SatCom For Net-Centric Warfare March 2009

# MilsatMagazine

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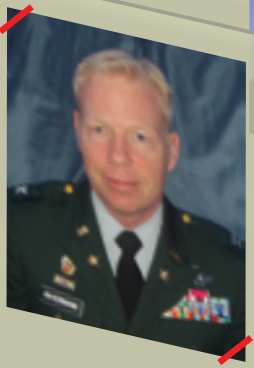

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# MILSATMAGAZINE MARCH 2009

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March 2009

**COMMAND + CONTROL**

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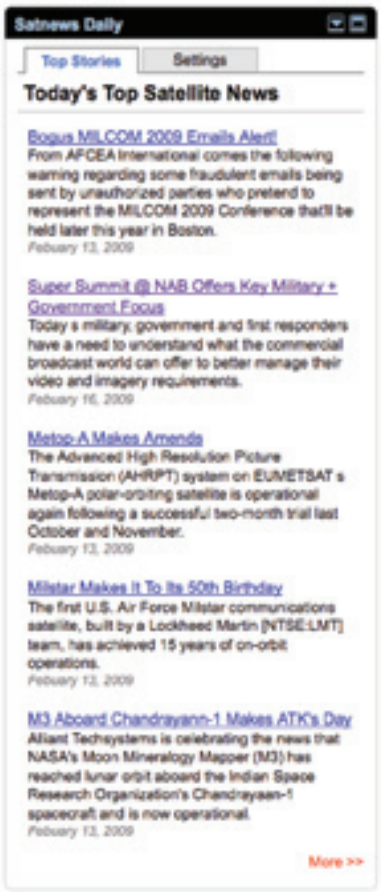
# *INCOMING — INFO TOOLS*

Welcome to this issue of ***MilsatMagazine*** — and to the ***National Space Symposium*** in *Colorado Springs* as well as the ***National Association of Broadcasters Military + Government Summit*** held concurrently with the **NAB 2009** conference in Las Vegas, for which we are an official **Media Sponsor**. All of these elements strive to accomplish one major need for all — the delivery of timely and usable information to help you accomplish your goals within the MILSATCOM and SATCOM industries.




In fact, to further bring ***MilsatMagazine*** into play for you, the Development Director for ***SatNews Publishers*** has coded in a new ***iGoogle Gadget*** that enables you to receive — automatically — the daily SatNews on your Google homepage! To activate the ***iGoogle SatNews Gadget*** is simplicity itself.

When you visit **SatNews.com**, you'll notice an animated **Google** icon move from left to right directly under the Satnews banner. Select that icon and you'll be taken immediately to ***iGoogle*** page, where then you click on the "***Add To Google***" button. When you accomplish this task, you should note your web browser taking you to your **Google** homepage with the message "**Satnews Daily has been added**" brilliantly appearing thereupon... now, as you are aware, you can simply move the ***SatNews*** windoid to whatever location you wish on your Google homepage.

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This issue features **COMMAND CENTER** interviews with leaders in the MILSATCOM world as well as technical articles to assist you with your satellite communication needs. Should you ever have the desire to communicate with our readers, just email me and we'll see if we can draft you into the ***MilsatMagazine*** *Info Service*. Thanks — ***Hartley Lesser, Editorial Director***

# COMMAND CENTER
# ROBERT OSTERHALER, CEO, AMERICOM GS

**From earning a BS in Economics from the U.S. Air Force Academy, to the receipt of an MBA from Texas A&M University, Robert Tipton (Tip) Osterhaler has served both his country as a Brigadier General in the U.S.A.F. to becoming the CEO of AMERICOM Government Services (AGS) in 2006. The company moved from a product oriented sales channel into an end-to-end satellite solutions company under his guidance, and focuses on the needs of U.S. government clients. AGS is a wholly-owned subsidiary of SES.**

Mr. ***Robert Tipton (Tip) Osterhaler*** became President and CEO of **AMERICOM Government Services** (**AGS**) in December, 2006. AMERICOM GOVERNMENT SERVICES, Inc. (AGS) is an independent corporation and wholly owned subsidiary of **SES AMERICOM**. During his tenure at AGS, the business has been transformed from a product oriented sales channel into an end-to-end satellite solutions company focused on the needs of its U.S. government clients. In fact, in 2008, the Company was the recipient of the largest government contract ever awarded to SES — US$286 million + — AGS also negotiated a contract with the U.S.A.F. to host a government operated payload on board a commercial aircraft.

Prior to joining AGS, Mr. Osterhaler was a Senior Vice President at **Science Applications International Corporation** (**SAIC**), a large systems, solutions and technical services company serving the needs of the U.S. government. And while serving his country, his military assignments included Vice Commander of the *Air Intelligence Agency*, **NATO** Staff Officer, and numerous command and senior staff assignments. He is also a Command Pilot, having accumulated more than 3,200 hours of flying time in fighter aircraft including multiple models of the ***F-4 Phantom II*** and the ***F-15 Eagle. MilsatMagazine*** (**MSM**) is delighted to present an interview with this dynamic leader.

### *MSM*

*Mr. Osterhaler, you have enjoyed a highly visible and important career, from that of a Command Pilot to becoming a general officer with the U.S.A.F. to leading a company involved in various modeling, sims and training solutions. From your involvement as a Brigadier General in the U.S.A.F., and as Deputy Assistant Secretary of Defense for European and NATO Policy, how did such prepare you for your current duties as the President and CEO of Americom Government Services? Please tell us about your background.*

### *Robert Osterhaler*

The experience I had in the Air Force, over the course of 28 years, gave me a very good appreciation for the central importance of reliable and capable communications systems. Whether I was involved as a Wing Commander in an operation, in the cockpit of an F-15, or sitting in the Pentagon making policy decisions, the ability to reach out instantaneously to obtain reliable information was central to everything we did, from tactical decisions to making longer-term policy decisions. The government at every level is more dependant on commercial communications infrastructure than probably any other single area, having an appreciation of its importance has been very valuable to me in my current position.

### *MSM*

*May we have some history of the company?*

### *Robert Osterhaler*

AGS has gone through a period of rapid change over the last couple of years. We added a significant number of people to the organization who have had direct experience in government. Prior to these changes, AGS had really been a market channel to the government that operated much like commercial market channels. AGS is a very different kind of organization now. Rather than starting with the proposition that we have bandwidth that we need to sell, we start with

the proposition that the government has requirements that it needs to meet, and we look for opportunities where we can provide solutions to the problems the government is struggling with.

### MSM

*What were AGS's successes over the past year, and where do you see company resources being applied over the next couple of years?*

### Robert Osterthaler

In 2008, AGS had the best financial year in its history. That's a wonderful thing to say, but what it reflects is that the changes we put in place over the past couple of years have enabled us to more effectively solve the communications challenges the government faces. It's merely a reflection of the fact that we are a better and different kind of organization than we used to be.

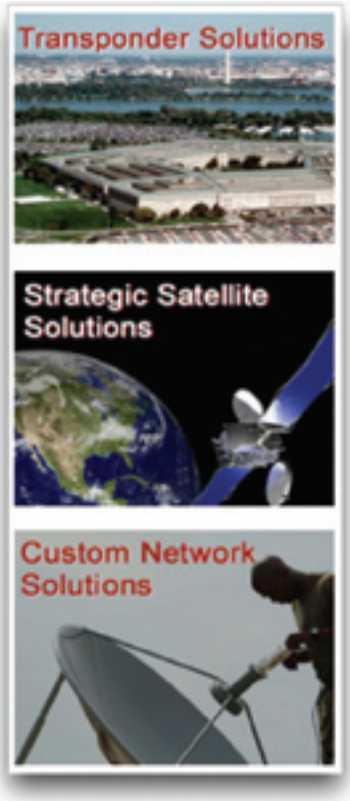
In 2008, we won a very large contract with the U.S. Army to continue support of their **TROJAN** network. We were awarded a contract with the U.S. Air Force to host an Air Force sensor payload and we found strength across our core business for all of our customers. The Army, Navy, Air Force and Marine Corps, and other agencies within the U.S. government are increasingly coming to us with their thorniest problems. The financial results really reflect the fact that we are better able to meet their demands.

### MSM

*How important is SATCOM's role for NGOs, government entities, and the military? What do you see as this industry's most crucial challenges, and how do you believe they will be overcome?*

### Robert Osterthaler

The commercial satellite industry is an essential part of the overall global communications infrastructure. Many NGOs and a lot of U.S. government agencies operate on a worldwide basis. They become dependant




on commercial satellite infrastructure, whether it is a matter of their intent or not. The capacity on board commercial satellites represents such a large percentage of the orbit capacity total and can be used for a variety of communication applications.

It has been well publicized that for the U.S. Department of Defense (DoD) more than 80 percent of the total capacity they use to support their deployed systems actually rides on commercial capacity rather than U.S. Government-owned capacity, which can serve as a reflection of dependence.

For the commercial industry, the challenge has always been to try to understand what the government is going to need so such can be taken into account in the decisions made about where to invest in satellite capacity. The difference in the way the U.S. Government (USG) and commercial customers purchase capacity is substantially different. The challenge has been to develop business models that will enable us to continue to develop the USG market in an environment where such different buying habits are commonplace. The reason this is such an important issue is that while the government is highly dependent on deployed commercial capacity, commercial industry is much more focused on its commercial customers. This is due to commercial customers consuming almost 95 percent of the total global commercial capacity on orbit. This creates a somewhat asymmetric situation where the government is more dependant on commercial industry than commercial industry is dependant on the government to buy their capacity.

Another challenge the government is faced with, and an area where commercial industry can help, is the risk associated with some of the larger programs. In terms of hosted payload opportunities, the government has a strong and understandable desire to reduce the risk associated with fielding their own space systems. There have been a number of high-profile government satellite programs which have been criticized for being behind schedule and over budget. One of the challenges the government has is the need to reduce risk by initiating technology development in sort of a spiral manner, rather than just fielding a constellation block-buy, which is the way the government purchases a lot of satellite systems. The *Commercially Hosted Infrared Program* (**CHIRP**) AGS is currently working on for the U.S. Air Force, is an example of how commercial industry can partner with government to provide timely and affordable access to space in order for government systems to be spaced-qualified before the government has to make major financial commitments, only to then learn that the technology they have used is not mature, or that it fails on orbit.

That is one area where I believe there is a potential for strong partnerships — somewhere along the lines of what we are doing with the CHIRP program. The government will look with increasing frequency at the commercial side's ability to provide needed capacity, especially in areas that don't require extensive technology development, such as spacecraft busses or in terms of actual transponders.

The recent UHF procurement conducted by **SPAWAR** is an example of a future where commercial industry, using its proven PM capabilities and high reliability, can provide hosted bandwidth on its spacecraft — whether that be on its entire spacecraft or on a partial area of the spacecraft — it may be in traditional commercial frequency ranges or it may be traditional government frequency ranges such as military Ka- or X-band, for example. There is a lot of potential for the government to obtain the needed capacity by working with industry to produce spacecraft that meet its specific requirements, rather than simply depend on the availability of commercial bandwidth to support its systems.

### MSM

*Americom GS is currently working with a number of important clients, such as AFRTS, the FAA, NASA, NOAA, and the South Korean armed forces. Could you tell us a little bit about your company's work with these entities?*


### Robert Osterthaler

What we are able to do for all of our government customers is provide a significant amount of capacity that will support very demanding applications, either point-to-point, point-to-multipoint, or multipoint-to-multipoint. Satellites can manage all of these needs — the way a satellite is configured may make it better suited for one set of applications than another. Users such as **AFRTS** are interested in the kinds of capabilities we routinely deploy for our direct to home customers on the **SES ASTRA** fleet and on portions of the **SES AMERICOM** fleet. Other users are more interested in the kinds of capabilities we provide our cable customers, or to our telecommunications partners who require very large pipes to move large quantities of data point-to-point. The application really determines exactly how ASG responds.

We have the capability across the fleet to meet a number of different demands. We have examples of our capabilities with all of our government customers. It starts with what the government customer needs, not necessarily what we have to sell. In the short term, we have many different kinds of capabilities on our deployed fleet. In the longer term, we have the ability to invest in the kinds of capacity that will be most suitable for the applications we think people will be dependent upon in the future.

### MSM

*The Space Segment, Global Information Grid, and a plethora of other services designed to assist the Warfighter are crucial to success. With the amount of capacity required to service mission critical undertakings constantly being assaulted by various needs (i.e., surveillance and intelligence missions by satellites and UAV/UAS as well as COTM and COTH), how does AGS continue to ensure bandwidth availability for your projects in theater as well as for NGOs and first responders elsewhere?*

### Robert Osterthaler

AGS is always focused on the customer's requirement, not necessarily just on the task of selling available unused bandwidth. We respond in a number of different ways. For near-term, immediate needs, we look to the SES fleet to determine whether or not appropriate capacity is available, and in sufficient quantities, to satisfy the requirements of the customer's application. If it is not available, we function in the market as an integrator and reseller and we have sources across the industry with whom we work every day to ensure the customer's needs are satisfied, regardless of the source of the capacity.

AGS is focused on providing the solution to the problem. We are an integral part of the SES family, and we endeavor to ensure the SES capacity is used whenever it is appropriate, however our number one concern is the customer's need.

### MSM

*AGS offers launch, satellite, ops and support for your strategic satellite solutions. Could you please outline those services and the role they play for your government and military customers?*

### Robert Osterthaler

At the corporate level, SES is really in the business of buying and operating satellites on behalf of customers who buy capacity off those satellites. AGS is involved in the investment decision making of our company and is always trying to gain insights as to what the government is going to require in the future in order for those insights to be brought into the discussions at the SES level. The intent of all this activity is to ensure we stay ahead of the government's needs for tomorrow and that we have suitable capacity available when and where the government is most likely to need it.

We maintain very close contact with the government in order to gain the type of insights needed to make informed investment decisions. We also understand the government doesn't always know where it is going to need capacity a couple of years into the future, so there is somewhat of an inherent risk in this process. Even with our commercial customers, there is some inherent risk in investment decision making — we are not uncomfortable with this process. We are getting better all the time with *future thought*, and this is really one of the primary activities I spend my personal time on — trying to understand how we can better serve the needs of the government user.

### MSM

*With custom networks built for our armed forces, NASA, and the FAA, would you take us through how the specific solutions were devised, tested, and implemented? How was AGS selected to bring these solutions to these various organizations?*

### Robert Osterthaler

One of the elements we focused a lot of attention on over the past couple of years is enhancing our abilities to design and deliver complex solutions. AGS has been in the solutions business for quite a long time, but providing end-to-end solutions requires a better understanding of the government's mission and operating concepts than just selling capacity. We have invested a tremendous amount of effort into strengthening our engineering team and into strengthening our design and delivery capabilities. This has been accomplished by putting into place disciplined processes which will ensure we can deliver what we sell at the price agreed upon and on the schedule promised to our government customers.

We have experienced a great deal of success with the processes we put in place and this is, in large measure, responsible for the government showing their continued confidence in AGS, such as with the award of the Army TROJAN contract, which is an extremely complex system. The AGS proposal was extremely detailed and demanding to write and is an excellent indicator of where I believe the Company has arrived as an organization.

### MSM

*How is capacity via SES satellite constellations apportioned to your clientele? With SES AMERICOM, SES NEW SKIES, and SES ASTRA all working hard to deliver communication solutions, how does each division determine need for capacity when so many projects need the satellites? With the AMC, Ciel, SATCOM,*

*NSS, IS, Astra and SIRIUS satellites, could you explain how Americom GS works with each of the SES divisions to determine transponder priorities?*

### Robert Osterthaler

As recent press reports have indicated, **SES AMERICOM** and **SES NEW SKIES** are consolidating their operations. This will bring the spacecraft of those two operating companies together into a single fleet. AGS has direct access to capacity on that fleet and we have visibility into the current status on the transponders, availability, and current pricing. It is a somewhat more indirect relationship with the SES ASTRA fleet, as their primary focus is on the European direct-to-home (DTH) market.

What that means for AGS is that much of the capacity on the SES ASTRA portion of the overall fleet is not necessarily suitable for the applications that our customers are looking for; nevertheless, we do have the ability to obtain capacity on the SES ASTRA fleet. We have visibility as to what is available and pricing as well — it is just done through a separate process than with the SES AMERICOM-NEW SKIES fleet.

### MSM

*Lastly, Mr. Osterthaler, what is Americom GS' future in MILSATCOM and SATCOM? And how do current global financial concerns affect your company's ability to consider growth?*

### Robert Osterthaler

AGS is going to continue to be the direct market channel to the U.S. government customer. In the coming year, AGS will focus on ensuring the future capacity of the fleet is suitable for the U.S. government. In terms of the current global economic situation, no one is unaffected by these financial concerns. Our customers are affected to a degree, and our business partners are affected. SES is unique among global operators in that the company is publicly owned and financially quite stable.

The condition of the credit markets makes it very important SES continues to operate in the predictable, somewhat conservative manner it always has, and such has served us very well over the past year. What AGS is doing right now is taking into account the fact that some of our commercial customers are likely to be placed under pressure by some of the current economic conditions. We will expand our fleet somewhat more conservatively with the probability that most likely will be the case.

The impact on our government customers I expect to be minimal. However, as the government will need to continue to provide bandwidth to systems that are already deployed in the field, I expect they will continue to depend on us in the near and intermediate-term to support the systems they have fielded and to support the new systems they have in the pipeline. To the extent that the government were to reduce its overall satellite bandwidth needs, then I'm sure we'd be affected by that. The reality is that such a move is unlikely to occur anytime soon.

Developing government applications continues to require significant supporting commercial capacity and nothing has been happening in the credit markets or the overall economy that is likely to change that very much. In the longer term, the ability of the government to continue to place its own owned capacity on orbit might actually require us to provide even more capacity as a total percentage than we have historically managed before.

As government budgets come under pressure in the coming years, the ability of the government to invest in multi-billion dollar owned systems could result in an increase in reliance on commercial systems. Therefore, I don't believe we'll see a lot changing in the near term as the government will continue to require our support. In the longer term, I think it is conceivable that the commercial side of this dynamic business will become even more of an integral part of the overall architecture.

### MSM

*Thank you for your time, Mr. Osterthaler.* MSM

# BRIEFING
# NEW NAB CONFERENCE FOR MILITARY + GOVERNMENT

*by Susan Sheppard*

**Today's military, government and first responders have a need to understand what the commercial broadcast world can offer to better manage their video and imagery requirements. Now, for the first time, the National Association of Broadcasters has teamed with industry and government partners to develop a conference targeted directly at the defense and military markets, at the world's largest, digital media show — 2009 NAB.**

The three-day ***Military and Government Summit*** — a program produced in partnership with **Harris Corporation**, **Raytheon**, **ITT**, and other leading defense organizations — is chaired by *John Marino*, Vice President, Science and Technology, **NAB**, and will be held **April 21-23, 2009** at the **Las Vegas Convention Center** in Nevada. Attendees will have access to the NAB Show floor — the world's largest video marketplace — which opens on Monday, April 20th. The ***Summit*** will identify ways in which government and military officials can use commercial video technologies for defense, military, and emergency response applications. Featuring keynote addresses by military speakers who are pioneers in the use of video for government applications, the Summit includes an opening keynote by *Kevin P. Meiners* of the ***Office of the Under Secretary of Defense for Intelligence*** (**OUSD**). Additional invited government speakers include Vice Admiral *Robert B. Murrett*, U.S. Navy, Director, **NGA**; and Brigadier General *James O. Poss*, Director of Intelligence, **Headquarters Air Combat Command**, **Langley Air Force Base**.

The opening day agenda includes a technology market analysis followed by a comprehensive session that reviews advances in technology. Additional presentations will be led by military, government, industry, and academia, as well as workshops, case studies, and technical papers by leading defense companies.

Presentations by **Harris Corporation**, **ITT**, **Motorola**, and **Texas Instrument**, will look at ways advancements in commercial-off-the-shelf video technology can be applied in defense and government applications. Subjects such as using IPTV to win the war on terror, wired and wireless video infrastructures, and getting more out of bandwidth in existing networks will be covered by industry experts.

Case studies about current military programs and applications that are driving future video and imagery applications include the *Army Range Commander's Council*, and new technologies for the global dissemination of video. Harris Corporation, together with government panelists, will review the most recent discoveries from ***Empire Challenge***, an annual event lead by the ***National Geospatial Intelligence Agency*** to test and evaluate situational awareness tools for joint military missions.

More traditional uses of video within government newsroom scenarios will be covered by the **American Forces Network** and the **NATO Channel TV**.

One of the situational awareness tools being developed with input from the **Department of Defense** is an application called *video asset management*. A comprehensive review of this tool will be offered at the ***Military and Government Summit***, along with case studies of specific applications. Led by Harris Corporation, this session will look at video archiving, managing video in a tactical environment, monitoring video quality at the source and a review of digital asset management tools.

Standards and architectures that influence military applications of video will be covered in the ***Motion Imagery Standards Board*** (**MISB**) panel session, plus topics covering standards for mobile war fighting, and architectures for *Wide Area Persistent Surveillance* motion imagery. Technical considerations for moving from analog or film to digital video environments will be covered, with specific emphasis on transitions for high speed engineering imagery, measurement and analysis, and motion imagery capture and post-capture.

Government and industry speakers will discuss specific examples of how video has been used by Federal agencies such as the **Department of Homeland Security**, the **Federal Emergency Management Agency**, **Customs and Border Protection**, including a case study regarding *Hurricane Katrina*. The **Emergency**

# PUSH VIDEO TO THE EDGE

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Let the world's leading experts in broadcast technology show you how to increase your ability to acquire; analyze; and distribute imagery, video and digital assets for mission-critical and other activities. Explore the tools being used to push information capture to the edge. Learn more about government and commercial imagery standards and how they affect products you are using, designing or recommending. Discover how to do business with the government, including avoiding the pitfalls and qualifying for programs. Then visit the expansive exhibit floor to see, touch and test solutions enabling situational awareness, IPTV, digital asset management, emergency communications and more.

The NAB Show's unique combination of education and exhibits makes it the ideal forum to uncover the commercial technology available, and explore how it's used and when to use it. To register or for more information, visit **www.nabshow.com**.

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Bottom left photo: Ted Kawalerski

**Alert System**, and other mass alert and notification systems will be reviewed in detail by industry experts with comment by government users.

Commercial companies who are new to working within government parameters can attend a workshop that is targeted towards helping them create successful partnerships with government organizations.

There is specific time within the three-day agenda for visiting the NAB Show floor, to offer attendees the opportunity to explore solutions enabling situational awareness, IPTV, digital asset management, emergency communications and more. NAB will also provide guidance to government attendees about making the most out of their time on the show floor and will offer guided visits to areas of the show that offer products and technologies that are being covered at the ***Summit***.

Registration for the ***Military and Government Summit*** is **$395** (government & Military rate) when registering by April 17th.

To register or for more information, select any graphic in this article or enter...

"http://www.nabshow.com/2009/education/military.asp"

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*About NAB*

*The National Association of Broadcasters is the premier advocacy association for America's broadcasters. As the voice of more than 8,300 radio and television stations, NAB advances their interests in legislative, regulatory and public affairs. Through advocacy, education and innovation, NAB enables broadcasters to best serve their communities, strengthen their businesses and seize new opportunities in the digital age. Learn more at www.nab.org.*

***Download the NAB Military + Government Summit brochure!***
***http://www.nabshow.com/2009/education/military.asp***

# ON TARGET
# KA-BAND LINEAR AMP SELECTION FOR WGS

**Military Satcom network engineers need to consider non linear effects of transmissions where signal levels are low or multiple carriers occupy a narrow bandwidth. Non linear characteristics of some Ka-band amplifiers' behavior reacts differently to Ku-band and X-band amplifiers, and therefore there is a need to carefully measure the performance of Ka-band amplifiers when selecting for use on Wideband Global SATCOM (WGS).**

This article discusses the importance of linearity in SATCOM amplifiers by addressing:

1. ***Why Amplifier Linearity is Important,***
2. ***How Linearity is Defined for FET Technology,***
3. ***How Linearity is Defined for MMIC Technology,***
4. ***Measuring Linear Power of MMICs,***
5. ***Using a Lineariser with MMIC Technology, and,***
6. ***Measuring Linear Power where a Lineariser is used***

## Why Is Amplifier Linearity Important?

Ideally, the amplifier output signal should be identical to the input signal. However the signal amplitude will be larger, and there is a time delay due to time taken for the signal to travel through the physical length of the amplifier. An amplifier that behaves in this way, or to a very good approximation, is referred to as a linear amplifier.

In practice all amplifiers will exhibit some deviation from this ideal linear response. The extent of this deviation, which usually increases as the output power level approaches the maximum power available, determines the non linearity of the amplifier.

If the signal is a pure tone, that is a single frequency, then the non linear distortion can be determined from the power levels in the second and higher order harmonics. In the frequency domain, the power in these harmonics is the main manifestation of the amplifier non linearity.

If the signal is a modulated one, then the non linearity will be seen not only as harmonics, but also as amplitude and phase distortion of the modulated signal. This is due to the power appearing at other frequencies outside the spectral bandwidth of the input modulated signal.

With digital signals, the amplifier non linearity degrades the Bit Error Rate (BER) of the signal and adds noise into other channels so degrading the BER of other signals. Consequently, it is necessary to set specifications for non linear behavior to guarantee the BER performance of the wanted signal and to avoid degrading the performance of other signals.

## How Linearity Is Defined For FET Technology

There are a number of ways to specify the non linear behavior of an amplifier, and over time, a number of short hand parameters have been adopted as de facto standards. **MIL-STD-188-164** is now widely being used as the industry standard, and this follows a long history of trying to succinctly define linearity. At RF frequencies, adequate information used to be contained in an imaginary point called the third order intercept point. This is the projected power level, where the extrapolated lines of the main power and intermodulation power, as functions of input power, intersect. If an amplifier was operated at a given level below this third order intercept point, then its linear performance was considered adequate.

At microwave frequencies, particularly for solid state amplifiers, it was found that the **P1dB** point which is the power where the gain drops by 1dB compared to the linear gain was a more realistic way to compare amplifiers. This was reasonable when solid state microwave amplifiers were designed with individual FETs as the basic building block. The P1dB point was typically a fixed value below the third order intercept point.

At higher frequency bands it was noted that this nominally fixed value tended to decrease. At 6GHz for example, the P1dB point might be 9dB below the third order intercept point, but at 14GHz the difference might be only 7dB. This is one reason that adequate information for comparison reasons is not contained in the third order intercept point.

With the move to MMICs (monolithic microwave integrated circuits), the frequency increased up into millimeter bands (greater than 20GHz), and with the wide diversity of modulation methods, the P1dB point is no longer a sufficiently accurate predictor of the amplifier performance in a system.

### How Linearity Is Defined For MMIC Technology

One way to make a comparative analysis between amplifiers as comprehensive as possible is to specify a wide range of non linear parameters and to set a limit on each. This typically involves specifications on the harmonic levels, and amplitude and phase deviations; when the amplifier is driven by a single tone and on the levels of intermodulation products generated when the amplifier is driven with two or more tones. Limits on the distortion of a modulated signal and the power levels generated in other channels by the effect of the non linearity on the modulated signal are also often added to the specification list.

For manufacturers of these devices and the power amplifiers, it is often necessary to test all these non linear characteristics and the relationships between them. This helps to understand the amplification process at the device and circuit level, and to improve and optimize performance. However, for potential users of this type of amplifier it may be confusing. Network designers may prefer one or two standard tests as an overall performance summary which would indicate what application the amplifier best suited, or how it compared to similar amplifiers.

