SatMagazine

SatApps A'Plenty

EXECUTIVE BRIEFINGS...
Euroconsult, Futron, NSR

THE FORRESTER + FLECK FOCI

NGA: GPS Consumer & Customer

PLUS...
Securing Your Hybrid Network
SMART Emergency Communications
SatSharks
Continuous Signal Reception
Improving Digital SatNets

AND MORE...

SATMAGAZINE APRIL 2009

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The Way Things Were + Are...   UPLINK

Here we are — Spring — the start of the SATCOM and MILSATCOM industry trade shows circuis. Although there have been a few alterations in various companies' plans to exhibit and/or participate at these shows, the numbers in attendance reflect a highly positive attitude regarding the business future of our various arenas. This is a good sign that the economic environs of our industries are weathering the financial ebbs and flows with far better aplomb than many had expected. Let us all be grateful for our employment, and that we are able to maintain and, yes, even forge further ahead with our satellite professions, and to create products and services that remain in demand across the globe.

I am particularly delighted in this issue to present the new capabilities afforded emergency communications, as offered by various companies such as SkyTerra and their SMART™ talkgroups. I have a personal interest in this arena of SATCOM... not so long ago, such emergency communications were hampered by differing frequencies and an inability to effectively control services in a unified manner. I offer one, personal, horrendous example of the way things used to be...

A military jet on approach to a Naval Air Station ran into difficulty and crashed directly into a tall apartment building located in the center of a medium-sized municipality. Jet fuel ignited and engulfed the building and surrounding area, with several deaths resulting immediately. The small cadre of police officers on third shift immediately responded to a Code 3 call to the scene, as did the city's fire department. The first responders did all in their power to save lives, ensure public safety, and then affected a perimeter to prevent additional loss of life and property damage. Calls for mutual aid were placed to surrounding cities and county services were requested, for everything from additional first responders to communications. State agencies were contacted and, as this was a military jet, federal and U.S. Navy offices were also notified. And then the communications nightmare began... no one could communicate with one another!

The local police department's operations center had to monitor a separate radio frequency for the fire department — dispatch had to keep two ears "open" to both police and fire communications to coordinate the dispatch of officers to the most needed locations — there was no direct communication between the local departments. Helicopters from a neighboring city and a local county agency circled the site of the tragedy. Telephone calls were placed from each of their particular dispatch centers to the local PD's dispatch center to relay information regarding the spread of fires, crowd control, and looter locations. State law enforcement agencies arrived to assist with crowd control, and their agencies could not communicate directly with the local PD's dispatch center. Patrol vehicles were positioned near one another in order for one unit to relay to dispatch what was being sent over the assisting unit's radio from that agency's dispatch center. There weren't enough phone lines to accommodate incoming and outgoing calls — command staff were juggling various portable radios as they listened to the different agencies relaying crucially needed information. Only so such could be relayed to the central communications center to ensure constant contact and updates to personnel in the field. Somehow, after three days of intense communication, safety and sanity returned to the city, but not without much wasted effort, frustration, expense, and a desire for updated communication technology. With SATCOM services such as SMART available nowadays, this scenario need never be repeated ever again — thank God.

Hartley Lesser, Editorial Director

Insight: Euroconsult Executive Briefing

Satellite Applications Continue To Emerge

by Rachel Villain, Euroconsult

Forty years after its introduction as an operational technology, satellite communications have reached maturity — the replacement of aging geostationary satellites and LEO constellations drive the industry's business cycle.

Incremental advances at the satellite and ground levels continue to result in new applications for individuals, businesses, and government organizations throughout the world. Currently, approximately 125 million satellite terminals are used around the world for a variety of communications and entertainment services.

Broadband SATCOM Everywhere

In 2008, the SATCOM industry appeared to have been largely spared the economic crisis, posting growth across the sector, from satellite manufacturers to ground equipment manufacturers and satellite operators. The combined 12 percent revenue growth achieved by the 40+ FSS and MSS operators in 2008 was partially driven by a low dollar relative to other industry trading currencies, *e.g.,* the euro. Nevertheless, most industry players reached organic growth in local currency.

In 2008, three geostationary satellites were launched for mobile communications

services (*Thuraya 3*, *Inmarsat I-4 Americas* and *ICO-GEO1*). Inmarsat's 14 percent revenue growth in 2008 illustrates the success of its investments in mobile broadband communication solutions, enabled by a fourth generation (4G)of highly capable satellites and new L-band terminals available for use at sea, in the air, and on the ground. The ecosystem of application developers, terminal manufacturers and local service providers also benefit from growing data communications demand from mobile users such as military forces, media, oil & gas, as well as shipping and trading. During 2009, several commercial airliners and private aviation companies are expected to

Fixed & Mobile Entertainment	# of terminals	Geographic markets served
DTH digital TV	100 million	Worldwide, with 1/3 of terminals in N.America
Digital audio broadcasting	20 million	USA + Canada
Digital multimedia broadcasting	1 million	Korea
Fixed & Mobile Communications		
VSAT private networks (civilian only)	2 million	Worldwide, with half of terminals in N.America
Mobile communications	1.8 million	Worldwide
Consumer broadband access	1 million	N. America

launch in-flight broadband access using **Inmarsat** bandwidth.

Mobile VSATs using Ku- and Ka-band satellite bandwidth also benefit from the demand for mobile broadband communications. Numerous new products (*e.g.,* **Viasat**, **SWE-DISH**, **Motosat**, **RaySat**, **ND Satcom**) coming from developments for government users requiring communications-on-the-move (COTM) have been launched for the commercial market. In Europe, several long distance high speed trains now offer broadband access to travelers, with IP connectivity provided by satellite and Wi-Fi. Additional in-train services are being implemented by North American railway companies.

Fixed consumer broadband access is a new application for satellite technology, first launched in North America where approximately one million subscribers receive services from **HughesNet**, **WildBlue** and **Telesat**. The legacy VSAT business for private communications networks is more international, with almost one million terminals in use outside the U.S., mainly in Europe, China, Brazil, and India. Two multi-spot beam Ka-band satellites are under construction in Europe and North America to provide ever-more cost effective bandwidth to make satellite solutions competitive with terrestrial broadband networks.
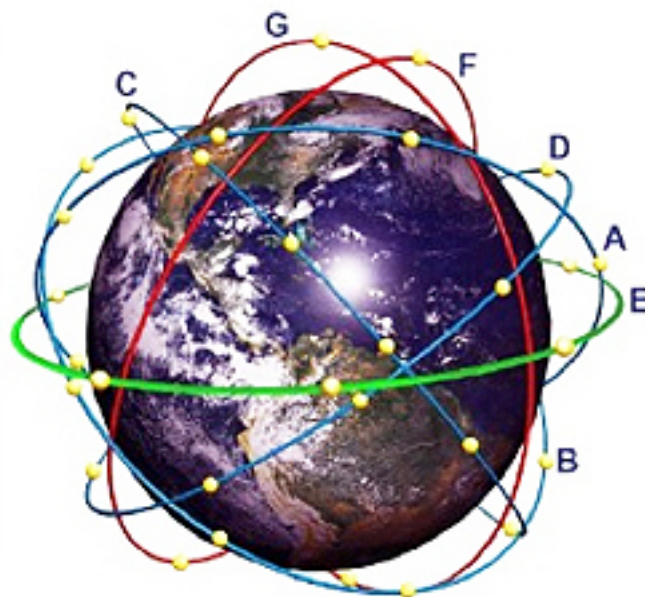
Plane	Amount of Active Satellites (Total)	Inclination	Height
A	8 (8)	45°	approx. 780 km
B	8 (8)	45°	approx. 800 km
C	6 (8)	45°	approx. 800 km
D	6 (7)	45°	approx. 800 km
F	0 (2)	70°	approx. 800 km
G	1 (2)	108°	approx. 800 km

RF Links

	Direction	Radio Frequency Range	Transmission Rate
Subscriber	Uplink	148.00-150.05 MHz	2,400 bps
"	Downlink	137.00-138.00 MHz	4,800 bps
GES	Uplink	148.00-150.05 MHz	57.6 Kbps
"	Downlink	137.00-138.00 MHz	57.6 Kbps

Insight: Euroconsult Executive Briefing

SatTech For Low Rate Data Connectivity

At the other end of the market, lower data rate applications for asset tracking, M2M, and AIS by satellite continue to develop. Satellite technology is increasingly used as a gap filler for terrestrial networks, especially for applications driven by security and safety regulations, or by a higher productivity of infrastructures.

In 2008, **Orbcomm** launched six Quick Launch satellites equipped with *automatic identification system* (**AIS**) for Coast Guards and government agencies in charge of maritime security. (*See Orbcomm table on previous page.*) Canada and Norway, two countries with such concerns, are developing small satellites specifically for AIS.

Machine-to-machine (**M2M**) communications by satellite is a small market relative to the services provided by terrestrial wireless networks (GPRS and 3G), with approximately 500,000 active terminals. Nevertheless, a growing number of wireless communications service providers have endorsed this satellite solution to complement their offerings to commercial and government customers when they move into areas outside the reach of terrestrial networks. As is the case for telephony, dual mode terminals are becoming available, enabling ubiquitous cost-effective communications from satellite or terrestrial networks.

World Satellite Terminal Base
For Entertainment + Communications Services

There have been a number of ups and downs in mobile entertainment by satellite. In the area of entertainment, digital radio broadcasting by satellite has shown more mixed results than digital TV broadcasting. In the U.S., the benefits of the merger of **XM** and **Sirius Radio** have been somewhat offset by the crisis affecting the car industry, which has limited subscription growth in this important market segment. (*See the table on the previous page.*)

Seven years after launch, **Sirius XM Radio** has succeeded in attracting 20 million subscribers in North America, but has yet failed to reach profitability. Elsewhere in the world, the other digital radio service by satellite ended in late 2008 with the bankruptcy of **WorldSpace.**

Insight: Euroconsult Executive Briefing
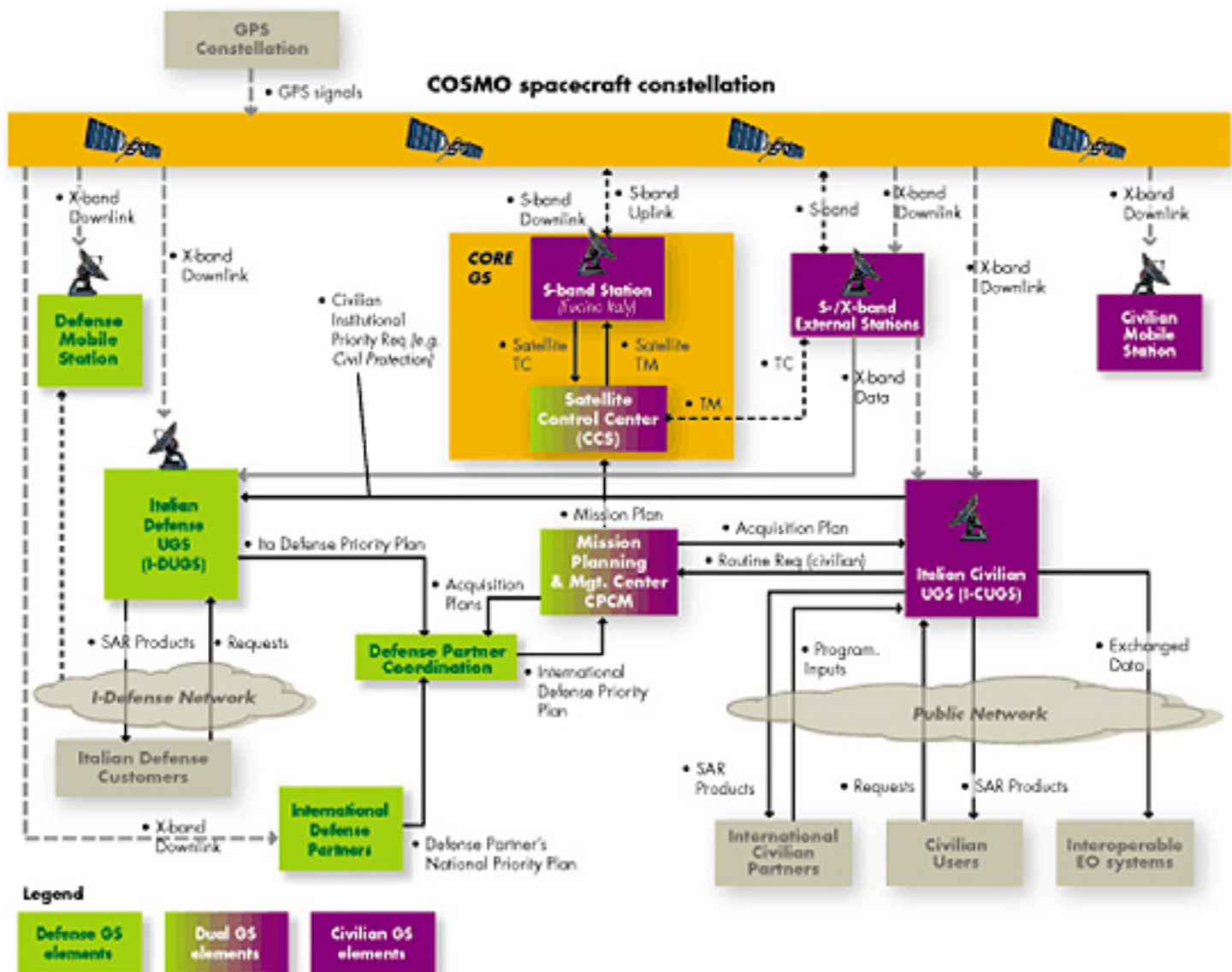
COSMO Skymed constellation architecture

The first ever mobile digital TV service by satellite was launched in Japan and Korea three years ago via a S-band satellite jointly owned by Japanese and Korean interests. In 2008, **MBCo** decided to terminate service in Japan due to poor subscriptions and **TU Media** service in Korea has had difficulties coping with competition from free terrestrial service.

In Europe, a **Eutelsat** satellite equipped with a S-band payload will be launched at the end of March for **Solaris Mobile**, a joint venture between Eutelsat and **SES Astra**. Solaris will be the first to test market acceptance for mobile satellite TV in Europe.

Satellite-based EO Evolves

Earth observation (EO) satellites used to be the privileged domain of governments. The democratization of satellite technology and the commercial data policy in the U.S. have lead other governments and private investors to enter the sector with more operational business objectives than simply scientific research.

Various forms of public-private partnerships have been developed, giving birth to more satellites with more diverse observation capabilities. In 2008, 18 civilian Earth observation satellites with different capabilities were launched around the world, eight of which were for three European multi-satellite constellations — **Cosmo-Skymed**, **SAR-Lupe**, and **Rapid Eye**. With more small satellite manufacturers, data sales, and geospatial
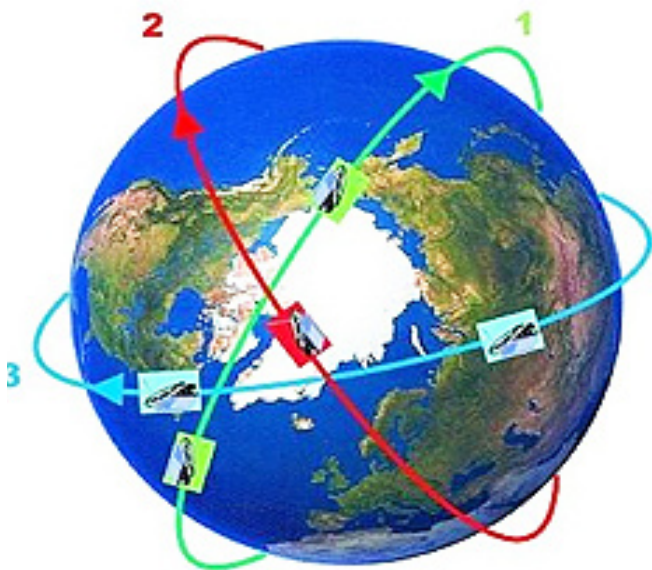
Mission	Launch Date
SAR-Lupe 1	December 19, 2006
SAR-Lupe 2	July 2, 2007
SAR-Lupe 3	November 1, 2007
SAR-Lupe 4	March 27, 2008
SAR-Lupe 5	July 22, 2008

SAR-Lupe constellation

RapidEye constellation

companies increasingly incorporating satellite radar and optical imagery into their product portfolios, commercial Earth Observation is truly expanding at each level of the value chain.

With local and global capabilities, satellite technology has demonstrated its versatility to accommodate both commercial communications and geospatial information requirements competing with, and yet complementing, terrestrial solutions.

About the author

Rachel Villain is the Director, Space & Communications, at Euroconsult, the leading international research and analyst firm in the satellite sector. She has more than 20 years experience analyzing the sector and providing counsel to leading companies in the industry.

Insight: The Forrester Focus

Another Major Mid-East TV Development

by Chris Forrester, Columnist

The past few years have seen a flurry of media hubs created in the Middle East, not the least of which is the giant Media Production City in Cairo (at 35 million sq. feet) which was completed in 1996. More recently established is the Dubai Media City and its associated facilities that opened its doors in 2000. Other clones have followed, each offering similar tax-advantages, 100 percent foreign ownership with promises to boost local media production, create jobs and place the venue onto the map — as far as Hollywood and Bollywood are concerned.

'twofour54' COO Wayne Borg

Dubai Media City

The need for new production space is unquestioned. Middle East television is expanding at a spectacular rate, with reliable forecasts predicting massive growth. For example, consultancy **Northern Sky Research** says the Middle East and North Africa (MENA) will enjoy an average 38 percent annual growth rate in the number of HDTV channels available over the next 10 years. Basic (standard definition) channels have seen growth rates of some 30 percent annually over the past few years on Arabsat. Every minute of this output depends on satellite TV for distribution.

Abu Dhabi's entry into this creative vacuum takes a very different approach and deliberately side steps the argument that millions of square feet are needed to

make a mark in production. '**twofour54**' COO *Wayne Borg* says the concept is very much focussed on creating the right ecosystem. "We launched in October last year, and have already mounted our first batch of vocational training sessions. For example, our learning academy, Tadreeb, is all about up-skilling and re-skilling of the workforce that's already in the region. As international players come into the region they need to see a talent pool that's trained in the very latest technology, and across all disciplines and techniques."

'*twofour54*' has linked with the **BBC**, **Thomson-Reuters** and the **Thomson Foundation** to raise production and craft skills to internationally-acceptable levels. *Borg* says they're already supplying training in sound recording, lighting, directing and producing as well as editing and other post-production skills. "We will broaden the scope to cover animation, web design and including finance for film production and accounting. The courses, which began in January, will reflect every aspect of the industry — and include music which is hugely important here."

Borg says that they're also offering internships to enthusiastic candidates. He said interns work with *twofour54*, or its international partners, and perhaps in

Insight: The Forrester Focus

the process move around the world to gain new skills and development.

'*twofour54*' has already managed to secure some heavyweight clients and partners. Not the least of which is **CNN**, now in the process of building its own studio at the facility in readiness to start daily transmissions of a nightly show.

Tony Maddox is CNN's international EVP/MD, based in Atlanta, and he says the Abu Dhabi operation satisfied two aims. "First, we have a number of bureaus already in the region, and we run our Middle East website out of Dubai and are already making programmes like Marketplace Middle East from the Emirates. We asked ourselves whether it was sensible to create a hub in the region, like a mini-London hub, because our viewing figures in the Middle East are always good. This would then allow us to create a daily show for prime-time viewing in the region, and where we could coordinate the other bureaus we have in the region. We

then had a sort of shopping list, all of which would be handled by Abu Dhabi, which included our regular 'Women in the Middle East' coverage out of Cairo, the same with output from Baghdad and Jerusalem. When the Abu Dhabi opportunity came along, we saw that we could operate our own facility, producing shows that we wanted to do, and it ticked all of the boxes. It also gave us a much greater level of coherence as far as the region is concerned."

