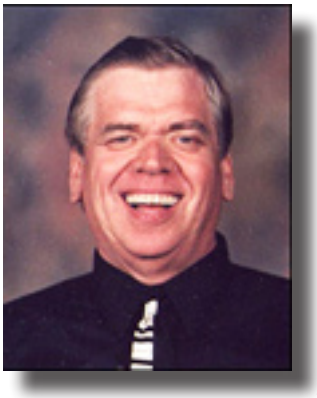
for data with self-similarities (fractals) such as financial trends. Some of the wavelet families are shown in *Figure 8 above*.

You can even create your own wavelets, if needed. However there is "an embarrassment of riches" in the many wavelets that are already out there and ready to go. We have already seen that with their ability to stretch and shift that wavelets are extremely adaptable. You can usually get by very nicely with choosing a less-than-perfect wavelet. The only "wrong" choice is to avoid wavelets due to an abundant selection.

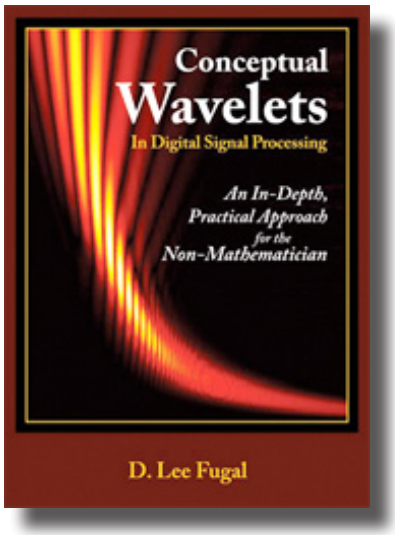
There is much more to discover than can be presented in this short overview. The time spent, however, in learning, understanding and correctly using wavelets for these "non-stationary" signals with anomalies at specific times or changing frequencies (the fascinating, real-world kind!) will be re-paid handsomely.

http://www.ConceptualWavelets.com

About the author



D. Lee Fugal is Founder and President of Space & Signals Technologies, LLC., a company specializing in the presentation of difficult concepts in an intuitive, understandable manner. He has over 30 years of industry experience in Digital Signal Processing (including Wavelets) and Satellite Communications. He has been a full-time consultant on numerous assignments since 1991. Additionally, Mr. Fugal offers short courses for Jim Jenkins at **ATI** *(**http://www.aticourses.com**).*



Executive Spotlight On...

Charlie Maloney, GOES N-P Program Manager
Boeing Space and Intelligence Systems, Boeing Integrated Defense Systems

***Charlie Maloney* is the *GOES N-P* Program Manager for Boeing Space and Intelligence Systems within Boeing Integrated Defense Systems. In this role, *Maloney* is responsible for final systems testing and launch preparations of the nexgen series of *Geostationary Operational Environmental Satellites* built for NASA and NOAA.**

Maloney brings more than 26 years of satellite expertise to Boeing in engineering and management, including the development of new product designs and requirements of communications and earth observation satellites and managing a diverse workforce of engineering professionals. For the past 11 years, *Maloney* has been an integral member of the GOES N-P Program. Prior to his role as Program Manager, *Maloney* was Deputy Program Manager and Chief Engineer of the ***GOES N-P*** Program, where he was responsible for the technical integrity of the spacecraft and ground segment... including end-to-end systems engineering and image navigation and registration. *Maloney* led the program through the final systems testing and launch of the first spacecraft in the series, ***GOES-N***, in May 2006. *Maloney* coordinated in-orbit testing of GOES-N and spacecraft acceptance by **NASA** and **NOAA** in December 2006.

Maloney's experience includes the overall design and integration of the GOES N-P spacecraft, including the spacecraft structure, spacecraft subsystems and instrument accommodation. Before joining the GOES N-P Program, *Maloney* served as the ***JCSAT-3*** Spacecraft Manager with **Hughes Electronics Corporation** on the JCSAT communications satellite program. He guided the first JCSAT spacecraft through systems testing, launch, and successful in-orbit testing in 1995 and served as Systems Engineering Manager for the launches of ***JCSAT-4*** in 1996 and JCSAT-5 in 1997.

From 1990 to 1992, *Maloney* led the docking and interface design team for ***Intelsat VI F-3 Reboost Mission.*** The program was designed to allow the Space Shuttle's astronauts to rescue the stranded F-3 spacecraft by carrying a 22,000-pound solid rocket motor up to orbit and attaching the massive motor and electrical connections to the F-3 spacecraft before sending it back out to space.

SatMagazine discussed a variety of topics surrounding GOES and Boeing with Charlie.

SatMagazine

Charlie, in January of 1998, NASA's Goddard Space Flight Center awarded Boeing the contract for three Geostationary Operational Environmental Satellites to be operated by the National Oceanic and Atmospheric Administration, otherwise known as NOAA. How did Boeing manage to acquire this important award?

Charlie Maloney

Starting with the launch of the first ***Applications Technology Satellite*** in December 1966, Boeing brings to the table more than 42 years of experience building advanced weather satellites. A key part of that experience was the development of the ***GOES D-H*** satellites. These were spin stabilized satellites and they used the spin of the satellite for pointing stability and to achieve the East-West scan of the Earth. In 1986, Boeing developed the ***HS601*** satellite, a body-stabilized spacecraft, which was compatible with the current generation of Imagers which used integrated scan mirrors to achieve both the North-South and East-West scanning of the instruments.

In 1995, Boeing started the development of a star tracker based attitude control system, with the intent of capturing high precision pointing programs such as GOES. These investments demonstrated Boeing's commitment to provide next-generation, best-of-industry environmental systems to NASA and NOAA, and ultimately enabled Boeing to propose a superior satellite and ground system design to meet NASA and NOAA's performance requirements. Upon completion of N through P, Boeing will have built a total of eight spacecraft in the GOES series.

SatMagazine

Why are the GOES satellites important and what are their capabilities? Are there any spatial conditions that would prevent GOES satellites from providing accurate information? How do solar flares, which are on the increase, affect GOES-O?

Charlie Maloney

The GOES satellites represent a critical national asset. They provide the only publicly available source of Earth imaging from the geostationary orbit, allowing imaging from the full Earth disk down to rapid scanning of intense weather regions. This imaging is performed in visible and infrared frequency bands and forms a vital part of NOAA's mission to understand and predict changes to the Earth's environment, delivering enhanced weather forecasting capability to protect life and property.

In addition to the imaging capabilities, ***GOES-O*** has a set of solar observation instruments that allow for imaging and monitoring of the sun in X-ray and Extreme Ultra-violet, for prediction and early warning of solar flares and coronal mass ejections. GOES-O also has a set of *Space Environmental Monitoring* instruments which allow scientists to track the Earth's magnetic fields and the high energy particles impinging on the Earth's atmosphere. As you would imagine from this description, the GOES-O satellite is specifically designed with protection against the harsh environments of space, including the very high energy particles and solar flares it is designed to observe.

SatMagazine

Will GOES-O offer additional features not available when GOES-N was built and launched? If so, what will those features offer and accomplish?

GOES-O satellite in the Boeing factory

Charlie Maloney

The GOES-O Imager has an enhancement in its 13µm channel. Resolution has been improved from 8 km to 4km. The finer spatial resolution provides for an improved cloud top product, height of atmospheric motion vectors, and volcanic ash detection.

SatMagazine

It must be quite challenging for Boeing to have to deal with two government agencies... NASA and NOAA. How is this accomplished? In particular, how do the various teams interact with one another?

Charlie Maloney

Boeing, NASA, and NOAA have established an outstanding working relationship. As all parties recognize the importance of having strong relationships — from the highest management levels to the engineers performing the detailed work — we focused early on to become a strong, integrated team. The only way to establish and maintain these strong and constructive relationships is through trust. We have established trust with our NASA and NOAA customers by taking every commitment we make very seriously and using all the assets of The Boeing Company to provide the most advanced weather satellites ever built with a significant improvement over earlier environmental systems. Likewise, we at Boeing recognize that the people of NASA and NOAA are dedicated to providing world-class systems to the nation. We consider it an honor to have the opportunity to help them complete their mission. With these common objectives, we work together very well.

SatMagazine

How well is GOES-N performing?

Charlie Maloney

GOES-N was renamed ***GOES-13*** after successfully achieving geosynchronous orbit and is performing very well, indeed. Although GOES-13 remains as the on orbit spare, it has been often used as an active backup for the current operational satellites, ***GOES-11*** and ***GOES-12***. GOES-13 has been demonstrated through on orbit testing to meet or exceed all performance requirements with regard to image location accuracy and repeatability, the primary mission of the GOES satellite.

GOES N-P images are two to three times more accurate than the previous generation of GOES satellites. The higher accuracy is achieved through greater knowledge of the spacecraft's orientation through the use of star trackers. The star trackers stare into the heavens and detect the pattern of stars. As the pattern of stars is unique at each location of the sky, it provides a highly accurate means of knowing and maintaining the spacecraft's orientation. The repeatability comes from a highly stable spacecraft structure that is not affected by the normal thermal variations that occur in space. That accuracy leads to better knowledge of the location, speed and direction of severe weather systems, such as hurricanes, and ultimately translates into the ability to protect lives and property.

GOES-O being loaded for shipment to Cape Canaveral AFS

In addition, NASA used two associate contractors to develop and produce the three primary instruments that were provided to Boeing as government furnished equipment. The *Imager* and *Sounder* were provided by **ITT** and are nearly identical to the instruments on the previous series, save for the enhancements to the Imager in the 13µm channel. The *Solar X-ray Imager* was developed by **Lockheed Martin**'s **Space Applications Laboratory.** Their extensive experience in the development of the solar observation instruments was brought to bear on this project.

SatMagazine

With Boeing as the Prime, what other companies are involved as subcontractors on the GOES projects? What do those companies provide to Boeing in the form of expertise and product?