### How is Linear Power Defined

A simple way to improve the linear performance of an amplifier is to operate it further backed off from the defined non linear point. If the system operation

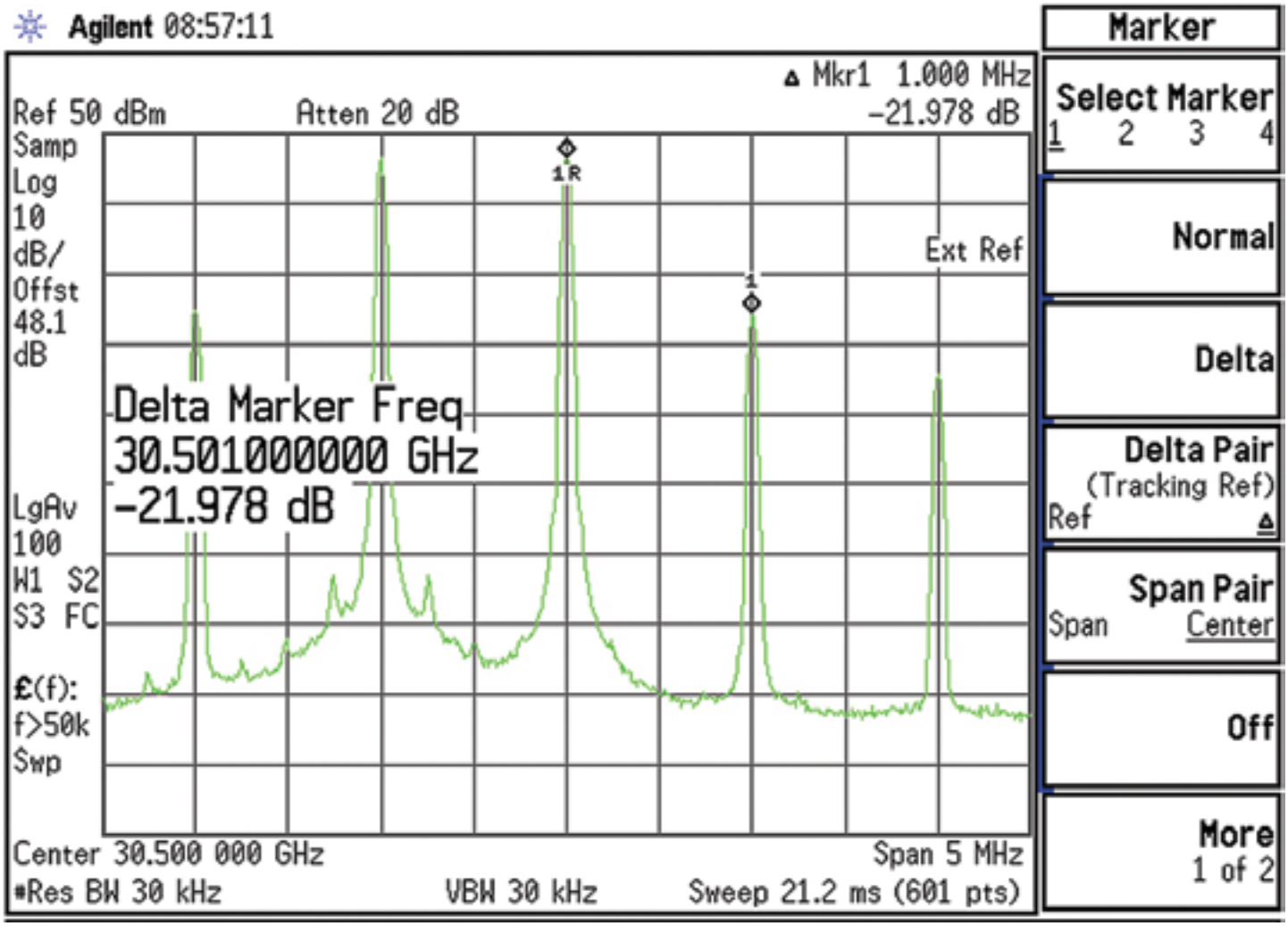


*Figure 1 — Two Tone IMD as displayed on a Spectrum Analyzer*

requires a given power level, then this means that a higher power amplifier is required. Increasing the power level, particularly at millimeter wave frequencies can be expensive in financial, thermal and reliability terms, and in general millimeter wave devices will exhibit more pronounced non linear characteristics than microwave devices for the same relative back off levels.

The concept and definition of linear power is a useful alternative to previous ways of trying to summarize non linear performance in one or two terms. The linear power is defined from the power levels as described below.

### Non Modulated Signal Definition

The linear power is defined as the total output power in two equal tones when the power in one of the third order intermodulation products is 25dB below the total power in the two tones. That is the intermodulation relative level (IMR) is 22dBc below the tone power level for both the upper and lower product. This is illustrated in ***Figure 1***.

### Modulated Signal Definition

This linear power is defined as that level when, for a specific modulated signal, the peak power in the sidelobes does not exceed **–30dBc** with respect to the peak power in the modulated signal at a specific frequency offset. This is illustrated in ***Figure 2*** on the next page. Typically the modulation is defined as ***OQPSK*** signal with 1/2 rate forward error correction and the offset is 1 symbol rate from the center frequency of the carrier.

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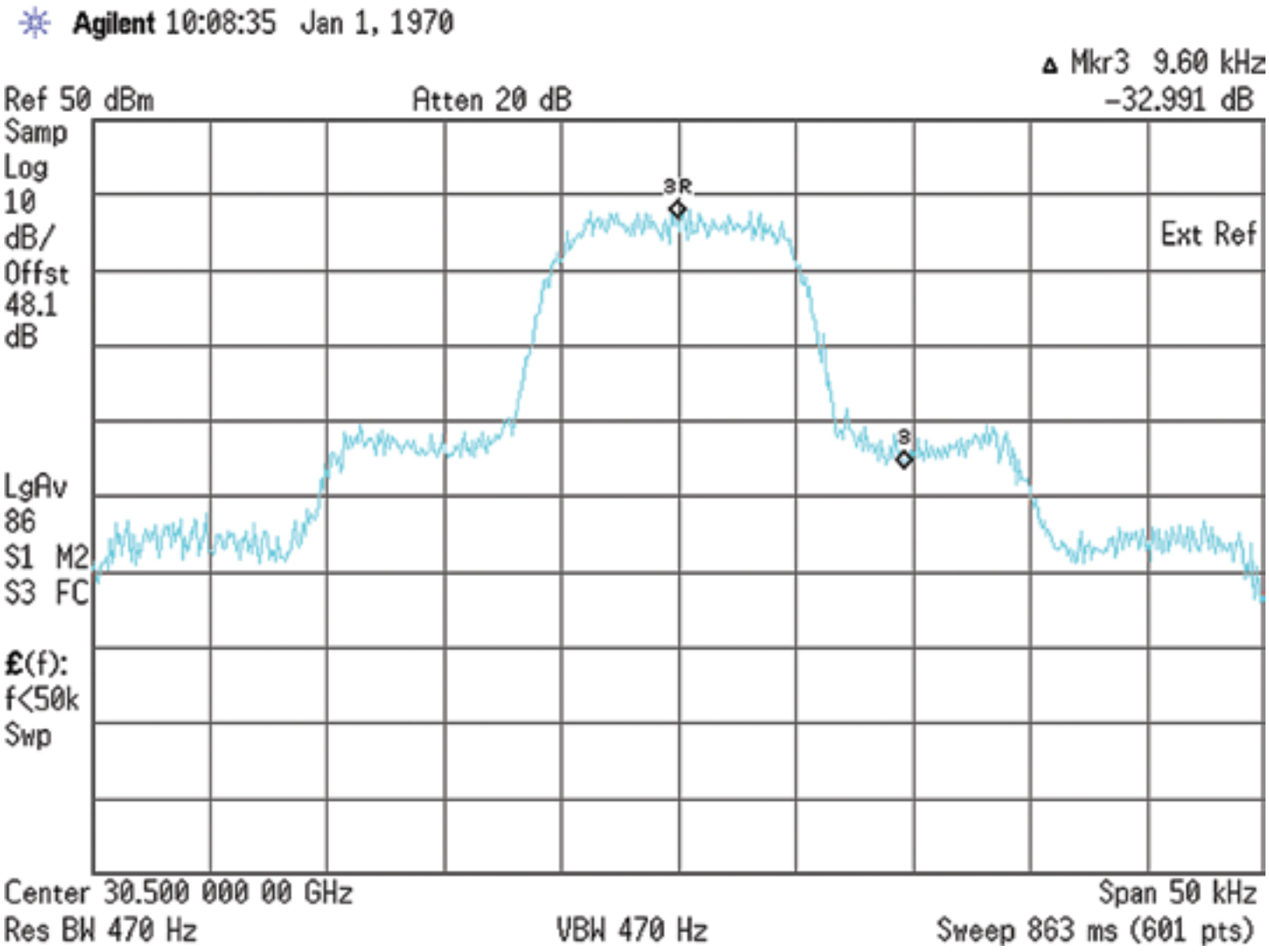


***Figure 2 — Spectral Regrowth of a 9.6 kBPS OQPSK signal with 1/2 rate error correction***

For an amplifier the linear power is formally defined as the smaller of the power levels as described above. This definition is a very useful shorthand description for evaluating power amplifiers for SATCOM operations. It is also used to set the measurement point where other non linear characteristics such as AM/PM, AM/AM, harmonics etc can be measured.

## Measuring Linear Power of MMICs

***Non Modulated Linear Power***

Until recently, the ***Spectrum Analyzer*** (**SA**) method was the most useful technique for measuring ***intermodulation*** (**IM**) levels and hence linear power. ***Vector Network Analyzer*** (**VNA**) techniques have now been expanded to measure IM and these offer the advantage that the IM levels can be seen in real time. As the operational power levels in SATCOM systems must be known precisely to realize a specified performance, the power meter is used for both SA and VNA measurements as the reference calibration device.

*Spectrum Analyzer Method*

This method is quite simple in practice although considerable care in the test set up and in the technique is required for accurate results. Two tones at a specified frequency spacing are applied to the amplifier and the output levels set equal on the SA display. The output power in the tones is increased until the upper and lower IM products which should be equal are each 22dB below the adjacent tone.

The power level is then measured with a power sensor (or with the SA if it has just been calibrated against the power sensor) and this power is defined as the linear power.

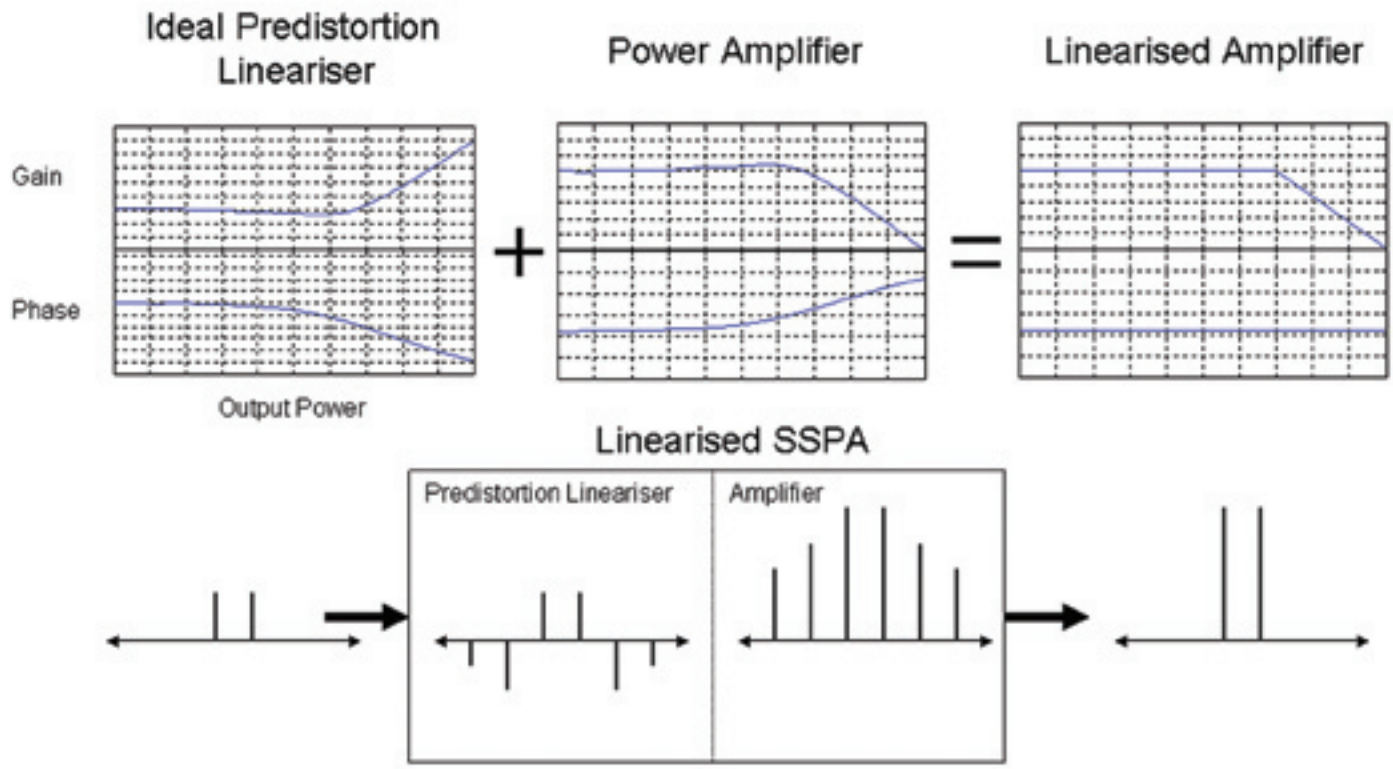


*Figure 3 — Ideal Predistortion Lineariser*

***Vector Network Analyzer Method***

The output power of a 4 port VNA, or a 2 port VNA with an additional frequency synthesiser, is calibrated against the power sensor at each tone frequency and set equal. Both signals are fed into the amplifier and the output of the amplifier is connected via a suitably calibrated coupler into the second port of the VNA.

The VNA display is then selected to display the power in one of the main tones and in either or both of the IM products and the power swept over the required range. The VNA display will show the main power and the IM power as a function of input power. Markers or a VNA trace equation can be used to define the 22dBc difference position and the output power level at this position measured with the power sensor.

The advantage of this technique is that amplifier parameters (*e.g.*, bias conditions, RF tuning, tone spacing, lineariser settings etc.) can be varied and the effects on IM seen immediately, over the selected power range, and at a number of frequencies. Refer to ***Figure 4***.

***Modulated Linear Power***

As SATCOM networks typically use QPSK or variants of QPSK as the modulation method, the linear power for a modulated signal is defined with a QPSK signal. This could be extended to other modulation types if necessary but QPSK, or rather the variant OQPSK serves as a useful reference.

The technique is straightforward at the conceptual level. The modulated signal is applied to the amplifier and the spectrum displayed on the SA as the power level is increased. When the power in either sidelobe at the specified offset reaches a level 30dB below the peak power in the main signal, the total power is measured and this is the linear power as defined by this technique.

As a QPSK signal can have different bit rates and error correction coding which may affect the results, it is necessary to further constrain the measurement. The point in the sidelobe where the relative power is measured is defined by the bit rate for a specific coding rate as shown in ***Figure 2*** where the modulated signal is a 9.6kBPS QPSK signal with 1/2 rate error correction.

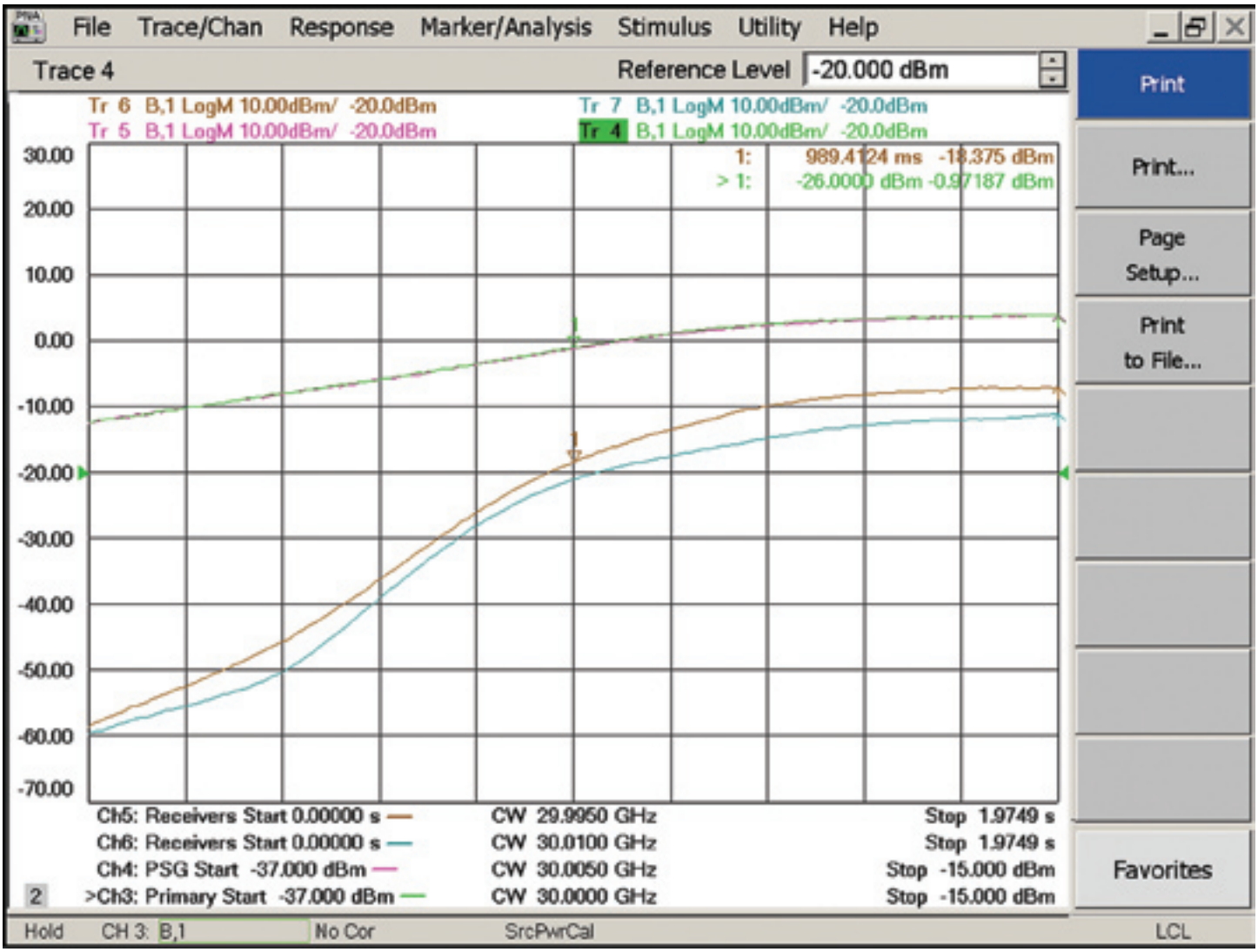


*Figure 4 — Unequal Intermodulation Products*

The linear power is defined as the lower value of the above two results. In general, the linear powers measured with both techniques will be quite similar but there may be differences of around 1-3dB which can vary with bias and other conditions of the amplifier.

***Using A Lineariser With MMIC Technology***

Linearisers, which reduce the level of the non linear characteristics, may therefore be a realistic alternative to increasing the power level but the inclusion of a lineariser may further complicate the specifications for non linearity. Typically, linearisers will improve the non linear behavior over a certain power or frequency range but may degrade it outside these boundaries.

It is instructive to compare the approximate differences in linear power relative to the maximum output power between typical Ku and Ka-band SSPAs. At Ku band, the linear power as defined by the two tone method has been measured to be typically 3-4dB below the saturated power level for SSPAs in the 100W power range. The linear power is therefore around 40-50W.

At Ka-band, the linear power as defined by the two tone method has been measured to be typically 7-8dB below the saturated power level for SSPAs in the 40W power range. The linear power is therefore only around 8W.

The difference in linear power compared to the saturated power between Ku and Ka-band SSPAs is primarily related to the performance of the devices currently available in each band. Consequently, if a typical Ka-band amplifier is linearised to increase the linear power to say 3dB below the saturated level, then the operational power can be increased from 8W to around 20W. This is a major improvement. At Ku-band, a lineariser will also give an improvement but the effect is not as significant and it is also cheaper to add 3dB more power at Ku band than it is at Ka-band.

### Measuring Linear Power Where A Lineariser Is Used

The two tone method of measuring linear power needs to be applied with some caution to Ka-band SSPAs especially if a predistortion lineariser is included with the SSPA circuit. Firstly, the non linear performance may not be the same across the operational frequency band so measurements should be made at several frequencies across the band. Frequency sensitivity is expected to decrease as the upper frequency limit of available MMIC devices increases well beyond the 31GHz mark.

A predistortion lineariser can be considered to operate by compensating the amplitude and phase distortions generated at higher output power or equivalently generating out of phase IM products to cancel the IM products generated in the final stages of the SSPA. These two concepts are illustrated in ***Figure 3*** located on the previous page.

It is a difficult challenge for a lineariser to achieve good cancellation of the IM products over wide power, frequency and tone spacing ranges and in general the lineariser will be set to maximise linear power. Some typi-


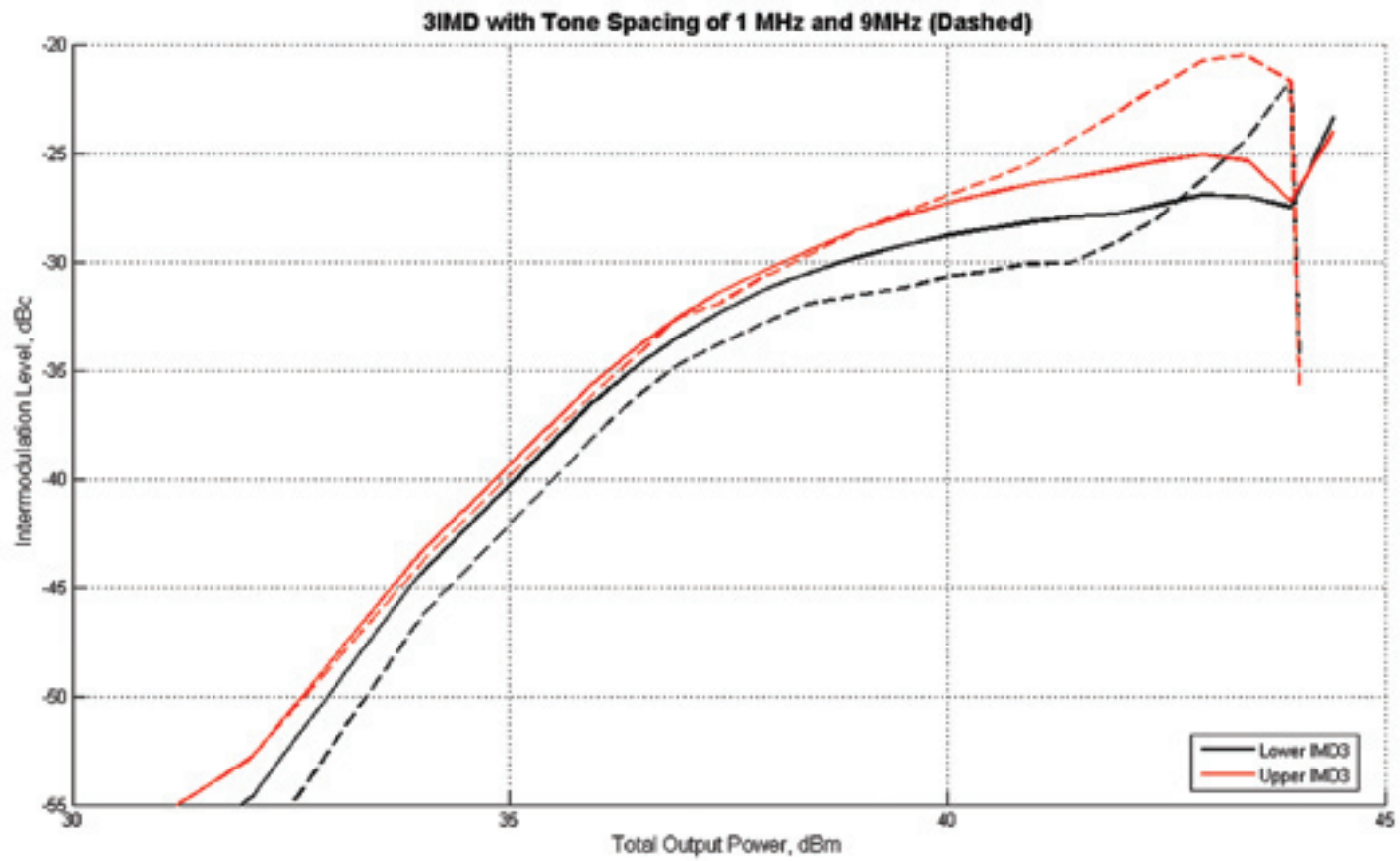


*Figure 5 — Tone Dependent IMD3 Products*

cal measurement issues to consider are listed on the next page.

## Unequal IM levels

The IM level either side of each tone should be within **±0.5dB** if the tone power levels are accurate to **±0.2dB**. If there is a considerable difference between the upper and lower IM levels then this will generally reduce the linear power available. A typical plot of the levels of both the upper and lower IM products is shown in ***Figure 4***, which shows the tone power in each CW Signal as measured by the VNA and the Upper and Lower **IMD3** products, **IMD3U** and **IMD3L,** respectively.

## Tone Spacing

Differences in upper and lower IM levels will generally increase as the tone spacing increases. Changing the tone spacing may also affect the absolute level of the IM products. Tone spacing dependent effects are usually associated with frequency dependent bias circuits or with sharp frequency sensitive circuits in the main transmission line.

Over a tone spacing range of, say, **1 to 20MHz**, the IM levels should not change by more than **±1dB**. A rather severe case of tone spacing dependency is shown in ***Figure 5*** for a Ka-band SSPA. This plot shows the upper (Red) and lower (blue) IMD3 products with 1MHz (solid) and 9MHz (dashed) tone spacings at 30GHz. It is clear that linear power measured at 1MHz spacing is quite different to that measured at 9MHz.

## Multiple IM Levels

For a standard SSPA, the third order IM levels are generally well above that of the higher order products so the power in these products is small even when the output power is within a few dB of the saturated power.