Maddox says the daily show out of Abu Dhabi will be seen throughout the CNN International system. "The Middle East can always be depended on for news! So it is entirely logical to make sure we cover those issues which have a global reach. But if the main news that night is the economy, then we'll go with that. Our stories out of London are not all about London, the same with Hong Kong, or even Atlanta. But if a plane lands on the Hudson River then that's a big story right around the world."

Insight: The Forrester Focus

"We are staffing up now. We are concentrating on getting everything ready in Abu Dhabi and the local teams have been very supportive, which is a huge help in pushing everything forward. We see everything being in place towards the end of this summer. We have already hired the Managing Editor and the person who will supervise the technical aspects, and the rest will now quickly follow."

Maddox says that Abu Dhabi was keen to win CNN's presence in the **twofour54** venture. "They've been very flexible which has been a huge help. But let me stress we have paid our way on this deal. We have not been given the facility, and there are very real costs to us in making this investment. They see us as the Anchor Tenant in the shopping mall, and that's nice."

"As far as Dubai is concerned the web-site production works well out of Dubai, so it will stay there. We have a good deal in place in Dubai, so we'll continue with it. Both generate news, which is not a big issue so we'll keep them both, and they are barely a 45 minutes drive apart." While *Maddox* didn't comment, it might be that CNN is hedging its bets and satisfying two highly competitive cities that want the CNN brand associated with their own media efforts.

twofour54's *Borg* says the enthusiasm shown locally for the opportunities created is impressive and encouraging. "We are focusing on weekly, highly-intensive vocational training courses, with participants coming from local companies as well as from Jordan, Kuwait and other countries. These short courses are deliberately chosen because businesses cannot afford to lose staff for weeks on end. However, as time goes on we will supplement this pattern with longer courses."

Intage is *twofour54*'s production arm. "The first studios are under construction right now and will be ready about June. There will be three initially, in a dedicated complex with a range of production and post-production facilities. The intention today is to fill a huge gap in the market. To be honest, there's very little by way of production facilities hereabouts, especially for organizations to use.

As broadcasters from other regions and further afield start generating new content then we will have these dedicated facilities. Meanwhile if someone else wants to slot themselves into one of the studios, then that's fine, too. CNN's studio is purpose built and separate to these three. Some people are choosing dedicated facilities, and others want a more flexible approach. We have also signed Rotana to partner with us, and use some of our facilities for film and drama production. Abu Dhabi Media is another of our key partners at twofour54, and part of the complex. Our role is to facilitate others, like Rotana, CNN and others, to produce their content."

The plan, initially gauged to 2014, extends well beyond that date in the calendar, and reflects what Abu Dhabi sees for itself as a world city in 2030. "This city is being positioned as a cultural centre within the region. You only have to look at what other cultural cities have, and usually, a strong and diverse media sector is part of the mix. We want the same. Our immediate priority is to focus on pan-Arab content, and creating a true, consolidated centre for excellence and Arab content. Our ambition, certainly by 2012-2014 is not only to match what's happening today in Cairo or Beirut, but to exceed them because we are offering so much more. Especially, when you look at the overall infrastructure which covers the entire content industry, whether it's music, drama, animation, games development, on-line work to publishing to broadcast to film. I don't think there's anywhere else in the region that's covering anything like this."

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

Insight: The Fleck Focus

Satellite Enabled Digital Cinema in Asia

by Michael Fleck

With an estimated 30,000 cinema screens, the Asia Pacific region is the largest untapped market in the world for this new wave of theatrical content. Across the region, there is a rapid conversion from the old optical projection to high definition digital projection. The systems range from US$50,000 to US$200,000 per screen and are being funded by governments, private investors, and cinema owners. Once installed, they allow the cinemas to eliminate celluloid, and projector movies from digital drives or 'trickle' downloads across the Internet. For US$5,000 per cinema (not per screen), these cinemas can be enabled to receive live content from anyplace in the world, giving them an impressive new revenue source.

The market in Asia is substantially different from the more established regions of North America and Europe. In North America, satellite service is being driven by Hollywood looking for efficiencies in feature film distribution. In Europe, alternate content is the primary benefit being sold.

Content

Alternate content provides cinemas with an additional revenue stream at little or no cost to them. It means they can attract new customers to their cinemas — people who do not want to see the usual super hero movies or romantic comedies. These attendees are prepared to pay a premium to view content that otherwise is inaccessible to them.

Insight: The Fleck Focus

In 2004, *Debra Kaufman* of **Regal CineMedia** in the United States put all in perspective. "On average, on a Monday or Tuesday evening, five to seven percent of our seats are filled," she said. "For the new forms of content, which take place early in the week, we nearly sell out. We can see anywhere from a 70 to 95 percent use of seats in the auditorium."

These alternate types of content are:

Live-Live: Events that are screened as they occur using satellite broadcast technology. The performance stage anyplace in the world is linked with cinema screens anyplace in the world.

Delayed Live: Live-Live events that are time shifted so screenings take place at a more appropriate local time. For example, Mozart's *The Magic Flute*, live from the San Francisco Opera in the evening, U.S. time, would be relayed at the appropriate delayed time for the Chinese audience.

Recorded Live: Some events are recorded then played back at a later time, usually within a month of the original event. For example, *Where The Light Is: John Mayer Live in Los Angeles* was recorded earlier in 2008 and played to cinemas across the U.S. for just one night on June 30, 2008. This enabled the producers to add more visuals and enhance the sound.

Archive: There is a wide range of material that is of interest to small groups that are not large enough to warrant showing on cable or broadcast TV such as old TV shows, movies, plays, and other entertainments that are distributed by satellite to reduce costs. Specialty programming for children is being packaged in North America and sent by satellite to about 150 cinemas every month.

Special Interest: Educational, marketing, sales, product releases, and religious/spiritual media: Cinemas are now generating additional revenue from special events. For example, on February 20, 2009 the Australian government's *Department of Youth* linked cinemas in 10 cities and towns across the country for the *Australian Youth Forum* (see below).

3D

The networks will initially be capable of high definition transmissions, but can be easily upgraded to receive live 3D content. This is a rapidly growing area and will be a big revenue driver into the future. *Gizmag* the print and online journal stated;

"The experience of 3D on the big screen when it's done right…is absolutely gob-smacking. The effect is not only of watching an image unfold in glorious, full color and detail, but goes one further and puts you in the action. Instead of watching you are participating. And that adds a level of intimacy, excitement and immersion that is just not possible with boring old 2D projection."

Home Grown Content

The events above are all sourced from existing content providers in the west and packaged for each country. While these will remain important sources of content, a larger market will be in the distribution of 'home grown' content. This will be compiled from a range of materials in each country. For example, pop music concerts, *Meet the Director* interviews for movie premiers, sports and other cultural activities.

Australia

The *Rural Digital Screen Network* (**RDSN**) was designed to combat in-built structural barriers that prevent many Australian screen programs from reaching audiences outside capital cities. The RDSN uses digital content format standards, connectivity and communication infrastructure, and advanced data servers to create new business and revenue models. Another aim was to enhance small businesses in the Australian production industry, by providing greater opportunities to distribute their films to regional markets.

Insight: The Fleck Focus

In 2007, the *Australian Film Commission* (now called *Screen Australia*) together with **Global Vision Networks** rolled out a pilot program to equip the eight RDSN cinemas for direct satellite reception. Over the next year, thousands of people in these rural communities experienced live transmissions of ballet, opera, and live theatre.

Satellite cinema in the Asia Pacific region has recently received another boost, with the entrance of **Hoyts Cinemas**. Hoyts is one of Australia's leading entertainment corporations owning and operating 45 cinemas, with more than 400 screens and 75,000+ seats throughout Australia and New Zealand. Hoyts has commenced a launch of satellite capable screens across the market.

Due to the small size of the Australian market, care was taken to develop a satellite platform capable of meeting the current and future requirements of all major players. Both the **Screen Australia** network and the rollout for Hoyts are using high power Ku- transponders on *AsiaSat 4* to deliver standard definition (SD) and high definition (HD) content. This is creating economies of scale as the market grows.

Global Vision Networks has partnered with **Omni-Cast**, the Australian distributor for the Toronto based **International Data-casting Corporation**. They are deploying the *SFX4104* which features dual carrier operation for file delivery and live events, that has; built-in **BISS** decryption for ease of interfacing with transmissions from remote (SNG) sources; can decode both legacy **MPEG2** and **MPEG4** AVC (H.264) HD video; and is enabled for future upgrade using *Sensio*™ technology for live 3D alternate content.

Australian Youth Forum

Applications in this early stage are in the delivery of alternative content as well as a strong push into the

Insight: The Fleck Focus

Enterprise market. The first major event using the Hoyts network was held on Friday, February 20, when hundreds of young Australians from across the country attended the inaugural Australian Youth Forum (AYF) event – **youTHINK** – hosted by the Minister for Youth, *Kate Ellis*.

In an Australian first, the 10 event locations were linked by satellite, enabling young people in every capital city, as well as *Cairns* and *Alice Springs*, to participate in a truly national conversation.

youTHINK was created by young Australians, for young Australians, through the *AYF Steering Committee*. This group helped design an event that encouraged young people to not only speak out on important issues, but to also be a part of a conversation about practical solutions. The national satellite link into venues of importance created the largest 'meeting room' in the country.

"I want to thank each and every person who attended youTHINK for taking the time to come along and give their insights, and help direct responses to the issues that matter most to them," said *Kate Ellis*. "It was a great experience to be involved in an event that came up with so many terrific new ideas and generated so much energy at every venue around Australia. From the Government's perspective, youTHINK was a great way to engage with young Australians — on the issues that affect them, now and into the future."

Enthusiastic participants exchanged much information during the event, with the discussion topics *Violence and Safety* and *Contributing to our Democracy*, creating passionate and intelligent debate.

The satellite link-up was launched by the dynamic Master of Ceremonies Fuzzy (*Faustina Agolley*) from **Video Hits**, who joined a crowd of around 120 young people at the host event in Sydney. Participants highlighted the importance of communicating to young people in ways that are accessible to them — through digital media such as **YouTube** and **Facebook**, to reach out to every young Australian, rather than only the "usual suspects." In the past, such a forum would have been limited to a single location, rather than including everyone who wanted to attend. By employing satellite distribution and modern cinema facilities, the technology driving the event was transparent to the participants.

Asia

Hoyts' initiative in Australia and New Zealand is being watched closely in Asia. In the northern spring and summer, a proof of concept for satellite enabled digital cinema is being rolled out in India and China. Its focus will be the distribution of a 'Western' alternative content to these markets, as well as distribution of home grown material. The scope of the project also includes test marketing in the corporate environment, and ongoing regulatory issues.

As Asia is a continent and not a country, many different languages, regulations, cultures, and geographies must be addressed to successfully implement any digital cinema project. Once all approvals have been received, contracts signed, and content sourced, then the real work begins with each country's different price points, marketing strategies, and success rates.

As the business model is new, even in Europe and America, cinema owners and other stakeholders are carefully monitoring Global Vision's efforts in Asia, the most populated place on Earth. They are eager for the aforementioned new revenue streams and keen to be the first in their markets to offer alternative content.

About the author
Michael Fleck, the Managing Director for Global Vision, established Mercury Communications, a corporate video production facility in 1986. Ten years later, under the trading name Global Vision Networks, Mercury is Asia's leading provider of Satellite Teleconferencing and Business Television (BTV) services, with representation in Sydney, Shanghai, Beijing, Hong Kong, Singapore, Kuala Lumpur and Delhi.
Prior to starting Mercury, Michael was Video Services Manager and then Marketing Manager for Prudential Assurance Company Ltd. Since leaving Prudential, he has focused on building Mercury's profile in Asia, developing a network of suppliers and contractors. Mercury's success can be largely attributed to the knowledge and contacts that he has made in this time, understanding the various cultures, regulatory environments and forming relationships with influential business or government figures.

Focus

Ensuring VoIP Quality...

by Danny Buetler, Alianza

Voice over IP (VoIP) allows digitized voice conversations to be transmitted via Packet Switched IP networks. Due to the unique nature of IP-based networks, certain minimum network requirements must be met in order to preserve the end-user's Quality of Experience (QoE).

There are three primary factors that contribute to the QoE of a VoIP call. The factors are *latency* (or delay), *packet loss,* and *jitter*. QoE is measured on the five-point *Mean Opinion Score* (**MOS**) scale defined in the **ITU-T recommendation P.800**. A MOS score of 4.0 is considered "Toll-Quality," the quality you would hear on a wired landline from your local telephone company. A MOS score between 3.0 and 3.7 is considered normal for cell phone use.

MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very annoying

Latency

Latency is the delay of the voice signal from the person on one side of the conversation to the person on the other end of the conversation. Latency is caused by three primary factors: the inherent delay of the IP-based network, the jitter buffer, and the codec used. **G.114** is an **International Telecommunications Union** recommendation regarding one-way transmission time. According to this recommendation, if delay is kept below 150ms, user experience is unaffected. However, as delay increases, user acceptance is increasingly affected.

Alianza recommends latency of less than 150ms. The Service Provider has the greatest influence on network latency. Factors affecting latency include bandwidth, network speeds, and, to a large extent, physical distance. Alianza recommends the Service Provider use **QoS** mechanisms such as *DiffServ*, *IntServ*, or *ToS* in order to decrease latency. Specifically, QoS benefits the most in limited bandwidth situations, such as the last mile, and should be implemented in these situations first. The Service Provider should also ensure that older hardware on the network is not creating a bottleneck. Older devices are typically slower and introduce more latency.

Packet Loss

As VoIP uses the IP-based network, each voice conversation needs to be packetized (broken up into small data packets) and compressed. Packet loss is when one or more of these packets are lost during transmission. Packet loss can have a detrimental effect on the end-user's QoE. Packet loss can come from network congestion or connectivity errors between endpoints. Packet loss can also come from the jitter buffer. As a general rule, less than 1 percent packet loss is considered acceptable.

To decrease packet loss, the Service Provider can ensure that sufficient bandwidth is available to meet network requirements at peak usage.

Jitter

Jitter is variation in the order and time in which packets are sent and received. Packets are numbered and sent chronologically as they are created. Because of network congestion, or the ability of packets to take different routes over the network, the packets may arrive out of order or with varying delays. In order to maintain a high QoE for the end-user, voice packets must arrive in a fairly consistent manner.

Unfortunately, the nature of routing and queuing methods in the various networks between endpoints introduces varying amounts of delay. Packets that were sent exactly 10ms apart may arrive with varied spacing. For good call quality, Alianza recommends that jitter be less than 20ms. Acceptable jitter is between 20 and 50ms. QoE will begin to degrade significantly as calls approach 50ms of jitter, and QoE will be severely impacted beyond this point.

To decrease jitter, the Service Provider can ensure that the same QoS mechanisms used to decrease latency and packet loss are in place.

Focus

Network parameter	Good	Acceptable	Poor
Delay	0-150 ms	150-300 ms	> 300 ms
Jitter	0-20 ms	20-50 ms	> 50 ms
Loss	0-0.5 %	0.5-1.5%	> 1.5%

Additional Factors

Some additional factors to consider when evaluating the Quality of Experience are:

- *End-Point Devices*
- *Local Network Gateway/Router to the Internet*
- *Local Upload Speed*
- *ISP Network and Quality Data Connections to the Internet Backbone*
- *Data Center*
- *PSTN Carrier Quality*

Recommended Parameters Summary

The table at the top of this page summarizes Alianza's recommended network parameters. Alianza is available to assist with testing or resolution of network-related issues.

VoIP Testing

Testing is generally required to understand how a Service Provider's network is performing and to expose any areas of weakness. Alianza recommends that the Service Provider run end-to-end tests to ensure that the network is optimized for voice traffic.

There are a wide variety of VoIP testing tools available. Alianza has standardized on the **Cisco IP-SLA** functionality available in their routers for VoIP testing. IP-SLA simulates VoIP traffic providing details around delay, jitter, and packet loss and also provides a MOS.

The Cisco IP-SLA functionality requires two routers, one on each end, and mimics actual call functionality by simulating the characteristics of VoIP UDP Packets. Alianza has an IP-SLA enabled router as part of its platform. It is the responsibility of the Service Provider to provide a route in their network as close to the end-user as possible.

Following are the details on how to configure your router for performing IP-SLA testing with Alianza:

Setup:

Enable IP-SLA Configuration on your Cisco router.

Firmware minimum: Version 12.4(4)T

Detailed minimum firmware version requirements for IP-SLA can be found at:

http://www.cisco.com/en/US/docs/ios/ipsla/ command/reference/sla_book.html

Ensure that two UDP Ports are open for communication with Alianza.

Port 1967:IP-SLA Control Port

Any additional UDP port greater than 1024 of your choosing

Enable IP-SLA on your router.

Enabling IP-SLA differs with the firmware revision but it is usually "`ip sla responder`"

Send Alianza the following information:

The second port number of your choosing from #2 above.

The public IP address of your router.

IP-SLA details are collected every minute directly from the Cisco router through SNMP. This information will be collected by Alianza over a predefined period of time (long enough to be statistically significant) and reported in graphical formats in order to provide an estimated QoE for the end-user. The Service Provider may choose to replicate IP-SLA testing over various parts of the Service Provider's network, either serially or in tandem.

Satellite Network Considerations

The same techniques used on a standard packet switched network are used on satellite networks to ensure maximum quality with minimal impact to valuable network resources. Due to the physical limitations of satellite networks, it is especially important that satellite operators planning to support VoIP understand and configure QoS on their network.

Focus

In addition to the recommendations listed in this article, and due to the difference in technologies between typical networks and satellite links, the following additional recommendations are uniquely suited to satellite providers when incorporating VoIP onto a satellite network.

- *Packet fine-tuning fills available timeslots and saves valuable bandwidth.*
- *Typically, the SIP/RTP packets (call flow) are intentionally very small. Especially on an Ethernet based network, if a few of the packets are dropped, the call is not impacted. On a satellite network, if this same technique is used, the network reaches an unnecessary early saturation. The "frames" in satellite links are much larger, but the timeslots available to each subscriber are available less frequently. By increasing the size of the voice packets to fill the available frames, more traffic can be sent. This modification increases call quality, since VoIP traffic is time-sensitive, and packets will be dropped if they do not have an available timeslot.*

- *Signaling control compensates for delay and provides security and consistency.*
- *Call control, or call signaling, is an integral piece in creating the perception of a high-quality call. The SIP standard compensates for outside of normal delays by allowing the call control flexibility in waiting for acknowledgments and making additional attempts before rejecting or terminating the call.*
- *Due to the nature of satellite technology, delay is inevitable on a satellite link. By keeping jitter and packet loss to a minimum, the delay is less noticeable and the overall voice experience can be very good.*

About the author
Danny Beutler is the Senior Platform Engineer at Alianza, Inc., the provider of an award winning hosted voice platform. His background includes senior network and systems administration design and implementation. At Alianza, he is responsible for designing the architecture and implementing components of the core voice platform.

Suborbital Spaceflight... It's Not Just For Tourists Anymore

by Jeffrey Foust, Ph.D., Futron

For the last several years, commercial suborbital spaceflight has been synonymous with a single application: personal spaceflight, better known as space tourism. That's due, in part, to the publicity attracted to this sector by the $10-million *Ansari X Prize* competition, won in 2004 by *Burt Rutan*'s SpaceShipOne, not to mention the marketing prowess of *Richard Branson* and his space tourism venture, Virgin Galactic. Several other companies are developing vehicles to serve this market, from small startup ventures like XCOR Aerospace to ultra-secretive Blue Origin, backed by Amazon.com founder *Jeff Bezos*.