Charlie Maloney

Boeing has several key partners on the GOES N-P Program. **Integral Systems Inc**. (ISI) provided the ground hardware and software elements. **ISI** is the prime contractor to NASA/NOAA for the previous generation ground system, and their expertise allowed the GOES N-P ground system to integrate seamlessly into the existing infrastructure. **Carr Astronautics** provided engineering support for the Image Navigation and Registration system, which uses a ground/space control loop to provide the high accuracy of the imagery. **Applied Technology Corporation** (ATC) provided the majority of the *space environmental monitoring* (**SEM**) instruments. Many of these instruments were enhancements of the previous generation of GOES SEM instruments that ATC also provided. This enabled the most cost-effective solution for the government.

SatMagazine

The GOES-N launch was conducted at Cape Canaveral Air Force Station in Florida. Will the same hold true for the launches of GOES-O and GOES-P? What will be the impact of the GOES-O launch?

Charlie Maloney

GOES-O and GOES-P will also be launched from Cape Canaveral Air Force Station in Florida. GOES-O is the second satellite in the series and completes the constellation pair to provide complete coverage of the western hemisphere in orbit with GOES-13. GOES-O, coupled with the on-orbit GOES-13, will greatly improve weather monitoring and provide earlier and more accurate predictions of severe weather events.

SatMagazine

Charlie, can you tell us anything about the next satellite in this series, GOES-P?

Charlie Maloney

GOES-P is part of the GOES N-P series of satellites and carries the same technology and instruments aboard as does GOES-O. The satellite will be removed from storage shortly after the launch of GOES-O to

GOES-O satellite, artistic rendering

start final in-factory preparations and testing prior to delivery to Florida for pre-launch checkout and integration onto the ***Delta IV*** launch vehicle. At this time, the launch of GOES-P is expected to be in early 2010.

SatMagazine

What does the future hold for GOES satellites as far as builds and launches? Does Boeing have a handle on what will occur for the next-gen constellation?

Charlie Maloney

Boeing has more than four decades of experience in the development of highly advanced satellites for earth observation and weather forecasting. The GOES N-P series demonstrates our ability to deliver quality products to our NASA and NOAA customers. We are pleased that NASA has reconvened its source selection board and will award a new contract for the ***GOES-R*** competition. We refer your readers to **NASA Headquarters Public Affairs, 202-358-1600**, for further information. We remain committed to NASA and to its mission of continuing to operate a highly capable weather monitoring system.

SatMagazine

What Boeing teams are involved in GOES-O? Who manages the teams, their history, and their counterparts at the subcontracting companies?

Charlie Maloney

At this point in the GOES N-P program, we have three main teams supporting GOES-O: the Launch Team, the Mission Team, and the Systems Engineering Team. The Launch Team performs the final tasks to put the satellite in flight configuration, fuels the satellite, and performs one last set of pre-launch tests. With the satellite fueled and in the fairing, only the test engineers remain to maintain the satellite until launch. The Mission Team will take control of the satellite immediately after separation from the launch vehicle. They will fly the satellite to its final orbit and perform a set of health checks, prior to turning the satellite over to NOAA's Mission Team who will perform the post-launch test program. The Systems Engineering Team supports both of the other teams and addresses any emerging satellite issues to make the satellite has a clean bill of health before it launches.

SatMagazine

What international agencies or governments also have access to GOES constellation imagery and data?

Charlie Maloney

The great thing about GOES images and data is that they are available to anyone for free. You can set up a ground receive antenna and get the data directly from the satellite, but the easiest way to get the data is from the Internet. There are dozens of websites out there with GOES data. A great web page with links to many of those websites can be found here: ***http://goes.gsfc.nasa.gov/text/goesds.html***. A favorite of mine is the ***GOES Project Hot Stuff*** site: ***http://goes.gsfc.nasa.gov/text/hotstuff.html***. It contains scrapbooks of historical imagery and videos. My all-time favorite is the first full disk image of the Earth from GOES-13: ***http://goes.gsfc.nasa.gov/pub/goes/060622_goes13_small.gif***.

SatMagazine

How will this generation of GOES satellites make a difference when the next Hurricane Katrina hits?

Charlie Maloney

Fundamentally, the GOES N-P series provides more precise data to the forecasters. All weather forecasting is based on modeling of weather systems. The more precise the data that is fed into the model, the more accurate the prediction will be of the future path and intensity. That accuracy has two major effects in the case of a major hurricane like Katrina. First, the better we can model these hurricanes, the smaller the potential landfall zone that will be predicted. From NOAA analysis, every mile of coastline that we can avoid evacuating saves one million dollars to the economies of the affected areas. But, more important than that is the potential to save lives. As predictions get more accurate, people will have more faith in those predictions and take the appropriate action to get out of harm's way. New Orleans is my home town, so I have a very real connection to the consequences of Katrina. We can't stop the forces of nature that manifest most awesomely in hurricanes like Katrina. But with greater knowledge, made possible by technologically advanced satellites like GOES-O, we can reduce the impact on our fellow citizens.

SatMagazine

Finally, Charlie, what one thing do you want people to know about GOES-O?

Charlie Maloney

I would like people to understand the commitment and dedication of the integrated team from NASA, NOAA, Boeing, and all of the contractors that made this amazing satellite possible. There are many people on this team that have dedicated the majority of their careers to this program. They do it because they believe in the mission of the GOES Program: To work as an effective, integrated Government & Industry team to ensure the economical, timely, and successful delivery of a highly technical Geosynchronous Space and Earth Environment Observing Satellite System used to predict the weather and climate change; to protect life, property, and the nation's vital interests; and to enhance the global quality of life.

SatMagazine

We appreciate the time you set aside to help us more fully understand the GOES project. Thanks, Charlie.

Customer	NOAA, NASA Washington, D.C. Greenbelt, Md.	NOAA, NASA Washington, D.C. Greenbelt, Md.	NOAA, NASA Washington, D.C. Greenbelt, Md.
Spacecraft	Modified Boeing 601	Modified Boeing 601	Modified Boeing 601
Launch	GOES-N	GOES-O	GOES-P
Date	May 24, 2006	2009	2009
Vehicle	Delta IV	Delta IV	Delta IV
Site	Cape Canaveral, Fla.	Cape Canaveral, Fla.	Cape Canaveral, Fla.
Orbital Slots	75° W longitude and 135° W longitude	75° W longitude and 135° W longitude	75° W longitude and 135° W longitude
On-orbit Life	10 years	10 years	10 years

Remote Sensing, The Revolution That's Coming

by Pedro J. Schoch

Almost everyone has seen the television news casts and Internet reports featuring meteorological images that illustrate the weather forecast. These reports have an immediate impact on our daily lives and it is something that we have all grown accustomed to.

The use of satellite images for weather forecasting is among the most popular applications from Earth Observing (EO) satellites. However, this is not the only remote sensing application that can be obtained from images and information coming out of the increasing number of remote sensing satellites orbiting the Earth with an impressive array of sophisticated cameras and sensors.

On top of the obvious military applications for monitoring and intelligence gathering, technological advances and the consistent support for remote sensing missions from Space agencies worldwide have contributed to the advancement of scientific knowledge of our own planet. The information received from these satellites has also fostered the design and development of new applications that address two of the main concerns of our society environment sustainability and security.

Nowadays, the images obtained by remote sensing satellites are received through sophisticated ground systems that provide valuable information for governments and public agencies. This information has proven very useful in a wide range of areas such as humanitarian crisis management, human-caused or natural disaster monitoring, maritime traffic surveillance, urban development planning, land use management, crop yield monitoring, biodiversity control, border and illegal trafficking surveillance and many other areas including health- and climate-related issues.

Several space agencies across the globe are aware of the valuable information space remote sensing systems can provide and, as a result, are investing in the development and operations of these systems. This trend is accelerating across the globe with the launch of new satellites and the incorporation of new countries that are eager to possess national remote sensing systems. A reduced number of commercial remote

Envisat satellite, whose payload carries nine Earth observation instruments

sensing satellite operators that provide images with increasing resolution along with a growing number of value-adding companies are combining to produce useful information and intelligence for end users.

Together with a number of other space areas in which **GMV** is an active player, remote sensing is an area of growth for the Company. GMV has been involved in all phases of a remote sensing mission, from preliminary feasibility and mission analysis studies to system design and development, integration, and operations support and maintenance. The Company also regularly provides processed images, information systems and services to end users to address their specific needs. GMV's systems are present in different remote sensing missions for various agencies, including **ESA** (***ERS***, ***Envisat***, ***SMOS***, ***Swarm***, ***GOCE***), **NASA** (***OCO***, ***Glory***) and **CNES** (***Helios I*** and ***Helios II***).

GMV's contribution to the flight segment encompasses the development of on-board software for satellite instruments and the development of instrument processor prototypes and in-orbit verification facilities. GMV is also very active in the **GNC/AOCS** field providing studies and simulators and contributing to the development of advanced navigation sensors.

Additionally, GMV provides several systems for satellite flight operations:

- *Mission control systems for real-time satellite control and command as well as housekeeping and payload telemetry monitoring and archiving*

- *Fight dynamics systems, for satellite orbit and attitude management, through orbit determination and maneuver planning and preparation*
- *Mission planning systems, to receive user requests and manage and allocate satellite resources*
- *Satellite simulators*

1986, GMV has developed precise orbit determination (POD) systems and algorithms for projects such as the ***Navigation Package for Earth Orbiting Satellites***

Swarm satellites, designed to conduct geomagnetic field surveys — this is a constellation of three satellites in three different polar orbits between 400 and 550 km altitude

(**NAPEOS**) for ESA, which is used for its *ERS* and *Envisat* missions. POD is also used to process navigation signals, an area where GMV plays a key role in *EGNOS* and *Galileo*.

Payload ground segment systems are extremely important in the processing of large amounts of raw images and data coming from sensors aboard remote sensing satellites. Through different levels of processing, from level 0 to level 4, data is received, corrections are applied to take into account the effects of the atmosphere and the characteristics of the sensor, algorithms are applied to obtain biophysical measurements, and orthorectification is applied. Even more elaborate products can be obtained through level 4 processing, whose output is more easily used to supply critically needed information.

