SatMagazine

Interference

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NASA Is SMAP'in The Earth

SMAP launch photo is courtesy of United Launch Alliance.

A United Launch Alliance (ULA) Delta II rocket carrying the Soil Moisture Active Passive (SMAP) payload for NASA lifted off from Space Launch Complex-2 at 6:22 a.m. PST on January 31, 2015.

This launch marks ULA's second launch of 13 planned for 2015, and the 93rd successful mission since the company was formed.

The SMAP mission was launched via a Delta II 7320 configuration rocket featuring a ULA first stage booster powered by an Aerojet Rocketdyne RS-27A main engine and three Alliant Techsystems (ATK) strap-on solid rocket motors.

An Aerojet Rocketdyne AJ10-118K engine powered the second stage. The payload was encased by a 10-foot-diameter composite payload fairing. In addition to SMAP, the Delta II delivered four educational cubesats as part of NASA's Educational Launch of Nanosatellite (ELaNa) initiative.

The SMAP mission is NASA's first EO satellite mission designed to collect global observations of surface soil moisture and its freeze/thaw state, data that have broad applications for science and society. SMAP will provide direct measurements of soil, all needed to improve our understanding of regional water cycles, ecosystem productivity, and processes that link the water, energy, and carbon cycles. SMAP science measurements will be acquired for a period of three years. A comprehensive validation program will be used to assess the accuracies of the soil moisture and freeze/thaw estimates.

Moog Inc. provided propulsion control for the SMAP. The ULA Delta II launch vehicle is equipped with a Moog engine swing check valve and servovalves on its first stage to aid in engine control upon liftoff. Moog also supplied the second stage engine control pilot valve for the AJ-10 upper stage engine, which controls hydrazine to the main valve.

The second stage of the Delta II guided the SMAP satellite into its injection orbit where it will perform propulsive maneuvers to reach its final, sun-synchronous orbit 426 miles (685 km) from Earth.

Moog delivered nine MONARC-5 thrusters and one qualification thruster to JPL. Thrusters were integrated onto SMAP and activated soon after separation from the Delta II second stage to de-tumble the spacecraft and initiate sun acquisition after solar array deployment.

Moog fill and drain valves also contribute to the SMAP propulsion system. High reliability of the propulsion system is crucial to ensure correct positioning of the spacecraft.
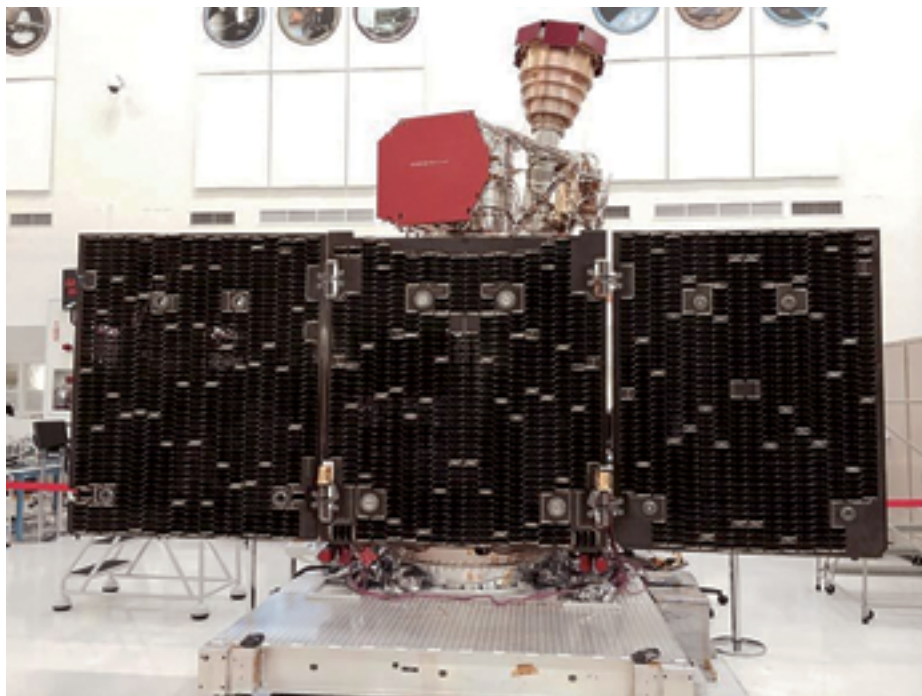
The ULA infosite: ***http://www.ulalaunch.com***
The Moog infosite: ***http://www.moog.com/***
The NASA SMAP infosite:
http://smap.jpl.nasa.gov/

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What's Up With NASA's SMAP?

The unfolded solar arrays to power SMAP and the golden feedhorn for its radar and radiometer are visible in this image taken during assembly and testing. Photo is courtesy of NASA/JPL.

If you were trying to forecast tomorrow's weather, you would probably look up at the sky rather than down at the ground.

However, if you live in the U.S. Midwest or someplace with a similar climate, one key to a better weather forecast may lie beneath your feet.

Precipitation and temperature are part of every weather forecast. Precipitation comes from clouds, clouds are formed of airborne water vapor, and vapor comes from evaporating soil moisture—soil moisture governs precipitation.

Evaporating soil moisture also makes air cooler, so it affects temperature. In certain kinds of climate, scientists believe, soil moisture is so influential that better observations of it might improve weather forecasts.

These climates are transitional: not too humid and not too dry. For example, the agriculturally productive states of the U.S. Midwest fall into that category.

"Better soil moisture observations lead to better land-atmosphere interaction in weather forecasting models and ultimately to a better prediction of temperature and precipitation," said Michael Ek, leader of the Land Hydrology Team at the Environmental Monitoring Center of the National Oceanic and Atmospheric Administration (NOAA). "Weather models need good initial observations of the land surface, or you're starting from the wrong place."

Better soil moisture observations are just what the Soil Moisture Active Passive (SMAP) mission will provide. SMAP will collect the most accurate and highest-resolution soil moisture measurements ever made from a satellite. SMAP will cover the entire globe in two to three days. The leading question has been how best to incorporate the new data into national weather forecasting models.

Forecasts will not improve the moment SMAP starts collecting data. U.S. Department of Agriculture research scientist Wade Crow, a member of SMAP's science team, explained that, as closely spaced global soil moisture measurements have never existed before, the mathematical models used in weather forecasting are not configured to include them directly.

Acquiring the best use out of the new observations has been a subject of active research for several years and will require some significant changes in how soil moisture data are assimilated into the models.

Data assimilation is necessary because weather forecasting models all drift a bit, just like cars. If you're driving on a perfectly straight road, you still need to keep a hand on the steering wheel or you'll run off the edge, sooner or later. Data assimilation in a model serves the same purpose as the slight movements of your hands that keep your car on course.

Drift is not a fatal flaw for a weather forecasting model any more than it is for a car. It is simply a sign that the Earth system is too vast and complicated to model perfectly with the resources available today.

To steer forecasts toward greater realism, models ingest, or assimilate, real-world data and use them in sophisticated mathematical techniques. Each time updated observations become available, they are assimilated to improve the starting point for the next forecast.

Closely spaced and highly accurate global measurements are an important part of the process. For soil moisture, however, current observations are not on a fine enough scale to meet the needs of weather forecasting models directly.

"Modelers compensate for the lack of direct observations of soil moisture by using more indirect measures, such as estimating it from observations of temperature and precipitation," Crow said. "As a consequence, modeled soil moisture tends to diverge from reality. SMAP will be directly observing the state that they want, so they won't have to back it out from proxy measurements." JPL scientist Eni Njoku is working with

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SMAP is managed for NASA's Science Mission Directorate in Washington by the agency's Jet Propulsion Laboratory in Pasadena, California, with instrument hardware and science contributions made by NASA's Goddard Space Flight Center in Greenbelt, Maryland.

JPL is responsible for project management, system engineering, radar instrumentation, mission operations and the ground data system. Goddard is responsible for the radiometer instrument.

Both centers collaborate on science data processing and delivery to the Alaska Satellite Facility, in Fairbanks, and the National Snow and Ice Data Center, at the University of Colorado in Boulder, for public distribution and archiving.

NASA's Launch Services Program at the agency's Kennedy Space Center in Florida is responsible for launch management.

JPL is managed for NASA by the California Institute of Technology in Pasadena.

For more information about SMAP, visit:
http://smap.jpl.nasa.gov/
and
http://www.nasa.gov/smap

Select the image above to download the PDF SMAP Handbook.

researchers at another forecasting center, the European Center for Medium-Range Weather Forecasts (ECMWF) in Reading, England. He said, "SMAP will provide benefits of higher soil moisture accuracy and spatial resolution than have previously been available from satellites. This could lead potentially to improved regional and global weather forecasts by ECMWF."

Environment Canada, the branch of the Canadian government responsible for weather forecasting in that nation, is also working on assimilating SMAP data into its models.

"The numerical weather prediction centers are adapting to the new availability of soil moisture information and thinking of ways they can exploit it," Crow summarized. "It will be really exciting to see what they find."

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Taking The Strain Out Of Assembling A Satellite

How is a satellite safely repositioned? Surrey Satellite Technology Ltd. (SSTL) reports such is done... delicately and slowly...

At SSTL, a highly regarded manufacturer of small satellites, the challenge is that, but despite their small size, they are often too big to manhandle. That's when the company relies on their overhead gantry cranes—this process was demo'd by SSTL in their Guildford-based Assembly, Integration and Test (AIT) Hall.

The twin three-axis cranes in SSTL's main AIT Hall are mounted on sliders so that they can be used almost anywhere on the main floor area. They have a lift capacity of 10 tons and 8 tons and the crane hook is 9.7 meters in height. These cranes are able to work independently, or together, and are precision-controlled using a handheld remote control. Operating them is a skilled job, requiring specialist training.

Surrey's "smaller" small satellites, such as the SSTL-100 and SSTL-150, are the size of a dishwasher. The process of constructing the panels on these satellites and integrating all the modules and instruments on board takes place on a wheeled platform that allows the engineers to work on the spacecraft from every side. The overhead crane is usually only required when the spacecraft is complete and needs to be lifted into its flight case for transportation to the launch site.

However, the larger platforms from the SSTL-300 range are the size of a mid-sized car. Some of the assembly for these platforms takes place on metal frames that allow SSTL to

Making final adjustments to the SSTL-300 S1 spacecraft in the horizontal position before the crane hooks are attached.
Photo is courtesy of SSTL.

Attaching the crane hooks to the frame.
Photo is courtesy of SSTL.

tilt the satellite from vertical to horizontal, and vice versa, in order to access all the panels.

The tilting maneuver is achieved using the overhead cranes, which allows the company to precisely control the movement of the extremely delicate engineering.

Making final adjustments to the SSTL-300 S1 spacecraft in the horizontal position before the crane hooks are attached, an SSTL photographer was present on the day that one of three SSTL-300 S1 spacecraft, currently under construction in the AIT Hall, was being precision-maneuvered from a horizontal to a vertical position, and then transferred to a new static working jig.

Slowly does it... Photo courtesy of SSTL.

The process took place over a period of approximately an hour and a half—everything is done at a slow speed to ensure safety and accuracy. A small team stages and choreographs the sequence, as one of the team members controls the crane with a handheld remote control.

Final tiny adjustments are made to bring the spacecraft down onto the new frame in exactly the right position so that it can be safely secured.
Photo is courtesy of SSTL.

There are three SSTL-300 S1 spacecraft currently under construction at SSTL. The satellites will form a new imaging constellation called DMC3 and are scheduled to launch this year.

The SSTL infosite for further information:
http://www.sstl.co.uk/

The SST-US infosite is located at:
http://www.sst-us.com/

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SRT Wireless To Shine Spotlight On Satellite Hacking

SRT Wireless has announced the company will have a strong presence at next month's Satellite 2015® conference in Washington, DC.

At the conference, SRT Wireless CTO Conrad Smith will be featured on the panel, *Cyber-Security Symposium Part 1: Securing IP Networks While Enhancing Performance*, where he will discuss the growing problem of satellite hacking and how best to secure satellite communications systems to prevent breaches.

In addition, next month's issue of *SatMagazine* will publish a feature story by Smith on that exact topic... an introductory teaser of that feature follows.

Corporate hacking went mainstream in 2013, with high-profile breaches of companies such as Target and JPMorgan Chase. 2014 witnessed the Sony hack, allegedly committed by agents of the North Korean government. Already, 2015 has seen the hacking of YouTube and Twitter accounts belonging to CENTCOM, which oversees U.S. military forces in the Middle East.

Satellite hacking represents the next frontier to be targeted by these ever-growing and more sophisticated breaches. In theory, satellite breaches could wreak havoc in areas that range from terrestrial communications to military operations, from oil and gas pipelines, to financial markets.

However, the reality of these types of dangerous hacks is closer than we think. The *Washington Post* reported that, in September, hackers based in China successfully breached National Oceanic and Atmospheric Administration (NOAA) weather satellites, which included the National Weather Service program. This breach resulted in NOAA's primary forecasting satellites being off-line for 12 hours.

While the problem was quickly resolved, such an attack demonstrated the vulnerability of U.S. government satellites not only to hacking, but hacking by foreign agents. Far from being innocuous, the National Weather Service satellites provide information that is critical for U.S. farming and transportation interests and for natural disaster planning, to name but a few.

For example, the National Weather Service satellites provided key intelligence that led to the early warning and evacuation notices prior to Superstorm Sandy's landfall. Even with those early warnings, Sandy caused an estimated $50 billion in damage when the storm hit the northeast region in 2012. Had there been even less notice to the approaching calamity, the economic damage would have been far higher than was actually suffered.

Last spring, cybersecurity advisory firm IOActive released a report detailing multiple vulnerabilities in a wide range of commercial and military satellite communications systems. These vulnerabilities include digital backdoors built into computer codes, hard-coded credentials that allow easy access to devices, insecure language protocols, and weak encryption of communications channels.

The firm found that these vulnerabilities could allow hackers to intercept, manipulate, or block satellite communications—in some cases, even to take control of satellites through a simple text message containing a malicious code.

"If one of these devices is compromised, the entire satellite communications infrastructure could be at risk," the report stated. "Ships, aircraft, military personnel, emergency services, and industrial facilities, which include oil rigs, water treatment plants and gas pipelines, could be affected."

In next month's *SatMagazine* article, SRT's Conrad Smith will review the history of satellite hacks so far, the types of attacks to which satellites and their communications are vulnerable, and the cyber-hardening safeguards SRT Wireless has built into their flagship hardware—the VIPturbo and Afterburner modems for the Thuraya satellite network.

For more on SRT's capabilities and markets, please visit
http://www.srtgrp.com
and
http://srtwireless.net.

If you will be attending Satellite 2015®, attend Conrad Smith's panel, which is scheduled for Monday, March 16th, at 9:00 a.m. in room 207B.

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North Korean Political Prisons To Be Monitored By Satellite

The Committee for Human Rights in North Korea (HRNK) and commercial imagery intelligence company AllSource Analysis (ASA) have announced a strategic partnership to use satellite imaging and analysis to monitor and report on North Korea's notorious political prison system.

"Up to 120,000 citizens are being held without due process in horrific, inhumane conditions for political reasons, and an estimated half-million people have died in these camps," said Executive Director Greg Scarlatoiu from HRNK's Washington, D.C., headquarters. "The collaboration with ASA will allow us to monitor, review and report on North Korea's vast system of unlawful imprisonment. Our collaboration will employ technology used for the first time to address such an enormous human tragedy."

This collaboration will focus on data collection using time-lapse tracking of current and historical images, combined with on-the-ground surveillance and testimonials from former prisoners, guards and other human sources to track developments and bring as much transparency as possible to the situation.

"What we are facing is a slow-motion Holocaust. Crimes against humanity are being committed at North Korea's political prison camps. The situation at these facilities is so egregious that comparisons have been made to World War II Nazi extermination camps where millions died," said Scarlatoiu. "Our goals include exposing this human rights disaster to the world and urging the North Korean regime to acknowledge its existence.

"Visual proof provided by ASA will enhance our ability to persuade the global community to pressure North Korea to allow United Nations agencies and the International Committee of the Red Cross access to the camps. Our ultimate goal is the complete, verifiable and irreversible dismantlement of North Korea's political prison camp system."

Additional information: ***http://www.hrnk.org*** and ***http://www.AllSourceAnalysis.com/***

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CNES' Jean-Yves Le Gall Offers His Insight For The Company In 2015

The President of CNES: Jean-Yves Gall.

CNES President Jean-Yves Le Gall delivered his New Year wishes to members of the French and international press in the Salle de l'Espace at Paris Les Halles.

This traditional gathering provided the opportunity to review a year of historic successes for CNES and to present the agency's strategy and challenges for 2015, a year in which the focus will be on climate in the lead-up to the COP 21 global climate summit in Paris in December. He began by reviewing achievements in 2014, which was a stellar year for France and Europe, the high points being the Rosetta-Philae mission and the ESA Ministerial Conference in Luxembourg, to which CNES was a key contributor.

The review covered the go-ahead for Ariane 6, the landing of Philae in which CNES was closely involved through the mission's Science Operations and Navigation Centre (SONC), and the many other successes where the company played a central role: 11 launches from the Guiana Space Centre (CSG)— six by Ariane 5, extending its track record to 63 straight launch successes, the fundamental contribution of the Pleiades satellites to national defence, the successes of Curiosity, Planck and GAIA, the proposed electric-propulsion satellite that is one of 34 projects selected under France's NFI new industrial policy, and numerous international partnership initiatives, including the balloon cooperation agreement with Google for Project Loon.

Jean-Yves Le Gall then looked forward to the major missions ahead, among them InSight, Mars 2020, SWOT, CFOSat, SVOM and MERLIN. However, the main focus this year will definitely be on climate, with the COP 21 global climate summit that France will be hosting in Paris in December.

The Jason 3, IASI NG, SWOT and MERLIN missions will thus be center stage. Indeed, the utility of satellite data to climatology has been formally recognized through the international Global Climate Observing System (GCOS) program and future Eumetsat missions, as well as the Earth Explorer program, all of which will bring new insights into what is driving global warming. In the field of sciences, Philae is expected to awaken in March and be in the thick of the action once again in August, while the SEIS seismometer will be delivered for the InSight mission and the JUICE mission will be on the rails. In telecommunications, the Galileo and NEOSAT missions will of course be pursued alongside the deployment of electric satellite propulsion systems, and in launch vehicles CNES's flagship Ariane 6 program will get underway.

To meet these many important challenges and assure the continued success of its key ongoing missions, CNES will have a stable overall budget for 2015 of 2,126 million euros, which reflects the top priority the government is giving to space and its strong commitment to maintaining France's leadership position in Europe.

Through this remarkable national space effort, representing an annual investment of around 30 euros per capita, France's civil space budget will remain the second highest in the world behind the United States (45 euros) but ahead of Germany (15 euros). Some 80 percent of this budget directly benefits French industry to sustain jobs and competitiveness, with every euro invested in the commercial space sector generating 20 euros in spin-offs for the economy.

Space supports 16,000 jobs in mainland France, in addition to the 1,700 jobs in French Guiana that generate five times as many indirect jobs for 20 percent of the Guianese working population. This contribution to

employment makes CNES a major player in France's economy.

This ambitious strategy will once again be implemented this year by the 2,450 highly motivated and expert employees at CNES's four centers of excellence: the Toulouse Space Centre (R&T, Philae, Jason-3, SWOT, ATV), the Launch Vehicles Directorate (Ariane 6, Ariane 5, Soyuz and Vega operations), the Guiana Space Centre (launches, Ariane 6 launch complex) and Head Office (space policy and relations with industry, ESA, the European Union and international partners).

In his wishes to the press, Jean-Yves Le Gall said, "2014 was a year that brought raised recognition of the benefits of space, in Europe and especially in France, and this trend is set to continue in 2015. The historic successes of Rosetta-Philae and the ESA Ministerial Conference in Luxembourg, which at France's initiative gave the go-ahead for Ariane 6, generated unprecedented public interest and considerably boosted collective awareness of the eminently valuable role that space plays in our daily lives."

The CNES infosite: ***http://www.cnes.fr/***

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Function Testing Is "A-OK" For First Launch Of Iridium NEXT

Artistic rendition of an Iridium NEXT satellite.

Iridium Communications Inc. has successfully completed the first testing phase of the Iridium NEXT platform software.

Developed by Thales Alenia Space, the platform software will manage all flight functions on Iridium NEXT satellites, including such systems as power management, solar array positioning, propulsion operations, navigation and attitude control.

This first phase completed all testing of primary functions in preparation for the first launch, which is scheduled to be in 2015.

Thales Alenia Space is the primary contractor for the software program, with SELEX Galileo contributing the software for its Multi-Headed Startracker, which determines the orientation of the satellite.

The platform software will now undergo two additional testing phases. This further testing will focus on systems integration and added functionality, and will ensure the satellite has greater autonomy to operate and recover from anomalies.

The software platform for Iridium NEXT satellites was developed with functionality similar to the software on Iridium's current satellites, which ensures that each satellite is able to autonomously recover from issues on orbit. This is a necessary element in limiting operations workload and rapidly reacting to on-orbit anomalies that, if left to ground intervention, could result in lost satellites.

The Iridium NEXT satellite network will consist of 66 in-orbit satellites and a number of in-orbit spares.

The constellation is scheduled to begin launching in 2015 and when fully operational will offer greater bandwidth and data speeds. Iridium NEXT serves as the platform for Aireon(SM), an important new global aircraft and surveillance system using space-based

ADS-B, as well as Iridium PRIME(SM), a turnkey solution for hosted payloads which will offer all elements of a successful hosted payload mission, at an estimated cost savings of 50 percent or more compared to current standalone solutions.

"Completion of this testing phase is a huge step forward in launching the constellation," said Scott Smith, chief operating officer, Iridium Communications Inc. "Through a close collaboration with Thales, we were able to develop this software successfully, and I have no doubt that continued rigorous testing will further prove its functionality and resiliency."

"This milestone reinforces the stability and dependability of the Iridium NEXT satellites as we move closer to launch," stated Denis Allard, VP Program Manager for Thales Iridium NEXT. "The rigorous and lengthy testing process helps verify that the satellites will perform as planned, and will provide dependable service to the network for years to come."

For more information on Iridium NEXT, visit ***https://www.iridium.com/About/IridiumNEXT.aspx.***

Additional details regarding Thales Alenia Space may be located at ***https://www.thalesgroup.com/en/worldwide/space.***

The Selex Galileo infosite may be accessed at ***http://www.selexgalileo.com/***.

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A Game Changer—SpaceX Selected To Launch ViaSat-2

Artistic rendition of the ViaSat-2 satellite.

Artistic rendition of the SpaceX Falcon Heavy launch vehicle.