It's easy to understand all of the interest in suborbital space tourism, given that market's potential size. A groundbreaking study performed by **Futron** in 2002 (and updated in 2006) indicates this could become a sizable, fast-growing market in the near future. As shown in the figure below, the demand for suborbital space tourism will reach more than 13,000 people per year by the end of the next decade, generating nearly $700 million a year in revenue.

While the focus to date has been primarily on space tourism, it's not the only application these markets can serve. The same vehicles that can carry people to the edge of space and back can also carry any variety of other payloads, from experiments intended to operate in zero-g, to sensors designed to study the upper atmosphere and space environment, to cameras able to peer down onto the Earth. Alternatively, these vehicles can carry upper stages designed to launch small satellites into orbit at a fraction of the cost of existing launch options.

Interestingly, one of the companies carefully studying these alternative markets is one of the companies
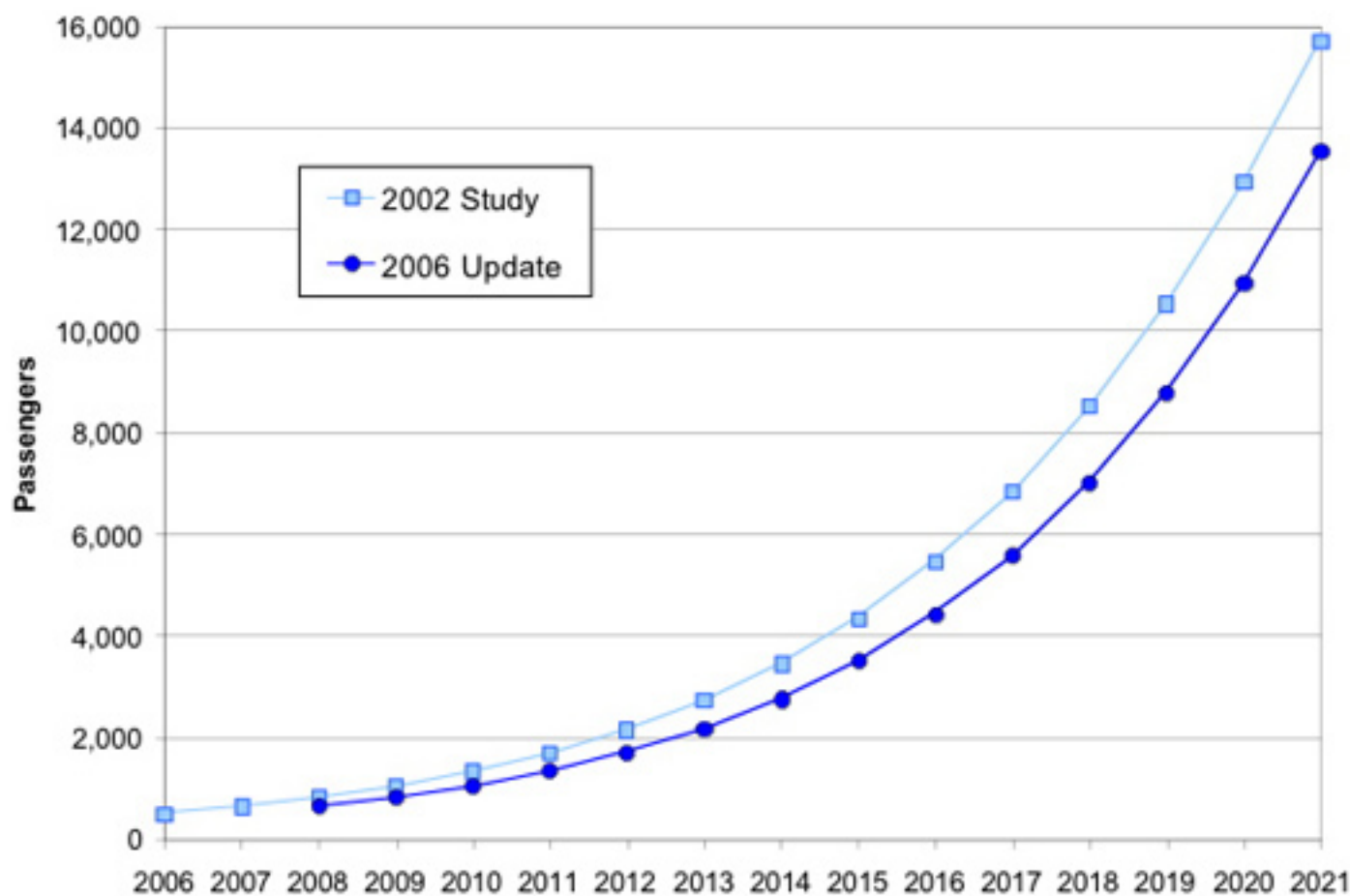
Projected demand for suborbital space tourism (in passengers per year). Source: Futron, 2006.

Insight: Futron Executive Briefing

most prominently identified with space tourism: **Virgin Galactic**. Its interest in going after these other markets had its roots, ironically, in its efforts to better serve the space tourism market, *Will Whitehorn*, the president of Virgin Galactic, explained in a speech at the FAA's *12th Annual Commercial Space Transportation Conference* in Washington, DC in February. Their early customers, he explained, wanted a spacecraft big enough to float around in during the several minutes the craft experiences weightlessness, which meant a bigger, and ultimately more capable, vehicle, called **SpaceShipTwo**.

According to *Whitehorn*, Virgin is examining several additional markets. One is suborbital scientific research, where Virgin flies various types of scientific payloads. These can include the types of experiments flown on sounding rocket flights today (but larger and also recoverable), performing work in areas like space science, aeronautics, and microgravity research. Routine suborbital flights would also allow carrying educational payloads, like student-built experiments, helping address the key issue of the future of the workforce within NASA and the aerospace industry.

Virgin is looking at additional uses for SpaceShipTwo beyond science payloads. One is to use them to test technologies designed for later use in space: a suborbital mission can provide several g's of acceleration during launch and reentry in addition to a period of weightlessness, provid-

ing a better environment for testing space hardware than on Earth. This can save time and money—not to mention embarrassment if a component is launched to space only to fail for reasons that could have been caught through such testing.

In addition to testing hardware on these flights, astronauts can be trained for future missions. Astronauts already go through extensive tests on NASA aircraft designed to provide brief moments of weightlessness.
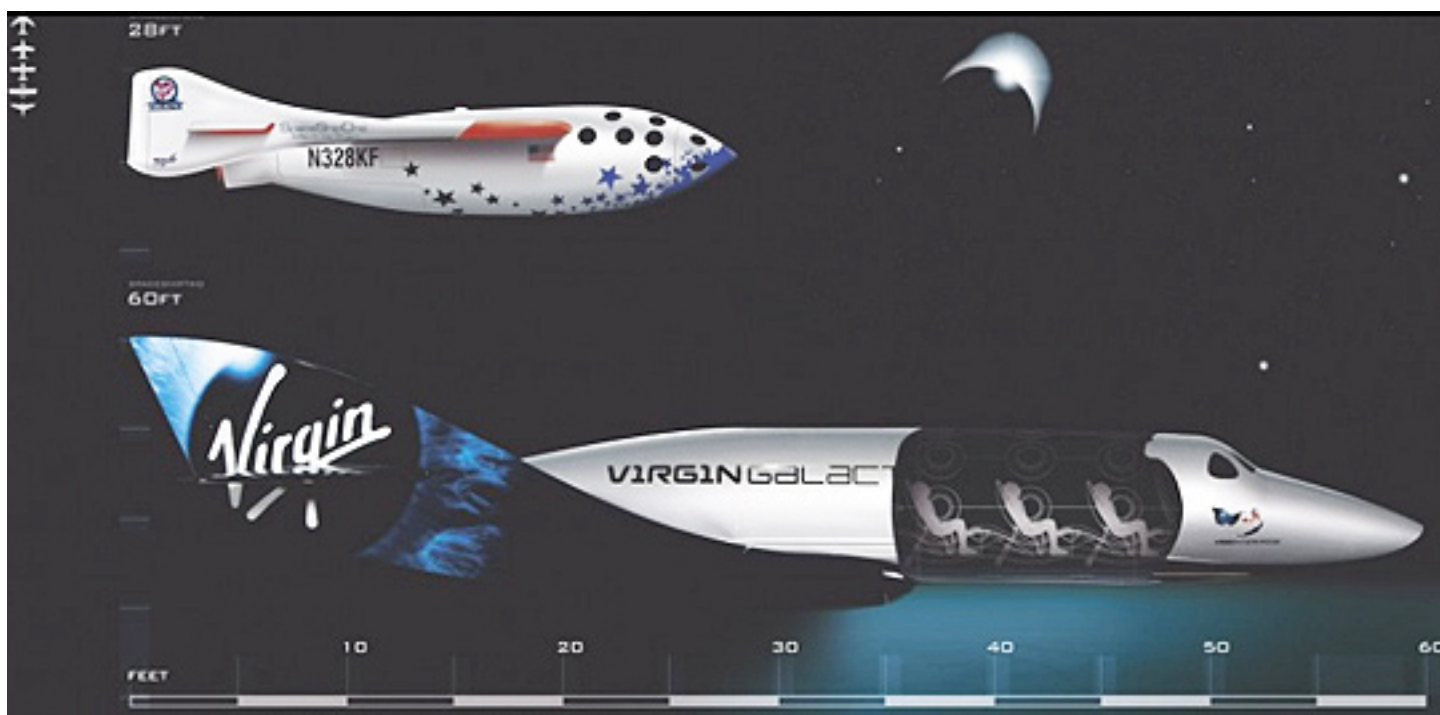
A scale comparison chart showing the evolution from SpaceShipOne to SpaceShipTwo - courtesy Virgin Galactic

However, a suborbital vehicle can provide weightlessness for several minutes at a time. Former NASA administrator *Mike Griffin* mentioned on several occasions his interest in buying flights for astronaut training, once vehicles became available.

The most intriguing alternative use under study by Virgin doesn't involve SpaceShipTwo at all. Instead, its carrier aircraft, *WhiteKnightTwo*, would carry aloft an expendable rocket capable of placing small satellites — up to 200 kilograms — into low Earth orbit. Virgin is working with **Surrey Satellite Technology Ltd.**, one of the leading small satellite manufacturers in the world, to study this market, although they have yet to make any decisions on the rocket technology they would use or the price for such launches.

Virgin is not the only company usually associated with space tourism that is also interested in these additional markets. **Rocketplane Global**, a company developing the *Rocketplane XP* vehicle for suborbital launches, initially from Oklahoma, is working with potential customers in the U.S., Japan, and elsewhere. The company has designed its vehicle to be able to accommodate standard-sized experiment racks flown on the International Space Station.

XCOR Aerospace, based just down the flightline at California's *Mojave Air and Space Port* where Virgin's

Rocketplane XP image, courtesy Rocketplane Global

Lynx suborbital vehicle, courtesy XCOR Aerospace

SpaceShipTwo is being built, is also looking at various research applications for its *Lynx* suborbital vehicle; a *Mark 2* version of the vehicle would feature external hardpoints for mounting a small expendable upper stage for launching nanosatellites.

Other companies are ignoring space tourism altogether and, instead, focusing on flying experiments and other applications. **Masten Space Systems** is developing the *XA* series of suborbital vehicles with an eye towards flying scientific, technology demonstrations as well as education payloads for as little as $250 per kilogram.

TGV Rockets, based in Oklahoma, has long been interested in doing remote sensing using suborbital vehicles: a vehicle that could quickly fly up to 100 kilometers could provide imagery of higher resolution than available form satellites, and on demand, without the overflight concerns of using UAVs — something of particular interest to the military.

What obstacles do these companies face in trying to expand beyond space tourism? One issue is a lack of awareness: many potential uses of these services are either unaware of these vehicles' capabilities or are even blissfully ignorant of their existence. That lack of awareness is starting to change, though.

In December, the **Personal Spaceflight Federation**, an industry group for the emerging commercial human spaceflight industry, and NASA's **Ames Research Center,** hosted a

workshop on how these vehicles could be used for science applications. The workshop, held in conjunction with the **American Geophysical Union**'s fall meeting in San Francisco, attracted more than 100 attendees, primarily scientists curious in the capabilities have to offer. A few months before that, **NOAA** signed an agreement to fly atmospheric sensors on Virgin's WhiteKnightTwo and SpaceShipTwo, albeit at no charge.

Another uncertainty is just how lucrative these non-tourism applications could be. In his February speech, *Whitehorn* estimated the size of the market for science,

Demo of Deep Throttle Engine Capability, courtesy TGV Rockets

However, these developments demonstrate the emerging commercial suborbital industry is diversifying, looking for markets and customers beyond tourism. That diversification is essential to the industry's long-term health and growth: an industry dependent on a single market is particularly vulnerable to disruptions to it, especially when it's something like tourism that can seem to be an unaffordable luxury in times of economic crisis. Given that many of the companies in this market have bigger goals in mind than ferrying tourists on suborbital jaunts—namely, developing successor systems that can provide low-cost access to orbit—anything that can broaden their customer bases and mitigate the effects of economic disruption can hasten the day when they achieve those goals.

About the author
Jeff Foust is a senior analyst and project manager with the Futron Corporation and has been with the company since late 2001. He investigates current conditions and future trends in domestic and foreign commercial, civil, and military launch industries and related markets. He has a Ph.D. in planetary sciences from the Massachusetts Institute of Technology and a B.S. with honors in geophysics and planetary science from the California Institute of Technology. He also maintains several online space resources, including the news aggregator Spacetoday.net and the weekly publication The Space Review.

aeronautics, and research work at more than $300 million a year. This figure was based on a market analysis a team with NASA experience had performed for the company. How much of that is addressable by Space-ShipTwo and other vehicles, though, isn't certain, nor is the size of satellite launch or other ancillary markets. Further study and outreach is needed here to better understand who would be likely customers for these vehicles and how much revenue they could provide to vehicle operators, particularly in competition with existing alternatives like zero-g aircraft flights and sounding rockets.

Focus

A SMART Model for Interoperable Communications

by Chief Charles Werner, Chair,
International Association of Fire Chiefs
Technology Council
   in cooperation with SkyTerra Communications

Public safety professionals and emergency responders are trained for the all-important job of protecting the public — on a day-to-day basis and when faced with a natural disaster or other emergency situation. Much of this training and preparation assumes that they will be able to communicate with each other when an emergency occurs.

For years, *land mobile radio* (**LMR**) networks have been the staple of public safety communications. Cell phones have increasingly been adopted as a communications tool by many first responders. However, neither option ensures reliable, interoperable and sustainable communications — the ability for multiple federal, state, local and tribal public safety teams to talk efficiently to each other during an emergency, or for daily operational communications.

Emergency situations can leave cellular networks congested or disabled, and land mobile radios typically only allow communications among officials within one unit or agency. Because of the radios' limited geographic reach and restricted number of licensed frequencies, the equipment may not allow multi-agency interoperable communications between a police officer, a firefighter, a local EMS crew, a hospital in a neighboring state, or a representative from the *Federal Emergency Management Agency* (**FEMA**). Hurricane Katrina illustrated the need for reliable, interoperable communications. However, the Gulf Region and other areas prone to hurricanes are not the only places in need of this type of technology. Wildfires, earthquakes, tornados, severe snow storms and other natural and man-made disasters such as 9/11, the Oklahoma City bombing, and hostage situations, all require reliable, inter-agency communications to ensure the safety and security of the public.

Achieving interoperable communications nationwide is an increasingly high priority for policy makers and the public safety and emergency response communities. It

WHAT IS SMART?

SMART – Satellite Mutual Aid Radio Talkgroup is SkyTerra's nationwide and regional program of public safety talkgroups that operates on the SkyTerra satellite network that enable critical and interoperable communications among homeland security officials, law enforcement, emergency responders, and public safety officials from various departments and agencies across the United States. By using SkyTerra's push-to-talk satellite technology, each member of a SMART talkgroup can participate in the talkgroup conversation. SkyTerra is making these talkgroups available without additional cost to SkyTerra public safety customers.

SMART...

* *Was pioneered by the Department of Justice (DOJ) and the Federal Bureau of Investigation (FBI) in 2007;*
* *Operates on SkyTerra's satellite communications network;*
* *Is virtually immune to terrestrial network congestion and destruction;*
* *Is able to establish communications in the most rural and mountainous regions;*
* *Offers one-to-many, push-to-talk, dispatch style communications;*
* *Is able to handle up to 9,999 users per talkgroup;*
* *Connects government & public safety agencies nationwide;*
* *Public safety personnel enrolled in one region are able to quickly join regions outside their regular jurisdiction should the need arise.*
* *All 50 states, the District of Columbia, the U.S. Virgin Islands and Puerto Rico have access to at least one of the nationwide and regional SMART talkgroups.*
* *The SMART program is available at no additional cost to SkyTerra Push-to-Talk (PTT) customers.*
* *The SMART program is providing federal, state, local and tribal interoperability on a nationwide communications network. This family of interoperable talkgroups operates at national and regional levels; and is managed entirely by federal, state and local agencies.*
* *International interoperability via cross-border SMART programs with Mexico and Canada is under development.*

is this growing concern that led an electronics technician with the FBI and an attorney with the DOJ to approach **SkyTerra Communications** (formerly *Mobile Satellite Ventures*) with an idea that would initiate the **Satellite Mutual Aid Radio Talkgroup** (**SMART**) program.

SMART is a satellite-based service that connects federal, state, local and tribal public safety professionals via numerous overlapping national and regional talkgroups. The SMART program is designed to tackle the financial and governance challenges that have often impeded the development of interoperable public safety communications.

SkyTerra's satellite network delivers reliability and interoperability. Satellite service is available even when cell towers and landlines are congested or damaged, and is accessible from remote areas not served by terrestrial communications networks. The mobility of SkyTerra's satellite terminals ensures that public safety officials can communicate, even if emergency operations' centers need to be evacuated, which was the case during Hurricane Katrina. In addition, SkyTerra's dispatch-style, push-to-talk technology is familiar to first responders and ideal for command and control. A SMART talkgroup

provides significant interoperability in addition to other talkgroups that a SkyTerra customer may already be using locally.

To reduce financial barriers, Skyterra offers the SMART talkgroups free of charge to anyone who already has *Push-to-Talk* (**PTT**) service with SkyTerra. Many government and public safety organizations across the country currently are SkyTerra subscribers.

Covering North America	
No. of Satellites	2
Coverage Area	North & Cenral America, Caribbean
Orbital Position	101.3° W, 106.5° W
Service Link Bandwidth	28 MHz
Spot Beams	6 Regional
Power (AEIRP)	57 dBW
G/T (dB/K)	2.5
L-Band Reflector Diameter	Two 5 x 6 m
First Launch	1995
Design Life (Inclined)	10 (12) Years
EOL Power (W)	3,000
Manufacturer	Hughes
Launch Mass (Kg)	2,900
Launch Vehicle	Atlas II AS, Ariane IV

Figure I

Focus

The management of SMART rests not with SkyTerra but is entirely in the hands of the people who know public safety best. Each SMART talkgroup is managed and monitored 24x7 by a different federal, state, or local public safety entity, ensuring design, control, and management by public safety officials through multiple public-private partnerships with SkyTerra.

SkyTerra's Current Generation Network

Reliability Via Satellite

Reliability is imperative for successful interoperable communications. Without reliability, the efficient and timely movement of critical services and resources can be severely compromised, potentially costing unnecessary loss of life and personal distress. The SMART program ensures reliability by using SkyTerra's satellite network. A satellite network is more dependable and available than landline or wireless service during an emergency or disaster, because satellites are generally more immune to the congestion and damage typically suffered by terrestrial networks, especially those touch-ing the *Public Switched Telephone Network* (**PSTN**).