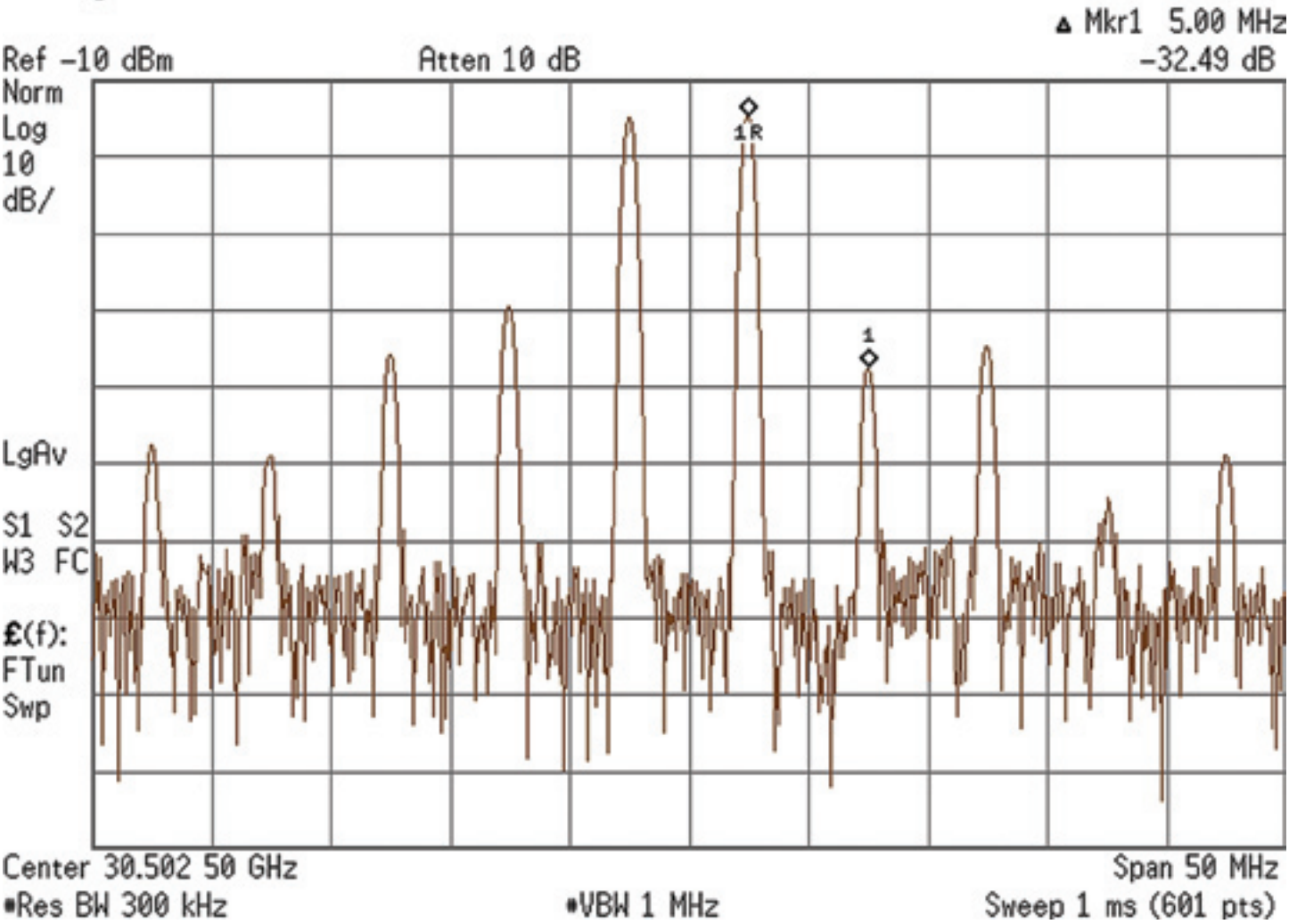


*Figure 6 — Higher Order IM Product Significance*

For a linearised SSPA, the out of phase condition of the pre distorted IM products may not hold over a wider frequency and power range. Another way to consider this is that compensation of the power dependent amplitude and phase curves will be approximate only and the curves may become non monotonic. This can be manifested as significant increases in the levels of higher order IM products which may be higher than the third order products.

This may affect the total power measurements as well as, of course, the performance of the SSPA in the system if there are significant power levels at 5, 7 etc. times the tone spacing. A case where the upper 5th order product is greater than the adjacent 3rd order product is shown in ***Figure 6***.

## Power Dependency

It is well established that the slope of the IM output level as a function of input power is about 2:1 but that this may increase before decreasing again as the power level approaches the maximum power level. With Ka-band SSPAs, the IM levels may exhibit increased deviations from the nominal 2:1 slope even at power levels well below the linear power point. A linearised SSPA will generally make this IM power dependency more complex.

If the linearised SSPA is operated well below the linear power region, then the IM levels may actually be higher than for a non linearised SSPA. This is illustrated in ***Figure 7***.

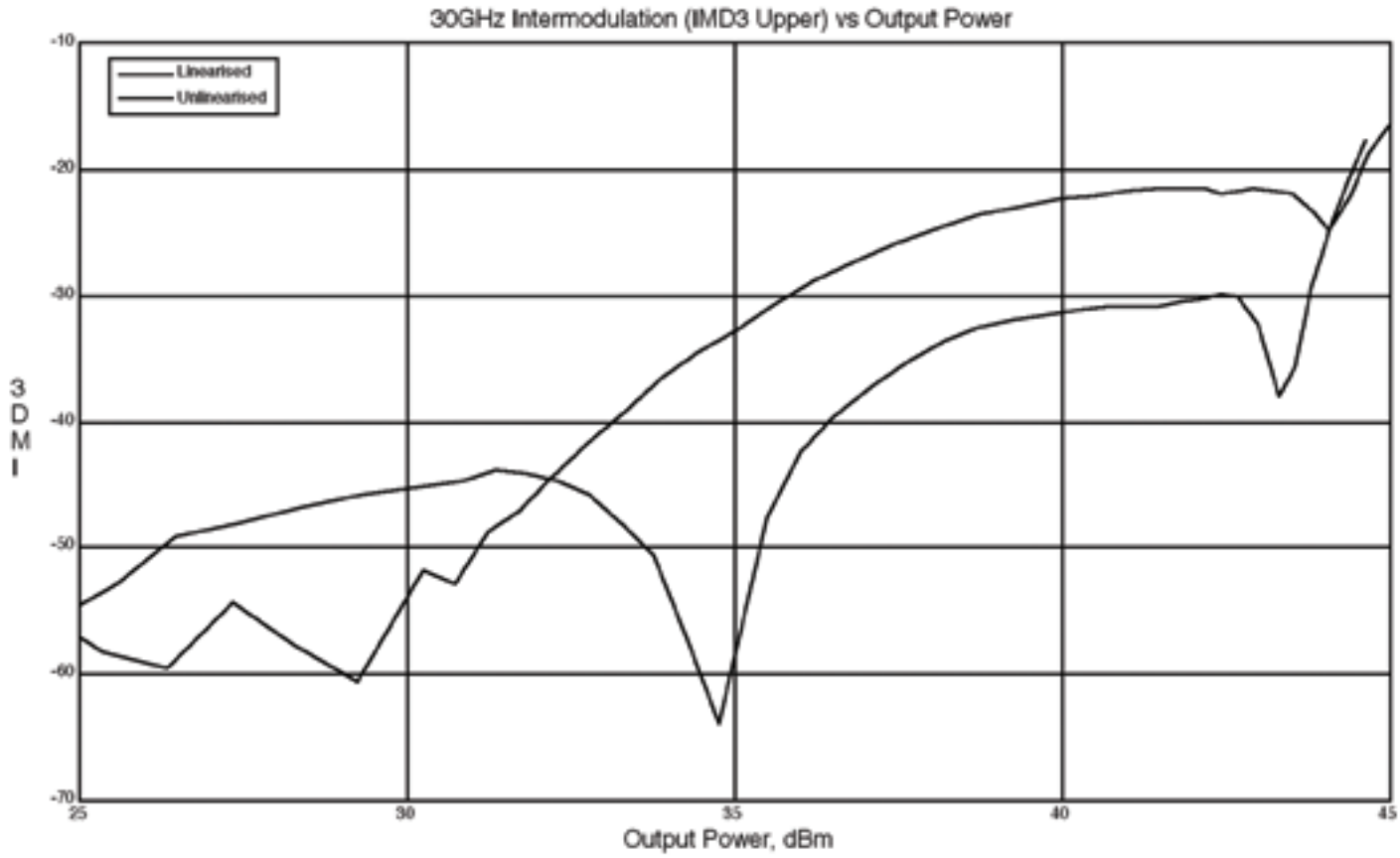


*Figure 7 — Intermodulation with and without a Lineariser*

## Conclusion

A linearised Ka-band SSPA can offer a major improvement over a non linearised one in that the linear power level can effectively be more than doubled, that is, improved by 3dB without any significant increase in DC power consumption, heat generated, size or layout of the SSPA. There will usually be a cost increase but this will generally be relatively minor if the lineariser is fitted during manufacture of the SSPA.

However, a lineariser does add complexity and as such it usually means that there are compromises in performance when the complete power, frequency and carrier spacing ranges of operation are considered. This paper has highlighted some of these issues and what to consider when doing evaluation testing of both linearised and non linearised SSPAs particularly at Ka-band.

MSM

*About EM Solutions*

*EM Solutions is a technology provider to commercial and military customers in the telecommunications sector. EM Solutions is a market leader in the supply of Ka-band products to defence and enterprise customers. The Company's products include LNB, BUC and SSPAs from 5W to 40W for Satcom market, and Fixed Point-to-Multipoint radios based on the WiMAX IEEE 802.16d standard. EM Solutions is also currently developing a Ka-band Mounted Battle Command On-The-Move Communications System for the Australian Defence Force. EM Solutions has developed all its products in-house, and has the organizational structure and focus to offer adaptation of core technologies and products to meet specific customer requirements.*

# COMMAND CENTER
# ADMIRAL (RET.) YOSSI LEVY, ORBIT TECHNOLOGY GROUP

**The dynamic Vice President of Orbit Technology Group is a retired Admiral who served in the Israeli Navy and, most recently, as Israel's Deputy Chief of the Navy. Mr. *Yossi Levy* joined Orbit as Vice President Business Development in 2005. He added sales and marketing to his responsibilities in 2006 and has been deeply involved with SATCOM for decades. Prior to joining Orbit, Mr. Levy held various senior management positions in the public and high tech sectors and has brought to the company his extensive leadership experience and management capabilities. Mr. Levy is a graduate of the Naval War College, Newport, Rhode Island, USA, and holds an MBA from the University of Derby. *MilsatMagazine* was delighted to chat with him and to gain insights from his unique perspective.**

### *MSM*

*Good day, Yossi. We are glad to have this opportunity to speak with you about Orbit's latest innovations. After many years of service in the IDF (Israel Defense Forces), you decided to join Orbit. What were the considerations behind this important career decision? Why did you choose to move into the satellite communications industry in general, and why Orbit in particular?*

### *Yossi Levy*

Modern battlefields, on land and at sea, have grown tremendously due to the availability of new advanced weaponry systems. New over-the-horizon communication solutions were required in order to transfer video and data over broadband communication links in real time. The best solution for these requirements is Satellite Communication. In my work at Orbit Technology Group, I draw on my understanding of the modern battlefield's needs and requirements, as well as on my vast experience as a seaman.

### *MSM*

*Orbit has been producing advanced, specialized antennas for the past 50 years, and is considered by many to be a leader in the field of stabilized antennas for mobile platforms, as well as providing specialized expertise in marine antennas. Orbit's main product in this area is* ***OrSat*** *and its global Ku-band coverage capabilities. What differentiates OrSat from other antennas?*

### *Yossi Levy*

Orbit is a sophisticated R&D-based company that developed a full range of in-house capabilities. This enables our exceptionally rapid response to field demands and feedback from our customers and partners around the globe. It also allows the Company to continuously create original, end-to-end, flexible solutions that meet our customers' changing needs and ensures them of real-time input and, actually, complete control, over the entire design and production process.

The company's extensive know-how, which has been amassed over decades of meeting various challenges and the successful developments of a wide spectrum of solutions for marine, air, and ground applications, gives us a technological advantage. This accumulated expertise assures the superiority of Orbit solutions and allows us to provide unusually broad insight regarding our customers' needs. We are able to then quickly create precisely tailored, cutting-edge answers for them. I can tell you from my experience that Orbit is a remarkably client-centered organization. We continue to expand our global support infrastructure and are determined to strengthen and extend our already well-established record for customer satisfaction.

The ***OrSat*** antenna is completely mature and extensively field-proven and has successfully passed stringent tests at sea. During the sea trials, these cutting-edge antennas maintained continuous connectivity during lengthy voyages in harsh conditions. Despite its compact size (1.15

within a 1.28 meter radome), the antenna has an extremely powerful engine. The *OrSat* provides reliable global satellite coverage in all weather conditions, atmospheric and marine, and delivers dependable broadband satellite communications for a wide range of uses, including Internet, TV, video, VoIP, and so on. The exclusive mechanical design, small footprint, no keyholes for continuous zenith-horizon communications, and its built-in RF package ensure an unmatched performance-to-size ratio. In addition, OrSat is easy to install, operate, and maintain. The antenna retains a high level of accuracy throughout its life cycle with absolutely no adjustments required.

As the only antenna system of its kind in the world that has been approved by **Intelsat** and **Eutelsat**, *OrSat* eliminates the need for testing to verify RF performance prior to operating on these networks, and can be installed by any major operator. **Anatel** approval was also recently added, enabling immediate service for providers in Brazilian waters as well, resulting in significant savings in cost and time. The system also offers an advanced filter — the Global LNB.

The overall design developed by Orbit is fundamentally different from that of others on the market, using composite materials rather than the more commonly used aluminum, producing a consistently high level of performance.

Together, these innovations enable pinpoint accuracy (within 0.1 degrees) in transmitting to the satellite. This performance level allows significantly reduced bandwidth and better **OPEX** (*Operational Expenses*). Installed on a variety of sailing vessels around the world, OrSat offers an extensive set of sophisticated features that are typically associated with larger antennas and higher costs.

### *MSM*

*In this new year, we can't help but wonder what new innovations you have up your sleeve!*

### *Yossi Levy*

Orbit invests continuously in development and dedicates significant amounts of time and thought to the critical requirements of today's market as well as future needs. In 2009, we will unveil the newest member of the ***OrSat*** family — that being a small maritime stabilized antenna system designed especially for small marine vessels under 30 m. The development of this antenna represents a major investment by the company. Responding to market demand for small antennas for commercial and military uses, this unique antenna has successfully passed multiple, stringent tests.

Lightweight and exceptionally robust, the new system is significantly smaller than our current OrSat antenna, which offers the largest gain possible for its size. Providing unlimited azimuth, the antenna can rotate continuously, assuring uninterrupted communication with the satellite — anytime, anywhere, under any conditions and in any situation.

The system is completely independent, requiring no intervention on the part of the vessel's crew. There are a host of other unique advantages — the antenna guarantees fast Internet access with up to 1024 kbit/s Downlink and 256 kbit/s Uplink. Electronic Beam Forming technology enables very fast and accurate, yet smooth and stable, tracking behavior. An integrated RF-package assures excellent RF performance and a special built-in compass makes a vessel compass unnecessary. The antenna is also simple to operate and to install.

### *MSM*

*In addition to the antennas for small marine platforms, are there any other innovations that Orbit will introduce in the next few months?*

### *Yossi Levy*

Yes. Orbit will also soon introduce a low-profile, VSAT Ku-Band mobile stabilized antenna system specially designed for trains. Based on breakthrough technology, the first-of-its-kind solution enables continuous Internet connectivity for high-speed trains traveling at over 300 km/h. The antenna, which is compliant with ETSI and FCC satellite regulations as well as the EN-50155 train standard, is attached to the roof of the train. This system provides a 1-2MBPS data rate (4/8W BUC).

Connected to a Wi-Fi Local Area Network (LAN), which will be optionally available in train compartments, the combination of antenna and LAN turns the entire train into a large hotspot. This will allow passengers to connect to the Internet from their seats, wherever this service is offered. The system, which we developed in cooperation with TES, has been tested and approved by a leading European railway company.

**MSM**
*What was the reason for the development of the special antenna for small vessels? What are the market requirements for small platforms? How is this antenna different from other solutions currently on the market?*

**Yossi Levy**
It is not only the large ships that need communications while at sea. Small ships that are far from land also need to maintain contact with those ashore and with other ships at sea. In fact, everyone needs connectivity.

The small ship antenna is the ideal solution for private ships and yachts, small commercial ships and fishing vessels, as well as small government and military ships. It is one of the world's smallest 2-Way Ku-Band-VSAT satellite communication antennas. The system offers very high throughput at a very reasonable price, such as professional airtime with 2048 kbps down and 256 kbps up. It is unusually user friendly and easy to install. Tracking information is derived from satellite signals, eliminating the pointing problems caused by sensor inaccuracy. The system delivers high positioning speed, high tracking speed as well as high accuracy with every movement of the ship through the use of EBF (Electronic Beam Forming), with unlimited high-speed tracking, and rotates constantly.



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| Ku-Band | 25 |
| Ku-Band | 40 |
| Ka-Band | 10 |
| Ka-Band | 20 |
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### MSM
*As a former military man (Deputy Chief of the Israeli Navy), how do you see the contribution of satellite communications for the military?*

### Yossi Levy
The need for communication at sea is immense. This is a huge market with enormous potential, a market whose needs have not yet been met. Orbit sees this as a great opportunity. Naval fleets spend extended periods of time at sea, often months at a time. The fact that the crew will be able to connect with people on land while they are at sea will certainly raise the morale of the sailors serving on ships as they will be able to maintain contact with their families during long tours of duty.

The connection to satellite communications also has great military potential, as ships can continuously remain in contact with their bases and headquarters as well as with other ships at sea. This is especially important for military personnel on vessels and for armies around the world.

Orbit also meets the needs of the global business market. Our antennas allow people to continue doing business as usual, even when at sea. In fact, you can now move your office to your yacht, cruise ship, or any other sea-going vessel, and be assured of uninterrupted connectivity with the rest of your team, your clients, and potential customers at every moment, for the entire duration of the voyage. You can even use high quality video-conferencing whenever required. Beyond business demands, Orbit's antennas enable you to maintain your online social and networking activities, as well as providing full entertainment options, enabling you to enjoy your favorite music and the latest films — online and in real time.

### MSM
*In your opinion, what are the market trends and how do you see Orbit's place in the international SATCOM arena?*

### Yossi Levy
The marine SATCOM market has developed much more rapidly than the air or ground SATCOM markets, mainly due to the lengthy duration of sea voyages. Today's market demands are for ever smaller antennas that can be easily used by all sizes of sea-going vessels. In response to this market demand, small-size, low-cost Ku-band antennas have been developed by a number of companies. They enable always-on broadband Internet connectivity for smaller vessels. However, there are significantly increased technical demands in the design of small Ku-band antennas. In addition, the need for compliance with satellite operator regulations often results in higher operational costs and lower cost/performance ratios. Up to now, relatively little attention has been paid to satellite operator approvals, but clearly, as the technology becomes more widespread, these approvals will become necessities.

Orbit has understood and has thoroughly prepared in advance for these new market directions. In addition to ensuring the quality of our antennas, the approvals from Eutelsat, Intelsat, and Anatel, save significant time and money during the installation process, as our antennas do not need individual verification by satellite operators.

Orbit is ready to fully capitalize on the industry's trend towards anytime/anywhere satellite communications. Market drivers include companies requiring constant contact with their crews, passengers on cruise ships needing ongoing contact with those ashore, and governments demanding to continuously monitor cargoes being shipped around the globe.

We believe in the coming year we will see an even greater leap in technology, leading to smaller, yet more powerful systems, installed on a greater variety of platforms. The world will be made increasingly smaller by ever more capable communications systems. We at Orbit are ready and poised to meet tomorrow's challenges with innovative new technologies, full regulation compliance, and exciting new products. MSM

# ON TARGET
# OPERATING XMPP OVER RADIO + SATELLITE NETWORKS

*by Steve Kille, CEO, Isode, Ltd.*

**XMPP, the Internet Standard eXtensible Messaging and Presence Protocol is being widely adopted for Instant Messaging (IM), Group Chat and Presence services in military networks.**

In this article *Steve Kille* looks at the military tactical requirements for IM, Group Chat and Presence, discusses briefly why XMPP is ideal for these services and as a building block for situational awareness systems in support of voice and video communication. Tactical networks often need to make use of Radio and Satellite networks with constrained bandwidth, high latency and difficult operational characteristics. The article concludes by looking at the problems of deploying XMPP over such networks, and reveals how XMPP can be effectively deployed in such environments.

## IM, Presence and Group Chat for Tactical Networks

Modern tactical communication has a complex mix of requirements that can include deployed units with a variety of communication links, participants from multiple countries working closely together and involvement of remote personnel (for example to provide specialist advice, or legal involvement with decisions to engage). The Instant Messaging family of services is a useful and important component of tactical communications.

### One-To-One Chat

There are situations in which using 1:1 IM to send or exchange short messages is more effective than formal messaging or voice communication:

- When communication links have capacity to send data but not voice.
- In very noisy situations where voice cannot be heard.
- In situations where absolute silence must be maintained.
- To provide information from a location where typing is easy (e.g., field HQ) to field locations in order to provide information that can complement voice.

### Group Chat

In some operational deployments (including many military scenarios) group communication is used more than 1:1 IM communication. If data is being provided, it makes sense to share it so that all interested parties can see the information. For example, it will enable external strategists or lawyers to observe communication in real time, and provide input as appropriate. It often makes sense to share information in the field, for example a group of ships jointly working out who will target what and how. Group chat is an important operational capability.

### Presence

Information regarding online presence can be useful data in support of other communication. Extended presences (additional information associated with presence) can also enable useful sharing. In particular geo-location can be supported as extended presence, enabling presence as a means of location tracking.

## Radio & Satellite Constraints on Tactical Networks

Tactical communication needs to use data communication links of widely varying speed and quality. It is important to be able to gain the benefits of fast networking when it is available to support a range of modern applications. However it is also important to be able to use slower links, when they are the only option available. As well as speed, latency and reliability are important characteristics that impact applications using data communications links. Key network technologies are:

- **Satellite.** Modern satellite systems provide bandwidth of 1 Mbps+, although many deployed systems are much slower (e.g., 4800 bps). Geostationary satellites have a latency of about 0.5 secs—it's common to chain multiple satellite links, giving greater end-to-end latency.

- **Line Of Sight Radio (VHF).** VHF Radio is widely used in tactical communications. Data links usually operate at 9600 bps (single VHF channel). Multiple channels can be combined to give full duplex communication and higher data rates. Although the physical latency is low, for a standard half duplex link, the low data rate will lead to turnaround times of half a second or more.
- **Line Of Sight Radio (UHF and faster).** Higher frequency radio will provide higher bandwidth than VHF. Different bands give different operational characteristics, ranges and opportunities for deployment. All are restricted to line of sight communications.
- **Beyond Line Of Sight Radio (HF).** HF Radio provides data rates from 75-9600 bps. Data rates can be highly variable. Turnaround time is typically 5-30 seconds. In order to optimize link utilization, data link protocols will hold the link open, leading to operational latency of two minutes or so. HF links can often be unreliable.

In many deployments, data communication links are shared between multiple applications. Link capacity may be partitioned, to ensure that specific applications do not take more than an allotted share of the bandwidth. This may reduce available bandwidth for a specific application to considerably less than the physical limit.

## Why XMPP for Tactical Networks?

XMPP is the protocol family of choice for military networks for one simple reason: **Standardization**. It enables interconnection of heterogeneous components, and integration of partner networks from other countries. In particular:

- The standard client/server protocol enables integration of users on a wide variety of systems, from specialized deployed units to office systems at HQ.
- The standard server/server protocol enables easy peer system integration.

XMPP is a rich protocol family with high functionality and security capabilities. It supports the core services of IM, Group Chat, and Presence. It also supports advanced capabilities, such as geo-location shared by extended presence and is a communications platform suitable to support future applications.

XMPP appears to be an ideal base for a standardized situational awareness protocol family. This gives interoperability benefits over proprietary systems, where all participants must use the same product.

## XMPP Configuration Options

The diagram on the next page shows two options for providing XMPP service over a slow link to a single client using standard XMPP protocols. In XMPP a client connects to a single server, and then there are direct server to server connections to support communication with clients on other servers.

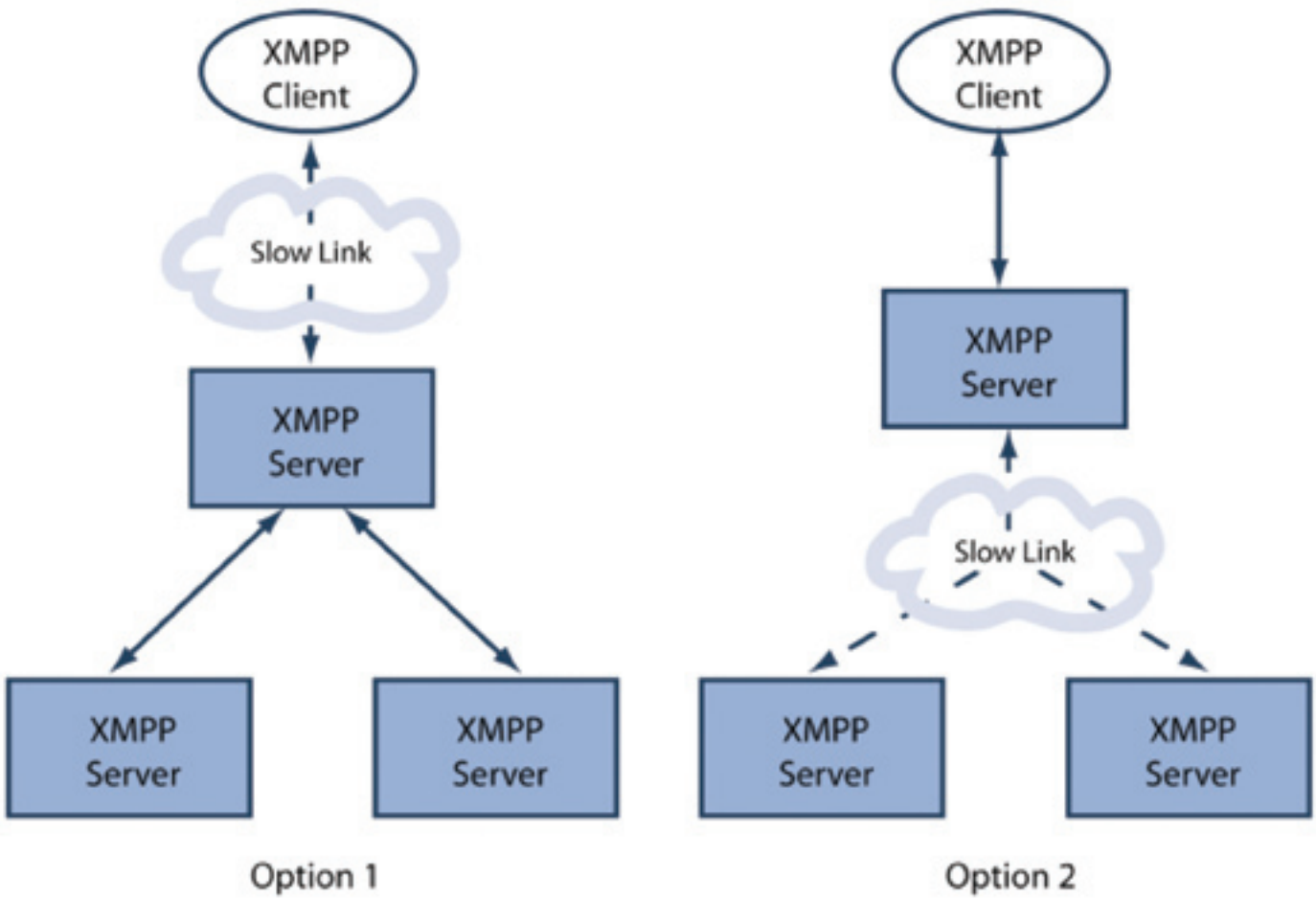
In the first option, the client connects to its server over a slow link. In the second option, the client is local to its server (fast) and the server communicates with other XMPP servers over a shared slow link. The relative performance of the two configurations can be considered for basic traffic:

*1—For message exchange, a message will traverse exactly one link in each case, so traffic load is similar.*

*2—Per connection overhead (setup and keepalive) is higher in option 2, as there are more connections over the slow link.*

*3—When a peer changes its presence status, this will be transmitted exactly once to the client, so overhead is the same in both scenarios.*

*4—When the client changes its presence status, this will be sent once over the client/server link and then over each of the server/server links which has a client that is monitoring presence. This gives a higher overhead for option 2.*




This clearly shows that, for a single client, operating the client/server protocol over the slow link (***option 1***) is going to be most efficient at the network level. Analysis in the next section is focused on client/server.