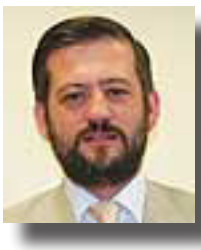
Beyond these systems, there is an area of great development potential, and that is the end-user segment. Users from various sectors, such as agriculture, forestry, security, or defense, to name just a few, can benefit greatly from services and applications developed on a level above the remote sensing data itself. These applications and services may also integrate data coming from in-situ sensors or other space applications, such as satellite navigation and satellite communications. The information received from these different sources and its integration into geographical information systems, decision support systems and the like, are key to address end user needs and to foster the development of a huge application market.

But we are still not quite there — market creation initiatives must continue to involve the end users and the value-adding companies in the development of prototypes and demonstration systems to maximize these technologies and make the information more widely usable.

GMV is taking a lead in this market through in-house expertise and technology in all three building blocks: remote sensing, GNSS, and telecommunications. Currently, GMV is involved in a number of projects through the ***Global Monitoring for Environment and Security*** program, which calls for the development of such services and applications. In particular, GMV is involved in projects that address ground infrastructure risk management, maritime security, forest monitoring, humanitarian aid response, atmospheric monitoring, land and sea integrated monitoring, and many others.

GMV looks ahead with optimism as the Company is convinced that remote sensing technologies constitute a firm promise for tremendous growth. The application of these technologies do have a direct benefit for our society and offer the promise of a better future for new generations.

About the author



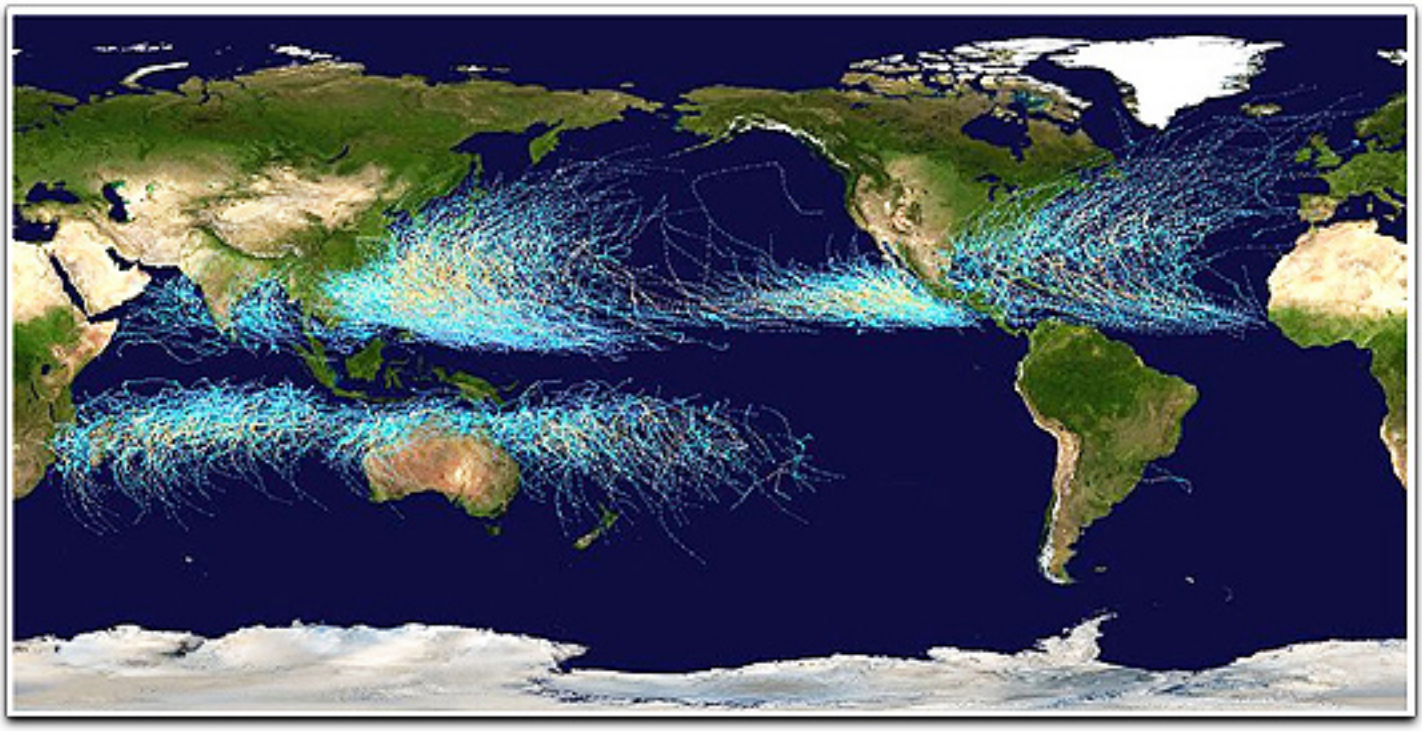
Mr. Pedro J. Schoch is the Marketing and Business Development Director of GMV, a global company that provides engineering, IT and systems integration for the Aerospace and Defense markets worldwide. Mr. Schoch has more than 19 years experience in the Space sector, where he has held positions in sw development, space operations, engineering and business development before moving into management positions.

There's Always Something Brewing All Year 'Round

by Rob Gutro, NASA Goddard Space Flight Center

Hurricanes and tropical cyclones develop in various places around the world all year 'round, and NASA's Hurricane/Tropical Cyclone Webpage covers them. The webpage offers daily storm updates and satellite images, latest research, stunning video animations, educational tools, scientists' profiles and historic storm information, on all storms going back to 2005, including monsters like Katrina.

NASA's hurricane webpage is a one-stop for anyone interested in hurricanes, and highlights NASA Hurricane research and latest storm information.



Map of the cumulative tracks of all tropical cyclones during the 1985-2005 time period Map of the cumulative tracks of all tropical cyclones during the 1985-2005 time period. The Pacific Ocean west of the International Date Line sees more tropical cyclones than any other basin, while there is almost no activity in the Atlantic Ocean south of the Equator. Credit: NASA

Tropical cyclones, the general name for a hurricane, typhoon, cyclone, tropical storm or tropical depression, form in different regions of the world at different times of the year. When the northern hemisphere hurricane season is active, the southern hemisphere is in winter-time, and vice-versa. So, when there's snow on the ground in the U.S., chances are the southern Indian Ocean or southern Pacific Ocean is dealing with a tropical cyclone.

Climatologist *Bill Patzert* from **NASA**'s **Jet Propulsion Laboratory** (JPL), Pasadena, California, is one of many NASA researchers that use data from NASA satellites. *Patzert* said, "Born over the tropical oceans, tropical cyclones impact most of our planet's population. These great storms can devastate entire regions, but also supply precipitation that sustains industry, agriculture and great urban centers of today's civilizations." *Patzert* continued, "Hurricanes can be scary, but we should not forget that they are also an important part of our planet's heat and water balance. We can feel their violence, but they also give our home planet relatively stable and warm temperatures worldwide, transporting vast amounts of heat and energy out of the tropics into the northerly latitudes."

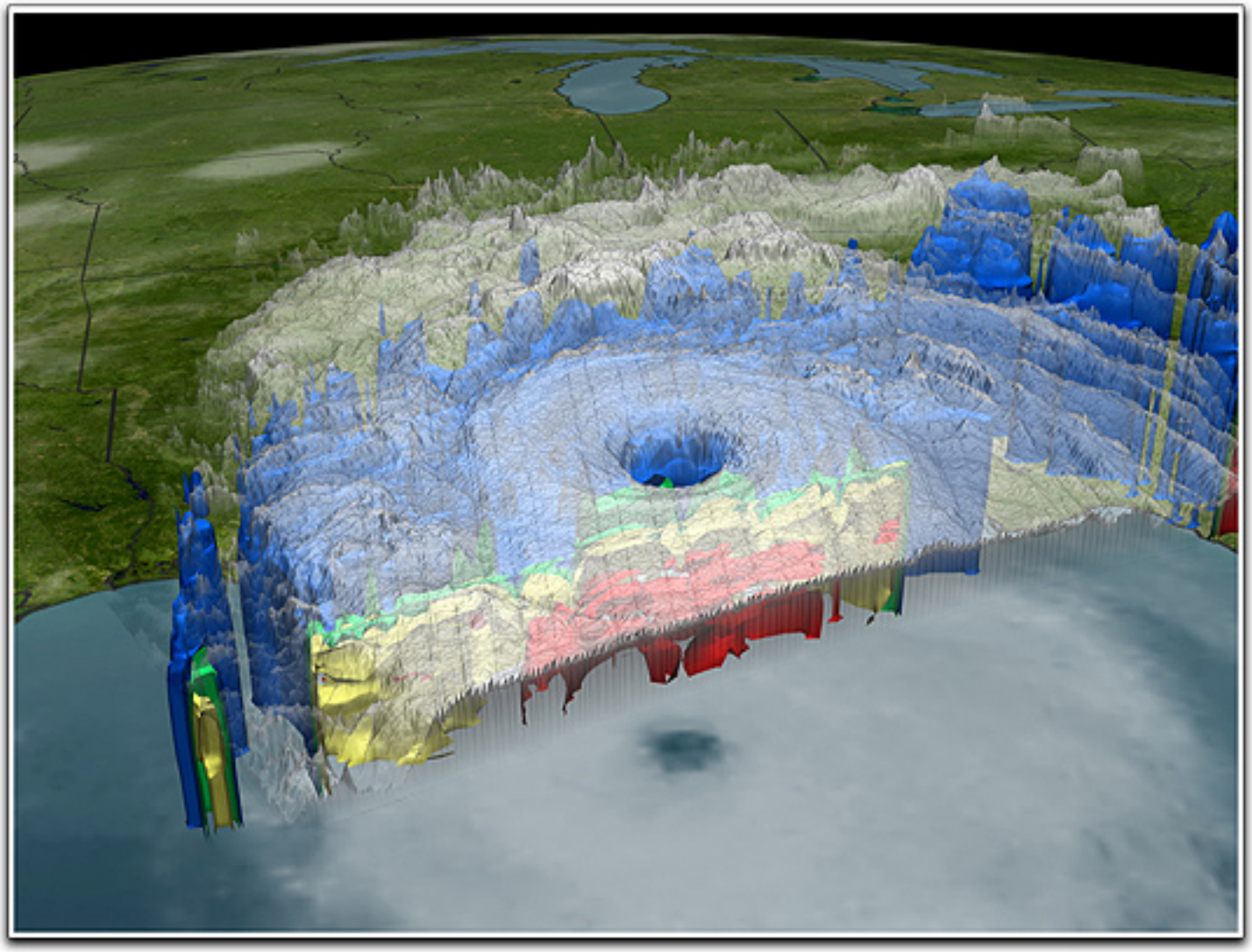
NASA has several satellites in orbit around the Earth that are used to study different aspects of these tropical cyclones, and NASA scientists conduct

hurricane research all through the year. Satellites include the ***Tropical Rainfall Measuring Mission satellite*** (**TRMM**), ***Aqua***, ***QuikScat***, ***CloudSat***, the ***Geostationary Operational Environmental Satellite*** (**GOES**), ***JASON-1***, ***OSTM/Jason-2***, ***Landsat***, and ***Terra***. Except for GOES, which is managed by the **National Oceanic and Atmospheric Administration**, all missions are managed either out of NASA Goddard or JPL. The GOES Project Office at NASA Goddard generates images and satellite animations.