Satellite networks also provide coverage in sparsely populated areas far from cellular and LMR towers. Sky-Terra's satellite network, in particular, is also capable of handling many simultaneous voice calls, PTT talk-groups, and low speed data transmissions. This capability ensures that public safety officials will be able to communicate, even when call traffic significantly increases during an emergency, because SkyTerra's communications don't depend upon the PSTN.

SkyTerra's two geostationary satellites, *MSAT1* and *MSAT2*, currently operate at **106.5° W** and **101.3° W**, respectively. They have six regional spot beams and a service link bandwidth of 29 MHz that provides satellite communications for all of North America and its coastal waters. (*See Figure 1 on the previous page.*) The extreme polar regions are not covered by SkyTerra's service.

In 2010, the SMART program is expected to transition to SkyTerra's two new satellites, which will be two of the most powerful satellites ever launched by a

Figure 2 - MSAT-G2

Figure 3 - Go-Kit

Figure 4 - Two-Wire Interface

commercial satellite operator. These satellites and the additional benefits of SkyTerra's next-generation network will be discussed in section three of this paper.

Mobile Satellite Communications

Mobility is an important cornerstone of interoperable communications for public safety — allowing emergency responders to stay in touch from the field and ensuring that those staffing emergency operations centers can take their SkyTerra satellite phones/two-way radios with them if a disaster forces them to evacuate.

To communicate with the satellites, SkyTerra users employ the **MSAT-G2**. The MSAT-G2 is lightweight and can be installed in a building, in a vehicle, or packaged as a *Go-Kit* for portable satellite communications. A Go-Kit is an MSAT-G2 packaged in a durable, water-resistant container with a battery to supply power for remote and "on-the-go" operations.

The MSAT-G2 contains three pieces of equipment: a handset, a transceiver, and an L-band antenna. The L-band antenna is auto-acquiring/auto-tracking and a 16 channel GPS receiver. The antenna is available in a land-mobile model or a maritime model that ensures consistent tracking of the satellite, even in choppy waters. The transceiver sends and receives signals to and from the satellites on SkyTerra's L-band spectrum (1500/1600 MHz), and the handset operates as either a telephone or a two-way radio. (*Figures 2 and 3 show the MSAT-G2 and the Go-Kit.*)

The MSAT-G2 operates in the lowest frequencies of the L-band range (for commercial satellite communications). The longer wavelengths in the L-band provide better penetration than higher frequency bands. Signal degradation due to weather is not an issue.

In addition, the MSAT-G2 can be integrated with a two-wire interface (See *Figure 4*.) The interface connects

the satellite terminal to a standard desk phone, providing a more traditional telephone experience, including a dial tone (which a satellite phone typically doesn't produce). If the desk phone is cordless, the satellite coverage extends throughout a building with the same reach as the cordless phone.

SkyTerra's MSAT G2 Third Party Interface Compatibility

Telephone Interface	**Link Communications** MSAT-PSTN Interface
Vehicular Repeaters	**CPI Communications** SV3SV Product
	Pyramid Communications SVR200/MSTA200 Product
Interoperability Modules	**Raytheon JPS Communications** ACU Products
	Communications Applied Technologies ICRI Product
	Link Communications Tactical Communications Bridge Products

Figure 5

Focus

The MSAT-G2 is also compatible with a number of off-the-shelf interoperability modules and vehicular repeaters. (*See Figure 5 on the previous page*.) The interoperability modules allow different brands and models of radios and wireless phones with PTT capability to interoperate with each other and the MSAT-G2 satellite telephone/two-way radio. The vehicular repeaters extend the range of an MSAT-G2 that has been installed in a car or truck. This set-up allows a public safety official to maintain connectivity when he exits his vehicle with an LMR portable radio. He continues to communicate on his portable back through the vehicle which is operating as a satellite repeater.

Satellite Telephony

SkyTerra's satellite network provides two services: **telephony and push-to-talk radio service**. The telephony service is full duplex so callers can talk at the same time, similar to a landline or wireless phone call. Directory assistance and GPS tracking are available. Other call management features such as voicemail, call waiting, call forwarding, call blocking, and conference calling are also available.

The telephony service is compatible with the *Government Emergency Telecommunications Service* (**GETS**). This is important during situations when an emergency responder needs to make an urgent call to someone on a landline phone. In this case, once the call travels from the MSAT-G2 to the satellite and back to Earth, it still must travel through the *Public Switched Telephone Network* (**PSTN**) to reach the individual on the landline (*See Figure 6 on the next page*.) Call blocking often occurs on the PSTN when network controls are enabled during an emergency to protect this critical, terrestrial infrastructure. If the PSTN is congested with calls because of the emergency, GETS ensures that urgent calls from public officials get past those network controls and are successfully completed.

Push-to-Talk: The Key to Interoperability

SkyTerra is currently the only commercial satellite operator in North America offering push-to-talk service. SkyTerra's two way, PTT radio service over satellite is a popular option for communications in remote areas or during emergency situations. The dispatch or two-way radio style is familiar to the public safety community and ideal for command and control. Individuals can efficiently broadcast messages to an entire talkgroup or talk one-to-one via a "private mode" talkgroup (*See Figure 7*.) The
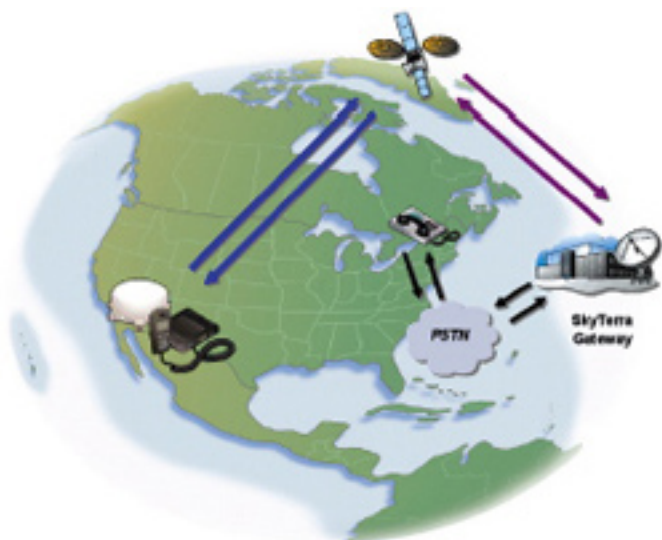
Figure 6 - Telephony Pathway

Figure 7 - Push-to-Talk Pathway

"trunking" concept inherent in SkyTerra's push-to-talk service allows a large number of users to share a group of channels by simply pressing the PTT button.

The network has been designed to provide the most effective possible use of limited satellite power and bandwidth. In addition to using demand-assigned communication channels, the network also employs the concept of "call types" to assign different satellite power and call-handling resources to each call, depending on its type. In an incident where PSTN and cellular network congestion is an issue, SkyTerra's group oriented communication is spectrally efficient as

it allows communication within a large group of users with a single set of frequencies without touching the PSTN. Frequencies are released following a pre-defined period of inactivity (hang-time).

Each talkgroup can support up to 9,999 users, and each user can belong to as many as 16 talkgroups; 15 talkgroups provide one-to-many PTT, and the 16th talkgroup is a private mode talkgroup providing one-

Focus
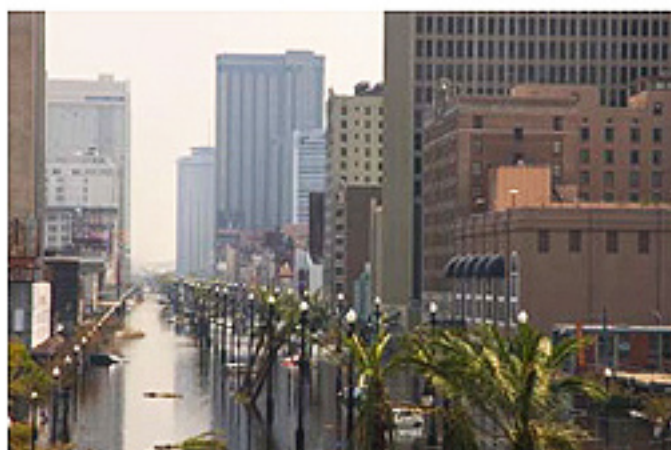
to-one PTT. All of this allows a department or agency to connect the entire department or subsets of a department who frequently work together. For example, a police department might set up a talkgroup for the entire force, another talkgroup just for senior management, and an additional talkgroup for the SWAT team. The SWAT commander could have all three programmed into his or her satellite phone for convenient access, as well as interdepartmental talkgroups.

Talkgroup managers can easily add any user — from any department or agency — provided the user has SkyTerra equipment.

Other features of the push-to-talk service include over the air programming, web-based GPS tracking, and priority interrupt, which allows a user a 20-30 second, hands-free interruption if another user is accidentally "keying" the microphone. The push-to-talk service also has dial-in and dial-out options. These options allow access to a talkgroup from anywhere in the world over any landline, cellular or satellite telephone (MSAT or other) with the use of a PIN; or access from the talkgroup to a preset phone number can also be accommodated. For example, if an emergency occurred while a supervisor was traveling in Europe, he or she could call in to the talkgroup within the United States to efficiently provide direction to the entire on-scene team.

To take advantage of the SMART program, a user department must:

- *Have a SkyTerra satel-*

lite radio kit.
- *Subscribe to SkyTerra service.*
- *Apply to the specific SMART talkgroup manager(s) for the talkgroup(s) requested.*

SkyTerra's service will not:

- *Provide high-speed data service for media such as live camera feeds.*
- *Provide handheld portable device communications similar to LMR portables.*

"It is critical for us to be able to quickly move rescue workers, medical support, repair teams and essential supplies in order to save lives and quickly begin recovery and rebuilding. And we can't do that when our communication systems are down."

Randy J. Johnson, assistant manager of communications for Plaquemines Parish, Louisiana

Case History: Mississippi Department of Wildlife, Fisheries and Parks

In 2003, the **Mississippi Department of Wildlife, Fisheries and Park**s purchased numerous SkyTerra units. The department had them installed in the vehicles of the officers who patrol the state's extensive waters and forests to ensure that fishing and hunting enthusiasts abide by state regulations. Mobile satellite communications are ideal for this unit, because the officers on patrol cover very large, remote areas that generally are out of LMR and cell phone range. SkyTerra's satellite network allows the department to stay connected and coordinate efforts, even when miles from home base and each other.

In 2005, Hurricane Katrina hit the Gulf Region damaging landlines, cellular networks, and LMR communication systems. Communications among the many federal, state and local entities involved in the rescue effort were extremely difficult throughout the region. SkyTerra's satellite network, however, never failed — before, during, or after the storm. As a result, the State of Mississippi was able to call on the Department of Wildlife, Fisheries and Parks for help. By parking the satellite-equipped patrol vehicles at critical government offices and emergency facilities, Mississippi was able to immediately restore statewide communications, helping the disaster relief teams coordinate and prioritize efforts to best serve the public in the wake of the disaster.

Satellite Mutual Aid Radio Talkgroups (SMART)

The Development of SMART

In July of 2007, *Robert Zanger* with the **DOJ-Wireless Management Office** and *Adam Siegel* from the **FBI** approached **SkyTerra** about the idea of a nationwide, public safety talkgroup to facilitate interoperable communications during a crisis among federal, state, local and tribal authorities. SkyTerra's push-to-talk service was ideal. However, in order to recruit users to the talkgroup — especially those in smaller, less-funded communities — the service could not be a financial burden.

To address this issue, SkyTerra revised its billing software and formed a new talkgroup category called **SMART**. SkyTerra offered unlimited access to SMART talkgroups at no additional cost to government public

safety users with SkyTerra service. For security pur-poses, it was also important that the public safety community had control over who could join SMART. For DOJ's **J-SMART**, the first talkgroup in the program, the **Department of Justice** agreed to manage the group. In addition, the joint FBI/DOJ communications center in Seattle monitors J-SMART 24 hours a day, seven days a week to mediate talkgroup operations and provide assistance in an emergency.

As a specific SMART talkgroup occupies just one of the 16 talkgroup slots available to each SkyTerra user, public safety professionals are able to maintain na-tionwide and regional interoperable communications of SMART separate from local talkgroups managed by individual agencies.

Public safety officials from departments and agencies across all levels of government soon joined J-SMART. By connecting these users, J-SMART created — for the first time — federal, state, local and tribal interoperability on a nationwide network across the United States.

Nationwide SMARTs

In addition to J-SMART managed by DOJ, the **National Security and Emergency Preparedness Talkgroups** (**NS/EP**) were created to ensure reliable communica-tion among critical **COOP/COG** sites across the coun-try, as well as the *Network Operations Centers* (**NOC**) of critical telecommunications' companies.

The **Department of Homeland Security**'s *National Communications System* (**NCS**) manages and monitors these three NS/EP SMART talkgroups. SkyTerra and NCS also worked together to custom design a box for the MSAT-G2 to be installed in every site. In addition to the transceiver unit, these boxes are equipped with diagnostic lights, surge protection, voltage regula-tion, and battery backup to ensure that these units are always powered and available if an emergency should occur.

The **Kentucky Department for Public Health** (**KDPH**) manages two National Public Health Satellite Talk-groups — **NPHST-1** and **NPHST-2**. NPHST-1 connects the health departments of **all 50 states** and the **Dis-trict of Columbia**, **Puerto Rico**, and the **U.S. Virgin Islands**. NPHST-2 connects a larger group of state and county health departments, hospitals, and other medi-cal facilities, ensuring reliable communications among

"SMART talkgroups are being set up to allow more effective communications among officials from multiple federal, state, local and relief organizations during emergency situations."
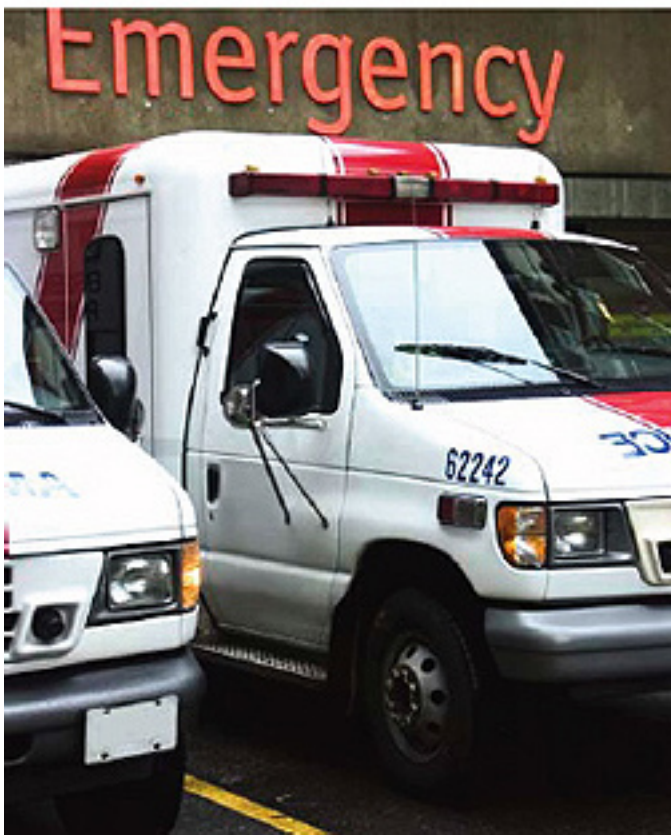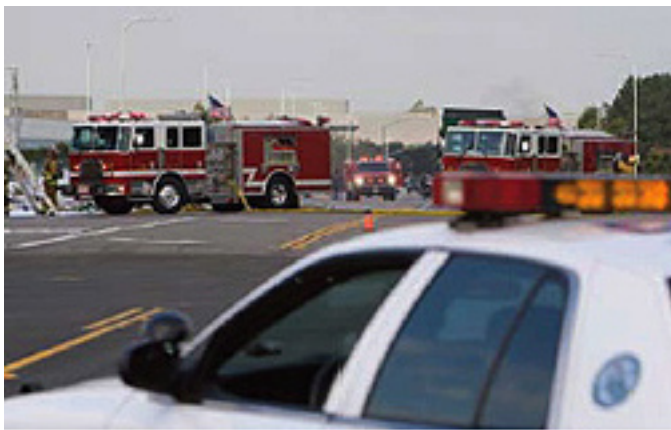
David Stone, Louisiana Governor's Office of Homeland Security and Emergency Preparedness

"Our southwest regional talkgroup enables critical and interoperable communications at all levels of public safety agencies and facilities in an eight-state region."

Kody Kerwin, telecommunications specialist for the Contra Costa County (CA) Fire Protection District

Regional SMARTs

Regional SMARTs enable public safety interoperability within smaller areas of the country. The first regional group addressed the need for interoperable communications across the Gulf Region, which continues to be plagued by hurricanes and tropical storms. SkyTerra established *G-SMART,* for public safety officials across **Texas**, **Louisiana**, **Mississippi**, **Alabama**, **Florida**, **Puerto Rico,** and the **U.S. Virgin Islands**.

G-SMART is managed by the *Louisiana Governor's Office of Homeland Security and Emergency Preparedness* and monitored by the *Louisiana State Emergency Operations Center*. The Governor's Office has the ability to quickly add and remove individuals to and from this talkgroup. This capability is important, as it allows federal organizations such as **FEMA** and the **Red Cross** and public safety teams from across the country to be included in the conversation when they arrive to help.

Since the development of J-SMART and G-SMART, SkyTerra has worked with local, regional and national entities to create eight more regional talkgroups. *Annex B* depicts how national and regional SMART groups overlap, detailing each group and providing contact information for each SMART manager.

Case History: Hurricane Gustav Preparations

Throughout the 2008 Labor Day Weekend, SkyTerra offices in the United States and Canada stayed in constant touch with federal, state, and local agencies equipped with SkyTerra technology operating in the Gulf States in support of Hurricane Gustav emergency response and relief efforts. In addition to G-SMART, the public safety personnel in the Gulf States were also able to conduct interoperable communications with the nationwide J-SMART talkgroup managed by the Department of Justice, as well as the neighboring 12-state *Southeast SMART talkgroup* — a regional group that encompasses various federal, state local, and tribal public safety organizations throughout the southeast U.S. The SkyTerra emergency communications team worked throughout the weekend activating new equipment, moving critical talkgroups to first responder's SkyTerra devices, and conducting long-distance refresher training in satellite communications. SkyTerra also provided loaner devices to several critical agencies that activated emergency response plans and deployed to the region.

the nation's health community. KDPH manages these two SMART talkgroups, and 24x7 monitoring is provided by the Director's *Emergency Operations Center* at the *Centers for Disease Control and Prevention* (**CDC**) in Atlanta.

"It is critical for us to be able to quickly move rescue workers, medical support, repair teams and essential supplies in order to save lives and quickly begin recovery and rebuilding. And we can't do that when our communication systems are down."

Focus

Talkgroups for Specific Purposes

While all of these SMARTs are used for command and control (C&C), SkyTerra's push-to-talk service also can be used for interoperable tactical operations. In addition to J-SMART, DOJ also operates *SMART-T.* This SMART would be used, for example, in a hostage situation or standoff where DOJ, state, and local law enforcement are all working together to manage a situation. Most likely, these groups would all have different types of day-to-day communication equipment. However, with SMART-T, DOJ could quickly add everyone involved in the situation to the talkgroup. The team could communicate seamlessly, helping to resolve the incident as quickly and safely as possible. Once the situation is over, DOJ can remove users just as easily.

Following the successful rollout of the Regional SMART Network, SkyTerra cooperated with the **Charlottesville VA Fire Department**, the **Kentucky Department for Public Health**, and the **United States Marshals Service** to establish three nationwide public safety talkgroups focused to serve fire service, emergency medical services, and law enforcement respectively. *Fire Service* (*F-SMART*), *Emergency Medical Services* (*E-SMART*) and *Law Enforcement* (*L-SMART*) provide an important supplement to existing interoperable communications among agencies with specific public safety missions.