## XMPP Protocol Performance

This section looks at some XMPP protocol examples, to give a sense of the protocol overhead associated with XMPP. It is not intended as a formal analysis. XMPP protocol uses an XML text encoding.

```
<message from='juliet@example.com'
         to='romeo@example.net'
         xml:lang='en'>
<body>Art thou not Romeo, and a Montague?</body>
</message>
```

This is an example message taken from the core XMPP standard (RFC 3920). A minimal message such as this example will have an overhead of around 100 bytes. Typical XMPP clients will use more features leading to a typical operational overhead of 2–300 bytes per message. The overhead for messages to group chat is similar. The main difference is that a client will send the message to a room, and then the same message will come back again (from the room) so the line is used twice.

Presence updates (***Chat State Notifications***) are a similar size to messages (2–300 bytes). One of these will be received whenever a roster member changes status. When the client changes status, one will be sent and then returned back from the server. Another common message type is IQ, which is used by the client to check server status from time to time. This has a typical overhead of 70 bytes each way. Startup has the highest overhead. The following measurements use two popular XMPP Clients (Pidgin; PSI) for a user with about 20 entries on the roster Basic data transfer as follows:

- Pidgin: 32 Kbyte (4.6 Kbyte sent to the server; 27 Kbyte back)
- PSI: 48 Kbyte (10.6 Kbyte sent to the server; 37.4 Kbyte back)

This data is primarily to ensure client and server are in sync. The main reason for this difference is the PSI is an XMPP only client that makes use of a number of advanced capabilities that give higher protocol costs, as opposed to Pidgin which is multi-protocol and makes more basic use of XMPP.

The startup retrieves a fairly large JPEG photo as a part of the user profile. If this is not done, the modified data is:

- Pidgin: 13.9 Kbyte (4 Kbyte sent to the server; 9.9 Kbyte back)
- PSI: 31.3 Kbyte (9.3 Kbyte sent to the server; 21.9 Kbyte back)

It is worth considering "handshakes", as this can be an issue with high latency networks. Once operational, XMPP is an asynchronous protocol, so the only handshaking would be due to TCP level traffic. On startup, a total of approximately nine handshakes are needed.

## XMPP Compression

XMPP provides compression using the DEFLATE algorithm. This can be applied in one of two ways:

- Directly with the XMPP protocol.
- Within TLS (Transport Layer Security)

The compression effect is the same, but TLS would increase the overheads at startup. The data from the previous section is without TLS or compression. With both types of compression, DEFLATE will give two effects:

*1—XMPP is a text encoded protocol, and DEFLATE will give an immediate benefit for typical traffic.*

*2—XMPP has a regular structure, and common elements are often repeated. DEFLATE optimizes for this by reference to data transmitted, and will give substantial compression as use increases. For example, if a peer user is changing presence status between a small number of values, the same packets will be used to report this change, and DEFLATE will give very high compression.*

It is worth considering how much compression is provided. The DEFLATE specification in RFC 1951 notes that "English text usually compresses by a factor of 2.5 to 3" (i.e., to 33–40 percent of the original size). Given that IM and MUC traffic is the primary user data carried by XMPP, this is useful compression. Protocol also compresses effectively.

Ad hoc measurements of a short lived connection suggest that typical presence updates will compress from 100 to 50 bytes, and typical message overhead will compress from 300 bytes to 120 bytes. Other measurements suggest that higher compression can be achieved (factor 4.5–5.8, so reducing data to range 17–23 percent of original size).

Startup measurements using PSI (Pidgin does not support compression) and the earlier setup gives:

- Without Compress: 31.3 Kbyte (9.3 Kbyte sent to the server; 21.9 Kbyte back)
- With Compression: 8.2 Kbyte (3 Kbyte sent to the server; 5.2 Kbyte back).

This is a factor of 3.8 (reduction to 26 percent of original size).

These compression characteristics and the high startup overhead mean that network performance is strongly optimized for long lived connections.

## XMPP Design and Scaling

When looking at the data numbers in the context of very slow networks, it might appear that XMPP has poor optimization. It is worth considering the broad characteristics and design goals of XMPP:

- XMPP is designed to provide an extensible communications and information publishing infrastructure. XML is a natural choice to achieve this, and provides an extensible approach that can be easily used in many environments. Although XML is not very compact, the

data sizes are small on modern networks, particularly in comparison with voice, video and other data in wide use.

- On a modern network, XMPP's network usage is very light.
- XMPP clients are generally developed to provide "best service" to the user. There is no need to focus on optimizing network traffic.
- The hard problem for a distributed or federated IM system is support of presence. Message switching load scales in a natural manner, with load proportional to usage. With presence, there is a need to update many clients over the network for each status change. Care needs to be taken to ensure that this scales well, and the XMPP design has taken considerable care on this point.

## Client/Server Deployment over Medium Speed Networks

With this basic understanding in place of XMPP performance, we can consider performance of XMPP Client/Server interaction over a medium speed network of 28 Kbyte's per second (3.5 Kbyte per second).

Startup of a typical client/server connection will take a few seconds and saturate the network during this time. After this two things will come into play:

- Compression (which should be used) will work increasingly effectively to optimize data transfer volumes.
- The traffic caused by typical short message and chat use (e.g., participating in a number of simultaneous 1:1 chats and group chat sessions) and presence update from a moderate sized roster will be feasible. A link of this speed would support a peak load of around 20 short messages per second. This would appear sufficient.

Understand that startup is slow — it will be important to maintain long lived client/server connections to efficiently use a network of this sort of speed. Some optimization could be achieved by using XMPP in a "more efficient" manner and to reduce the number of messages sent. For example, many clients send information of the form "User XXX is Typing". It could be argued that this is not really needed and is just wasting network capacity. On the other hand, in many situations there is ample network capacity to do this, and this additional information provides value to the recipient (they may have an urgent requirement on the response, and it is useful to know that it is being prepared). There is a danger that attempts to optimize traffic will reduce the value of the service.

This will be particularly difficult to handle in a network that has a mixture of links of varying speed. It is suggested that in all but the very slowest of networks, that straightforward deployment of XMPP will be viable and sensible.

## HF Radio & STANAG 5066

HF Radio is the most difficult communications medium for which there is a general support requirement. It has low bandwidth, very high latency, and poor reliability. In order to use HF efficiently for data traffic, **STANAG 5066** is the approach of choice. To use the HF Network efficiently, it is important to operate the application directly over STANAG 5066, and not to use IP. This is discussed in the Isode whitepaper "HF Radio & Network Centric Warfare", which can be found on the Isode website (www.isode.com). In order to use XMPP over HF Radio, it is important to include STANAG 5066 as a part of the solution architecture.

## Point to Point Deployment Over Slow Networks

Consider operating standard XMPP over a network running at 2.4 Kbyte/sec (300 bytes per second), which is a typical (but not minimum) HF radio speed. Startup at this speed is going to be very slow (over a minute for the example connection described earlier). This will be compounded by two elements:

*1—Long Lived connections may be impractical for several reasons:*

- Slow networks are often unreliable, which would mitigate against long lived connections.
- For a slow network, the overhead of maintaining an open connection may be unacceptable.
- HF radio does not do data and voice simultaneously, so data links have to be closed for voice traffic.

*2—High latency will make things much worse. XMPP startup involves around nine handshakes, which will have a significant impact if network latency is high.*

Even in steady state, 300 bytes per second is going to be tight for IM traffic. Consider (without protocol overhead) a user monitoring several group chats. It is easy to picture that there would be 300 bytes per second of user data, without even considering XMPP protocol and presence overhead.

It is very clear that simple deployment of XMPP over a slow network is not going to work. We now consider what needs to be done to address this.

The diagram at the top of the next page shows the architecture **Isode** recommends for deployment of XMPP over slow links. On both sides of the slow link is "standard XMPP" and a special protocol is used between the servers over the slow link. There are a number of advantages to this architecture:

- The impact of the slow link is hidden from users not affected by it.
- Standard XMPP clients can be used.
- Multiple clients can be supported on an end system sharing access over a slow link, without significant overhead. Note that the slow link has only one server at each end, so that distribution of common data to multiple servers does not happen over the slow link.

The protocol should have a number of characteristics:

*1—There should be no connection establishment. This will be achieved in two ways:*

- It should offer a connectionless mapping onto IP using UDP, with reliability provided by the application.
- There should be a mapping onto RCOP (STANAG 5066 Reliable Connection Oriented Protocol) to provide efficient operation for HF. This will typically be used for short data transfers.

*2—Data encoding should be optimized for each packet, as algorithms such as DEFLATE are not very useful for connectionless operation.*

*3—There should be a filtering option, to remove traffic that is not considered necessary over the slow link.*

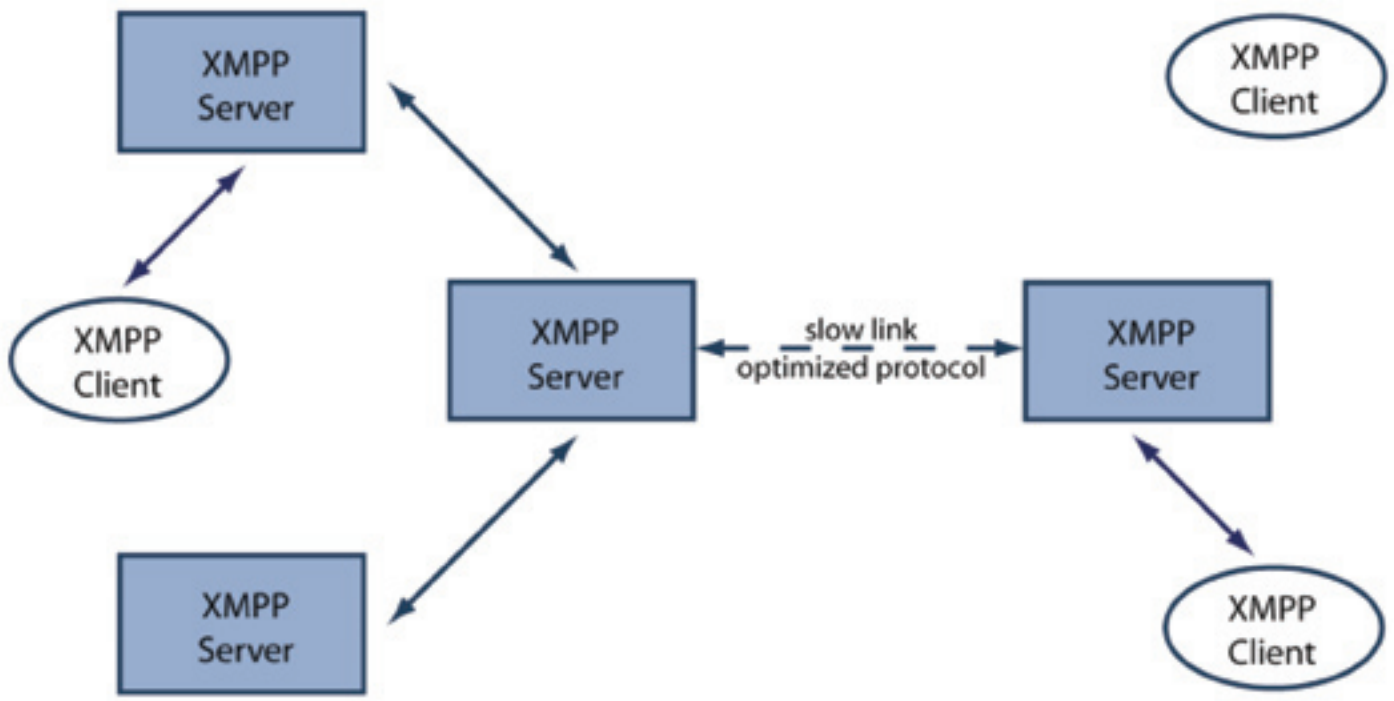
*4—Retransmission should be XMPP aware. For example, when sending presence, the current value should always be used.*

## Multicast and EMCON

Many slow networks use underlying broadcast transmission, and it is desirable that the application can make use of this. A related problem is that it is desirable to support end point in radio silence (EMCON or Emission Control). This means operation without acknowledgements. The architecture for this is at the top of the next page.

The optimized protocol discussed in the previous section may be extended to support this.

- Use of multicast will require a completely connectionless mapping: IP networks are supported with UDP and IP Multicast.
- HF is supported with STANAG 5066 UDOP (Unreliable Datagram Oriented Protocol).
- Presence status will always be broadcast, so that all interested parties can read it.




- Group Chat messages will always be broadcast and selected by interested parties.
- Retransmission's can be selective or automatic (to support EMCON).

## Conclusions

XMPP is important technology for supporting military tactical communication. It is useful directly, and as a basis for interoperable situational awareness systems. The protocol has good functionality, extensibility and scaling characteristics and can be deployed directly over fast and medium speed networks.

For very slow networks (e.g., 2.4 Kbyte's per second) and over HF Radio at all speeds, the protocol overheads of XMPP, in particular startup, are too high, and a modified approach is needed to take advantage of XMPP.

Isode recommends a server-to-server architecture, which isolates the performance impact of the slow link. Variants are proposed to deal with:

- Operation over IP (using UDP) and over HF Radio using STANAG 5066.
- Support of point to point links, and multicast configuration to optimize use of Satellite and Radio networks.

Isode plans to release updates of its ***M-Link XMPP Server*** that supports this architecture.

*About the author*

*Steve Kille is the CEO of Isode, which he founded in 1992 and re-launched in 2002. Steve has been closely involved with many key Internet technologies since 1980 and has brought several of them to market with Isode. Steve has 20 years of experience with messaging, directory, and security, and has been responsible for a range of widely deployed products and standards. He has written 40+ RFCs (Internet Standards), and is one of the authors of LDAP (Lightweight Directory Access Protocol). From 1981 to 1992, he was a Senior Research Fellow at University College London and led U.S. and European funded research projects on messaging, directory, networking and distributed systems. He has published a book and numerous papers and articles.*


*Steve has BA and MA honours degrees in Physics from Oxford University, and Masters degrees in Electrical Engineering from University of Manchester Institute of Science and Technology and Stanford University, where he was a Fulbright scholar. He was born in London, where he now lives.*

# BRIEFING
# MILCOMSATS OF THE USSR/RUSSIA

*by Jos Heyman, Tiros Space Information*

**In much the same way as the U.S. military forces use communications satellites, the USSR/ Russian military forces are a heavy user of communications satellites. A detailed analysis of the nature of the satellites used by the USSR/Russia indicates, however, that a different approach is taken to meet what essentially is the same objective, taking into account the local requirements.**

In addition, it is believed the military forces of USSR/ Russia also make extensive use of communications satellites which provide principally civilian services, such as the ***Molniya*** system. The three generations of Molniya satellites were placed in a highly eccentric orbit so that ground stations at high northern latitudes had access to the satellites. In these orbits the Molniya satellites were, for about 9 hours, over the USSR/Russia's continental mass. An operational system consisted of at least three satellites.

## Strela

The USSR was an early extensive user of the so called 'store-dump' satellites, where a received signal is stored on board the spacecraft until the signal is downloaded as it nears a convenient ground station. This approach can be effective if there are multiple satellites in orbit.

The USSR's ***Strela*** system used satellites designated in the ***Kosmos*** multi-objective series. The ***Strela 1*** series was essential a series of technology satellites to demonstrate the feasibility of placing multiple satellites in orbit and they had a mass of 50 kg.

The operational satellites were known as ***Strela 1M***. The 61 kg satellites were launched in batches of eight and it is believed that the operational system used 24 to 30 satellites. The satellites, while retaining the store-sump approach, provided a near real time communications facility for the USSR military forces and were more or less randomly distributed in orbits of about 1500 km.

The ***Strela 2*** series of store-dump communications satellites had a mass of about 750 kg and were built by **NPO PM**. The satellites' transmissions have been observed in the 153 MHz and 204 MHz bands, although other frequencies may also have been used. No separate generations have been identified but it is highly likely that the spacecraft have been modified over the years. An operational system consisted of three satellites in a typical 780 x 810 km orbit with an inclination of 74 degrees. The three spacecraft were spaced 120 degrees apart.

The final store-dump series of communications satellites was designated as ***Strela 3***. The satellites were built by NPO PM and had a mass of 230 kg. They were launched in groups of six by means of a ***Tsyklon 3*** launch vehicle. The operational system consisted of 12 satellites. At some launches two of the six satellites were believed to have been larger than the remaining four. From 2002, the satellites were launched in pairs by ***Kosmos 3M*** launch vehicles.

## Raduga 1

The ***Raduga 1*** series of geostationary satellites is based on the civilian Raduga series built by NPO PM using the ***KAUR-3*** platform. Also known as ***Globus***, the 2000 kg satellites are equipped with ***Tor*** transponders operating in the 4/6 GHz band and are optimized for telephone and telegraph communications. The first of these satellites was launched on June 21, 1989. From 2002, the satellites were launched in pairs by ***Kosmos 3M*** launch vehicles.

** = satellite failed to orbit

| Name | Int. Des. | Launch |
|---|---|---|
| Kosmos-38/40 | 1964 046A/C | August 18, 1964 |
| Kosmos-42/43 | 1964 050A+C | August 22, 1964 |
| Kosmos-4-3 | 1964 050C | August 22, 1964 |
| — | — | October 23, 1964 |
| Kosmos-54/56 | 1964 011A/C | February 21, 1965 |
| Kosmos-71/75 | 1965 020A/C | March 15, 1964 |
| Kosmos-80/84 | 1965 070A/E | September 3, 1964 |
| Kosmos-86/90 | 1965 073A/E | September 18, 1965 |

***Table 1 - Strela launch dates***

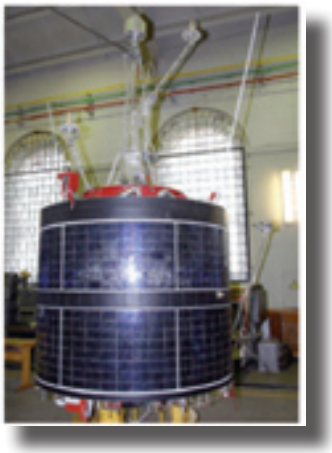
| Name | Int.Des. | Launch |
|---|---|---|
| Kosmos-336/343 | 1970 036A/H | 25-Apr-1970 |
| Kosmos-411/418 | 1971 041A/H | 7-May-1971 |
| Kosmos-444/451 | 1971 086A/H | 13-Oct-1971 |
| Kosmos-504/511 | 1972 057A/H | 20-Jul-1972 |
| Kosmos-528/535 | 1972 087A/H | 1-Nov-1972 |
| Kosmos-564/571 | 1973 037A/H | 8-Jun-1973 |
| Kosmos-588/595 | 1973 069A/H | 2-Oct-1973 |
| Kosmos-617/624 | 1973 104A/H | 18-Dec-1973 |
| Kosmos-641/648 | 1974 024A/H | 23-Apr-1974 |
| Kosmos-677/684 | 1974 072A/H | 19-Sep-1974 |
| Kosmos-711/718 | 1975 016A/H | 28-Feb-1975 |
| Kosmos-732/739 | 1975 045A/H | 28-May-1975 |
| Kosmos-761/768 | 1975 086A/H | 17-Sep-1975 |
| Kosmos-791/798 | 1976 008A/H | 28-Jan-1976 |
| Kosmos-825/832 | 1976 054A/H | 15-Jun-1976 |
| Kosmos-871/878 | 1976 118A/H | 7-Dec-1976 |
| Kosmos-939/946 | 1977 079A/H | 24-Aug-1977 |
| Kosmos-976/983 | 1978 005A/H | 10-Jan-1978 |
| Kosmos-1013/1020 | 1978 056A/H | 7-Jun-1978 |
| Kosmos-1034/1041 | 1978 091A/H | 4-Oct-1978 |
| Kosmos-1051/1058 | 1978 109A/H | 5-Dec-1978 |
| Kosmos-1081/1088 | 1979 024A/H | 15-Mar-1979 |
| Kosmos-1130/1137 | 1979 084A/H | 25-Sep-1979 |
| Kosmos-1156/1163 | 1980 012A/H | 11-Feb-1980 |
| Kosmos-1192/1199 | 1980 058A/H | 9-Jul-1980 |
| Kosmos-1228/1235 | 1980 102A/H | 23-Dec-1980 |
| Kosmos-1250/1257 | 1981 022A/H | 6-Mar-1981 |
| Kosmos-1287/1294 | 1981 074A/H | 6-Aug-1981 |
| Kosmos-1320/1327 | 1981 116A/H | 28-Nov-1981 |
| Kosmos-1357/1364 | 1982 040A/H | 6-May-1982 |
| Kosmos-1388/1395 | 1982 073A/H | 21-Jul-1982 |
| --- | --- | 24-Nov-1982 ** |
| Kosmos-1429/1436 | 1983 002A/H | 19-Jan-1983 |
| Kosmos-1473/1480 | 1983 069A/H | 6-Jul-1983 |
| Kosmos-1522/1529 | 1984 001A/H | 5-Jan-1984 |
| Kosmos-1559/1566 | 1984 052A/H | 28-May-1984 |
| Kosmos-1635/1642 | 1985 023A/H | 21-Mar-1985 |
| Kosmos-1748/1755 | 1986 042A/H | 6-Jun-1986 |
| Kosmos-1794/1801 | 1986 092A/H | 21-Nov-1986 |
| Kosmos-1852/1859 | 1987 051A/H | 16-Jun-1987 |
| Kosmos-1924/1931 | 1988 016A/H | 11-Mar-1988 |
| Kosmos-2008/2015 | 1989 025A/H | 24-Mar-1989 |
| Kosmos-2064/2071 | 1990 029A/H | 6-Apr-1990 |
| Kosmos-2125/2132 | 1991 009A/H | 12-Feb-1991 |
| Kosmos-2187/2194 | 1992 030A/H | 3-Jun-1992 |

*Table 2 — Strela 1M launch dates*

| Name | Int.Des. | Launch |
|---|---|---|
| Kosmos-103 | 1965 112A | 28-Dec-1965 |
| --- | --- | 16-Nov-1966 ** |
| Kosmos-151 | 1967 027A | 24-Mar-1967 |
| --- | --- | 15-Jun-1968 ** |
| Kosmos-236 | 1968 070A | 27-Aug-1968 |
| --- | --- | 27-Jun-1970 ** |
| Kosmos-372 | 1970 086A | 16-Oct-1970 |
| Kosmos-407 | 1971 035A | 23-Apr-1971 |
| Kosmos-468 | 1971 114A | 17-Dec-1971 |
| Kosmos-494 | 1972 043A | 23-Jun-1972 |
| --- | --- | 17-Oct-1972 ** |
| Kosmos-540 | 1972 104A | 25-Dec-1972 |
| Kosmos-614 | 1973 098A | 4-Dec-1973 |
| Kosmos-676 | 1974 071A | 11-Sep-1974 |
| Kosmos-773 | 1975 094A | 30-Sep-1975 |
| Kosmos-783 | 1975 112A | 28-Nov-1975 |
| Kosmos-836 | 1976 061A | 29-Jun-1976 |
| Kosmos-841 | 1976 069A | 15-Jul-1976 |
| Kosmos-858 | 1976 098A | 29-Sep-1976 |
| Kosmos-923 | 1977 059A | 1-Jul-1977 |
| Kosmos-968 | 1977 119A | 16-Dec-1977 |
| Kosmos-990 | 1978 019A | 17-Feb-1978 |
| Kosmos-1023 | 1978 063A | 21-Jun-1978 |
| Kosmos-1048 | 1978 105A | 16-Nov-1978 |
| Kosmos-1110 | 1979 060A | 28-Jun-1979 |
| Kosmos-1125 | 1979 078A | 28-Aug-1979 |
| Kosmos-1140 | 1979 089A | 11-Oct-1979 |
| Kosmos-1190 | 1980 056A | 1-Jul-1980 |
| Kosmos-1269 | 1981 041A | 7-May-1981 |

*Table 3: Strela 2 launch dates*

*Strela 1M satellite*



*Strela 2 satellite*

| Name | Int.Des. | Launch |
|---|---|---|
| Kosmos-1302 | 1981 084A | 28-Aug-1981 |
| Kosmos-1331 | 1982 001A | 7-Jan-1982 |
| Kosmos-1354 | 1982 037A | 28-Apr-1982 |
| Kosmos-1371 | 1982 051A | 1-Jun-1982 |
| --- | --- | 30-Aug-1982 |
| Kosmos-1420 | 1982 109A | 11-Nov-1982 |
| Kosmos-1452 | 1983 031A | 12-Apr-1983 |
| Kosmos-1486 | 1983 079A | 3-Aug-1983 |
| Kosmos-1503 | 1983 103A | 12-Oct-1983 |
| Kosmos-1538 | 1984 019A | 21-Feb-1984 |
| Kosmos-1570 | 1984 056A | 8-Jun-1984 |
| Kosmos-1624 | 1985 006A | 17-Jan-1985 |
| Kosmos-1680 | 1985 079A | 4-Sep-1985 |
| Kosmos-1741 | 1986 030A | 17-Apr-1986 |
| Kosmos-1763 | 1986 052A | 16-Jul-1986 |
| Kosmos-1777 | 1986 070A | 10-Sep-1986 |
| Kosmos-1814 | 1987 006A | 21-Jan-1987 |
| Kosmos-1850 | 1987 049A | 9-Jun-1987 |
| Kosmos-1898 | 1987 098A | 1-Dec-1987 |
| Kosmos-1937 | 1988 029A | 5-Apr-1988 |
| Kosmos-1954 | 1988 053A | 21-Jun-1988 |
| Kosmos-1992 | 1989 005A | 26-Jan-1989 |
| Kosmos-2056 | 1990 004A | 18-Jan-1990 |
| Kosmos-2112 | 1990 111A | 10-Dec-1990 |
| Kosmos-2150 | 1991 041A | 11-Jun-1991 |
| Kosmos-2208 | 1992 053A | 12-Aug-1992 |
| Kosmos-2251 | 1993 036A | 16-Jun-1993 |
| Kosmos-2298 | 1994 083A | 20-Dec-1994 |

**Table 3 continued: Strela 2 launch dates**

| Name | Int.Des. | Launch |
|---|---|---|
| Raduga 1-1 | 1989 048A | 21-Jun-1989 |
| Raduga 1-2 | 1990 116A | 27-Dec-1990 |
| Raduga 1-3 | 1994 008A | 5-Feb-1994 |
| Raduga 1-4 | 1999 010A | 28-Feb-1999 |
| Raduga 1-5 | 2000 049A | 28-Aug-2000 |
| Raduga 1-6 | 2001 045A | 6-Oct-2001 |
| Raduga 1-7 | 2004 010A | 27-Mar-2004 |
| Raduga 1-8 | 2007 058A | 9-Dec-2007 |

**Table 5: Raduga 1 launch dates**

| Name | Int.Des. | Launch |
|---|---|---|
| Kosmos-1617/1622 | 1985 003A/F | 15-Jan-1985 |
| Kosmos-1690/1695 | 1985 094A/F | 9-Oct-1985 |
| --- | --- | 15-Oct-1986 **x6 |
| Kosmos-1827/1832 | 1987 026A/F | 13-Mar-1987 |
| Kosmos-1875/1880 | 1987 074A/F | 7-Sep-1987 |
| Kosmos-1909/1914 | 1988 002A/F | 15-Jan-1988 |
| Kosmos-1994/1999 | 1989 009A/F | 10-Feb-1989 |
| Kosmos-2038/2043 | 1989 074A/F | 14-Sep-1989 |
| Kosmos-2090/2095 | 1990 070A/F | 8-Aug-1990 |
| Kosmos-2114/2119 | 1990 114A/F | 22-Dec-1990 |
| Kosmos-2143/2148 | 1991 033A/F | 16-May-1991 |
| Kosmos-2157/2162 | 1991 068A/F | 28-Sep-1991 |
| Kosmos-2165/2170 | 1991 077A/F | 12-Nov-1991 |
| Kosmos-2197/2202 | 1992 042A/F | 13-Jul-1992 |
| Kosmos-2211/2216 | 1992 068A/F | 20-Oct-1992 |
| Kosmos-2245/2250 | 1993 030A/F | 11-May-1993 |
| Kosmos-2252/2257 | 1993 038A/F | 24-Jun-1993 |
| Kosmos-2268/2273 | 1994 011A/F | 12-Feb-1994 |
| Kosmos-2299/2304 | 1994 086A/F | 28-Dec-1994 |
| Kosmos-2328/2330 | 1996 009D/F | 19-Feb-1996 |
| Kosmos-2337/2339 | 1997 006D/F | 14-Feb-1997 |
| Kosmos-2352/2357 | 1998 036A/F | 15-Jun-1998 |
| --- | --- | 27-Dec-2000 ** x3 |
| Kosmos-2384/2386 | 2001 058A/C | 28-Dec-2001 |
| Kosmos-2390/2391 | 2002 036A/B | 8-Jul-2002 |
| Kosmos-2400/2401 | 2003 037A/B | 19-Aug-2003 |
| Kosmos-2408/2409 | 2004 037A/B | 23-Sep-2004 |
| Kosmos-2416 (AKA Rodnik) | 2005 048B | 21-Dec-2005 |

**Table 4 — Strela 3 launch dates**

*About the author*

*Jos Heyman is the Managing Director of Tiros Space Information, a Western Australian consultancy specializing in the dissemination of information on the scientific exploration and commercial application of space for use by educational as well as commercial organizations. An accountant by profession, Jos is the editor of the TSI News Bulletin and is also a regular contributor to the British Interplanetary Society's Spaceflight journal.*

Tiros Space Information

# COMM OPS
# WINNING WAYS FOR SERVICESAT

**January 31st 2009, was a proud day for Servicesat. Just 12 months after being approached by one of Iraq's largest TV stations, Servicesat was able to deliver an original, tailor made, low-cost digital broadcasting solution enabling one of the largest TV stations in Iraq to broadcast LIVE in five Iraqi provinces the entire day throughout the Iraqi elections.**


The major challenges for **Sevicesat** and the TV station in ***Iraq*** were having to work within a very short time frame, due to the tardy awarding of the contracts. The Company also had to ensure large quantities of hardware arrived safely in Iraq, with deliveries made simultaneously from numerous ports around the world.