ViaSat Inc. is taking another step forward in the transformation of satellite broadband with the selection of SpaceX to launch ViaSat-2, the company's next generation high-capacity broadband satellite.

ViaSat-2 is scheduled for a late summer 2016 launch aboard a SpaceX Falcon Heavy from the Kennedy Space Center in Florida.

The ViaSat-2 satellite is expected to cover seven times the geographic area and offer twice the bandwidth economics advantage of ViaSat-1.

Falcon Heavy is an evolution of the flight-proven Falcon 9 that is used to launch commercial satellites as well as cargo missions to the International Space Station.

Starting with ViaSat-1, ViaSat began a transformation of satellite communications into a network technology that can provide high-performance services competitive with terrestrial alternatives, rather than being merely a last resort.

ViaSat-2 is designed to provide another leap ahead in broadband service quality for residential, mobile, and enterprise satellite services. Now under construction by Boeing, ViaSat-2 will become the fourth satellite in the ViaSat fleet.

"One of the primary objectives for ViaSat-2, beyond higher speeds, is to offer more data with all of our service plans. That's what customers want from any wireless service," said Mark Dankberg, ViaSat chairman and CEO. "We can do that by building a network with lots more network capacity at a cost that will attract more customers, and that's what this new class of satellite is designed to do."

ViaSat-2 is expected to cover seven times the geographic area and offer twice the bandwidth economics advantage of ViaSat-1, which is already the highest capacity satellite in the world.

Planned coverage includes North America, Central America, and the Caribbean basin.

The satellite will also provide a bridge of coverage across the North Atlantic, connecting North America with high-capacity coverage in the U.K. and Europe for high-speed in-flight Internet and other mobile services.

Since high-capacity satellite services were launched with Exede® Internet in January 2012, the technology has re-ignited satellite Internet subscription growth and gained industry recognition for high-performance and innovation:

A February 2014 FCC report showed Exede Internet outperforming all other ISPs in delivering promised speeds for the second year in a row, with 90 percent of Exede subscribers receiving 140 percent or better of the advertised 12 Mbps speed during peak periods.

The ViaSat infosite:
https://www.viasat.com/

The SpaceX infosite:
http://www.spacex.com/

InfoBeam

Picasso Has Atmospheric Intentions

Artistic rendition of ESA's Picasso CubeSat.

The PICosatellite for Atmospheric and Space Science Observations (Picasso) CubeSat is designed to investigate the upper layers of Earth's atmosphere.

Developed for ESA by the Belgian Institute of Space Aeronomy (BISA) with VTT Finland and the U.K.'s Clyde Space, Picasso will measure the distribution of ozone in the stratosphere and profile the temperature of the mesosphere and the electron density in the ionosphere.

Just 30x10x10 cm in size, the CubeSat will use a miniaturized multispectral imager for atmospheric 'limb sounding' with the Sun as the light source, and a multi-needle 'Langmuir probe' sampling the electron density of the space around it.

CubeSats are standardized pico- and nano-satellites formed in cubes of 10 cm per side, with a maximum mass of 1.5 kg per cube, intended to make access to space affordable for small companies, research institutes and universities. One-, two- or three-cube CubeSats are currently being flown.

Picasso is one of a number of CubeSat missions being backed by the In-Orbit Demonstration element of ESA's General Support Technology Program. The satellite will be launched in 2016 as part of QB50, a network of 50 CubeSats to probe largely unexplored layers of Earth's atmosphere.

Information regarding the General Support Technology Program may be viewed at
http://www.esa.int/Our_Activities/Space_Engineering_Technology/CubeSats

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Satellite Tools To Play Even More Important Roles For U.K. Government Services

Satellite data could soon be playing a bigger role in vital Government services with the start of the first 14 projects funded under the U.K. Space Agency's Space for Smarter Government program (SSGP).

From flood management to air quality monitoring, and breast cancer screening to shale gas impact monitoring, the projects will explore new ways for central and local Government to embed space services such as Earth observation (EO) and satellite navigation in everyday operational activities, enabling them to save money, increase innovation and deliver more efficient public services.

The U.K. is a world leader in space services and technologies with the Government and the space industry aiming to grow the sector to a £40 billion turnover per year by 2030. The use of space by the Government is a vital part of this growth strategy and will enable SMEs and other space sector organizations to further develop viable satellite enabled services for export or commercial use.

Minister for Universities, Science and Cities, Greg Clark, said, "The U.K. space sector is an engine of growth for the U.K., growing at over 7 percent per year with over 5,000 jobs created in the last two years. Space is increasingly playing a vital role in our everyday lives and through this new program the Government will harness the potential of space and integrate it into its day to day business to help save money, innovate and make more effective decisions.

"The uniqueness of this program is that all of its projects have the public sector customer

Countryside Council for Wales: updating the habitat map using satellite imagery

fully engaged. For example, the Department of Environment has formed an oversight group to rapidly assess the outcomes of the SSGP projects that could assist in its goal to increase its use of EO in accessing impactful evidence to develop and implement policies in more cost-effective ways."

The Space for Smarter Government Program is a strategic, national, program established and led by the U.K. Space Agency in 2014, and delivered in collaboration with the Satellite Applications Catapult, to enable the public sector to save money, innovate and make more effective policy decisions by using space products, data and services for routine business.

SGP has developed a challenging and exciting set of activities for 2014/15, including:

- *A campaign to raise awareness and inspire use of satellite applications and data*
- *Provision of neutral and critical support for the public sector, understanding its requirements and supporting the development of sector owned strategic road maps/action plans.*
- *A budget of £1m for funding projects able to demonstrate or build towards operational services*

This announcement is the result of the first and second call for projects. All will run for three months from January to March 2015. Total cost £700k.

Additional information is available at: *http://www.spaceforsmartergovernment.uk/*

Scotland: Closing the gap in broadband coverage in remote areas

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Crystal's Dynamic Rebranding

Crystal has announced the launch of new company branding in concert with this new year.

Building on almost 30 years of dedicated experience creating reliable solutions wherever content flows, Crystal has rebranded the company from "Crystal Solutions" to simply "Crystal" and has updated its logo, website and product suite.

During its history, Crystal has worked with a wide range of notable companies throughout the video and satellite ecosystem. Crystal is an expert in building solutions for complex, mission-critical networks and environments.

Every day billions of dollars of content flow through satellite, network and cable systems that rely on Crystal technology. The new brand will be on display at the Satellite 2015 show in March.

Along with showcasing its new brand, Crystal will demonstrate its range of solutions including Crystal Control, Crystal Spectrum, Crystal Insight and Crystal Carrier ID.

"We are an innovative company in a dynamic industry," said Roger Franklin, CEO, Crystal. "This re-brand reflects our heritage within the industry while reinforcing that Crystal is at the forefront of providing innovative solutions for current and future requirements."

Crystal has experienced steady growth over recent years and has ambitious targets, predicting 400 percent growth in the next six years.

Growth will be attained through innovative products, solutions and services that enable clients to manage their complex networks while providing the flexibility they need to adapt to the rapidly changing and evolving media environment.

For a look at the new Crystal, please visit ***http://crystalcc.com/***

InfoBeam

Geospatial Analysis By DigitalGlobe Helping To Save Elephants

A new report published by *DigitalGlobe Inc. African Parks, Enough Project and the Satellite Sentinel Project* details how the use of satellite imagery and predictive analytics is helping park rangers combat illegal elephant poaching in the Democratic Republic of Congo's Garamba National Park.

The African elephant population has declined by more than 50 percent in the past 30 years, and poachers are killing the elephants of Garamba at an unprecedented pace.
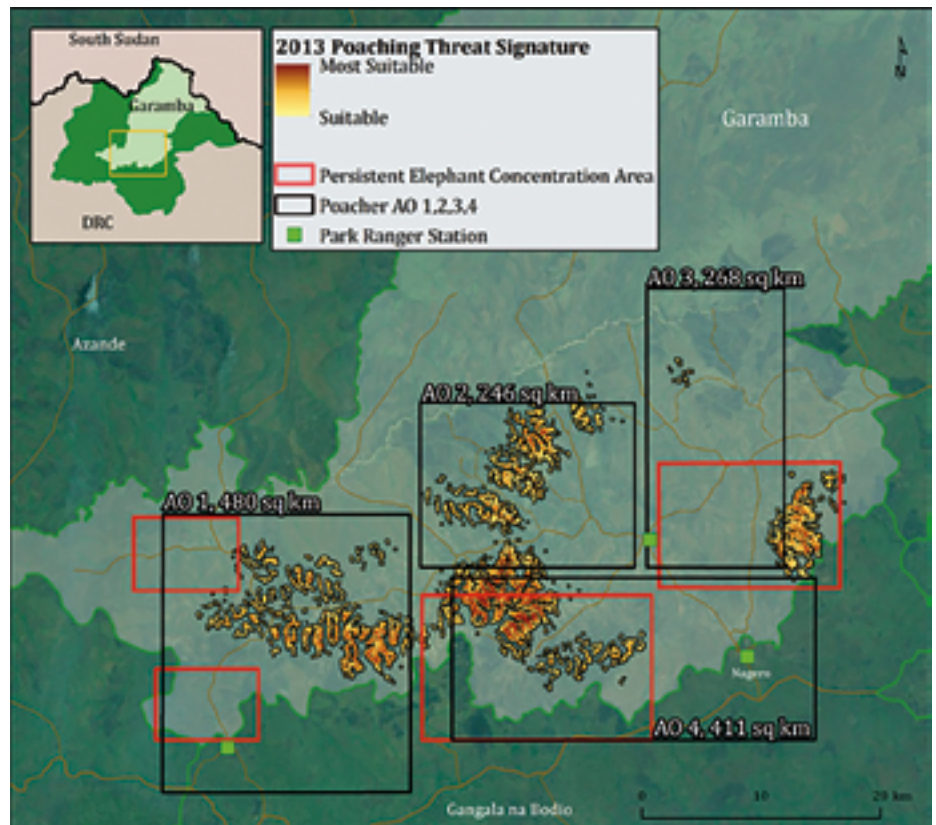
Since mid-April 2014, park rangers have found the carcasses of 131 elephants, slaughtered for their ivory tusks that can sell for tens or hundreds of thousands of dollars on the black market.

Unlike in the past, when criminal gangs carried out most of the poaching, the main actors appear to be heavily armed groups using professional techniques, some of which have been involved in Central Africa's many conflicts and have carried out atrocities against civilians, creating much misery and suffering over the past decade.

For Garamba's rangers, tracking poachers through the vast park is daunting and dangerous. The park itself spans an area of about 4,920 square kilometers.

With limited resources, rangers face the daunting task of tracking elusive groups of poachers who use stealth and an intimate knowledge of the terrain.

Working with the Enough Project and African Parks, which manages Garamba on behalf of the Congolese government, DigitalGlobe analysts were given the location and date of the elephant remains discovered between 2011 and 2013, elephant collar data, ranger patrol routes, and the locations of known poacher camps.

Using this data, analysts conducted historical geospatial trend analysis, cost surface travel analysis, key terrain analysis, and predictive analysis using DigitalGlobe's Signature Analyst™ geospatial analytic software.

The analysis revealed areas of the park that share similar geospatial characteristics with the locations of previous poaching sites, where future poaching incidents are most likely to occur. The result was a 98 percent reduction in the area of the park in which poaching is likely to occur, including a 95 percent reduction in the area of the historical poaching zone.

"By focusing on the many geospatial factors that make some areas of the park more vulnerable to poaching than others, we can extrapolate that data to predict where poachers may strike next," said Heath Rasco, DigitalGlobe senior geospatial scientist. "This information is being used to focus scarce patrol resources and establish checkpoints at key access points to poaching hot spots."

To learn more, visit our interactive site, located at
https://www.digitalglobe.com/interactive/garamba/

You can also download the full report, *Poachers without Borders: New Satellite Imaging and Predictive Mapping to Empower Park Rangers and Combat Ivory Traffickers in Garamba National Park* at
https://www.digitalglobe.com/interactive/garamba/downloads/DigitalGlobe_Garamba_Poaching.pdf

InfoBeam

Saving Lives Is A Crucial Charter For NOAA

To view a short video that displays NOAA's polar and geostationary satellites, please access
http://www.nesdis.noaa.gov/about_ satellites.html

NOAA's fleet of weather satellites helped save 240 people last year from potentially life-threatening situations throughout the United States and its surrounding waters.

In addition to their vital role in weather forecasting, NOAA's polar-orbiting and geostationary satellites can detect distress signals from emergency beacons carried by downed pilots, shipwrecked boaters, and stranded hikers.

Information captured from these satellites, including location, are then relayed to first responders on the ground who assist with search and rescue efforts.

Of the 240 rescues in 2014, 112 were waterborne rescues, 15 were from aviation incidents, and 113 were from events where small handheld devices called Personal Locator Beacons or PLBs were used.

Other rescue highlights from 2014 include:

- *Alaska had the most SARSAT rescues, with 78, which was lower than 2013's total of 99. Most of the incidents involved disabled snowmobiles in the North Slope region, and four people were rescued after their small plane crashed into a lake near Galena. Florida had the second highest number of rescues, with 26.*

- *Signals received by the NOAA satellites helped the U.S. Coast Guard to rescue five people from a capsized fishing vessel 20 miles off the Oregon coast.*

- *The pilot of a small plane was rescued after he crashed into the sea, while flying from the Bahamas to Ft. Lauderdale, Florida, and another pilot was saved when his plane crashed in the sea on a flight from Florida to the Bahamas.*

- *Four children and four adults were rescued off the coast of Hawaii in Kaiwi Channel after their boat sank.*

NOAA satellites are part of the international Search and Rescue Satellite Aided Tracking System, known as COSPAS-SARSAT. This system uses a network of spacecraft to detect and locate distress signals quickly from emergency beacons onboard aircraft and boats, and from PLBs.

When a NOAA satellite finds the location of a distress signal, the information is relayed to the SARSAT Mission Control Center based at NOAA's Satellite Operations Facility in Suitland, Maryland. From there, the information is quickly sent to a Rescue

NOAA - SARSAT map of U.S. rescues.

Coordination Center, operated by either the U.S. Air Force for land rescues, or the U.S. Coast Guard for water rescues.

"From helping rescue a lost hiker to finding a capsized fishing vessel to providing the data and information that underpins our daily weather forecasts, NOAA satellites help protect lives and property every day," said Chris O'Connors, NOAA SARSAT program manager.

Since 1982, COSPAS-SARSAT has been credited with supporting more than 37,000 rescues worldwide, including more than 7,492 in the United States and its surrounding waters.

By law, owners of emergency beacons are required to register them with NOAA at: ***http://www.beaconregistration.noaa.gov***. That registration information often helps provide better and faster assistance to people in distress. It may also provide information about the location of the emergency, how many people need assistance, what type of help may be needed and other ways to contact the owner. At the close of 2014, NOAA's registration database contained more than 430,000 entries.

NOAA's mission is to understand and predict changes in the Earth's environment, from the depths of the ocean to the surface of the sun, and to conserve and manage our coastal and marine resources.

NOAA's infosite:
http://www.noaa.gov/

See SARSAT rescue locations and descriptions on an interactive map at
http://www.nesdis.noaa.gov/sarsat_ rescues_2014.html

Branson Advances His Satellite Initiative

By Chris Forrester,
Senior Contributor

There's a British saying, which uses as its basis that buses—to those patiently waiting in a queue—always come in threes! This does seem to be true recently regarding new satellite constellations.

First, we had Sir Richard Branson, in a blog as well as in an interview on CNBC, citing his enthusiasm for Greg Wyler's plan to orbit 648 small satellites. Wyler's company WorldVu Satellites last week received backing from Branson's Virgin Galactic space-plane operation as well as from Qualcomm's Paul Jacobs. Branson and Jacobs will join the WorldVu/OneWeb Ltd. board of directors. Branson is reportedly tempting other large investment funds into joining the Wyler scheme. Speaking in Davos on January 21, Branson said the project was "Earth-changing" in its magnitude and importance, and that he was investing £2 billion "and "we are going to have a very good return."

WAR of the SATELLITES

Then we had SpaceX pioneer Elon Musk talking on January 16 of his plans to start building as many as 4,000 smaller satellites. Musk spoke in Seattle where he is building a new production facility. His scheme is quite separate from the Wyler/Branson/Qualcomm scheme. He said, "Our focus is on creating a global communications system that would be larger than anything that has been talked about to date."

The third slice of news concerned Google confirming that the company would be investing in Musk's SpaceX.

That both major schemes are seemingly well-funded is undoubtedly good news, but whether there's room for either project is a major question.

According to Musk, SpaceX will focus on making their own satellites for the time being, rather than competing with launch customers, although that could change over time. "I think we would consider building satellites for ourselves and for other people," Musk said. "We'll start by building ones that address the specific application that we are working on, and then we will be more than happy to sell to other people."

Musk is undoubtedly a serial disruptor, bringing fresh ideas and concepts to well-established business practices: in electric cars, in rocket launching, and now with satellite building. "We're going to start by building our own constellation of satellites, but that same satellite bus and the technology we develop can also be used for Earth science and space science, as well as other potential applications that others may have."

Musk said his was to be a $10 billion-valued project and would eventually help fund communities living on Mars—his ultimate goal. Musk spoke enthusiastically of 4,000 of these mini-satellites, each one orbiting some 900 km above Earth. However, there is no specific mention as to where the transmission frequencies will come from, nor of the transmission pattern itself, other than a statement from him that he has talked to "international regulators."

Speaking late on January 16, Musk seemed especially keen to distance himself from the Wyler project. He said, "Greg and I have a fundamental disagreement about the architecture. We want a satellite that is an order of magnitude more sophisticated than what Greg wants. I think there should be two competing systems." He further explained that he wanted his team to design and build a new satellite propulsion system based on all-electric thrusters.

Richard Branson

Elon Musk

The Branson/Virgin Group and Jacobs/Qualcomm pair are definitely investing in 'OneWeb Ltd.' and referred to the deal with Wyler as "the biggest order ever for putting satellites into space." and added "By the time our second constellation is developed, the company will have launched more satellites than are currently in the sky." WorldVu/OneWeb will use Ku-band transmission.

Branson told CNBC that he believed [his system] represented a very efficient way of getting satellites into space. "It's much more efficient than the big rockets of the past. We can literally take off every three or four hours." Branson said the initial investment for the first batch of satellites will be around $2 billion. "We can still be very competitive on prices, as far as the end-user is concerned. We believe that the break-even of this is not enormous. We feel it makes sense economically as well." He added that his space plane would be taking off every three or four hours or so, and could easily replenish satellites as they came out of orbit, and would, over time, be expanding the constellation to 2,400 units.

Branson took a dig at Musk's scheme, saying there was not space for another network. "If Elon wants to get into this area, the logical thing for him would be to tie up with us."

In his blog, Branson added, "Delighted to share news of an incredibly exciting project that could transform the world: we are creating a new constellation of satellites to make high speed Internet and telephony available to billions of people who don't currently have access."

Virgin Galactic is working on a two-stage rocket ("LauncherOne") that would launch small satellites from his WhiteKnightTwo space-tourism aircraft at heights of some 45,000-50,000 feet. "LauncherOne will be built using advanced composite structures, and powered by our new family of LOX/RP-1 liquid rocket engines.

Each LauncherOne mission will be capable of delivering as much as 225 kilograms to a low inclination Low Earth Orbit or 120 kilograms to a high-altitude Sun-Synchronous Orbit, for a price of less than $10M," Branson said in his blog.

Wyler, on January 14, said he expected to start launching satellites in 2017. He issued an RFP towards the end of last year and official news as their manufacturer is expected by this spring. The WorldVu/OneWeb ITU frequency filings expire between 2018 and 2020, so launch timing is critical. Wyler's team is also busy building the satellite receiver antenna, which

Virgin Galactic's WhiteKnight Two carrying LauncherOne.

Qualcomm's Paul Jacobs.

reportedly will be a phased array dish measuring some 36 x 16 cm and would be designed to receive broadband Internet.

Whether the overall news from Wyler's team can be aligned to the Musk plan, only time will tell. Wyler has repeatedly stated that WorldVu wanted to co-own its satellite production facility.

Not everyone is as optimistic as Sir Richard Branson, or Greg Wyler, or Elon Musk, for that matter. Roger Raush of specialist consultancy TelAstra, and who has a wealth of experience and of seeing similar giant constellations burn up either through over-ambitious plans or poor timing. He said, "It's highly unlikely that you can make a thriving enterprise out of this," said Rusch. "It's inconsistent with experience. These individuals are up against the laws of physics."

Rusch reminds us that even those constellations that did survive the 2000 to 2002 'dot-com' boom and bust are still under threat. He says that even Iridium's fleet is now quickly aging (88 were launched between May of 1997 and November of 1998 and are reaching their end-of-life).

Set against this caution, there is no doubt that players such as California's Viasat (641,000 subs at mid-2014) as well as Echostar-Hughes' Jupiter-1 (935,000 as of July 2014) have carved out extremely valuable niches in supplying broadband-by-satellite to a growing number of perfectly content subscribers, and Eutelsat's Ka-Sat (166,000 as of November 2014) is doing the same for Europe. The same optimism extends to Inmarsat (for maritime/aeronautical/specialty users), and Telenor's planned Thor-7. Much the same optimism revolves around the SES-backed O3b mini-constellation now beginning to make real headway.

However, a pair of quite revolutionary projects from Wyler or Musk represents a quantum leap in next-generation services. We need more financial evidence. Of course, the likes of Branson, Qualcomm and, especially Google, can make multi-billion dollar investments. If the ROI is sound, great. If it doesn't work, then such becomes a tax deduction.

Northern Sky Research (NSR) last week hurried out a paper suggesting that the industry might well be on the threshold of a step-change in terms of available capacity. "If even half of the LEO constellations in the exhibit above see the light of day, we are looking at a subscriber and bandwidth landscape that is totally different from any projection that would be considered achievable in today's date.

NSR reminds us, as does Roger Rusch, that history is littered with high-flying projects that have fallen from the sky. More than just the challenge of building, financing and launching any of these constellations, this is also making a return on that investment. There are ARPUs to be considered, as well as the cost of receiving equipment.

"Cost of CPE today is around $250 to $500. Is an order of magnitude reduction expected here of $25 to $50? Even a terrestrial broadband connection needs $20 CPE in most parts of the world, so perhaps a 50 percent reduction at best is realistic? ARPUs today are in the range of $50 to $200. Another 10-fold reduction expected here to $5 to $20? Residential broadband in most parts starts at about $10 per month for a 2 Mbps connection so this, again, seems to be an over-reaching expectation," said NSR.

"If Elon or Richard or Google or Facebook want to connect the "next billion" people to a satellite based Internet solution, a lot has to change besides just cost of hardware and service. Other constellations that started with a similar vision soon ran into either costly antenna design, or the need to pivot to an enterprise market that made more sense in the longer term, or both.

