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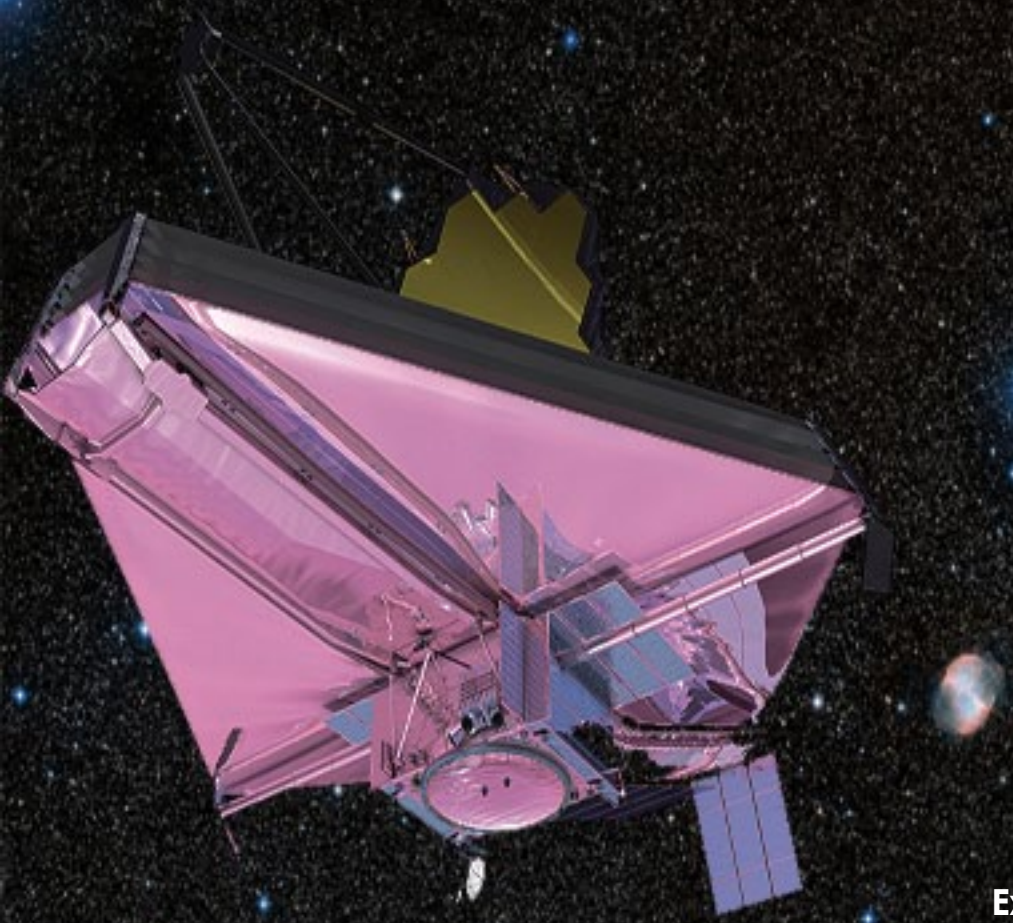

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In this issue...

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plus
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Harris + SATCOM For Drilling Ops
iDirect + The Backhaul Conundrum
GeoEye + Urban Growth Analysis
Bert Sadtler + Careers
Executive Spotlight — Dr. Akbari, SkyBitz

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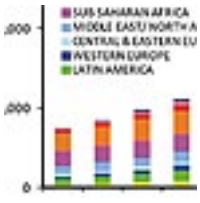




Prime: The Untold Story Of NASA's JWST

The abundance of recent news about NASA's James Webb Space Telescope barely scratched the surface of what's really happening with this unique space-borne observatory…by *Scott P. Willoughby*, **Page 24**

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I frequently hear questions on this topic. Twitter, Facebook and LinkedIn among others have become parts of everyday discussions…*by Bert Sadtler,* **Page 54**

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Dr. Akbari has more than 18 years of strategic, sales and marketing, product development and operational experience across many critical high-technology industries…**Page 56**

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A Higher Linkage

STM Group, Inc. delivered a SatLink Hub 9400 LE by NSSLGlobal, Ltd. for their new location in Brewster, which will be used to expand and enhance NSSL-Global's coverage with DVB-RCS technology.

This fully-redundant hub currently serves the Pacific Ocean Region using multiple Forward Links. NSSLGlobal, with partner Telemar Scandinavia, will also upgrade and expand their Cyprus hub serving the Middle East in the coming months with additional plans to upgrade the Cyprus hub to RCS2 in Q1 of 2012. This will be the world's first commercial implementation of the new DVB-RCS2 standard, all implemented by STM using the SatLink product line.

The new hub will serve subscribers of NSSLGlobal's two major VSAT services, Broad-IP for land applications and Cruise-IP for maritime applications. Applications include high-speed Internet access, TV/Video services, VoIP, and GSM backhaul, which can operate all on the same VSAT with excellent QoS. DVB-RCS2 provides for higher order modulation and coding (up to 16QAM 5/6) along with many other significant technical advances contributing to much higher throughput, link availability, and bandwidth efficiency.

Total efficiency gains with RCS2 can be as much as 300 percent on TDMA carriers compared to legacy VSAT networks. SatLink DVB-RCS and RCS2 networks employ DVB-S2 Forward Links with ACM (Adaptive Coding and Modulation) operating up to 45Msps with 16APSK 9/10. The SatLink implementation of RCS2 builds on the standard with "ACM per burst" with dynamic MF-TDMA carrier groups up to 50 Mbps in capacity, plus many value-added IP features. This yields much better QoS and higher Committed Information Rates (CIRs) for subscribers at a significantly lower cost than SCPC services.

European Space Agency's Key 2012 Events

First launch of Vega — Europe's family of launchers will welcome its smallest member, Vega, which is scheduled to launch on February 9th from CSG at Europe's Spaceport in French Guiana.

BepiColombo — ESA's mission to explore Mercury will undergo extensive testing in 2012. The complete launch stack configuration (Structural and Thermal Model), composed of the European and Japanese orbiters, the Transfer Module and the Sunshield, will be assembled for mechanical testing and presented to the media at ESTEC, Noordwijk, (The Netherlands), also in February.

Artist's impression of Vega during launch. Vega is due to launch in January 2012, in what will be it's maiden launch, from Kourou, French Guiana. Credits: ESA - J.Huart

James Webb Space Telescope — The successor to the Hubble Space Telescope will feature several major ESA contributions, including the MIRI mid-infrared instrument. This scientific instrument will not only provide stunning astrophotography 'à la Hubble' but also allow the study of distant stellar populations and galaxies, as well as faint comets and the Kuiper Belt.

Swarm Constellation— The multi-satellite Swarm mission will provide the best survey of Earth's magnetic field and its temporal evolution, and improve our knowledge of Earth's interior and climate. A briefing and a last look at the satellites will be conducted after completion of testing and before shipping to the launch site. Swarm consists of a constellation of three satellites in three different polar orbits between 400 km and 550 km altitude. High-precision and high-resolution measurements of the strength and direction of the magnetic field will be provided by each satellite. This will also occur in February.

A constellation of three satellites form the Swarm Earth Explorer mission. Swarm will identify and measure magnetic signals stemming from Earth's core, mantle, crust, oceans, ionosphere and magnetosphere – all of which create the magnetic field that protects our planet. This information will provide insight into processes occurring deep inside the planet and yield a better understanding of the near-Earth electromagnetic environment and the impact solar wind has on Earth. Credits: ESA–P. Carril


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Envisat: 10 years in orbit — The largest Earth observation satellite ever built will mark 10 years in orbit on March 1, 2012. Having provided European scientists with environmental data, the applications are manifold and cover the land surface, the oceans, ice coverage and the atmosphere.

Launch of ATV-3 by Ariane 5 — Each Automated Transfer Vehicle (ATV) can deliver up to 7 tons of cargo to the International Space Station, including food, drinking water, gases, research and maintenance equipment and around 3 tonnes of propellants. The versatile craft also regularly boosts the Station's orbit and occasionally manoeuvres the complex to avoid collisions with space debris. With it, Europe is contributing in kind towards its share of the operational costs of the Station.

The third ATV (ATV-3) is named Edoardo Amaldi after the Italian physicist and space pioneer. Equipped with its own propulsion and navigation system, ATV is a multifunctional spaceship, combining the fully automatic capabilities of an unmanned vehicle with human spacecraft safety requirements.

ESA astronaut André Kuipers will be the prime operator, monitoring the ATV rendezvous and docking. André and his Russian crewmate Oleg Kononeko will monitor the ATV as it approaches the Station. They are trained to intervene in the event a problem prevents the ATV from docking. A high-precision navigation system guides ATV on a rendezvous trajectory towards the Space Station, where it docks automatically to Russia's Zvezda module.

End of in-orbit testing of the two first Galileo satellites — Since their launch on 21 October, the two Galileo satellites have undergone a detailed checkup from ESA's ground station in Redu (Belgium) to ensure their payloads are performing as specified.

André Kuipers during a training session in the full-size ATV simulator at the European Astronaut Centre, in Cologne, Germany, 5 July 2011. Kuipers, a Dutch national and member of the European Astronaut Corps, will fly to International Space Station for a long duration mission in 2011. Credits: ESA - S. Corvaja, 2011

Soyuz lifts off for the first time on October 21, 2011, from Europe's Spaceport in French Guiana, carrying the first two Galileo In-Orbit Validation satellites. Credits: ESA/CNES/ ARIANESPACE - S. Corvaja

ISS User Symposium — The ISS User Symposium will discuss research accomplishments on the International Space Station and debate in cooperation with international partners and other space-faring nations how space science should develop after 2020, and even after the Space Station. An open event will allow the general public to share in the fascination of science in space. The symposium will take place in Berlin, Germany, from May 2nd through the 4th, 2012.

Launch of MetOp-B meteorology mission — MetOp-B has been developed and built by ESA in a joint effort with Eumetsat. MetOp-B will follow MetOp-A, launched in October 2006. The MetOp satellites are a series of polar-orbiting meteorological satellites operated by Eumetsat. They complement the US polar-orbiting weather satellite network operated by NOAA. MetOp-B carries 11 instruments to improve numerical weather prediction and to contribute long-term climate data.

ECSITE Conference, the European Network of Science Centres and Museum — ESA will be present at the annual conference of ECSITE, which attracts over 1000 science communication professionals. For the first time, space will be the main theme of the conference, and it will be organised by the 'Cité de l'Espace' in Toulouse, one of the few permanent visitor centres dedicated to space in Europe, and a long-standing partner of ESA. Toulouse, France, is the location, from May 25 through June 2, 2012.

Launch: Meteosat Second Generation-3 — The Meteosat Second Generation satellites have been developed and built by ESA and are exploited by Eumetsat. They are designed to fulfil user requirements for improved weather prediction. MSG-3 will continue the successful series of operational meteorological satellites that started with

Meteosat-1 in 1977. The first second-generation (MSG-1) satellite with its improved capabilities was launched in 2004, followed by MSG-2 in December 2005.

Liftoff of Soyuz flight VS01 with the second satellites pair of the Galileo constellation — Europe's Galileo satellite navigation system will see the launch of the second two In-Orbit Validation satellites. With the first four satellites of the constellation and their ground network, ESA will be able to validate the overall Galileo concept. The launch should occur within the August/September timeframe.

Opening of the Deep Space Antenna 3 — The third Deep Space Antenna will complete the ESA deep space network. It will allow current and future deep space missions to be conducted with three antennas spread around the globe. November is the expected timeframe for this event.

Gaia scientific instrument delivery — Scheduled for launch in 2013, Gaia is a global space astrometry mission that will make the largest, most precise three-dimensional map of our Galaxy by surveying an unprecedented number of stars — more than a thousand billion. The Gaia scientific

Photo of the Gaia sunshield deployment test at Astrium, Toulouse, 2011. Credits: Astrium France

instrument assembly will be ready and delivered end of 2012. It features the largest digital camera ever to be flown in space.

James Webb Space Telescope: delivery of NIRSpec — The successor to the Hubble Space Telescope will feature several major ESA contributions, including the NIRSpec near-infrared spectrograph. This scientific instrument will allow the continuous observation of 100 faint galaxies to determine their chemical composition, and the rate at which stars are forming. It will also allow astronomers for the first time to detect water on planets around other stars. This should occur in December of this year.

The ESA Council at Ministerial Level — The Ministers in charge of space activities in the Member States and Canada will conduct a two-day Council meeting in Italy at the end of the year, where ESA programs for the years to come will be proposed.

A Major Blending

O3b Networks has entered into partnerships with a series of industry leading vendors who will enable the company to deliver the benefits of its ground breaking technology to customers worldwide.

General Dynamics' SATCOM Technologies, Comtech EF Data Corporation and Gilat Satellite Networks, along with previously announced partner ViaSat, will provide a comprehensive range of customer access systems for use on the O3b network capable of delivering throughputs from 1Mbps to 1Gbps. This range of O3b VSAT terminals provides O3b customers the flexibility to choose the features and functionality most suited to their needs.

General Dynamics' SATCOM Technologies will manufacture simple, affordable and reliable 1.8m and 2.4m antennas for use with a series of standard transmitter packages.

Comtech EF Data Corporation will offer a line of O3b-ready modems and hub systems based on its popular CDM modem products. The O3b Comtech EF Data solution will include compression and network optimization functionality developed specifically for mobile backhaul and trunking applications. Customers will be able to repurpose existing Comtech EF Data hardware for use with the O3b system.

Gilat Satellite Networks will provide high capability VSAT hubs and modems based on its highly successful SkyEdge II platform. Gilat O3b modems will support standard GEO and O3b MEO operation, and will be customized for cellular backhaul and IP trunking applications. Gilat will also offer value-added services such as integration with other sub-system providers and terminal installations.

Satmex — A New Beginning

Satmex, a leading satellite services provider in the Americas, offers creative business and technology solutions to improve the customers' profitability.

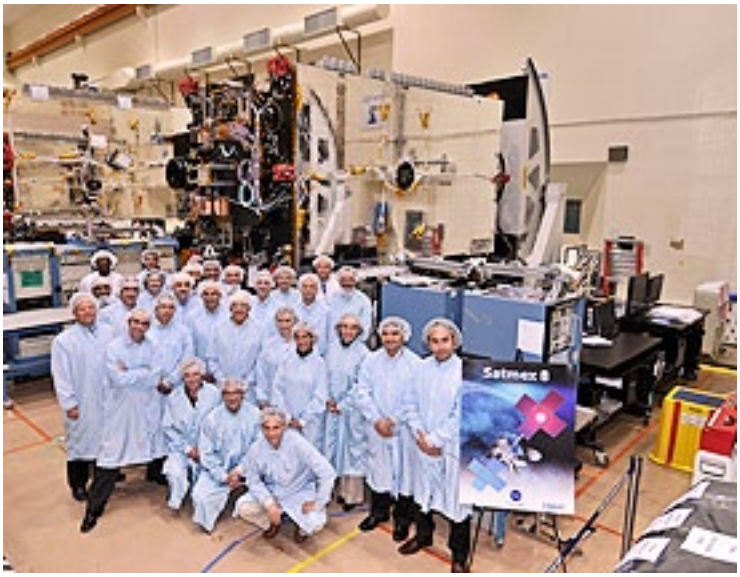


Photo of the Satmex team and Satmex 8, courtesy of Space Systems/Loral

Standing on a firm foundation after the Company's successful 2011 restructuring, Satmex has initiated a new beginning in 2012 as preparations continue for the launch of the new satellite, Satmex 8.

Satmex 8 will be launched in the Q3 of 2012 and will replace the Company's successful Satmex 5 satellite at the 116.8 degrees West orbital slot. Built by Space Systems Loral, Satmex 8 will provide hemispheric and regional coverage throughout the Americas in both C- and Ku-bands.

Satmex 8 will be the most powerful satellite in the fleet and will provide customers with very high power levels and excellent elevation angles from any location within the coverage beams. These benefits will provide optimum performance for any data and video application.

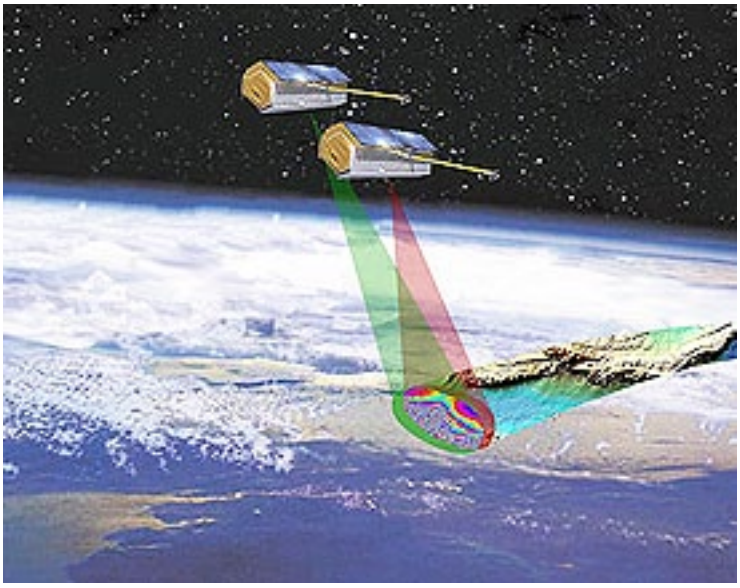
The satellite will also have a broad cable neighborhood in Latin America, supporting Satmex's video expansion.

This satellite provides SatMex the opportunity to expand its service offerings as well as further supports customers as competitive advantages and significant efficiencies are developed for their networks.

Satmex is extremely excited about this new phase of growth and development, celebrating a strong start with the launch of Satmex 8 and anticipating many more exciting ventures.

Satmex 2012— Building Futures

article by Clemente Cabello, V.P., Business Development, Satmex



The tandem formation TerraSAR-X/TanDEM-X, image courtesy of EADS Astrium.

The Earth In 3D

After a year in service, the German Earth observation satellite TanDEM-X, together with its twin satellite, TerraSAR-X, have completely mapped the entire land surface of Earth for the first time.

The data is being used to create the world's first single-source, high-precision, 3D digital elevation model of Earth. The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) controls both radar satellites, generates the elevation model and is responsible for the scientific use of TanDEM-X data.

It is reminiscent of ballet on ice; throughout the last year, Germany's radar satellites, TanDEM-X and TerraSAR-X, have been moving through space in close formation, at times just a few hundred metres apart. Strip by strip, they have recorded Earth from different angles and transmitted high-resolution radar data from their orbit at an altitude of 514 kilometres down to the three ground stations — Kiruna (Sweden), Inuvik (Canada) and O'Higgins (Antarctica).