Excellent logistical coordination, coupled with superior cooperation from various shipping companies, made this possible. Although the systems were being set up just one day before to the Iraqi elections, and despite the heart-stopping last minute activation of the service, the entire project was an immense success and a huge accomplishment for Servicesat.



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Working from firm order to implementation required a mere four weeks. This was only possible as a result of Servicesat having sufficient equipment supplies, and due to their excellent relationship with an efficient production unit in the USA, which has the quickest turn over for these kind of products anywhere in the world.

As a result of this achievement, this particular Iraq TV station is already discussing other solutions with Servicesat, for broadcasting at other events, and they could be set to place a second order worth thousands of dollars. For the amount that other traditional satellite service providers have been charging for their services, Servicesat can provide its customers with twice the length of broadcasting time. Servicesat can also halve the current cost of the necessary hardware typically supplied in the broadcasting industry. Servicesat's low cost services and mobile antennas are an amalgamation of three, state-of-the art products that have been brought together to provide the equipment and service for an SNG product that is amongst the lowest priced of its kind in the market today.

One such piece of equipment is the Company's award winning ***Direcstar*** auto-deploy antenna. This is a one-touch, self aligning, auto deploy antenna that, once installed, requires no technical training to operate. The antenna is deployed and locked on to the satellite in two to three minutes.

In conjunction with the antenna, Servicesat has teamed up with **Quicklink** to use their most up-to-date compression techniques for live MPEG4 video delivery. **Hughes Network Systems** and their scalable, high-performance broadband satellite router, the ***HN 7000s*** and dedicated capacity in-routes, can provide trouble-free, live streaming, anywhere within the ***Eutelsat W1*** satellite footprint. In October last year, Servicesat demonstrated these services at their stand at **Gitex**, broadcasting live from Cyprus to Dubai every two hours. In March this year, at **Cabsat 2009**, the Company will be accomplishing the feat in Hall 1, **Stand # E1-33**.

The CTO of the Iraqi TV company expressed his thanks for the "great job" provided by the Servicesat team. He was very "impressed with the outcome and quality" of the video, even with as little bandwidth as 256 dedicated uplink speeds. The CTO was so convinced of the technology provided by Servicesat, that he wishes to replace his traditional DSNG equipment with that supplied by Servicesat, providing him savings of tens of thousands of dollars. MSM

Servicesat offers two grades of service :

- 409 Kbps dedicated upload, with 512 Kbps shared download
- 820Kbps dedicated upload with 512 shared download.

# BRIEFING
# TIME TO RETHINK ITARS

*by John Stone, Near Earth LLC*

**The headline was quite succinct — Iran successfully orbits satellite — it's time to rethink ITARs!**

In 1999, under the recommendation of a bipartisan commission headed by California representative ***Christopher Cox***, the United States government instituted a sweeping change in its regulation of satellite and related technology exports.

Previously, the export of these items had been regulated by the **Commerce Department**, and American satellites were sold and launched worldwide, including in China. Following a highly visible scandal concerning the unauthorized transfer of satellite launcher technology from American satellite manufacturers to Chinese launch vehicle manufacturers, the export of satellites came under much greater scrutiny. At the root of this scandal was the dual use capability that many satellite and launch vehicle technologies have in missile applications (recall that most early launch vehicles were, in fact, repurposed and modified ballistic missiles).

The form of this scrutiny was the ***International Trafficking in Arms Regulations*** (**ITARs**), under which satellites and satellite components were classified as munitions and exportation came under the purview of the State Department. Under this new regime, strict regulations and accompanying sanctions were instituted to prevent the transfer of technology from American Satellite manufacturers to their customers.

While it was intended that implementation of these standards would prevent unwanted technology trans-


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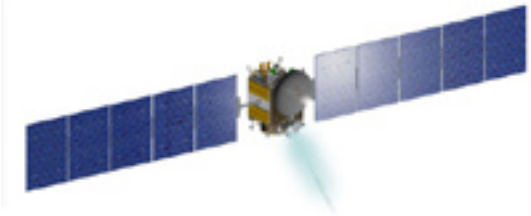

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fer (and that the cost of the standards would be borne by the purchasers), the ***Law of Unintended Consequences*** intervened.

In particular, many satellite buyers simply took their business elsewhere. As a consequence, much of the commercial satellite business for non-American customers migrated to European vendors, leading to a serious loss of market share (and related employment, tax revenues, R&D funding, etc.).

In more recent times, fresh competition from Israeli, Chinese (*e.g.,* Nigeria's ***NigComsat-1*** and Venezuela's ***Simon Bolivar*** satellite) and Indian (*e.g.*, ***W2M***) satellite vendors has also emerged, with aggressive pricing and guarantees, if somewhat checkered results. China, in particular, seems to be using its space program as a means of diplomacy to win new friends in the developing world.


Now, the circle of spacefaring nations has grown again, with the successful launch of Iran's first indigenously developed satellite and launch vehicle. This feat was achieved not only with ITARs in place, but substantial additional international sanctions, as well.

From the perspective of this writer, 10 years after the fact, applying ITARs to satellite exports appears to be a case of chasing a train that has already left the station. An increasing body of evidence demonstrates the rest of the world appears quite capable of developing their own launchers and satellites without our "assistance".

Needlessly punishing American firms that provide environmentally responsible, trade and budget deficit reducing, high paying technology jobs by effectively baring them from international markets seems counterproductive to say the least.

With a whiff of change now detectable in Washington, we think it's high time to consider changing these regulations to reflect the times. It's the least we can hope for. MSM

*About the author*

*Mr. Stone brings a wealth of finance and industry experience to the Near Earth team. In addition to his background in corporate finance and as a senior research analyst for both equity and debt securities, John also has an extensive background in science and engineering. As a consequence, his efforts for the group reflect a combination of financial acumen, broad technical knowledge and a scientist's rigor.*


*Immediately prior to joining Near Earth, Mr. Stone worked in the corporate finance unit of National Securities, where he was involved in sourcing, banking and distribution of private placements for early stage technology companies. From 2000 to 2002, he worked as a senior equity and debt analyst at Ladenburg Thalmann and Company. At Ladenburg, he covered satellite and cable broadcasting equities, and satellite/launch vehicle manufacturer and the debt of a networking company.*

# COMM OPS
# GOING DOWN UNDER FOR AFGHAN SATCOM SUPPORT

*by Marc LeGare, CEO, Proactive Communications, Inc.*

**As a young soldier in the U.S. Army, I often heard jokes about the mess hall being out of food once you advanced through the line. I would then relate the same joke to other situations I encountered in which my main resource was no longer available. At Proactive Communications, Inc. (PCI), I have often challenged my staff to go back to the mess hall to find more bandwidth for Afghanistan.**

**PCI** supports a broad customer base of U.S. military and DoD agencies in Afghanistan for satellite communications, and for the past three years our requirements have remained stable and predictable. However, in 2008, the strategic picture for our Afghanistan-based customers started to change. We projected large increases in customers and circuit sizes. Unfortunately, as we searched for this type of capacity in the area, we received many "no more Afghanistan bandwidth in the mess hall" replies.

Afghanistan is a marginally covered area of the world, and until the war started, there was not much demand for satellite capacity in that country. However, in 2001 the country became center stage in the war on terror. Although Iraq has overshadowed Afghanistan in terms of Coalition resource investment, that has all changed with the new U.S. Administration — communications resources that support that area are now at a premium. In light of this shift in focus, the dilemma at PCI became how to expand our satellite coverage capacity for our customers while still being postured for changes.

## Satellite Challenges

Afghanistan presents some unique challenges for providing satellite communications that are not present in Iraq. As mentioned before, Afghanistan has no real commercial requirements for satellite coverage at the retail/consumer level, and the geography itself is extremely challenging because the mountain ranges often block low-look angles.

While C-band is sometimes available, frequency coordination with the Joint **Task Force J6** is still required at any Coalition base or camp. Ku-band footprints with any usable capacities are often "up and down" and therefore subject to other countries' regulation and local ISP schemes. Every U.S. military and affiliated customer is going to need to have unfettered access to **.mil** and **.gov** websites; therefore, the IP scheme needs to be "friendly."

The last two challenges are cost and supportability. To remake the IP scheme entails a dedicated line or MPLS cloud. This is often expensive and time consuming to deploy. Finally, any support plan needs to be sustainable in terms of teleport maintenance, import/customs timelines, and language translation.

## The Solution

PCI has had to think "out of the box" on a number of large-scale U.S. Government IT projects in Iraq, but to overcome the bandwidth hurdle in Afghanistan, PCI actually had to think "out of the continent."

This search resulted in a relationship with **NewSat**, a publicly listed Australian company (ASX:NWT) with an engaging sales force, technically adept engineering staff, a willingness to be flexible to PCI's requirements, and the ability to offer a significant piece of the puzzle — bandwidth over Afghanistan.

As a result of this engagement, NewSat has expanded PCI's resource pool by using ***NSS-6*** with teleport facilities in ***Adelaide***, **Australia**. This combination of satellite, teleport, and partner staff tripled PCI's Afghanistan service and has also provided additional capacity to Iraq and Northern Africa, all while operating from an established "safe haven" of a Coalition partner country.

NewSat's technical heart is the two teleports it operates from Adelaide and Perth. These teleports are manned around the clock every day of the year, offer military accreditation, and boast a total of 26 antennas, many up to 13 meters in diameter. The teleports connect to 13 satellites, including those of **NewSkies**, **Intelsat,** and others.

## Bringing New Services to Afghanistan

With this expanded bandwidth capability, PCI is now able to deliver the industry's first ***Unified Communications*** solution to customers in the re-


*NewSat's Adelaide, Australia, Teleport*

gion for a rich media environment of fully integrated voice, data, video and secure messaging over a satellite communications network infrastructure. The package optimizes feature functionality, reduces configuration and maintenance requirements, and provides interoperability with a wide variety of other applications.

The Unified Communications framework will permit rapid deployment of emerging applications such as desktop IP telephony, unified messaging, telepresence, mobility, desktop collaboration, enterprise application integration with IP phone displays and collaborative IP contact centers. Instead of relying on a third party for VoIP capability, PCI developed its own VoIP service internally which will allow for lower prices and greater customer support for PCI's customers. The increasing U.S. and international focus on Afghanistan will bring on new communication challenges for soldiers, government officials and civilians. The country's sparse infrastructure and mountainous terrain, along with increasing demand for advanced communication technologies, add additional complexity to this challenge. Working together, PCI and NewSat have created a solution that will help Coalition forces coordinate their efforts as the war in Afghanistan continues to escalate. MSM

*About the author*

*Mr. LeGare became CEO of Proactive Communications, Inc. in 2006 after serving as the company's Chief Operating Officer and Operations Manager since 2003. Under Mr. LeGare's leadership as CEO, Proactive Communications has become the first U.S. company to work directly with the Iraqi Ministry of the Interior.*

*Prior to joining PCI, Mr. LeGare was Senior Consultant and Operations Manager for Force XXI Battle Command Brigade of TRW/Northrop-Grumman. From 1981 to 1999 Mr. LeGare served various command and staff positions for the U.S. Army worldwide including Battalion Commander from 1999 to 2001. LeGare earned a B.S. from the United States Military Academy, West Point, a Master of Science from the Air Force Institute of Technology and a Master of Military Arts and Sciences from the School of Advanced Military Studies.*

# BRIEFING
# ADVANCED MILCOM ON COMMERCIAL SAT SYSTEMS

*by José del Rosario, NSR*

**Except for the WGS-1 satellite that was launched in 2007, the current fleet of military communications satellites represents decades-old technology and capabilities. In order to address current as well as emerging requirements for national security objectives, newer and more powerful systems are being developed and deployed by the U.S. Military. These assets include the *Wideband Global Satcom* (WGS), *Advanced EHF* satellites (AEHF) and the *Mobile User Objective System* (MUOS) programs.**

Advances in IT are changing the way warfighting and peacekeeping are being conducted. The ability to transmit critical information in theater in real-time, or near real-time, securely to and from various parts of the globe has enabled faster deployment of highly mobile forces. Bandwidth per soldier requirements has increased tremendously, and the result among others is that troops have become more capable in adapting quickly to changing conditions in the battlefield.

Satellite communications have played a key role in providing interoperable, robust, communications; however, the current fleet of satellites has proven to be inadequate in terms of bandwidth supply to address current as well as future operations. In the next, or future, "network-centric" architecture that will upgrade or evolve future operations, advanced communications' systems will be required.

Advanced military satellite communications are often identified, and to a large extent, defined by the upcoming ***AEHF*** program. AEHF will provide global, highly secure, protected, survivable communications for all warfighters serving under the U.S. Department of Defense. Moreover, AEHF will provide greater total capacity and offer higher channel data rates compared to current milstar satellites.

The higher data rates permit transmission of tactical military communications such as real-time video, battlefield maps and targeting data. In addition, AEHF will also provide the critical survivable, protected, and endurable communications to the National Command Authority including presidential conferencing in all levels of conflict.

There is now an undeniable and accepted recognition that militaries around the globe cannot do away with commercial systems. Even if the U.S. Military were to achieve independence in terms of its bandwidth supply, the other benefits such as flexibility and redundancy that the commercial industry offers are invaluable.

## Challenges and Requirements

FSS and MSS commercial satellites currently provide the same types of applications, including real-time video as well as tactical military communications. Commercial satellites are even a part of UAV missions, currently a growing and highly-critical application suite for warfighting that will increase in the future. Moreover, commercial satellites in terms of bandwidth may be able to throughput higher data rates based on currently available satellites based on bent-pipe and on-board processing programs. The sheer number of commercial satellites currently deployed makes bandwidth availability much higher compared to current and planned military programs, specifically for the U.S. military.

In terms of the definition as well as the main difference between AEHF and commercial communications satellites, AEHF will provide survivable, highly secure, protected, global communications for all warfighters serving under the U.S. Department of Defense, whereas commercial satellite systems are vulnerable in the event of attacks or engagements that include nuclear capability. In terms of the ability to throughput secure, reliable, real-time or near-real time data, commercial systems could play a role in providing advanced communications for military missions.

**MILSATCOM** systems are generally categorized as wideband, protected and narrowband:

- ***Wideband systems provide high capacity,***
- ***Protected systems feature antijam, covertness, and nuclear survivability, and***
- ***Narrowband systems support users who need mobile voice and low-data-rate communications.***

In terms of these categories, commercial systems can tap into wideband and narrowband applications via FSS and MSS platforms. Indeed, commercial outsourcing by the U.S. Military has led to healthy leases of wideband/broadband capacity for missions in Iraq and Afghanistan, and for UAV missions in both countries as well as Pakistan. For narrowband applications, the U.S. Military has had a contract with Iridium, specifically for such capabilities.

The only challenge, or requirement, not met by commercial systems lies in the protected realm. By definition, protected systems such as AEHF have the ability to avoid, prevent, negate, or mitigate the degradation, disruption, denial, unauthorized access, or exploitation of communications' services by adversaries or the environment. This is particularly epitomized by activities that involve nuclear capabilities.

Another challenge or requirement currently unmet by commercial platforms is the ability to offer wideband capacity in the Polar Regions. AEHF will feature an ***Advanced Polar System*** both for wideband as well as protected needs. The ability of the commercial industry to offer wideband services in Polar regions may change with the upcoming **Iridium *NEXT*** constellation. However, the requirement for protected wideband communications will once again remain a challenge in the commercial realm.

Other features in upcoming advanced military systems include:

- ***Capacity gains and improved features such as multiple high-gain spot beams that are important for small terminal and mobile users.***

- *For AEHF, data rates up to 8.2 Mbps for future U.S. Army terminals will be provided.*
- *For global communications, AEHF will use inter-satellite crosslinks, eliminating the need to route messages via terrestrial systems. This is planned for the TSAT program as well towards the end of the next decade.*

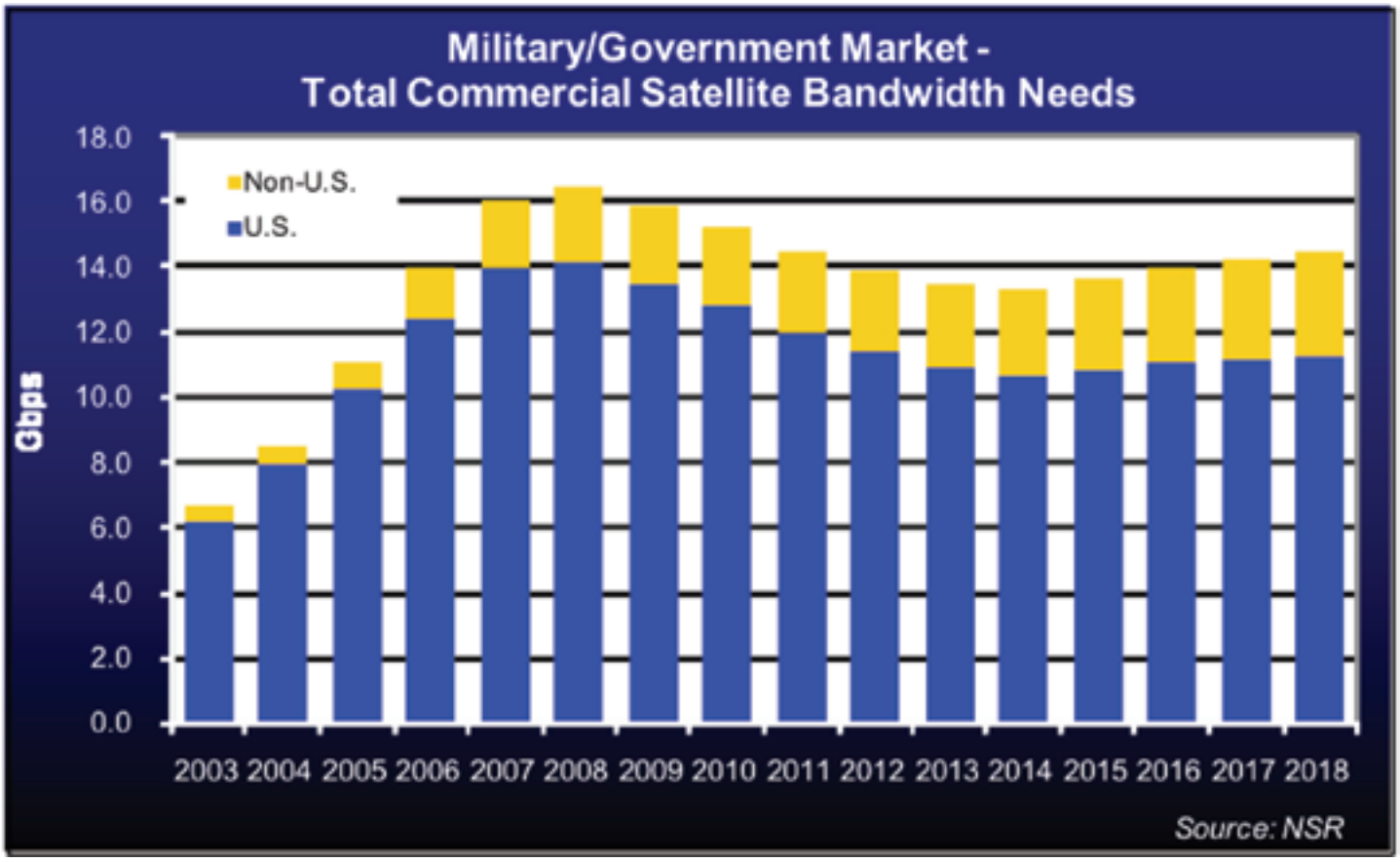
Commercial systems can address these requirements:

- *In terms of capacity gains, current broadband satellite programs such as iPSTAR, Spaceway (HNS) and WildBlue have spot beams, and these service providers can engineer bandwidth capabilities to approach, or even exceed, 8.2 Mbps.*
- *The challenge, of course, is the footprint since both programs are not global. However, planned systems such as Ka-Sat, Viasat and Yahsat should enable higher regional coverage across the globe.*
- *In terms of crosslinks, this is not yet a feature comparable to AEHF or the upcoming TSAT program. However, initiatives in hosted payload arrangement can link multiple satellites via router-in-the-sky solutions that can replicate linkages in the aforementioned military programs.*

## The Market

Developments in military areas are incorporating commercial systems in "***Netcentricity***." For instance, **Viasat**'s ***MD-1366 EBEM*** modem is a commercially available modem for the military's high-speed broadband and multimedia transmissions certified to **MIL-STD-188-165**B. The MD-1366 defines a military standard for high-speed satellite communications that use military and commercial satellites at X-, C-, Ku-, and Ka-band frequencies. Equipment manufacturers are likewise receiving RFPs and contracts for multi-mode terminals that can point to either military or commercial satellites.

Advanced military communications feature advanced methods of interference and jamming analysis where



terminal equipment is built to encrypt and decode transmissions. More importantly, advanced systems have the ability to survive rough treatment in hostile climates, specifically in a nuclear scenario.

Apart from the protected feature of the upcoming AEHF system, commercial systems can certainly participate in the future network architecture for future warfighting given the advancements and availability of commercial assets both in the space segment and in the ground segment. Anti-jamming, encryption and other secure military and commercial instruments can be incorporated to either approximate, or directly apply, military requirements on commercial resources.

In **NSR**'s latest market research report, ***Government & Military Demand on Commercial Satellites, 5th Edition***, we outlined the commercial bandwidth requirements by U.S. as well as non-U.S. entities. The vast majority of commercial bandwidth has, and will, likely continue to be used by the U.S. Government; however, international commercial bandwidth needs are foreseen to increase at steady levels over the next 10-years as well.

Total demand for the entire government and military market will certainly diminish given that the U.S. Military is the anchor tenant in this sector. As proprietary assets begin to be deployed, terminals that support programs such as the ***JNN/WIN-T***, which point to proprietary systems, will require less commercial bandwidth.

However, it is NSR's view that commercial demand will continue over the long term. Commercial satellite demand is expected to diminish, but not disappear. NSR believes that the commercial market in terms of bandwidth demand has peaked in 2008 and will likely begin to decline until 2014 before growing at positive levels once again beginning in 2015.

This development is due mainly to two reasons. First, the military needs redundancy and flexibility in its operations, as mentioned previously. Proprietary systems face internal technical challenges, and flashpoints around the globe develop very quickly. Commercial capacity ensures availability, as well as a secondary option should the primary preference be unavailable. Second, and more importantly, the vision for warfighting and peacekeeping in the future will begin to move to more automated activities such as UAS and UAV operations. And here, bandwidth including commercial satellite capacity will continue to play a key role in running these programs for surveillance, intelligence gathering and even tactical missions.

## More To Come

Quite simply, advanced military communication satellites differ from commercial satellites mainly in terms of specialized components that make them less vulnerable, and more effective in a nuclear environment. As such, NSR expects continued and increased participation of the commercial industry in the development and provision of advanced military communication services. MSM

About the author

*Mr. del Rosario covers the Asia Pacific region and is a senior member of the consulting team where he focuses his research on quantitative modeling, data verification, and market forecasting for the wireless industry and satellite communications sector. He conducts ongoing research with specialization in policy analysis, regional economic indicators, regulatory initiatives and end user demand trends. Mr. del Rosario has advised clients on market trends, implications, and strategies on such diverse topics as WiMAX, mobile communications, mobile video, 3G offerings, terrestrial microwave services, IPTV, IP telephony, multi-mission satellite programs, launch vehicles, broadband equipment and services, Internet trunking, and Enhanced IP Services. Prior to joining NSR, Mr. del Rosario worked with Frost & Sullivan as Program Leader of the Mobile Communications Group, as Senior Analyst & Program Leader of the Satellite Communications Group, and most recently as Country Manager for the Philippines. Mr. del Rosario holds a Master of Arts degree in Applied Economics from The American University, and a Bachelor of Science degree in Political Science/International Relations from the University of Santa Clara.*

# COMMAND CENTER
# WILLIAM HARTWELL, G.M. + SR. DIRECTOR, RIVERBED

**William Hartwell leads the Federal Markets Division at Riverbed Technology and is responsible for driving the Company's products and services for WAN Optimization and Application Acceleration into Federal Civilian Agencies, the Department of Defense, and the Intelligence Community. Prior to joining Riverbed, Hartwell was Vice President of Business and Channel Development of government markets at Motorola, where he developed teams to drive enterprise mobility solutions into the public sector markets. In addition, he was Vice President of the Federal Government area at Symbol Technologies prior to its acquisition by Motorola. Hartwell also spent eight years at Cisco Systems, where he developed senior sales, systems engineering, channels, and business development teams with extensive customer and industry knowledge across the Federal Markets.**


### MSM
*Bill, you have a history in the government space, working at Motorola and Cisco Systems. What compelled you to join Riverbed Technology last year?*

### Bill Hartwell
There are a number of reasons why I joined Riverbed. First, the Company is the recognized leader in WAN Optimization with more than 5,500 customers around the world, plus a significant installed base of government customers in many countries. After working at larger organizations, it was compelling to join a small, growing company that has the market recognition Riverbed does.

We have a strong partner ecosystem with large VARs, system integrators, and service providers — many of whom are focused specifically on government customers. Riverbed is also investing to make certain that our products meet the needs of our Federal customers. Features such as **SMB** signing, encrypted exchange acceleration, SSL acceleration, data-at-rest encryption, and SCPS are very important to our government customers.

### MSM
*How are organizations today using WAN optimization solutions? How does the technology wo*rk?

### Bill Hartwell
Riverbed provides ***Steelhead*** appliances, which are placed on either end of a WAN link. We also sell a software-only version of the technology (***Steelhead Mobile***) that sits on the laptops of mobile users. Customers use our technology to accelerate applications over the WAN, reduce bandwidth requirements, consolidate IT infrastructure, and improve disaster recovery processes.