"The recent shake-ups at the likes of Kymeta are not helping the larger ecosystem, and neither are the hurdles in terms of gateways required or landing rights in various countries. Global ISPs, while growing into behemoths of the likes of Comcast, AT&T, Verizon, Vodafone and others are struggling to expand their network infrastructure without adopting priority data pricing strategies that are the subject of Net Neutrality debates worldwide. Funding seems to be the least of the concerns for the satellite broadband entrepreneurs right now, and rightly so," said NSR.

Senior Contributor Chris Forrester is a well-known broadcasting journalist and industry consultant. He reports on all aspects of broadcasting with special emphasis on content, the business of television and emerging applications. He founded Rapid TV News and has edited Interspace and its successor Inside Satellite TV since 1996. He also files for Advanced-Television.com. In November of 1998, Chris was appointed an Associate (professor) of the prestigious Adham Center for Television Journalism, part of the American University in Cairo (AUC), in recognition of his extensive coverage of the Arab media market.

The Road To Interference Detection Implementation

By Martin Coleman, Executive Director, Satellite Interference Reduction Group (IRG)

Over the past year, I have caught myself talking about Carrier ID (CID) again and again—the time has come to change the record.

So much has happened, as pointed out by Crystal Solution's Roger Franklin, and a small part of me feels that perhaps the job is done. However, this need is far from completed.

Yes, we have the standard and a number of important resolutions, we have equipment available and that is growing in number, but now we need to make certain that the technology and the products lead to widespread implementation. And, as we have requested in the past, the need continues for industry-wide support, especially now from those who transmit services to a satellite.

Education, Education, Education

One of the most significant challenges we face in regard to implementation of CID is imparting the knowledge and understanding of our industry regarding this crucial technology. Those who are involved with, or have been part of, bringing global initiatives to the table need to continue this push with us and other organizations. This must be a continuous process in order for satellite operators, manufacturers and uplinkers that have yet to make the move to see that they are equipped with the correct facts and industry support to meet CID deadlines.

At IRG, of course, we have started that activity. As an example, last year we ran a series of Carrier ID tours at major trade shows, walking participants through the process, from transmission, through detection, to resolution. The tours were well received by all participants. They learned from the experts at each of the stops on the tour and asked questions that mattered to them. We also produced postcards to hand out trade events that showed exactly what is involved for users to ensure they are CID ready which, in most cases, is very little. These cards are still available should anyone need some to pass on to their customers.

With our End User Initiative (EUI) Advisory Committee, we have also written a number of articles that have been aimed at educating broadcasters on how to ensure they are CID ready.

Carrier ID & the QA Process…

Satellite Operators

Inserted Carrier ID ...the Key that unlocks the Process!

Type Approval & other QA Data
ID is the Key

Check & Resolve + Updates

User/Uplinker/ Broadcaster

STOP Interference Now! (it's a SIN!)

Presented by Martin Coleman - Executive Director sIRG   www.satirg.org

CDI injected by modulator

Reading CID

Transmitting CID

Image is courtesy of Newtec CY.

CID encoder from Harmonic and we worked with them to setup tests with satellite operators prior to that product's official launch.

We have a list of CID ready encoders and modulators on our infosite (**http://satirg.org/resources/cid-ready-products/**) which is being updated to included detection systems. For the most part, we are in close collaboration with the manufacturers—if you are producing products that are not listed at the aforementioned infosite, please let us know so we can include them right away.

There are a few manufacturers still to come on board and I would urge them to contact us so we can help them make CID happen. The approved ETSI standard details are readily available and will give them something to follow to ensure the correct technical implementation.

Educating Users

This is, by far, the biggest area of need. As an entire industry, we must work on this fact. We already know that satellite interference has a detrimental impact on services, so no matter which part of the chain you are involved in, your best interest is to solve the interference problem.

At IRG, our CID and EUI advisory committees will be focusing much of their efforts on educating the users, through practical guides, webinars, and workshops across the globe. As mentioned, this activity started last year, but was specifically focused at the broadcast industry. We need to extend that reach to other verticals and maintain the flow of information to help them understand how to be CID ready. We will be starting this process in March with an Oil & Gas masterclass, which we are running in conjunction with SMi, alongside its Oil & Gas Telecommunications event in London.

That is also where the rest of the industry comes in, and I know a lot of that has already started, with manufacturers educating their customers on which products have CID and how to enable it in those products. Satellite operators are also communicating with their customers, explaining what CID is, how it helps, and how to check if their products are CID compliant.

The Road Ahead

While we are in the process of prioritizing other technology to reduce satellite interference, such as VSAT services and geolocation processes, it is clear that we must still extend a great deal of effort into the CID initiative. By working together to educate the industry and users, let's see if we can obtain widespread implementation throughout 2015.

Additional information regarding IRG is available at:
http://www.satirg.org/

Martin Coleman started his company, Colem, as an engineering services and design consultancy. Using his experience in management systems, Colem now supplies a unique satellite and broadcast control system design based on the industry standard GE Proficy iFIX Process Control platforms. Martin has worked with numerous broadcasters and satellite operators, improving their process control, including BSkyB, Reuters and YLE. Prior to setting up Colem, Martin was involved in the engineering and operations of various BT satellite projects for Madley and Goonhilly ground stations in the U.K. His background is in satellite and international telecommunications.
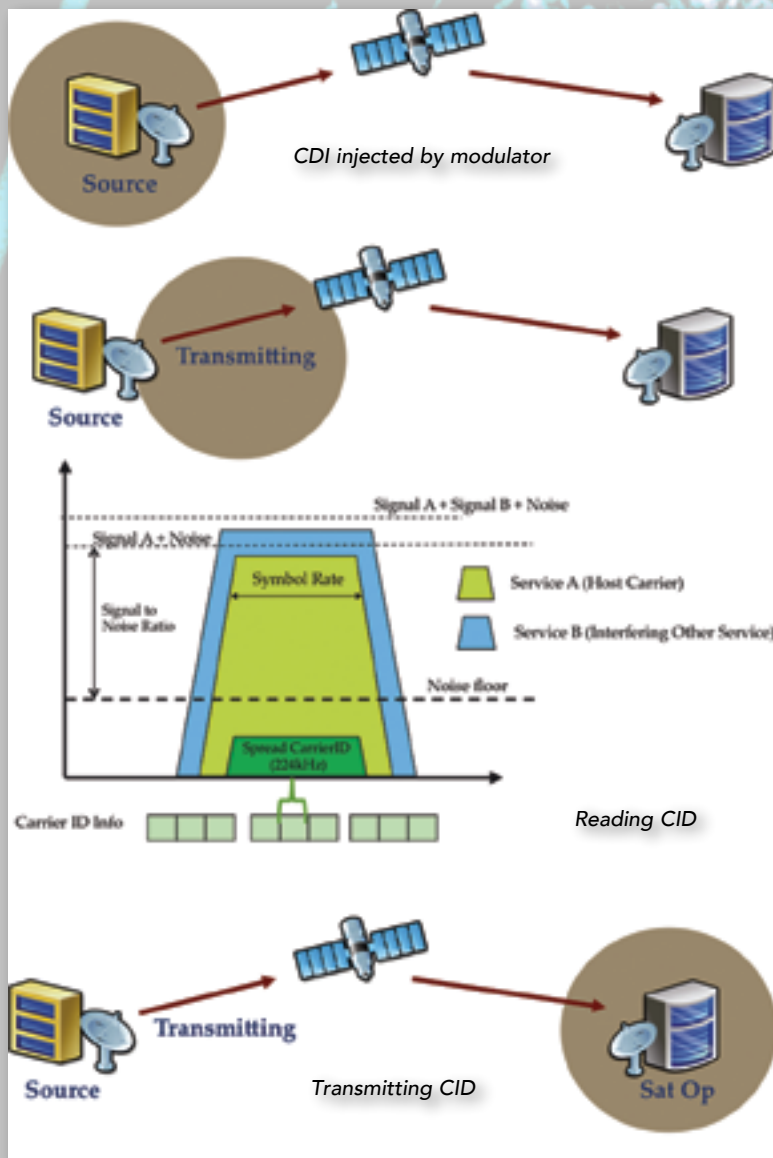
Educating Satellite Operators

All of the major satellite operators have been heavily involved and have initiated CID implementation. The passed resolutions mean that all satellite operators should have begun this process. However, some smaller operators may still need our support to finish the job and to understand the processes; how to use and populate the CID database; and how to detect CID once implemented. This will be a major priority for IRG over the coming months, producing material and guides to continue to help the industry understand exactly what is involved. IRG is planning a series of webinars with the same intention.

Educating Manufacturers

The manufacturers are, for the most part, on board with CID implementation. 2014 saw a number of new products enter the market, each one assisting with some part of the CID process. We also witnessed the launch of the first

New RFI Cancellation Technologies Attack Interference

By Bob Potter, Chief Technology Officer, SAT Corporation, A Kratos Company

Radio Frequency Interference (RFI) continues to be a significant problem that affects both satellite operators and end users alike. There is much coordinated effort to combat the issue on the part of operators and industry groups such as the Satellite Interference Reduction Group (sIRG) and the Global VSAT Forum (GVF).

Approaches include Carrier Identification Codes (CID), advanced monitoring and geolocation technologies and more robust operational training. Moreover, there is a new generation of mitigation technologies arriving to market that are designed to aggressively identify interference and unilaterally neutralize it.
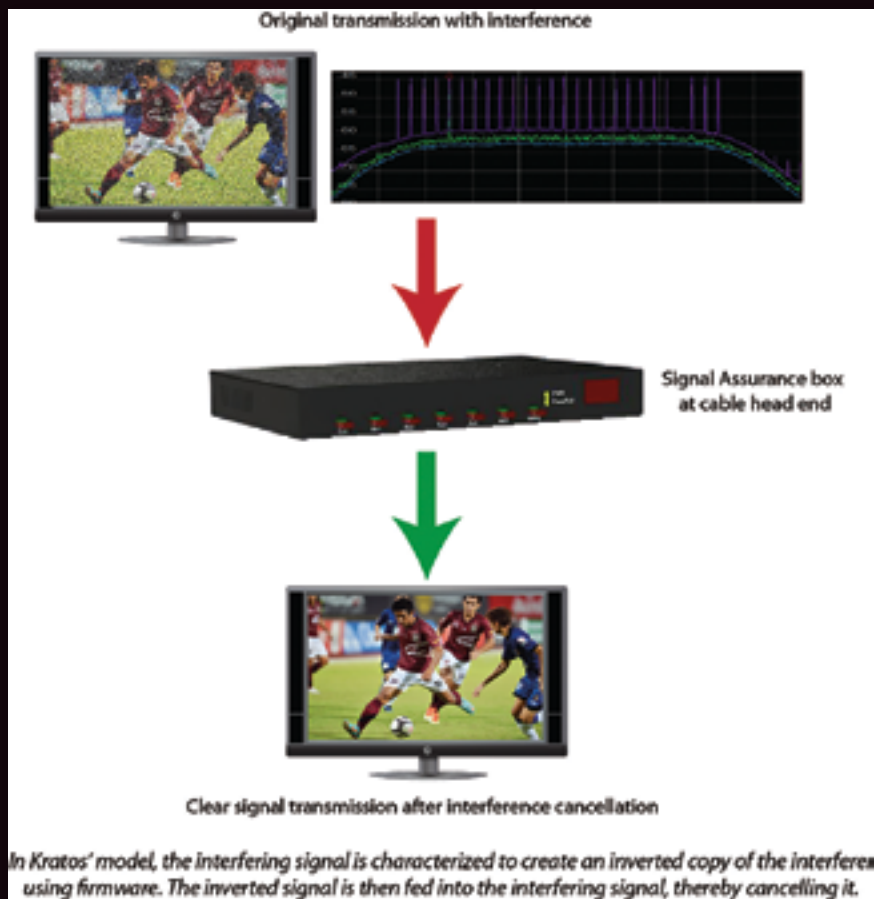
Satellite interference has been steadily on the increase for many reasons. Hardware and installation costs for VSAT terminals have decreased considerably over the past few years, which has contributed to the rapid growth of a segment that includes more than 3.5 million VSATS now in service. As the geostationary belt becomes more crowded, and as satellites are stationed closer together with smaller antennas that distribute RF signals over a broader area, the opportunity for interference continues to increase.

According to Martin Coleman, Executive Director, sIRG, VSAT systems cause approximately 40 percent of all interference and are responsible for 50 percent of downtime caused by interference. The scope of the problem continues to grow in line with demands for SATCOM bandwidth. For example, as military requirements continue to exceed MILSATCOM capacity and/or capabilities, military communications are increasingly placed onto commercial payloads, requiring newer, low-cost methods of providing resiliency to interference. Operators and industry groups report that signal interference significantly impacts profit margins, Quality of Service (QoS) and operational efficiency; and from the MILSATCOM perspective, can negatively impact surveillance operations and critical communications.

Detect, Locate & Now... Eradicate

Newer mitigation technologies are taking a far more proactive approach, going beyond traditional detection and location techniques that, alone, do not resolve the issue. Rather, they only provide the means to address the interference. As the bulk of RFI occurrences are accidental, this most often means contacting the interfering party to settle the issue. In some cases, where the interference stems from a remote site such as an oil rig, a considerable amount of time must be spent to assign someone to resolve the interference, resulting in lost revenue and extended outages. New approaches seek to independently eliminate interference through signal separation and/or signal cancellation and anti-jamming measures.

Original transmission with interference

Signal Assurance box
at cable head end

Clear signal transmission after interference cancellation

In Kratos' model, the interfering signal is characterized to create an inverted copy of the interferer using firmware. The inverted signal is then fed into the interfering signal, thereby cancelling it.

Kratos Tests Blind Separation To Separate + Cancel Interference

Kratos has demonstrated a different solution. Using Monics® carrier monitoring algorithms, the interfering signal is characterized to create an inverted copy of the interferer using firmware. The inverted signal is then fed into the interfering signal, thereby canceling it. Firmware, with its inherent reliability, as opposed to software, allows for installation in the communications chain to reduce any potential delay, or latency, in the communications signal. Only receive site equipment is required, inserted in line with the existing receive equipment. This approach includes the ability to protect any signal, including TDMA signals from CW/Sweepers or modulated SCPC/MCPC carriers.

The protected spectrum could contain TDMA or hoppers, but with this approach, the timing remains unchanged on the protected waveforms. Tests indicate that it is easier to interfere with the TDMA narrow band signals than with large outbound signals. To keep the network up, Kratos has developed a system that can be inserted into a network—no reconfiguration or adjustment is required for additional timing delays. This configuration provides a high level of automatic interference protection to high priority carriers and works for modulated (SCPC) and unmodulated (CW and sweeping CW sweepers) causes of interference.

Unlike other approaches to signal cancellation, Kratos employs "blind separation" (the separation of signals without the aid of prior information about the interfering signal) to detect and isolate the interfering signal so that it can be safely canceled. When canceling a sweeping CW signal, the system can track and cancel signals with sweep rates up to 1MHz per second.
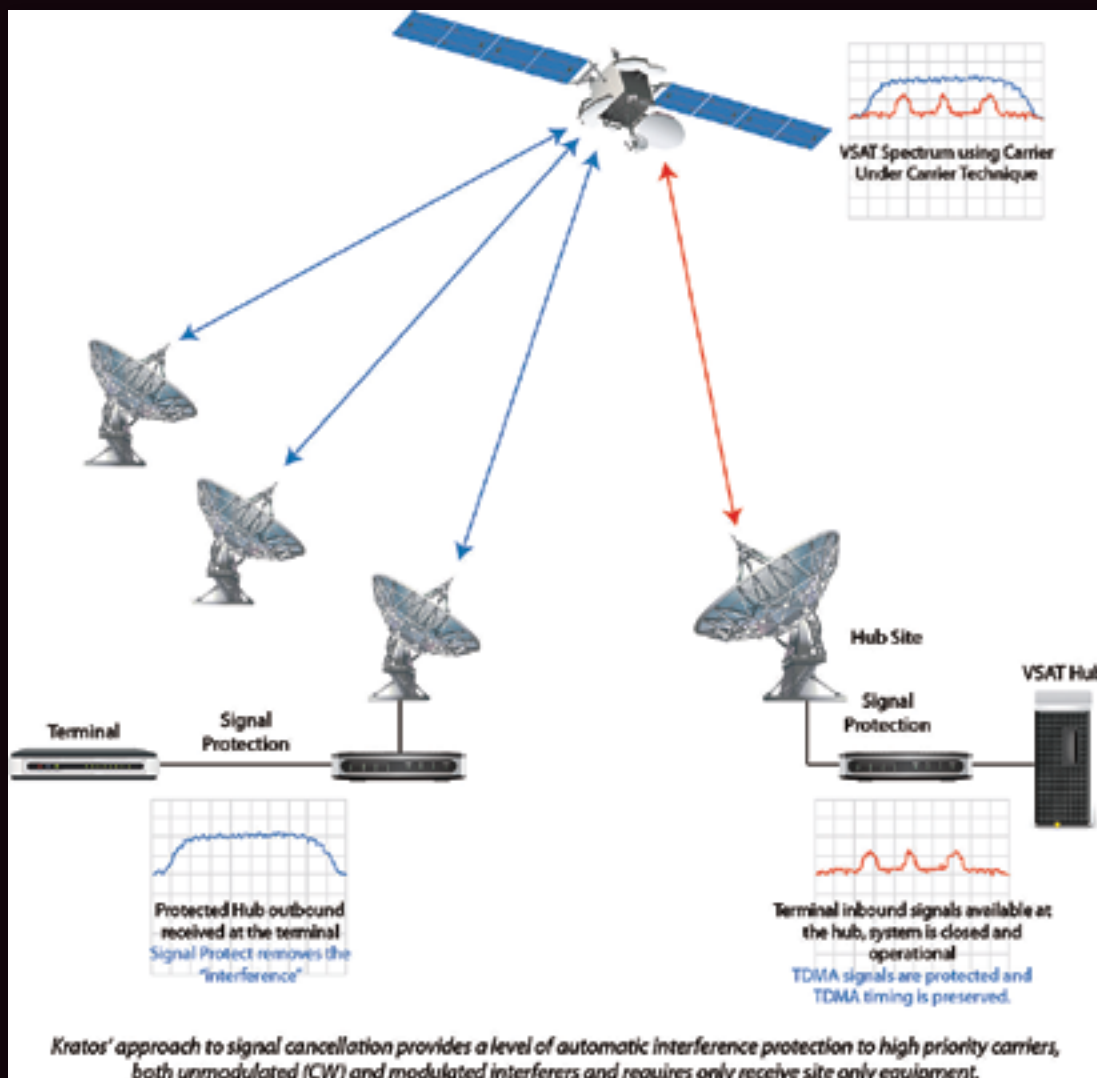
The system will provide greater than 25dB of cancellation and is currently the only solution to support all variations of multi-point to multi-point communication. The system can readily be established with the same basic information one would use to set-up a standard modem and can be easily managed and controlled with monitoring products such as Compass® and NeuralStar®. This provides customers with the ability to control the solution in the same way they can control the rest of the communications chain.

For service providers, satellite operators and teleport operators alike, the ability to quickly cancel interference without the cooperation of the interfering party will help assure QoS, interference-free communications as well as time-sensitive delivery of critical communications.

Evolving approaches such as these are exciting, but they are not alone. There are numerous, new enhancements to traditional approaches to neutralizing the effects of RFI. These include information sharing, and carrier monitoring, detecting and locating the source of the interference (geolocation) and operator training.

One trend is to move interference resolution directly into the satellite. Eutelsat, for example, recently announced plans to deploy an experimental TV channel interference mitigation function for the first time on their upcoming EUTELSAT 8 West B satellite. The satellite is scheduled for launch in 2015 and will be stationed over the Middle East and North Africa. Eutelsat's approach involves installing new-generation frequency converters behind the satellites receive antennas, enabling Eutelsat to change the frequency of an uplink signal without any impact on the downlink frequency received by user terminals.

In another example, a number of companies recently tested a U.S. Air Force-approved frequency hopping waveform that can be used as either a satellite-based networking hub or as a ground-based communications terminal. The anti-jam technology is based on a secure tactical waveform that is said to provide greater resistance to interference.

VSAT Spectrum using Carrier Under Carrier Technique

Protected Hub outbound received at the terminal
Signal Protect removes the "interference"

Terminal inbound signals available at the hub, system is closed and operational
TDMA signals are protected and TDMA timing is preserved.

Kratos' approach to signal cancellation provides a level of automatic interference protection to high priority carriers, both unmodulated (CW) and modulated interferers and requires only receive site only equipment.

Increased Focus On Operational Training

Proper training is increasingly recognized as the first line of defense against interference; however, only if the training maintains pace with technology. There is growing agreement within the industry that improved training will reduce uplink errors and improve equipment maintenance and installation practices.

Three of the most practical and impactful areas for improving the human performance of RFI mitigation professionals include realistic training to better prepare operators for today's wide variety of RFI scenarios, workflows to create a unified view of the monitoring-to-mitigation problems, and user-friendly tools designed to match how operators think and accelerate response times.

Strengthening these three areas enables Level 1 operators to tackle interference challenges more efficiently and effectively, producing better resource and talent utilization internally and faster response times and customer service externally. To date, GVF and sIRG have trained well over 10,000 technicians through a global certification program.

The World Broadcasting Unions-International Satellite Operations Group (WBU-ISOG), a global organization of broadcasters, recently announced the formal adoption of a resolution that supports industry initiatives for training. Specifically, they have endorsed the GVF Satcom Professional certification program that is now offered to satellite news gathering (SNG) operators worldwide. A combination of online and classroom-based training has been launched in the Middle East, Europe and North America, and plans are underway to begin delivery in every other region of the world.

New Approaches To RFI Location + Identification

The first step toward mitigating the disruptive effects of satellite interference is the rapid detection and analysis of an interfering signal through effective carrier monitoring. Once the interfering signal is identified and characterized, the source can be located by a number of geolocation systems on the market.

Modern geolocation systems, such as satID® from Kratos, offer next generation features and capabilities designed to save operator effort and, thereby, cost. Features such as scenario templates, higher levels of automation, improved reporting capabilities and integrated operator notebooks enable geolocation to be performed by more, less experienced operators. This improves operational efficiency and can also represent a significant financial savings to the organization.

Another method of identifying the source of an interfering signal is Carrier Identification (CID) codes. Under the auspices of sIRG, many satellite operators are embedding a unique CID code to a signal transmission. The code is embedded in a separate carrier onto the carrier(s) it is identifying. Operators can use Digital Spectrum Analyzers (DSA) to extract the CID, quickly identify the source of the interfering signal and then contact the interferer to resolve the interference issue.