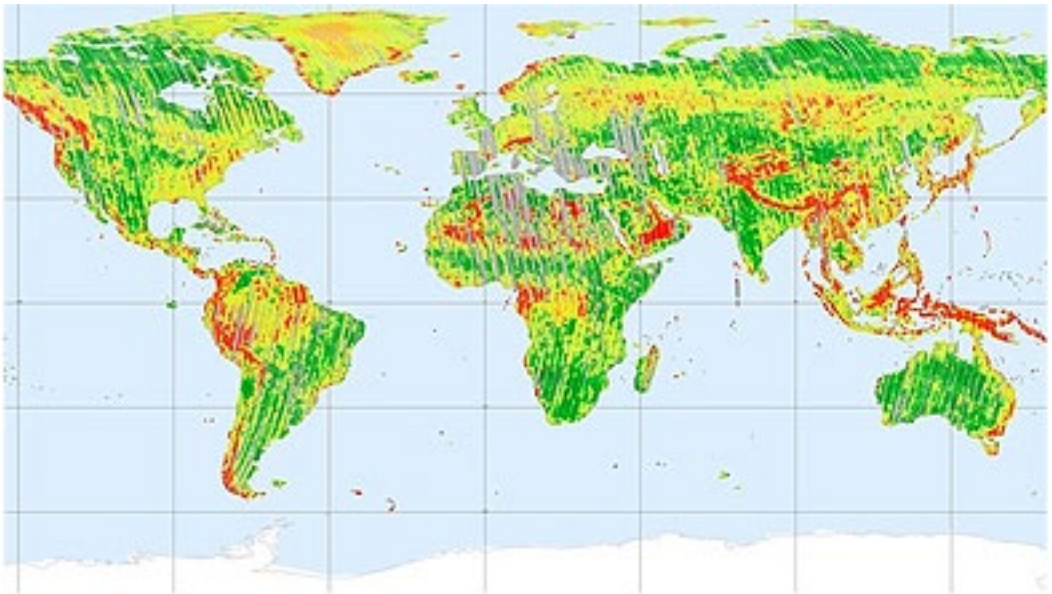
"The mission is running better than expected and there have been no unscheduled interruptions in the programmed formation flight of the two satellites. All safety mechanisms are functioning robustly and in a stable manner," said Manfred Zink, project manager for the TanDEM-X ground segment at DLR. Over the course of 2011, the distance between the satellites was progressively reduced down to the minimum permitted value of 150 metres.

This satellite mission is the first of its kind; it remains unique and is highly complex, even for experienced engineers.

"Following the launch of TanDEM-X on June 21, 2010, there was a six-month test phase, during which we subjected the satellite and its behaviour in near-Earth orbit to intense scrutiny and carried out our calibration work," Zink said. During this time, TanDEM-X commenced formation flying with its identical partner satellite, TerraSAR-X, which was launched in 2007. On 14 December 2010, the operational part of its mission began, collecting data for the high-precision elevation model.

The radar system views the ground from two different points in space, achieving 'depth perception' in a manner similar to binocular vision in humans. "The generation of accurate elevation data calls for precise coordination of data from, and between, both satellites," said Gerhard Krieger, systems engineer for the TanDEM-X mission. Differences, for example in the cable lengths on the two radar instruments, as well as the distance between the two satellites, need to be calibrated very precisely. "This is a truly enormous challenge when you consider that a millimetre of variation can cause up to one metre of elevation error," he added.

The strips of terrain recorded by the satellites are processed into elevation models measuring 50 by 30 kilometres. Due to the ultra-precise calibration, when this 'basic data' is compiled at the end of



TanDEM-X has captured the entire Earth, strip by strip. Image courtesy of DLR.

The first TanDEM-x mosaic of Iceland, courtesy of DLR.

the process to generate a global 3D map, it is already of very high quality. By mid-2013, TanDEM-X and TerraSAR-X will have imaged the complete land surface area of Earth — roughly 150 million square kilometres — several times. The intention is to create an exceptionally accurate, global and homogeneous 3D elevation model that promises to be of equal interest for commercial and scientific purposes.

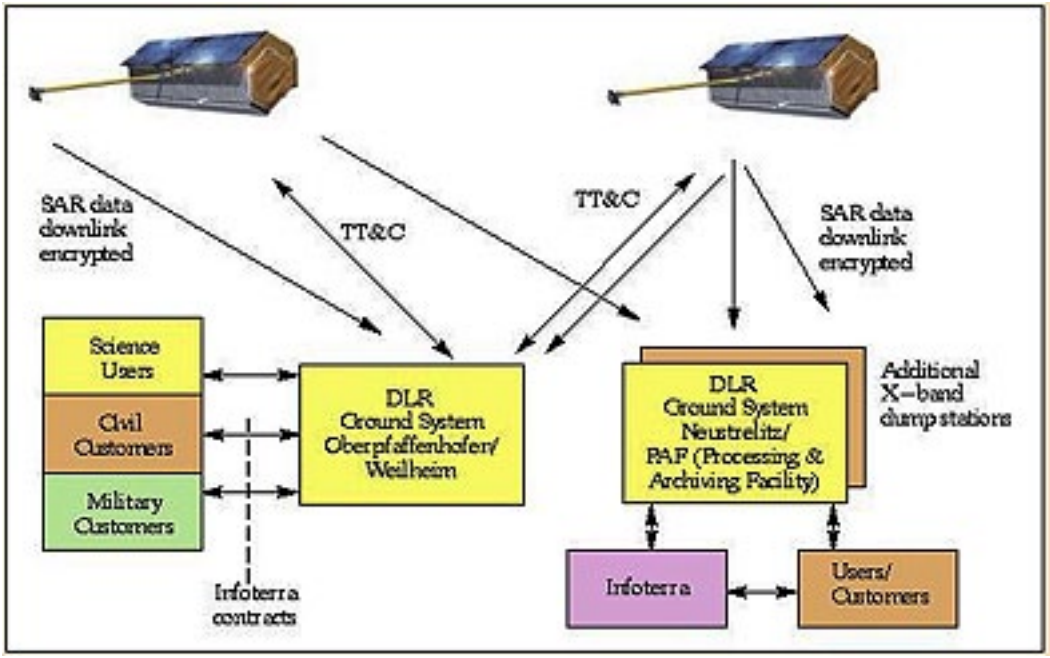
Initially, at least two complete coverage cycles of Earth's land surface were planned. Some parts, one example being the vast majority of Australia's landmass, were recorded by the satellite duo with sufficient quality during the first overflight.

"The level of precision depends on how well the ground reflects the radar pulses transmitted — and subsequently received — by the satellites," said Manfred Zink. For example, the Sahara is more difficult to image because the signal literally 'sinks into the sand' and is lost. For regions of dense vegetation, such as rain forests, additional imagery and careful adjustment of the distance between the satellites are necessary. "We are going to be left with a few blank areas on the map, but we do of course seek to minimise these gaps," states Zink as he thinks about the coming months.

"We want to gain a better understanding of Earth as a system and to employ the data for climate and traffic research, for example," says Irena Hajnsek, scientific coordinator for the TanDEM-X mission. In 2011, she gave the 'green light' for 166 of the research applications submitted to DLR.

"Most of these originated in the USA and Germany. The TanDEM-X capabilities are to be used to address questions of land usage and vegetation, hydrology, geology and glaciology," said Hajnsek.

The two Earth observation satellites can also generate information about the height of the snowline or the change in ice masses of the two polar regions, as well as provide geological maps of regions subject to volcanic and/or earthquake activity. The speed of ships or road vehicles can be measured, as can changes in the natural world.



An overview of the TanDEM-x overall system architecture, image courtesy of DLR

The work performed by these two radar satellites is also valuable for agriculture. "Based on the height and structure of a plant — such as rapeseed, for example — it is possible to draw conclusions about its quality and biomass," said Hajnsek.

About the mission

TanDEM-X is operated by the German Aerospace Center (DLR) with funds from the German Ministry of Economics and Technology in the form of a public-private partnership with Astrium GmbH. DLR is responsible for the scientific use of TanDEM-X data, planning and implementation of the mission as well as controlling the two satellites and generating the digital elevation model. Astrium built the satellite and shares the costs for the development and use. Commercial marketing of TanDEM-X data is managed by Astrium Services' GEO-Information Division (formerly Infoterra GmbH), a subsidiary of Astrium.

Outback Solar Challenge

Students from the University of New South Wales (UNSW) put their solar-powered vehicle — plus BGAN and IsatPhone Pro — to the test when they drove 1,864 miles (3,000 km) across Australia's Outback.

The World Solar Challenge saw 36 teams from 20 countries pitted against each other in the race from Darwin to Adelaide.

UNSW's Sunswift Team from Sydney had the support of Addcom

The Sunswift IV vehicle

Contact Solutions, an Inmarsat service provider to resellers, businesses and end-users across Australia.

Addcom Contact Solutions supplied Sunswift with two IsatPhone Pro satellite phones and an Addvalue Wideye SAFARI land vehicular BGAN terminal for their three-wheeled, carbon fibre vehicle, called Sunswift IV.

The equipment gave the team reliable and race-critical access to the internet and voice calls, even in the middle of the Australian desert where 3G networks are practically non-existent.

Thanks to the vehicular terminal, they were able to stay connected even when travelling at speeds of up to 62mph (100km/h). Sunswift used BGAN to:

- *Download customised hourly weather data and information from a supercomputer located at UNSW that helped them calculate optimum travel speeds without completely draining the vehicle's battery*
- *Keep followers informed via social media, with real-time updates, photos and technical data*
- *Transmit updates to the web-based Sunswift Live map that allowed those who were following the adventure to pinpoint their progress*

In addition, IsatPhone Pro allowed them to keep in touch with race HQ and the support the Sunswift team.

During the race the competitors battled challenging bush fires, dust storms and extreme temperature changes.

In the end, just seven teams made it over the finishing line, with UNSW Sunswift coming in a creditable sixth.

"It was obviously a mission to finish against all the odds, with such cloudy skies and temperature changes," said Robert Lewis, national channel manager at Addcom Contact Solutions.

"Thanks to satellite communications, the Sunswift team were able to download data to help its strategist calculate the best driving techniques and avoid disaster zones."

Platinum Pride

Marlink has been certified as a 'Platinum Partner' by Inmarsat.

The Platinum status is the highest level of Inmarsat's Partner Accreditation Programme, confirming Marlink's strength in the MSS market with its 8,000 seagoing vessels with Inmarsat equipment.

Of Cosmic Importance

Morehead State University Space Science Center staff and students have delivered a satellite to NASA's Launch Services Program Friday, January 6, marking a major milestone in the Space Science Nanosatellite program.

The Cosmic X-Ray Background Nanosatellite (CXBN) was developed by MSU and partners during the past year and passed rigorous space environment testing and a series of design reviews, culminating in the flight readiness review held on December 31.

CXBN is an astrophysics mission whose goal is to provide an improved measurement of the universe's X-Ray background, and could help resolve a mystery in modern cosmology — the origin of the cosmic X-ray background. In Big Bang cosmology, the universe was created 13.8 billion years ago and relic radiation across the electro-

magnetic spectrum that the event produced is studied to lend insight into the physics of the early universe. The relic radiation peaks in the microwave part of the spectrum, with a smaller secondary peak in the X-ray regime. While the microwave background radiation is well understood having been studied since the mid-1960s, the X-ray background is less well understood and few measurements exist that allow astronomers to interpret its origin.

The existing measurements are imprecise and differ from each other significantly, a condition

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which precludes astronomers from knowing which of the physical models developed to explain the X-ray background is correct. The CXBN mission addresses a fundamental science question that is clearly central to our understanding of the structure, origin, and evolution of the universe by potentially lending insight into both the high energy background radiation and into the evolution of primordial galaxies.

The mission was selected in January 2011 by NASA to fly on the Operationally Unique Technology Satellites (OUTSat) Mission as part of NASA's Educational Launch of a Nanosatellite (ELaNa) program. The Space Science Center submitted a proposal to NASA in Fall 2010 which was subsequently awarded, resulting in the flight opportunity on the OUTSat Mission.

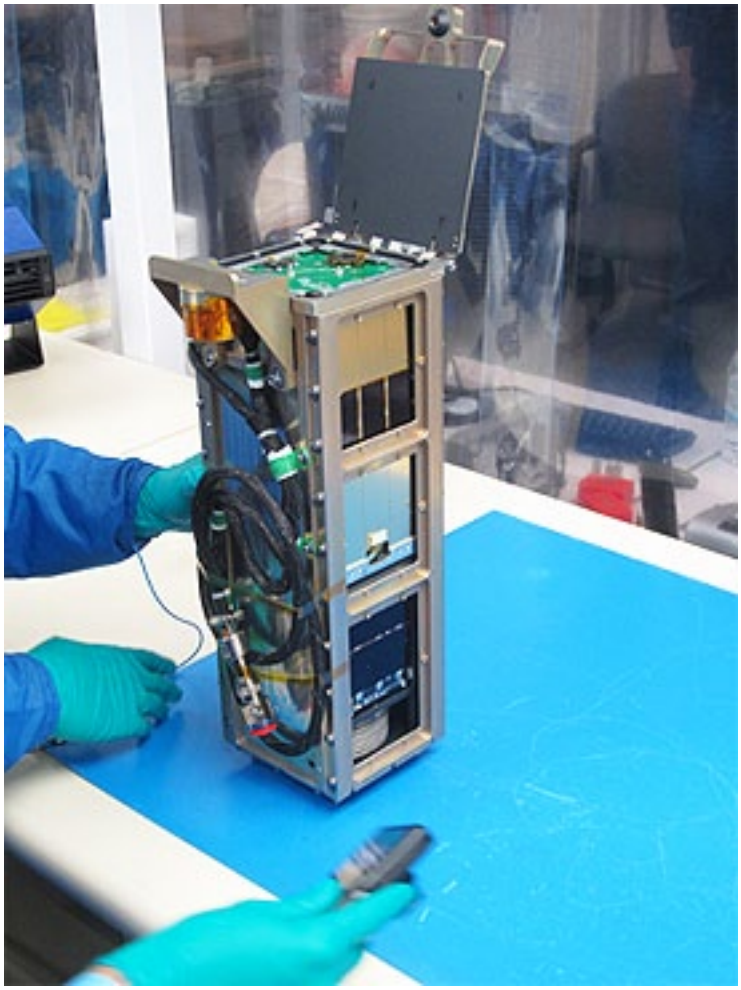
The idea behind the science mission was developed by Dr. Ben Malphrus, director of the Space Science Center and chair of the Department of Earth and Space Sciences, and his long-time collaborator Dr. Garrett Jernigan, astrophysicist at the University of California Berkeley.

A partnership ensued that resulted in MSU becoming the lead institution on the program — being responsible for the design, fabrication and testing of the spacecraft bus, including spacecraft structures, subsystems, software systems and on-orbit operation of the spacecraft.

Dr. Jernigan's team at UC Berkeley and collaborators at Black Forest Engineering (BFE) in Colorado designed and built the science payload — a silicon-based X-ray detector, one of the most sensitive ever built in the 20-100 keV energy range. Other collaborators are engineers and scientists including Dr. John Doty from Noqsi Aerospace, Dr. Lance Simms at Lawrence Livermore National Laboratories, Dr. Steve Anderson at Sonoma State University and members of the Kentucky Space staff led by Twyman Clements.

MSU's team consists of Assistant Professor of Space Science Kevin Brown, who serves as the systems engineer, leading the efforts to design, fabricate and test the spacecraft systems. Brown added significant nanosatellite experience to the Space Science Center team, having designed and built spacecraft systems at Lockheed Martin, Stanford University and Astrodev. He worked closely with the student team, training them in the various technologies and processes involved in designing and developing spacecraft components to operate in the extreme environment of space.

Other team members include Dr. Roger McNeil, dean of the College of Science and Technology; Jeff Kruth, electrical and radio frequency engineer; Eric Thomas, Star Theater director; Bob Kroll, space systems engineer; Michael Combs, satellite earth station operations engineer; and a team of undergraduate and graduate students.



The student engineering team is led by Tyler Rose of Carlisle, who participated in the design and fabrication of every component of the spacecraft. Numerous students had the opportunity to participate in the program, providing invaluable experience for them in actual space systems design — a rare opportunity for graduate students, and an exceedingly rare event for undergraduate students.

About a dozen students from Kentucky, Ohio and internationally — from Italy, South Korea, and South Vietnam — form the student engineering team. They participated in all aspects of engineering design and fabrication of the spacecraft and performed the work in concert with the Space Science Center faculty mentors.

Once on-orbit, the spacecraft will be operated by students using MSU's 21-meter Space Tracking Antenna and other ground assets. The science data collected will be reduced, calibrated and analyzed by astrophysics students under the direction of faculty mentors.

To participate in design reviews, mission readiness reviews, design and fabri-

cation of the spacecraft subsystems, proto-flight testing, operation of the spacecraft, and analysis of the science data represents extraordinary opportunities for students.

The satellite itself adheres to the CubeSat form factor — a nano-satellite standard now adapted worldwide, that was invented by Bob Twiggs, professor of Space Science, while at Stanford University. CXBN is among the most sophisticated and capable CubeSats ever built. The satellite is a 2U Cube (measuring 10 x 10 x 20 cm and weighing 2.5 kg) and will track the sun and orient itself toward the sun on-orbit using an innovative attitude determination and control system, while rotating once every six seconds, allowing the science array to scan the universe.

The satellite also contains state-of-the-art command and data handling systems, power management systems (using deployable solar panels), communication systems, and thermal and structural components — all designed and built at MSU's Space Systems Development Laboratory. Nearly all of the environmental testing (including vibration analysis, electromagnetic testing, and functional testing) was conducted in the MSU Space Systems Verification Laboratory. Thermal-vacuum (T-vac) testing was conducted at the Kentucky Space facilities and the University of Kentucky.

CXBN is significant in that it is the first satellite entirely built at MSU, with the exception of the science payload, which was built at BFE, UC Berkeley and Morehead State. Space Science Center staff

Morehead students involved in microassembly.

participated in the design, fabrication and operation of a number of other micro and nanosatellite systems including KySat-1 (with Kyspace), EduSat (with the University of Rome), RAMPART (with a consortium of universities and government labs), and Frontier-1 (with KySpace), but CXBN represents the first major satellite project that Morehead State University has taken the leading role in developing.

CXBN was developed on a highly compressed schedule — having been designed, built, and tested in one year. This rapid development time is a hallmark of the CubeSat form factor. NASA made the award in January 2011 and the satellite was delivered to CalPoly in San Luis Obispo, California, in January 2012, almost one year after the award. Dr. Malphrus indicated that "the project was only possible on this timeline because of the extraordinary dedication of time and effort from the team, and because nearly all of the space systems development, fabrication, and testing infrastructure has been established at the Space Science Center, allowing all of the work to be done in-house."

"The accomplishments of this team at MSU in partnership with Kentucky Space staff that I have seen since coming to MSU are truly amazing. I have been on the sidelines watching and the level of complexity in the projects and the professionalism skills they now possess make an awesome team that I would rank as the best university team that I know of. These skills have been demonstrated by the delivery of CXBN — a very sophisticated satellite developed on a nearly impossible timeline," said Twiggs.

The CXBN project represents an important benchmark for MSU's Space Science program — a satellite designed, built, tested, and to be operated by, staff and students.

CXBN will be launched from Vandenberg Air Force Base, Vandenberg California in August of 2012.

Additional information is available by visiting the project's website at:

http://universe.sonoma.edu/CXBNanosat/

One Billion More Asian Mobile Connections

According to the GSM Association (GSMA), mobile penetration in the Asia Pacific will reach a landmark three billion connections in Q1 2012, nearly two years earlier than projected. More importantly, by 2015, the region is expected to reach 4.1 billion connections, growing at twice the rate of Europe and North America, and will account for 40 percent of mobile data traffic worldwide.

NSR's findings are certainly consistent with the GSMA's projections. For satellite-based backhaul, the Asia Pacific is expected to account for the largest share of in-service units and revenues until 2020. The rate of growth should lead to more than a doubling of installed satellite BTS units in Asia, indicating that while BTS installations in developed country markets are showing signs of saturation, satellite backhaul demand in the Asia Pacific is not foreseen to taper anytime soon.

Two key markets will drive growth in the region — China and India. Today, China alone has 940 million mobile connections, which exceeds the combined connections in Europe and the U.S. Moreover, even as Asia's growth has been on a blistering pace, China and India have penetration levels at just 60 percent, which means that one billion people are still without a mobile connection.

The opportunity for the satellite industry in Asia is certainly promising, and it is worth noting that the region's dynamic growth is coming at a time of severe financial pressure around the globe. Many economists have argued that the engine of growth will likely rest with Asia, and this appears certainly true in the mobile industry.