Aqua and ***Terra*** have several instruments between them that are often featured on the hurricane page, the ***Atmospheric Infrared Sounder*** (**AIRS**), ***Advanced Microwave Scanning Radiometer-E*** (**AMSR-E**) and ***Moderate Imaging Spectroradiometer*** (**MODIS**). TRMM has the first and only precipitation radar in space and can provide stunning three-dimensional pictures of the structure of tropical cyclones.

Using all of these satellites and their instruments, NASA scientists gather data on many factors that determine why a tropical cyclone might have strengthened or weakened. Data includes: storm and surface winds; sea surface heights and temperatures; rainfall intensity and area; lightning; cloud water; water vapor; cloud heights, extent of cloud cover and cloud temperature, humidity, atmospheric pressure; cloud development; and size of the storm.

The National Oceanic and Atmospheric Administration's (**NOAA**) ***National Hurricane Center*** (**NHC**) and the ***Joint Typhoon Warning Center***, both organizations that forecast hurricanes, also use data from these NASA satellites and instruments in their forecast decisions. The NASA Hurricane Page also has live alerts directly from the NHC — readers can get the latest Atlantic Basin storm information immediately when it is issued.



TRMM *and* ***GOES*** *satellite composite image of Hurricane Katrina on Sun., Aug. 28, 2005 Tropical Rainfall Measuring Mission and GOES satellite composite image of Hurricane Katrina on Sun., Aug. 28, 2005 at 5:30 PM EDT. Blue areas are at least 0.25 inches of rain/hr.; Green 0.5+ inch/hr; Yellow 1.0+ inch/hr.; Red 2.0+ inch/hr. Credit: NASA TRMM*

NASA's Hurricane Webpage also includes news highlighting new scientific findings about tropical cyclones and before and after storm images. There's also an extensive education section including lesson plans. Users can also meet the team of scientists behind NASA's hurricane research from oceanographers to atmospheric scientists.

Hurricane multimedia is also a big part of the webpage. Included are stunning animations created at NASA Goddard's Scientific Visualization Studio with great educational value. They range from "***What is a Hurricane***," and "***A Hurricane's Heat Engine***" to "***Arlene to Zeta: A Look at the 2005 Hurricane Season***." The International Space Station and the space shuttle also provide storm photos.

There are many links to hurricane websites, including the NASA satellites and NASA computer modeling sites; NOAA sites; **U.S. Geological Survey** and **Federal Emergency Management Agency** websites.

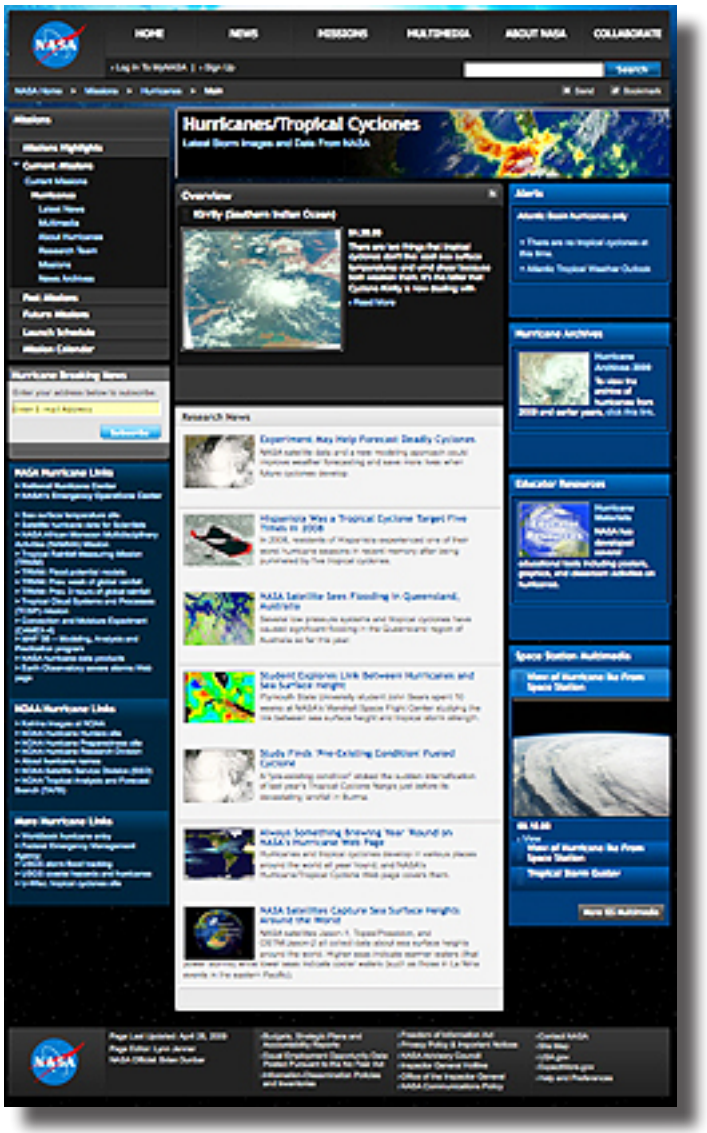
Readers can receive breaking news with the new RSS feed or email subscription option for breaking news alerts. Twitter.com subscribers can also get the latest hurricane news on that site under "***NASA Hurricane***."

NASA's Hurricane Webpage will continue to make NASA's unique data sets available to the global community of climate scientists; and hurricane researchers, forecasters and educators. "The intent is to increase the understanding of these powerful storms and to work with educators, climate researchers, and

research and operational agencies worldwide to save lives, decrease property loss and, thus, improve the economic well being and safety of the billions of people living in the tropics," *Patzert* said.

"There's always a tropical cyclone brewing somewhere and NASA satellites and the NASA Hurricane page always have them in their sights," *Gutro* added.

Visit the NASA Hurricane /Tropical Cyclone webpage by selecting the graphic below...



About the author

Rob Gutro is a Deputy News Chief in the office of Public Affairs at NASA's Goddard Space Flight Center, Greenbelt, Md. He's also a meteorologist and manages and writes storm updates for NASA's Hurricane/ Tropical Cyclone webpage. He works with NASA's News Chief to ensure the quality of news stories on NASA research in Earth science, Astrophysics, Heliophysics and technology done at NASA Goddard.

Rob's always been fascinated with hurricanes, growing up in New England. Rob focused on hurricanes during his schooling in meteorology, and was one of several people who developed NASA's Hurricane Resource Web Page. He continually provides updates on hurricanes and typhoons around the world. The webpage, located at ***www.nasa.gov/hurricane*** *has satellite images, NASA research, hurricane videos and animations, scientist biographies, lesson plans, hurricanes in history, hurricane facts and so much more.*

Rob enjoys talking about weather and especially hurricanes. He speaks at schools, museums, and social organizations about NASA's research on hurricanes.

Prior to coming to work for NASA in 2000, Rob worked as a radio broadcast meteorologist at the Weather Channel and was heard on more than 40 radio stations across the U.S. providing forecasts. He also worked for the National Oceanic and Atmospheric Administration (NOAA) as a technical writer, and worked in public affairs for a hurricane season at the National Hurricane Center in 1993.

Rob has almost 20 years of radio experience. He was a weekend on-air talent at country music radio stations in Annapolis and Nashville. He also worked in radio in the Boston area, Manchester, New Hampshire and Baltimore, Maryland. From 1993 to 1994 he broadcast forecasts for Baltimore's National Weather Service office over NOAA Weather Radio.

Insight: NSR Executive Briefing

Short-Term Future Of Broadband Satellite Services Is Uncertain

The broadband satellite market over the last two years has been very successful with consistent gains in sites, subscribers and revenues. The strong growth recorded in 2007 flowed through into 2008, and as of the writing of this study, the market appeared to still be holding up in most parts of the world. While many in the industry are confident that the broadband satellite sector will weather the current difficult economic climate only lightly scathed, there is no doubt a strong undercurrent of uncertainty. The sales process has been slowing for broadband VSAT networking services, satellite capacity issues and high capacity prices are impacting certain markets, fiber and undersea cable continues to be rolled out impacting trunking services, and no one today is sure to what extent various government programs to bring broadband to rural areas in developed countries will truly help single site satellite broadband service providers.

The general consensus is that as long as the global economic downturn bottoms out in 2009 and true

Broadband Satellite Markets, 8th Edition

A Worldwide Analysis of Industry Trends and Market Forecasts from 2008 to 2018

Publication Date: April 2009
Format: PDF on CD-rom - Including all Related Excel Files

NSR

DESCRIPTION | TABLE OF CONTENTS | EXECUTIVE SUMMARY | ORDER NOW

Description

Satellite broadband services grew solidly in 2008 following a very strong year in 2007. Broadband VSAT networking applications for both corporate and government clients made steady gains, and single site satellite broadband Internet access services continued to demonstrate their viability in North America, Australia and Europe. It is no surprise that broadband trunking services remain under pressure in many markets, yet wireless backhaul, notably for cellular networks, saw another excellent year.