A new approach adds a metacarrier, or subcarrier, containing a unique identity transmitted under the spectral density of the main carrier. This method adds no extra bandwidth or power and minimally affects the signal-to-noise ratio of the carrier as the CID signal is placed within the host carrier bandwidth and below the noise floor of the signal.

From a transmission standpoint, this generic solution is extremely effective and appeals to SCPC and FSS operators. The major issue with subcarrier CID resides in the receiver side. The operator must have accurate measurement tools to extract the CID from the interfering signal. Carrier monitoring and interference detection systems, such as Monics®, can extract the CID from the carrier with no new hardware required.

To facilitate the use of CID, a Satellite Operator Carrier ID dataBase (CIDB), a centralized data repository for all satellite operators to use at no charge to store and search for Unique Carrier IDs, is being developed by the Space Data Association. The database will enable rapid identification of an interference source and allow rapid interference mitigation among cooperating operators.

Accidental or Deliberate... RFI Is Still a Problem

RFI can be accidental (which accounts for anywhere from 95 to 98 percent of all interference)—or deliberate. Included in the former are human error, cross polarization leakage, equipment issues and adjacent satellite interference.

Examples of human error include transmitting on the wrong frequency, at the wrong time and incorrectly pointing the antenna, among other scenarios. Cross polarization interference falls into the accidental category as such might be caused by antenna misalignment, due to human error, or external forces such as high winds. Equipment issues can include faulty cabling, poor antenna specifications and potentially less reliable equipment due to the pressure to lower manufacturing and installation costs. Adjacent interference is becoming more prevalent as two-degree spacing between satellites in a geostationary arc becomes more common.

Deliberate RF attacks on satellites include piracy and jamming. Piracy, or unauthorized access, occurs when carriers (with content) are transmitted toward a satellite without any prior contract with the satellite operator. Intentional jamming can be the result of one party's objection to the content (political, cultural, social, etc.) of the targeted carrier and/or extenuating circumstances (political situation, social unrest, etc.)

The source of intentional jamming is generally locatable; however, this interference is almost impossible to remove without political intervention, and even then that may prove difficult. As such, efforts to combat it—such as signal cancellation—are a priority issue for all operators.

Playing Defense

Because of the steady growth of interference events in satellite communications, operators and end users have placed increased effort on finding ever better solutions to address this growing challenge. The best defense against interference, be it accidental or deliberate, is to command a portfolio of counter measures that include the latest in interference suppression technologies, such as Kratos' automated signal cancellation capability.

Bob Potter is the CTO of SAT Corporation, a Kratos Company and a leader in developing innovative systems, products and services for RF communication link interference mitigation. SAT is a premier supplier of such systems to the satellite industry. Bob's primary focus is on interference resolution techniques for spectrum efficiency and signal assurance. His experience in RF systems design and measurement techniques extends back more than 25 years. He is a leading member of sIRG with focus on carrier ID. Mr. Potter holds a B.Sc. with Honors degree in Electronic Engineering from Southampton University, U.K.

The Challenges Of VSAT Interference

By Petter Amundsen, Chief Executive Officer, VeriSat

Satellite interference is a relatively new topic for VeriSat. We have worked in the industry for a number of years, providing test equipment and monitoring solutions for interactive satellite communications and VSAT technologies.

Last year, SES approached us with the problem of VSAT interference and asked us if we could find a way to identify the terminal ID, to which I naturally replied, "Of course."
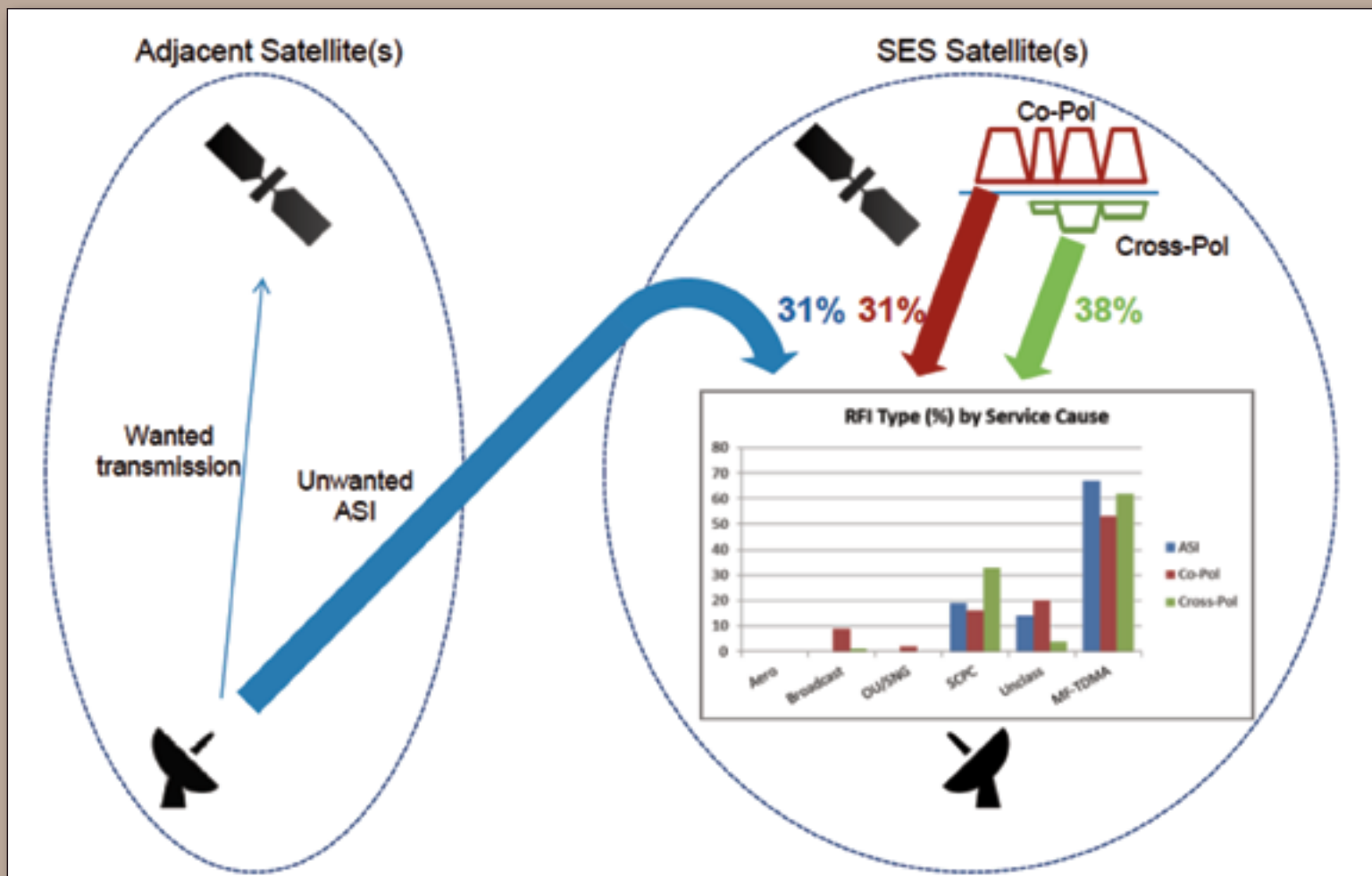
The VSAT Story
VeriSat is already well versed in the VSAT environment, where systems are often operated in remote, unmanageable locations and increasingly used in mobility applications. As IRG explored in their previous column, equipment quality and accuracy of the installation is paramount, all the while quite difficult to achieve under all the circumstances that can present themselves over the life time of operation. Antenna misalignment and faulty hardware may easily lead to cross polarization or adjacent satellite interference (ASI).

SES explained VSAT MF-TDMA systems cause a significant amount of interference for their fleet, and, due to the nature of VSAT systems, they also require the longest time for the resolution of all RFI types. The main problem is that there is no standardized way to detect the identity of the interfering VSAT terminal, as there is no mechanism—such as Carrier ID—in place for that identification.

Naturally, the business impact is less than ideal and leads to degraded services, loss of revenue due to unusable bandwidth, unsatisfied customers, and annoyed neighboring satellite operators, all elements which no operator wishes to experience and a problem they are all working hard to avoid and control.

The Existing Process
Today, satellite operators use various tools and manual processes to identify and manage VSAT interference. These tools include automated X-Pol measurements and manually moving groups or individual terminals to

other frequencies. If only one terminal is causing interference, geolocation solutions can be used, but this is generally not feasible without knowing which burst belongs to which terminal.

VeriSat was asked to derive a solution that would quickly and efficiently identify the terminal ID causing the interference, while measuring the ASI at the lowest level possible, ideally at a level lower than where the interference causes significant problems. The other requirement was that the solution should be able to run independent of the VSAT hub.

The Solution

SatGuard, which is able to identify the source of adjacent satellite interference (ASI) and cross-polar interference (XPOL) caused by VSAT terminals, was our developed solution.

SatGuard uses VeriSat's software radio technology combined with off-the-shelf hardware and captures and analyzes the signals from the operational and the interfered links. The system then finds the terminal ID by decoding the operational satellite links and correlates this information with the bursts detected in the interfered signal, where it is only the burst presence that is detected, as the SNR here is normally too low to decode any content. The source of interference—the terminal ID—is then determined. By providing the terminal ID to the VSAT network operator, the necessary actions to halt the interference can be performed.

Burst Detection

Two approaches are used: power level measurement and waveform correlation. Good results based on power level detection require accurate measurement of the noise floor, as well as synchronization to frame and time slot structure. Also needed is the averaging of a reasonable amount of bursts for each terminal.

With accurate noise floor level measurements, burst levels of -10 dB SNR can be detected.

When correlation is used, the interference level can be measured well below what visible interference levels, allowing interference to be measured and monitored proactively and corrected before the interference causes operational problems for other services.
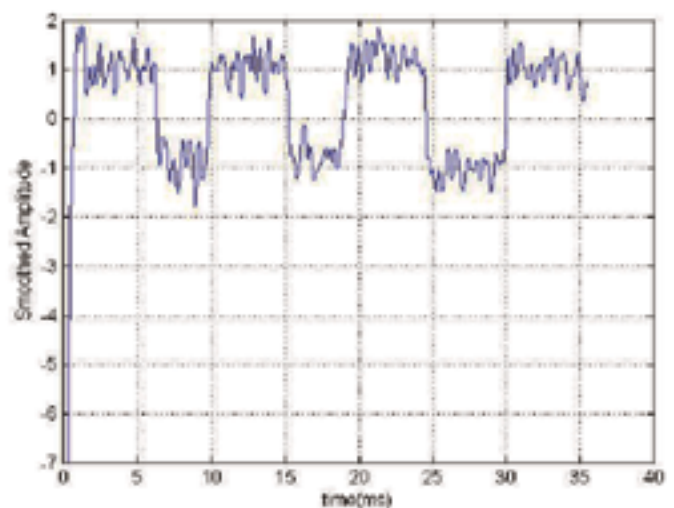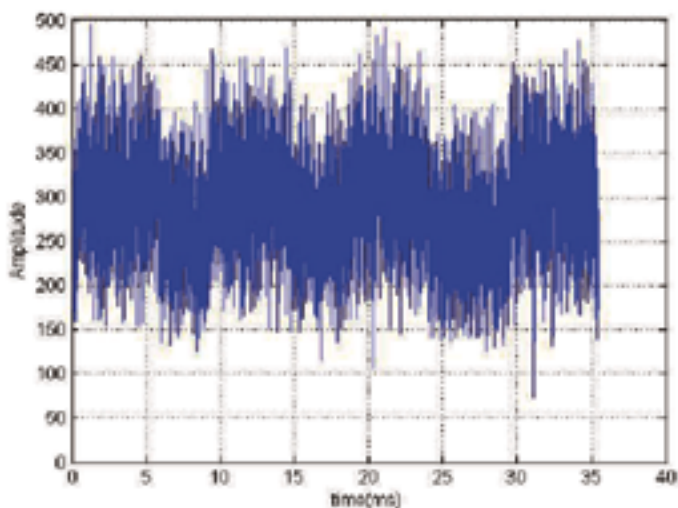
The Result

The measured results using SatGuard have been most pleasing. Satellite operators are able to measure the level of ASI and XPOL interference level for each terminal at levels below the threshold for detectable interference with normal interference measurement tools. SatGuard can also monitor interference even when ASI and XPOL interference are masked by other services by performing carrier cancellation. VeriSat plans to extend this technology to also support geolocation of individual terminals.

VeriSat has conducted a series of successful tests on live networks to find the terminal IDs of interfering terminals. Tests show that interference levels as low as -10 dB SNR can be measured, corresponding to a level where the interference is no longer an operational problem.

The technology will be enhanced in the coming months to allow measurements of interference at nominal levels for use under terminal line-up and commissioning. SatGuard will—for the first time—allow operators to actively monitor VSAT terminal interference levels on a regular basis (daily or weekly), thereby detecting interference problems as they occur.

For additional company information, please visit **http://verisat.no**

Petter Amundsen is the Chief Executive Officer of VeriSat, which is headquartered in Norway.

Detecting Carrier ID

By Roger Franklin, Chief Executive Officer, Crystal

Carrier ID (CID) has been a topic of conversation in recent years because it is one of the most effective means to combating satellite interference.

For any regular readers of *SatMagazine*, I'm sure you are already familiar with the technology and the recent milestones, which have led to an ETSI standard for CID and the introduction of a number of new modulators, modems, and encoders that include CID as a base feature.

This year, industry associations and satellite operators will push to educate users about the benefits of CID and how to ensure it is activated—which may simply be a flick of a switch on their existing equipment.
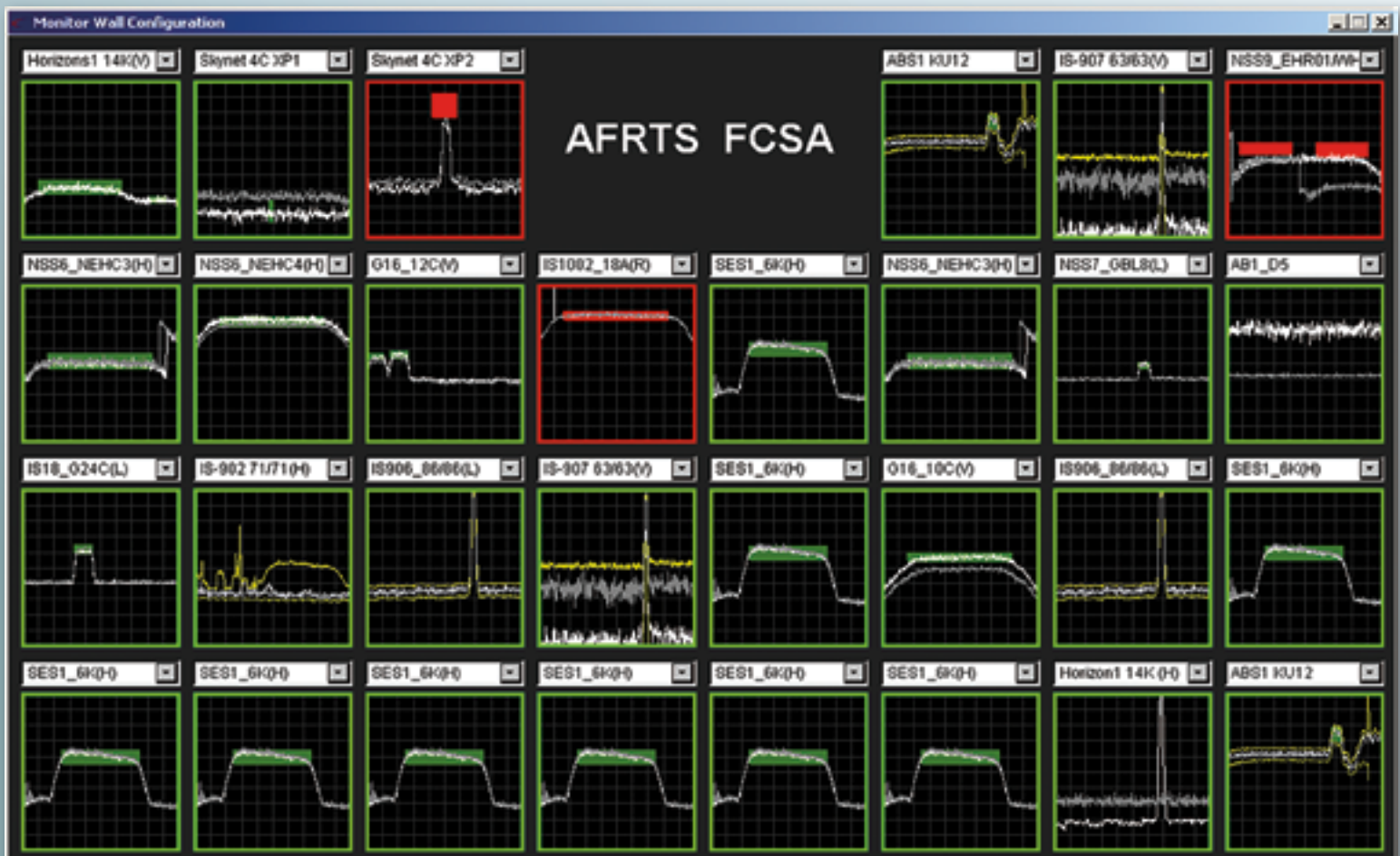
The Resolutions

As part of new resolutions, World Broadcasting Unions—International Satellite Operators Group (WBU-ISOG) have placed a number of key milestones in place for supporting Carrier ID. The first milestone was reached in January of 2015, requiring all satellite operators to initiate implementation of CID.
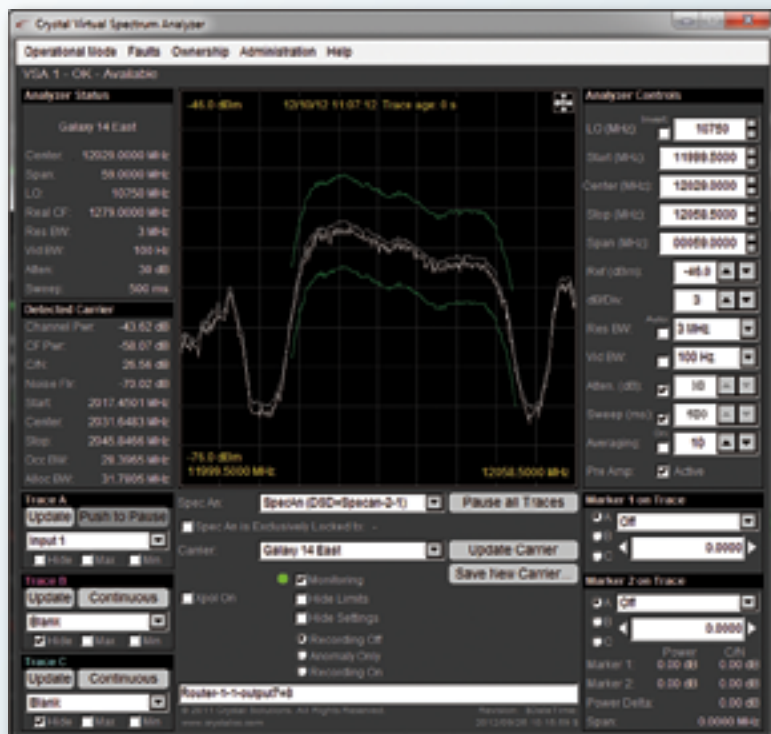
Uplinkers need to take special note, as they must include CID compliance in all requests for proposal within three years time. By January of 2018, it will be a requirement to include CID for all SCPC and MCPC video and data transmissions.

The Importance Of Detection

Once the industry begins transmitting Carrier ID, it is vital that it can be detected. This means, for satellite operators, the following tasks lie ahead. They must:

• *Ensure proper implementation of CID across their networks*
• *Implement technology and processes for reading CIDs*
• *Link CIDs to their customer contact details*
• *Supply the required information to the central database for easy and efficient industry-wide interference resolution*

Crystal's Virtual Spectrum Analyzer screenshot.

The major satellite operators are leading in the various interference initiatives and are well on the path to that end goal. The difficulty is for the smaller satellite operators who do not have CID available across the network. Once CID is transmitting, they'll need the proper monitoring equipment in place.

Satellite Operators' Access Centers need the ability to detect CID information without disrupting the satellite access process so they can extract IDs for transponders under their control and populate the central database with those IDs.

While the bulk of responsibility lies on the shoulders of the satellite operator, ultimately the end user's job is to ensure CID is implemented and correctly transmitted.

Uplinkers should have access to CID detection hardware that verifies they are transmitting the correct ID. This is challenging for uplinkers that move or reconfigure carriers routinely, as this is not a simple case of checking once for verification. If in support of 'ad hoc' live coverage transmissions, such as sporting events, news or concerts, they must ensure that for each event the CID info is present and displaying correctly.

Automated Processes

Automating processes is an important step for interference resolution. Quite simply, the more you automate, the less potential there is for human error.

The central database developed by Analytical Graphics Inc. for the Space Data Association (SDA), which is described in more detail by The SDA Chairman, Mark Rawlins, in this issue, is a perfect example of an automated tool. If the industry builds systems to automatically feed into the database, we can drastically reduce the time and effort necessary to resolve interference.

Crystals' Network Management System screenshot.

For example, by ensuring that satellite operators and satellite access centers can automatically identify carriers they control and automatically populate the central database, the industry can ensure constantly updated and accurate ID information. The better the information, the quicker interference events will be resolved.

Quicker, Cheaper Detection

Carrier ID detection needs to occur throughout the chain to ensure accuracy and effectiveness. There are a number of detection systems on the market that do a great job, but their complexity and cost is prohibitive to smaller operators, small access centers, and most users.

Crystal launched Crystal Carrier ID last year to support the growing demand for easy-to-use detection systems. If the industry is to succeed in combating interference, CID detection must be cost effective and time-efficient.

Additional information is available at the Crystal infosite:
http://crystalcc.com/crystal-carrier-id/

Roger Franklin is the Chief Executive Officer of Crystal. Founded in 1986, Crystal designs and delivers network monitoring and management solutions that improve operational efficiency, analyze errors, and enhance system resiliency, particularly for businesses that deal with complex and dispersed distribution pathways. Every day, program and advertising content worth billions of dollars flows through Crystal equipment managed by Crystal for leading media, enterprise, and satellite customers—including Fox, CNN, Disney, and Intelsat. Crystal, a privately held company, is headquartered in Greater Atlanta, Georgia.

*For more information, please visit **http://crystalcc.com**.*

Getting The Data Right

By Mark Rawlins, Chairman, The Space Data Association, and Director of Communication System Operations, Eutelsat

Across the industry, we are seeing a growing importance and emphasis of data for a wide variety of purposes. Interference is no exception. If we have the correct data, and the ability to analyze and use of that data effectively, we can make great headway in resolving interference.