However, tapping or cashing in on the Asian opportunity is easier said than done due to a number of reasons:

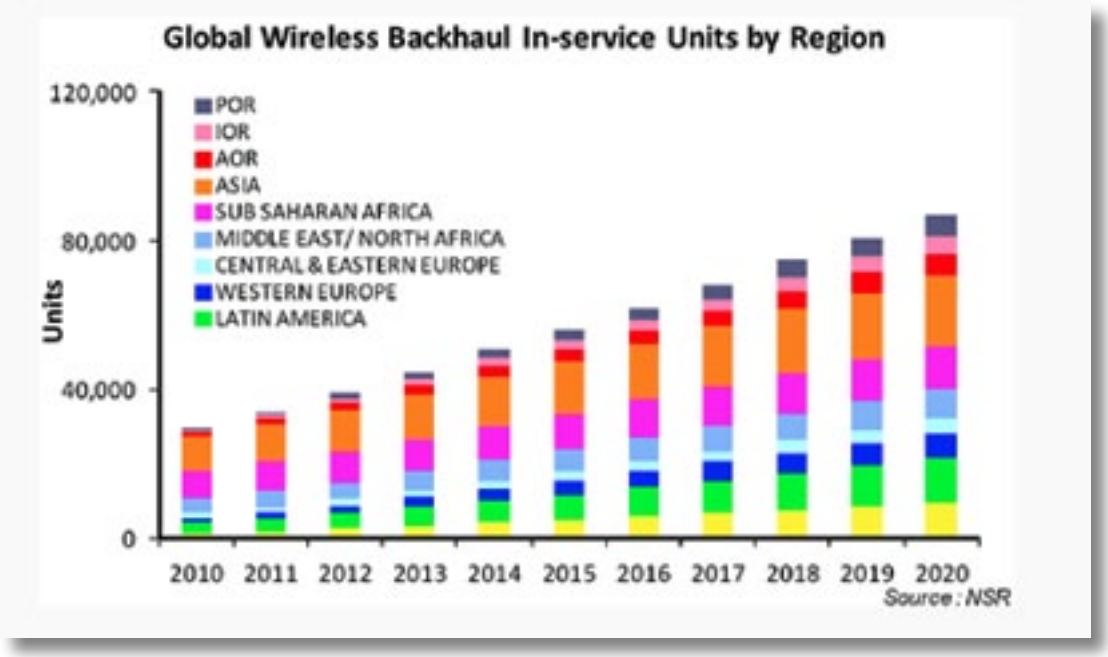
Access to key markets, notably China and India, may be hindered by regulatory factors such as preferential treatment, which may be afforded to national operators and suppliers.

The rate of urbanization is expected to be high over time, limiting the addressable market for satellite backhaul as the value proposition rests in rural markets.

Although wealth has grown substantially, the higher costs associated with satellite backhaul compared to terrestrial alternatives will be a challenge in the economic structure of rural markets.

If the GSMA is correct in its projections of adding one billion connections in Asia, rural markets will have to account for a relatively large share of the pie given population demographics. Yes, urbanization is on the rise, but a large base will remain in rural areas. Satellite backhaul cost structures will have to address rural dynamics, and here, NSR projects those players with the most compelling cost structures both on the CAPEX and OPEX side stand to gain a better foothold. Solutions that target mobile data, particularly broadband mobile data, should likewise prosper over time.

This information was extracted from NSR's report *Wireless Backhaul via Satellite, 5th Edition*



Eider Way, USGS Covers The Ducks

On its way to deliver emergency fuel to Nome, Alaska, the Russian tanker Renda will move through an area used by wintering spectacled eiders, a federally threatened sea duck.

However, to protect the ducks and their wintering habitat, resource managers from the U.S. Fish and Wildlife Service and navigators from the U.S. Coast Guard are using satellite telemetry information from the U.S. Geological Survey to plot a route for the tanker that minimizes impacts to this species and its habitat.

"Nearly 20 years ago, USGS biologists used the latest satellite tracking technology available at the time to uncover the mysterious wintering behavior of the spectacled eider, now a threatened species," said USGS Director Marcia McNutt.

"Little did these scientists know at the time that their information would be critical in allowing a Russian tanker decades later to thread the needle to Nome in order to deliver

life-saving fuel oil without taking a toll on these elusive sea ducks."

The arctic nesting sea ducks are now wintering south of St. Lawrence Island in the northern Bering Sea, where sea ice abounds and abundant prey in the form of clams and other invertebrates appears to be critical for the species' winter survival.

"As stewards of the environment, we found the data invaluable to our mission planning and execution while protecting our nation's critical spectacled eider habitat," said U.S. Coast Guard Capt. Craig Lloyd, District 17 Chief of Response.

Satellite telemetry provides a way to track animals regardless of location, time of day, or weather. Transmitters send information to orbiting satellites, which relay the data to land-based receivers.

Implantable satellite transmitters were first used by USGS Alaska Science Center biologists in 1993 to discover the molting (when birds shed old feathers and grow new ones) and wintering distribution of spectacled eiders. At that time, no one knew where the species lived during the many non-breeding months. But, USGS tracking data and subsequent aerial surveys revealed that spectacled eiders wintered in the northern Bering Sea, within the pack ice.

"Not only was this a surprise, but we've learned that about 380,000 spectacled eiders, or almost the entire population of this species, use this area every winter for five to six months; an amazing natural phenomenon in an incredibly harsh environment," said Matthew Sexson, USGS biologist.

In 2008, USGS biologists began marking spectacled eiders with improved transmitters with longer life cycles to learn more about the species to help resource managers plan conservation actions and strategies. Each transmitter can last as much as two years, providing an opportunity to learn more about year-round migratory patterns and habitat use of this unique species, Sexson said. Between 2008 and 2011, 129 transmitters were deployed at nesting areas in coastal Alaska.

The project is expected to produce continuous tracking data from 2008 through 2013.

"Protecting America's fish and wildlife resources is a shared responsibility. It is satisfying to see agencies working together to protect threatened and endangered species, while meeting the needs of our communities," said Ellen Lance, the Endangered Species Branch Chief for the U.S. Fish and Wildlife Service's Alaska Region.

More information about this research can be found on the ***USGS Alaska Science Center*** webpage. One can also follow the research by subscribing to the research ***Twitter*** feed.

An Odyssey For Intelsat

Sea Launch will launch the Intelsat 21 communications satellite during the third quarter of 2012.

The spacecraft will be lofted into an optimized geosynchronous transfer orbit (GTO) using the reliable Sea Launch Zenit 3SL launch system. The launch will occur from Sea Launch's Odyssey launch platform at its equatorial launch site located at 154 degrees West, in the international waters of the Pacific Ocean.

Built by Boeing Satellite Systems Inc., the 702-MP Intelsat 21 satellite will replace the Intelsat 9 satellite located at 302 degrees East and will serve the leading video distribution and DTH neighborhoods in Latin America. It is designed for 15 years of service.

"Sea Launch is very pleased to be entrusted with another launch from the world's largest satellite operator," said Kjell Karlsen, President of Sea Launch. "We greatly value the trust and confidence placed in the entire Sea

Launch team with this key assignment." Sea Launch and Intelsat signed a multiple launch services agreement for as many as five missions on the Sea Launch system in 2010.

Going Solar In Space

For its first mission to the International Space Station, SpaceX's Dragon spacecraft will use deployable solar arrays as its primary power source for running sensors, driving heating and cooling systems, and communicating with SpaceX's Mission Control Center and the Space Station.

Dragon's solar arrays generate up to 5,000 watts of power — enough to power more than 80 standard light bulbs. The solar arrays, shielded by protective covers during launch, deploy just minutes after Dragon separates from the Falcon 9 second stage, as it heads towards its rendezvous with the Space Station.

While many commercial satellites and NASA missions such as the Hubble Space Telescope use solar arrays, Dragon will be the first American commercial transport vehicle to do so.

Past American spacecraft such as Mercury, Gemini, Apollo and Shuttle used fuel cells or battery

Artistic rendition of the Dragon spacecraft with solar panels fully deployed, courtesy of SpaceX.

packs. Fuel cells are limited by the amount of chemical reactants (typically oxygen and hydrogen) that the vehicle can carry. Batteries alone are limiting due to their mass and the amount of power they can carry.

Solar energy provides a key benefit — long-term power. Combining Dragon's solar arrays with a compact and efficient battery pack provides a reliable and renewable source of power. When in the sun, Dragon's solar arrays recharge the battery pack, and the charged batteries provide power while Dragon passes through the Earth's shadow. With solar panels, Dragon will have the power it needs for longer trips, whether to the Space Station or future missions to Mars.

Dragon's deployable solar arrays were developed from scratch by a small team of SpaceX engineers. To ensure they will survive the harsh environment of space, our engineers put the solar arrays through hundreds of hours of rigorous testing including thermal, vacuum, vibration, structural and electrical testing.

SpaceX conducts most of these tests in-house. The video below shows an array full deployment test using testing equipment developed by SpaceX as part of a NASA Commercial Orbital Transportation Services (COTS) milestone.

Dragon is the first privately developed spacecraft to successfully return from Earth orbit and it is also the only reusable spacecraft in operation today.

A Gain With, And For, Africell

Thuraya has signed a service partner agreement with Africell Holding (a subsidiary of Lintel Holding).

Through this partnership, Africell will be providing Thuraya's data and voice services in Gambia, Sierra Leone and the Democratic Republic of Congo. Thuraya provides border-to-border seamless satellite coverage over Africa, which complements existing terrestrial operators such as Africell ensuring that consumers out of GSM reach can access reliable and cost-effective satellite communications. Thuraya allows access for people on the move to enjoy the ubiquitous coverage of the Company's robust network by simply inserting their GSM SIM cards into any Thuraya

handheld.

"Africa offers significant business opportunities due to its size, geographical composition, population and economical potential. The new partnership with Africell is part of our strategy to enhance our distribution network and reach out to our vertical industry consumers wherever they choose to operate. We aim to empower people and businesses in Africa through modern, cutting-edge and reliable value satellite communications," said Thuraya's Chief Executive Officer, Mr. Samer Halawi.

Thuraya offers the world's smallest satellite broadband solution to support 384 Kbps streaming Thuraya IP and the only satellite handheld to offer full walk-and-talk capability Thuraya XT. This is in addition to maritime, tracking, capacity leasing, and other specialized space-based solutions.

Africell Holding operates three GSM operations; Africell Gambia, Africell Sierra Leone, and Africell RDC. The Gambia and Sierra Leone operations are leaders with around 60 percent market share in both markets; the DRC operation is set to be launched by Q2 2012.

Turnkey Solution Provides SeaAccess

Communications are consistent whether sitting at a desk in a land based office or offshore in Brazil on a supply vessel.

Harris CapRock Communications, delivers turnkey Very Small Aperture Terminal (VSAT) communications to five of Siem Offshore's supply vessels, located offshore in Brazil. Harris CapRock's SeaAccess Communications™ provides fully managed communications for remote and harsh environments. The SeaAccess solution will enable Siem to extend its corporate IT network and applications to its vessels. Siem Offshore Inc. is an owner and operator of modern support vessels for the global oil and gas service industry.

"We require a robust communications solution onboard our vessels to support our crew and our day-to-day operations,"

said Cato Engebretsen, director of supply chain for Siem Offshore Inc. "It's important for our fleet to be fully connected to headquarters and our other offices at all times, and after assessing the capabilities of Harris CapRock and its ability to provide local service and support in Brazil, it was the clear choice for our team."

Harris CapRock will deploy end-to-end VSAT communications to enable corporate networking, Internet access, Voice over IP, real-time monitoring and reporting, and crew morale services. All equipment will be tested in Aberdeen, U.K., and then shipped and installed locally in Brazil. The turnkey solution includes network design, equipment and installation, as well as service and 24/7 support from Harris CapRock's Customer Support Center (CSC).

The contract has the potential to be extended to an additional four vessels. Harris CapRock was selected as Siem Offshore's communications partner as a result of its deep experience in providing local service and support in Brazil, combined with its reputation for delivering highly reliable solutions.

"The agreement with Siem Offshore's Brazilian operations highlights the quality communications technology that we've built a solid reputation on in the market," said Pal Jensen, president of SeaAccess, Harris CapRock. "Our presence in Brazil continues to grow as we broaden our systems integration services, project management capabilities and in-region field service and support. This partnership is a natural extension of the progress we have made."

Track Those Flights

This leading provider of satellite-based communication, tracking and on-board aircraft data systems has announced the release of an updated version of their popular Latitude WebSentinel iOS App.

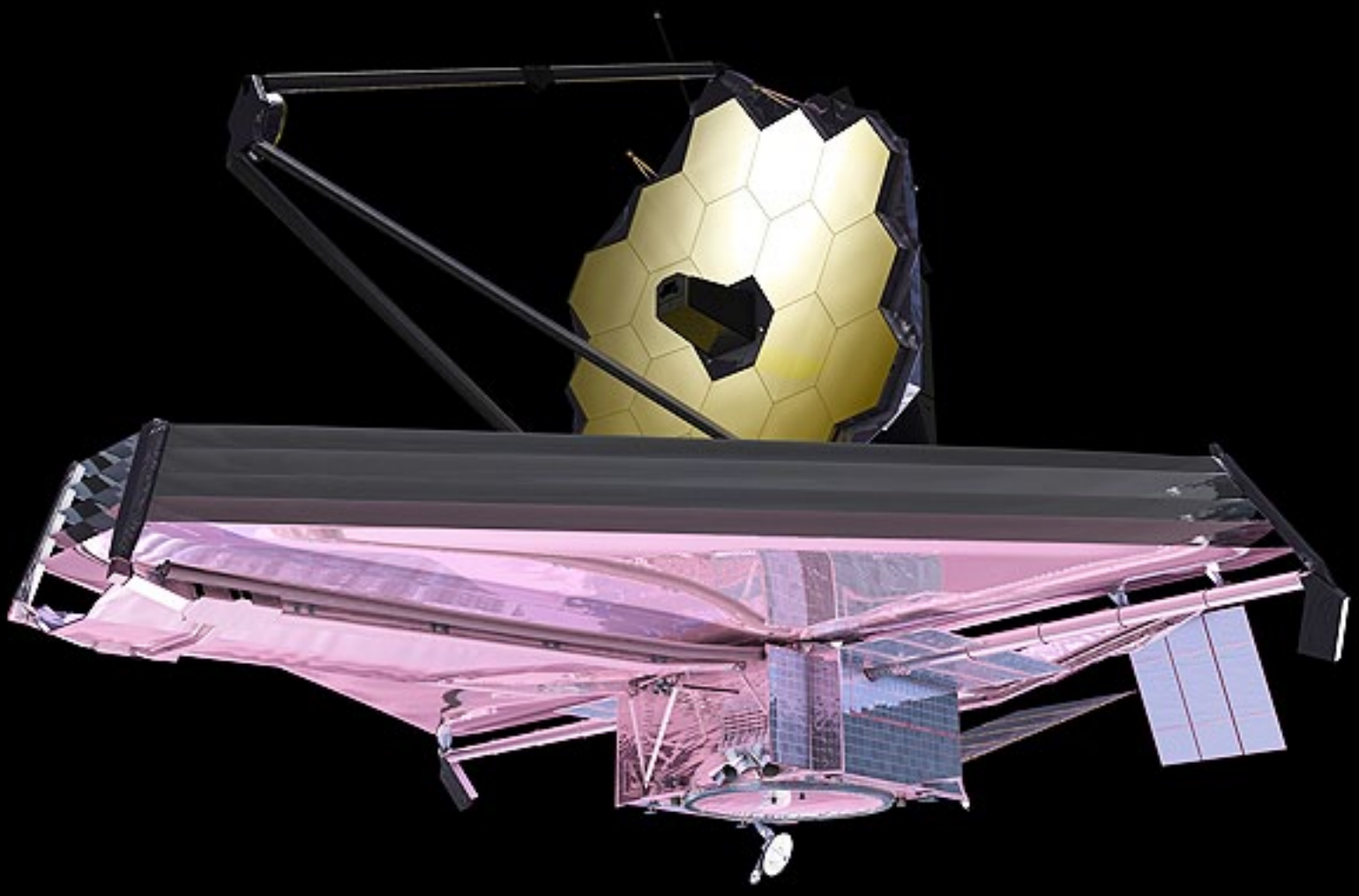
Registered users of Latitude's SkyNode® SATCOM products who have a WebSentinel service account can now view live and historic flight tracking data, adjust reporting parameters and do two-way text messaging with their SkyNode products using the intuitive interface and high-resolution image quality that Apple® products are known for.

The App is freely available in the iTunes® App Store and functions on the iPad®, iPhone®, and iPod Touch® products by Apple®. For users of Latitude's existing iOS App, the new version is available as an update.

The Untold Story Of NASA's James Webb Space Telescope

by Scott P. Willoughby, V.P. + Program Manager,
James Webb Space Telescope, Northrop Grumman Aerospace Systems

In 2011, the program made amazing technical progress in many areas. By far the most stunning accomplishment has been the completion of the telescope mirrors. All 18 hexagonal primary mirror segments were polished to accuracies measured in mere atoms, together with the other three mirrors that make up the telescope: the secondary, tertiary and fine steering mirrors. The secondary, a convex mirror and the most challenging, was completed with a surface figure accuracy that exceeds its requirement. The last group of six primary mirror segments just completed final cold verification test at **Marshall Space Flight Center** in Huntsville, Alabama.



Although presenting a set of far different complex challenges, the five-layer sunshield has also made an important transition: from sub-scale testing to full-size layer testing. The first measurement of the 3D shape of a full-size membrane was made to ensure it will meet very demanding alignment and clearance tolerances. This is the last step before the flight sunshield is fabricated and represents years of painstaking work and innovative engineering. Never before has such a huge expanse of material been engineered to perform to the requirements of such a unique mission.

The spacecraft design and propulsion systems are rapidly advancing, and the flight software that will enable the telescope to communicate with the ground station has been verified. Flight units and test units of the four science instruments are in various stages of integration and performance testing. The telescope is on track for the next step in its evolution — integration — where the parts are assembled and tested as a system.

As a lesson learned from the ***Hubble Space Telescope***, the strategy of tackling the most difficult technical challenges first was adopted by the Webb team. The most critical and technically daunting aspect of the telescope is its primary mirror.

Mirror, Mirror — Who's The Most Perfect Of Them All?

Technology for lightweight mirrors in space telescopes has been in some form of development since 1998, when NASA was part of the *Advanced Mirror System Demonstration* program, a project funded by a multi-agency government group.

In 2003, a year after **Northrop Grumman Aerospace Systems** was selected to build ***Webb***, a panel of experts from the contractor team, NASA and the science community began looking at mirror materials specifically for this telescope. The two mirror technology candidates, beryllium and glass, underwent rigorous tests, studies and analysis: beryllium won because it performed so well at extremely cold temperatures. Webb will operate in deep space at what are called cryogenic temperatures, near minus 400 degrees Fahrenheit.

In 2003, a year after Northrop Grumman Aerospace Systems was selected to build Webb, a panel of experts from the contractor team, NASA and the science community began looking at mirror materials specifically for this telescope. The two mirror technology candidates, beryllium and glass, underwent rigorous tests, studies and analysis: beryllium won because it performed so well at extremely cold temperatures. Webb will operate in deep space at what are called cryogenic temperatures, near minus 400 degrees Fahrenheit. Teammate Ball Aerospace & Technologies Corp., Boulder, Colorado, provides the telescope's optical design and mirrors, and the wavefront sensing and control design and algorithms.

Once beryllium was identified, the mirrors began a long, Earth-bound journey, trucked across the country for 14 stops in 11 different locations, some several times. Powder from a beryllium mine in Utah was pressed into huge mirror blanks at **Brush Wellman** in Elmore, Ohio. The blanks were then shipped to a new online facility at **Axsys Technologies**, Cullman, Alabama, where the blanks were machined to a honeycombed structure on a thin face-sheet to reduce mirror weight and retain stiffness.