It's the combination of de-duplication, TCP optimization, and application-specific protocol optimization that makes the difference. And, of course, Riverbed accomplishes all with the simplest-to-deploy solutions, which means our systems can scale to the world's largest deployments.

### MSM
*What are the benefits Riverbed is providing to military organizations? What are some examples?*

### Bill Hartwell
Customers are using our technology in a variety of ways. The ***U.S. Defense Contract Management Agency*** (**DCMA**) deployed Riverbed Steelhead appliances at 47 sites to enable consolidation of IT resources and reduce the number of data centers from 17 to two, while still providing LAN-like application performance for users.

Military customers can also accelerate applications to remote locations to give warfighters timely access to mission-critical information. One of the largest navies in the world uses Riverbed products to simplify communication between ships and their terrestrial-based support facilities for IP-based voice, video, and data collaboration. They use high-latency, low-bandwidth satellite links between their support facilities and ships all over the world. Using Riverbed Steelhead appliances, they have achieved "near-ter-

restrial" performance of key web applications on all of their ships and reduced bandwidth utilization by nearly 70 percent.

Increasingly, we are seeing SATCOM kit builders using Steelhead appliances, or mobile clients, in place of traditional TCP-PEP devices. The result is a higher performing solution that addresses more of the warfighters' performance bottlenecks. Many times this approach also allows organizations to have a single WAN optimization solution across the enterprise networks instead of several difference solutions.

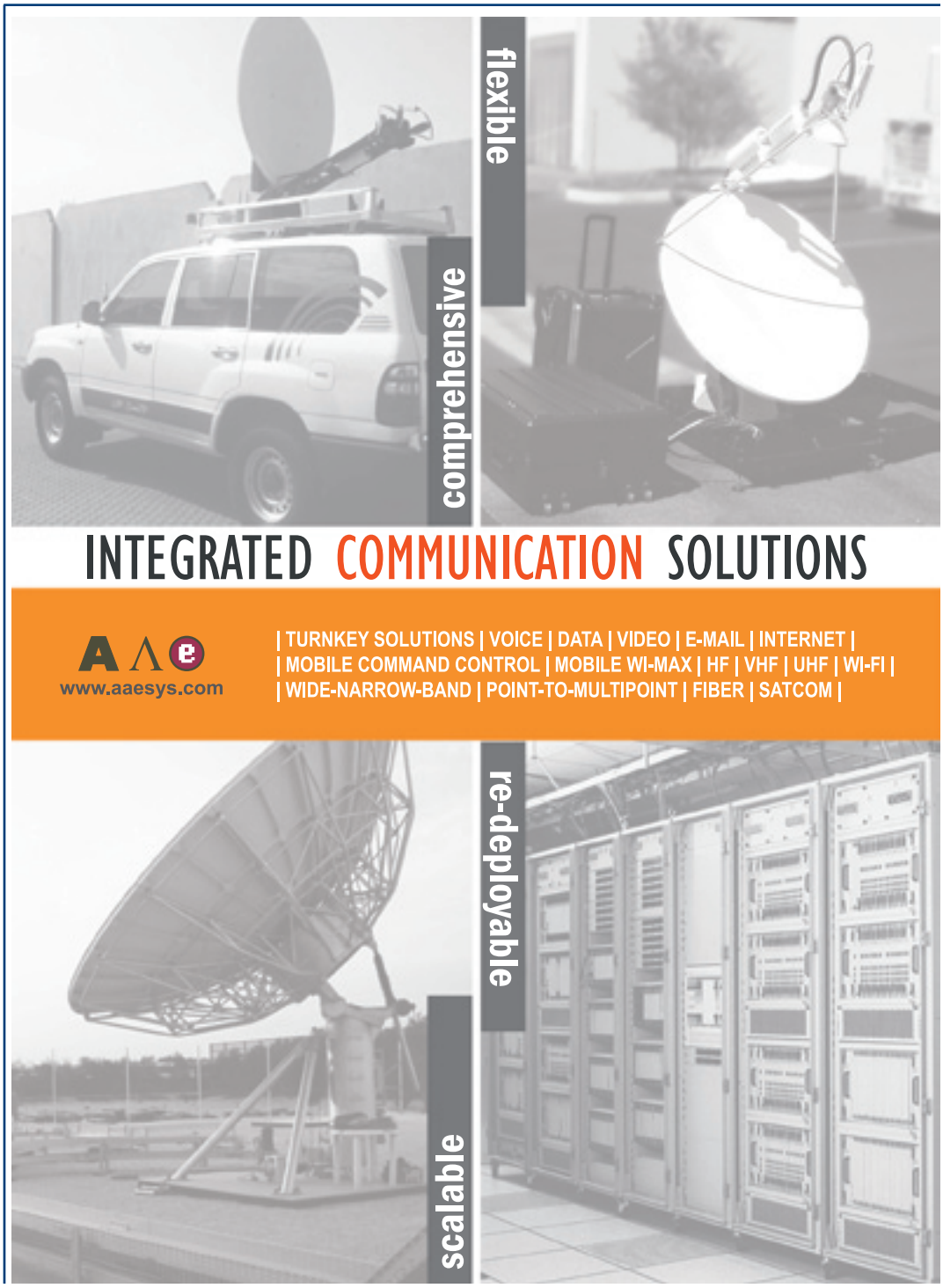
### MSM

*What will military organizations find unique about the Riverbed WAN optimization solution?*

### Bill Hartwell

Military organizations need to keep a small IT footprint at remote sites while providing warfighters LAN-like access to critical information from anywhere in the world.

To help address this, Riverbed recently enhanced its ***Riverbed Services Platform*** (**RSP**) offering with virtualization based on ***VMware***. The RSP allows customers virtualization of essential third-party software modules onto Steelhead appliances, allowing further consolidation of their IT infrastructure at remote sites, and even greater ROI on their Steelhead appliance investment. The enhanced RSP is an enterprise-class platform that enables drastic reduction in the remote site footprint by running up to five virtual machines, without the need for separate dedicated servers. This approach will enable military organizations to improve asset use, reduce physical footprints, control IT costs, improve net-centric operations, and ultimately make the server-less remote site a reality.



### MSM

*Riverbed recently announced SCPS interoperability. How do military organizations benefit from deploying SCPS-enabled WAN optimization solutions?*

### Bill Hartwell

For military customers that depend on satellite WANs, Riverbed has partnered with **Global Protocols, Inc.** to integrate ***SkipWare®***, the market-leading SCPS implementation, into Steelhead appliances. With Riverbed and SkipWare together, military customers can get the best of both worlds: the market leading acceleration capabilities of Steelhead appliances alongside best-of-breed SCPS functionality from SkipWare.

Military customers deploying the combined solution can achieve greater application performance benefits, and bandwidth reduction, across their satellite WAN, while maintaining SCPS interoperability. It also enables military organizations to optimize connectivity with any SkipWare-based military network and maintain full interoperability with any other SCPS-based network.

MSM

*About Riverbed*

*Riverbed Technology is the IT infrastructure performance company for networks, applications, and storage. Riverbed provides the only comprehensive WAN optimization solution to a host of severe problems that have effectively prevented enterprises from sharing applications and data across wide areas. Riverbed's Steelhead appliance address all of the issues that affect application performance over the WAN, dramatically improving the performance of applications that companies and knowledge workers rely on every day — including file sharing, email, backup, document management systems, IT tools, as well as ERP and CRM solutions. With Riverbed, any of these applications can be accelerated somewhere between 5 and 50, and even up to 100 times faster.*

# BRIEFING
# FASTER, HIGHER, STRONGER...

## A Theme for Military Communications, Not Just Olympic Athletes

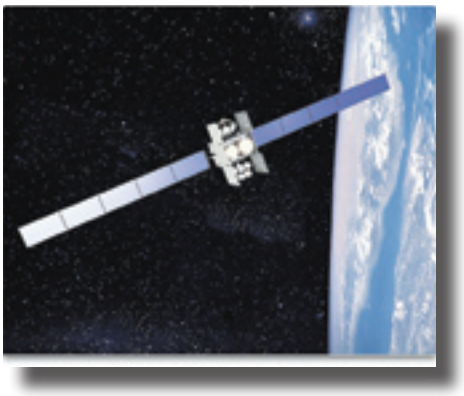
*by Andrea Maléter*

***Broadband Communications-On-The-Move Drives Military Satellite Services Worldwide***

**In recent years defense organizations around the world, led by the U.S. DOD, have been pursuing the means to achieve "net-centric warfare", in other words a fully interconnected battlespace with all forces communicating on an integrated, IP-based network. Net-centricity requires seamless communications, and thus the search for ways to increase the speed, bandwidth and power of communications across the battlespace, from ground to air and back, has driven R&D and implementation budgets for true broadband on-the-move capabilities.**

The resulting expanded technology developments have increasingly made it possible for enhanced battlefield information to be communicated with or retrieved from a full range of moving platforms including individual warfighters, unmanned sensors (UAVs), and combat vehicles/vessels/aircraft. These command and control systems, when integrated with broadband satellite capabilities, enable seamless communication of voice, email, text, imagery and other data key to enhancing situational awareness and decision-making, thus providing "soldier-system interoperability" and, in turn, net-centricity.
While much attention has been focused on the big-ticket items in the sky — the U.S. ***WGS*** and ***TSAT*** satellite programs in particular — the *real* drivers of service growth will be the funding of specific applications and programs to build and deploy aircraft, tanks and other vehicles equipped to operate with those satellites. While these programs do not individually have the size, scope or impact to generate extensive publicity, their funding is key to the actual use of WGS, TSAT or other technologies.

Key to implementation of such systems has been advanced satellite and antenna technology supporting transmissions while in motion using the higher-bandwidth capabilities of Ku/Ka/X-Band, rather than the more limited capabilities of lower-frequencies used by radio or even L-band satellites which dominate the maritime market.



***WGS***

From the perspective of the **DoD**, all of these programs are part of the ***Global Information Grid*** (**GIG**), the concept of providing full IP-based connectivity for operations including virtually all combatant commands and services. For the Army the core program within the GIG is ***LandWarNet***, for the Air Force it is ***C2 Constellation***, and the Navy has ***FORCENet***.

***TSAT***

Each of these intersects across the Combatant Commands, and mobile broadband is key to them all. Starting with **Special Operations** use of UAVs and COTM terminals, plus ***Transcomm*** operation of VIP aircraft, expanded programs include Army and Marine use of the COTM terminals with ***Mounted Battle Command on the Move*** (**MBCOTM**) capabilities that unfetter commanders from the command post and will lead to future secure wireless LAN and Land Warrior and UAV deployments.

As discussed below, these programs are being deployed as well by multiple other countries, and their evolution continues with new solutions, platforms and user terminals, with different needs and approaches for three key areas: piloted aircraft, UAV, and ground mobile markets. The drivers and bands used are summarized in the following table on the next page...

| Requirement Driver | Aircraft | UAVs | COTM | Frequency Band |
|---|---|---|---|---|
| Command & Control | ✓ | | ✓ | Ku, X, UHF, L |
| Situational Awareness | ✓ | ✓ | ✓ | Ku, X, UHF, L |
| Imagery | ✓ | ✓ | ✓ | Ku, Ka |
| Logistical/Admin Support | ✓ | | ✓ | C, Ku |
| Reachback to DISN/HQ | ✓ | ✓ | ✓ | Ka, X, UHF |

Each of these markets is currently dominated by U.S. military procurements, and in each case, growth is tied to the deployment of specific groups of platforms (aircraft, vehicles, wearable systems). However, looking forward past 2011, as new platforms are acquired and deployed, Europe (NATO and otherwise) is expected to be a major market, as are key countries in Asia.

## Higher and Faster... Airborne Communications

While the somewhat erratic history of broadband services on commercial aircraft has received more press, military communications with airborne platforms have continued to evolve and expand for both piloted aircraft and UAVs. In fact, it has been the success of these systems that is partially supporting the apparent readiness of the airborne broadband communications market to move from a predominantly military business to one with a large civil government base, and now back into the commercial realm.

The volumes of piloted airborne platforms may not be as high as those for UAVs, but they are moving to higher growth rates as a result of new procurement cycles around the world. As countries pursue new military aircraft programs, or plan upgrades of existing programs, they are choosing to incorporate enhanced communications systems. The key drivers of this market are the availability of smaller, lighter, streamlined and stabilized antennas, along with the growth in programs for strategic platforms such as those for extended VIP transport, medical/evacuation transport, and advanced tactical or special operations activities.

In addition to defense organizations, civil government users increasingly are demanding access to broadband in their aircraft. These include everything from emergency response helicopters to transport aircraft

*Predator UAV (U.S.A.F)*

*Global Hawk UAV (U.S.A.F.)*

to smaller planes carrying government officials, each of which has requirements for access to email, Internet, imagery and other broadband capabilities.

In the non-piloted area, UAV demand for satellite bandwidth has been well-established, largely due to the high-profile platforms such as the ***Predator*** and ***Global Hawk***, each of which can use a full transponder of Ku-Band capacity. But a wide range of platforms are being deployed with the need for broadband communications to support enhanced imagery and other sensor capabilities as well as expanded "soldier-system interoperability" programs which require direct communication of sensor data to the warfighter. These needs are expected to grow with anticipated increase in UAV deployments to replace troops on the ground in key theaters of operation. As the flying sensors take to the skies the data they collect is increasingly required to be transmitted directly to individual warfighters who must decide how to act on the intelligence collected, and themselves transmit orders to others.

Given their even tighter constraints than those of piloted aircraft, UAV-based communications are especially focused on the availablity of smaller, lighter, stabilized antennas. Developments in this regard have been taking place in a number of countries, as part of the tremendous expansion of international UAV programs. While the U.S. currently produces about half of the UAVs in service, there are now more than 30 countries producing UAVs of various sizes and capabilities. While only a small percentage of these drones requires broadband communications, this is clearly an area that will grow in the future with new developments in sensor capabilities, and expanded deployments.

Overall, U.S. markets represent the vast majority of all airborne broadband satellite communications demand in the next three to five years. A steady market is anticipated to develop in Europe, however, as multiple countries push forward with interoperable air communications and multinational coordination, with some of these procurements being NATO-based and others nation-specific.

## Faster and Stronger... Truly On-The-Move Land Mobile Broadband

In contrast to the piloted airborne and UAV markets, where operations are clearly mobile, the ground-mobile market is more complex. COTM covers a wide range of applications including: Command and Control, which tends to be asymmetrical with most bandwidth to the remote terminal; and Intelligence, Surveillance and Reconnaissance (ISR), where data is generated on the remote platform, so while also asymmetrical, most bandwidth is from the remote terminal.

The biggest issues for implementation and growth of COTM services include: interference and regulatory compliance; limited power from satellite beams that may have been designed for larger antennas; limited bandwidth; and the need for terminals to operate across multiple platforms — on the ground, sea, or in the air.

While there has been a lot of discussion about communications on the move, and the deployment of vehicles equipped with satellite antennas, most of these programs to date — including the ***Joint Network Node*** (**JNN**) which has fielded large numbers of terminals — have actually been communications on the pause or on the quick-halt, not truly on-the-move.

Most of the "on-the-move" terminals now in operation are at L-band and UHF, on **Inmarsat** and **Iridium** in particular. Given the limitations of the frequency bands at which they operate, the services on these systems do not currently meet the 1Mb or greater speeds usually associated with the term broadband. True broadband maritime mobile services are, however, starting to grow with availability of Ku/Ka/X-band on ***WGS***, ***XTAR,*** and other commercial satellites and new U.S. Navy program requirements.

For the ground based systems within **MBCOTM**, new programs such as ***WIN-T*** are adding true on-the-move requirements. The use of smaller, lighter stabilized antennas is driving this, in conjunction with both commercial Ku/Ka/X-Band capacity and the newly available WGS capacity. Particularly interesting here is the development of expanded "soldier-system interoperability" programs such as the ***Landwarrior*** and ***Integrated Soldier*** systems of U.S., U.K., Canada, France, Spain, and other nations that connect individual warfighters to unit vehicles and back into field or headquarters command centers. Part of the concept of net-centricity is the interconnection of these individuals and vehicles with the newly enhanced UAVs, incorporating sensor fusion technology to provide full situational awareness as well as communications capabilities..

Currently, the most concrete opportunities derives from U.S. customers, but there is significant ongoing procurement of ground-based platforms by NATO, individual European nations, Japan and other countries. Much of the potential for COTM is beyond the next few years — post 2012 — as countries adopt new technology into their procurement and refurbishment programs.

## Like The Olympics, This Is A Global Event

As noted above, while the U.S. military is leading many of these programs, and currently dominates the market, there are extensive programs now in development around the world for airborne as well as ground-based mobile broadband Ku/Ka/X-Band satellite communications. Key markets in other parts of the world, and their drivers are summarized below.

***Europe*** — European military procurement programs have three separate but interconnected components: individual national programs, programs of the ***European Defense Agency*** (**EDA**), and **NATO** programs. This complex structure means that planning and procurement of new military platforms and associated communications systems is fragmented by country and organization. Decisions to budget for new programs must be negotiated within a government, a process that often adds delay. Nevertheless, as an aggregate market for both airborne and ground-mobile broadband communications Europe is expected to surpass the U.S. While slow but steady growth is

expected in the next 10-years, the current budget shortfalls in some key countries may slow the rate of expansion in the near-term, especially given the need to decide which budget will be used for each program.

Adding to the strength of the European participation in these markets is the fact that key aircraft, UAV and ground equipment programs are based in Europe, in addition to some major spacecraft programs such as ***Skynet*** and ***Syracuse***. The companies involved in these programs can leverage not only their intra-European contracts, but also their work for other nations, to support future research and development activities. In fact, the recent reductions in European programs, coupled with greater program collaboration, are likely to push European competitors to be more aggressive in seeking U.S. and other military business

***Asia*** — While **China** is widely seen as having the largest military program in the region, it is a closed system, and is not discussed here. **Japan**, on the other hand, has increased its role, and is now adding military activities to its space policy programs. Japan's relatively light but advanced airborne force is expected to evolve in the coming years, and impose greater demand for advanced air communications. Medical evacuation platforms like the ***Black Hawk*** or command-and-control platforms like the ***E-767,*** are particularly likely to need broadband capabilities. On the ground side, as Japan's stable numbers of ground forces phase out old technologies in favor of new, a small but growing COTM target market is expected to evolve in the 2013 to 2017 time frame,

**Australia** has taken a high-visibility role in the broadband satellite world through its decision to partially fund one of the future WGS spacecraft. To leverage this in-space capability, Australia's relatively small aggregate airborne platform base is likely to increase. This base currently consists primarily of VIP transport platforms. At the same time, Australian ground forces' demand for COTM is likely to grow in demand, again, in part, to leverage their WGS capabilities. This business is limited in the near-term by the small size of the market and limited diversity of military ground vehicles and applications.

**India** presents a very different picture, and as it continues to modernize its air force, demand for advanced airborne communications will increase, in particular as a result of procurement of special operations air platforms. India is also expanding its spacecraft developments, further supporting the growth of all broadband communications capabilities. And while its sheer number of vehicles makes India's ground forces one of the largest single-country markets for COTM — larger even than the U.S. — advanced applications may not be India's main focus, limiting growth in new program implementation.

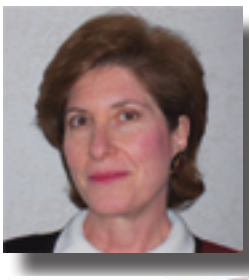
**South Korean** demand for airborne communications is also expected to remain steady over the next decade, but remain limited by the lack of advanced new communications applications. At the same time, with numerous forces deployed along the demilitarized zone, South Korean ground COTM demand is likely to grow rapidly, with modernizing applications driving expansion post-2015.

## New Challengers Will Certainly Appear

Just as new satellite technologies will make more bandwidth available to more users, and new technologies in antenna design and waveforms will increase the number of platforms that can incorporate satellite services, so too new applications will certainly be designed to take advantage of all that technology. One of the uncertainties for the future is where those technologies and applications will be developed and deployed first. Just as in athletics, there may be surprising outcomes as a result of who decides to invest to go faster, higher or stronger. MSM

*About the author*

*Andrea Maléter, Futron Technical Director, has over 30 years experience in global satellite and telecommunications industry sales, marketing, regulatory and policy management. She has provided decision support advice to space and telecommunications companies and government agencies, and has assisted in developing new commercial applications, regulatory and business strategies. Prior to Futron, she was a consultant at PricewaterhouseCoopers, and before that held management positions at INTELSAT and COMSAT.*



# COMMAND CENTER
# COLONEL PATRICK H. RAYERMANN, COMM-FIO, NSSO

**Colonel Rayermann was raised in Southern California and started his professional life as an employee of the Jet Propulsion Laboratory. In 1981, he graduated from UCLA and its ROTC program with a BS degree in physics and a commission as a 2nd Lt. in the United States Army Signal Corps. As a company grade officer, he served as an assistant project manager at Ft. Monmouth, New Jersey, then as a planning officer with the 7th Signal Brigade and as the Commander of A Co, 44th Signal Battalion, which used the *TRI-TAC* communications system he helped to develop. He deployed to Northern Iraq as part of *Operation Provide Comfort*.**

Colonel Rayermann's field grade assignments have included Executive Officer and Commander, **1st Satellite Control Battalion**, manager of all logistics support throughout the former Soviet Union for the ***Nunn-Lugar Cooperative Threat Reduction Program***, which serves to eliminate, neutralize, or safeguard elements of what was the Soviet strategic arsenal, and as Chief of Space Operations at the ***Defense Information Systems Agency*** (**DISA**). In 1985, Colonel Rayermann served as a member of the ***Army Space Initiatives Study***. He made space support relevant to the warfighter during his assignments with the **7th Signal Brigade**, the **44th Signal Battalion**, the **1st Satellite Control** (SATCON) **Battalion** and with DISA. In 1999, he became one of the initial officers designated as a Space Operations expert (Functional Area 40) within the U.S. Army.

His assignments as a Space Operations Officer have been as the **G3** of **U.S. Army Space and Missile Defense Command/Army Forces Strategic Command** (**USA SMDC/ARSTRAT**) and as the ***Chief of the Space and Missile Defense Division*** in the **Department of the Army G-3/5/7**. During 2006, he participated as a member of the White House Office of Science and Technology Policy-chartered ***Future Land Imaging Interagency Work Group*** (FLI IWG) which developed a plan for a ***U.S. Land Imaging Program*** to provide a strategy to achieve a continuous, routine U.S. operational space-based land imaging data collection capability. Colonel Rayermann currently serves as the **Director of the Comm-FIO** office within the **National Security Space Office (NSSO)**.

### *MSM*

*Colonel Rayermann, as the Director of the Communications Functional Integration Office with the NSSO, would you please describe your duties? Also, you became one of the first Space Operations Experts within the U.S. Army, a new career path in 1999 — what did this assignment entail?*

### *Colonel Rayermann*

Hartley, thank you very much for this opportunity to address your questions. My principle duty as the Director, Communications Functional Integration Office (Comm-FIO) at the (NSSO) is to lead the team responsible for the stewardship of the ***Transformational Communications Architecture***, or **TCA**. The TCA was initially developed in 2003-2004 to describe the vision for a future set of satellite communications capabilities that would both be an element of the **Department of Defense**'s ***Global Information Grid*** (**GIG**) and an element of the communications capabilities supporting portions of the U.S intelligence community and Federal civil agencies, such as **NASA** and **NOAA.** As the Director, **Comm-FIO**, I lead the team, which is charged to maintain and evolve the TCA to consistently — on a time cycle of roughly every two years — ensure that it provides a reasonable, affordable projection of the necessary evolution of the SATCOM capabilities available to U.S. warfighters, necessary to meet a realistic projection of future communications needs.

When I became one of the first Army officers designated as a **Functional Area 40 (FA 40)—Space Operations Officer,** I was already assigned to the Space Operations portion of the Defense Information Systems Agency (DISA). My designation as a *Space Operations Officer* did not change the details or responsibilities entailed with my then-current assignment; rather, it recognized my years of experience in the space arena and ratified the roles and responsibilities to which I was already assigned in the Space Operations elements of DISA.

### MSM

*How important is space support to today's warfighter in countering ever-evolving threats, all the while ensuring joint interdependence, and what various roles does it play in ensuring force success?*

### Colonel Rayermann

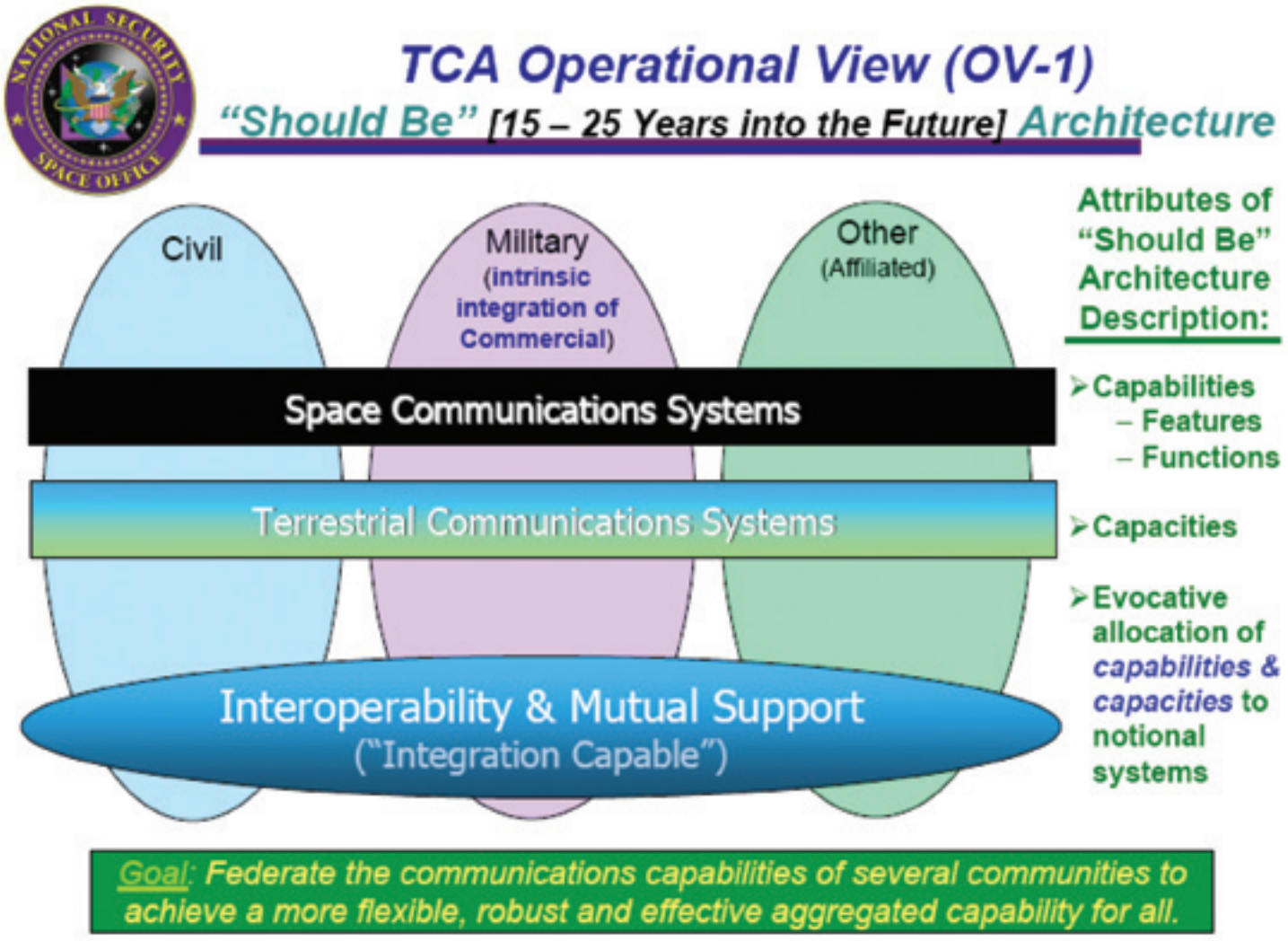
Space support has become a very beneficial tool in the warfighter's modern quiver that contains a broad range of capabilities. Space systems provide a number of capabilities, which are taken together and offer exceptional flexibility and global capability. It is important to recognize that, in spite of the advantages offered by space systems, U.S. forces continue to train to be prepared to operate should these capabilities be unavailable for any particular operational scenario. Having said this, these same capabilities have contributed to the growth of *Joint-ness* in the means by which the U.S. military conducts and plans to execute its various assigned missions and taskings. reconnaissance, weather, timing, navigation, terrain navigability, force protection and communications are mission areas where space makes substantial contributions.