At the Space Data Association (SDA), we have been working with other industry associations, as well as our members, to determine what data is needed and in what format to effectively combat interference.

Space Data Center (SDC)

The SDA responded to the need for more shared data to help improve operational efficiency, we initiated the Space Data Center (SDC). Operated by Analytical Graphics, Inc. (AGI), the SDC is the satellite community's first global operator-led network for sharing high-accuracy operational data to improve overall space situation awareness and satellite operations.

The SDC was established by the SDA to ensure that adherence to the fundamental principles established by the SDA, namely, to allow the controlled, reliable and efficient sharing of data critical to the safety and integrity of the space environment and the RF spectrum. The system operates to safeguard the SDA member data and to allow communication to other members of the information needed to react correctly to a collision risk situation. Today, the SDC is active in assuring the safety of members' satellites and spacecraft and provides a collision warning system.

Work is underway to extend the services that the SDC can provide from what exists today to more Radio Frequency interference orientated services, such as automatic Geolocalization Solution Set calculation and a Carrier ID database. The original SDA principle is applied; to share data in a secure manner, to safeguard and improve operations in space.

Geolocation Solution Sets

The major priority for the SDA's RFI committee currently is the SDC function that will allow the automatic computation of Geolocation Solution Sets and generation of geolocation datasets.

When interference occurs, especially when there is no CID available for the interfering carrier, geolocation is an important tool for quick and efficient location of that carrier. The more we can improve that process, the better for those suffering interference.
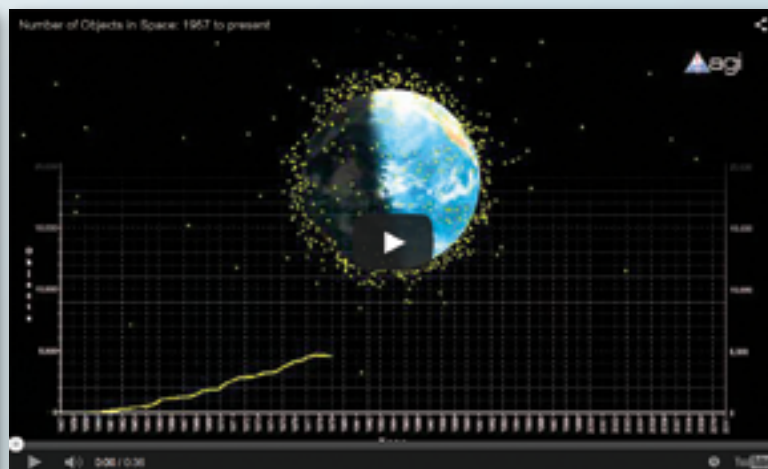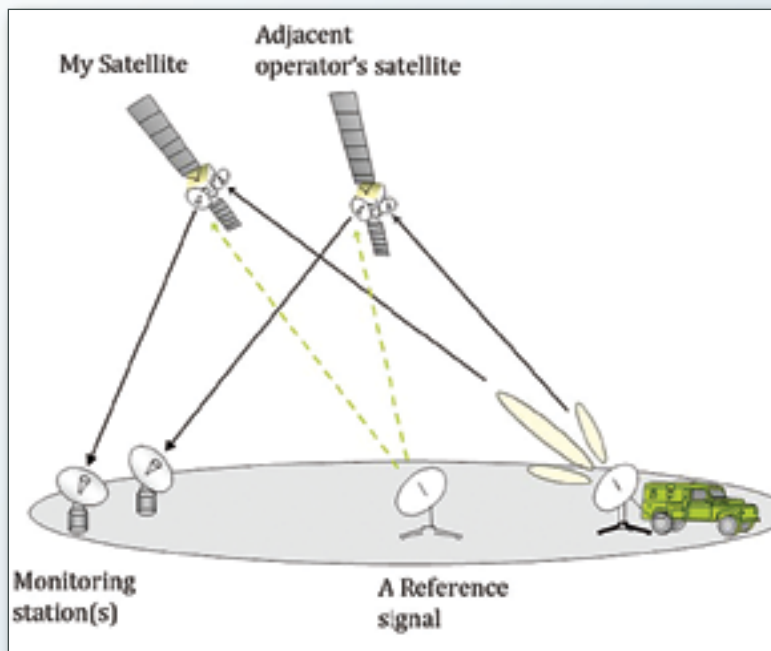
We are currently working on implementing this new feature into the SDC— the concept behind it is that, based on a description of the RFI event, the SDC will analyze critical payload data for the victim and adjacent satellites. This will enable the system to compute optimum satellite pairings for geolocation and generate a set of data that can be downloaded into a member's geolocation system, including accurate ephemeris data for the two satellites.

SDC already contains all the data concerning the satellite locations and ephemeris data as part of its conjunction warning function. We are, however, currently working to collect all the data elements that are needed for identifying geolocalization solution sets, such as frequency bands, conversion frequencies, coverage areas, cross strapping configuration, and reference carriers etc.

AGI is proceeding with development of a prototype system, based on data collected so far by Eutelsat, Intelsat, and SES, for three of their own satellites, specifically selected to have other operators satellites in close proximity. The prototype system will be manual; however, once we have validated the proof of concept, the idea would be to move towards an automated system. By early March, we hope to have the proof of concept available for initial testing and will be able to provide updates on that during various interference-related meetings at Satellite 2015.

SPACE DATA ASSOCIATION

» Direct support of operations; founded by satellite operators

» Operational data exchange ensures safety of operations

» Technical support ensures integrity of your operations

» Shared costs enables optimal participation

To view this informative AGI video that illustrates the number of objects in space from 1957 to the present time, please access https://www.youtube.com/watch?feature=player_embedded&x-yt-cl=84503534&x-yt-ts=1421914688&v=6Qf6VIvLGZk

Carrier ID Database

The Carrier ID (CID) Database is an important part of the success of the Carrier ID initiative and has been a huge focus for IRG, SDA and other significant industry groups over the last couple of years.

In its most elementary form, the minimum information contained in an active CID data stream would typically be the MAC address or reference number of the modulator being used to make the transmission. When an Earth station is registered with a satellite operator, this information needs to be added to the Earth station registration information (for each modulator and updated by the earth station operator if it changes). The satellite operator will be implementing a mechanism where all the CID numbers that he has linked to earth stations in his database will be provided to the SDC.

It is, of course, possible for an Earth station operator to fill in more fields in the CID field so that a faster and more direct approach can be made without resorting to the SDC.

The CID Database will only contain the CID numbers and the name of the satellite operator whose customers they belong to. As an Earth station operator, you simply need to check you have CID-ready products, and if so, ensure it is switched on and tell your operator so that they can enter the information into their own internal and CID database.

Only SDA member satellite operators have access to the service from this database. When interference occurs, the only information that another satellite operator would see is which other satellite operator they need to contact about a specific carrier. Then that operator must contact their own customer to resolve the issue.

Last year, we set ourselves the target of the World Cup in June to have a prototype database ready. We managed to reach that target and were able to support CID transmission on broadcast carriers during the event. It was also a valuable learning exercise for us, and we are now working on some further refinement of the database for future implementation.

Last year, we also announced that the CID database would be available to all satellite operators, not just SDA members. This is really important, as for any of these initiatives to be successful we need widespread implementation, and our members get additional benefits for their membership.

The tools available to satellite operators within their monitoring systems are now available so that the CID information can be read and recorded at any time—this would normally take place at the time of the satellite access.

Future Updates

The two functions described above are a priority for us . However, in the future, we see other useful functions being added to the SDC to help resolve RFI more quickly and efficiently. These include distribution of RFI alerts, RFI prediction for LEOP / drifting satellites, and administrative logging and reporting functions.

All in all, we are working towards a system, which includes and can analyze as much data as we can conceivably feed in to help us an industry improve information sharing efficiencies, the safety of flight of satellites and spacecraft, and the quality of services by space based communication systems.

Editor's notes:
* Photo of Mark Rawlins is copyright Denis Allard
* Also, the Global VSAT Forum (GVF), Space Data Association (SDA), and Satellite Interference Reduction Group (IRG) will be hosting a series of meetings at Satellite 2015, starting with the SDA User's Meeting on the afternoon of Monday, March 16th at the Intelsat office, followed by the GVF Interference Prevention Summit on the morning of Thursday, March 19th, in room 209 AB at the conference center. IRG will be hosting an interference workshop on the afternoon of Thursday, March 19th, and all day Friday, March 20th, at the Intelsat office.

Broadcasting + Satellites: A Pair With A Future

By Carlos Espinós Gómez, Chief Executive Officer, HISPASAT

The broadcasting sector is experiencing a thrilling moment, filled with changes and new developments of all kinds, from technology and consumer habits to business models.

Some prophets of doom are already predicting the death of linear television. They argue that in an almost immediate future, television will only be watched via the Internet and on demand, on a variety of devices and in any location.

However, viewing is not going to play out exactly in this way, at least not for the next decade or so. While it is true that new ways of watching television are coming into their own, the most accurate and recent data indicate, firstly, that the number of homes with a television set worldwide will have increased by more than 120 million between the years 2012 and 2015. Additionally, among all of the technologies transferring content, those that will grow the most are DTH television platforms, which broadcast via satellite. These platforms will see an increase of 100 million homes (in fact, according to a survey carried out by Digital TV Research, satellite television earnings will exceed those of cable television this year), and cable broadcasting technologies will add another 62 million homes. Meanwhile, IPTV will not go beyond an increase of 45 million.

Therefore, traditional screens and formats continue to thrive when watching audiovisual content. Euroconsult expects the offer of linear channels to grow by 50 percent within 10 years, amounting to 48,000 by 2021. Among these, the increase in High Definition (HD) channels will be proportionally even higher, as they are set to triple, going from 5,600 in 2012 to an estimated 17,000 in 2021.

Television consumption has also increased significantly over the past years, but today linear television continues to be the clear leading trend in opposition to on-demand television. According to a survey carried out by IHS, this predominance will remain steady throughout the coming years. Although the rate may start to decline, in 2017, traditional channels will still account for, at the very least, 75 percent or more of the television market, even in the most technologically developed countries.

On the other hand, on-line television consumption will not surpass 7 percent, and pay video will reach a maximum of 5 percent. Within payTV, OTT services' market share will not surpass 10 percent by 2017 in the U.S., one of the countries where these services are most highly developed, despite the fact that they are expected to almost duplicate their business figures during these years.

Hence, all these data indicate that initial steps are being taken toward a paradigm shift in the world of audio-visual content, as well as in the way such is consumed. This change will not entail an end to television as we have known it so far. What is indeed evolving at a fast pace is the users' own requirements with respect to the quality of images and the ability to watch them

wherever and whenever they want, as well as technologies that can meet these demands—these are the requirements that will define the future of television.

4K As A Spearhead

The technology that is making it possible to substantially increase image sharpness and enhance users' immersive experience is Ultra High Definition (HDTV / 4K). 4K multiplies, by four, the number of conventional high definition pixels and achieves a much higher resolution (4,096 x 2,160). However, that is not all: UHDTV also offers a higher frame rate, which intensifies temporal resolution in order to perceive moving images with better quality. 4K also provides a wider range of colors and more bit depth, which helps to enhance color transition as well as increases the dynamic range in order to see details better under lower contrast conditions.

Image quality is one of the most relevant factors for payTV customers; having 4K channels will constitute a competitive advantage for television platforms. Moreover, UHDTV set prices dropped exponentially over the past year, and they are estimated to match current HD television prices in one or two years' time.

On the other hand, there are already many venues, such as cinema productions, that are being produced in 4K. All this is leading us to believe this new technology will enjoy fast commercial development, even more than HD managed to accomplish in the past. We also expect that satellite—which already had a prominent role in the development of HD or television digitalization as it is the most efficient channel to broadcast such a large amount of information—might also be the reference medium for this new process.

Nonetheless, in order to implement this technology rapidly in homes, different plug-ins will be needed to make the process viable. One of them is the High Efficiency Video Coding (HEVC) standard, published in January of 2013, with the purpose of being a key element in the development of 4K broadcasting, as it improves coding efficiency by 50 percent over the previous standard, MPEG-4.

This path is also being explored in the satellite sector. In order to achieve greater transmission efficiency, an update of system DVB-S2 (called DVB-S2X), has been developed, which makes it possible to increase efficiency by 30 to 40 percent for two-way services, and by approximately 10 percent for one-way services, such as the classic DTH platforms.

Artistic rendition of HISPASAT's Amazonas-5 satellite. Image courtesy of HISPASAT.

The combined use of HEVC and DVB-S2X will enable a 60 percent improvement in efficiency, which will make it a great deal easier to implant UHDTV, by achieving a better use of frequency bands and fairer prizes.

The expectations are that, in two years, coinciding with the Rio de Janeiro Olympics, these new codifying and transmission systems will enable 4K transmission on bandwidths similar to those of HD in its earliest stages. The schedule, similar to that of HD's penetration, could even become a reality in a shorter period of time, thanks to the enthusiasm raised by this new technology among industries, operators and consumers.

Multi-Screen Freedom

In addition to higher image quality, consumers want to access audio-visual content from any device, anytime, anywhere. Linear television has not given up and still reigns supreme among home screens. Now, other devices and formats have joined in the market and television is being consumed more and more outside the home, although currently in small proportions.

Multi-screen television is already a reality worldwide, but most television consumption continues to occur in the home via all manner of devices: televisions, personal computers, laptops, smartphones or tablets.

In short—satellite constitutes the best medium to transmit content, owing to this technology's capacity and ability to deliver global coverage, with high quality and versatility. The integration of satellite broadcasting services through Internet Protocol networks, and thus, the conversion of satellite

signals to IP, forms the backbone of the multi-screen experience at home. It enables high-quality, simultaneous and personalized distribution of this content to any device connected to the domestic IP network. The advantages of IP distribution are apparent: expanding the experience of traditional television to new devices in any location; freeing up broadband networks from traffic, and adding value to pay operators' content.

This integration of satellite signals into IP networks will enable all of the improvements to satellite television content achieved so far, in terms of quality, quantity and ubiquity, to be enjoyed in the most profitable way for operators and consumers, as existing networks may be used and optimized.

At HISPASAT, we work on different projects that aim at achieving this goal, such as implanting the SAT>IP telecommunications protocol. Through this protocol, the satellite signal is converted into IP directly at the reception point, thanks to a small server that may be placed in the antenna itself, or in the user's home, without needing to carry out any complex installation or generating additional costs. This technology makes it possible to provide high-quality content more efficiently via satellite to all the screens in a home.

These same principles have guided the innovation project ICT2020, led by HISPASAT, which has worked on optimizing Common Telecommunications Infrastructures. The purpose of this project is to make the most out of existing resources in buildings for new developments in telecommunication technologies and services and to improve the way they are used in order to support greater volumes of information, via solutions that allow for the integration of satellite and optical fiber.

A Hybrid Horizon

The satellite broadcasting sector is in its prime right now, offering an appealing horizon for technological innovation. The multiple challenges posed by users' demands, the convergence of formats and networks, and the changes already taking place in the ways we watch television, all will have to be faced. This is horizon which, as we have already seen, will most certainly be a hybrid one, marked by the coexistence of differing forms of linear and on-demand content, of transferring signals, and of screen types. For satellite sector professionals, an interesting path is opening up in the field of broadcasting, as audio-visual content is becoming the service that users most value. The interest that telecommunications operators are showing in offering these kinds of added-value services to their customers has made this absolutely clear. Phone companies do not want to be left outside the increasingly growing content market, or to limit themselves to being mere conveyors of voice and data. Indeed, they are adapting their business strategies to integrate television and cinema into their offerings.

In the context of all these developments, the role of satellite will remain an important one. Satellite broadcasting is already a key element in the distribution of audio-visual content, directly by means of DTH platforms which air via satellite, and for TDT and cable networks, where it often acts as a link between head ends.

Satellite broadcasting will also be able to integrate with IP networks to distribute contents to all forms of household devices—already this technology leads the high-quality, 4K content broadcasting arena. Because large capacity allows satellite to air incredibly high levels of quality, as it can reach any place on Earth, and because of its high technological development and the easy deployment of its networks, satellite is set to constitute and remain one of the top technologies for broadcasting.

Now we need to work on transforming all of this potential into competitive advantages that allow us to reach our goals—certainly a thrilling challenge for all of the actors taking part in this film.

Carlos Espinós Gómez is Chief Executive Officer of Hispasat. He was named to the post in 2011, after having served on the company´s Board of Directors in representation of Abertis since 2008.

He started his professional career in the Telecommunications Division of Andersen Consulting in 1990. In 1997, he joined the Technology Division of ACESA, a company specialized in the toll road sector and the seed of what later became Abertis, now the global leader in infrastructure management. In 2001, he transferred to Abertis Telecom, the Group´s telecommunications management company. There, he served as Deputy General Director and Managing Director of the Infrastructure Satellite Division, and he successfully managed the Group´s activities.

Mr. Espinós holds a degree in Telecommunications Engineering from the Polytechnical University of Catalonia and has completed coursework in Management Development and Corporate Finance at the IESE Business School. He has also completed specialized courses in Technology, Telecommunications and Information Technology at Andersen Consulting.

He has been a member of the board of directors of important telecommunications companies and serves on the advisory boards or executive committees of various organisms related to the sector.

An EOmag 2015 Viewpoint + Survey Participation

By Geoff Sawyer, EARSC Secretary General (This editorial first appeared in the *eomag Winter 2014/2015* issue, repurposed with permission.)

Last year, 2014, was a most exciting year for Earth Observation (EO) companies. We witnessed some massive changes in the market that included the arrival of Skybox 1 & 2 data, the entry of Google via their purchase of Skybox Imaging, the launch of Worldview 3, the authorization for the sale of satellite imagery with resolutions down to 25cm, and the launch of several other initiatives that are all aimed at putting more commercial imagery on the market.

In Europe, Astrium launched SPOT 7, Deimos II was launched, Blackbridge and E-geos announced next generation systems and the first Copernicus satellite—Sentinel 1—was launched. The last of these, marking the start of the operational phase of Copernicus, promises further change as large volumes of data become freely available—2015 should see the launch of Sentinels 2 & 3, further increasing the free data available.

When I was a young engineer in the 1980's responsible for the design of Europe's first radar to be launched on the European ERS-1, we used to think ESA was the market for satellites. At the time, the space agencies were essentially the only customers and, naturally, everything was focused around their needs. These were in turn largely determined by science and research. This attitude exists even today, even if such has been largely changed by the appreciation of the need to address a commercial market.

Sentinel-1, the first Earth observation satellite to be built for Europe's Global Monitoring for Environment and Security 'Copernicus' program. It is a C-band imaging radar mission to provide an all-weather day-and-night supply of imagery.

The mission will benefit numerous services such as those that relate to monitoring Arctic sea-ice, routine sea-ice mapping, surveillance of the marine environment, including oil-spill monitoring and ship detection for maritime security, monitoring land-surface for motion risks, mapping for forest, water and soil management and mapping to support humanitarian aid and crisis situations.

Image is courtesy of ESA/ATG Medialab.

The telecommunications market was the first to emerge and was already starting to do so with commercial companies buying satellites and selling communication services. In EO some early efforts were being made to sell imagery and companies were being set up to do so; however, we were a long way from the point where a private company would build and launch a satellite using its own resources. Indeed, even today a fully commercial business model is quite rare.

Understanding the market is a fundamental requirement for commercial companies trying to do business within the EO world. Similarly, for policy makers, understanding the impacts of their policy decisions is a fundamental requirement. The former requires a detailed survey of the market, the latter a detailed survey of the industry.

Two years ago, **eo**mag conducted our 2013 industry survey, which provided a more detailed picture of the EO services industry than we had ever before attempted. Since then, many elements have changed and we have just launched our 2015 survey which will update and further develop our industry view.

Artistic rendition of the WorldView-3 satellite.
Image courtesy of DigitalGlobe.

This is quite a challenge, not the least of which is due to language differences. The survey is in English, as we believe that most companies operating in the domain of EO services, such as in the scientific field, frequently use English. A questionnaire in English can be quite complex and we are trying to restrict the material to essentials that are consistent with gathering a good picture of the industry and how it is evolving.

We are happy to have some international partners to help us with this global survey, including the GEO secretariat in Geneva, which will help distribute the link through their networks and maybe assist in gathering some of the responses. It is too early to acknowledge everyone, but I'll offer additional information once the results are complete.

The EARSC goal is to have results available in mid-2015 and to publish a report, which will be freely available. We have the support of ESA to conduct the survey and, if any reader wishes to learn more, they can contact either EARSC or ESA-ESRIN to do so.

In particular, we wish to be in a position to understand the impact of Copernicus on the industry and on the market. This, then, is the focus of our survey as of this writing.

We have already launched what we call the core survey to more than 500 companies in Europe and Canada to gather specific data on their businesses. This will shortly be followed up with phone interviews for what we call the "full survey," which will explore some of the softer factors and strategic issues through a conversation.

However, **eo**mag, the publication voice of the EASRC (European Association of Remote Sensing Companies), has decided to go further, once again.

According to the Impact Assessment published by the European Commission (EC) in 2013, Copernicus will create 9,000 direct jobs in the downstream sector. The EARSC survey will show the impact on the private sector but Copernicus is primarily a public program with its first objective to provide public policy makers with information.

Consequently, we are extending our survey to look at the benefits which Copernicus will bring to the public sector in terms of access to information, effectiveness and, of course, employment. In the next few weeks, we shall launch a second survey questionnaire which will be sent to public bodies in Europe with questions on their involvement in Copernicus and the benefits they have seen or anticipate to receive.

However, this is a global industry and European policy is that Sentinel data will be available on a free and open basis, not limited to only European companies. Hence the fourth section of our survey will address companies worldwide to try to understand how much they benefit from access to these data.

If you are someone from the private sector, or from a public body in Europe reading this article, we are counting on you to complete the relevant part of the survey. Your contribution will be kept absolutely confidential to EARSC and only the aggregated, anonymous results will be public. If you do not receive a request to participate and you think you should be included, do not hesitate to contact us.

This is going to be quite a challenge to gather and analyze all of the data we anticipate receiving, but it is fundamental to understanding the EO sector and the policy makers' impact on the industry. This is one of the EARSC's major projects—not the only one, to be certain, and more information will be made available in a future **eo**mag article.

In the meantime, I wish all **eo**mag readers a successful and, above all, a healthy 2015.

To read **eo**mag, please visit *http://www.eomag.eu*

Careers: The Road To The Future... Five Ways To Focus Your Business For Continued Growth

By Bert Sadtler, Senior Contributor

While the satellite communications industry faces challenges, the markets also remain vibrant, robust and ripe with opportunities. At the heart of any successful organization is great talent—people can be the most critical catalyst to growth. Employers need to get it right and make "great hires"— however, getting there is often a complex problem for companies to successfully solve.