Primary mirror segments outside a chamber in the X-ray and Cryogenic Facility at NASA's Marshall Space Flight Center, Huntsville, Alabama. All primary segments are chilled to near minus 400 degrees Fahrenheit to insure they perform as expected in the deep cold of space. Credit: MSFC/NASA

The lightweight blanks were then shipped to **L-3 Integrated Optical Systems — Tinsley** in Richmond, California, for precision grinding and polishing — a difficult task because beryllium is extremely hard and takes a long time to polish. The operation must also be done carefully to produce smooth mirrors with the right shape, or optical prescription, for their operating temperature despite being polished at room temperature in a process known as cryo-polishing. The mirrors underwent their

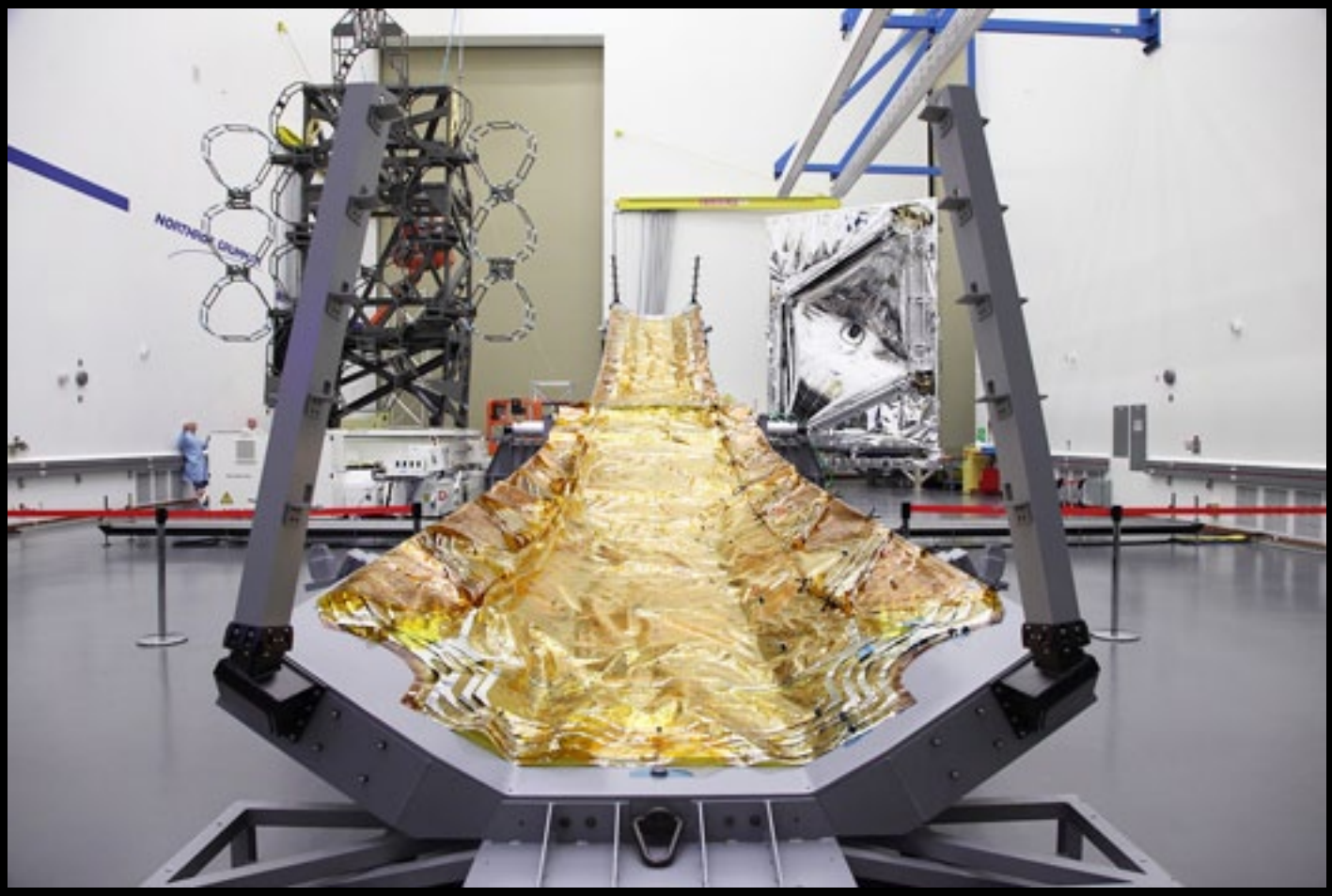
first super-cold test in the *X-ray and Cryogenic Facility* at **Marshall Space Flight Center**, where they were measured to see how they change shape as they cool. That information was used in the next polishing cycle so that when the mirrors cool during the next test, they "distort" into the right prescription.

Every polishing cycle is a complex operation with many different steps. Each mirror segment underwent very exacting testing and measurement about 100 times. Verifying that the mirrors are polished to tolerances of millionths of inches required extremely sensitive equipment. Temperature variations, air turbulence or floor vibrations can throw off the accuracy of these nanometer-scale measurements, so L-3's polishing facility was especially designed to eliminate or minimize these effects. The size of each mirror segment also drove requirements for polishing equipment. These new manufacturing processes had to be created just for Webb's large optics.

After the polishing process was complete, the mirror segments were sent to **Quantum Coating** in Moorestown, New Jersey, where a microscopically thin coat of gold was evaporated onto the mirror's surface to maximize its ability to reflect infrared light. The segments made a final trip to Marshall to confirm performance after coating. At the end of this process, which concluded in December 2011, the segments are finished with component-level testing.

Backed By Strength + Precision

In parallel with mirror manufacturing, two support structures, one for on-the-ground assembly and the other simulating a flight structure, were making headway to completion. The larger structure is a giant structural steel frame for integrating the mirrors, their support structure the mirror backplane, and the science instruments. Installed in the clean room at NASA's **Goddard Space Flight Center**, the platform was constructed by



The Webb Telescope Integrated Validation Article (IVA) with folded sunshield test membranes in open position in the high bay at Northrop Grumman, Redondo Beach, California. Engineers use the IVA for fit checks and tolerances between the membranes and the structure that holds them. In the background at left is a mockup of the structure that supports Webb's primary mirror. Credit: Northrop Grumman.

Northrop Grumman's partner, **ITT Exelis,** to support the weight of the entire optical telescope, a load of more than 3.7 metric tons. ITT also built and demonstrated the mirror installation equipment, which consists of an overhead tracking system and a robotic arm with micro-positioning capability.

The other completed support structure is the backplane pathfinder, a test version of the flight backplane that is designed to support the weight of the mirrors, instruments and other elements during launch and hold the 18-segment, 21-foot-diameter primary mirror nearly motionless while the telescope peers into deep space. The backplane must meet exacting thermal stability requirements. For example, it must not change shape by more than 38 nanometers (about 1/1000 the diameter of a human hair) while the telescope is operating, even though it will experience temperatures colder than -400 degrees Fahrenheit.

The pathfinder backplane is a full-scale engineering model of the central section of the flight backplane and will be used to demonstrate integration and test procedures prior to their use on the flight telescope. The pathfinder consists of 12 of the 18 hexagonal cells (the center section) of the telescope. It will support a subset of two flight-spare primary mirror segment assemblies, the secondary mirror and aft optics subsystem. The pathfinder is made of the same material with the same tolerances as the flight backplane.

With A Sun Protection Factor Of 1.2 million

After years of tackling the myriad engineering challenges that accompany a layered sunshield as large as a tennis court, the Webb team has moved forward into an important new testing phase. The sunshield material, made of a tough plastic film, Kapton ®E, is only one-to two-thousandths of an inch thick, about as thick as a human hair, and covers a surface area the size

Technicians at ManTech International's facility in Huntsville, Alabama, check the layer 3 sunshield test membrane mounted on a fully simulated flight structure. Each of the five tennis court-sized sunshield test layers will be 3D shape-tested to validate computer models. Photo credit: Northrop Grumman.

of a tennis court. The layers are separated from each other and held in place by spreader bars and deployable booms. The sunshield keeps the telescope in shadow to operate near absolute zero, so Webb's science instruments can see far into the most distant galaxies.

In September, 3-D shape testing of full-size templates, or pattern membranes, began at partner **Man-Tech International**'s facility in Huntsville, Alabama. These tests tell engineers how the full-size sunshield layers will behave once deployed. Test results are compared to computer models to validate the computer models. A high-precision laser radar tool creates a 3D map, or picture, of the material surface. This map will be compared to computer models to see if the material behaved as the model predicted, and was able to meet critical clearances with adjacent hardware. The test will be done on all five template layers of the sunshield. The month-long testing used flight-like material for the sunshield, and a full-scale test frame and hardware attachments. Each sunshield layer is stitched together like a quilt from over 52 individual pieces because no manufacturer makes Kapton sheets as big as a tennis court. The completion of full-size testing of sunshield layer-3 is the final step of the sunshield's development and gives engineers the confidence and experience needed to manufacture the five flight layers.

The Origami Telescope

After all five layers of the full-size template sunshield complete testing and model analysis, they will be sent to Northrop Grumman's high bay in Redondo Beach for yet another fit check. The sunshield layers are folded, much like a parachute, so they can be safely stowed for launch. Work has been ongoing using the Sunshield Full-scale Mockup test article to test the fit between aligning and attaching the folded membrane layers to the sunshield support structure. Checkouts like these allow engineers to validate the sunshield design and prove out processes developed specifically for Webb well before tackling flight production.

Technician checks layer 3 sunshield test membrane mounted on a fully simulated flight structure at ManTech International 's facility in Huntsville, Alabama. Credit: Northrop Grumman.

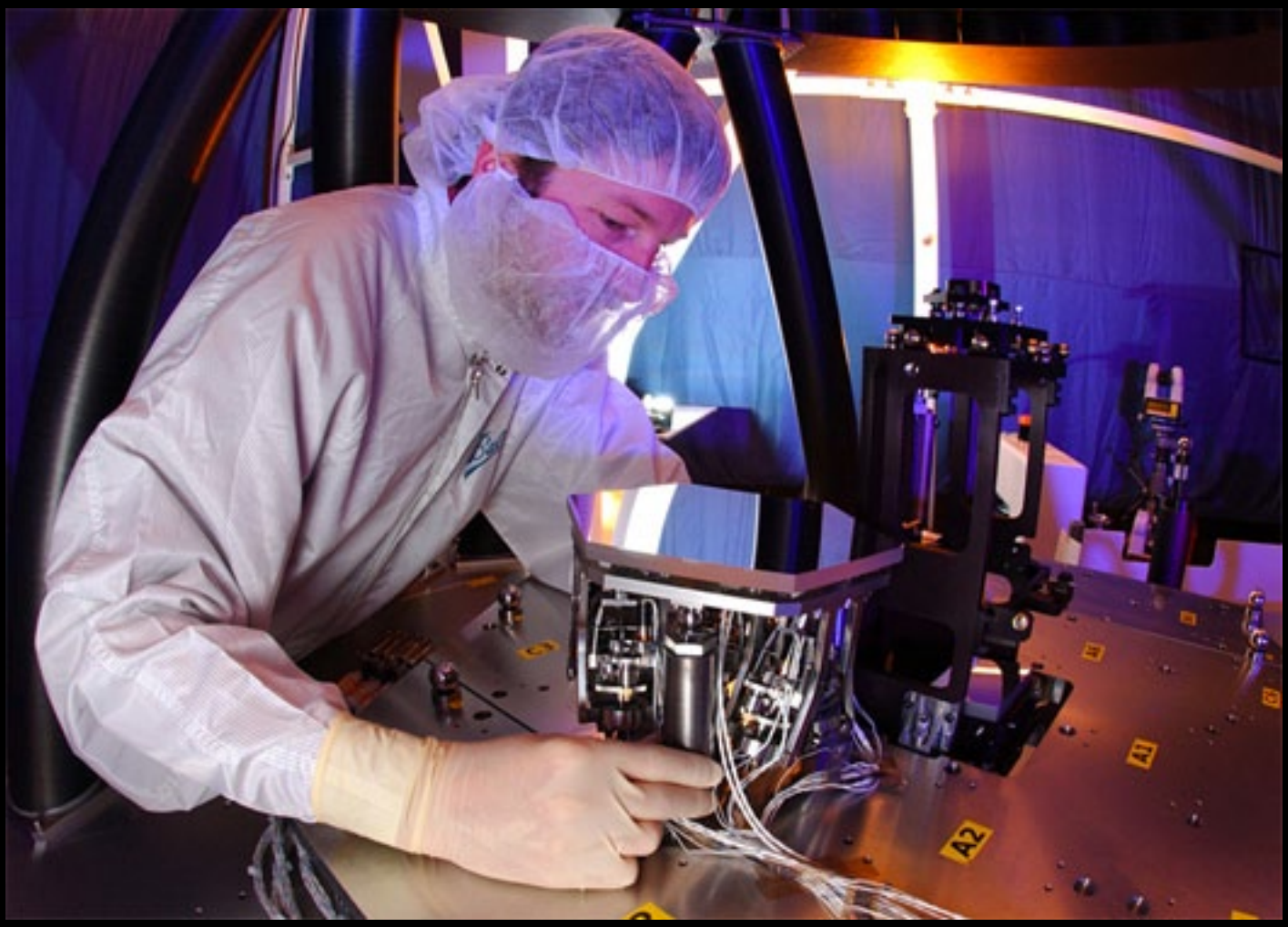
Starting early next year, the sunshield layers will be very precisely aligned on a giant 2,000-pound platform. Each one of five templates or pre-flight model layers will be spread out on the table where holes will be made in the exact locations needed to attach the layers to the structure for launch. To ensure proper fit and function, the hole positions are different for each layer and their locations are controlled to a small fraction of an inch. Hole positioning is a critical task because all the holes in five folded membranes must align, so that the sunshield layers are held in a predetermined configuration to survive launch so that they can later unfold in a carefully orchestrated way. The process will begin with the first of five template membranes in January 2012 and continue through the year, interspersed with fit checks on the full-size telescope mock-up. Construction of the five flight membranes is scheduled to begin in mid-2013.

Suspended In Space, Held In Place

Supporting the sunshield and telescope is the spacecraft, which is moving forward through design reviews in the run-up to the Critical Design Review (CDR). The spacecraft has completed five of 12 subsystem Critical Design Reviews. These are:

Command and Data Handling Subsystem
Attitude Control Subsystem
Deployment Control Subsystem
Flight Software Build 1
Flight Software Build 2

In addition, work has continued beyond subsystem CDR maturity. Engineers have verified the flight software responsible for ground commands and science data delivery meets mission requirements. Launch and deployment software verification testing will begin by next summer, followed by software for attitude and



Technician working on a early, sub-scale, test JWST mirror segment. Photo courtesy of Ball Aerospace & Technologies Corporation.

thermal control. Early completion of flight software verification testing achieved cost savings and significant risk retirement for the program.

Four spacecraft structure sub-assemblies have passed critical design review, representing substantial progress for the bus design:

- The primary structure that supports the observatory during launch and operations. This 350 kilogram graphite composite structure is designed to support 6.5 metric tons.
- The propulsion structure module, which supports the spacecraft propulsion subsystem responsible for orbit insertion and maintenance.
- The cone assembly, which mates the primary observatory support structure to the Ariane 5 launch vehicle.
- The spacecraft to telescope isolator, which reduces vibration between the spacecraft and telescope.
- A sunshield support structure sub-assembly
- The support structure for the communications downlink antenna to the Deep Space Network.
- The support structure for the cryocooler which cools the Mid-Infrared Instrument (MIRI)

The spacecraft's propulsion system is moving forward with a critical design review confirming a thermal upgrade to 16 monopropellant rocket engine (MRE-1) thrusters. They were modified to withstand the high temperatures on the spacecraft generated by both the sun and reflected heat from the sunshield. The 6-inch long MRE-1 thrusters provide one pound of thrust each to unload momentum and provide precision attitude control on-orbit. Propulsion engineers have also completed building four flight Secondary Combustion Augmented Thrusters, which provide eight pounds of thrust each and supply orbit maintenance after the launch vehicle finishes its burns.

Tools For Discovery

Webb's four instruments are designed to work primarily in the infrared range of the electromagnetic spectrum, where light becomes heat. They will also have some capability in the visible light range. The *Near Infrared Camera* (**NIRCam**) engineering test unit has undergone performance evaluation at NASA's Goddard Space Flight Center in Greenbelt, Maryland. The University of Arizona and Lockheed Martin are constructing the flight instrument. The *Near Infrared Spectrograph* (**NIRSpec**) flight instrument has been assembled and is now undergoing testing in Europe. The *Mid-Infrared Instrument* (**MIRI**) flight unit construction is complete and has finished its cryogenic performance tests at the **Rutherford Appleton Laboratory** in England.

The *Fine Guidance Sensor/Near-Infrared Imager and Slitless Spectrograph* (**FGS/NIRISS**) is currently being tested in preparation for delivery to Goddard in summer 2012.

Putting It All Together

Although much work remains to be done, the telescope's engineering design has been proven through component-level testing. As that is completed, the Observatory moves into its all-important integration and test phase, when components become subsystems and subsystems become whole, ready for testing at a systems engineering level.

Webb is unique in the history of space telescopes. There is no mission planned either by NASA or any other space agency that can achieve Webb's science goals. These goals are transformative and will open a new era in astrophysics. Webb will see the first galaxies; study the assembly and evolution of galaxies and the role of dark matter, stars, and metals; characterize the nature of liquid water on planets around other stars and reveal the births of stars and planetary systems.

Through one-of-a-kind design, careful planning and rigorous testing, the James Webb Space Telescope is on track to fulfill its purpose and give us a story to tell that surpasses our wildest imaginings.

About the author

Scott P. Willoughby is the vice president and program manager for the James Webb Space Telescope Program at Northrop Grumman Aerospace Systems. The program is currently on contract for the design, development and delivery of the Observatory to NASA's Goddard Space Flight Center. Scott has had a leadership role on the Webb telescope program since September 2009 when he was named program manager. In his more than 20 years with the company, he has held roles at increasing levels of responsibility in integration and test, production and supply chain, product design/development, and systems engineering.

Previously, Scott served as the P858 program manager in Advanced Concepts, Technology and Emerging Systems. His primary responsibilities were to drive process improvements and delivery of this critical and strategic program. He oversaw program management including financial management, capital, human resources, customer and subcontractor interfaces and all levels of contract management.

Global Connections Create Capacity Of The Premier Kind

by Paul Sims

When SES-4 reaches its coveted orbital slot, it will be the 50th satellite in the growing SES fleet. The largest and most advanced of all SES spacecraft will bridge four continents, a clear illustration of the satellite operator's partnership strategy aimed at helping its customers grow and expand around the world. SES-4 offers seamless coverage over the Americas, Africa, Europe and the Middle East.

Artistic rendition of the SES-4 satellite. Image courtesy of Space Systems/Loral.

The SES-4 satellite being loaded into a cargo plane for transport to the launch site.

SES is investing in the capacity and people to greatly enhance customer capabilities and opportunities in established and emerging markets. More than a dozen satellites are being launched in a two-and-a-half year span to meet global demand for content and connectivity. And SES' new regional leadership structure is firmly in place, including the newly appointed sales leader in the Americas, Elias Zaccack.

"SES has the right capacity, the best coverage, people and operational structure to help our customers reach new levels of success," said Zaccack, Senior Vice President of Commercial Sales for SES in the Americas. Zaccack is a seasoned SES executive and industry veteran with extensive experience in North America and Asia-Pacific.

He will be working closely with the North America, Latin America and Occasional Use sales and support teams, as part of a global strategy focused on driving growth and building customer alliances. "Our customers rely on our regional and global expertise and financial stability as much as they do our satellite capacity, big competitive advantages for SES," noted Zaccack. "And with a record fleet investment program well underway, our regional and global customers can grow with us virtually anywhere they want to go."