### MSM

*I believe you initiated your space career as a high school student with the Jet Propulsion Laboratory in California. How did this lead to your command officer career in the U.S. Army? Isn't the Army path somewhat unusual for someone who wishes a career in the satellite environs?*

### Colonel Rayermann

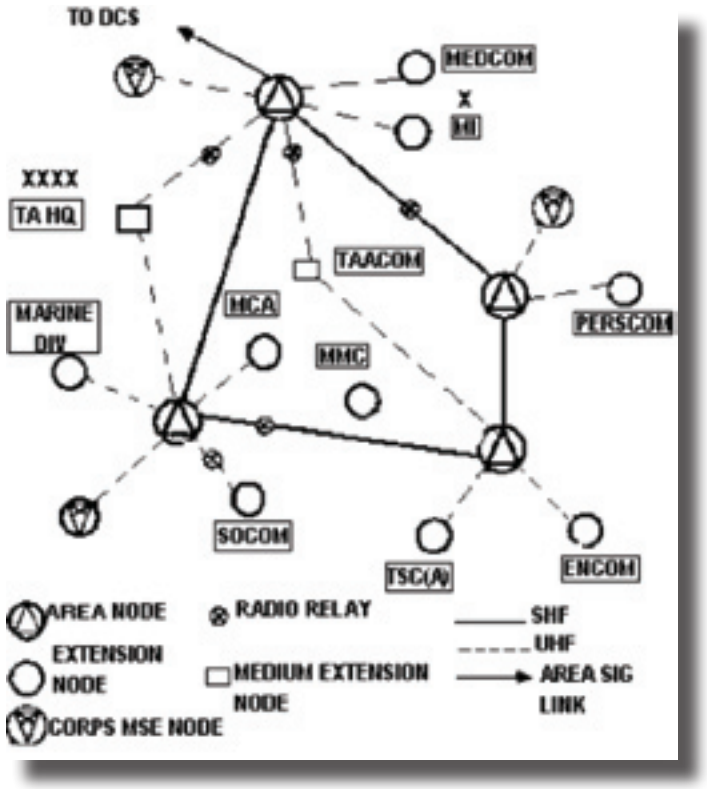
Hartley, you are correct... I first had the opportunity to pursue my interest in space technology and ex-




*Transformational Communications Architecture*

ploitation while I was in high school through a youth program sponsored by the Jet Propulsion Laboratory (JPL), and then as an employee of JPL itself. This opportunity did not specifically lead to my career in the Army; I had always had an interest in becoming an officer in the U.S. military, following the example of my father and many of my other ancestors.

However, we should note the important pioneering role that the Army filled in the 1950s in developing the nascent capabilities which led to the American space program and became a part of NASA as the decade of the 1960s began. It was an Army-developed booster that lofted the JPL-designed and built satellite, ***Explorer I***, which became America's first successful satellite at the end of January 1958. While the Army may be a somewhat unusual path for someone who is interested in the development and application of space capabilities, it is filled with precedent. Roughly a dozen Army astronauts have now flown in space as part of the Space Shuttle, MIR, and International Space Station programs.




***TRI-TAC Communications System***

### *MSM*

*Would you describe the TRI-TAC communications system and how it assisted with the Kurds in Northern Iraq in 1991? What is today's equivalent to TRI-TAC and what is that system designed to accomplish?*

### *Colonel Rayermann*

The **TRI-TAC** communications system was a multi-service set of communications capabilities which brought the first generation of interoperable digital communications to the Army and the Air Force during the 1980s. It provided the primary, high capacity (for that time) communications support to U.S. forces who executed ***Operations Desert Shield*** and ***Desert Storm*** as well as ***Operation Provide Comfort*** via U.S. forces that provided security assistance to the Kurds in Northern Iraq.

The current equivalent to TRI-TAC in the U.S. Army is the ***Warfighter Information Network-Tactical*** (**WIN-T**) program, which has already begun to field capabilities to Army soldiers and will continue to do so through a series of phased improvements over the next decade. WIN-T is designed to be the Army's battlefield/tactical portion, or tactical contribution, to the overall **GIG**. WIN-T is intended to provide a broader range of communications services than the TRI-TAC program was designed to do — today, for example, we have capabilities for the use of IP as a means of transport and video support to theaters of operation that were simply not available to deployed military forces when the TRI-TAC program requirements were defined in the mid-1970s.

### *MSM*

*You were the G3 of U.S. Army Space and Missile Defense Command, Army Forces Strategic Command, as well as the Chief of the Space and Missile Defense Division in the G3-/5/7. Could you tell us about your experiences in that role?*

### *Colonel Rayermann*

These positions were quite distinct. As the G-3 of **USASMDC/ARSTRAT**, I was basically the Chief Operating Officer for that Command with the responsibility of helping the Commanding General orchestrate activities. Those activities included research and development, the leadership and readiness of the Command's forces in its core mission areas of missile defense and space, as well as the Command's, then new

role as the Army Component Command to the new U.S. Strategic Command of presenting Army forces to **USSTRATCOM** in its mission areas. Those areas covered Global Command and Control; Space; Global Ballistic Missile Defense; Global Communications; Global Intelligence, Surveillance & Reconnaissance; Information Operations; Global Strike; and Combating Weapons of Mass Destruction. This role was challenging and exceptionally professionally rewarding. Personally, this was a job that was exciting and involved me in every area of significant personal and professional interests I have.

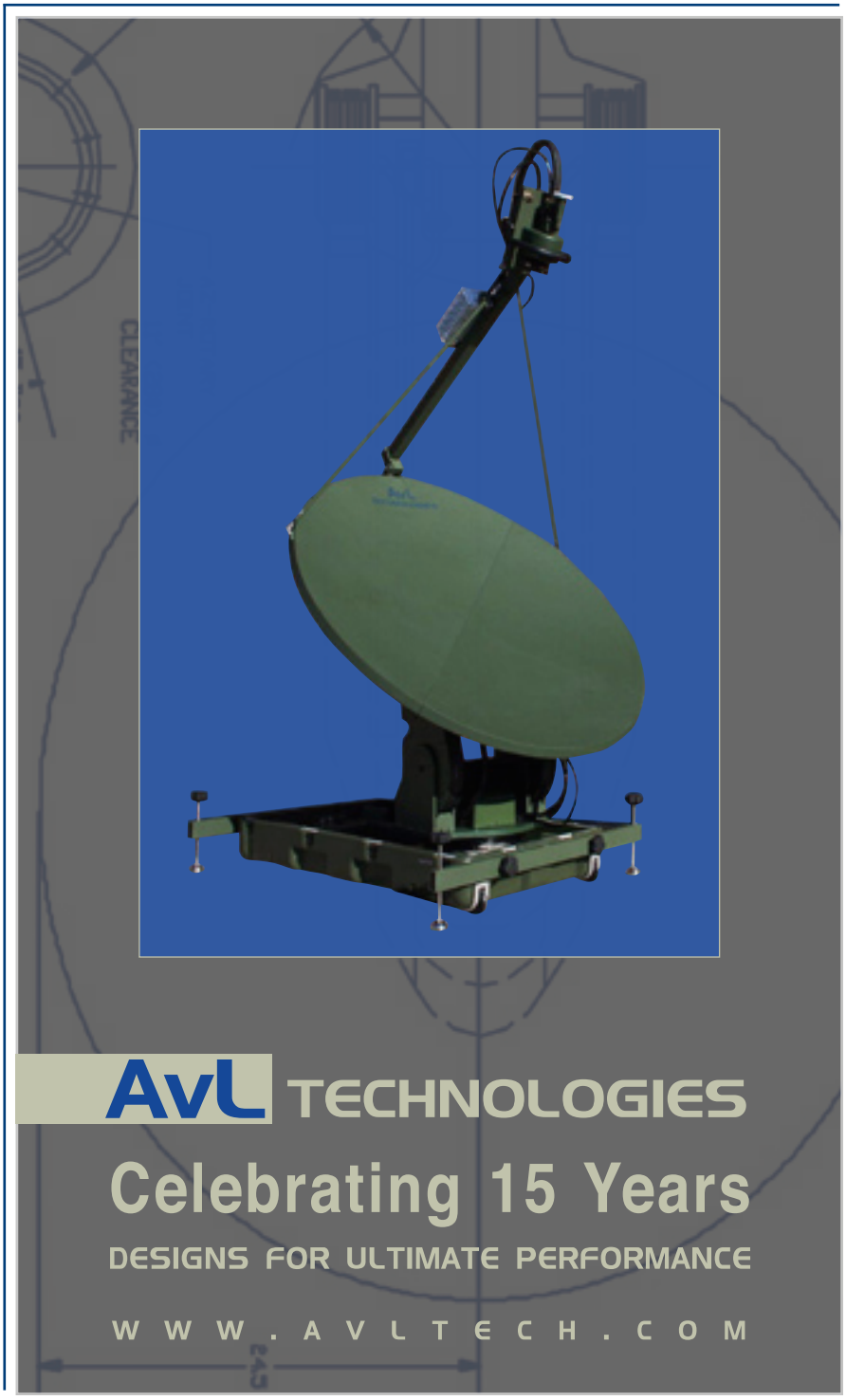
On the other hand, as the Chief of the **HQDA G-3/5/7 Space and Missile Defense Division**, I was responsible for representing the G-3/5/7 (or "chief operating officer") of the Army in space and missile defense matters; for working collaboratively with a broad range of stakeholders from across the Army to develop, gain approval, and articulate Army positions pertaining to the development, delivery, and doctrinal use of space capabilities; for recommending to the G-3/5/7 chain of command sound approaches through which the Army could explain and advocate for the missile defense and space capabilities it needs; and for coordinating with other stakeholders across the ***National Security Space*** **community** to help achieve a balanced, affordable plan which validated that the Army's needs for space capabilities could be met.

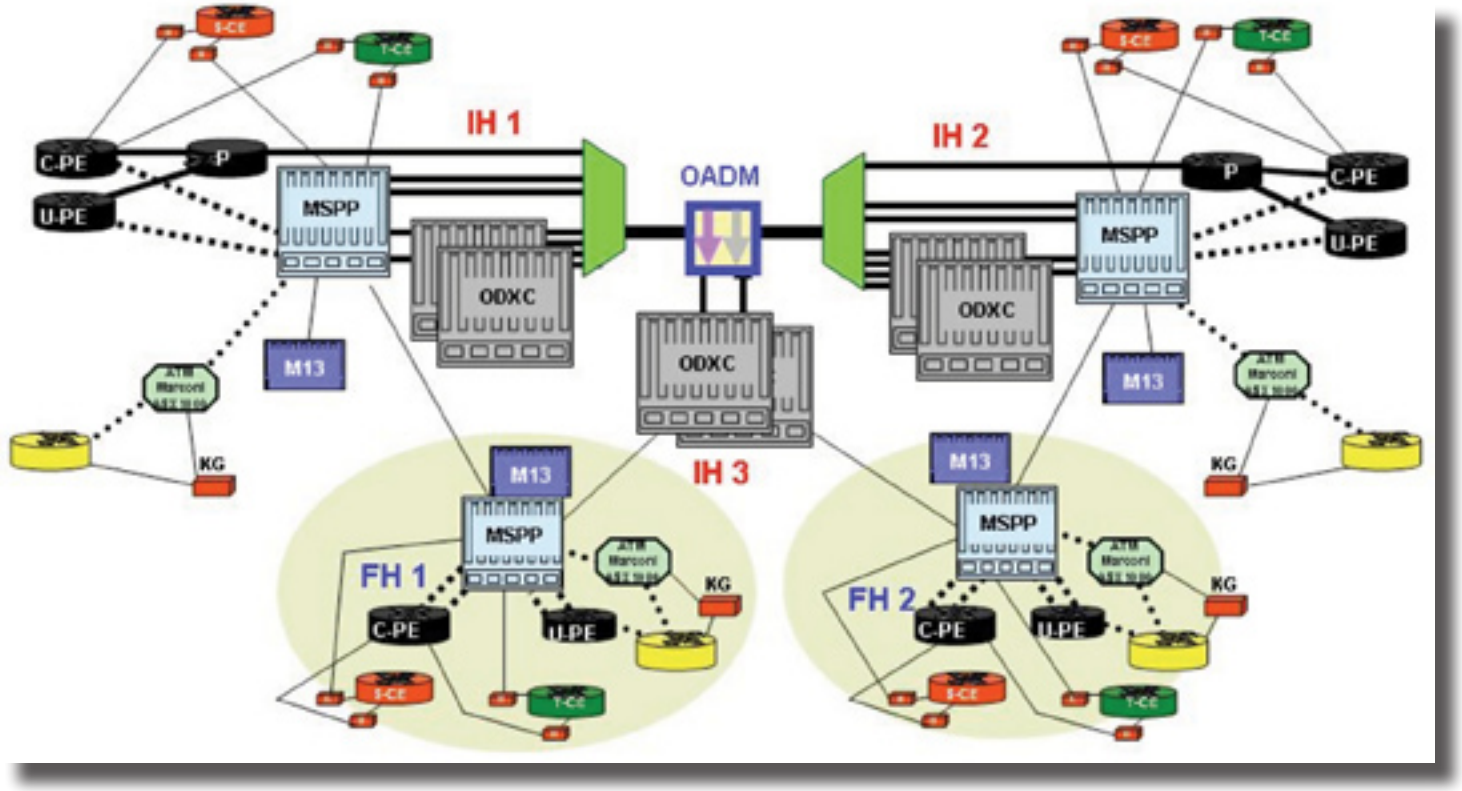
### *MSM*

*How did you become a member of the Army Space Initiatives Study? What was the goal and was it successful?*

### *Colonel Rayermann*

The Vice Chief of Staff of the Army, General *Maxwell Thurman*, recognized that the activation of **Air Force Space Command** and the formation of **U.S. Space Command** signaled a clear maturation of U.S. space capabilities in support of the U.S. military. He realized that the Army should consider — or at least evaluate — what its future role with regard to space capabilities should be. General *Thurman* directed the Army's Personnel Command to identify 30 officers who knew something about space to be formed as the ***Army Space Initiatives Study***. By coincidence, I had submitted my résumé at that time as part of a request






*Global Information Grid diagram*

that the Army identify me with the ***Space Activities Additional Skill Identifier*** (ASI), 3Y. Apparently, my experience at JPL and my availability made me an appropriate candidate to be one of the "**ASIS 30**." The goal of ASIS was to identify whether the Army should engage more actively in space matters and activities; if so, how and what programs and goals should the Army set for itself forecasting out about 25 years into the future. We fulfilled this goal, which permits me to assert that the ASIS was successful. Perhaps more appropriately, 24 years later, the crucible of history indicates that our work in ASIS turned out to be fairly accurate in about 30 percent of our prognostications — some amazingly so, while clearly "off the mark" in about 30 percent of our forecasts; and partially close while being partially off the mark in the remaining 40 percent. Overall, I believe upon reviewing our forecasts and the accuracy over time of similar efforts, a most respectable result.

## MSM

*In 2006, you were a member of the Future Land Imaging Interagency Work Group, a White House Office of Science and Technology department, which developed A Plan For a U.S. Land Imaging Program. Could you define the program and its goals? Were they successful?*

## Colonel Rayermann

I appreciate this question, Hartley. My opportunity to participate in the **FLI IWG** to help represent and articulate Army and DoD perspectives with regard to the sustainment of ***LANDSAT***-like capabilities came about somewhat accidentally; however, it was a tremendous experience and I remain humbled, as well as honored, to have been able to participate in it. I've never seen such a diverse group of individuals work as collegially and unselfishly as the team which comprised the FLI IWG did.

The goal of the FLI IWG was to craft a recommendation for how the U.S. could programmatically maintain a consistent, sustainable, affordable, and predictable program for mid-resolution imaging of the Earth's surface for the purposes of assured, sustained environmental monitoring. I believe our final recommendation achieved this goal and implementation of the overall approach recommended by the FLI IWG has begun.

### MSM

*GIG relies heavily upon SATCOM architectures... what technologies do you see as being primarily responsible for driving warfighter support over the next few years? How well are commercial companies addressing the needs of the military? Plus, sometimes the procurement processes for MILSATCOM equipment seems unending... are there any plans afoot to streamline this process?*

### Colonel Rayermann

The GIG relies on a number of differing technologies or phenomenologies. Ultimately, this is a strength — diversity yields robustness and adaptability. I believe that over the next four to five years, the increasing use of IP (as through the ***Joint IP Modem***) and the introduction of ***Dynamic Bandwidth ReAllocation*** ("**DBRA**" pronounced "Debra") will permit us to make more efficient use of the finite bandwidth resources available and will yield substantial improvements in our ability to provide affordable, essential communications throughput in support of our warfighters.

I believe commercial firms, manufacturers of spacecraft/space hardware and owner-operators of space systems, are addressing the needs of the military very effectively, responsively and with innovation. Quite frankly, industry is able to adapt, respond, and innovate, in most cases, more rapidly than the government. There are many reasons for this — some are good and some at least a bit frustrating; the key point is that appropriate awareness of industry capabilities coupled with appropriate, transparent business dealings with industry can foster opportunities for government individuals to incorporate commercial solutions as a part of their total tool set.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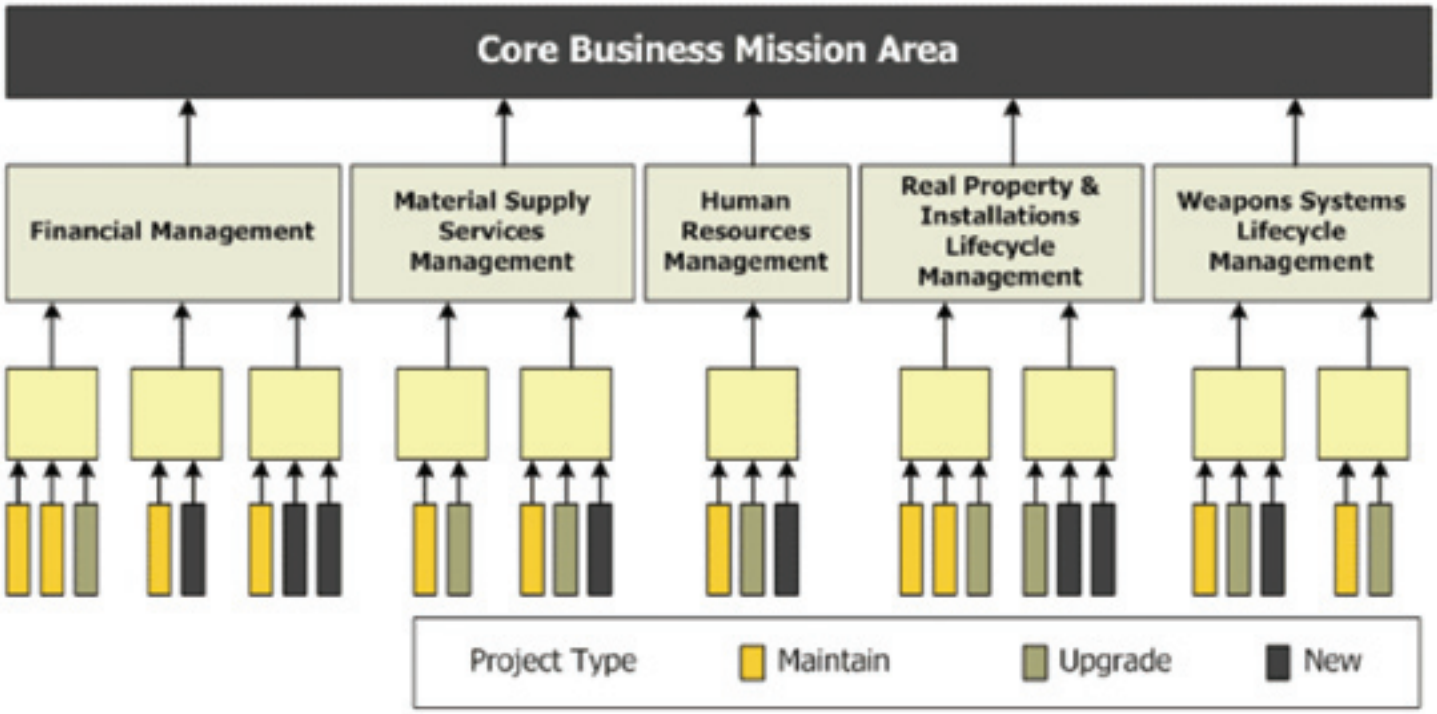


***DoD Project Portfolio by Mission Area example***

The procurement processes for MILSATCOM are not unique; they are governed by the same guidelines as all federal procurements and informed by the unusual challenges which space systems must address that terrestrial systems do not face. The **NSSO** has no direct influence regarding the DoD's acquisition processes; however, we can certainly advocate for the adoption of modifications or exceptions that make sense.

Overall, though, based on my own 20 years or so of experience with government acquisitions, I personally agree with Mr. *Tom Young*, Dr. *Ron Sega*, Lieutenant General *Mike Hammel* and other recognized senior acquisition professionals who have worked to restore DoD, and especially military space acquisitions to a firmer footing. These individuals have pointed out that we need to return to fundamental, basic principles in how we, in DoD, structure procurements; inculcate sound systems engineering into all of our developments and acquisitions; hold requirements to a firm baseline and allocate funds for acquisition efforts in total sums which cover the full costs. These costs must be rigorously estimated to be properly commensurate with the scope of the acquisition effort and the risk we are willing to accept in not achieving the performance and schedule set for the program.

### *MSM*

*Information access on the move is so important to ensure boots on the ground aren't simply slogging through more and more fog of war. Do you see nanotechnologies playing an important role in such applications in the future?*

### *Colonel Rayermann*

This is an interesting question, Hartley. I think it's reasonable to assess that to the degree we can miniaturize systems and reduce the power that is required for their operation, the more our mobile, tactical forces (especially individual Army and Marine combat troops) will be able to take advantage of them. This applies to SATCOM terminals — especially likely the future developments are in handheld communications terminals. Nanotechnologies offer some interesting possibilities in reducing the Size, Weight and Power [consumed/required] (a.k.a., "SWAP") but I am not able to predict how quickly the benefits of nanotechnologies may be applied to battlefield communications and information access systems.

### *MSM*

*I would imagine there must be a great need for interagency cooperation between all branches of the*

*services in regard to MILSATCOM projects. Do you find yourself at the NSSO working to ensure the communication links between the various services remain in place and working? What are some of the major "challenges" you need to confront to bring projects to fruition (other than Congressional budget hearings!).*

### Colonel Rayermann

Hartley, you've hit upon an area which is important, upon which we continually focus, and in which we can always improve. Communication and cooperation across all elements of the National Security Space community — Federal agencies, Congressional committees and industry — is essential. At the NSSO, one of our key roles is to foster and facilitate improving collaboration across all elements of the National Security Space community. Overall, we find that there is a tremendous spirit of cooperation within this community. However, even so, there are occasions where different members of the community have divergent needs and/or perspectives; there are also situations where miscommunications and misperceptions occur. Working to help the National Security Space stakeholders balance legitimately divergent needs, and ensure we are all communicating in a common way with uniform understanding, are two of the significant, recurring challenges we work to overcome.

### MSM

*You have a Master's Degree in Computer Resources and Information Management, as well as in Strategic Studies. What coursework would be recommended for students today who wish to become involved in the space environs? And how can we encourage our youth to become involved in this most crucial of sciences, rather than other, less relevant pathways?*

### Colonel Rayermann

This is an area of intense interest to the **NSSO** as well as to many senior leaders throughout our government and industry. I personally share their interest, having benefitted from some tremendous opportunities to learn and operate in the aerospace-space sciences fields when I was in my youth. In terms of course work, one always benefits from a firm foundation and developing a comfort with advanced mathematics — they will always serve you well — but never forget the basics of arithmetic. Beyond that, physics, applied physics, astrophysics, engineering, mechanical, applied and aerospace, chemistry, geology, and astronomy all come to mind. There are, of course, others. In most cases, people will benefit from having a firm technical foundation if they are going to work in the aerospace-space sciences arena.

I'm not sure that I would categorize all of the other potential career alternatives to one in aerospace and the space sciences as less relevant; there are very important fields of endeavor that have significant relevance to our society and our nation. However, we certainly would like to see far more young people becoming excited about and entering aerospace and the space sciences. This is a tough challenge. Certainly, I think there is a place for providing high school and college age young people with opportunities —such as I had — to work in a professional setting in these fields, to learn the joy and rewards of discovery; of building something new and unique; to build their assurance that they too have the innate intelligence and can develop the skills to become successful "rocket scientists," astronauts, or other space professionals.

A clear government commitment can help this process, but one can also argue that we have had a clear, robustly funded commitment to aerospace and the space sciences for decades, the NASA and military space budgets taken together are a significant investment. Perhaps we should strive to more clearly convey just how important aerospace, space sciences and science in general have become to our nation and to any society during the dawning of the Third Millennium. It seems as though this should be obvious to all, and yet somehow we are not "closing the deal" with an appropriate percentage of our young people.

One approach may well be to have more frequent, less costly programs so that an individual can envision being involved in at least four or five programs during the course of a professional career. Today, people who began working on the space shuttle program in 1969 or 1970 can retire having only worked on the shuttle program after a career of 38 to 40 or so years. This is an unusual case, but it is illustrative. In the decade of the 1960s, people worked on three generations of manned spacecraft in one 10-year period: there were constantly new challenges and new opportunities. Having proven your mettle and gained experience on one program, you could move on to another in a new capacity building upon your previous experience.

We'll probably never return to the pace of 1960s when it comes to the advent of new programs, capabilities and challenges. But perhaps if we adjust our paradigm a bit, we can more clearly craft distinct new challenges and opportunities to be available every five to 10 or so years, and this doesn't have to be exclusively with manned space, with spacecraft, with launch vehicles or with scientific sensors — maybe we achieve this kind of opportunity set by a prudent mixing across the full scope of the aerospace and space sciences fields.

### MSM

*What are the most concerning challenges for the U.S. Army and the Department of Defense in both tactical and strategic levels, and what policies will ensure our nation remains the leader in warfighter superiority? Are shrinking budgets for the military going to affect the long-term viability of our services?*

### Colonel Rayermann

I am not in a position in which I can authoritatively address this set of questions as thoroughly as you would prefer. Fundamentally, the Army, the other services, and the DoD remain committed to developing, training and equipping the most capable military which can affordably meet the guidance provided to our military by our nation's leaders in the Executive and Legislative Branches. We continually work to understand what current and potential future threats to U.S. citizens and our nation are, and to properly prepare ourselves to deter and, if necessary, defeat them. We work to do so in ways that both communicate and are consistent with our ethical values as a people.