SkyTerra is currently working to develop SMART talkgroups for cross-border interoperability. SkyTerra envisions three SMARTs on the **U.S./Mexican border** and another three on the **U.S./Canadian border**. Discussions regarding governance of these SMART talkgroups will soon be undertaken with appropriate officials from Canada, Mexico, and the U.S. (*See Figure 8*.)

Border SMART™ Talkgroups

- MAB-1: Mexican American Border
- MAB-2: Mexican American Border
- MAB-3: Mexican American Border
- CAB-1 Canadian American Border
- CAB-2 Canadian American Border
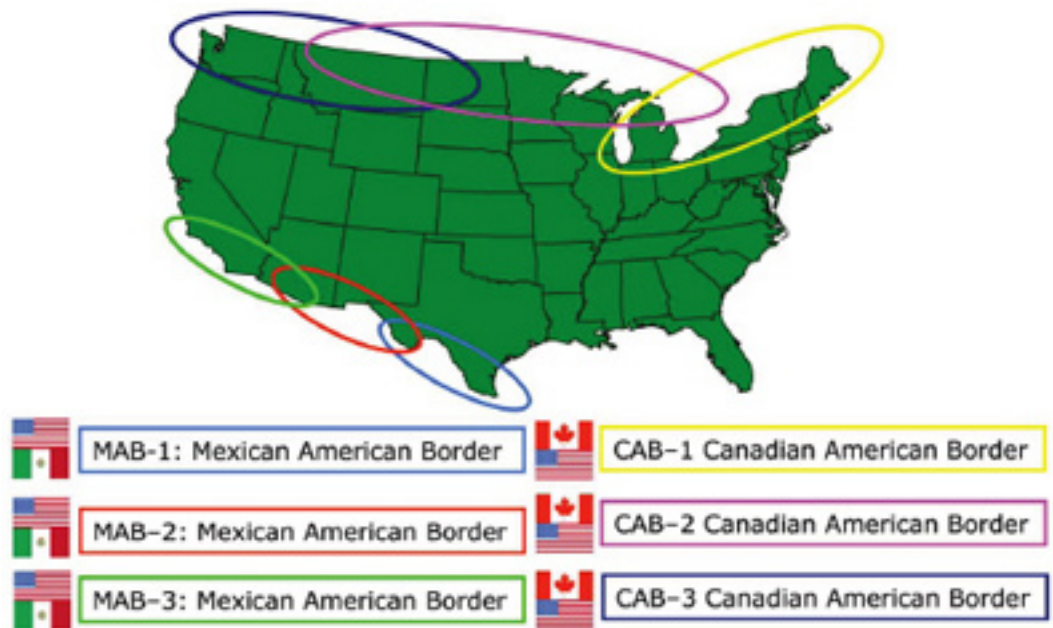- CAB-3 Canadian American Border

Figure 8

A SMART Model for Interoperable Communications.

*Copyright © 2009 IAFC Technology Council*

Border SMART Talkgroups

For emergency response, law enforcement, or public health, SMART meets the need for nationwide interoperability among multiple federal, state, local and tribal public safety teams, providing these professionals with the communications tools they need to ensure the safety and security of the American public. SMART has established federal, state, local, and tribal interoperability on a nationwide network at the national and regional level and all managed by federal, state, local agencies and one not-for-profit, the **U.S. Earthquake Consortium**.

Powerful New Satellites

SkyTerra's Next-Generation

SkyTerra is currently building its next-generation, integrated satellite-terrestrial network. In order to support the dramatic increase in users as well as the growing number of broadband applications, SkyTerra is constructing two new satellites, *SkyTerra 1* and *SkyTerra 2*, which will be two of the most powerful commercial satellites ever built.
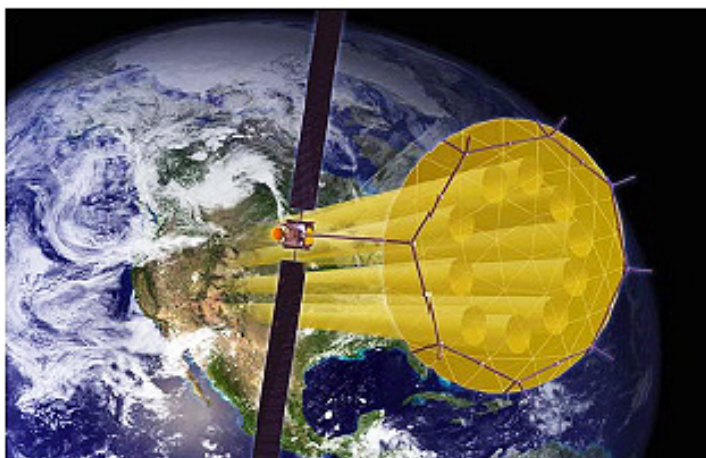
These two new geostationary satellites, which will replace *MSAT1* and *MSAT2*, will operate at **101.3° W** and **107.3° W**, will have 500 spot beams, an antenna diameter of 22 meters (75 feet), and will have 10 times the power of current generation satellites. These new satellites will support the bandwidth and applications that current and future generations of wireless communication users demand. The satellites are expected to begin operations in 2010.

A SMARTer Decision

In recent years, the United States has faced a variety of costly natural and man-made disasters. From hurricanes and tornadoes, wildfires, flooding and earthquakes to high profile standoffs and the 9-11 terrorist attacks, events have taught us that many emergencies today affect significant numbers of the population.

This has amplified the need for dependable communications that enable organizations to communicate with each other. These situations have also demonstrated time and time again that mobile satellite communications is quite often the only means available to the public safety/emergency responder community.

To address these needs, federal, state and local agencies have voluntarily banded together with SkyTerra in a public-private partnership to create the SMART program — enabling nationwide and regional interoperability at no additional cost to SkyTerra users.

Next-Generation Satellites Covering North America	
No. of Satellites	2
Coverage Area	North & Central America, Caribbean
Orbital Position	101.3° W, 107.3° W
Service Link Bandwidth	33 MHz
Spot Beams	500
Power (AEIRP)	79 dBW*
G/T (dB/K)	21*
L-Band Reflector Diameter	22 m
First Launch	2010
Design Life (Inclined)	15 Years
EOL Power	12 Kwatts
Manufacturer	Boeing
Launch Mass (Kg)	5400 (fueled)
Launch Vehicle	Proton/Breeze M, Zenit-3SL

* Over primary service area

Figure 9

As SMART is a feature provided at no cost to SkyTerra's public safety users, it is a cost-efficient program that delivers measurable return on investment — swift and reliable communications interoperability for emergency response and contingency operations. With the rapid growth of SMART, public safety and emergency responders have a resource that enables communications interoperability that is immediate, reliable and always available.

A SMART™ MODEL FOR INTEROPERABLE COMMUNICATIONS

by Jim Corry, V.P., Government Solutions, SkyTerra LP

For more than 32 years I've been a user of public safety communications and, throughout this period, have seen first hand the need for improved communications interoperability for federal, state, local, and tribal jurisdictions. For more than two decades, as a federal law enforcement officer, I voiced my concern for improved communications interoperability. For the past 10 years, I've tried to solve this challenge as a private sector communications executive. The biggest barriers to communications interoperability for this nation's public safety community always seem to be governance and budget issues.

That changed in August 2007, when Adam Siegel of the FBI and Robert Zanger of the Department of Justice's Wireless Management Office proposed a public-private partnership with SkyTerra to establish a nationwide, interoperable Satellite Mutual Aid Radio Talkgroup (SMART™). SMART would be for the exclusive use of public safety officials on SkyTerra's unique satellite two-way radio network; but they insisted that there not be any incremental cost to SkyTerra's government and public safety customers. To take advantage of the free SMART program, an agency must subscribe to SkyTerra's basic push-to-talk (PTT) service.

SkyTerra's executive leadership team agreed with their request and not only created the first nationwide SMART talkgroup managed by the Department of Justice, but also authorized the creation of an entire program of public-private partnerships across the nation with federal, state, local, and tribal agencies. Shortly after the creation of the DOJ nationwide SMART talkgroup, *David Stone* and *Jay Lockwood* of the

Louisiana Governor's Office of Homeland Security and Emergency Preparedness created the first regional SMART talkgroup providing interoperability throughout the Gulf States.

The result is a full suite of SMART talkgroups for nationwide and regional communications interoperability. SkyTerra's fully operational SMART program provides federal, state, local, and tribal interoperability via SkyTerra's nationwide network. The program is nationally and regionally focused and completely administered, managed, and monitored by public safety officials from all levels of government across the nation.

Each national SMART talkgroup serves a different public safety community such as law enforcement, fire service, Emergency Medical Services (EMS), public health, and National Security/Emergency Preparedness. J-SMART, the initial Department of Justice talkgroup, serves as the common denominator for all government and public safety agencies nationwide. Regional SMART talkgroups managed by state and local agencies, as well as one by the Central U.S. Earthquake Consortium, supply geographical interoperability on a multi-state, regional basis. Soon to be released are international SMART talkgroups serving public safety needs on both sides of the Canadian/U.S. and Mexican/U.S. borders. Every talkgroup operates under guidelines outlined in official Standard Operating Procedures.

Chief *Charles Werner* has done an excellent job of distilling some very technical issues into a very clear and straightforward report. I have learned from *Adam Siegel*, *Robert Zanger*, *David Stone*, *Jay Lockwood* and all the other SMART talkgroup managers, that interoperability can be achieved when creative, cooperative people from both the public and private sectors solve a problem by overcoming governance and money issues. I'm very honored to be associated with everyone who has proven that national public safety interoperability can truly be realized. The personnel involved in creating and deploying the SMART program are managing a program that is very clearly a SMART model for all interoperable, public safety communications technologies.

Beyond The Platform Wars... Is Collectivism Coming To TV?

by Carlos Placido, **NSR**

To obtain a glimpse of the future of television beyond today's push for technology pragmatism and cross-platform play, one must simply observe recent developments driven by some of the most respected players in the industry. Netflix's expansion of their successful ''collaboratively-recommended'' mail-order DVD rental service into streaming distribution is a classic (and anticipated) case, as could be TiVo's aggregation of online video and collaboratively-filtered menus. However, perhaps a more surprising example is CNN's recent decision to rely on ''collectivist'' peer-to-peer (P2P) distribution technology for their live video streaming channel at CNN.com.

When seeing this in the context of other Internet-TV developments, the long-term picture for television can look scary, especially for traditional distribution players. **Adobe** intends to extend *Flash* video to the TV set and add P2P capability into their ubiquitous Flash video player. In fact, Adobe and **Broadcom** have just partnered to produce silicon chipsets to bring the Adobe Flash Platform to TV set top boxes (STBs) and other broadband-enabled TV devices to experience web TV on plasma screens, including HD streaming. Web video, collaborative-filtering, and P2P grid streaming entering the living room suggest that "*crowdsourcing*," or, in other words, making use of collective actions for specific tasks, is coming to mainstream TV. Clearly, it is not yet panic time for traditional television, but it appears that the era of TV collectivism is upon us, whether we like this term to describe it, or not.

The End of the Platform Wars as We Know It

With TV digitization, PC-TV convergence, and growth in high definition (HD) screens and services, it is no secret that television is going through the single most profound transformation since the arrival of color TV in the 1970s. However, with Internet pressures building and consumers starting to take back their attention from traditional media, it could be argued that the impact of the mass-customization forces transforming television is rather on the league of the impact experienced in the 1950s — with the arrival of broadcast TV itself.

In order to retain and expand their user base and contain competition from *over-the-top* (**OTT**) offerings, distribution players are "crossing the technology border." Cable MSOs, telcos, DTH operators, broadcasters, as well as wholesale distributors and aggregators, are all adopting pragmatic strategies across traditionally competitive

platforms, leading us to believe that platform-bounded service competition is ending. Examples abound, but the following iconic cases can be highlighted:

- *U.S. broadcasters are placing their content online and plan free digital mobile TV offerings to regain eyeballs going to cable and the Internet.*
- *Orange (Europe's largest IPTV player) and Telefonica (world's most international telco) both rely on satellite (DTH) for extended TV coverage.*
- *Major U.S. MSOs, including Comcast and Cox, are exploring wireless alternatives and are united under "Project Canoe" to fence off Google from the lucrative national TV ad aggregation business.*
- *EchoStar is launching a telco-friendly HITS platform, while also developing Sling-enabled HD-DVR and Tru-2Play set top boxes for the cable industry.*
- *Telmex is acquiring cable and WiMAX operations for the last mile in Latin America.*
- *Content aggregator IPTV Americas is shifting focus from telco-centered IP services toward more fragmented cable operators, in partnership with SES New Skies*

Technology pragmatism is clearly a stamp on today's competitive environment. Thus, focus is given to developments in HDTV, mobile TV, cross-platform and quad-play convergence which are, most certainly, shaping the business in the short-to-medium term. However, movements taking place beneath the surface involving social-economic factors such as collaborative distribution, peer recommendations, and social advertising, are possibly driving the most profound long-term changes to the industry, as intelligence and bargaining power shifts toward the edge of the network.

Shifting Power Among Content, Distribution, and Consumer Attention

Television is moving away from a mass-market, "one-size-fits-all" era, defined by limited content, controlled distribution, and expanding consumer attention towards a future of mass personalization where content and distribution will be abundant. Also realize, conversely, consumer attention will be focused and will be charged a premium for such services. This is a long-term view; we are in the midst of such a transformation that's impacting content, advertising and distribution. This transitional stage is characterized by power shifts where content has moved fast toward abundance, but broadcast-quality TV distribution continues having bottlenecks at various points (despite broadband growth). To these distribution bottlenecks,

we can also add the fact that clearing rights for premium content distribution across various technologies is not simple, though certainly not an issue for the rise of *user-generated content* (**UGC**). However, the tipping point in power structure shifts is in the hands of consumers, whose attention has reached the limits of expandability and has now begun to retreat.

Since the arrival of broadcast TV, consumer attention to the medium has historically expanded. In the U.S., TV viewership is at all time highs. Additionally, TV networks have consistently increased the amount of ad time, costs mainly born by the consumer side of the two-sided TV network economic ecosystem. In a sense, the opportunity cost of the time spent watching ads has been low. This has begun to change with the Internet generation, devoting more time online and valuing their time higher. Although 18-34-year-olds, the segment most targeted by advertisers, continue watching TV, they increasingly tend to rely on the Internet for entertainment and often multitask between TV and PC to watch what they want.

Additionally, consumers are bypassing the local service provider's "closed" services encouraged by the Internet's network externalities. Classic examples are **Skype** and **Vonage** in telephony and **Hulu** or **Netflix** in web video. Provided the net neutrality and non-discriminatory principles of the Internet prevail, telecom and entertainment services will continue to move away from platform-bound, locally-constrained service silos towards utility-like connectivity and distributed resources, where speed, processing and storage become ubiquitous, like electricity, enabling — on demand — a host of new application blends and virtual services.

What becomes clear with these developments is that the various access technologies, from broadcast to unicast, are challenged to properly handle the complete spectrum of content with complex trade-offs among variables such as popularity, picture quality, ad value, premium content value, etc. With expanding choice, enabled by new ways to produce, contribute, and distribute media, consumers are, as never before, in the driver's seat of this transformation directed towards serving their generic and specific digital lifestyles.

However, the amount of content produced by professionals and consumers each day is overwhelming, and

far outpaces the physical ability of any closed-network service provider to distribute and the users' ability to index through it without collective cooperation.

Crowdsourcing + Collectivism

TV "crowdsourcing," the concept of taking a task such as distribution or content indexing traditionally performed by the service provider, and outsourcing it to an undefined, generally large group of people or community in the form of an "open call," appears to be gaining momentum in the new form of grid streaming. As power shifts toward consumers and social nets at the edge of the network, enhancing TV distribution evolves toward tapping into these edge resources by letting such resources "sort it out."

The arrival of P2P distribution to live video and adopted by such major players as **CNN** is of significant importance, as it implies the entertainment sector has come to realize P2P could find its usefulness outside the darkness of P2P file sharing and piracy. In fact, it is believed that CNN now delivers at least 30 percent of its *CNN.com* live video traffic via P2P distribution (the remaining coming from video servers), reaching 25 million users. P2P grid streaming was behind the webcasting of *Obama*'s presidential inauguration ceremony and has possibly labeled *CNN.com* as the world's largest live streaming case. Peer-to-peer distribution for CNN relies on a plug-in from a company called **Octoshape**, which is also reportedly working with European broadcasters.

TV news is a fertile ground for P2P distribution as piracy issues are low. Any piece of news is, after all, history as soon as it sees the light of broadcast. However, leaving aside security and privacy concerns, the democratizing power of P2P grid streaming is enormous. In theory, as technology improves, live content could reach millions of people by sending out the stream only once from a single video server (or desktop computer), effectively "crowdsourcing" distribution to the net, which will take care of the job of doing this in the most efficient manner. In a sense, P2P grid streaming can be thought of as extending the **Akamai** model all

the way to the edge of the network, but saving content owners (or aggregators such as *YouTube*) thousands of dollars in distribution costs and potentially putting both large and small video contributors on equal distribution economic footing.

It is quite interesting that for a company such as CNN, born in the cradle of capitalism, adopting "collectivist" P2P puts it in touch with a term that touches the nerves of many conservatives. In political terms, collectivism is immediately associated with labels such as "socialism," "communism" or "fascism". However, collectivism is a term largely linked to technology since the arrival of the Internet. Peer-to-peer distribution is, by definition, a collectivist technology, and even the network neutrality through the U.S. legislation for the Internet is, considered by many, a "collectivist" principle because *BitTorrent*, among many, can free ride on Comcast's last-mile bandwidth. Also, many of the success stories of the Internet rely on the collective wisdom of the crowd, including, most notably *Wikipedia* content and *Google* search engine, which, despite neither being authoritative nor precise at the micro level, do provide great efficiencies and accuracy at the macro level.

The definition of collectivism as to when "an individual is not an end to himself but only a tool to serve the ends of the group," advocates collective control over production and distribution, which is exactly what is happening with the growth in *UGC*, open-source initiatives, social networking and P2P, turning traditional thinking upsidedown as virtual groups take over. Truth be told, however, even in technology there is a constant struggle between individualistic and collectivist behavior, with the latter prevailing only when giving the right incentives to individuals. While it is in the collective interest for all to upload/upstream to others (so everyone receives the file/stream quickly), it is also in the individual interest to save bandwidth by only receiving and hence free-riding on others. This leads to what some call "individualistic collectivism." Paradoxically, as demonstrated by the use of collaborative filtering in user menus, "collectivist" technology can help treat large audiences as individuals.

In some cases, collectivist behavior results from the fact that such behavior does not bear a perceivable cost to the individual. Prime examples are *Netflix*

subscribers that, by renting DVDs, provide additional data to be input into their collaborative-filtering "organism, used by Netflix to recommend DVDs to subscribers, or *Tivo* users that, while they time-shift programming and swap channels, are providing data to be used by Tivo in its *StopWatch* ad survey platform.

In other cases, collectivist behavior comes from the fact that users do not perceive the resources that they are putting to service the network (such as hard-drive storage, upstream network capacity, and CPU cycles) interfere with their "individualist" resources. Or, if they do, such disadvantages are outweighed by the advantages brought by the network, such as the ability to watch content that would otherwise be only available for a subscription fee in cable or satellite TV — such as CNN TV news.