An interesting phenomenon to observe is that what initially got a business off the ground then requires a 180 degree shift in focus once that business has achieved critical mass.

Picture this: your firm has matured to being recognized as a functioning, operating, successful business. As important now as it ever was, requiring more than the solo effort of the company owner, is business growth. Growth requires the owner to "let go" of some of the control and ensure the correct talent is in place, allowing s/he or to assign responsibilities to key members of the business—delegation is key.

Some say it's like "Having the right people sitting in the right seats on the bus." If it were only that simple. For example, how do you even know that you have the correct people on the bus in the first place?

With the morphing into a leadership direction comes the necessary requirement for structure. Has the business developed and implemented a structured approach for the incorporation of valued talent to ensure a developing and sustained path for growth?

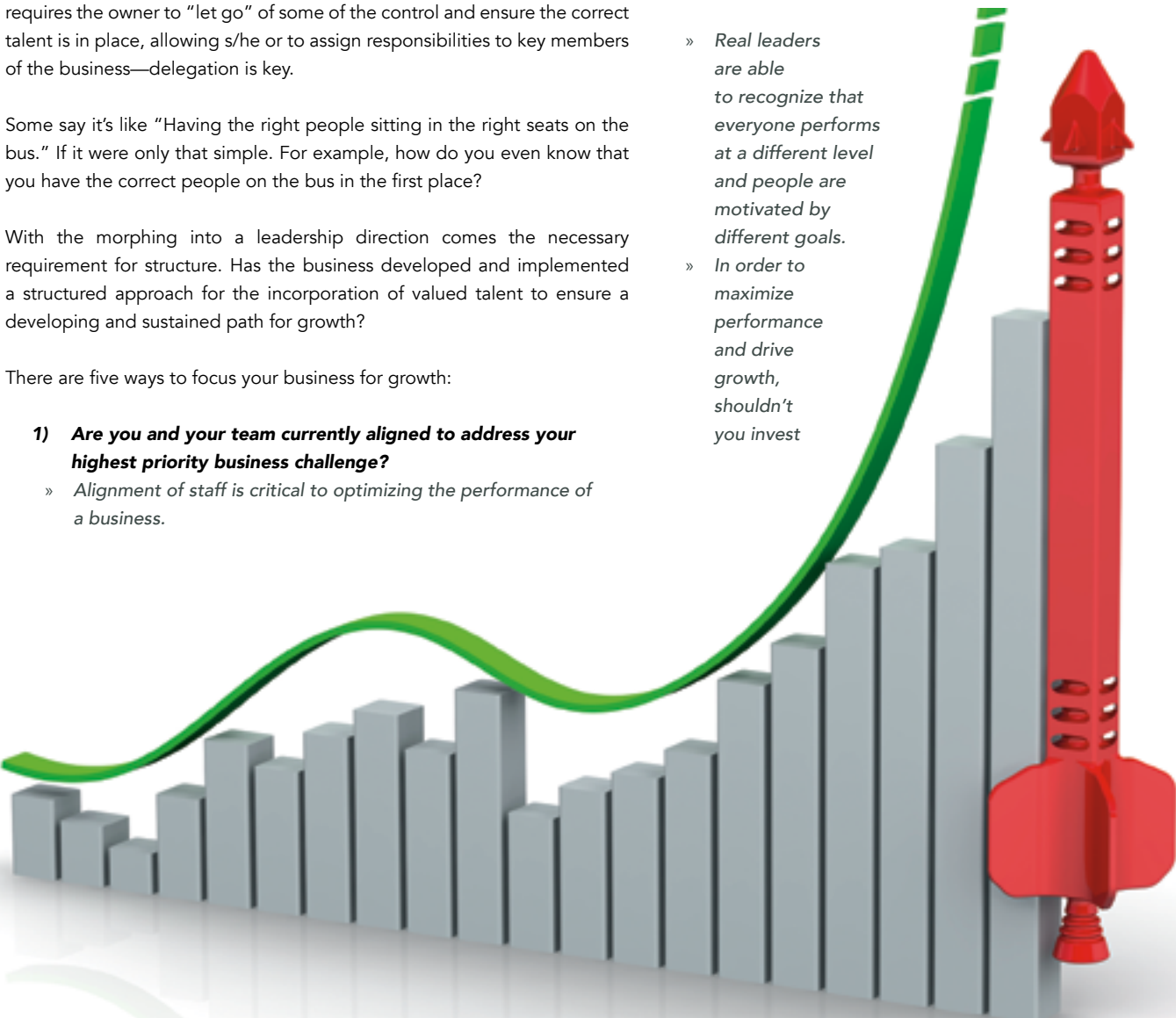There are five ways to focus your business for growth:

1) **Are you and your team currently aligned to address your highest priority business challenge?**
   » *Alignment of staff is critical to optimizing the performance of a business.*
   » *Alignment can indicate continuity and consistency—everyone needs to be pulling the business's oars in lockstep and in the same direction.*
   » *This question also addresses the need for the business to define the highest priority challenge: "What is keeping you up at night?" Define the biggest challenge before you can address and solve that impediment.*

2) **Do you know what motivates your employees?**
   » *Let's not lose sight of the importance of people in your business. Regardless of what the business does, people are needed for the business to be successful.*
   » *Understand and appreciate that everyone is different and a diverse workforce can be an accelerant for growth.*
   » *Real leaders are able to recognize that everyone performs at a different level and people are motivated by different goals.*
   » *In order to maximize performance and drive growth, shouldn't you invest*

the time in finding out what is motivating the individuals who report to you?

3) **Are you measuring your business's performance?**
» *As the adage goes, "the devil is in the details," and today, analytics have come a long way to help business leaders understand more about business performance and success metrics.*
» *With today's fast-moving and dynamic marketplace, shouldn't company goals and objectives be measured in a shorter period than the financial year? Why not try 3 to 6 months, instead of 12?*
» *If the business leadership can define the 12 month goals and then parse them into smaller chunks, measuring business performance becomes frequent. With the ability to obtain a performance status snapshot, adjustments can be implemented to insure a successful path forward for ideal performance.*
» *"Adjustments" equate to "business agility." Today, businesses must be more agile than ever to adapt to changes in the marketplace and with their competition.*

4) **Are your employees measuring their performance?**
» *Once the leadership has implemented a structured approach to measuring performance, then the employees can measure their own performance.*
» *Enabling your workforce to "own" their responsibilities can go a long way to improved engagement and productivity.*
» *Ideally, every employee is assigned individual goals and objectives that collectively grow the business.*
» *With an individual approach, the over-performers are easy to notice and reward, while the under-performers quickly appear in plain sight, proving an opportunity to possibly detect and prevent a problem.*
» *The simple assignment of individual goals and measurement of them provides employees with "immediate gratification" when exceptional work is performed and an opportunity for improvement when goals are not met.*

5) **Can you "allow" employees to leave?**
» *There was a time when employees retired from the same company after a 20 to 30 year career. That was then, this is now. Employees seek growth and change as well as other opportunities with differing companies. Prepare for such changes by having a plan.*
» *Recognize that employees today have an average of 3 to 5 years per job and plan accordingly when you can.*
» *Inevitably, your employees will make a change. If you restrict them, they can become your business's "enemy for life." If you can support their change, they could be a great asset as an employee for a partnering business.*
» *Remember, the business culture that "let's an employee leave" is likely to grow by giving away control in order to gain more.*

Regardless of what the business is that you are running, your success depends on the "correct talent in place," the ability to motivate your talent on an individual basis, a structure to measure performance and, most importantly, the ability for leadership to "give away control" in order to gain growth.

There are many cases of employees who have brought their employer significant value when the employee was offered more opportunity. One example is for the employee to be held accountable for the completion of responsibilities while simultaneously also being given some autonomy. This setting has proven to develop successful leaders/managers.

A second example is developing a corporate culture for employees to leave your employment. "Business divorce" has become a normal course of business these days. Holding onto an employee may offer your business a temporary advantage, but such is not long term thinking. In the long run, your business should have a structured succession program and come to expect that the best talent will be recruited away. You can't keep everyone forever. Additionally, should a valued employee accept an employment opportunity with, say, a business partner or with a company with whom you do business, such could prove to be quite valuable to your growth plans.
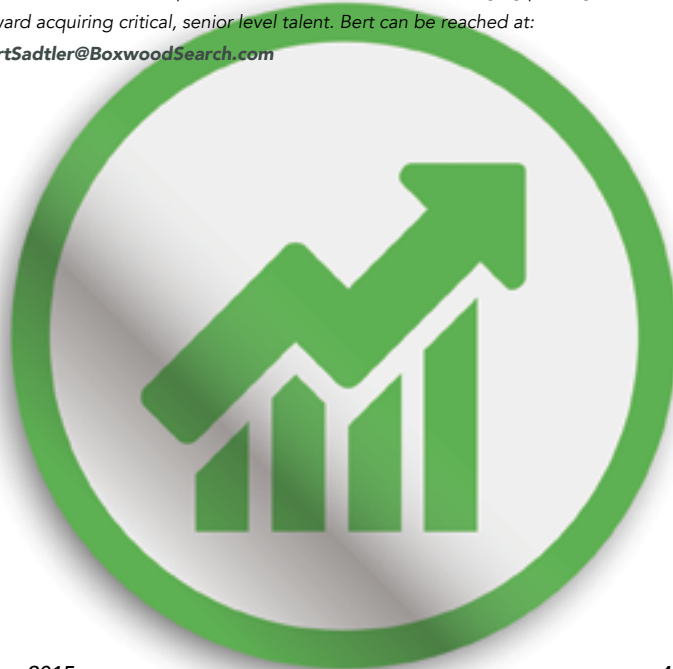
Back to the point... are you truly ready to give away control to others in order to grow your business?

Good hunting!

Boxwood is a management, consulting and recruiting firm with offices in the Washington D.C. region and also in the Greater Tampa Bay Region in Florida. As a dedicated, consulting resource to employers, Boxwood develops strategies for organizational growth through performance rewards, as well as the evaluation and acquisition of critical talent. Market sectors include: SATCOM, Government Contracting, Communications and Technology.

Bert Sadtler is an invited speaker to discuss the shift in the employer's performance-based compensation models as well as the changing paradigm toward acquiring critical, senior level talent. Bert can be reached at:
BertSadtler@BoxwoodSearch.com

A GL Communications Focus:
SATCOM — Apps, Testing + Test Tools...

Ever since Sir Arthur C. Clarke brought his proposal for geostationary satellite communications to the world in the 1945 edition of *Wireless World* **magazine, their use has brought hope, prosperity, entertainment, and knowledge to humanity, all starting with the launch of Intelsat's Early Bird, the first commercial geostationary communications satellite in 1965.**

The future is equally optimistic for SATCOM. The scope of this article, however is more modest, as it takes a look at some of the current trends in satellite communications applications, testing, and test tools.

Referring to *Figure 1* on **Page 55**, Satellite Technology Applications, the unique aspects of the satellite communications channel, especially of geosynchronous satellites, will be reviewed in this article.

> » *Wide area connectivity almost anywhere and everywhere in the footprint of the satellite beam—thus applications such as video broadcast and mobile phone are possible for large populations*

> » *Almost instantaneous network deployment, with no wired infrastructure required—thus voice, data, and video applications can be available almost immediately*

> » *Propagation delay of about 250 milliseconds (up + down) and if you consider round trip, then almost 500 milliseconds*

> » *An RF channel that is more than 36,000 km long before amplification or repetition—this results in a free space path loss in the range of 190 to 208 dB (for frequencies in the 2 to 15 GHz range). In the past this was a show stopper. Now, however, high gain antennas, power amplifiers, ultra-low-noise receiver sensitivities and like technologies have ensured that such is no longer a problem.*

> » *Variable channel characteristics that can be totally absent or severely degraded as during sun outages, or bursty errors during rain and snow, or during clear sky low random/Gaussian errors if power/signal is constrained*

> » *Limited bandwidth since the available electromagnetic spectrum must be shared among all users—one area of world politics in which engineers and scientists have actually cooperated without acrimony*

The above characteristics present challenges and opportunities. This article discusses some of these environments.

Mobile Networks Satellite Backhaul
Issues, Test Tools + Requirements

Broadband mobile networks are the "in thing" these days, extremely competitive, and maximizing revenue is always a major, driving factor. These networks have dispersed radio access sites with their concomitant towers, antennas, and base stations that must connect to the core switching network efficiently.

Typically, when the distance between the base station equipment and the core of the network is short, the use of copper or fiber cables is viable, with the voice and data carried over widely available Time-Division Multiplexing (TDM) technology (T1, E1, T3, E3, and so on). Alternatively, the transmission can be carried over newer ATM, SDH (fiber optics) or IP networks. All of these techniques can use either copper, fiber, or radio links for physical layer connection.

The use of radio links as the transport medium can be more efficient when the distance between the base station equipment and the core network is large, or when the terrain is mountainous. Satellite backhaul is most efficient for rural regions or remote areas where terrestrial links are scarce or expensive to deploy. Satellite backhaul can also replace traditional point-to-point links with point-to-multipoint solutions to accommodate high bandwidth requirements and traffic concentration of many base stations.

Testing such networks can also be a challenge. Unlike 2G networks that offer mainly voice connectivity, 3G and 4G networks provide better data services over Internet, such as access to email, video, fax, and MMS. The delivery of these mobile services has to overcome the challenges of delay, synchronization, coverage, bandwidth optimization, and cost effectiveness. To address the coverage and infrastructure cost, satellite technology is evolving towards integration with small cell technology. Please see *Figure 2*, located on **Page 55**.

Test Requirements: Satellite Backhaul For Mobile Networks

Simulation of the entire wireless core network infrastructure in a lab or field environments prior to deployment may be used with pre-defined network configurations, protocols, security settings, applications, and conformance tests. Pre-deployment testing can benefit functional, interoperability, and stress testing scenarios.

The overall objective of such a lab test suite is to provide a base network environment that enables service providers to test applications, devices, and services prior to deployment of real-time networks. Each lab test suite emulates all the core network elements and traffic types within the 2G, 3G, and 4G Wireless infrastructure. Desirable features of such lab test suites would be; interoperability, scalability, field upgrade, and future-ready framework to address the rapidly changing technology.

If possible, satellite mobile backhaul testing should support:

- *End-to-End voice and data quality testing*
- *Simulation of interfaces between Base Station to Core Network over T1 E1, SONET/SDH, and All-IP medium*
- *Sub-channel testing over T1 E1*
- *Signaling, voice, data, and fax transport capability*
- *Point to multi-point configurations*

A typical complete lab suite provided by one test equipment manufacturer is shown in *Figure 3, located on* **Page 56**.

Satellite Delay Measurement Over Voice, T1 E1, Datacom, T3 E3, + Optical Interfaces

As mentioned earlier, geosynchronous satellites are about 35,780 km above the surface of the Earth. An RF signal (at the speed of light = 300,000 km/ sec) takes 35,780/300,000 = 0.119 sec or 119 milliseconds to reach the satellite. Ignoring delays within the satellite, the signal is generally repeated, amplified, and retransmitted back to Earth for another 119 milliseconds, thus the sum of the up + down delay is approximately 239 milliseconds. This delay is greater than the distances involved in terrestrial systems. The round trip propagation delay of almost 500 milliseconds can cause issues for both voice and data transmission if not considered in the initial system design. Please see *Figure 4*, located on **Page 56.**

For example, if satellite circuits are used for voice, the quarter second delay may cause double talk, unless the parties know beforehand that they are speaking over a satellite circuit. If 'A' utters a few words and expects a response from 'B' within 100 milliseconds (normal conversational delay), but does not get one, then 'A' may repeat, only to hear 'B's' response during the repetition. This causes both parties to stutter and restart the conversation. Further, as is common, the parties will be talking on 2-wire telephones, then tail echo cancellation is essential, otherwise the half second echo makes normal conversation impossible. This is shown below in *Figure 5*. If the near-end cancelers fail to cancel the near-end echo, then the echo will traverse the satellite path—an annoying half-second echo will be heard by the talker. Please see *Figure 5*, located on **Page 57**.

Typical characteristics expected of an echo canceler (EC) in TDM networks include...

- » *Provides voice echo cancellation of up to 128ms echo tails*
- » *Meets ITU-T G.164, G.165, G.168 (2000 / 2002) requirements for echo cancellation*
- » *Fax / Modem G.164 and G.165 (2100 Hz) tone disable detection*
- » *Supports various Signaling Protocols (SS7, ISDN, GSM, Frame Relay ...)*
- » *Non-Linear Processor with Comfort Noise Insertion*
- » *Double-Talk Detection*
- » *Narrow-Band Signal Detection*
- » *Eliminates long echo tail*

Test equipments that can test the echo cancelers or simulate the echo cancellation across the network are necessary tools to ensure error-free voice communications. GL provides many tools to test and measure echo canceler performance. Further information on these tools is available at **http://www.gl.com/echocan.html**.

In the case of data transmission over satellite, protocols used to ensure error free and high throughput data flow requires modification so that delays in acknowledgement do not throttle the transmitter—i.e., the transmitter should not have to wait for acknowledgement of past frames to send future frames. Usually this is accomplished by permitting the transmitter to send many frames unacknowledged, but not so many that poor error rates would degrade throughput substantially. For example, when ISDN protocol is used, the underlying repeat request protocol is called LAPD. The frame numbering scheme is extended to permit the smooth flow of frames.

Test equipment that can emulate such protocols, simulate delay, and error rates is valuable to measure real-life performance of data applications. GL's Signaling and Traffic Emulation tools are widely used in the industry for such simulations **http://www.gl.com/signaling-and-traffic-simulator.html**.

Measurement Of The Satellite Delay

Measurement of the satellite delay and tail delays is also useful in system design and proper configuration of networks. For example, when digital bit streams are present and error free transmission is possible, at least for 5 seconds, then the technique below can be used to measure precise OWD (one way delay) and RTD (round trip delay). In addition to these, measuring latency introduced by the device itself is also important to consider. Please see *Figure 6*, located on **Page 57**.

Satellite Delay Measurement On Ethernet Platforms

IP-based satellite mobile backhaul networks are characterized by the service level agreement (SLA) performance criteria that helps users measure the overall Quality of Service. SLA performance factors such as packet delay, packet delay variation (jitter), and packet loss are important to support services such as voice and data. These parameters are defined as follow:

- » *Throughput—the data transfer rate achievable by the Ethernet/ IP network*
- » *Delay (Latency)—the delay introduced by the Ethernet/IP network in transferring packets*
- » *Packet Loss—the number of frames lost in transit*
- » *Out of Sequence Packets—measures the amount of frames that are delivered out of sequence.*
- » *Burst ability—the ability of the network to handle full rate traffic*

Tests such as BERT, RFC 2544, and Y.1564 SLA tests are very useful methods to determine Ethernet/IP QoS metrics and can be used to test the Service Level Agreements (SLA) by service providers.

Bit Error Rate Test clarifies how many bits were received and how many error bits were received during this time of transmission, i.e., ratio of erroneously received bits to all received bits. Acceptable error rates start from 1 error in 10 million bits or 1 x E-7. To measure this kind of error rate accurately, the tests have to run over time to build up a statistical picture of the errors. BERT on Ethernet / IP Test tools should support testing at various levels:

» *Layer 1 (Physical layer)—Payload is made up of BERT patterns*
» *Layer 2 (Framed Ethernet layer)—Bit pattern is inserted as the Ethernet Payload*
» *Layer 2 with Stacked VLA—Bit pattern is inserted as Ethernet Payload with VLAN tags*
» *Layer 2.5 (MPLS)—Bit pattern is inserted as MPLS Headers*
» *Layer 3 (IP level)—Bit pattern is inserted as the IP packet payload*
» *Layer 4 (UDP level)—Bit pattern is inserted as the UDP packet payload*

Please see *Figure 7*, located on *Page 58*.

The Latency (or the delay) tests, which are significantly important in Ethernet is measured as the time taken for the frame, from the time it leaves one end to arrive at the other end. This is very useful measurement, because of the many delay-sensitive applications like VoIP, Video, Financial services etc.

An Ethernet/IP tester used in satellite communications must support BERT, RFC 2544, and Y.1564 SLA tests at minimum. GL's Ethernet Tester are precisely designed to handle these testing requirements, with information at *http://www.gl.com/telecom-test-solutions/testing-ethernet-ip-wan-networks.html*.

Satellite Delay Compensation Application
In maritime applications, many remote radio sites transmit the same signal simultaneously for the purpose of communicating to boats, ships, and aircraft over a wide geographic area. The remote radio sites may be connected by terrestrial or satellite circuits. In order for the signals to arrive at the same time (within milliseconds) at the remote radio sites, voice delay elements are inserted in the circuits. Please see *Figure 8*, located on *Page 58*.

Microseconds accuracy is required otherwise the voice signals will be unintelligible at the intended destination. There may be hundreds of DS0s that require independent delay elements with delays from 20 milliseconds to 2000 milliseconds. Test platforms for T1 E1 from GL can insert independent delays for each DS0 in each direction.

Satellite Delay, Error, Jitter Simulation
The simulation of most commonly occurring conditions over satellite links such as; delay, bit errors, packet loss, and jitter, are essential to assess the behavior of voice, data, and video applications. Many Ethernet/IP Testers, WAN Link Emulators available from many test equipment manufacturers permit such simulation in the comfort of the lab. This equipment permits adding delays, errors, and other impairments over 10/100/1000 Mbps Ethernet. They also allow the user to accurately emulate bandwidth, latency, loss and congestion.

Additional options allow real-time traffic graphs and network statistics. GL offers a host of such solutions for such simulation and testing, with information available at *http://www.gl.com/telecom-test-solutions/network-impairments-simulation.html*

Similarly, test equipment that permits delay and error simulation over TDM can assess voice, data, and video applications over TDM based networks. GL provides such tools across all interfaces and technologies, including IP, SONET SDH, ATM, and Analog, shown in *Figure 9*, located on *Page 59*, and at *http://www.gl.com/errorinsertion.html*.

Voice + Data Quality Testing Of Narrowband Satellite Channels
With the increasing demand for Internet traffic, digital TV and other digital services, it becomes necessary to evaluate end-to-end voice and data quality with appropriate test tools. The test tool must be capable of interfacing to different satellite end-user devices with ease. The test tools must allow users to send and receive the simulated voice and data traffic (as seen in real-time) over satellite network using these test tools and performing the QoS measurements. Requirements of such test tools include:

» *Allowing network independent tests*
» *Support for different codec types—low bit transmission over IP*
» *Support for all satellite devices*
» *Delay and echo measurements*
» *Automated, and centralized control of test points distributed over different locations*

When the network technology becomes important, one can also simulate the real-time voice and data traffic over various networks using network-specific protocol simulators end to end. Use of ITU standard voice quality algorithms PESQ and POLQA is essential. A versatile test suite by GL provides these capabilities within a portable single-box solution with the flexibility of connecting to, and between, any network, any service, and any interface: *http://www.gl.com/eMedia/network-wide-voice-and-data-quality-monitoring.html*. Please see *Figure 10*, located on *Page 59*.