Regions Covered

- o North America
- o Latin America
- o Western Europe
- o Central & Eastern Europe
- o Middle East & North Africa
- o Sub-Saharan Africa
- o Asia

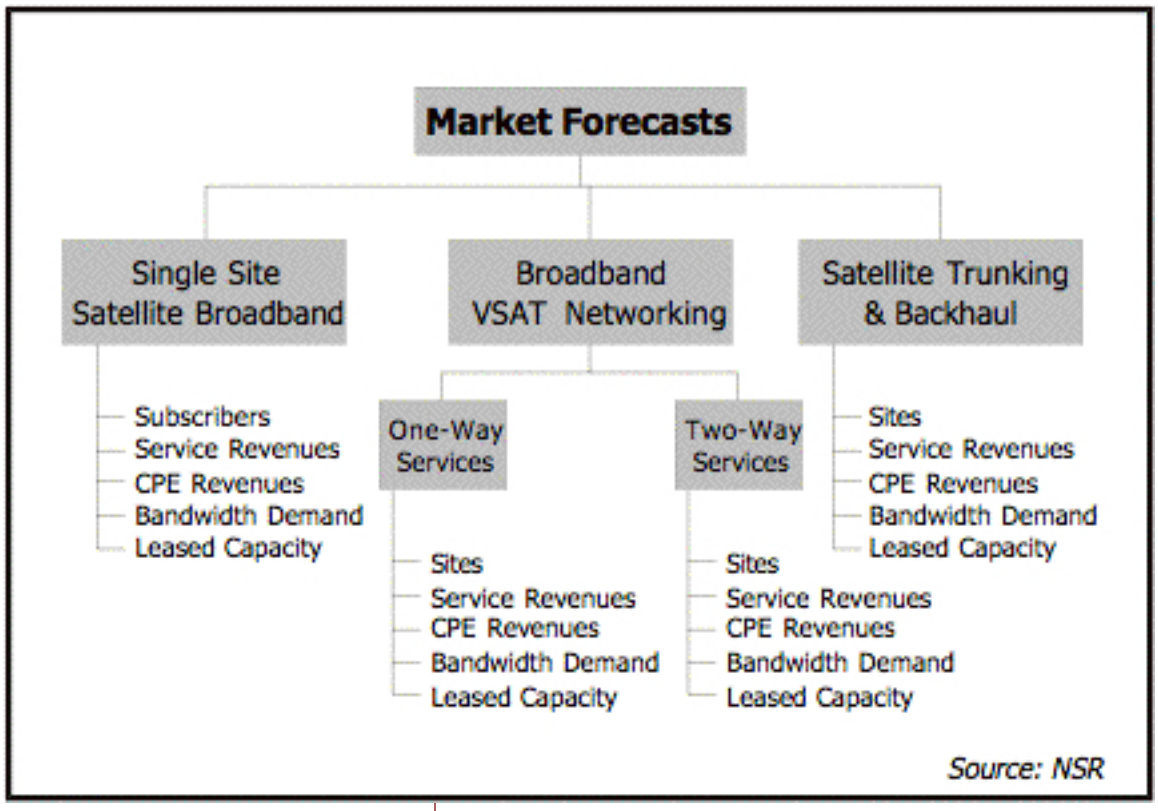
Sectors and Applications Analyzed

- o Broadband VSAT Networking Services
  - • One-Way Broadband VSAT Networks
  - • Two-way Broadband VSAT Networks
  - • Small & Medium Enterprise Two-Way VSAT Networks
- o Single Site Satellite Broadband Services
  - • One-Way Satellite with Terrestrial Return
  - • Two-Way Satellite
- o Satellite Trunking & Backhaul Services
  - • Satellite Trunking Market
  - • Satellite Backhaul Market

Units/Revenues Forecast by Region

- o Sites/Subscribers
- o Service Revenues
- o Customer Premises Equipment Revenues
- o Bandwidth Demand
- o Leased Commercial Capacity Demand

growth returns by the end of the year, the satellite broadband market should come through these dark days in relatively strong shape. However, if the crisis continues well into 2010, then all bets are off, and damage to the industry could start to pile on.



It is NSR's view that Q2 and Q3 2009 will be the real indicators of how the satellite broadband market will end up faring the economic downturn. Key to watch will be the sales process and how quickly, or not, deals will close. This applies both to the broadband VSAT networking and trunking and backhaul segments. The single site satellite broadband Internet access market appears to be somewhat more insulated because people are spending more of their leisure time on the web as opposed to spending discretionary income elsewhere. Further, broadband access is being seen ever more as a necessity in life (at least for developed countries), and households and businesses are more willing to sacrifice in other areas in order to maintain a broadband service.

Nonetheless, the upfront costs of taking on a single site satellite broadband service is still viewed as challenging by some, and continued difficult economic times make this barrier appear ever higher. The move by North American service providers like **WildBlue** and **Hughes** to leasing of equipment is certainly a step in the right direction, and government programs like the ***Australian Broadband Guarantee Program***, which **NSR** truly hopes is emulated in one fashion or another in North America and Western Europe, is another. Still, even the single site satellite broadband Internet access market is bound to be impacted if the global economic crisis continues beyond 2009.

In this eighth edition of the ***Broadband Satellite Markets*** study, NSR continues to maintain its consistent, bottom-up approach to modeling and forecasting demand for broadband VSAT networking services, single site satellite broadband Internet access services, and the broadband trunking and backhaul sector. **Compared to one year ago, the most substantial change to NSR's view on the market is the realization of the severity of the current economic crisis roiling global markets and the impact this could have on demand as described above.**

On the most uppermost level, NSR is generally confident that the broadband satellite markets assessed in this study will make it through these difficult economic times and, in fact, it is likely that there will be a spike in demand in the 2011-2013 period. This is driven by the assumption that delayed projects will be restarted as economic conditions improve, plus a number of satellite launches expected in 2009 and 2010 should ease some capacity constraints on certain markets, such as Sub-Saharan Africa, the Middle East & North Africa, and Latin America, so that projects that had been blocked because of capacity issues will be able to roll out.

Beyond 2014 the picture is somewhat less clear, but NSR currently does not see any reason to expect anything less, on a global average, than growth at least equal to historical rates of the last several years.

For the forecasts in this ***Broadband Satellite Markets, 8th Edition*** study, NSR continues to use a bottom-up methodology that starts with an assessment of the number of active broadband VSAT sites or satellite broadband Internet access subscribers in each region under investigation for the end of year 2008 and then projects forward growth in each market segment based on a detailed analysis of regional growth drivers and restraints. This forms the core of each forecast and drives all other aspects of the forecast. Once the sites or subscribers assessment is completed, NSR next estimates revenues generated from service fees and *customer premises equipment* (**CPE**) sales. Then NSR forecasts total satellite bandwidth demand needed to provision all services and, finally, the portion of this bandwidth that comes from commercially leased C-, Ku-, and *high throughput satellite* (**HTS**) capacity.

