# Satellite Times®

A publication of Grove Enterprises

$3.50 US
$5.75 CAN

Volume 3, Number 5 May/June 1997

# DEEP BLACK

## *ST Looks at America's Military Space Programs*

# Swagur
## ENTERPRISES

Swagur Enterprises
P.O. Box 620035 • Middleton, WI 53562-0035
Phone/Fax 608-592-7409
Web page at: http//www.execpc.com/~swagur/
E-mail: swagur@execpc.com

**PRODUCT PRICE LIST:**

| | |
|---|---|
| SuperSwagursat | $275.00 |
| Swagur-Amp-L | $225.00 |
| Bias T | $80.00 |
| Bias T with amplifier | $125.00 |
| Swagur-Horn-C | $120.00 |
| Swagur-LA | $130.00 |
| OFS Weather-FAX | $445.00 |

S&H $8.75 ($25.00 foreign)

**SuperSwagursat designed for owners of ICOM R7000, R7100 & R8500 receivers. It produces superb weather pictures and voice.**

Satellite Times

Cover Story

*Cover Photo: A Titan IV emerges from its own billowing cloud of smoke and fire, heading into the dark skies above Vandenberg Air Force Base, Calif. on December 5, 1995, carrying a Crystal photo reconnaisance satellite into orbit. (Lockheed Martin Astronautics)*

## Deep Black

**By Philip Chien**

Since the Cold War is over, and the Russian civilian/military space programs are mere shells of their former presence, many Americans wonder what is the status of the U.S. military space program. Author Chien takes an in-depth look at the U.S. government's secret space program in part one of Deep Black. Story on page 10.


Vol. 3, No. 5

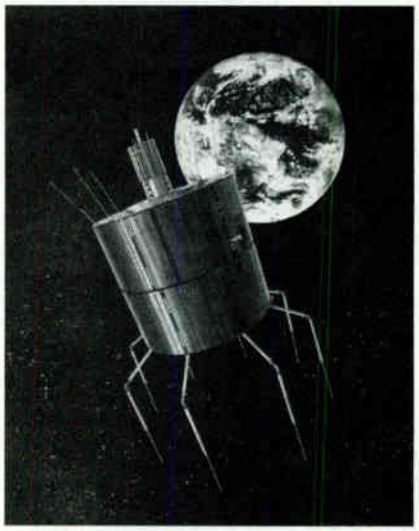
CONTENTS

May/June 1997

## Granddaddy Longlife

**By Philip Chien**

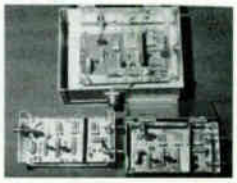
How long do communications satellites last—five years, ten years, more? Read about a communications satellite that has been in service for nearly three decades. Story begins on page 16.



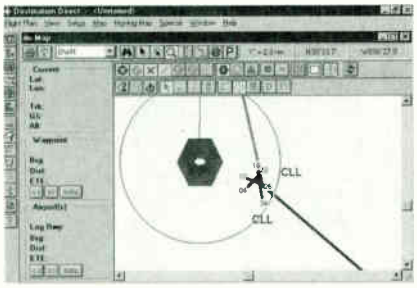
## Monitoring Meteor Activity by Radio

**By Bill Black**

With the firestorm of Leonid meteors expected sometime in the next four years, amateurs all over the world are looking for ways to monitor the event. One way to accomplish this task is via radio. Master meteor monitor Bill Black examines ways to hear this event and the available resources in his feature story on page 22.



## DEPARTMENTS



*Global Position System technology has become a useful tool to just about anyone who travels the vast expanses of the great outdoors. Aircraft pilots probably stand to benefit the most from this technology. Haskell Moore looks at a new product for the pilot from Delta Technology in the ST Test starting on page 68.*




ST

*SATELLITE TIMES* (ISSN: 1077-2278) is published bi-monthly by Grove Enterprises, Inc., Brasstown, North Carolina, USA.





**Address:** P.O. Box 98, 7540 Highway 64 West, Brasstown, NC 28902-0098
**Telephone:** (704) 837-9200
**Fax:** (704) 837-2216 (24 hours)
**Web site:** http://www.grove.net/hmpgst.html
**Internet Address:** steditor@grove.net

**Subscription Rates:** $19.95 in US and $28.50 in Canada. Call for air mail rates for other countries. For more information, please see page 94.