DCME (Digital Circuit Multiplication Equipment)
Satellite capacity is somewhat more expensive than terrestrial capacity. DCME technology, basically a voice compression technique, is widely used in satellite based telecommunication networks, integrating DSI (Digital Speech Interpolation), VBR (Variable Bit Rate), LRE (Low Rate Encoding) and any other effective compression transmission technologies to multiply the traffic capacity of digital E1 circuits.

DCME-6 is connected to both sides of the 2 Mbps bearer transmission link, enlarging the conventional 2Mbps link circuit capacity by 4 to 6 times by means of the complicated signal compression coding and channel dynamic distribution without changing the existing load group coding speed and shape, G.703 inlet and G.704 transmission control protocol on TS0.

This technology is widely used in the satellite IDR (Intermediate Data Rate) equipments, single-determination TDMA satellite link circuits, digital microwave and digital UHF link circuits, digital cable and optical fiber stress routers, and many combined long-distance or short-distance digital link circuits.

DCME-6 is applicable for telephone, voice-band data, signaling message and some transparent data link circuit. Please see *Figure 11*, located on **Page 60**.

Test + Verification Of DCME Links

The DCME testing, analysis and verification can be performed with DCME monitoring software such as GL's DCME analysis software— *http://www.gl.com/dcme.html*.

The DCME analysis software with appropriate hardware interfacing capability may connect non-intrusively to the bearer side of DCME equipment to perform real-time and post-processing of the bearer signal. In real-time mode, the status of the bearer including synchronization, bearer loading, fax loading and other statistics should be monitored.

In post processing mode, the entire DCME bearer signal should be captured using the available special recording applications for E1 trunks. The captured file is then analyzed with the DCME analysis software.

In the DCME analysis software, the software aligns to the DCME frame, and the DCME control channel(s) are decoded. The data is displayed to permit bit level analysis and verification of channel mapping and implementation timing of the DCME protocol. DCMEs use variable bit rate (VBR) encoding to create overload channels to handle overload conditions. Bearer channels are randomly selected for rate reduction. The software identifies the bit mode of each overload and normal channel (4, 3 or 2 bits).

Additionally, a Facsimile subframe analysis software may be used that permits bit level analysis and verification of fax data sub-multiplexing on the DCME output bearer signal. The DCME analysis software calculates the mapping and interleaving algorithms, FEAC and permits time of implementation verification.

Satellite WAN Links

Generally, the WAN networks are implemented using various terrestrial technologies like T1, E1, T3, E3, SONET/SDH, ATM, xDSL, Frame Relay, and IP/MPLS. Each of these technologies have their own bandwidth, delay and loss characteristics.

Sometimes, there may be a need to use wireless/satellite networks for WAN as a secondary link to handle the outages of the terrestrial primary links due to natural or man-made disasters. The satellite links introduce delays in excess of 500 milliseconds and bit error rates as high as 1x10-6, causing havoc for protocols and applications. There arises a special need to test services at such conditions, and to determine the most cost-efficient WAN technology to meet the required performance.

The most obvious source of performance degradation is bandwidth bottlenecks, but this is certainly not the only cause. Latency, jitter, packet loss, congestion, and other impairments can all wreak havoc on throughput and responsiveness, and simply increasing WAN bandwidth may do little to improve performance.

Application performance over WAN networks can be highly sensitive to bandwidth, latency, jitter, loss, and other WAN impairments. Testing these applications on the local network generally fails to identify critical issues that impact the end-user experience. Fortunately, a new generation of WAN network emulation appliances makes it simple and affordable to test applications in the lab under real-world conditions, ensuring smooth roll-outs of new applications and helping to optimize the performance of the applications for the end-users.

A WAN Emulator must be capable of emulating the bandwidth, delay, jitter, packet loss, bit error rate, and background traffic characteristics of WAN network, all at once. Only a simultaneous emulation of all these impairments will help in testing under real world conditions. Please see *Figure 12*, located on **Page 60**.

Following are some of the conditions that one can evaluate using a good WAN emulation tool...

How much bandwidth is needed?

Modern IP networks carry traffic that are bandwidth-intensive. There is a need to pre-determine how much bandwidth is needed to keep the applications running smoothly. For example, a huge video file with 3D, good quality audio, and 1080p resolution requires 10to 20 Mbps bandwidth speed to run as smoothly as a live TV and allow sharing the bandwidth with other users for other activities. A WAN Emulator should be able to emulate the Bandwidth throttling characteristic of real WAN networks. Additionally, it should allow the emulation of Background traffic competing with the test traffic for the limited WAN bandwidth.

How efficient is downloading and uploading files on the network?

Minimizing the time required to complete the transfer of large files, without being corrupted is the need of the hour. Large institutions such as banks rely on overnight data backup to a centralized facility. The real-time conditions to be tested here are bandwidth limitations, and latency. WAN Emulator must be capable of modeling traffic from a full enterprise network of regional, branch, and local offices, all connected to a centralized datacenter. It should allow network administrators to...

—View applications as they will be seen by different end-users
—Verify the operation of application servers with concurrent users
—Emulate the bandwidth, and the latency (delay) characteristics of the WAN network

How do applications like VoIP, Video conferencing perform?

Modern IP networks are increasingly used to carry out voice and video traffic for applications like voice and video conferencing. Such traffic is sensitive not only to the bandwidth bottlenecks, but are highly sensitive to the latency, jitter and packet loss introduced by the WAN network.

How well do the enterprise applications all running together work?

Critical enterprise-level applications that run over the IP cloud such as e-commerce applications, banking applications, and voice/video conferencing, need to be tested for negligible packet loss, responsiveness, scalability, and so on.

Conclusion

The deployment of a cost effective SATCOM network requires comprehensive testing tools packaged with the capability of multi-interface, and multi-functionality. Many test equipment manufacturers already offer variety of testing tools to meet the requirements discussed in this article. One such test system that has captured interests of many telecommunication carriers and service providers is a fully configured compact test system from GL Communication Inc. This system contains all (or any) of the interfaces mentioned in this article plugged-in to a single chassis, helping to cut on the overall infrastructure costs.

A snapshot of this all-in-one platform accommodating six test modules is pictured in the right-hand column. Each module can be controlled independently with user-configurable rates to accommodate required test features.

Editor's note:

All of the figures mentioned in the GL Communications article appear from Page 55 through Page 60.

- » *Ethernet / IP (10/100/1000 Mbps) Interfaces*
- » *DataCom Serial Interfaces (RS-232, V.35, RS-422/449)*
- » *Channelized and unchannelized T3 E3 and OC-3 STM-1 Interface*
- » *Channelized and unchannelized T1 E1 Interfaces*
- » *Unchannelized OC-12 / STM-4 Interfaces*
- » *Analog - RJ-11 2-Wire, FXO FXS, 4-Wire, PTT Interfaces*

GL Communications Inc is a leading Test and Measurement manufacturer that caters to worldwide telecommunications industry with a comprehensive suite of telecom testing solutions, telecomm lab solutions, and consulting services for a variety of telecom networks including Wireless, IP, TDM, and Fiber Optic lines."

*Visit **http://gl.com/** for further company and product information.*
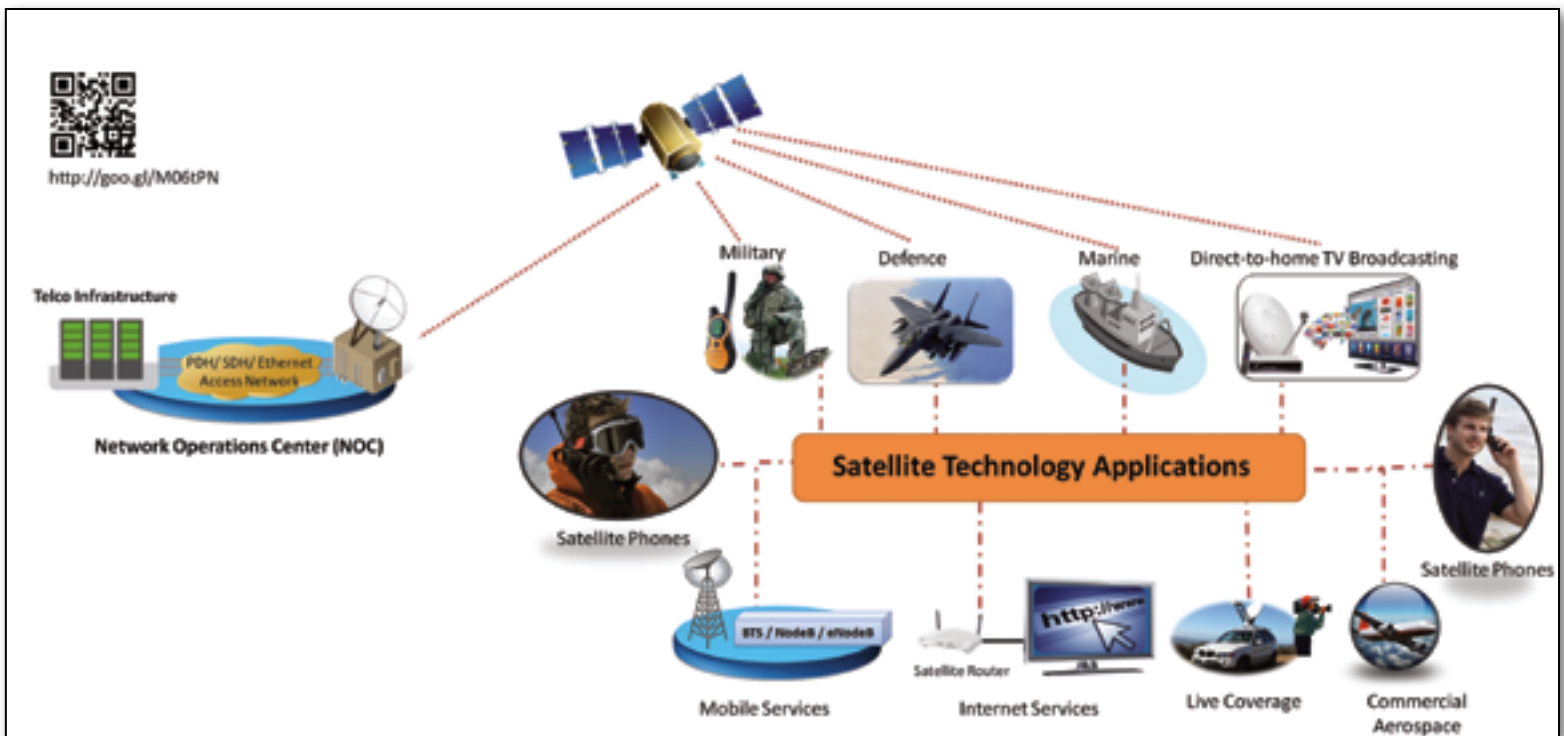

Pictured above: GL Communication's All-In-One Test Platform.

Figure 1. Satellite Technology Applications.
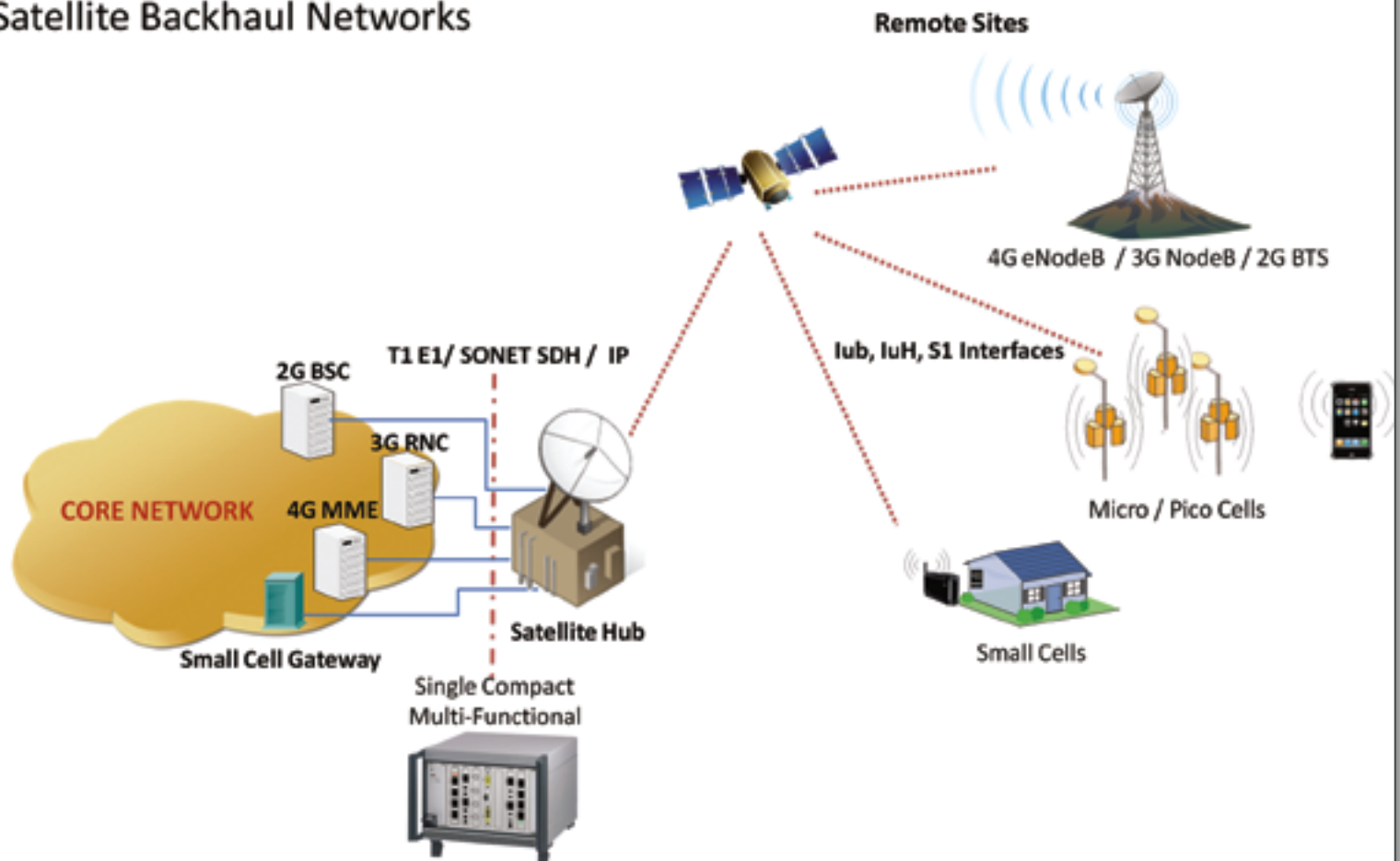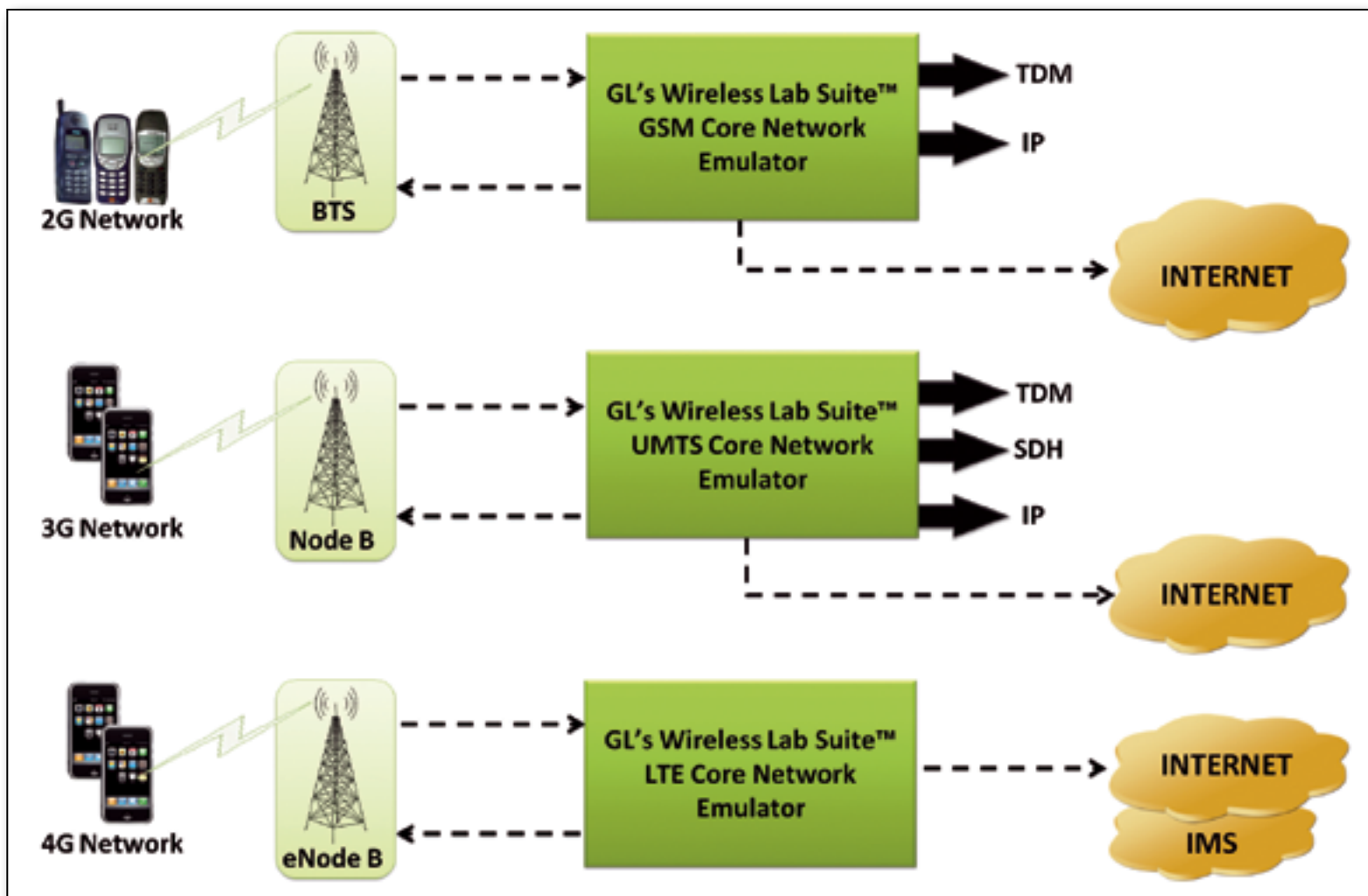

Figure 2. Satellite Backhaul for Mobile Networks

Figure 3. Mobile Core Network Simulator

One-Way Propagation Delay
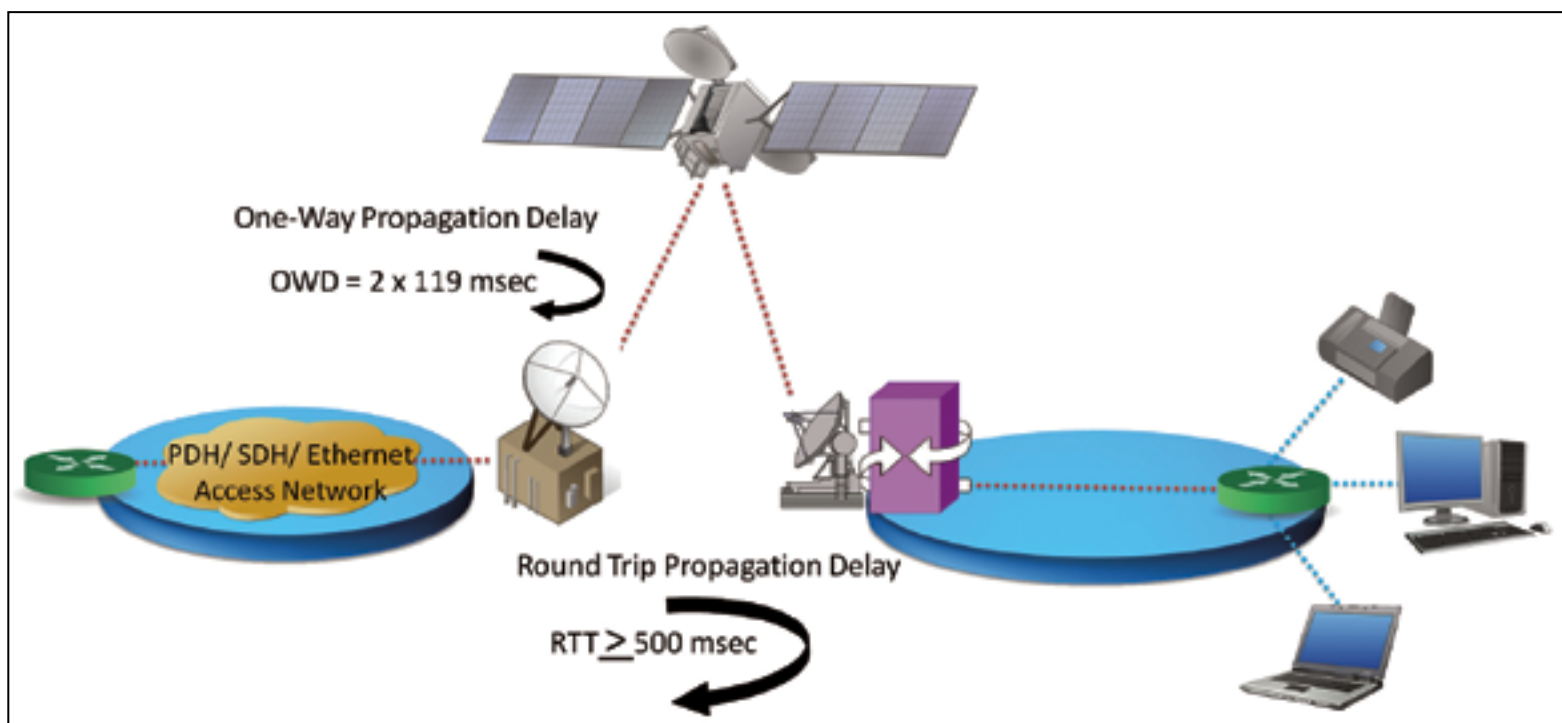
OWD = 2 x 119 msec

PDH/ SDH/ Ethernet Access Network

Round Trip Propagation Delay

RTT ≥ 500 msec

Figure 4. Satellite Delay

Figure 5. Echo Cancellation in Satellite Networks

Tx BER Pattern

Rx BER Pattern

X

Output Signal

Detect Error
Reset / Start

Counter

Input Signal

Delay Measurement in Microseconds Accuracy

Figure 6: Delay Measurement in Satellite Networks

Tx BER Pattern

Rx BER Pattern

X

Output Signal

Detect Error
Reset / Start

Counter

Input Signal
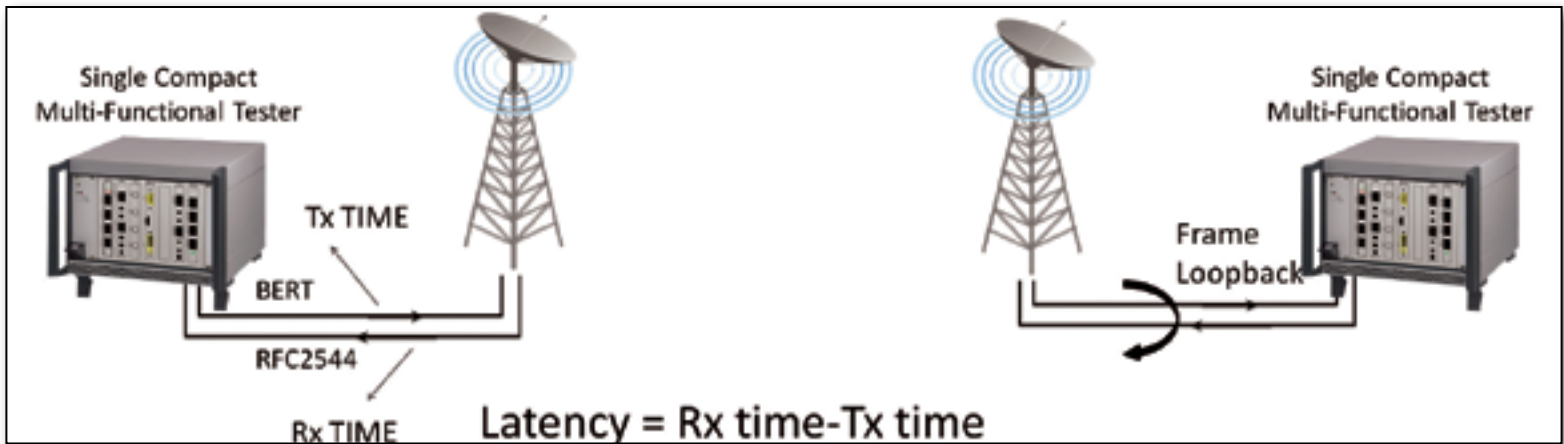
Delay Measurement in Microseconds Accuracy

Figure 7. Delay Measurement In IP Over Satellite Networks.