Adobe P2P and Flash Video Reach The Living Room

Not surprisingly, Adobe is also working toward adding P2P video streaming capability to its ubiquitous Flash player, installed on 99 percent of Internet-enabled desktops worldwide. Its Flash video version 10 has P2P features built-in, but Adobe also intends to become prevalent in the living room. Today, some TiVo DVRs have the ability to display *YouTube*, *Amazon-on-Demand*, *Netflix,* and *CinemaNow* web video content on the TV set. Adobe is working with *Broadcom* (a large chipset manufacturer) to make generic Flash video decoding available in other TV consumer devices such as set top boxes for seamless PC-TV addressability, which will possibly accelerate the transition to HD web-based video on televisions. Although P2P capability in these TV chipsets has not been announced, such development is a possibility.

Even outside telecom, P2P technology appears to be the focus of attention. Scientists argue that the current global economic crisis, when seen through the glasses of global warming and power dependency on oil, has reached an inflection point set to foster the development of smarter, green-friendly, high-tech electricity grids, where, interestingly enough, the answer to macro-level efficiency could come from imitating Internet P2P networks.

The Network IS The Platform

Every company is adapting to this transitional phase in telecommunications and entertainment and pragmatically adopting means to enhance, or protect, their

business, seeking to strengthen gatekeeping, by (among other things) expanding distribution capabilities. This, however increasingly pushes players for openness.

While it is not panic time for traditional television, as the exact picture of how television will look like in 10-years is not entirely clear, there is no question that television, just like all other basic consumer services including voice and data, is being driven by changing consumers' behavior and technology developments that foster intelligence toward the edge of the network, including collective actions such as collaborative-filtering and peer-to-peer distribution.

The platform wars are ending. Tthe mantra now is how to gain, retain, and monetize empowered consumers for as long as possible, even if doing so exposes vulnerabilities. During current transitional times, there will clearly be a mix of approaches that present opportunities and threats to the collective resources and wisdom of the network, which is where answers will ultimately be cemented into place. In this platform-agnostic world, collectivism has arrived, or in other words — **the network IS the platform.**

About the author

Carlos Placido has more than 12 years of progressive experience in the areas of consulting, program management, research and engineering in telecommunications and entertainment. Mr. Placido has carried out independent business development, technology assessment and management activities, including market research studies for NSR, assessment of regional business potential for vendors and project management at Telefonica. Until 2004, he led a development team at Intelsat in Washington, D.C. where he was responsible for identifying and validating emerging video and data technologies for their potential applicability to new and existing services. Mr. Placido's development efforts at Intelsat included advanced video networks, IP television, satellite multicasting and broadband, having made significant contributions including spearheading satellite IPTV, improving Internet throughput enhancement and pioneering high-speed satellite LAN-to-LAN. Mr. Placido is currently based in Buenos Aires, Argentina. He holds an engineering degree from the University of Buenos Aires and an MBA from the University of Maryland, Smith School of Business. He is fluent in Spanish and English.

Insight

The NGA: GPS Consumer and Contributor

by Vice Admiral Robert B. Murrett, Director, NGA

Over the past decade, the NAVSTAR Global Positioning System (GPS), managed by the U.S. Air Force (USAF) Space Command for the Department of Defense (DoD), has become the most exploited space-based asset that the U.S. government has ever developed. As GPS provides space-based radio navigation for anyone with a GPS receiver, both civilian and military uses have increased exponentially.

In fact, everything geospatially oriented today is reliant on GPS. Most military and intelligence operations depend on knowing precisely where something is located. *National Geospatial Intelligence Agency*'s (**NGA**) mission is to provide the accurate, timely, and actionable *geospatial intelligence* (**GEOINT**) to our mission partners, when and where they need it most. From the warfighter on the front line to the local search-and-rescue team seeking flood victims, NGA provides GEOINT to support operational and decision-making needs.

For example, we provide the geospatial products that enable our warfighters — soldiers, sailors, and airmen — to accurately locate and hit targets. Our analysts will build a picture for the warfighter by layering natural features, such as rivers, hills, and waterways, with man-made features, such as roads, power lines, and buildings, to develop a 2D or 3D picture for common use. Knowing that a target of interest exists is important; knowing where exactly that target of interest is located ensures accurate targeting and minimizes the risk of collateral damage. To target an object, the warfighter needs accurate geographic coordinates. Subsequently, each data layer used in the development of a GEOINT product is referenced to a standard coordinate system.

Ensuring Accuracy + Reliability

U.S. national security, transportation and navigation safety, economic interests, and scientific uses all rely on GPS. This increasing dependence demands that the coordinate information and reference system be both accurate and accessible. NGA plays an essential role in maintaining and improving the accuracy and reliability of GPS by providing the DoD with precise GPS orbits, satellite and station clock corrections, and Earth orientation information. NGA is a daily consumer of GPS as well as a robust contributor, as well.

NGA and its predecessor organizations partnered with the DOD to develop the *World Geodetic System 1984* (*WGS 84*) as the standard geodetic frame of reference. The WGS 84 global reference frame provides a mathematical representation of the Earth's shape, a 3D coordinate system, and a gravity model that is essential for computing satellite orbits and precise locations on, above, or below the Earth's surface. WGS 84 provides a common, standardized reference frame for interrelating and integrating all geospatial data, including GPS-derived position location information. This global reference information is what allows users to determine their locations on Earth based on the precise positions of GPS satellites in space.

Prior to the 1950s, coordinate systems were developed regionally. Once satellites became available in the 1950s and 1960s, we were able to establish an Earth-centered, global coordinate system. Today, the WGS 84 coordinate system used by GPS is defined by the 3D coordinates established by the combination of the U.S. Air Force and NGA satellite tracking stations distributed around the world. The more accurately we know the positions of these tracking stations, the more accurately we can determine the GPS satellite positions. Currently, we estimate the accuracy of these station coordinates within a few centimeters or less. As a by-product of this data processing, we can also detect small variations in the Earth's orientation in space and its rotation rate. This information is crucial for the accurate and precise orientation and geopositioning of satellite imagery.

Precise timing is the key to GPS's accuracy. Every DoD GPS tracking station and GPS satellite is equipped with an atomic clock, each of which runs at slightly different rates. NGA collocated a tracking station with

Insight

our nation's master timekeepers at the U.S. Naval Observatory (USNO) in Washington, D.C. This allows us to take advantage of the stability, precision, and accuracy of the USNO time by defining it as our GPS "master clock," and then to adjust all the other satellite and station clocks to the master.

Reliability of service is essential to GPS effectiveness. Beginning in the 1980s, NGA provided personnel support at the GPS Joint Program Office (now the GPS Wing) at *Los Angeles Air Force Base* (**LAFB**) and the *Operational Control Station* (**OCS**) at **Schriever AFB** in Colorado Springs. Additionally, we invested in building and operating a global network of unmanned GPS tracking stations to augment the Air Force's permanent GPS tracking stations. The result has been substantial benefits to the entire GPS user community. As part of a major accuracy improvement initiative, NGA stations now feed real-time data to the GPS through the OCS at Schriever AFB. These data are incorporated into the real-time estimation process for GPS orbit determination, resulting in increased accuracy and integrity of GPS navigation signals for GPS users.

Looking Forward

Future improvements and maintenance of GPS, augmentations, and backup capabilities are necessary to meet growing national security, economic, commercial, and scientific requirements and opportunities. For example, new foreign-based *Global*

Navigation Satellite Systems (**GNSS**), such as the Russian *GLONASS* and the European *Galileo* System, provide additional options for current and future GPS users. These foreign systems are not yet as robust as our GPS system, but may be in future years. With ongoing efforts to ensure interoperability among all the systems, every system may be vulnerable to the same intentional or unintentional interference. The sheer number of combined GNSS satellites, upwards of 60–100 in the future, may help to mitigate these effects.

Focus

The defense community is exploring new mitigation strategies to counter electromagnetic radiation interference caused by solar flares or geomagnetic storms, as well as intentional and unintentional radio jamming caused by man-made techniques. DoD's development and implementation of a military-only code and other new satellite features are designed to protect and preserve U.S. strategic access to GPS, even in hostile environments.

As we look toward the future and the next evolution of GPS, we must ensure interoperability and compatibility in the context of geospatial information. NGA will continue our strong collaboration with the USAF to ensure future satellite procurement and technological decisions to consider GEOINT needs and capabilities. Additionally, NGA's continued participation in the International GNSS Service, the international organization that produces state-of-the-art GNSS data and products for the scientific community, will also help ensure that NGA stays up-to-date on the latest GNSS science and technology.

As both a consumer of, and a contributor to, GPS, NGA is committed to integrating and working collaboratively with our mission partners as we make the best decisions to ensure our national security, safety, and stability.
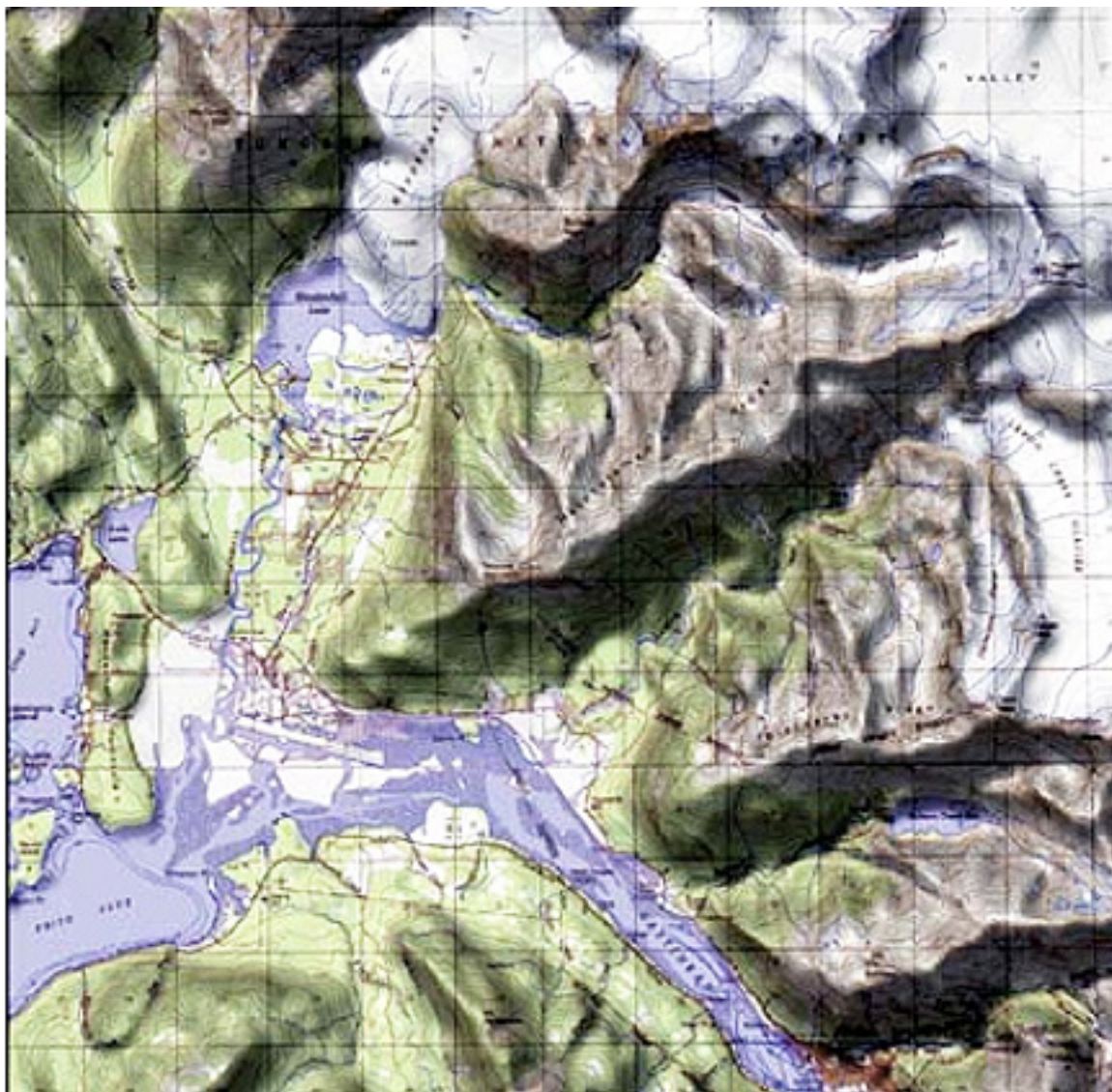
Shaded relief map of Juneau, Alaska — The Department of the Interior, U.S. Geological Survey (USGS) is the distributor of public sale NGA topographic maps, publications and digital products.

About the author
Vice Admiral Robert B. Murrett is the director of the National Geospatial-Intelligence Agency (NGA).

Editor's Note: This article previously appeared in the November/December 2008 issue of NGA's Pathfinder magazine.

Feature

Securing Your Hybrid Network
What Every Satellite Operator Should Know

by Steve Christian, Verimatrix

Satellite systems provide an excellent way to broadcast large amounts of content to wide geographic areas. But satellite pay-TV operators are struggling to offer interactive and on-demand services as they experience more competitive pressure. In general, satellite operators are enhancing their lineup with HD via the existing Digital Video Broadcast (DVB) infrastructure. Yet in order to compete effectively with cable and Internet Protocol Television (IPTV) services, they need two-way communications capability in order to offer enhanced on-demand services.

Satellite operators have now started to embrace IP-based technologies to implement interactive services. The combination of DVB and IPTV delivery technologies within a hybrid network takes advantage of the strengths of each: an RF-based broadcast network for one-to-many simultaneous content delivery, combined with a scalable IP network for the interactive one-to-one services.

Existing tiered content packages will continue to be delivered using the available DVB infrastructure, while video-on-demand (VOD) and interactive services are added over a localized IP broadband network.

The most recent data from **IMS Research** forecasts satellite hybrid set-top boxes (STBs) will account for three quarters of all hybrid set-tops shipped worldwide in 2012, based on leading satellite TV operators' strategies to strongly position themselves against land-based competitors.
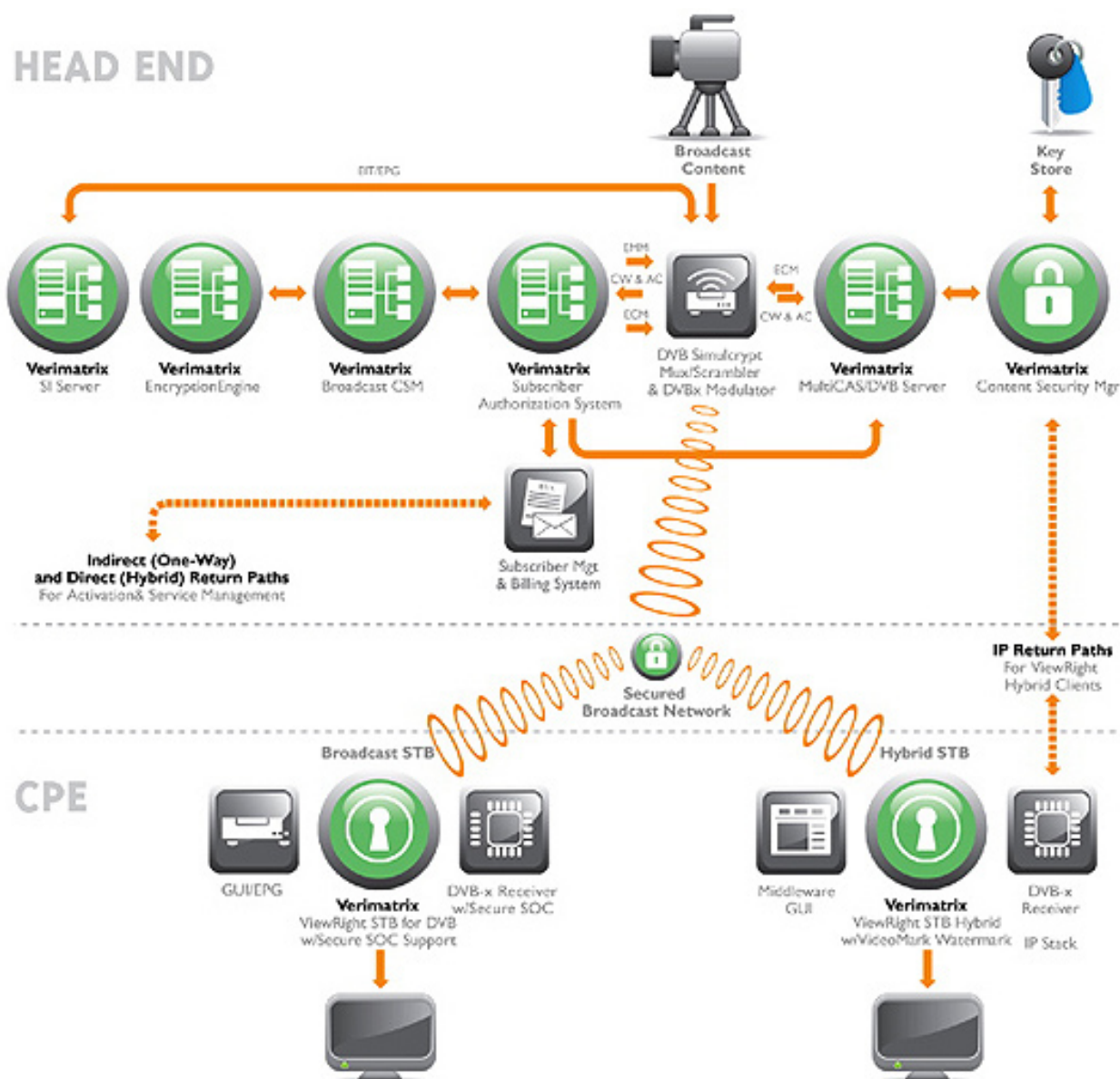
Unified Content Security for DVB Broadcast and Hybrid Networks

Additionally, the analyst firm **MRG** is researching new information covering the growth of hybrid STBs that reveals excellent potential in some markets where broadband is already available, and where multi-channel digital video broadcast is already in place. MRG's new ***Global Hybrid Set-top Box Report for IPTV*** reveals a (conservatively estimated) installed base of well over 13 million hybrid STB units in 2009, with at least 15 percent Compound Annual Growth Rate (CAGR) through 2013. (*This report will be available from MRG in April of this year.*)

Enhanced Business Model Opportunities

One of the big opportunities of delivering video over an IP infrastructure is the ability to completely incorporate a home network and STB within the service. Through a home gateway, operators can provide a command center for flexible home entertainment options and retain some control over the network behind it.

Real-time interactivity and personalization are also attractive services, such as VOD, catch up TV, and DVR. Providing interactivity within program streams can increase stickiness and subscriber loyalty such as vot-

Pay-TV Operators

The traditional view of content security as a necessary evil has been overturned by the on-demand revolution in broadcasting. Flexible and effective content security is the essential enabler of innovative business models that can increase competitive positioning.

Therefore, content security has become a critical strategic decision. Ideally, a content security platform should:

- Work across all the emerging platforms and devices

- Offer a multilayered approach to content security, combining all the required CA and DRM mechanisms within a single platform

- Provide a cost-effective solution that can be easily renewed and implemented, particularly as operators migrate to a hybrid network.

Regulators

The convergence between broadcasting and broadband can be a significant headache for regulators, with a blurring of previous demarcations between content and communication and often even between the agencies involved.

Great variations exist in regulatory ambitions and politics between countries. For example, some countries may want to block content that is critical of the government, while other countries are mainly concerned about offensive material.

One common theme is a concern with copyright enforcement, and an interest in developing tools that can help regulators police the system being created, such as digital watermarking.

Content Owners

The threat of large scale piracy, which undermines the revenue potential of their product, is still very prevalent. Content owners' focus is on enforcing digital rights through technological and legal processes.

While the delivery of content via an IP network can have both positive and negative dimensions, it also creates greater visibility of content throughout its lifecycle. Two-way IP networks provide the potential for checking that DRM rules are being enforced, and tracing individual content files.