**Postmaster:**
Send address changes to *SatelliteTimes*,
P.O. Box 98, Brasstown, NC 28902-0098.

# TELE-SATELLIT

**http://www.TELE-satellit.com**

TELE SATELLIT

INTERNATIONAL SATELLITE MAGAZINE

SPECIAL OFFER!
SUBSCRIPTION!
3 for $30

To cover the world sky
To reach the Earth satellites
There is one magazine

More than 200 full color pages, issued every 2nd month, global satellite chart with frequencies, channel addresses, satellite footprints, channel identification images and insight reports from various global locations.

**Please send or fax this subscription form to:**

**TELE-satellit GB**
**c/o Christine Williams**
**PO Box 1124, Ascot, Berkshire,**
**SL5 0XH, Great Britain**
**Fax (011-44)-1344-20354**

**for faster service, please Email:**

**100574.1003@compuserve.com**

***YES***, send me the most reliable and well-respected authority on World's Satellite Industry. Please start my Test Subscription of 3 issues for only **US$ 30.**
I enclose my cheque payable to:
**TELE-satellit GB** or debit my credit card.
I have absolutely no obligation after this test subscription expires.

Name.....

Company.....

Address.....

.....

Zipcode.....

City.....

Credit Card number .....

Expire date .....

- VISA
- Access/Mastercard
- American Express
- Diners

Date ..... Signature.....

# DOWNLINK

**By Larry Van Horn**
*Managing Editor*
*steditor@grove.net*

# Suppose you were an idiot and ...

I guess I really ought to know better than to sit down on this one day of the year, and write my *Downlink* editorial column for *Satellite Times*. You see it is April 15, 1997, and (for those of you who aren't U.S. citizens) this is the deadline to file our federal tax returns with the United States government (IRS). I get totally depressed when I have to cut that personal check to the Internal Revenue Service (IRS) every year.

Now don't get me wrong, I agree that we as citizens of this great land should all pay our fair share to Uncle Sam. But when he turns right back around and wastes my hard-earned money ... see, I'm now getting depressed and mad. Let's see if I can illustrate my point.

Last week, NASA wasted taxpayers' money by launching the STS-83 space shuttle mission with a number two fuel cell that was known to be bad and which cut the mission short. Cost to the taxpayer: $5-6 million.

But, there is an even more bizarre expenditure of our hard earned money that has recently surfaced. Last October, NASA (under contract number NASW96013), asked the National Academy of Sciences "to examine and provide advice on planetary protection issues related to possible sample-return missions to near-Earth solar system bodies, specifically Mars." This project from NASA was turned over to the Space Studies Board of the National Research Council, which is the research arm of the National Academy of Sciences. The study was chaired by Kenneth Nealson, a professor at the Center for Great Lakes Studies at the University of Wisconsin in Milwaukee.

And what was the major finding of that study by Professor Nealson and his colleagues?

"In any rational person's mind, the probability of bringing back something dangerous [from Mars] is very, very, very low. But the public perception will be that very, very, very low is not zero. Therefore, NASA is not prepared for that public perception, there will be efforts to stop sample return by those who are afraid of it," Nealson told *Space News*' Leonard David in a March 18 interview.

And what is their solution to these public perceptions? It is at this point that I recommend our U.S. readers hold on to your wallets just a little bit tighter. From the committee executive summary:

> **"Recommendation:** A research facility for receiving, containing, and processing returned samples should be established as soon as possible once serious planning for a Mars sample-return mission has begun. At a minimum, the facility should be operational at least two years prior to launch. The facility should be staffed by a multi-disciplinary team of scientists responsible for the development and validation of procedures for detection, preliminary characterization, and containment of organisms (living, dead, or fossil) in returned samples and for sample sterilization. An advisory panel should be constituted with oversight responsibilities for the facility."

Unbelievable! Spending millions of dollars for public perception on something that has a very, very, very low probability of existence. We have a number of government labs that worked on chemical and biological warfare for the Pentagon during the Cold War not one of them is capable of handling this project?