Forecasts by Market Segment

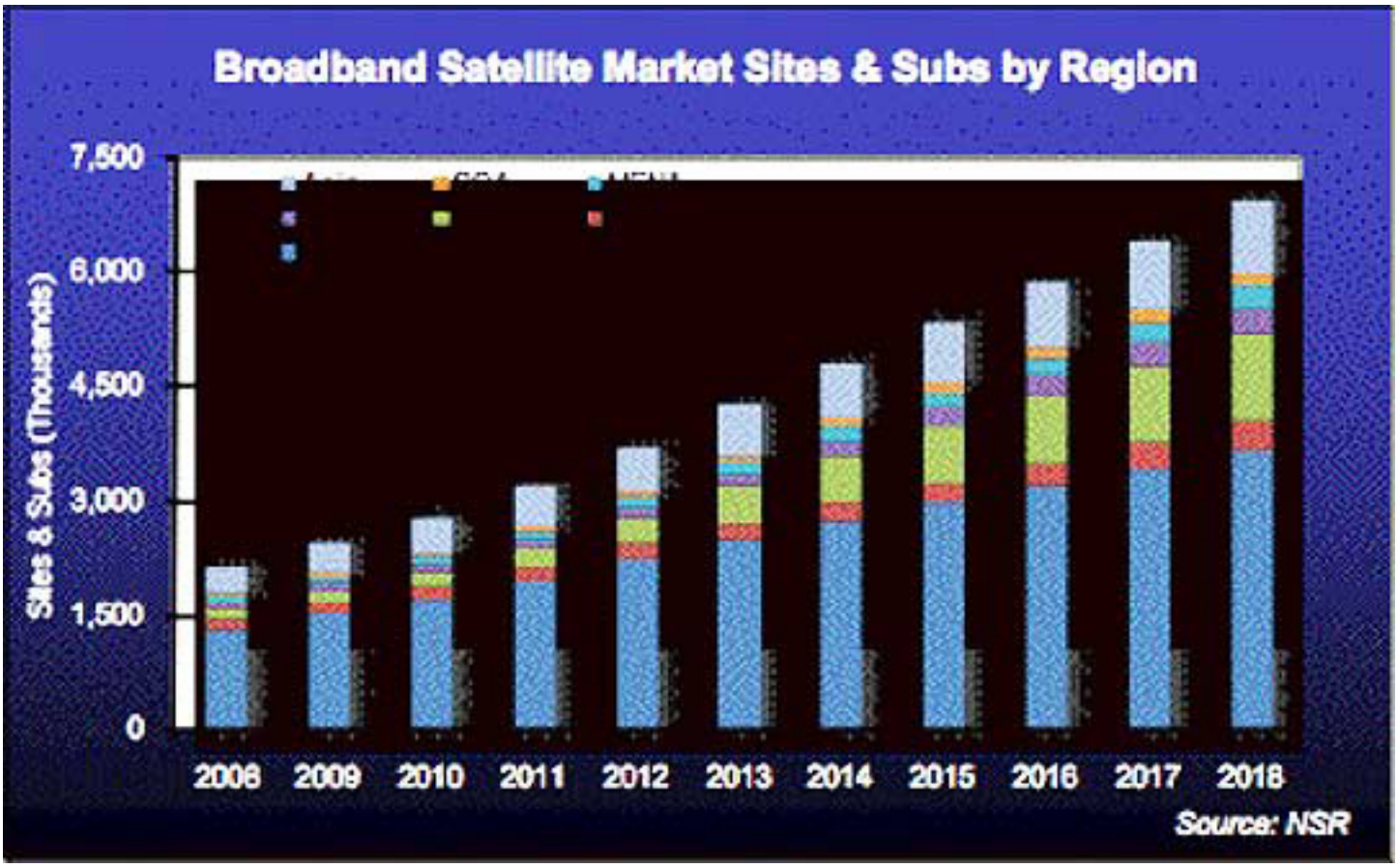
Global Site and Subscriber Forecasts

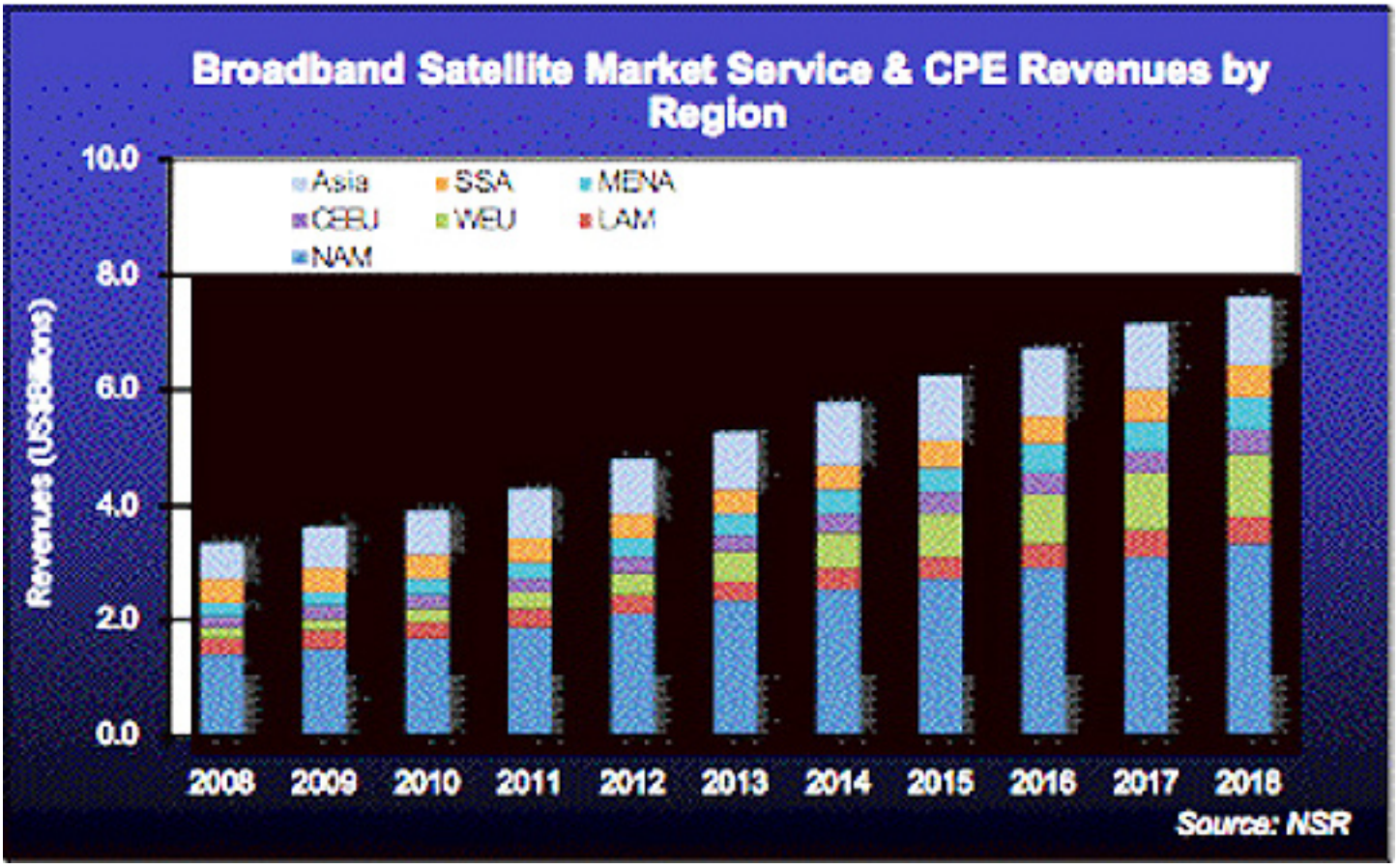
- *The base forecasts for the BBSM 8th Edition study, upon which all further projections are made, are for one-way and two-way broadband VSAT networking sites, single site satellite broadband Internet access subscribers, and broadband trunking and backhaul sites.*
- *The forecasts are made individually for North America, Latin America, Western Europe, Central & Eastern Europe, the Middle East & North Africa, Sub-Saharan Africa, and Asia.*
- *Combining the global base of broadband VSAT networking sites, single site satellite broadband Internet access services subscribers, and broadband trunking and backhaul sites,* **NSR forecasts a better than tripling of the worldwide installed base and a net gain of over 4.8 millions sites/subscribers.**
- **Single site satellite broadband Internet access services will lead the way with a projected net global gain of better than 3.8 million subscribers**. *North America will be the biggest market over the entire forecast period, and Western Europe will quickly come to dominate second place with the fastest rate of subscriber growth.*

- **Broadband VSAT networking services will see sustained gains from both corporate clients and government projects with an anticipated net gain of almost 1.1 million sites**. *Two-way broadband VSAT services will dominate the market, and North America will remain the single most important region. Yet, Asia and Sub-Saharan Africa will have some of the fastest rates of site growth, and Latin America will have the third largest net broadband VSAT site gain after Asia and North America.*
- *The broadband trunking and backhaul market is no doubt the smallest of the three addressed, but it does generate the highest revenues per installed site, making it a very critical sector for the market.* **Total trunking and backhaul sites will increase by better than 2.4 times driven by growth in backhaul for cellular and broadband wireless access networks**. *Developing parts of the world will account for the most new demand with Sub-Saharan Africa leading in terms of net site gains, followed closely by Asia and then the Middle East & North Africa.*

Global Service & CPE Revenues Forecast

- *Service revenues come from per-site fees paid by customers to managed service providers for the VSAT network or trunking/backhaul site. In the case of dedicated hubs, this is equivalent to capacity leasing and maintenance costs that a company or government agency would pay. For a single site satellite broadband Internet access service, service fees are the monthly subscription fees paid by the service user.*
- *Customer premises equipment (CPE) revenues come from the sale of all hardware and software needed by the customer for each VSAT or single site satellite broadband location. The service revenues described above specifically exclude any CPE revenues.*
- **NSR projects that total service and customer premises equipment revenues to be generated by the broadband satellite market will climb from US$3.3 billion in 2008 to over US$7.6 billion in 2018**, *representing a net gain of some US$4.3 billion.*
- **Service revenues account for around 90% of all revenues in the industry over the ten-year forecast period** *and will be growing at a substantially faster rate than CPE revenues. This illustrates the importance industry players place on moving into the services side of the market.*
- *North America will be the single biggest market in service and CPE revenue terms; however, Western Europe will have one of the fastest rates of growth based on*


Broadband Satellite Market Sites & Subs by Region
Sites & Subs (Thousands)
7,500
6,000
4,500
3,000
1,500
0
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Source: NSR

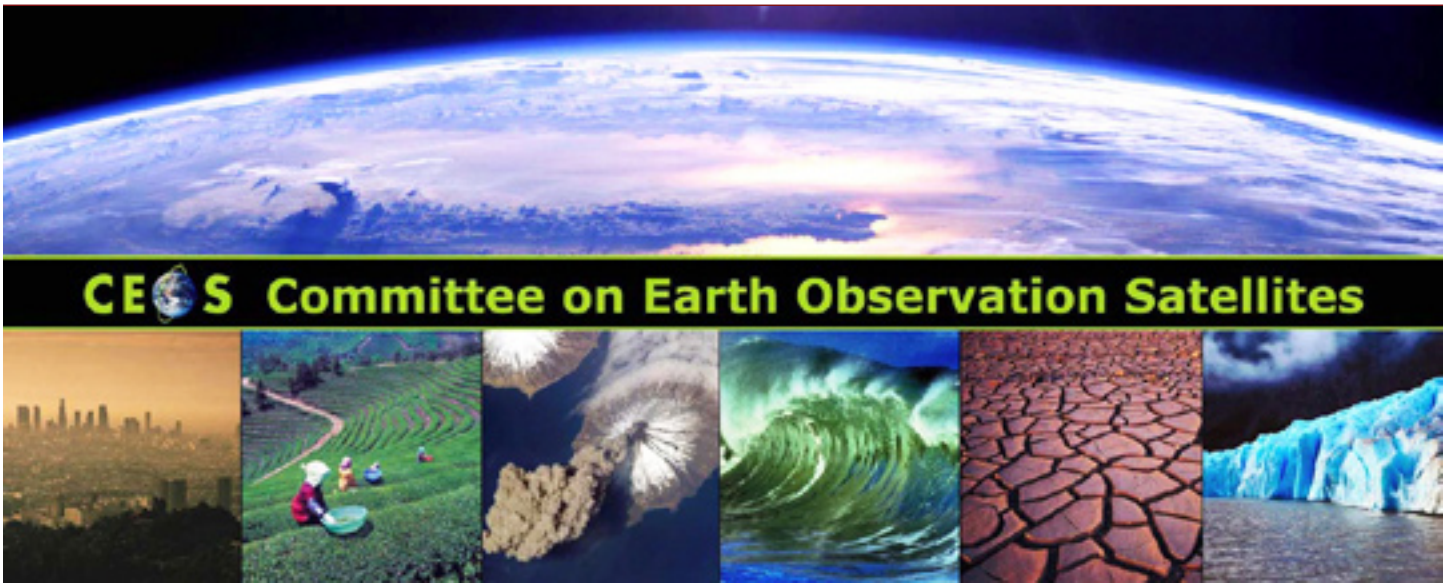

Broadband Satellite Market Service & CPE Revenues by Region
Revenues (US$Billions)
10.0
8.0
6.0
4.0
2.0
0.0
Asia
SSA
MENA
CEEU
WEU
LAM
NAM
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Source: NSR

NSR's expectation that single site satellite broadband services are on the verge of breaking out in this region.