The main business benefit is the ability to extend early release windows and increase revenue, without increased risk of piracy.

Weighing Multiple Perspectives on Security

ing in competitions or interactive advertising that enables the purchase of products directly through the TV.

Additionally, offering Internet-based video content can place operators on the leading edge of menu options. Over-the-top and long tail content can be served within a walled garden environment, insulated from threats such as viruses that permeate the Web.

A common thread that helps satellite operators meet all of these objectives, and arguably the very foundation of digital convergence, is IP-based technologies. Throughout the broadcast head-end and inside the multimedia savvy home, IP has emerged as the com-

mon building block. There are numerous scenarios available for satellite operators to enhance their competitiveness, which are all made possible by a bidirectional channel enabled by IP.

Yet, in order to deliver material ranging widely in value from blockbusters to niche content, hybrid network architectures raise unique issues regarding content security and digital rights' enforcement. These challenges are typically met by a variety of incompatible *conditional access* (**CA**) and *digital rights management* (**DRM**) solutions.
Dealing with more than one security platform creates

Feature

management challenges for pay-TV operators and content owners alike. Newer generations of content security architectures can help resolve these challenges through a multi-layered approach that supports all content types, delivery networks and display devices — typically from a single head-end.

Flexible, Layered Security Approach

A multi-layered security approach allows operators to optimize content security for different platforms, consumer devices and customers, within a single platform. Operators are able to deploy just enough security to meet their varying business objectives. Too onerous security incurs unnecessary costs and can deter customers, while too little of course can encourage piracy and unauthorized access to services.

Most consumers are simply looking for clear and transparently-enforced rules relating to the material they purchase. In fact without these rules in place, the variety of different purchase and rental options available today could not exist. A unified content security approach eliminates any negative perceptions of DRM policies and allows consumers to simply enjoy the content they purchased.

Advantages of Software-Based Security

The advent of IP-based infrastructures for play-out and transmission has one main implication for content security. Renewability of security subsystems is a distinct advantage in a landscape of fast changing threats and business opportunities, making software-based security an attractive option. Content security is an arms race against pirates and fraudsters, so the content security must be renewable. Software-based security offers flexible renewability options allowing operators to stay a step ahead.

Migration Considerations

Operators need to consider their content security transition plan for the hybrid migration. For example, one-way satellite broadcasters have historically favored hardware-based security systems. As they add IP-channels they would need to upgrade to a hybrid STB. They are then faced with a choice: either manage two separate security systems, which is costly and cumbersome, or select a unified security approach that protects both broadcast and IP-delivered programming by establishing a single content authority.

The DVB *Simulcrypt* standard, which allows two CA

systems to work side-by-side, facilitates the upgrade from legacy boxes to hybrid by using software-based content security in the hybrid receivers. Thanks to the two-way communications capability, there is no need for hardware-based security in hybrid devices. This allows for a transparent transition that will not be at risk of disrupting business operations. Operators can phase in new STBs to quickly take advantage of higher value subscribers and lower content security costs for improved profitability.

Satellite operators need a unified content security system that not only brings significant cost and operational savings from managing just one platform, but also enables the deployment of a transparent security regime across all the network and device permutations that subscribers are demanding. A unified content security system has a vital role in the transition towards hybrid networks. Most importantly, it supports multi-layered protection, allows new business models to emerge and flourish.

About the author

*Steve Christian handles the marketing and development oversight of Verimatrix's **VCAS™ for DVB** content security solution targeted for DVB hybrid and DVB broadcast networks.*

VCAS for DVB enables operators to combine standards-based and proven DVB technology for broadcast distribution with the interactivity of IP-based networks using a single security system. Prior to joining Verimatrix Mr. Christian was VP, Marketing at Nine Systems, Inc. — a world class provider of streaming media services. He has also run his own technology marketing consultancy, contributing "virtual VP" expertise to a variety of software, wireless and security organizations that successfully sharpened their marketing strategy, positioning and go to market programs. He lead the marketing team at Wind River Services (initially Doctor Design, Inc.), and his extensive marketing experience also includes driving technology development and international product management at ST Microelectronics, Raytheon and Scicon in the U.K. Mr. Christian has a 1st class degree in Physics from the University of Bristol and an MBA from the Open University in the U.K.

Focus

SatSharks — Knowing Where They Are...

by Danielle Edwards, NSSL

A **U.K. armed forces expedition recently conducted a diving and shark tracking exercise off the coast of Costa Rica as part of the worldwide effort to increase shark conservation. A key element of the program was using SATCOM technology to update the team blog and podcasts in order to engage the public. NSSL, the international satellite communications service provider, contributed essential equipment and support for the expedition. The *Broadband Global Area Network* (BGAN) *Explorer 500* satellite communications device, and an Iridium handset, enabled the entire team to benefit from high-speed broadband data and voice communications with the United Kingdom while at sea throughout the expedition.**

Expedition *Jurassic Shark 2* ran for 20 days in the remote *Socorro* and *Guadalupe* Islands, off the coast of Costa Rica. Jurassic Shark 2 consisted of a group of divers from the Armed Forces working with leading shark researchers to tag 20 sharks with radio transmitters to collect and record data for analysis.

The team consisted of 16 military personnel, including the Royal Air Force, Royal Marines, and the Army. The expedition focused on three species: *Great Whites*, *Hammerheads,* and Whale Sharks. The expedition included three scientists, each one a specialist in one of the three species of sharks being studied.

Major *Andy Reed*, Jurassic Shark 2 expedition leader, was swimming with sharks on a daily basis. "It is not inherently dangerous if you keep your wits about you.

Attracting new ocean friends

Working with the NSSL equipment

The sharks like to watch their prey for a while to decide if it will be an easy meal or not. They will smell and bump you before considering any attack. As long as you don't panic and you gently push them away with a camera or spear-gun they won't bother you." Andy notes that the Great White Sharks are an exception to this rule as their natural aggressiveness means you have to be careful whenever they are close by.

The tagged sharks are currently being tracked in order to learn more about their habits and movements. In addition to the tracking data, the divers and scientists were able to observe the shark populations firsthand to establish how closely the different shark populations were interrelated.

The diver's spectacular underwater video footage of the team tagging sharks and the NSSL kit provided the team with stunning video content to upload to their blog on a daily basis. Additionally, it permitted them to keep in touch with loved ones for birthdays and anniversaries.

"The battery could last a full week before recharge and we used it for about 15 minutes at the end of each day for uploading about 1MB of blog/pictures and 1MB of video from our Mac," said Major Reed. "It was essential the BGAN unit worked with our Macs, so NSSL was the best solution for us."

Danielle Edwards, Product Marketing Manager at NSSL, commented, "We have a strong customer relationship with the Armed services and it is a pleasure to support a group such as this with such exciting and ambitious goals. This once again proves how essential SATCOM equipment can be when communicating from remote and challenging locations."

About the author
Danielle Edwards joined NSSL in January 2005 after leaving her native South Africa. Danielle promoted the launch of Broadband Global Area Network (BGAN) to new and existing clients; promoted the launch of maritime BGAN in 2007; handled the general marketing of NSSL; and established NSSL and e-go Solutions as separate satellite communication providers within the same company. Danielle has more than eight years of experience with technology firms,

About the company
NSSL offers an international service in the satellite communications arena, and is one of the leading providers of BGAN, the most advanced SATCOM systems currently available.

Input: Tools Of The Trade

Paradise Datacom's PCMA-70 BANDWIDTH EXTENDER is designed to provide satellite-based system operators with a way to greatly increase their utilization efficiency of transponder spectrum to reduce operating costs.

The degree of savings depends on a number of factors including satellite performance and link design as it relates to the transponder power and bandwidth required to accommodate the traffic. System design considerations are expressed later in this article.

PCMA-70 uses *Paired Carrier Multiple Access* (**PCMA**) a patented technology developed by **ViaSat.** PCMA uses an adaptive, self-interference cancellation technique to allow transmit and receive carriers of a duplex link to be superimposed on to one another to achieve space segment savings of up to 50 percent (*see Figure 1.*)

With the PCMA-70 installed in the modem's IF loop, a sample of the transmit signal is routed to the cancellation circuits where it is modified to emulate propagation effects and then used to eliminate the transmit carrier signature from the composite local + distant signals being received from the satellite.

PCMA-70 is housed in a 1-RU (1.75") chassis and is available in a number of band-pass configurations including 2, 5, 10, 20 and 36 MHz. Redundancy switching is also available.

System Design Considerations for PCMA

The extent of savings that can be realized by implementing PCMA is dependant upon a number of factors that should be confirmed by performing a thorough satellite link analysis. For optimum performance, the following conditions should be met:
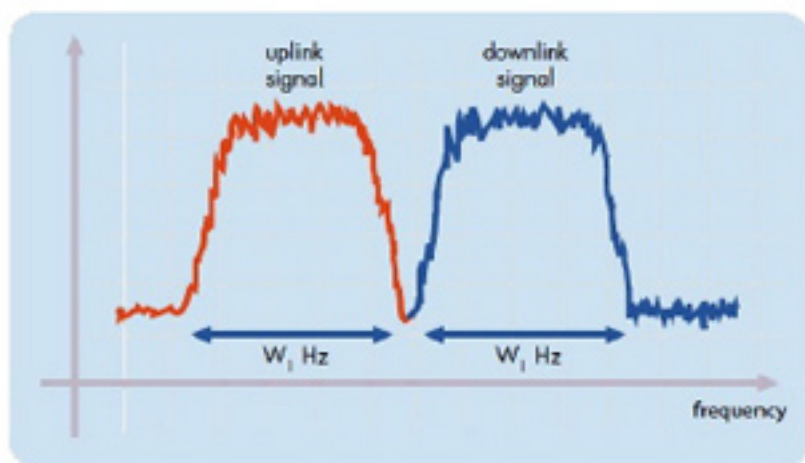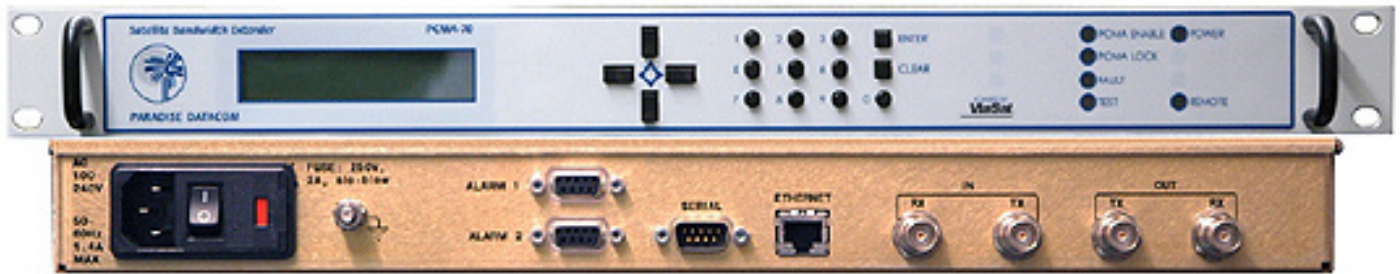

Typical SCPC satellite link with separate frequency slots for transmit and receive carriers.
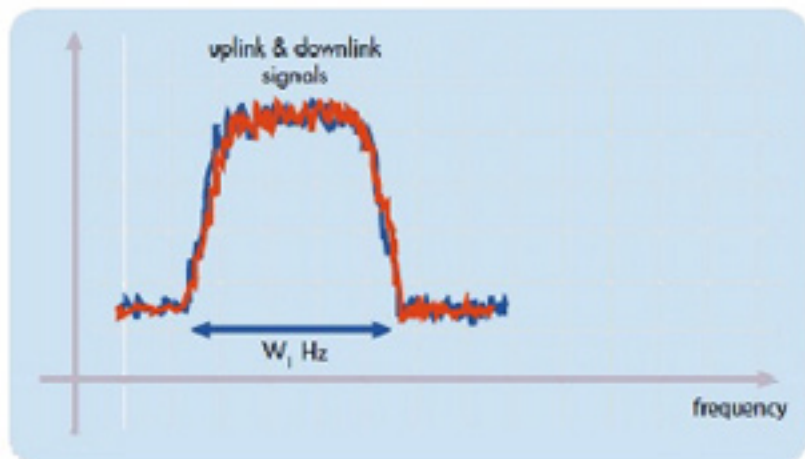
Using Paired Carrier, uplink and downlink carriers are superimposed, allowing savings of up to 50% on space segment.

Figure 1 - Overlapping of carriers into common spectral footprint.

PCMA-70 Bandwidth Extender

- Links must be bandwidth-limited as opposed to power limited. For maximum benefit, required XPDR power should be half of required bandwidth so that superimposed carriers are balanced

- Each site in the network must be able to receive its own carrier *(i.e.,* no cross-strapped transponders

- Only signals with an occupied bandwidth of 150 kHz to 36 MHz will work with PCMA-70.

- Automatic Uplink Power Control (AUPC) is recommended to maintain power levels during rain-fade conditions since maintaining the carrier levels to +/- 5 dB limits Eb/No degradation to ~0.2 dB.

- Power asymmetry between carriers should be no more than 10 dB.

- For existing links, signal power must be increased 0.15 - 0.5 dB, depending on relative carrier power ratio.

For cases in which the system architecture has a power limitation component preventing the ability to achieve maximum benefit from PCMA, changes in ground station components and settings can provide the additional power necessary. These changes include:

- Increasing antenna size at one or both ends of the link

- Improving coding gain i.e. changing from Viterbi to TPC/LDPC or modulation/FEC rate i.e. 8PSK 7/8 to QPSK ¾ therefore requiring less power to achieve a target bit error rate (BER).

- Using a higher quality LNA/LNB

- Switching to a higher power transponder

SCPC Applications

For single point-to-point or co-located multi-carrier point-to-point applications, a PCMA-70 can be placed on both ends of the link as depicted in *Figure 2*. This can be provided in the form of outboard PCMA-70s or
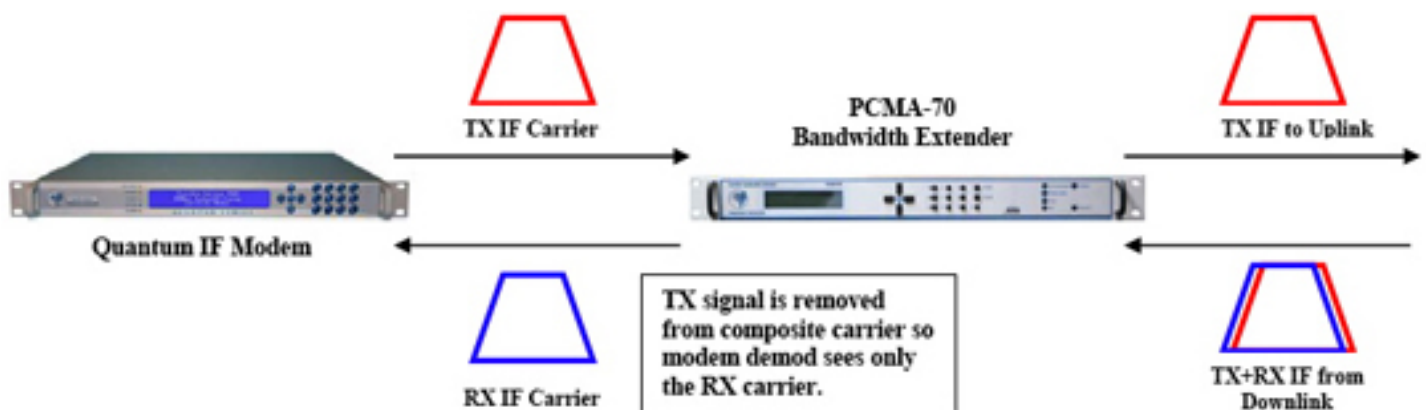
Figure 2 - Point-to-Point SCPC Terminal (two required)

Input: Tools Of The Trade
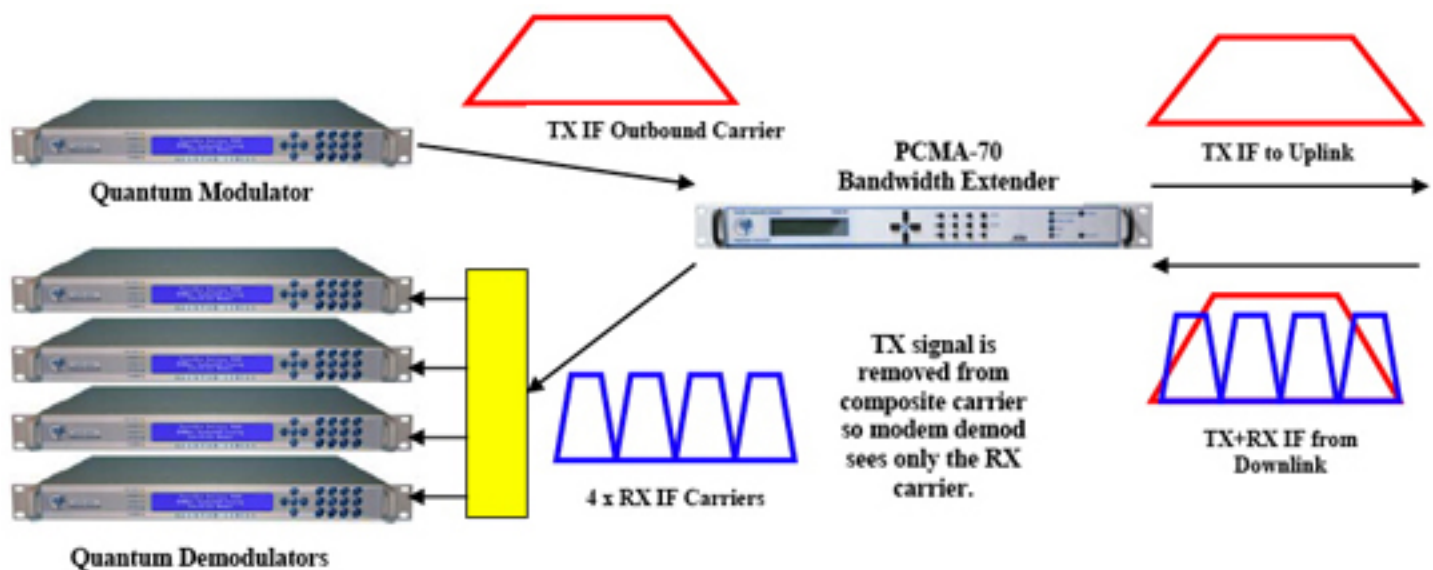
Figure 3 - Point-to-Multipoint Hub

Paradise modems with embedded PCMA, or a combination of both. The diagram on the next page shows a simplified diagram of a PCMA-70 installed in the TX and RX IF links of a Quantum satellite modem.

The principal benefit of using a PCMA-70 over the embedded PCMA is that multiple modems can be trunked into a single PCMA-70 using a passive combiner/divider network as long as the aggregate traffic does not exceed 36 MHz of bandwidth.

For point-to-point links, maintaining similar carrier power levels minimizes Eb/No degradation with the effect being less significant for lower order modulation schemes. For example, two TPC/QPSK carriers with a 10 dB power ratio will experience a maximum degradation of ~0.4 dB whereas changing the modulation to TPC/8 PSK increases degradation by ~0.5 dB.

Point-to-Multipoint Applications

The spectrum savings benefit from the PCMA-70 is equally applicable to many VSAT or point-to-multipoint system architectures. In the example depicted in *Figure 3*, multiple return signals are being transmitted within the larger outbound carrier's spectral foot print. A single modulator generates an outbound carrier sending information to four remote sites. The remotes generate lower data-rate return carriers that are placed within the same transponder spectrum being occupied by the larger outbound carrier. The composite TX + RX carriers received at the hub are routed through the PCMA-70 where the outbound carrier originated at the hub is removed leaving only the four carriers received from the remotes.