Figure 8. Satellite Delay Compensation.
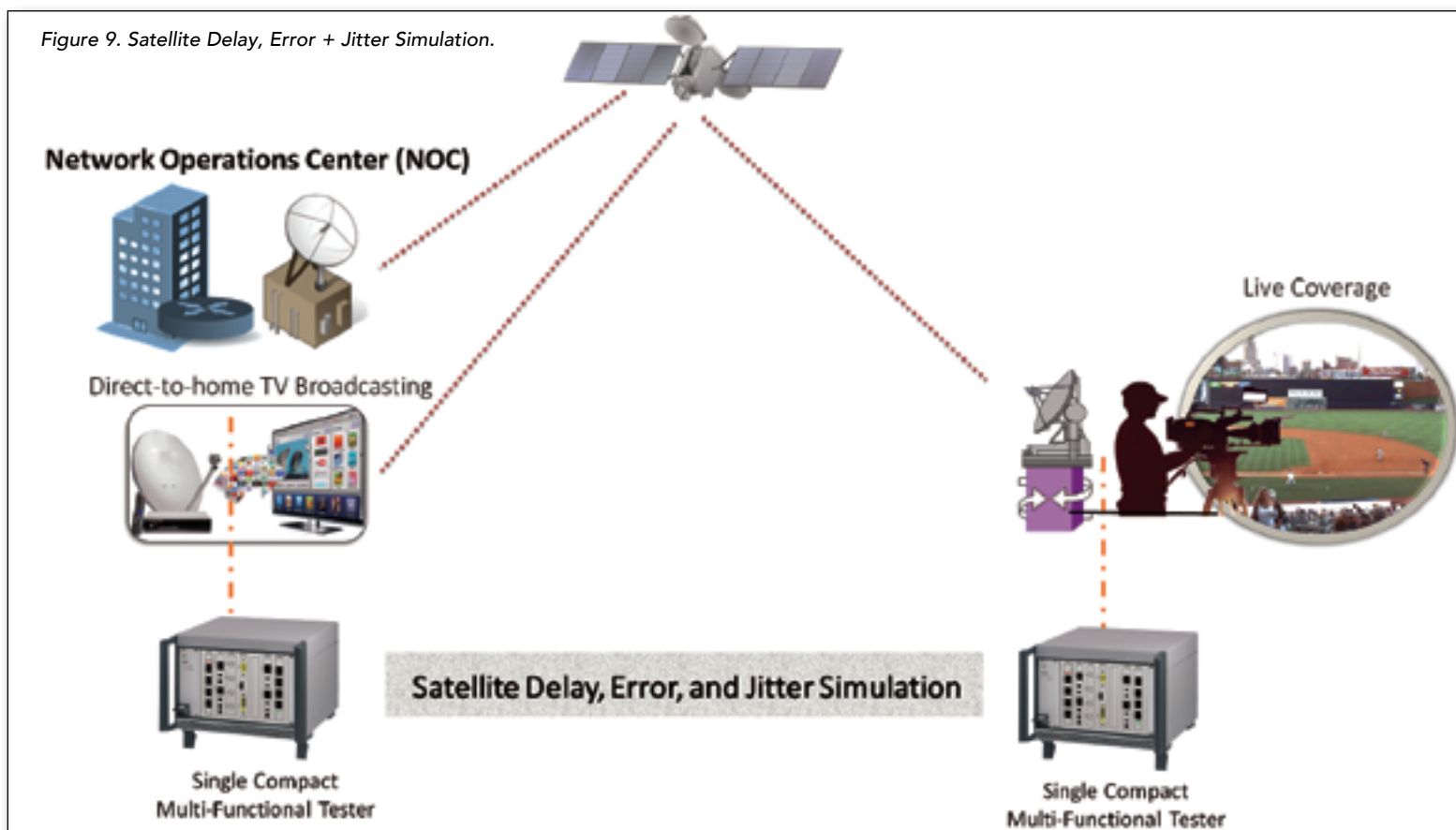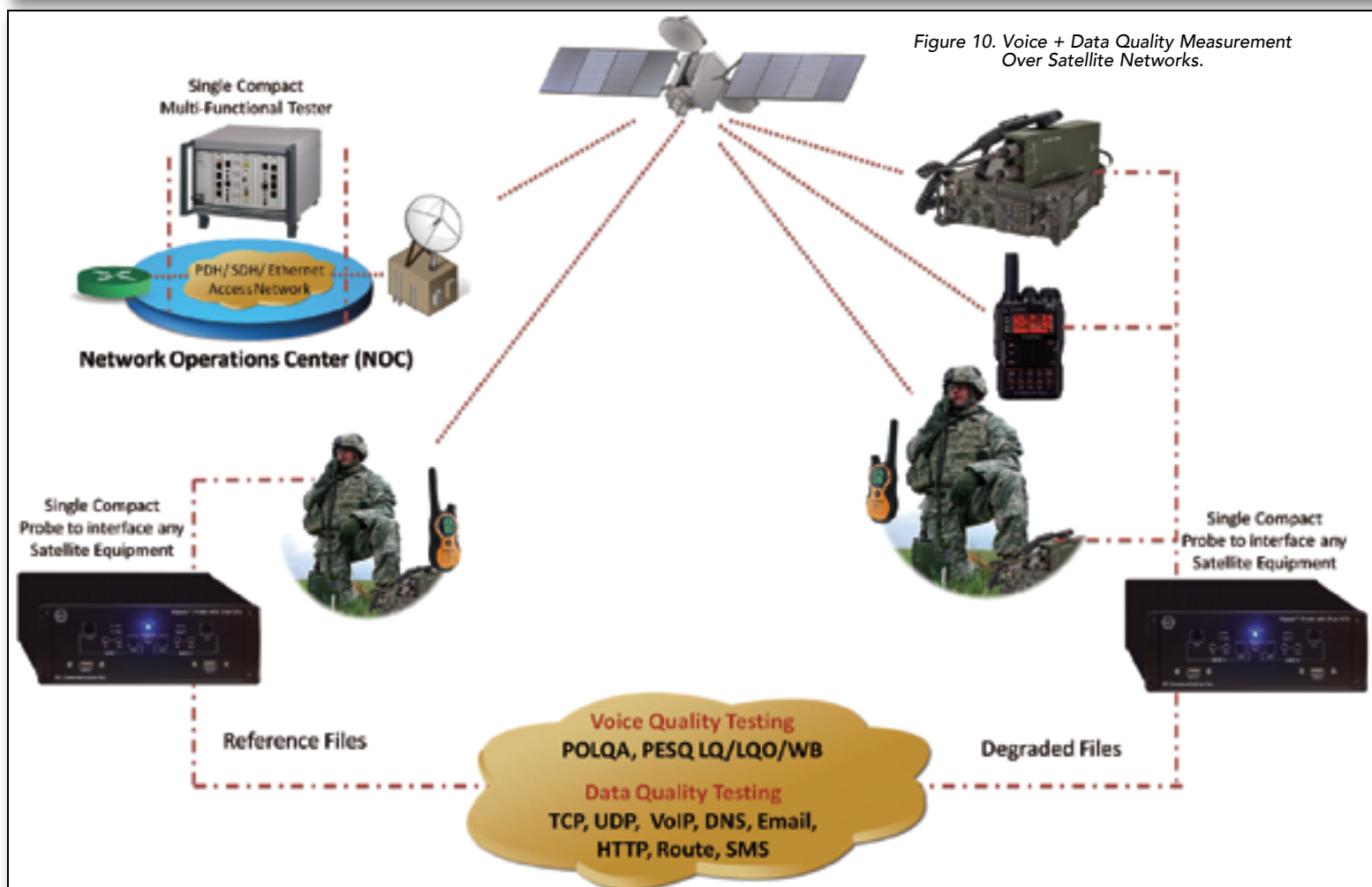
Figure 9. Satellite Delay, Error + Jitter Simulation.

Network Operations Center (NOC)

Direct-to-home TV Broadcasting

Live Coverage

Satellite Delay, Error, and Jitter Simulation

Single Compact Multi-Functional Tester

Single Compact Multi-Functional Tester

Figure 10. Voice + Data Quality Measurement Over Satellite Networks.

Single Compact Multi-Functional Tester

PDH/SDH/Ethernet Access Network

Network Operations Center (NOC)

Single Compact Probe to interface any Satellite Equipment

Single Compact Probe to interface any Satellite Equipment

Reference Files

Degraded Files

Voice Quality Testing
POLQA, PESQ LQ/LQO/WB
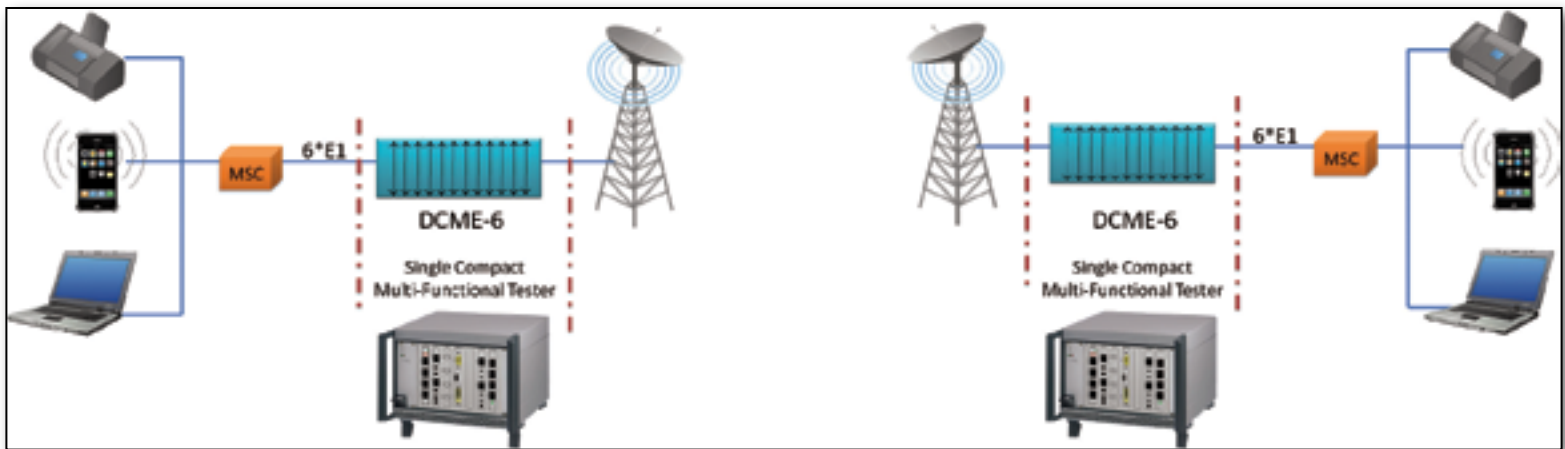
Data Quality Testing
TCP, UDP, VoIP, DNS, Email, HTTP, Route, SMS

Figure 11: DCME Applications and Testing over Satellite Networks

Figure 12. Satellite WAN Links Applications + Testing.

InfoBeam

SWOT's This All About

Artistic rendition of Thales Alenia Space' SWOT satellite.

Thales Alenia Space has been selected by French space agency CNES (Centre National d'Etudes Spatiales) to build the oceanography satellite SWOT (Surface Water and Ocean Topography).

Produced in collaboration with NASA's Jet Propulsion Laboratory (JPL) on behalf of the French and American space agencies, SWOT is an oceanography program that will demonstrate new applications, and is a follow-on to the Jason-1, 2 and 3 operational missions. It will incorporate unprecedented technological innovations in altimetry.

As the name indicates, SWOT is designed to study ocean topography and surface water on the continents. SWOT comprises both an oceanography and a hydrology mission.

For oceanography, the satellite will provide measurements of ocean surface and wave height with higher resolution than its predecessor Jason satellites. This data will be used to analyze and understand the effects of coastal circulation on marine life, ecosystems, water quality and energy transfers, resulting in more accurate models of the interactions between oceans and the atmosphere.

The hydrology mission will evaluate continental surface water, to study changes in water storage in humid zones, lakes and reservoirs, as well as flow rates in rivers.

Thales Alenia Space will develop a new-generation platform for the SWOT satellite, offering, for the first time, a controlled atmospheric reentry of the satellite at end-of-life, in line with the French Space Operations Act. The company will also handle satellite assembly, integration and testing (AIT), delivery to the launch center, and operations for the launch campaign.

The SWOT payload comprises two subassemblies, KaRIn and NADIR. Built by JPL, KaRIn (Ka-band Radar INterferometer) comprises two Ka-band antennas, located 10 meters apart but precisely positioned in relation to each other.

It offers two-dimensional observation capability over a 120-kilometer swath, with horizontal resolution of 50-100 meters, programmable on either side.

The interferometry type altimeter will provide coverage of lakes, rivers, reservoirs and oceans, at a repeat rate of twice every 21 days. Thales Alenia Space is also offering to supply the RFU (Radio Frequency Unit), which is at the heart of this instrument.
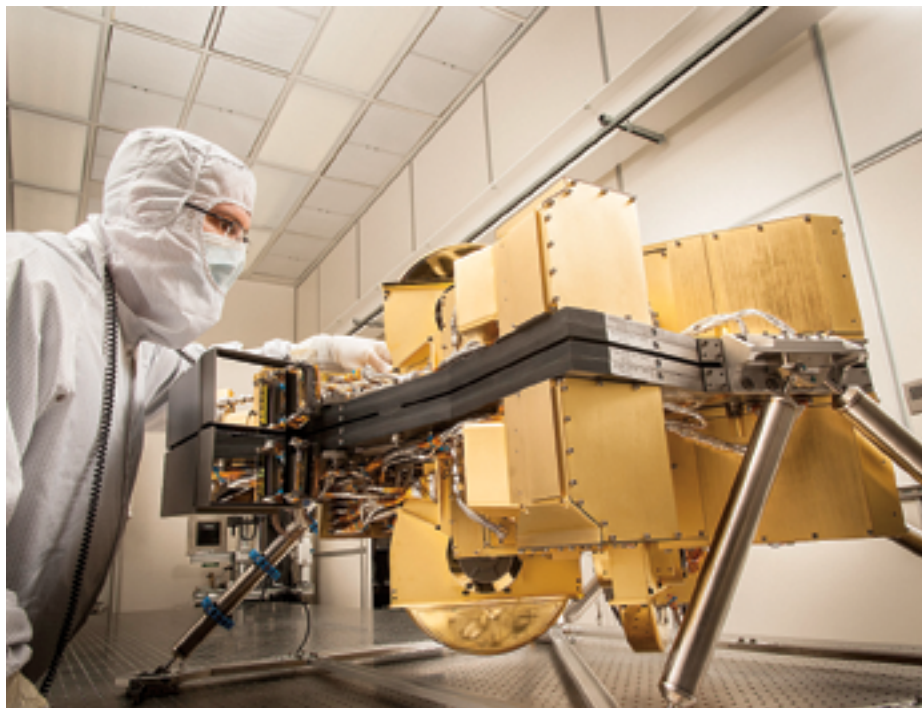
The NADIR module comprises the same instruments as on the Jason satellites, including the Poseidon dual-frequency altimeter made by Thales Alenia Space. It also includes the Thales-built Doris system for precision orbital determination, an AMR (Advanced Microwave Radiometer), the GPSP (GPS Payload) and the LRA (Laser Retro-reflector Array) built by JPL.

Weighing about 2 metric tons at launch, SWOT will be placed into orbit at an altitude of 890 km, with an inclination of 77.6 degrees. Compatible with the Antares, Falcon 9 and Atlas V launchers, it is expected to be launched in 2020 for a demonstration mission lasting about three years.

Hervé Hamy, Vice President for Observation and Sciences at Thales Alenia Space France, said, "SWOT will be the very first satellite to offer controlled reentry, and will also incorporate new-generation avionics that perfectly match CNES's new ISIS standard. Winning this new contract paves the way for our product policy to include swath altimetry, and bolsters Thales Alenia Space's world leadership in space altimetry."

The Thales Alenia Space infosite:
https://www.thalesgroup.com/en/worldwide/space

InfoBeam

Lockheed Martin's NIRCam Integration Tests Prove Worthy For James Webb Telescope

NIRCam The Near-Infrared Camera for NASA's James Webb Space Telescope is seen in a cleanroom at the Lockheed Martin Advanced Technology Center in Palo Alto, California. Photo is courtesy of Lockheed Martin.

The Near Infrared Camera (NIRCam) instrument Lockheed Martin helped develop for NASA's next deep space telescope surpassed expectations during recent testing.

NIRCam successfully completed its first integrated testing with NASA's James Webb Space Telescope. The optical sensor will see farther into the cosmos and further back in time than any other instrument.

NIRCam will see farther into the cosmos and further back in time than any other instrument. Scientists are preparing NIRCam for new trials beginning this year. Produced under contract with the University of Arizona, NIRCam is the primary science camera on the James Webb Space Telescope (JWST) and it also functions as the sensor that is used to align the observatory's primary mirror.

NIRCam performed significantly better than requirements during the first integrated, cryogenic testing program at Goddard Space Flight Center, Maryland.

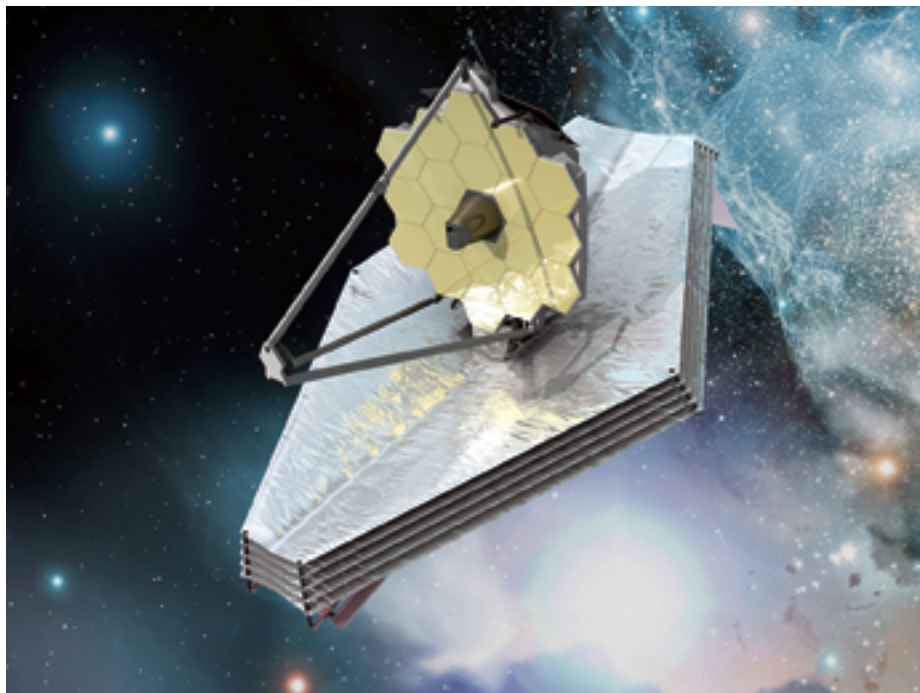In April of last year, NASA installed the instrument alongside others in the Integrated Science Instrument Module (ISIM), which finished cryogenic and vacuum testing late last year. The ISIM is preparing for vibration testing, scheduled to occur in early 2015.

Unlike Hubble's single monolithic primary mirror, JWST's primary mirror is made up of 18 individual, adjustable segments that will be aligned in space. NIRCam's performance is essential to the telescope's success.

Alison Nordt, NIRCam program manager at Lockheed Martin. "JWST is an infrared observatory, requiring all of the optical components to operate at a cryogenic temperature under 40 Kelvin, which is less than 40 degrees above absolute zero, the temperature at which all atomic motion ceases. That's a significant challenge when you're building low-distortion optical mounts, aligning optics at room temperature and designing mechanisms to move precisely."

The Lockheed Martin infosite:
http://www.lockheedmartin.com/

NASA's James Webb Telescope infosite:
http://jwst.nasa.gov/

Artistic rendition of NASA's James Webb Telescope.