Global Bandwidth and Leased Commercial TPE and Capacity Demand

- *The bandwidth forecast conducted by NSR includes all satellite bandwidth, whether originating from commercial or dedicated satellites, used to provision services for broadband VSAT networking, single site satellite broadband, and broadband trunking and backhaul. For this study, NSR classifies Wildblue-1 and Spaceway-3 (plus any follow-on satellites for these companies) as the only dedicated satellites active in the market.*
- *As stated in previous years, it is both growth in sites and subscribers as well as the increasing amount of bandwidth provisioned to existing sites and subscribers that are the underlying trends in the bandwidth demand assessment.*
- ***Single site satellite broadband Internet access services will quickly become the largest consumer of satellite bandwidth**, and North America will be the leading region due to its strength in both single site Internet access and broadband VSAT networking services.*
- *Beyond transponder leasing of classic C-band and Ku-band FSS capacity, NSR has defined a new categorization for the "high throughput satellites" (HTS) that are playing an ever more predominant role in broadband satellite markets. These are satellites or payloads that have at least twice, but usually many times more, the throughput of a classic FSS satellite for the same orbital spectrum allocation.*
- *In very general terms, trunking and backhaul services are driving most of the C-band capacity demand gains, while broadband VSAT networking and again trunking and backhaul services are behind the increasing demand in Ku-band FSS capacity.*
- *It is single site satellite broadband Internet access services that account for most of NSR's anticipated gains in leased commercial HTS capacity, though broadband VSAT networking services are increasingly expected to be provisioned by HTS capacity later in the forecast period.*

CEOS: Optimizing The Benefits Of EO Through Int'l Cooperation



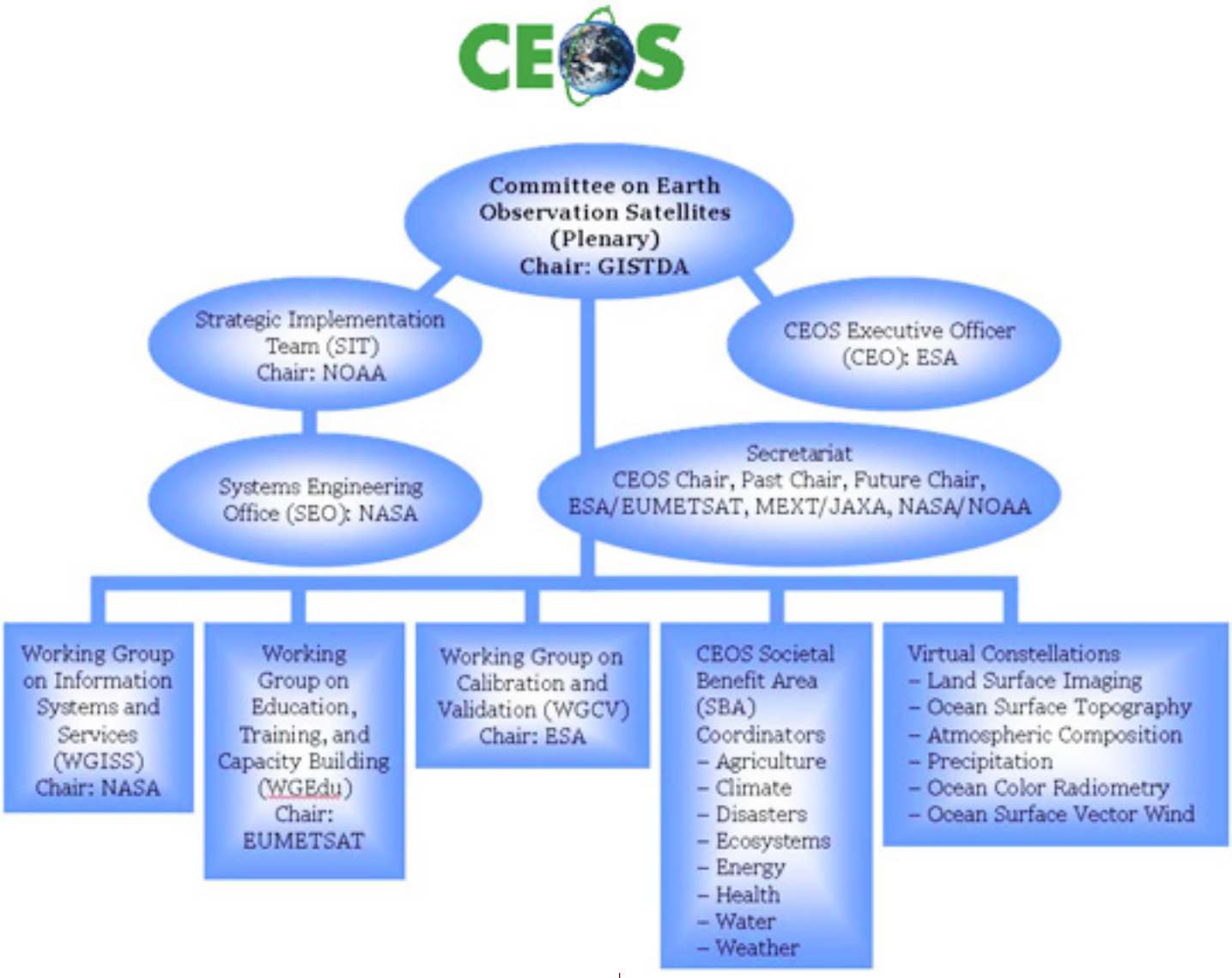
An improved understanding of the Earth System — it's weather, climate, oceans, land, geology, natural resources, ecosystems, and natural and human-induced hazards — is essential if we are to better predict, adapt, and mitigate the expected global changes and their impacts on human civilization. Earth observation data and derived information are essential inputs in the development of this understanding. Earth observations provide the evidence necessary for informed decision-making — supporting the science which underpins strategies for global environmental decision-making — and for monitoring our progress on all geographical scales as we explore new development paths aimed at sustainable management of the planet.

There are estimated to be more than 100 Earth observation satellite missions currently operating, sending environmental information such as cloud cover, sea surface winds, and volcanic activity to ground stations and space centers around the world. Earth observing systems help to provide data in support of a wide range of information needs, including parameters which are central to: improved understanding of Earth system processes; improved predictions, especially on a regional scale; evidence vital for governments when deciding whether to fund mitigation measures in response to climate change; monitoring and compliance; and management and mitigation. The beneficiaries of Earth observations are a broad range of users including: national, regional and local decision-makers; organizations responsible for the implementation of international Conventions and treaties; business, industry, and service sectors; scientists, researchers, and educators; and ultimately, every inhabitant of planet Earth.

Earth observation satellites can be owned and operated by governments, international organizations, commercial companies, research and academic institutions, and others. Because of the varied ownership, many of these systems operate independently, exchanging little or no information with other organizations. Producing better information on the global environment has become a worldwide priority, and international partnerships are essential to achieving this goal because no country can monitor the entire Earth by itself. Understanding a planet as complex as Earth clearly requires a global effort. In 1984, as scientists were beginning to frame the critical questions that needed to be answered, several space-faring nations created the ***Committee on Earth Observation Satellites***, **CEOS**, to coordinate internationally all civil space-borne missions designed to observe and study our planet.

CEOS Objectives

Bringing space-based sensors, ground-based data analysis systems, and skilled experts together requires a well-coordinated international effort and a strong commitment from space agencies. CEOS was established in 1984 at the request of the ***Economic Summit of Industrialised Nations Working Group*** (**G7**) ***on Growth, Technology, and Employment***, as the international forum for space agencies in *Earth*



observation (**EO**). This group recognized the multidisciplinary nature of satellite EO and the value of coordination across all proposed missions.

CEOS is dedicated to international collaboration among space systems and EO missions. Participating agencies strive to address critical scientific questions and to develop national satellite programs with common standards and systems that can provide data to the international community while not unnecessarily overlapping satellite missions of other agencies. The purpose, mission, and requirements of space systems, however, remain the responsibility of individual space agencies.

CEOS has three primary objectives:

- *To optimize benefits of space-borne Earth observations through cooperation of its Members in mission planning and in development of compatible data products, formats, services, applications, and policies*
- *To serve as a focal point for international coordination of space-related Earth observation activities*
- *To exchange policy and technical information to encourage complementarity and compatibility of observation and data exchange systems*

CEOS Organization

Governmental organizations that are international or national in nature and are responsible for a civil space-borne Earth observation program currently operating or in development are eligible for membership in CEOS. In addition, CEOS accepts associate membership for

Governmental organizations that are international or national in nature and currently have a civil space-segment activity in planning phases or a significant ground-segment activity that supports CEOS objectives as well as other existing satellite coordination groups and scientific or governmental bodies that are international in nature and currently have a significant programmatic activity that supports CEOS objectives. CEOS currently has 28 *Member Agencies* and 20 *Associate Agencies*. The chart below depicts the CEOS elements.

CEOS Role for the Global Earth Observation System of Systems (GEOSS)

The intergovernmental ***Group on Earth Observations***, **GEO**, was established by a series of three ministerial-level summits. GEO includes over 75 member countries (***http://earthobservations.org***), the **European Commission**, and over more than 50 participating organizations — including CEOS — working together to establish a ***Global Earth Observation System of Systems*** (**GEOSS**). The GEO vision for GEOSS is to realize a future wherein decisions and actions for the benefit of humankind are informed via coordinated, comprehensive, and sustained Earth observations and information. GEOSS will build on and add value to existing Earth-observation systems by coordinating their efforts, addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements, and improving delivery of information to users.