SES' Elias Zaccack

New Possibilities

SES' customer base throughout the Americas features some of the biggest names and most innovative startups in the worlds of media and entertainment and enterprise. Many are reaching into new markets and exploring new possibilities using SES' capacity.

Turner Broadcasting System, Inc., for example, is using capacity on at least four SES satellites to distribute news and entertainment programming to millions of viewers throughout North America and Europe. Once operational, the high-powered SES-4 will enable CNN to deliver breaking news from North America to European affiliates. Much of CNN's satellite news gathering (SNG) across the U.S. and Canada relies on SES satellites. And DTH audiences across the UK and Germany receive a variety of Turner programming, ranging from CNN to the Cartoon Network, from SES spacecraft.

"SES has the satellites, personnel and expertise that Turner Broadcasting System needs in order to reach audiences around the world," said John Ball, Vice President of International Distribution Technology for Turner Broadcasting System. "Our long-term distribution partnership with SES is an important component of our global content delivery strategy."

SES' occasional use capacity, which enables much of the world's breaking news coverage, is bound to be in high demand over what will be an eventful 2012. "This will absolutely be an eventful year for Occasional use," said Samantha McCloskey, Vice President of Global Occasional Use Services for SES. "The U.S. Presidential election in November and the 2012 London Olympics headline an impressive list of world events and broadcasts that will require major capacity on our fleet."

"We have the fleet in space, the feet on the street and the proven expertise and leadership throughout the Americas region, at a time when our customers are looking to expand into new opportunities," noted Steve Bunke, SES' Vice President of North America Sales.

Microspace is another good example of an innovator leveraging the SES fleet to reach new markets. The digital content distributor will utilize SES-4 to allow major North American retailers to extend their digital signage campaigns globally. One major brand's in-store promotional videos will reach flat screen TVs positioned throughout its outlets and shopping center locations across Europe. Microspace uses significant transponder capacity on multiple SES satellites to enable much of its growing content delivery network, currently serving more than 250,000 remote links worldwide.

Emerging Markets

SES' heritage in cable television distribution throughout the U.S. has led to a leadership position in cable and DTH growth across Latin America. The NSS-806 satellite is the region's leading video neighborhood, with the advanced SES-6 satellite poised to take over that desired title once it's operational next year. Increasingly, AMC-9 is positioned to become a popular video neighborhood over Mexico, demonstrating the nimble nature of the SES fleet. AMC-9 is able to serve most of the U.S. and Mexico.

"Latin America has been, and will continue to be the hottest market for SES in the foreseeable future," added Dolores Martos, Vice President of Latin America Sales for SES. "SES continues to add capacity into this important market, and we will continue to remain closely aligned with our media, enterprise and government customers and to provide the best solutions possible to drive growth and profitability," Martos said.

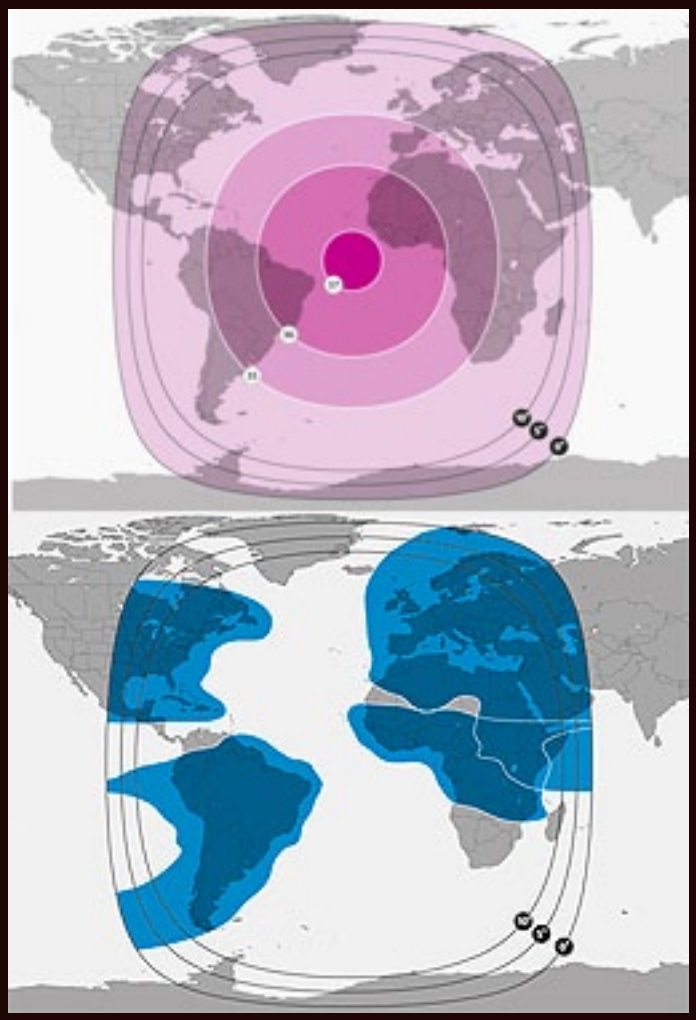
HD is on the verge of driving capacity demand across Latin America. And SES' HD leadership in the U.S. and Canada will provide much of the necessary expertise to ensure a successful rollout in the emerging markets of Brazil and beyond. SES delivers 6,000 TV and radio channels globally. It has the world's leading HD platform with more than 1,100 high-def channels. The operator reaches more than 245 million cable, DTH and IPTV homes. SES is the undisputed leading DTH satellite operator, carrying 43 DTH platforms over its fleet of 50 satellites. SES is adding capacity over Asia to meet increasing demand for quality TV programming. Relying on SES' unsurpassed DTH know-how across Europe, new DTH providers in places like Vietnam and the Philippines are driving a wave of extensive channel lineups capable of satisfying the region's appetite for popular content.

VSAT demand is on the rise across remote and isolated countries and communities, especially in places like the inland nations of Africa and the Middle East where terrain is rough and fiber is out of reach and often unreliable. SES is extending the capabilities of mobile data and broadband — life-changing technologies that are opening the door to education, jobs and economic development in many underserved regions.

The SES-4 satellite undergoing inspections at Space Systems/Loral.

SES is the lead investor in O3b Networks, a first-of-its-kind Ka-band operator set to launch an initial Medium Earth Orbit fleet of 12 satellites aimed at connecting the unconnected around the world. SES and O3b fleets will play a complementary role in closing the bandwidth gap in remote and rural markets.

Oil and gas companies and maritime service providers are also tapping the global SES fleet to offer VSAT-delivered broadband to isolated rigs and deep ocean platforms and ships drilling and searching for reserves in distant seas. The maritime and oil and gas industries are increasingly using SES bandwidth to expand into emerging markets and to keep remote crews connected with colleagues at headquarters and family at home. SES satellites are also enabling shipping and drilling firms to monitor their mission-critical operations in some of the remotest locations on Earth.



SES-4 coverage maps—top, C-band, bottom, Ku-band

"It's an exciting time to be part of SES, working with the industry's best people and most advanced fleet to help our customers reach and exceed their global ambitions," noted Zaccack. "Everything we do at SES revolves around our customers' global success."

Key data

Expected orbital location	338°E
Coverage	North America, Latin America, South Africa, North Africa, Europe, Atlantic Ocean
Launch date	Q1
Launch Vehicle	Proton Breeze M
Design Life	15 years
Satellite Manufacturer	Space Systems Loral
Uplink Frequency	C-band: 5.85 - 6.425 GHz Ku-band: 13.75 - 14.5 GHz
Downlink Frequency	C-band: 3.625 – 4.20 GHz Ku-band: Americas: 11.70 – 12.20 GHz Europe & Africa: 10.95 – 11.20 GHz 11.45 – 11.70 GHz 12.50 – 12.75 GHz
Polarisation	C-band: Circular Ku-band: Linear
Total Transponders	C-band: 52 (36 MHz equivalent) Ku-band: 72 (36 MHz equivalent)

Global Showcase

SES will showcase its new global brand and latest solutions next month at the Satellite 2012 Conference and Exhibition in Washington, DC. More than a dozen SES executives will be featured speakers during key panels and roundtable presentations covering everything from next generation satellite technologies and military communications initiatives to exciting opportunities in Latin America, Africa and Asia. For more information about SES or the growing SES fleet, upcoming launches and more, visit www.ses.com.

About the author
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Addressing SATCOM Needs For Terrestrial Drilling Ops

by Keith Johnson, President, Energy Solutions, Harris CapRock Communications

As natural resource exploration across the globe has consistently experienced drastic changes over the past years, one subject remains at the forefront of the race for the next big find — the allocation and availability of new energy sources. Whether it's delving into some of the deepest waters or charging into untapped terrains, the oil and gas drilling market requires robust communications now more than ever before to ensure mission success.

It is often a given that maritime markets depend upon satellite communications for operations, as drill ships and commercial shipping vessels are mobile and cannot be tethered to fiber networks. For land drillers, however, communications infrastructures can often be an afterthought. When on land, it's become an assumption that anyone can just pull out a smartphone and gain access to all the connections and information needed at any point in time. The truth is, for drill sites, this is not always the case. A company may have rigs in the middle of a well-networked city, but much of the drilling market exists in remote areas where cellular signals cannot accommodate data transmission and communications needs.

At the heart of each drilling company's operations is its need to communicate. As land drilling sites are constantly being constructed, relocated and exhausted, the right communications solution requires rapid deployment and must be able to adapt to suit the ever-changing needs of the company.

Why SATCOM?

Drilling companies can manage any number of drill sites, ranging from just a few placed around a small deposit to hundreds across multiple countries and continents — each equipped with a skilled field team. In addition, corporate headquarters and field offices house teams of specialists, administrative staff and corporate personnel. As all personnel are required to work together seamlessly to manage drilling operations, it's important that each site be treated as an extension of the home office, with comprehensive communications capabilities. This generally requires cellular, WiMAX and Wi-Fi signals to connect between offices and drill sites, as well as to utilize technology within each site.

Of course, the location of a drilling site is not always convenient for the physical networks already established by carriers. Internet and cellphone coverage may not be available for each field crew, limiting their ability to communicate with other sites and team members, as well as conduct off-the-clock activities. Therein lies the true value of satellite communications — the strategic

placement of a fully contained communications solution allows for consistent, flexible coverage across a wide geographic area without building a local, physical infrastructure.

This type of flexibility is what makes a SATCOM service provider the ideal solution for the communication needs of land drilling operations. Not only does it meet the demands of drilling contractors, exploration and production operators and service companies, but SATCOM services will also save countless dollars by eliminating hardware and maintenance costs for what can often turn out to be extensive network requirements.

Needs

Without the proper communications infrastructure in place, a land drilling network can easily become a logistical nightmare. A dependable network allows for real-time transmission of critical drill site data, voice connectivity and corporate networking so that company resources can immediately be distributed where they're needed most.

In addition to corporate functions, crew morale is extremely important in the land drilling arena. As teams are often subjected to remote environments for weeks on end, it's important to provide them with outlets to remain close to families and friends. Satellite services allow drilling companies to easily allocate enough bandwidth to provide broadband Internet access and voice connectivity for drill site teams to connect with families and attend to matters unrelated to work. This makes for more efficient crews and may even reduce costs associated with human resources.

Of course, every drilling company's needs are different. They operate in different geographic areas, and as new fuel deposits are discovered or exhausted, they are constantly expanding, contracting and relocating to new locations. In many cases, this may limit the company's choices when it comes to a SATCOM service provider. Overcoming these challenges requires only that the drilling company select a service provider already invested in its own global infrastructure. Partnering with a global service provider that owns and operates the network ensures that, regardless of how remote the site, drilling companies can trust that they have reliable communications support for their missions.

Capabilities

For an industry in which profit is directly dependent upon the amount of materials allocated in a certain period, time is money. For every hour of network downtime, maintenance, setup and deconstruction, the drilling company is losing money. This is why a company's communications partner must be able to produce network components that are ready to deploy at a moment's notice. In addition, it pays to choose a provider with the resources to not only meet the company's immediate coverage and capability needs, but to manage unforeseen issues as well.

With drilling sites going up and coming down within a matter of hours or days, often without a predetermined

lifespan or timeline, communications equipment must be easily portable and capable of going online without delay. That means site data can begin transmission as soon as it's installed and commissioned by the site crew, and can therefore provide more accurate numbers for the drilling headquarters. These requirements have led to Very Small Aperture Terminal (VSAT) technology becoming a major player in SATCOM services for land drilling operations, as these terminals are easy to transport and can go online quickly.

Deployment, flexibility and network maintenance procedures may look different for every provider, depending on its size, so it's important to take these components into consideration before signing a contract. More specifically, a provider should be able to offer coverage beyond a company's current area of operations to allow for expansion. In addition, the provider's customer service program should offer the ability to proactively diagnose and remotely troubleshoot communications issues as they arise, preferably with 24/7 support so customers can stay focused on their core mission.

Availability

It's not enough for a service provider to have a wide variety of communications products and services; it must also have the network resources and infrastructure in place to accommodate clients' changing needs. For companies with a global presence, it's not cost-effective to sign contracts with local service providers in each country because that often means having to manage multiple vendors and invoices, not to mention the headaches associated with identifying the source of accountability for certain issues. Rather, larger, more established service providers may have the resources to offer connectivity for multiple countries or continents, saving the driller time and money.

In addition, wider networks generally come with multiple, local field offices and service centers, as opposed to a single headquarter location. This will save valuable time during deployment and maintenance, as site managers will be able to maintain more efficient relationships with hardware and network maintenance crews on a localized basis.

However, it may not always be necessary for service providers to have a service center or office near every drill site, as many of them offer remote capabilities. Since satellite networks are not static, network components may be adjusted remotely via the provider's Network Operations Centers (NOCs) to repair coverage issues or redistribute signals to new areas. This is an added benefit over stationary wireless networks, which have very limited flexibility to compensate for coverage needs.

Selecting A Provider

An efficient provider will offer a different combination of technology, services and packages, generally in a tailored combination to fit the specific needs of a client. Again, while this may have a larger price than those offered by a smaller company, it will save money in the long run when it comes to expanding capabilities across new regions and will save time and money in deployment and maintenance. Plus, the partnership will extend beyond the two companies' headquarters and will allow site managers to maintain communication with local technicians and other valuable stakeholders to make sure a site doesn't lose connectivity.

Of course, the success and reliability of a SATCOM network depends upon the quality of technology and service of the provider as well as of the enablement of drill site crews to operate and maintain network components. That is why it is important to choose a provider with the resources to help site managers keep a close watch on the network and react quickly when problems arise.

About the Author

Keith Johnson is president of Energy Solutions at Harris CapRock Communications, a premier global provider of managed satellite and terrestrial communications solutions, specifically for remote and harsh environments including the energy, government and maritime markets. Harris CapRock owns and operates a robust global infrastructure that includes teleports on six continents, five 24/7 customer service centers, AssuredCare customer service and network management program, local presence in 23 countries and more than 275 global field service personnel supporting customer locations across North America, Central and South America, Europe, West Africa and Asia-Pacific regions. To better serve the energy market, Harris CapRock launched a new solution, FieldAccess, in August 2010, which serves land drilling operations with broadband Internet, voice connectivity, corporate networking and real-time data to remote sites. Delivered via a managed service, FieldAccess includes equipment, service and support with in-region technicians and strategically located equipment depots near major oil and gas plays.

Solving The Backhaul Conundrum

by Richard Deasington, Senior Director, Vertical Markets, iDirect

After a decade of domination by GSM standard second generation (2G) mobile phone networks, the world has embraced third generation technology (3G). Two-G systems laid a broad foundation for extending voice communication to the vast majority of the world's population. Yet 3G holds even greater promise, enabling mobile operators to deliver both voice and data connectivity to subscribers and greatly expand their revenue potential.

Specifically, 3G technology provides a more profitable path to serving rural subscribers in both developing and developed countries. For many of these customers, 3G service represents the most affordable access to high-speed Internet connectivity — sometimes the only access. According to the International Telecommunication Union (ITU), only 15.8 percent of the population in developing countries has Internet access and only 22.5 percent have a computer. In the future, Internet access will primarily be through mobile devices, and this represents a significant opportunity for mobile operators. In fact, a new report by Cisco projects reveals that mobile data traffic will increase 26-fold worldwide by 2015, with the population of mobile-only Internet users surging from 14 million in 2010 to 788 million in 2015.

What's stopping mobile operators from pursuing these opportunities? One key challenge is backhauling rural network traffic in a way that makes it affordable for mobile operators to extend their services. Fortunately, 3G operators can look to recent progress in the expansion of 2G into rural areas through satellite backhaul as a model for similar growth. Thanks to falling infrastructure costs, the transition to IP and advancements in satellite backhaul technology, mobile operators are primed to bring 3G to the rural market.

How 2G Operators Cracked the Rural Market Through Satellite Backhaul

Traditionally, mobile operators relied on a technology called SCPC (Single Channel Per Carrier) to backhaul 2G Base Transceiver Station (BTS) traffic. It was a simple solution, but was often operationally inefficient because the capacity of the satellite link between two modems had to be configured for peak usage — which typically occurs for only a few hours on the busiest day of the year.

Since satellite bandwidth is the most expensive element in budgeting for a remote base station, the wasted capacity from SCPC made it a poor value proposition for

connecting remote and rural locations (see Figure 1). With the development of satellite networks based on TDMA (Time Division Multiple Access) mobile operators were now able to centrally manage a single pool of bandwidth that is shared across many sites. This provided a more cost effective way to allocate bandwidth based on the real-time requirements of each BTS location.

Will Satellite Backhaul Work Over 3G?

As Mobile operators have increased their service offerings to include data they began to update their infrastructure from Time Division Multiplexed (TDM) links to IP-based solutions to take advantage of the efficiencies offered by IP.

This migration has also been supported by innovations in technology in the satellite market to support the increased requirements for data transport and to help make the business case work for 3G connectivity in remote and rural areas. For example, the move to the second generation of the Digital Video Broadcasting standard, or DVB-S2, has made TDMA networks dramatically faster and more efficient. Likewise, the development of Adaptive Coding and Modulation (ACM) has helped mobile operators address the long-standing challenge of rain fade.

Another innovation, introduced by iDirect, is the integration of TDMA and SCPC onto a single platform (see Figure 2 on the next page). For the majority of cellular sites, traffic is a variable, which is ideal for TDMA. However, in some circumstances, links must remain at a fairly constant capacity, which requires SCPC capability.

To handle both scenarios, the iDirect system can easily switch a standard Evolution series remote working in TDMA mode to operating as a SCPC terminal with a few clicks of a mouse. This flexibility allows operators to change remotes between SCPC and TDMA as often as they like, and also allows an operator to start with a very small variable throughput at a remote site and then switch to a dedicated connection when there is a business justification for SCPC.

The development of femtocell technology is a third key innovation supporting the deployment of 3G networks. Femtocell technology, which is significantly less expensive than macro-cell technology, is a game changer in developing nations because it clears a path for mobile operators to extend data service to rural markets where mobile Internet access is the norm.

Making the 3G Business Case for Satellite Backhaul

To demonstrate the business case for satellite backhaul, let's examine the typical capital and operating costs associated with satellite backhaul and the typical ROI a mobile operator can expect.

Hardware costs

In a TDMA network, the satellite equipment costs include a hub system at a mobile switching center and the remote routers located at base station sites. While there are many variables, for a network of a few hundred sites we could estimate the total cost for both hub and remote equipment at $3,000 - $6,000 per site.

In a typical SCPC network, each remote operates individually without a centralized hub. This makes each remote site more expensive, but eliminates the cost of the central hub. However, because the cost of SCPC modems are typically around two or three times that of TDMA systems, once the cost of a TDMA hub has been amortized across as few as twenty sites, the capital cost for TDMA is lower.