I believe if one examines U.S. history, one will find that there has been an amazing degree of consistency from our political leadership in guiding, prompting and supporting appropriate policies, guidance and military preparations to preserve our Nation and protect American citizens. I don't foresee this changing but I also do not have the prescience to describe what the policies for the future should be. The affordability of the activities of the Federal Government, although not explicitly addressed in the U.S. Constitution, has always been a responsibility of our Executive and Legislative Branch leaders. It is fundamental. A successful, robust, vibrant economy is one of the cornerstones of our success and strength as a nation. We cannot have military security without economic security.

Due to a variety of factors — more today than a year ago — it seems almost certain that the amount of National Treasury (taxes) that are directed towards the U.S. military will decrease over the next few years. The key here is for the National Security community in our nation to honestly and incisively assess the potential threats to the U.S. and to craft force structures that are innovative coupled with systems and doctrines to deter and, if necessary, to defeat those threats. We must also support our nation's leaders in assessing how to prudently prepare our military consistent with these constructs in a manner that our nation can afford as it also expends our citizens' tax dollars to meet the many other challenges and opportunities before us.

### MSM

*Thank you, Colonel. Please know how much we appreciate your insight. Best of success to you...*

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## SatCom For Net-Centric Warfare

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# ON TARGET
# SIPR TO THE SOLDIER

*by Jim Sprungle and John R. Lane*

**The U.S. Army is currently deploying its fourth generation *Time Division Multiple Access* (TDMA) satellite communications terminals to Warfighters supporting the global War on Terror (GWOT). The *SIPR/NIPR Access Point* (SNAP) terminals are *Very Small Aperture Terminals* (VSATs) using *commercial-off-the-shelf* (COTS) equipment to provide secure *beyond line of sight* (BLOS) communications to battalions and below.**

Until recently, ***SIPR*** was only available at the brigade and above level and has been moving downward in the force structure during recent years through technology advances. This need to provide reliable secure BLOS communications to even smaller maneuver units has been driven by the need for smaller highly equipped units operating in very remote locations. No where is this more evident than in the mountainous terrain of ***Afghanistan***. The SNAP VSAT is highly transportable and sets up quickly to provide multi-megabit connectivity to provide a wide array of broadband services via NIPR and SIPR including access to encrypted voice, video and imagery data. The capability of warfighter access to both NIPR and SIPR using a single shared satellite carrier provides robust throughput while conserving bandwidth resources, which are very costly using the commercial satellite fleet. Now let's examine some of the history regarding SATCOM terminal advances over the recent years.

As early as 1996, the ***Commercial SATCOM Terminal Program*** (**CSTP**) began providing DoD and other Government users with access to a full spectrum of commercially available SATCOM services and products such as fixed, deployable, VSAT and mobile terminals. This rapid acquisition program is intended to augment current and emerging SATCOM needs with cost-effective commercial solutions. Depending on customer needs, terminals are appropriately sized for data transmission requirements and network interoperability. Terminals can be delivered and installed at worldwide locations and fielding support can include training, spares as well as operation, maintenance, and logistics support services as required. The CSTP team has successfully fielded commercial SATCOM terminals around the globe including Asia, Europe, and Southwest Asia.

The first widely used commercial terminal fielded by CSTP was the ***Deployable Ku-Band Earth Terminal*** (**DKET**). More than 75 of these systems are operating around the world and provide intra-theater and reach back connectivity for U.S. CENTCOM's satellite network. These terminals provide up to 80 Mbps of throughput using traditional ***single channel per carrier*** (**SCPC**) technology, they are fairly large and therefore used for strategic communication links, or as hubs, for the SNAPs and other VSATs. With these larger systems, each link had to be sized to accommodate the potential maximum throughput needed and, thus, not very bandwidth efficient. A more highly deployable and bandwidth efficient solution was needed.

As a result of ***Operation Enduring Freedom*** (**OEF**), the Army identified a need for a BLOS communication system capable of providing increased throughput for battalions deployed over a more widely dispersed geographical grid than was possible with the ***Mobile Subscriber Equipment*** (**MSE**) and other traditional Army communications systems. A new COTS system based on TDMA was developed and integrated using portable 1.5 meter and 2.4 meter flyaway antennas. The ***Interim Ku-Band Satellite System*** (**IKSS**) was designed as a battalion enabler, improving network connectivity from the brigade down to the battalion. The **3/2 Stryker BCT** took this system into Iraq in 2003. It received high marks for improved bandwidth.

The next step in the Army's digital transformation came in 2004 with the design of the ***Satellite Transportable Terminals*** (**STT**) for the **3rd Infantry Division** (**3ID**) for use in the ***Joint Network Node*** (**JNN**) ***Network***, now known as the ***Warfighter Information Network – Tactical*** (**WIN-T**) ***Increment 1***. The STT is a trailerized 2.4M Ku-band (soon to be upgraded to Ka-band) satellite terminal with on-board ***Environmental Control Units*** (**ECUs**) and generator, designed to be a towed ***Highly Mobile Multi-Wheeled Vehicle*** (**HMMWV**). JNN provides voice-over-IP and dynamic IP technologies and systems to provide direct reach back capabilities to higher command and/or strategic locations using FDMA and TDMA technology. The STT can provide up to 6 Mbps FDMA satellite communications in addition to the 3-5 Mbps

TDMA shared carrier. Four transit cases support the user interfaces into red and black voice networks, network and management service components, and ***Voice over Internet Protocol*** (**VoIP**) phones with access to both NIPR and SIPR. Since 2005, all Army divisions have been and/or are scheduled to be outfitted with JNN, with over 900 STT fielded to date.

Small forward operating units require more highly mobile solutions than JNN's vehicular based equipment. As a result, CSTP has fielded small quantities of VSATs that provide SIPR and NIPR access to Army users in OEF and ***Operation Iraqi Freedom*** (**OIF**). These transit cased VSATS included ***SIPR Point of Presence*** (**SPOP**), ***Provisional Reconstruction Team*** (**PRT**) and ***Military Transition Team*** (**MITT**) terminals.

The ***SIPR/NIPR Access Point*** (**SNAP**) VSAT is the first transportable satellite terminal designed for operation over **DoD**'s ***Wideband Global SATCOM*** (**WGS**) satellites in addition to Ku-band operation on commercial satellites. In response to this requirement for highly portable and interoperable tactical communications, **TeleCommunication Systems, Inc.** (**TCS**) of Annapolis, Maryland, has designed and manufactured the ***Swiftlink SNAP*** (**SIPR/NIPR Access Point**) ***Suite*** of deployable satellite communication products. SNAP is derived from the Company's highly-acclaimed ***Swiftlink*** family of deployable communications products that have been field proven special operations community over several years. The Swiftlink SNAP Suite provides the robust scalability and unparalleled flexibility necessary to bring the latest state-of-art technology to Warfighters.

The Swiftlink SNAP suite provides interoperability among three different SATCOM terminals utilizing three different frequency bands — Ku-, Ka- and X-band — and three interchangeable baseband solutions to provide the Warfighter with compact, lightweight, highly flexible NIPR/SIPR communications packages while still providing a common logistics tail. The SNAP products were designed to have the maximum ability for interoperability with Army and Joint users in any existing or planned networks. The Swiftlink SNAP suite maximizes network access with five interchangeable modem solutions to address custom needs. The SNAP terminals were designed to accommodate a range of commercial modems including ***Viasat S2*** modems uses by PM WIN-T Increment 1, ***iDirect Infinity*** modems used by the ***Special Operations Forces*** (**SOF**) community and prewired for **NCW** modems or any future commercially available modem. Operating in point-to-

***TCS offers two standard SNAP VSAT terminals featuring a unique pack-in-the-box pedestal design that is lightweight with fewer moving parts.***

point, hub and spoke, and full mesh configurations, the Swiftlink SNAP suite supports communications objectives ranging from special operations to traditional Warfighter maneuvers.

The TCS SwiftLink SNAP systems provide multimedia communications capabilities for encrypted voice, video and imagery data. TCS SwiftLink products are highly transportable and ruggedized, with a graphical user interface that greatly simplifies the set-up and operation of the system. The modularity and "plug and play" interfaces between all RF and baseband configurations inherent in the SwiftLink provide a tailored, and cost effective, solution for every mission.

The Swiftlink SNAP's highly flexible module design offers 64 unique configurations in a compact, lightweight, and user-friendly system tailored to satisfy that user's unique requirements.

"Our SwiftLink SNAP solution is the newest and most capable VSAT deployable system available to the Department of Defense," said *Michael Bristol*, senior vice president of government solutions for TCS. "To successfully work with, train and advise the Allied security forces, it is critical that our U.S. troops have the technology and support necessary for secure and reliable communications, regardless of their technology expertise. Our VSATs are designed to enable General Purpose Users to quickly set up and access broadband satellite services for mission-sensitive communications. There is no need for highly trained SATCOM users to operate our SNAP solution in today's Army."

TCS is well positioned to support the Army's Logistics requirements for terminals currently fielded in CONUS, Iraq, and Afghanistan. SNAP terminals have robust logistics support packages to include ***Contractor Field Service Representatives*** (**CFSRs**), onsite training classes, spares and online training sessions. In addition, each SNAP terminal is fielded with RF spare parts and a ***Forward Deployed Depot Spares*** package is provided for a network of terminals. TCS has established an in-theatre depot center with SNAP technicians and engineers stationed at Camp Victory, Iraq, to provide regional repair and technical support.

TCS has conducted numerous classroom training sessions in both **CONUS** and **OCONUS** locations over the last 12 months. To augment new equipment training, TCS has developed an interactive Web Based Training (WBT) website that allows the military access to training sessions for product refresher or new user training. The WBT allows the military to "attend" a training session in remote areas without traveling to a formal classroom, or waiting for a formal instructor-led classroom session. The WBT provides a self-paced, interactive, objective-based way to teach the students about the system. Further stimulus is that the WBT uses both graphics and flash animations to provide a system overview, equipment descriptions, and details on installation, operation, troubleshooting and maintenance of the system. MSM

*About the company*

*TCS is delivering SNAP systems at a robust pace at its 45,000 square foot manufacturing center in Tampa, Florida. The SNAP Program has a contract potential of up to 1,500 terminals and 30 Field Service Representatives. TCS has also implemented manufacturing surge capacity and 24 hour built to print service for urgent delivery schedules. Since 1987, TCS has produced wire-*

TCS TeleCommunication Systems
Enabling Convergent Technologies®

*less data communications technology solutions that require proven high levels of reliability. TCS provides secure deployable communication systems, wireless and VoIP E911 network-based services, engineered satellite-based services and commercial location applications using the precise location of a wireless device. TCS Swiftlink products are designed for highly reliable, on-the-move and on-the-quick halt secure communications in some of the world's most hostile and remote locations.*

*About the authors*

*Jim Sprungle is the Senior Director, TCS, and he attended the U.S. Naval Academy and served as a*

*Communications Officer in the Surface Navy for six years. After leaving active duty, Mr. Sprungle worked for Verizon Communications for three years designing network infrastructures. For the last eight years, Mr. Sprungle has worked at TeleCommunication Systems (TCS) as Senior Director of Government Programs and Global Logistics.*

*John R. Lane has worked in SATCOM for the Army since 1992 and he is currently the Project Leader of the Commercial SATCOM Terminal Program manager, with a team of 12 professionals. He has 25 years of experience in military communications. Prior to joining the government in 1989, John worked as a Senior Engineer with Computer Science Corporation for six years, where he was a consultant on various military communications programs.*

# ON TARGET
# MEETING THE WARFIGHTERS' GROWING NEEDS

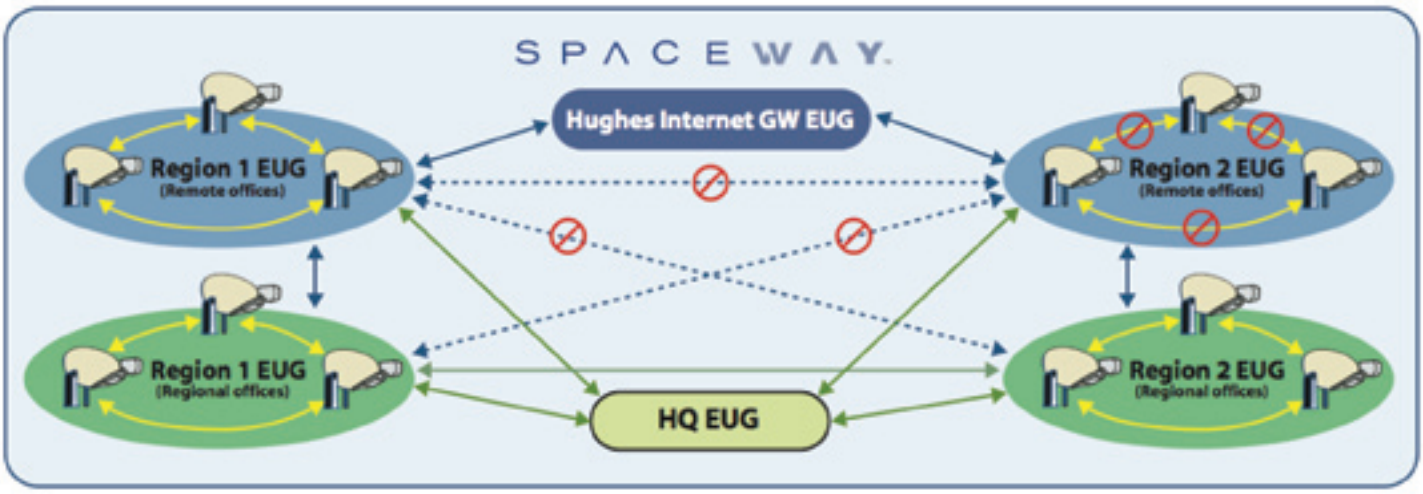
*by Rich Lober, G.M., DISD, Hughes Network Systems*

**The men and women of today's U.S. military, whether serving as active duty, reserve, or in civilian support roles, are the heroes that protect America's people, ideals, and interests at home and abroad. They face key operational and mission-focused challenges: fighting the wars in Afghanistan and Iraq, expanding the Department of Defense's (DoD) role into homeland security, and undertaking substantial efforts to transform DoD's forces and infrastructure into a 21st Century military enterprise. A key component of meeting each of these challenges is ensuring that the warfighter has leading edge satellite broadband communications solutions to fulfill mission requirements.**

***Commercial-Off-The-Shelf*** (**COTS**)-based satellite communications solutions add to the speed, ubiquity, flexibility, and security of the net-centric enterprise and development of the ***Global Information Grid*** (**GIG**). Most importantly, COTS-based solutions ensure that whether on the ground in *Afghanistan*, in international air space or managing operations from the Pentagon, the warfighter remains connected — receiving and sharing the information needed to safeguard U.S. interests.

**Hughes** has a long history as an innovator in satellite broadband technology, having invented ***Very Small Aperture Technology*** (**VSAT**) networks more than 20 years ago. As the leader of Hughes DISD activities, I am providing information about how to incorporate satellite broadband COTS solutions into the strategy for net-centricity — meeting the immediate needs of the warfighter and the broader vision of developing the GIG. Implement common platforms for fixed and mobile applications. The battlefield of today is the mountains of *Afghanistan*, the rough terrain that borders *Pakistan*, the desert of *Iraq*, and small, rural communities throughout these countries. ***Communications-On-The-Move*** (**COTM**) are essential for mission success, providing the line of site and ubiquitous service that ensures that our soldiers can access needed intelligence from their command and report activities on the ground. In the case of emergency medical needs, a soldier's life may be saved in the "golden hour" following injury using satellite applications — if on site medical personnel have access to transportable satellite solutions to communicate details to locations far away from the battlefield.

Using common SATCOM technology for fixed and mobile applications ensures uninterrupted connectivity, enhances interoperability, and adds to the security of communications. For example, the ***Hughes HX System***, a *FIPS* compliant, Internet Protocol (IP)-based network, can be configured to provide ***Quality of Service*** (**QoS**) tailored to each individual terminal. The HX System bandwidth allocation scheme for managing traffic requests reallocates bandwidth based on inactivity, freeing up unused bandwidth and allowing an operator to make more efficient use of space segment resources.



The system is unique in that it may be used for fixed, ground mobile, shipboard and airborne applications all using the same HUB equipment and core modem. It also utilizes advanced adaptive coding algorithms to yield one of the most bandwidth efficient systems on the market today. Implementing common technology across platforms has the added benefit of enabling the DoD to leverage the buying power of the government to obtain best value. Above all, standards based, COTS solutions such as DVB-S2 ensure that the warfighter is always connected.

The latest generation satellite technology, such as the Hughes ***SPACEWAY®3*** system, employs on-board traffic switching and routing, resulting in single-hop mesh connectivity among multiple sites. This yields dramatically improved flexibility to dynamically configure any networking topology — with minimum transmission delay and maximum security. Specific sites can be readily assigned to defined groups that are governed by strict rules enabling or prohibiting connectivity.

The ***Defense Information Systems Agency*** is studying this issue, and recently developed a *Cooperative Research and Development Agreement* (**CRADA**) with Hughes to study ***Network Centric Enterprise Architecture*** validation of IP networking with the ***Regenerative Satellite Mesh*** (**RSM-A**) standard and the SPACEWAY® 3 system. Under this CRADA, Hughes and DISA will perform research and development that supports overall IP convergence as the basis for seamlessly integrating DoD SATCOM networking and information needs with the GIG.

I encourage other DoD components to incorporate mesh architectures into near-term and future net-centric planning whether they be through the use of a processing satellite such as SPACEWAY 3 or

through adaptations of conventional satellite systems, such as the Hughes HX System.

Consistent, reliable communications is the backbone of mission success. As the DoD creates the GIG and identifies the key components that form the framework of true net-centricity, it is important to be able to ask: "how easy is it to configure?" "Is it all working?" And…"how do we know?"

With tight budgets and the need to pare down priorities, it might be easy to overlook the need to improve network management software as a key element of developing the GIG. Instead, I would suggest that network management software is critical to improve network operations, monitor the status of network capabilities, and fix network problems before an unnecessary glitch or network failure negatively impacts the warfighter. Lessons can be learned in this area from commercial SATCOM operators such as Hughes, who manages over 600,000 customer sites from a single network operations center in the U.S. and others.

Meeting mission objectives with tight budgets while maintaining our increasing need for global military presence, demands that DoD seize every advantage. COTS-based satellite broadband solutions present a remarkable advantage, arming the warfighter to protect and defend the U.S. while ensuring their own safety — anytime, anywhere — through enhanced communications. As net-centricity continues to evolve and the DoD expands the GIG, COTS-based satellite broadband solutions must be a key piece of that foundation. MSM

*About the author*

*Rick Lober is Vice President and General Manager for the Defense and Intelligence Systems Division (DISD) at Hughes Network Systems. He may be reached at...*

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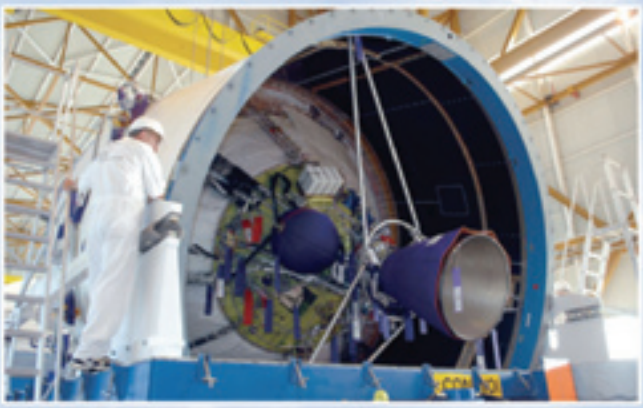

**The Heart of the Satellite**

A look inside SPACEWAY 3 reveals a dazzling array of complex equipment. Key components are:

- **Bus**. This is the engine of the satellite, which maintains the orbital position and provides the basic services necessary to operate the payload. These include propulsion, power generation and storage, and thermal control.
- **Payload**. This is the communication system, or cargo, of the satellite. It consists of the uplink antenna, switch matrix, digital signal processor, 10 Gbps fast packet switch, and downlink phased array antenna.

# BRIEFING
# ISCE 2009 SATCOM CONFERENCE IS REVEALING

**The Military — NGOs — First Responders — Government Agencies — all require secure and viable access to SATCOM solutions in order to respond to their crucial missions with success. Such is becoming increasingly difficult to ensure — SATCOM environs continue to change as new technologies and new processes are brought into play, capacity is hard to acquire, and increasing costs can play havoc with budgets. How can one update their knowledge as to these changes, quickly and effectively?**

- *Review of CEM® program requirements (experience, education, professional contributions and more)*
- *Explanation of the Associate Emergency Manager program requirements; application procedures, and tips for successful program completion*
- *An overview of the CEM® / AEM exam, the standards upon which the exam is based, sample exam questions along with a Q&A period*

One path to an updated understanding of changing environments is the **ISCe 2009** event ***SATCOM Solutions For Military and Civil Agencies in a Changing Environment***. This conference is going to be conducted from June 2nd through June 4th at the fabulous **San Diego Marriott Hotel and Marina** in San Diego, California. Co-sponsored by the ***International Association of Emergency Managers*** (**IAEM**) and the ***Global VSAT Forum*** (**GVF**), the venue is also the home for the ***3rd Annual Navy Commercial SATCOM Users Workshop***.

This year, there are special pre-event training workshops presented on Monday, June 1st. **Workshop A** is ***Communications for Disaster Relief and Emergency Management***, which will be offered from 9:00 a.m. to 5:00 p.m. with emphasis on...

The instructor is *Nick Crossley*, the CEM Commissioner. Additionally, two certifications will be offered by the IAEM, those being the Certified Emergency Manager (**CEM**) and the Associate Emergency Manager (**AEM**).

**Workshop B**, also a full day session, is focused on ***Satellite Technology and Networks*** and is presented by ***UCLA Extension*** and ***Application Technology Strategy, Inc.*** (**ATSI**). Presented will be the fundamentals, applications, and approaches for satellite networks used in military and civil government environs. Presenting the course is *Bruce Elbert*, MSEE and MBA, President of ATSI. Those attending will receive information regarding…

- ***How a satellite provides communications links to typical Earth stations and user terminals***
- ***The various technologies used to meet requirements for quality of service and reliability***
- ***Basic characteristics of modulation, coding and Internet Protocol processing***
- ***Networking challenges unique to satellite systems and how these can be overcome***
- ***How satellite links are used to satisfy requirements of the military for mobility and broadband network services for warfighters***
- ***The characteristics of the latest U.S.-owned MILSATCOM systems, including WGS, MUOS, AEHF, and the approach for using commercial satellites at L and Ku bands***
- ***State-of-the art approaches for emergency communications through commercial satellite systems at L, C, Ku and Ka bands***

The conference will be presenting VIP speakers in the mornings, at breakfast, and a number of intriguing sessions to follow each day:

## *Tuesday, June 2*

***10:30 a.m.***

**Civil I**

- ***SATCOM Solutions Helping to Overcome the Toughest Challenges for Emergency Management***

**Military I**

- ***Hosted Payloads: Cost-Effective Solutions for Government Requirements in Space Session***

***1:30 p.m.***.

**Civil II**

- ***Integrating SATCOM with Terrestrial Networks to Meet the Needs and Requirements of National Civil Agencies***

**Military II**

- ***Ground Systems and the End User — Networked Mobility and Portability***

***4:00 p.m.***

**Closing Plenary Session**

- ***Telcom and SATCOM: Key Tools for Reconstruction and Nation-building***

***5:30 p.m.***

- ***Evening Reception, hosted by SSPI***

## *Wednesday, June 3rd*

***9:00 a.m.***

**Plenary Panel**

- ***Interview with Military Leaders: Effective SATCOM for Military Users: Accomplishing the Mission within Fiscal Realities***

***11:00 a.m.***

**Civil III**

- ***SATCOM Technologies to Facilitate Broadband Mobile Applications for Civil Agencies***

**Military III**

- ***Advanced MILSATCOM Systems Update: 2010 and Beyond!***

***1:30 p.m.***

**Civil IV**

- ***Ku- and Ka-band Terminals, Systems and Solutions for Civil Agencies***

**Military IV**

- ***Combatant Command's Perspectives***

***3:30 p.m.***

**Closing Plenary Session**

- ***New Administration, New Priorities: What's the Impact on the Industry from New/Modified Federal Requirements?***

***5:30 p.m.***

- ***ISCe Awards Dinner and Reception***

***Select the graphic below for more information.***

# BRIEFING
# SATCOM ADOPTION BY THE MILITARY

**The opportunity to speak, albeit briefly, with the Director of Engineering for iDirect Government Technologies, Mr. *Karl Fuchs*, was most informative. Here is the gist of the conversation...**

### MSM
*SATCOM is becoming widely-deployed by government and military organizations. Where do we stand today with military adoption?*

### Karl Fuchs
Two-way satellite IP networks have become the standard communications infrastructure relied on daily by military organizations. We've reached a point where SATCOM has become ubiquitous for all forms of military communications. Currently, the military uses SATCOM to support a wide range of critical applications including logistics, morale and welfare, command and control, and even UAV video transmissions.

### MSM
*What are some of the current trends you have noted in military SATCOM?*

### Karl Fuchs
One of the biggest trends in military communications currently is developing high portability, low profile applications for high-speed satellite connectivity. It used to be that one device was responsible for connecting up to 100 soldiers. Now the trend is personalizing these services and bringing broadband capabilities closer to each individual soldier. Other new trends include telemedicine applications, Comms on the Move technology for military aircraft, and fully rugedized mobile hubs.


Mission Critical Remote Communications

When having the right information is critical to operations, you can't afford to settle for anything less than iDirect Government Technologies (iGT) broadband capabilities. With iGT you can provide the best service and support for all voice, video and data applications anywhere in the world, with the highest VSAT data rates. The iGT VSAT solution is an easy to deploy fully encrypted solution that can support all of your mission requirements with high network availability.

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### MSM
*How is SATCOM being brought to individual soldiers?*

### Karl Fuchs
The technology is progressing toward field units capable of fitting in a soldier's rucksack. These units would use a very light bidirectional antenna for voice, video and data connectivity during battlefield operations. For example, soldiers would have the ability to receive battlefield imagery that identifies potential threats, transmit video of a situation back to base, or receive command and control information. Using a deployable field network, medics on the battlefield can even transmit x-rays and imagery of a wounded soldier back to doctors who can interpret the injury and advise proper treatment.

### MSM
*How has the satellite technology used in field deployable networks become more durable?*

### Karl Fuchs
Dedicated comms vehicles using mobile hubs is nothing new. However, some of the older equipment was prone to a decreased life span as a result of rust, excessive jostling, and extreme conditions. Today, new ruggedized hubs are being built to last much longer with corrosion-proof stainless steel casing and components with increased temperature tolerance to withstand harsh environments. A fully ruggedized mobile hub can be transported to support SATCOM anywhere in the world at a moments notice. This allows the military to be more autonomous and avoid relying on fixed hubs operating from distant areas.

### MSM
*How is current SATCOM technology able to support all of these simultaneous applications while meeting military-level security requirements?*

### Karl Fuchs
On a military network, quality of service rules must be designed to ensure that mission critical voice, video and data is delivered with high fidelity and that only the lowest priority data is subject to degradation. Technology breakthroughs are enabling engineers to reconcile data security requirements with quality of service priorities for military networks.

This is so that the high-priority traffic designation, required for mission critical communications, can be recognized by advanced encryption devices. MSM

*Karl G. Fuchs is Director of Engineering for iDirect Government Technologies (iGT). Fuchs leads iGT's team of federal systems engineers and serves as chief architect for new product integration as well as the chief technical resource. Fuchs has more than 15 years of experience and accomplishments in the areas of technology and the federal government. Prior to joining iGT, Fuchs was Director of Systems Engineering at Nortel Networks serving the Verizon account team where he lead a team of Systems Engineers designing IP, Frame Relay, ATM and DWDM networks. Before joining Nortel Mr. Fuchs designed IP and ATM networks for Sprint and the Federal Government. To email Karl, select his photo.*

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