In point-to-multipoint applications, maximum savings is achieved when the return carriers will fit within the spectral footprint of the hub's outbound carrier. The hub carrier level should be a minimum of 10 dB above the level of the return carriers to insure that the remote sites receive the outbound carrier with sufficient carrier-to-interference (C/I). No cancellation is required at the remotes as the return carriers will be treated as interference or system noise in relationship to the larger outbound carrier.

The satellite link analysis typically includes a small amount of additional system loss to compensate for this effect. Since in many STAR and VSAT network architectures, the hub-to-remote ratio can be high, the symbol-rate asymmetries between the outbound and inbound signals must be accommodated by the signal canceller. Asymmetries of up to 20:1 have been recorded and higher asymmetries are certainly possible.

Paradise Datacom's QUANTUM Satellite Modem

It is important to note that the system architecture described in *Figure 3* does not require carrier cancellation at the remote sites. Consequently, a single PCMA-70 at the hub station is all that is required. This can result in significant savings over embedded technology for point-to-multipoint topologies.

Embedded PCMA

For sites that are equipped with a single modem, an embedded version of PCMA can be purchased as a field upgrade for any Paradise Datacom Evolution, Vision or Quantum modem shipped after January 2009. Modems shipped prior to January 2009 can be retrofitted at one of Paradise Datacom's factories in the U.S. or the U.K. Currently, modems can be ordered with the internal PCMA hardware installed at the factory prior to shipment allowing the feature to be installed on site at a future date.

QUANTUM and VISION modems with PCMA provide the added benefit of DVBS2 technology for an even greater degree of spectral efficiency. DVB-S2 alone can increase efficiency over Turbo Product Code by 15 percent and DVB-S by 30 percent.

Paradise Datacom system engineers can perform an in-depth satellite link analysis to identify the potential benefits of implementing this cutting-edge technology.

Improving Digital Media Satellite Networks

by Keith Dunford

Since the early days of transcontinental, intercontinental and global networking of television content, great attention has been directed to maintaining the integrity and quality of video and audio content. **Prior to the introduction of digital television in the late 1980's, satellite links were analog and subject to deterioration in signal-to-noise ratio and other distortions. This resulted in lowered quality of the video and audio signals delivered to consumers.**

Analog systems required a large amount of transponder bandwidth, at first one 525/60 or 625/50 television signal in one 36MHz transponder. This was later improved to enable two such programs to be carried in the same bandwidth. With the advent of MPEG-1 digital compression, very little changed in bandwidth requirements, however deterioration in baseband signals was substantially eliminated. The advent of MPEG-2 in the early 1990s allowed greater compression ratios enabling up to six standard-definition (NTSC / PAL) programs to be carried in a 36MHz satellite transponder.

This virtual increase in transponder capacity and availability effectively lowered the cost of satellite links, delivered improved quality, and set the stage for affordable global, national and even local satellite news gathering.

With the introduction of *Advanced Video Codec* (**AVC**) technology and specifically MPEG-4 /H.264 standards, a further improvement in performance and cost savings have been made possible. Content encoded in AVC/H.264 can be carried over a satellite link requiring only 50 percent of the bandwidth used

Application	Encoding Standard	Data Rate	Modulation	FEC	Symbol Rate	Occupied Bandwidth
HD News Gathering	MPEG-2	10Mbps	DVB-S / QPSK	R=3/4	7.24Msps	9.76MHz
	MPEG-4/H.264	5Mbps	DVB-S2 /8PSK	R=3/4	2.24Msps	3.03MHz
SD News Gathering	MPEG-2	5Mbps	DVB-S / QPSK	R=3/4	3.62Msps	4.88Mhz
	MPEG-4/H.264	2.5Mbps	DVB-S2 /8PSK	R=3/4	1.12Msps	1.52MHz

Figure 1 — Bandwidth saving using DVB-S2 and H.264 encoding

for the equivalent of MPEG2 encoded content. The standard has also afforded improvements in perceived video quality.

The use of high performance compression systems and digital satellite links has delivered the greatest benefit to *Digital Satellite News Gathering* (**DSNG**) operations, allowing real time, live news production to achieve reduced cost and improved performance. The transition from standard definition (SD) to high definition (HD) newsgathering has required new satellite transmission technologies that address the requirement of higher encoded data (bit-rates) of HD content that are at least twice that used for broadcast quality SD content. However the available channel bandwidth for DSNG is substantially the same, and in terrestrial microwave **DENG**, this has recently been reduced by 5MHz, from 17MHz to 12MHz per channel, in restructuring of the 2GHz *Broadcast Auxiliary Services* (**BAS**) band.

Improved compression systems such as AVC/H.264 have decreased the data rate required for broadcast standard HD and SD content. Improved channel coding technology has also increased the data throughput of

satellite and microwave links. These distinctly different technologies, when combined in a satellite transmission system, have made possible the transmission of HD content in substantially the same bandwidth previously used for SD content.

The move from DVB-S to the newer **DVB-S2** standard has increased the data carrying capacity of a satellite transponder channel by as much as 30 percent when using equivalent modulation schemes, as indicated in *Table 1*. The increased throughput of a DVB-S2 enabled channel is made possible by improved *Forward Error Correction* (**FEC**) codes such as inner code *Low Density Parity Check* (**LDPC**), concatenated with a *Bose-Chaudhuri-Hocquenghem* (**BCH**) outer code.

The new FEC codes provide an improved signal-to-noise ratio at the receiver (lower Eb/N0) for identical modulator constellation and FEC overhead compared to DVB-S. With the objective of maintaining a constant system *Bit Error Rate* (**BER**), the lower Eb/N0 values for DVB-S2 allow use of higher-order modulator constellations to achieve a BER equal to that for a DVB-S channel. This provides DSNG operations the option of using higher order modulation schemes

Figure 2 — Fujitsu IP-9500 High Performance H.264 SD/HD Encoder with built-in DVB-S2 modulator option

Focus

such as 8PSK as opposed to widely used QPSK in DVB-S systems. This provides approximately twice the channel payload capacity, without increasing existing satellite channel bandwidth.

The significant improvement in channel coding and the use of higher-order constellations are increasing virtual channel payload capacity. DVB-S2, with 8PSK modulation and an FEC of 3/4 allows broadcast standard HD content (720P/60Fps or 1080i/30Fps) video, audio and metadata with multiplexed data rate in the order of 10Mbps to be transported within the same 5.5MHz satellite channel previously needed for broadcast standard definition content.

Fujitsu has incorporated both **H.264** advanced video compression and **DVB-S2** modulation technology into the high performance *IP-9500e* encoder and *IP-9500d* decoder system shown in *Figure 1* above. This system, along with other improvements in digital satellite content contribution and distribution, will be demonstrated during the upcoming **National Association of Broadcasters Convention** at Las Vegas in April.

In addition to improving bandwidth utilization and network performance, satellite networking of television content many times requires several intermediate links to complete end-to-end delivery. This is referred to as *concatenation* and has been an area of significant attention in regard to maintaining video and audio integrity. In earlier ana-

log systems, demodulation and re-modulation of the television signal at each en-route satellite terminal contributed to signal degradation particularly video signal-to-noise, which in many instances reduced the image at the point of delivery to less than that normally acceptable for broadcast television.

The addition of digital video compression in satellite networks has created new challenges in mitigating the effects of degradation caused by concatenation in the multiple encode-decode process associated with

Figure 3 — 4:2:0 chroma degradation in concatenated satellite links

intermediate digital turn-around operations. One particular problem is that of maintaining the integrity of the 4:2:0 chroma component where an HD-SDI interconnect is used between concatenated decoders and encoders. This relates equally to both the widely used MPEG-2 and newer MPEG-4 (H.264 / AVC) codec standards.

HD-SDI is inherently a 4:2:2 interconnect which requires that a 4:2:0 stream be up-sampled and then down-sampled at each digital turn-around. This can, within as little as 4-5 concatenated links, result in visual blurring of the color image to the point where the content can be severely degraded as shown in *Figure 3*.

This has particular importance in *Digital Electronic News Gathering* (**DENG**) where as many as 10 concatenated operations can take place before final delivery to network affiliates and others. Video encoded by

AVC/H.264 using 4:2:0 chroma sampling can provide significant operational and economic advantages, but can be subject to severe degradation due to concatenation of decoders and encoders in the chain that use SD/HD-SDI as the interconnect. *Serial Digital Interface* (**SDI**) is inherently a 4:2:2 interconnect which requires that a 4:2:0 stream be up-sampled and then down-sampled at each digital turn-around as shown in *Figure 3*. This can, within as little as 4-5 concatenated links result in visual blurring of the color image to the point where the quality and integrity of HD content can be severely compromised.

There is now a solution to this long standing problem, and soon to become available in the **Fujitsu** *IP-9500* series of encoders and decoders. It uses a precise set of filters which process the 4:2:2 chroma component, down-sample it with a low pass filter and 2:1 vertical sampler to create a 4:2:0 output. At the receive end,
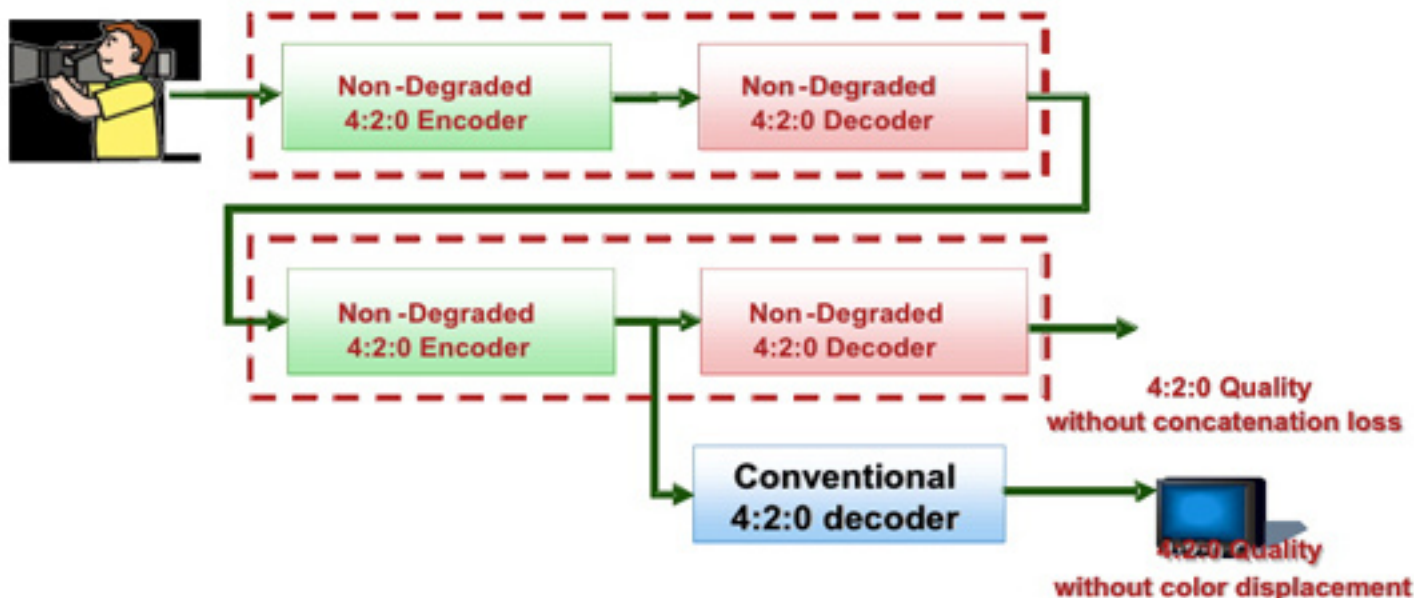

Figure 4 — Interoperability consideration

or intermediate turn-around point, the 4:2:0 chroma component is accurately up-sampled to re-create a 4:2:2 signal as shown in *Figure 3*. The result is no degradation, allowing an encoded 4:2:0 stream to be carried efficiently over a concatenated satellite link.

In order to achieve non-degraded 4:2:0 chroma resolution throughout the concatenated chain it is necessary that all encoders and decoders in the link use identical filter sets. However, interoperability with other decoders has been taken into consideration, allowing a 4:2:0 encoded video stream to be decoded by other manufacturers decoders not fitted with the precision filter technology. Such decoders may, however, be subject to normal concatenated chroma degradation.

The non-degraded filter technology has been proven in tests demonstrating its ability to protect the integrity of the 4:2:0 chroma component in up to 16 concatenated encode and decode operations.

The combination of several new technologies and standards including; DVB-S2; AVC. / H.264; and Non-degraded 4:2:0 has the potential to significantly improve the performance, operation and quality of digital satellite networks, and at the same time delivering valuable cost savings.

About the author

Keith Dunford is currently a consultant for the Video Solution Group, Fujitsu Computer Products of America, Inc. Keith is Managing Partner of The Exam Group, a consulting company engaged in technology evaluation and integration for the Electronic Media and IT industries.

Focus

Plan B... For Continuous Signal Reception

by Jörg Schmidt, DEV-Systemthechnik

Black screens and complete audio dropouts around the world for 18 minutes; what sounds like a scenario from the Stone Age of live broadcasting became a reality for the 29.46 million TV viewers who wanted to watch the Euro semi-final between Turkey and Germany in the summer of 2008.

This happened to be a glitch that resulted in the *European Football Association*, **UEFA**, having to pay a seven-figure compensation to the members of the *European Broadcasting Union* (**EBU**). In this case, the interruption was caused by a power failure at the broadcast centre in Vienna. A failure of one or several antennas in a headend could also have similar consequences, in which operators will be held accountable. An automatic antenna redundancy system, however, would ensure you were on the safe side.

A thunderstorm with heavy rain and squalls had knocked out the broadcast centre's technology in Vienna. Headend operators suddenly faced a scenario similar to the one just described — if a thunderstorm knocked out even just one antenna, transmission problems — the screen stays black until the damage has been repaired.

The repair of roof antennas is particularly tricky and dangerous, especially with a thunderstorm raging outside. And what if the antenna is snapped off by the wind? Sometimes it is only the antenna's *low noise block* (**LNB**) that is broken — whatever the cause,

headends should have a proper backup system in place in order to ensure uninterrupted service.

Just To Be On The Safe Side

However, it would be absolutely uneconomical, in particular for large headends, to purchase a replacement antenna for every single antenna used. Individual solutions are complex to develop and, therefore, rather costly.
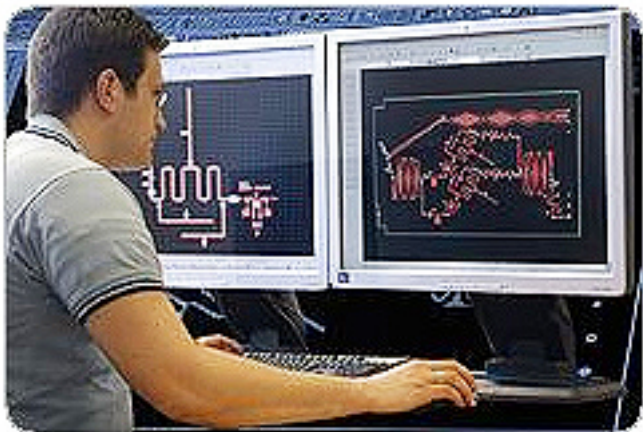
Focus
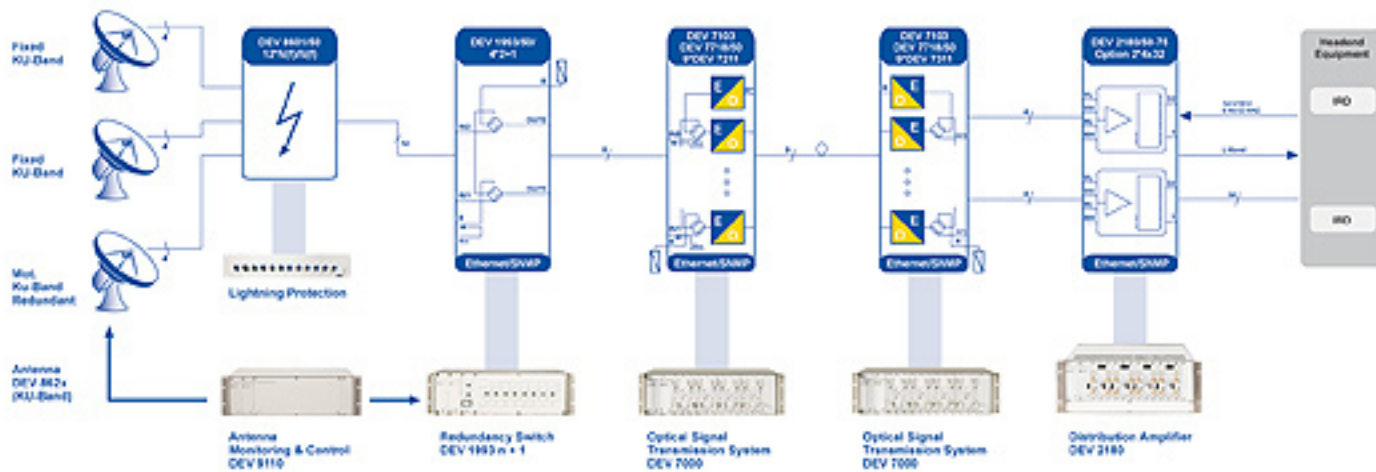
What does it take to find an easier and less expensive solution? What is needed is a comprehensive and automatic system that monitors the RF signals of several stationary antennas, a solution that uses a motorized antenna as backup. The motorized antenna then replaces the defective antenna, if needed.

This solution is an automatic antenna redundancy system that is comprised of a motorized antenna, a redundancy switch, and a control unit that connects, queries, and controls the two elements. First, the actual signal strength is compared with the preset threshold at the input of the redundancy switch. If the received signal strength drops below the threshold value, this is reported to the *Antenna Monitoring and Control System* (**M&C**) by the control unit, which then analyzes where the error message was generated.

The motorized antenna is then directed at the same satellite the defective antenna was targeted upon and takes over the transmission. As the management systems of a headend are not designed to control antennas, this is automatically done by the antenna redundancy system.

The RF signal handling expert from **DEV Systemtechnik** has developed the antenna redundancy system **N+1**, which offers an all-in-one solution for large headends. As many as 16 antennas can be replaced by the motorized antenna. Furthermore, the solution comprises a scalable two-stage system, *i.e.,* 2+1, 4+1, 6+1, and so on. This makes for a highly flexible solution unmatched on the market.

In addition, an individually configurable information interface provides for communication with the headend's management system so the user is able to control the current status of the subsystem. As a result, the management system provides information on the faulty antennas, from which satellite the motorized backup

antenna will be receiving its signals, and when it has been activated. The entire process from the failure of an antenna to the analysis of the signal, and from the adjustment of the backup antenna to switching to headend reception, is carried out automatically. If required, every step can also be done manually.

A Reliable, Economic Solution

The antenna redundancy system offers headend operators an entirely new range of opportunities for efficient operation and business management. Until now, the only answer to the problem of antenna failure has been to manually set up and adjust a replacement antenna or to develop an individual, but rather expensive solution. The antenna redundancy system provides operators with a readily available and established system that comprises fully coordinated components, and that allows communication with almost any management system. Further configuration for other sections of the transmission path can be provided upon request.

A quicker and easier way to ensure reception in case of antenna failure does not exist. The automation of redundant antenna concepts and their integration into the management systems of headends allows, at the same time, to significantly reduce the overhead for backup services. And, last but not least, TV viewers can be assured antenna failure will not be an issue during the next broadcast of a football cup.

About the author
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