Advancements in mobile infrastructure have also reduced the cost of deploying a small cell to act as an eNode B at remote and rural locations, which lower the costs compared to traditional macrocell deployments.

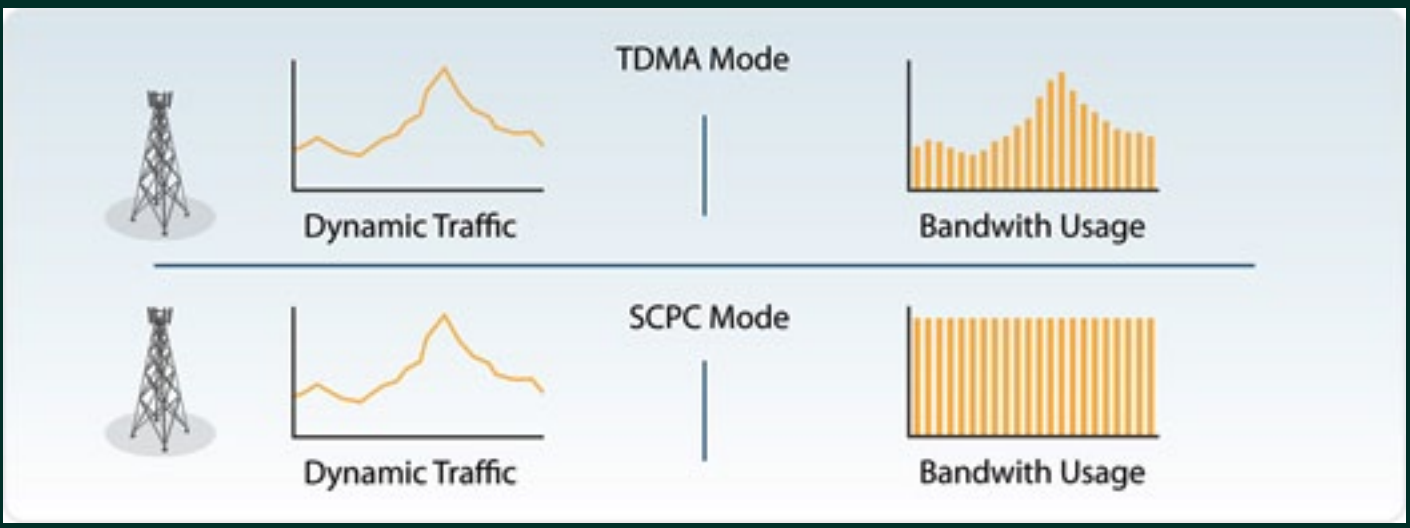

Figure 1. Comparison of per-site bandwidth usage under SCPC and TDMA systems (capex) make it unlikely to be economically feasible.

Operating Costs
When using a TDMA satellite system, such as the iDirect Evolution system, the bandwidth cost is directly related to the peak requirement for IP bandwidth across the whole network. This can be derived from the individual 3G remote base station (Node B) busy hour traffic figures. With iDirect, users can easily calculate this figure by calculating the peak bandwidth (in Mbit/s) and the amount of satellite bandwidth (in MHz) to determine the amount of traffic that can be supported on the network.

By combining TDMA and SCPC on one network, iDirect further reduces operating costs by allowing a mobile operator to switch a router from TDMA mode to a dedicated SCPC link based on usage needs. This also reduces equipment and labor costs by eliminating the need to swap remote hardware and maintain dual networks.

Efficient 3G Backhaul A Reality
New developments in IP-based satellite systems make satellite the ideal medium to reach the remote and rural sites that are the key areas lacking 3G coverage. The combination of lower cost and highly efficient satellite backhaul with the new generation of highly economic 3G base stations makes the business case for rolling out 3G to remote and rural areas a clear winner.

To learn more about the advantages of IP-based satellite systems for 3G backhaul and to see sample business cases that highlight the cost savings and potential revenue gains of deploying 3G networks over VSAT, visit iDirect.net to download the full white paper upon which this article is based...

http://www.idirect.net/Applications/Cellular-Backhaul/Extending-3G-Coverage-To-Remote-Areas-White-Paper.aspx

About the author

Richard Deasington has more than 25 years of experience in the telecommunications industry, holding senior level positions in R&D and Engineering working closely on voice, data and transmission network systems. In his current role as Senior Systems Engineer Richard is currently responsible for leading iDirect's engineering and sales efforts for GSM backhaul solutions. Prior to joining iDirect, Richard held Managing Consultant position at PA Consulting Group and later Questus Ltd where he focused on mobile systems: GSM and 3G systems in particular. He has been involved in a large range of mobile related activities from architecting the world's first shared 3G network to leading the design of a range of network planning tools. Richard has written several well-known books and published many articles on subjects ranging from 3G power amplifier efficiency to network sharing and push-to-talk. Richard holds a Bachelor of Science degree with Honors in Computer Science with Biology from the University of London.

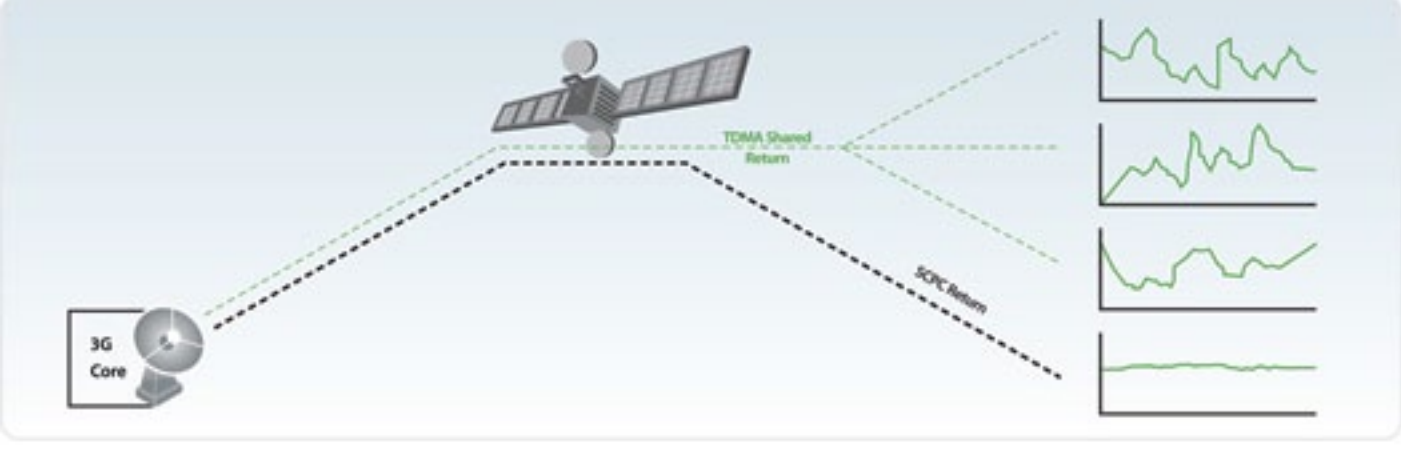

Figure 2: Shared TDMA carriers used for variable traffic volumes; SCPC used for steady traffic volumes.

Urban Growth Analysis Via Landsat

by M. Gregory Hammann, Senior Director, GeoEye

Campinas City, Brazil, is one of the 10 fastest growing cities in the world with just over a million people in 2010. Does the new growth show signs of urban/suburban sprawl? This study investigates a null hypothesis that growth in Campinas cannot be characterized as urban sprawl because the growth in urban land use/land coverage (LU/LC) is the same as the population growth during the same period. Land use/land coverage was measured using ***Landsat***™ imagery from 1989 through 2010.

Unsupervised and supervised classification methods were combined to separate urban (including suburban) areas from non-urban areas. *Near-infrared color composite* images (**NCC**), the *Transformed Normalized Difference Vegetation Index* (**TNDVI**), band-6 thermal images, and the *Tasseled Cap* analysis were produced. Population growth was estimated from official Brazilian census reports. The area was measured in the resulting urban/non-urban classes using the NCC images. The increase in urban LU/LC was 26.9 percent between 1989 to 2000 and 22.5 percent during 2000 to 2010. The population growth rate was 13.4 percent and 10.3 percent during 1991 to 2000 and 2000 to 2010. The growth in urban LU/LC was over double the population growth and the null hypothesis is rejected, concluding that there is evidence for urban sprawl in Campinas, Brazil. Other evidence includes the appearance of new urban areas separated from the central hub of urban growth in a "leap-frogging" pattern.

Campinas City, Brazil

Brazil is a country with many natural resources and a growing economy and population. São Paolo is one of the largest cities in the world with a population of almost 19 million (Anonymous, 2011a; Kotkin, 2010). Just to the north of São Paolo is the city of Campinas, which has the distinction of being one of the 10 fastest growing cities of the world (Kotkin, 2010) with a population of about one million, people (Anonymous, 2011b). According to the 2010 Brazilian census (Anonymous, 2011b), the urban population in Campinas continues to increase and the rural population is decreasing. The City of Campinas has been campaigning to bring in investors stressing that it is a green city and a great place to live and run a business (Anonymous, 2011a). How is Campinas growing and what impact does that growth have on the surrounding environment? Is the growth in the population by increasing the urban density and the use of high-rise buildings, or is the city growing outward from the central business district? What is the impact of the urban growth on the human quality of life?

There is much literature characterizing urban sprawl, its definition, how to measure it and its impact (Ewing et al., 2002; Johnson, 2001; Harold et al., 2003). Ewing et al. (2002) cites the quote from Justice Potter Stewart on pornography that "most people would be hard pressed to define it, but they know it when they see it"; the same applies to urban sprawl. A general definition for urban sprawl is growth in the urban LU/LC at a faster

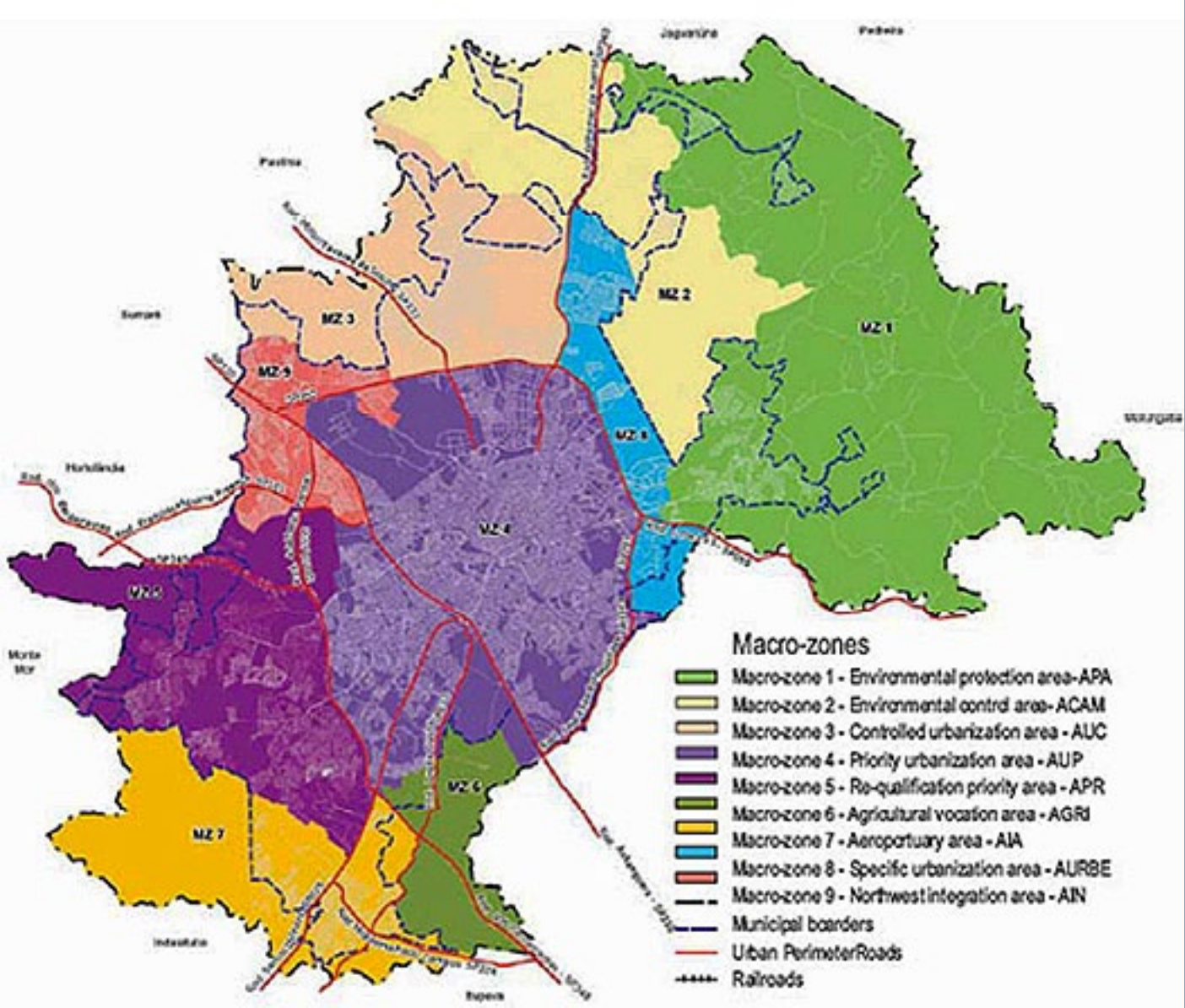

Figure 1. Map of São Paulo's Campinas County, State of São Paulo, Brazil.

rate than the population (Ewing et al., 2002). Bhatta et al. (2010a) reviewed much of the recent literature looking for a better definition of urban sprawl and found that like Ewing et al. (2002), there is much disagreement on an exact definition but most agree that unorganized and uneven urban growth is a basic indicator. In general, researchers agree that urban sprawl represents a costly, poor use of available resources with several negative implications for society (Ewing et al., 2002; Bhatta et al., 2010a). New areas that grow away from the city center are typically of single use, low density areas, with increased dependence on private vehicles for transportation and in general a lower access to necessary services and goods.

Many researchers have stressed the importance of using GIS and Remote Sensing to study urban sprawl and the measure of impervious surface is a vital tool (Kumar et al., 2008). Satellite imagery and GIS tools are in common practice and many locations are generating public information critical for the planners (Anonymous, 2002; Sawaya et al., 2003; Sudhira et al., 2004; Yuan, 2008). Impervious surface estimates, vegetation indices and land surface temperature (LST) using Landsat imagery have been studied by many researchers (Yuan and Bauer, 2007; Yuan, 2008; Meng et al., 2010).

The city government of Campinas published in 2006 their plan for urbanization and land use for the county (Anonymous, 2011c). In "The Plan" the county is divided into nine Macrozones and each one has its development plan (*Figure 1 on the previous page*). The urban city center is in the Macrozone 4, which has been defined for priority urbanization. Macrozone 1 is an area under environmental protection.

Methodology

Study Location

The study area is Campinas City, Campinas County, State of São Paulo, (*Figure 2 on the next page*). The city coordinates are 22° 54' 3" S, 47° 3' 26" W Datum WGS84. The 2010 population was estimated at 1,080,999 (IBGE, 2010) with over 98.3 percent in the urban region. The population density was 1,359 inhabitants/ km² for 2010 (IBGE, 2010). The municipal area of Campinas covers 795.667 square kilometers.

Data Collection

Data sources are defined in *Table 1, (*shown below). The Internet was used to look for sources for the GIS layers as well as to obtain population data from Campinas, Brazil. DIVA holds a large collection of GIS layers and several relevant layers with administrative areas, roads and rivers and water bodies were obtained. First, a small-scale GIS database of Brazil was built to learn the context around the study site before focusing on a local study. The administrative areas 1 and 2 were located but the file for the third had the same information as the second; thus the state and county boundaries were obtained, but not the city boundaries so this study is carried out at the county level.

Population estimates for the city of Campinas were available at the Brazilian Institute of Geography and Statistics (IBGE) website. The most recent census was in 2010 and population estimates were available from 1970. Landsat imagery was located at the USGS Earth Explorer website site. Nearly cloud free imagery was searched for in Path/Row 219/76, and selected when available between 1989 and 2010.

Census Population Data

The census population estimates were plotted against year, and the growth rate was calculated. In this case, growth is defined simply as the percent change between two successive estimates.

Image Analysis

ERDAS Imagine 2010 was used for the image processing. The image processing and analyses followed these steps:

1. Download full level 1 data files and uncompress
2. Stack layers of 7 bands to combine into a single file
3. Rectify the images using the image from April 2010 as the reference, and resample with a square pixel size of 30x30m
4. Reproject to a map projection UTM 23S, WSG84
5. Subsample the images to a block surrounding Campinas country using an AOI to assure they have the same coverage
6. Create and evaluate natural color (RGB=321) and NIR color composite (RGB=432) images

Information Type	Source
Landsat 5 TM	Landsat 5 TM 7-band raster image. LT52190762010108CUB00. Collected 4/18/2010. WRS Path/Row: 219/76.
Landsat 7 ETM+	Landsat 7 ETM+ 7-band raster image. L71219076_07620001023. Collected 10/23/2000. WRS Path/Row: 219/76.
Landsat 4 TM	Landsat 4 TM 7-band raster image. LT42190761989298XXX03. Collected 10/25/1989. WRS Path/Row: 219/76.
Brazil Administrative Shape Files	DIVA GIS http://www.diva-gis.org/gdata
Brasil Census Population Data	Brazilian Institute of Geography and Statistics. http://www.ibge.gov.br/home/

Table 1. Data Sources

Figure 2. Map of São Paulo's Campinas County, State of São Paulo, Brazil.

7. Calculate and evaluate the Transformed Normalized Difference Vegetation Index (TNDVI)
8. Display and evaluate the thermal band 6 for each image
9. Calculate the Tasseled Cap Analysis
10. Classify the images with the objective being to identify and quantify the LU/LC including suburban areas if possible
11. The accuracy assessment was only done subjectively for this paper by comparing with the LandSat images with Google Earth

The TNDVI was calculated as follows:
TNDVI = ((NIR-Red/NIR+Red)+0.5))^(1/2)

A hybrid technique was used to classify the Landsat images. First, an unsupervised classification was done with 30 classes to generate a set of spectral signatures to evaluate for a supervised classification. After evaluating the set of 30 signatures, some were deleted and others were added. The separability analysis in ERDAS 2010 was used to evaluate the signatures. The land cover corresponding to the signatures was visually identified by comparing to the unclassified RGB images and Google Earth.

The Tasseled Cap analysis was performed on the image from April 2010 and the urban and suburban areas were very identifiable. However, this analysis was not possible for the other images because ERDAS 2010 could not find the sensor information associated to the data. Integration with GIS ArcGIS v10 was used. Shapefiles of Brazil administrative areas were used to create a map of the state of São Paulo and Campinas County. The country boundary was used to clip the Landsat images to the county area. The Campinas City use plan (Anonymous, 2006) was obtained, which includes a map of their "macrozones". Each macrozone is managed separately with its own land use plan. The boundaries of the macrozones were digitized from a JPG image (Campinas City Hall) using ArcGis 10 to use as another feature layer.

The sets of natural and near-infrared color composite imagery (NCC) were subjectively evaluated along with Google Earth to understand the features. The TNDVI images are displayed to show two classes: Impervious surface areas, and everything else such as open vegetation areas, bare soil, and trees and forested areas. The Landsat TM band 6 thermal band was rendered as a psuedocolor image in ArcGis 10 to suggest urban heat areas. The images resulting from the supervised classification were recoded to only show the urban areas and everything else. The coverage in area of the urban areas in the classified images were estimated by multiplying the number of pixels by the area of each pixel (30x30m). The coverage and decadal increase in the urban land cover with the population estimates and growth rates were plotted. Images were clipped to the Campinas County boundary.