CEOS provides active and engaged support to GEO, especially the space component of GEOSS, where CEOS is able to play a unique and important role. The 20+ years invested by CEOS agencies towards these objectives has resulted in recognition of CEOS as the primary forum worldwide for coordination of space-based Earth observations. In 2007, CEOS developed an Implementation Plan for Space-based Observations for the GEOSS, which identifies the targets and actions required for delivery of the space segment of GEOSS — focused exclusively on the space segment aspects and on the efforts of space agencies to implement it. CEOS Member space agencies have endorsed the decision that the execution of this plan becomes the primary activity of CEOS as a coordination body — and of its subsidiary groups.

The CEOS Implementation Plan (CEOS IP) adopts the same target timescales as the underlying GEOSS Plan (2 years, 6 years, and 10 years) and priorities have been assigned to a large number of actions designed to achieve the target outcomes for the GEOSS.

There are three main implementation mechanisms (and resource pools) available to CEOS to undertake the work required on individual actions in support of GEOSS space segment targets: (**1**) ***the Strategic Implementation Team*** (**SIT**) and the ***CEOS Secretariat***; (**2**) ***the CEOS Working Groups***; and (**3**) t***he CEOS Virtual Constellations***. These groups are described below.

CEOS Strategic Implementation Team (SIT)

The ***CEOS Strategic Implementation Team*** (**SIT**) was created in 1996 to advance the involvement of CEOS in the development of the ***Integrated Global Observing System*** (**IGOS**). The SIT is comprised of CEOS Member Principals and some Associates with the authority to commit agency support to initiatives as they unfold. With the integration of IGOS Themes into GEO, the SIT now plays a central role in coordination of existing and future missions of CEOS agencies, particularly to support GEO in its realization of the space segment of GEOSS. The SIT's objective is to define, characterize, and develop the vision for CEOS participation in GEO and in particular, to strengthen the CEOS linkages to GEO and GEOSS. The SIT is currently engaged in objectively defining and prioritizing a series of "actionable" actions and demonstrated results that will support corresponding GEO ***Societal Benefit Area*** (**SBA**) Tasks. For each of the GEO Tasks that CEOS contributes to, key CEOS actions have been identified with a direct traceability established. The SIT places strong emphasis on progressing GEO Tasks and has achieved commitments from CEOS agencies to conduct the assigned Tasks.

CEOS Secretariat

This group provides most of the coordination between plenary sessions and is maintained jointly by the ***European Space Agency*** (**ESA**), the ***European Organization for the Exploitation of Meteorological Satellites*** (**EUMETSAT**), the ***National Aeronautics and Space Administration*** (**NASA**), the ***National Oceanic and Atmospheric Administration*** (**NOAA**) of the United States, the ***Ministry of Education, Culture, Sports, Science and Technology*** (**MEXT**) and the ***Japan Aerospace Exploration Agency*** (**JAXA**).

CEOS Working Groups

Working Group on Calibration and Validation **(WGCV)**
The goals of the **WGCV** are to enhance coordination and complementarity, to promote international cooperation, and to focus activities in the calibration and validation of Earth observations for the benefit of CEOS Members and the international user community. WGCV addresses issues relating to sensor system calibration/validation as well as validation of geophysical parameter/derived products. A major emphasis of these activities is to enable reliable comparison and synergistic use of information across the global gamut of Earth observing systems in support of GEO and GEOSS goals and objectives. The subgroups of WGCV are as follows: ***Terrain Mapping***; ***Microwave Sensors***; ***Synthetic Aperture Radar***; ***Infrared/Visible Optical Sensors***; ***Land Product Validation***; and ***Atmospheric Composition***.

Working Group on Information Systems and Services (WGISS)
The major CEOS goal is to coordinate the development of satellite Earth Observation missions. The CEOS **WGISS** provides the means of achieving the CEOS primary coordination objectives by providing a range of data and information services better attuned to the needs of users than could be delivered by provider members and associates acting independently. Through WGISS, the policies of coordination and cooperation between the programs of the Members and Associates can be realized.

Working Group on Education, Training, and Capacity Building (WGEdu)
The key task of the ***CEOS Working Group on Education, Training, and Capacity Building*** (**WGEdu**) is to coordinate existing and planned education and training activities of its Members in Earth observation techniques, data analysis and interpretation, use of

derived standard products and services, and Earth observation applications. Emphasis also is placed upon the development and provision of education and training resources that maximize the societal benefits of Earth observation data, products, and services, particularly for developing countries.

CEOS Virtual Constellations

In support of GEO objectives and as a space component of GEOSS, CEOS has developed the concept of virtual, space-based Constellations. A ***CEOS Virtual Constellation*** is a set of space and ground segment capabilities operating together in a coordinated manner, in effect a virtual system that overlaps in coverage in order to meet a combined and common set of Earth Observation requirements. The individual satellites and ground segments can belong to a single or to multiple owners.

The Constellation concept builds upon or serves to refocus already existing projects and activities. The Constellations effort provides a unique forum to achieve political visibility and increase mutual benefit among space and other environmental agencies in support of cross-cutting GEO Tasks and Targets. In particular, they offer opportunities to share experience in the development of algorithms; standardize data products and formats; exchange information regarding the calibration and validation of measurements; facilitate timely exchange of and access to data products from existing and planned missions; and facilitate planning of new missions — ranging from coordinating orbits to optimizing observational coverage to sharing implementation of mission components. The interim goal of a Constellation is to demonstrate the value of a collaborative partnership in addressing a key observational gap; the end goal is to sustain the routine collection of critical observations. Implementation of Constellation activities is ultimately dependent on the coordination of formal agreements among participating agencies.

Four initial, or pilot, Constellations currently exist: ***Land Surface Imaging***; ***Ocean Surface Topography***; ***Atmospheric Composition***; and ***Precipitation***. Two new Constellations were proposed in 2008 and are currently under development for full implementation: ***Ocean Colour Radiometry*** and ***Ocean Surface Vector Wind***. Each Constellation study has a lead or leads from space agencies with a heritage of operations in the relevant EO domain, and a team of participants from other space agencies willing to contribute to implementation coordination through CEOS.

The Constellations might be considered to be a cross-cutting activity within CEOS. Some studies do map directly onto specific GEOSS space segment requirements (*e.g.*, the ***Precipitation Constellation*** directly serves the GEOSS targets of 3-hourly global precipitation measurements and for implementation of the ***Global Precipitation Model*** [**GPM**] and other supporting missions). The outputs of the other studies span the targets of several ***Societal Benefit Areas*** (**SBAs**) — including *Climate* in all cases and the provision of observations for ***Essential Climate Variables*** (**ECVs**) — and are equally important in providing resources and attention to the issue of continuity of space-based observations for key measurements of ocean, atmosphere, and land.

Major Recent CEOS Achievements

In 2008, CEOS Agencies allocated a large number of resources to secure the successful completion of a number of significant activities. As a result of these collective efforts, more than 30 new datasets have been generated, most of these publicly accessible. The following representative examples illustrate some of the 2008 CEOS accomplishments, specifically in support of the GEO:

- *Four additional carbon flux towers were installed in Africa to improve the network of ground-based observations of greenhouse gases.*
- *Users can now access 10 years of GlobCarbon information on the evolution of the vegetation cover and its related parameters.*
- *The 50m orthorectified mosaic product generated from the Advanced Land Observing Satellite (ALOS) L-Band Synthetic Aperture Radar instrument data may be accessed from the new ALOS Kyoto and Carbon Initiative website.*

A major effort conducted by the ***CEOS Working Group on Calibration and Validation*** has led to the generation of the ***Quality Assurance Framework for Earth Observation*** (**QA4EO**), which is a set of guidelines on calibration/validation for data quality control/assurance and best practices. This activity aims at increasing the availability, suitability, and reliability of observations.

Development and distribution of the ***CEOS 2008 Earth Observation Handbook***, a special issue which provides a comprehensive overview of efforts to address Climate Change and a major update on space-based Earth Observation missions.

A large share of 2008 CEOS priority actions addressed all aspects of climate-related observation of the atmosphere, ocean, and land. These have included improvement of data calibration and validation, reprocessing of past datasets, and improving availability of data and products to all countries. For example, ***Essential Climate Variables*** (**ECVs**) for the Arctic and Antarctic have been generated in real-time from **NOAA**'s ***Advanced Very High Resolution Radiometer*** (**AVHRR**) sensor data to support the International Polar Year and to provide a long-term historical dataset of polar climate change ranging from 1981 to the present. Products include surface temperature, snow and ice extent, and clouds and winds.

In support of GEO objectives, CEOS has also successfully completed a number of key activities in connection with the Virtual Constellations concept described earlier. Good progress has been achieved in the initial four constellations focused on ***Atmospheric Composition***, ***Land Surface Imaging***, ***Ocean Surface Topography***, and ***Precipitation***. Two new additional Virtual Constellations are proceeding with implementation: ***Ocean Colour Radiometry*** and ***Ocean Surface Vector Winds***. The Ocean Colour Radiometry Constellation will provide scientific data products related to marine ecosystems and ocean biogeochemistry for near-surface global ocean and coastal waters. The Ocean Surface Vector Wind Constellation will collect observations of ocean surface vector winds over the global ice-free ocean that will be used for operational analyses and forecasts, as well as retrospective research.

Major On-Going CEOS Activities

Among its priorities for 2009 and following the declarations from the last **G8** in *Toyako* (Japan), in July 2008, CEOS Agencies will conduct focused activities in two main areas: (**1**) *deforestation and forest degradation, relating to* ***Reducing Emissions from Deforestation and Degradation*** (**REDD**) *and monitoring of other carbon trading and financial instruments*; and (**2**) *closely associated measurements relevant to the reduction of greenhouse gas emission and to better understand climate change processes and modeling*.

CEOS and Future Earth Observation

CEOS agencies are operating or planning around 240 satellites with an Earth observation mission over the next 15 years. These satellites will carry more than 385 different instruments. The sustained investment by space agencies will ensure the provision of information of unique value in both public and commercial spheres, derived from the measurements of a diverse range of geophysical parameters and phenomena. For more information, please visit the CEOS website ***www.ceos.org.***

Editor's Note
The 2009 CEOS Chair is Dr. Darasri Dowreang and the article has been provided to SatMagazine, courtesy of the CEOS Secretariat. Additionally, Dr. Dowreang is the Deputy Director, Geo-Informatics and Space Technology Development Agency of Thailand.

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