Results

The urban and suburban areas in Campinas County, Brazil are very clear in the NCC imagery (*Figure 3*). In these images red is the reflectance from green vegetation, blue is constructed surfaces (impervious) and green shades are bare soil.

The TNDVI is another good way to identify urban areas. Water would have the lowest numbers but is not separated in the present analysis. Figure 4 shows the urban areas identified by TNDVI from 1989, 2000 and 2010. Especially in the urban center (Macrozone 4) the increase in urban land cover is quite apparent.

Urban areas generate heat and vegetation enhances cooling; this has been called the Urban Heat Island effect. *Figure 5* shows the hot spots in Campinas County measured by the thermal band on the Landsat satellites. Base soil can get very hot and is apparent in the other macrozone; for the priority-area for urbanization (Macrozone 4), the increase in heat is quite apparent.

The Tasseled Cap analysis shown in *Figure 6* is quite striking. The features are very clear and even the suburban areas are clearly separated (orange colors) from the urban areas which as shown in red (when observed under zoom). The blue lines are the roads and were combined with the red urban areas to estimate impervious surfaces. Classification of a series of Tasseled Cap images and measurement of the land cover could be valuable for future work.

The urban area and some of the suburban areas were identified with the final supervised classification recoded into a binary thematic map; urban areas and non-urban areas. *Figure 7* shows the urban areas identified for each image year; 1989, 2000 and 2010. Again, the increase in urban areas is evident especially in the Macrozone 4.

The amount of urban land cover has been increasing (*Table 3*); the rate of increase in urban coverage during the last 30 years has been over double the population growth rate (*Figure 9*).

Conclusions

Comparing the images during 1989-2010, and the population growth rates compared to the rate of increase in urban land coverage, it must concluded that the null hypothesis should be rejected; there is evidence that suggests that Campinas County is showing signs of Urban Sprawl. The urban area land coverage is increasing faster than the population is growing, and the growth pattern shows the 'leap-frogging' affect where isolated areas (mostly suburban) are popping up with less access to required services. The natural color and NCC images show the distribution of the urban areas growing out from the city center. The growth has not been concentric but is in discontinuous radial extensions of the city.

About the author
M. Gregory Hammann is a Senior Director at GeoEye, Inc. and PhD student at George Mason University in the Earth Systems and Geospatial Sciences program with a concentration in Remote Sensing. MS from Oregon State University and BA from Whittier College. He lives in northern Virginia with his wife and two children.

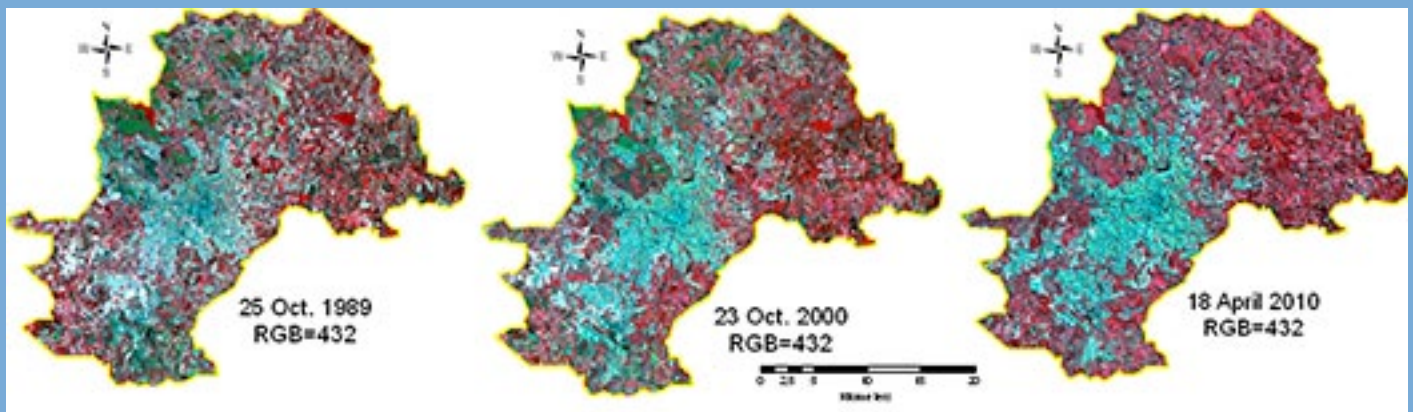

Figure 3. Near-Infrared false color (RGB=432) from Landsat imagery.

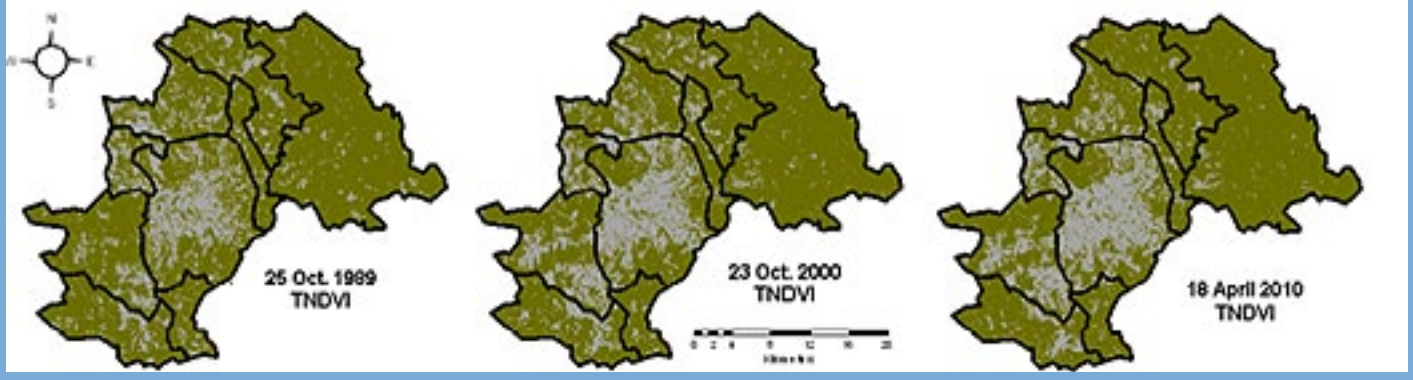

Figure 4. TNDVI analysis from Landsat imagery was rendered into two classes; urban and non-urban. The boundaries for the Macrozones are shown in black.

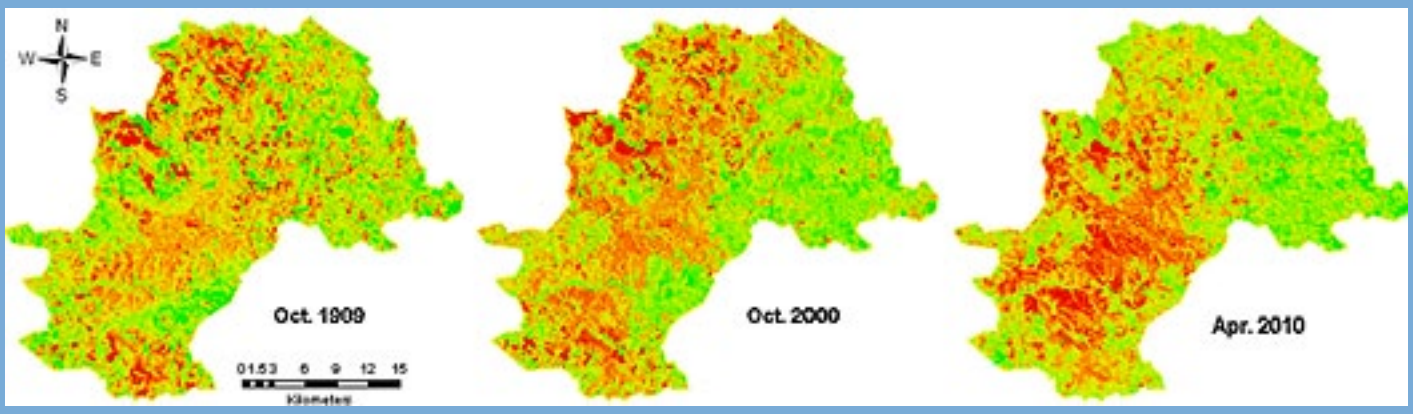

Figure 5. Landsat™ band 6 thermal image rendered in psuedocolor to show the high spots of urban heat in Campinas county. Red is the higher temperature.

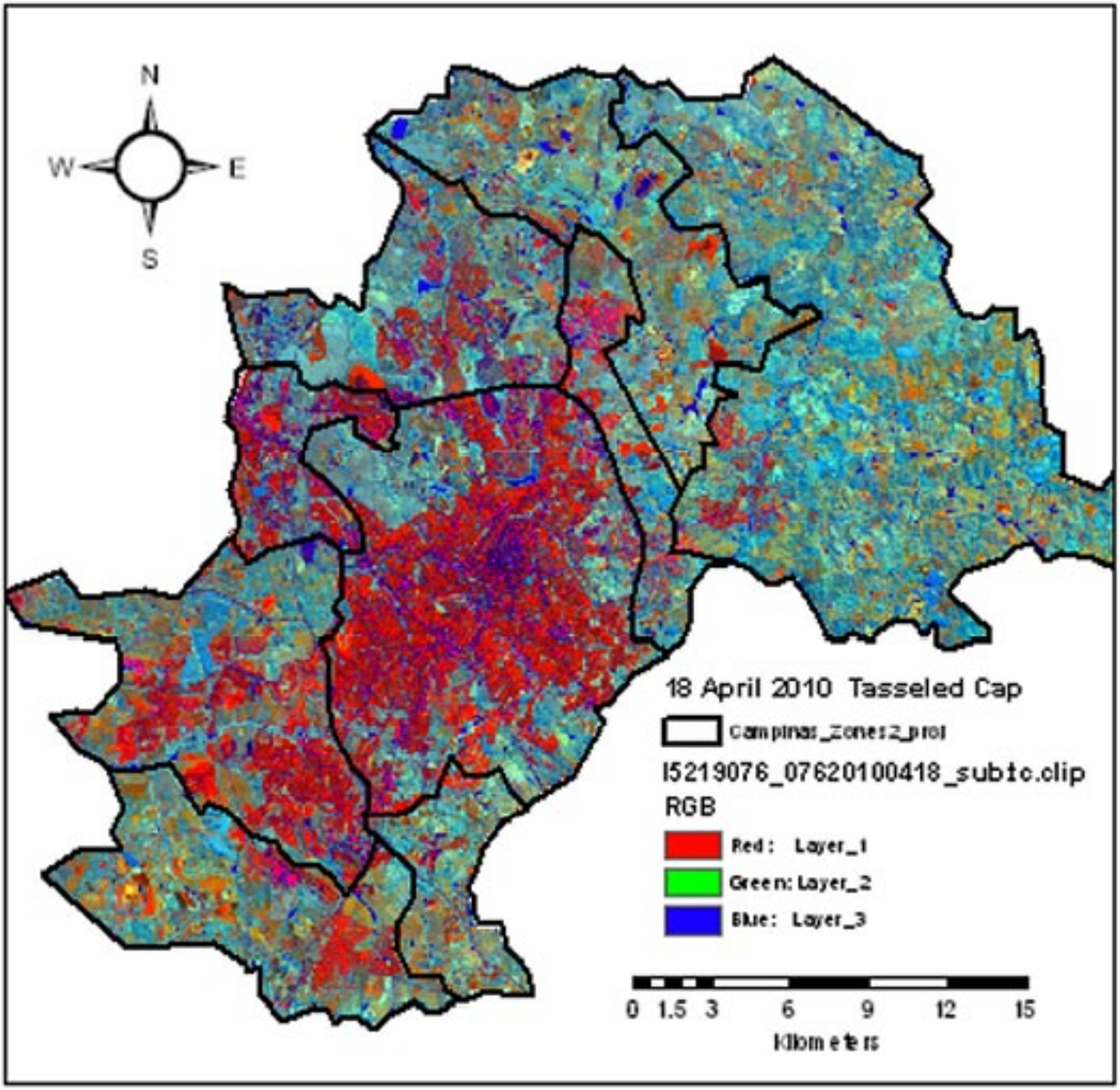

Figure 6. Tasseled Cap analysis on Landsat 5 TM image from 18 April 2010. RGB is rendered from the TC bands 1, 2 and 3; the boundaries for the Macrozones are shown in black.

Year	Rural Pop.	Urban Pop.	Total Pop.	% Change Urban Population
1970	40,395	335,469	375,864	
1980	73,151	591,415	664,566	43.3%
1991	22,671	824,924	847,595	28.3%
2000	16,366	953,030	969,396	13.4%
2010	18,546	1,062,453	1,080,999	10.3%

Table 2. Population estimates from the official Brazilian Census and the percent of population growth.

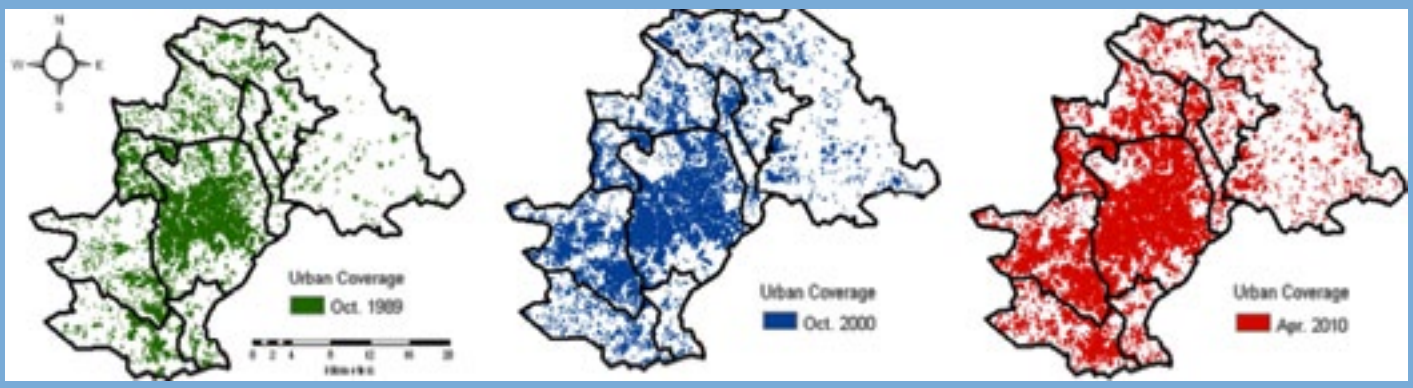

Figure 7. Landsat™ imagery after a supervised classification and recoding to show only the urban areas in 1989, 2000 and 2010; the boundaries for the Macrozones are shown in black.

The formal land development plan was published by the city of Campinas in 2006 and the individual plans for each Macrozone are underway (Anonymous, 2011c). Therefore, we are observing the results of either not having a previous plan or not supporting it with the necessary laws. We could expect that if the new plan is followed, new urban growth should be more organized.

Seasonal changes in vegetation and agricultural cycles are likely to have some effect on these results. The April 2010 image shows many differences from the October image; changes in the agricultural cycles as well in the tree leaf colors make a very different spectral environment. Of course this doesn't change the urban area but it does change the surrounding areas which makes the image classification more difficult. Another issue is that bare soil is not an impervious surface, but when it is bared for construction that could count as urban land use but in the classification it can get confused with other bare soil areas. More fields were bare in October compared to April. So the local vegetation cycles should be used to determine when is the best time to collect imagery and use imagery from all the same dates as available.

Another problem is the lack of a good accuracy assessment of the signatures used for the classification. More work is necessary to improve the signature extraction and evaluation, and to determine the user and producer's accuracy statistics. In this case, the separation of the urban area from everything else was the focus, but within the urban area, many pixels are mixed at Landsat resolution. Higher resolution imagery will permit more detail to study the urban centers and better classify the green areas within the city. The open areas in the county provide recreation opportunities for people, but the green areas in the city (Urban Tree Canopy) was difficult to measure in this study. The thermal images suggest areas of increased urban heat where more green areas need to be established. In the urban center downtown areas, you can see some areas with trees and small parks but elsewhere the constructed density is very high. The housing construction style is with very small yards and many structures seem to be sharing walls (Google Earth). The more affluent areas have more green space and there are two lines of homes between the access streets vs. three in other areas of the city. The counties to the east are agricultural and can provide Campinas County with the necessary fresh goods.

Image feature extraction from complicated urban areas might be improved by using an object-oriented analysis instead of the pixel-based classification used in the present study (Bhaskaran et al., 2010); that is an opportunity for future work.

The American Forests organization describes the importance of increasing the amount of tree cover in urban areas (American Forests, 2011). The Confederation of US Mayors (Anonymous, 2008) expressed the importance of improving the amount of urban tree cover in their cities and makes recommendations for humid areas in the USA (Table 4). Another important follow-on study would be to determine the urban and vegetation proportions in each of the Macrozones, and how they have changed in time compared to the LU/LC cover city plan.

The LU/LC for urban areas needs to be estimated for 1970 and 1980 to improve our understanding of the historical trends in both population and urban LU/LC growth. Next steps for this study are to use very high resolution (<4m) imagery as a source of ground truth to calibrate and validate the classifications in the Landsat imagery. The Tasseled Cap analysis appears to provide important spectral information and should be compared between the years to evaluate any improvement in the classification accuracy. Finally using very high-resolution imagery it will be possible to evaluate the Urban Tree Canopy in different sectors of the city.

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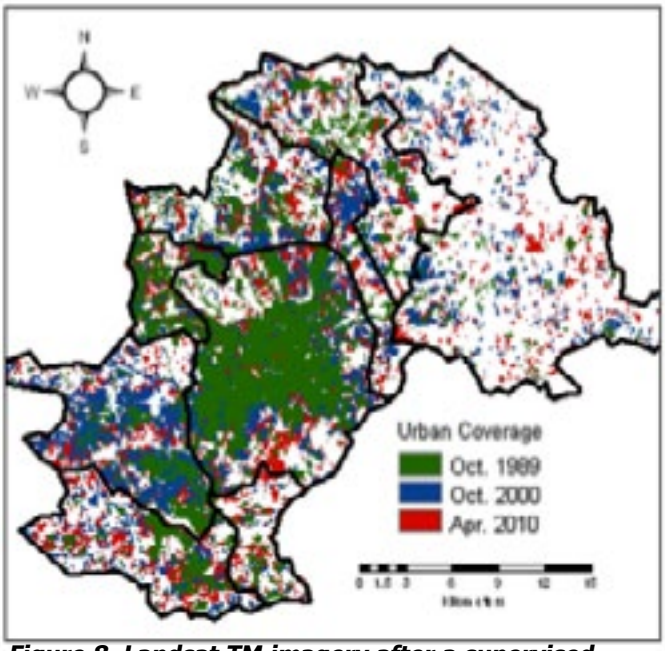

Figure 8. Landsat TM imagery after a supervised classification and recoding to show only the urban areas. Urban land coverage in 1989, 2000 and 2010 is overlaid to show the changes with time.

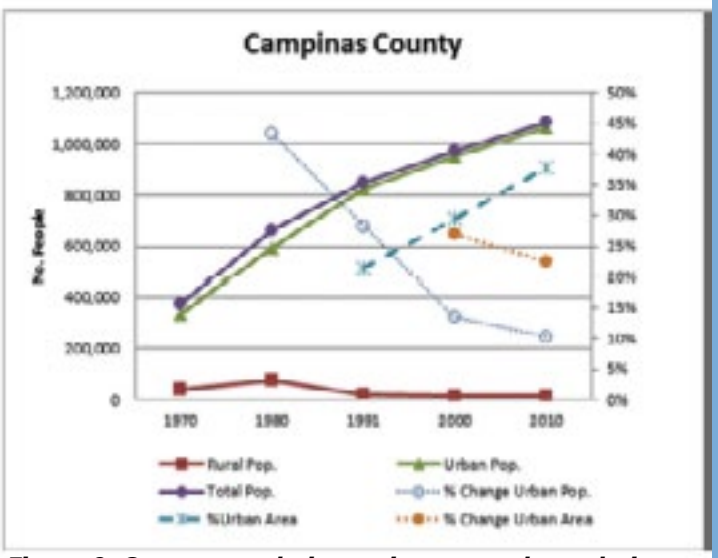

Figure 9. Census population estimates, and population growth rate; percent area with urban land coverage and the percent of change in urban land coverage for 2000 and 2010.

Year	Pixels	Km2	%Urban Area	% Change Urban Land Use/Land Cover
1989	190006	171.005	21.5%	
2000	259866	233.879	29.4%	26.9%
2010	335220	301.698	37.9%	22.5%
Total Area for Campinas (Km2)			796.746	

Table 3. Urban coverage in km2 estimated from the classified Landsat™ images; percent urban area, and the percent change in urban land use/ land coverage.

Average tree cover counting all zones	40%
Suburban residential zones	50%
Urban residential zones	25%
Central business districts	15%

Table 4. Recommendations for Urban Tree Cover. (Anonymous, 2008).

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The Road To The Future — Better Backgrounders

by Bert Sadtler, President, Boxwood Executive Search

These are extremely challenging times for employers who need to acquire top level talent as well as for those seeking a career change. Today, companies' economics compel them to re-assess their talent needs in order to remain competitive and drive growth. The satellite communications industry remains ripe with new opportunities. Employers are challenged with making a "great hire." For the candidate, finding an opportunity can sometimes be a rather difficult proposition. To assist with career searches, we asked Bert Sadtler of Boxwood Executive Search to respond to readers' questions regarding the processes of recruitment and hiring as well as how Companies can retain crucially-needed talent. Boxwood is located in the Washington DC region and has success in senior level recruitment in satellite communications, government contracting, and within the intelligence community. If you would care to submit a recruitment, hiring, or retention question specific to our satellite communications and related industries for Bert to answer, please email your question to BertSadtler@BoxwoodSearch.com.

This issue's inquiry:

Dear Bert,

Technology and the increased use of social networking appear to make recruiting, screening and referencing easier and more automated. Do you use these tools and do you think they simplify the hiring process?

Thank you,
JT, Chief Operations Officer

Dear JT,

Thank you for your note. I frequently hear questions on this topic. Twitter, Facebook and LinkedIn among others have become parts of everyday discussions. Social networking has gained full acceptance in our business lives. It only makes sense for it to be applied to recruiting and hiring.

First, let's define: The goal of good recruiting. The answer: Hire a long term, valuable asset to your organization. Good recruiting should be measured beyond the candidate simply accepting your offer. The measurement should be the employee's tenure and contributions made following the hire.

Before we view it as the "Holy Grail", let's think about what we did prior to social networking and technology. In earlier years, good recruiting involved determining the requirements, identifying candidates, screening, interviewing, reference checking and finally hiring. These are the same steps and processes that are used today and likely will continue into the future.

So, where is the use of current technology and social networking most useful? I find these tools to be best in identifying potential candidates. Technology has made it easier and faster to access information. Social networking has made it easy for people to promote their qualifications, offer their opinions, highlight their accomplishments and raise their visibility.

Candidates can be identified through numerous means that include networking, postings and tools including LinkedIn. However, identifying a potential candidate through technology tools and social networking tools does not necessarily mean they are ready to be hired. Candidate identification should not be confused with candidate development and recruiting.

Once a candidate is identified, the recruitment process remains in the early stage. Quality time needs to be invested by the hiring manager in getting to know the candidate. A critical part of good recruiting includes cultural fit and chemistry. Technology makes it appealing to accelerate hiring. Screening, interviewing and referencing still need to be completed prior to making an offer. Technology does not replace live discussions and in-person meetings.

While there is a temptation to take short cuts, be reminded that the goal of good recruiting is a long-term hire. Recruitment should not be measured by the number of candidate resumes or influenced by a hiring quota timeline.

Without following the recruitment process, there is a risk that you have not developed chemistry with the candidate and don't know them. At the same time, the candidate has not had time to get to know the new employer. Short-cutting recruitment steps can lead to a failed hire where either the new employee leaves within a few months of being hired or is dismissed during the first six months because they were not a good fit. The total cost of a failed hire is significant which can mostly be avoided by remaining committed to good recruitment practices.

The tools of technology will continue to evolve. The tools offer us automation and simplify our business lives. They are still tools for us to choose or not choose.

Hope you found this to be helpful. Best of luck.

Sincerely,
Bert Sadtler

Dr. Homaira Akbari, President + CEO, SkyBitz

Dr. Akbari has more than 18 years of strategic, sales and marketing, product development and operational experience across many critical high-technology industries including software applications, IT services, security systems for homeland defense, telematics and location-based services, and telecom. Dr. Akbari has held senior management positions in TruePosition — a subsidiary of Liberty Media Corporation, Microsoft, Thales, Cambridge Strategic Management Group (CSMG), and worked as a scientist at CERN, the European Center for Nuclear Research. She draws on her international experience including nine years in Paris, London, Beijing and Cape Town. She holds a Ph.D. with honors in particle physics from Tufts University and an MBA with distinction from Carnegie Mellon University. She is the author of more than 50 scientific articles in international journals and a frequent speaker at industry conferences and tradeshows. She serves as a judge at MIT $100K Business Plan Competition, is a member of the Advisory Council of the Johns Hopkins Department of Physics and Astronomy and The Loudoun County CEO Cabinet, and is a contributor to several nonprofit organizations. Washington Business Journal named Dr. Akbari among its "Women Who Mean Business" in 2008.

SatMagazine (SM)
Dr. Akbari, thanks for taking the time to chat with our readers. First of all, would you please tell us something of your background and how you initially became interested in satellite communications?

Dr. Akbari
I became President and CEO of SkyBitz in October 2007. I came to the company after serving as Executive Vice President for Operations with TruePosition, a wireless location technology provider. My past experience also included stints as a senior director for Microsoft, as a corporate vice president at Thales and as a scientist for CERN, the European Center for Nuclear Research. I have a Ph.D. with honors in particle physics from Tufts University and an MBA with distinction from Carnegie Mellon University. I've always had an interest in technology overall and in the late 90s I saw an opportunity for connected assets through satellite technology. When I was recruited to join SkyBitz, I was able to realize my vision through their satellite-based M2M solutions.

SM
What lead you to become the President and CEO of SkyBitz?

Dr. Akbari
I have been working in and out of location-based technology services since 2001 and it has always been important to me to stay in touch with the contacts that I meet. I met one of the SkyBitz board members in 2007. We kept in touch and built a relationship. Eventually I was called and offered the CEO position in October 2007.

SM
What is SkyBitz' history in this market segment?

Dr. Akbari
SkyBitz was born out of innovation, which has been the backbone of the company's success. The company was originally founded as Eagle Eye Technologies, Inc. in 1992 and was awarded two contracts to design a satellite based tracking system by the Defense Advanced Research Projects Agency (DARPA) in 1994. This led to the development of SkyBitz's patented Global Locating System (GLS) technology and communications protocol and the start of what is now the industry leader in remote and unpowered asset tracking marketplace. SkyBitz has been commercially available since 2002 and has received many awards recognizing the company for its continued growth in the market year after year. In 2009, DARPA released a feature case study documenting how SkyBitz successfully launched DARPA-funded technology into private, government and international markets. SkyBitz has continued to innovate and bring new products and solutions to the market and in-turn, grow its customer base.

We specialize in real-time decision-making tools for companies with unpowered assets such as trailers, containers, rail cars, power generators, heavy equipment and other assets. We serve a wide variety of industries including transportation, construction, oil & gas, chemical, intermodal and government operations.

SM
Have you always had an interest in asset tracking, your Company's main focus?

Dr. Akbari
As I watched mobile telephony increase by roughly 35 percent in the mid-90s, it occurred to me that any service that tells us where things or people are located, is going to be the future. In early 2000 I was already working on enterprise and consumer based asset tracking and was thinking about how it could be expanded upon to connect assets and increase productivity.

SM
How do asset tracking products differentiate themselves for government and military clients as opposed to those in the commercial realm?

Dr. Akbari
For SkyBitz, the government and military clients are looking to track and manage their assets for better utilization, like our commercial clients do, but security and safety are a larger concern. Also, it is critically important for the product or solution to be compatible or able to integrate with existing government/military ERP systems.

SkyBitz has an open API that allows our solution to be flexible for integration. Government and military customers are also concerned with keeping costs low and maintaining reliable situational awareness of their assets. Also, in the defense agency realm, assets are moved to remote or rural locations, which requires satellite connectivity with global coverage with extended device battery life. 36 percent of DoD assets are overseas — with heavy movement between multiple theatres. The SkyBitz GLS platform is well suited for the government sector due to the security of the location data, efficiency of its information gathering and communications protocol, as well as its accuracy and reliability.

Satellite communication has been important to both government/military and commercial SkyBitz customers in order to maintain total visibility of their assets. SkyBitz built a Global Location System platform, which supports a large number of location technologies, communication network infrastructure, short-range technologies, and sensing technologies.

With our commercial customers we focus more on helping them improve their business operations concerning better asset utilization and gaining efficiencies to save them money. Our products and solutions also help them generate more revenue through intelligence for detention billing and as a theft deterrent as well as providing better customer service and meeting government compliance regulations.

SM
As a leader in asset tracking solutions, how do you see companies and governments evolving to address the growing need for better global supply chain visibility?

Dr. Akbari
I see companies and governments turning to technology solutions to provide more reporting and sharing of information between objects and people for a smarter supply chain. Without asset monitoring services deployed all along the chain of custody, customers must perform status checks manually, which results in increased labor costs and inefficient use of assets.

One of the key trends is the convergence of local-area and wide-area tracking and monitoring technologies. Connecting these technologies to each other is necessary but it needs to go a step further. Ultimately, total visibility will be achieved at the platform level whereby supply chain ERP software connects all the disparate components of asset visibility and security.

SM
How do you deal with data delivery to and from the tracked devices to your firm's Data Center?

Dr. Akbari
It depends on the product. Our main solution, GLS, is a unique protocol where information is transmitted from the SkyBitz Mobile Terminal to the SkyBitz Satellite Gateway over an L-band satellite link using a GLS-burst-message-optimized proprietary protocol. The proprietary GLS processing system at the Gateway then calculates the position of the Mobile Terminal, rather than the Mobile Terminal calculating its position remotely (this is key to our devices having industry leading battery life — making them ideal for non-powered assets). Data is then transferred to the Service Operation Center for processing. After receiving data from the Satellite Gateway, the Service Operation Center processes it for delivery over the Internet to our web-based application, InSight, or for integration into various fleet dispatch operating systems or ERPs. SkyBitz InSight offers a comprehensive, secure web-based asset-monitoring and information management tool. SkyBitz InSight delivers a global view of operations or asset-level specifics.

SM
Please explain how SkyBitz differentiates itself from other tracking service companies in regards to your use of a different SatCom protocol? What makes your patented system better than those reliant upon GPS?

Dr. Akbari
The most important differentiation of SkyBitz is that we put our customers and their needs at the center of everything we do. From technology, to the software platform, to services, to our customer support, we thrive on exceeding our customer's expectations and delivering value every day. One of the top benefits our customers tell us is important to them is getting accurate information that allows them to make quick decisions to improve their business operations. The patented SkyBitz GLS technology provides a powerful, long-term solution to the complex problem of remote asset tracking and information management. SkyBitz GLS technology is able to achieve better power efficiency than GPS-based technologies because the position of an asset is calculated at the SkyBitz Data Center and then delivered to end-users through a web-based easy-to-use platform called SkyBitz InSight.

Communication on the SkyBitz GLS network is achieved through the use of bi-directional satellite communication and customers can reconfigure the unit remotely using InSight and then it reports directly back to them. Our customers gain total visibility and control over their tracked assets through SkyBitz InSight, with no complex integration or software installation. The real differentiator for us is SkyBitz InSight, which provides real time information that is integrated into our customers businesses, allowing them to make smart decisions based on all the facts. SkyBitz InSight is personalized, fully customizable and provides robust reports that are downloadable. The combined real value of GLS plus SkyBitz InSight, customers tell us, is a long lasting solution that lets them set their own business rules, which in turn leads to significantly increasing their operational efficiencies and lowering their cost of ownership. Other providers utilize traditional GPS

chipset-based communicators that are not well suited for installation on assets that remain un-tethered and un-powered over long periods.

SM
What are some of your Company's latest successes?

Dr. Akbari
In January 2010, SkyBitz launched its latest asset tracking solution, the GLS400, a finalist for the Telematics Update Award (Best Telematics Service & Applications for commercial vehicles category). Sales of this new solution in January alone, were four times greater than the average monthly sales of products during the previous year. Since then, SkyBitz experienced stellar sales the first half of 2011, with strong bookings and revenue growth. This is the result of key new customer acquisitions and existing customers' re-commitments as well as strategic vertical market expansion. The company's operations expanded to a truly global platform via a new long term partnership with Iridium Communications and their global satellite network coverage. Also, SkyBitz has been named in Inc. Magazine's Inc. 5000 list five straight years, including 2011. This year I was named as a winner of a Washington SmartCEO 2011 Brava! Award. With new solutions and additional enhancements yet to be announced, the company is uniquely positioned to continue on this growth path and further solidify its position as the North American market-share leader through 2011 and beyond.

SM
With all the technologies available to organizations and government agencies, where do you see the next big advances coming from?

Dr. Akbari
I think the next big advances will come from technologies (hardware and software) that connect the dots for people and makes things simpler for both the consumer and for businesses. For example, technologies that can figure out a simpler way for consumers to interact with applications "apps" will be big. Today, consumers and businesses must decide on every individual app they

want to download to solve individual needs. In the future, if someone can come up with a way to get multiple apps into one — to come together to solve multiple issues, they will have a big winner on their hands.

SM
As companies try to stay ahead of their competition and find themselves further expanding their operations globally, what does this mean for national security concerns? What can be done to insure proper precautions are taken to recover theft and properly track shipments and confirm those shipments are what they say they are? This is especially crucial when it comes to various military shipments.

Dr. Akbari
With globalization of the supply chain, the movement of goods across the entire chain of custody is becoming complex and vulnerable — making it difficult to have control and total asset visibility at several levels. In terms of asset visibility, operations managers and executives are flooded with more information than ever and they still struggle to "see" and act on the right information. National Security and total asset visibility in vital components of supply chain (manufacturing, transportation and trans-shipment, warehousing and distribution, etc.) can be achieved if businesses have connected assets integrated into their ERPs. An asset tracking and information management solution can help companies accurately track their assets, learn the status of each asset in near real time, and quickly recover from theft by learning its location position, or even communicating back to the asset.

SM
We touched earlier on companies expanding operations globally. What regions that have been slow to adopt sophisticated asset tracking solutions do you see taking off in the near future? What challenges may be associated with this adoption?

Dr. Akbari
I'm not so sure it's a matter of slow adoption in regions vs. getting the right technology out. One of the main challenges to adoption is regulatory issues. Mainly, regulatory issues as they pertain to terrestrial roaming requirements (and associated charges) and satellite, regarding landing rights. To expand within a country, it is less difficult, but to cross countries' borders, which is typically where commerce works in transportation, this becomes an issue. Regulations are not consistent amongst countries.

SM
With the increasing interest in M2M and mobile communications, what role do you see this playing in asset tracking? Is there a role for it in asset tracking? Do you have any current or potential agreements with companies involved in the M2M environs?

Dr. Akbari
With more than two thirds of the world's population having adopted mobile telephony, the next big fundamental change in our lives will come from "Internet of Things" which connects physical assets to people and to each other. While there are 6.8 billion people on the planet, there are trillions of assets (consumer-based as well as enterprise-based) in the world.

Many companies rely on large physical assets and equipment to do their business. Assets are like people. You need to manage them in order to have an efficient business. For enterprises, the proposition revolves around three fundamentals: Increasing the utilization of an asset, optimizing asset's operational parameters and improving the securitization of the asset. There are a large number of different types of assets. SkyBitz's current focus is on wide-area, large and remote enterprise assets. Our customers are consistently gaining 600 percent return on investment in the first year of adoption of our solution.

The adoption of asset management technology is on the rise across all our company's targeted verticals. SkyBitz experienced stellar sales the first half of the year, with strong bookings and revenue growth. Product shipments for the first half of 2011 are up over 35 percent when compared to the same time period in 2010.

Oil & Gas, Chemical Market: Increasing fuel charges, at-risk current reserves and continuously higher demand have resulted in a booming industry and has generated

dramatically higher revenues; demand driven by increasing efficiency, asset security and environmental concerns.

Trucking: After a major depression in this industry in 2008 and 2009, the industry has seen a strong rebound. Global trailer production has been over-booked for the next 12-18 months and is expected to accelerate due to improving economic conditions and the need to expand and replace aging fleets (the growth is estimated at 12+ percent as compared to 3 percent historical numbers).

Heavy Equipment and Construction: Experienced huge growth in last 12 months driven by improved billing accuracy, increased regulations (California Air Resources Board) and the need for reduced costs in equipment maintenance.

Government: Driven by the Department of Defense's desire for total asset visibility in the supply chain; regulatory issues and the need for cost reduction (led in large part by Ashton Carter) requires much higher utilization of assets.

Intermodal: Consistently becoming an alternative for long-haul freight shipment; experienced 35 percent+ growth in 2010; increasingly competitive with trucking in quality of service.

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In one to two years, how do you see the landscape of asset tracking evolving? What challenges or issues will need to be addressed that are not prominent issues today?

Dr. Akbari
Today there is fragmentation, and, in the M2M enterprise world specifically, there are individual technologies to handle different business issues like in-cab technology, field tracking, and software for route planning. There are too many separate technologies that businesses must adopt in order to solve their business issues. In the future I see companies bringing together the hardware and the software layers on a unified platform, it will make it easier for businesses to manger their operations and adopt technology solutions. At SkyBitz, we're already converging local area Telematics with wide area.

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Fewer qualified professionals will be available over the coming years for careers in the various fields and disciplines required by SatCom and ancillary businesses, thanks to a profound lack of education in the disciplines required for success. How do you feel our industry should promote the opportunities for highly respected and well paying careers in SatCom, and how can the industry assist in STEM curriculum in our schools?

Dr. Akbari
I agree the industry needs to encourage and support STEM education in order to develop the talent needed in the future. Coincidentally, I recently spoke to a group of students and faculty at Johns Hopkins University Zanvyl Krieger School of Arts and Sciences and the Department of Physics & Astronomy about how a physics education can well-prepare students for many different career options. I presented alternative career models for physicists in fields ranging from Wall Street, Defense, Technology and Venture Capital. As part of this research, I interviewed a number of successful physicists who have taken key positions in government and the business world, outside of the traditional roles most people think of when they think of physics education. I also shared my background and experience after getting a Ph.D. in particle physics from Tufts University and later a MBA from Carnegie Mellon University, which has helped me in the business world. I believe scientists and especially physicists (whether they are in academia or research) have an important role to play in advancement of our society across many dimensions.

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Lastly, as you look back upon your career, what products or projects are you most proud of bringing to fruition?

Dr. Akbari
I'm most proud of my time at SkyBitz and working with the talented team there to produce a culture of teamwork and innovation. When I first started at SkyBitz, I worked hard to transform the culture of the company from an engineering oriented focus. We changed from being an inward focused technology company to an externally based, market focused enterprise. As a result we have created a growing ecosystem of partners and suppliers. We are the market share leader in asset tracking in the U.S. and a thriving, growing company that has remained profitable even during the economic recession. When I joined the company, it was not EBITDA positive. We have created a diversified set of products and solutions and are now positioned to go global.