Here is another alternative: How about if we take the Martian material we get back down to Atlanta, Georgia, to the Centers for Disease Control (CDC) and do the research in those existing facilities? I'm sure if they can contain the ebola virus, Martian micro-organisms shouldn't be a major problem. Besides, they can probably use the work (and the extra pay).

The study mentioned above was just the first step in this process. And what did it cost you and I to pay for these words of wisdom? $150,000.00.

Now before we even spend millions on the lab mentioned above, we have a martian rock right here on Earth. Just flip back to your September/October 1996 issue of *Satellite Times*, page 88, and check out meteorite ALH84001. You remember that rock don't you? The one that they believe shows there is life on Mars. We are spending a minimum of $1.3 million dollars of tax payer money through the National Research Council to examine that hunk of igneous rock for primitive life on Mars. Let's see, I'm up to about $7.45 million and counting at this point.

And who is it that signs the checks for all this? You guessed it our elected representatives in Congress. Those wonderful folks who spend our hard earned tax money like there is no tomorrow. The same folks who love to hold public hearings (spectacles), such as the February 5 hearing by the House Subcommittee on Telecommunications, Trade, and Consumer Protection entitled "Is Anyone Listening? You Betcha." (See the April 1997 issue of *Monitoring Times* magazine for details on what $10 million dollars buys in Congress).

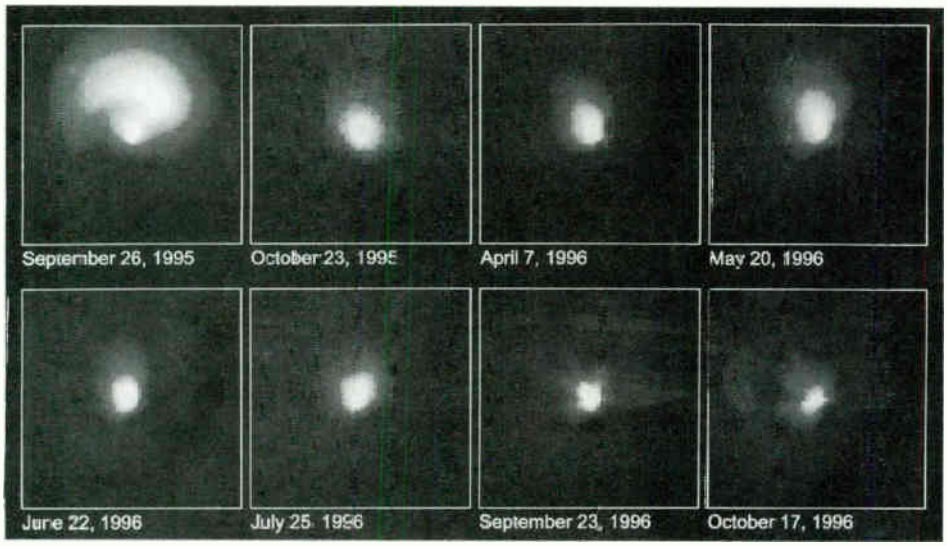
To Congress, I will say this. As a taxpayer, I'm listening and I'm outraged. Before you start investigating others for illegal campaign contributions, you might want to start in your own house. Maybe once we clean that mess up, then we might be able to start reducing wasteful and frivolous spending by our elected officials. No talk, no speeches, no hearings (Lord knows we have too many of those). Deeds and actions is what we want from our elected officials. "Show me the money." Until then, don't look for a lot of respect from the tax paying citizens of this country.

One of my favorite writers is Mark Twain. And on this tax dateline day 1997, he can best illustrate my mood right now:

*"Suppose you were an idiot and suppose you were a member of Congress. But I repeat myself."* — *Mark Twain*

# SATELLITE MONITOR

**By Wayne Mishler, KG5BI**
*E-mail: mishler@ipa.net*




***This is a series of Hubble Space Telescope observations of the region around the nucleus of Hale-Bopp, taken on eight different dates since September 1995. The first photo shows a strong dust outburst from the nucleus when the comet was beyond the obit of Jupiter. Images in late 1996 attest to the activation of multiple vents on the surface of the nucleus as it moved closer to the sun.***

## Hale-Bopp full of surprises

Chances are you've seen the Comet Hale-Bopp looking like a red-orange fuzzball against a velvet-black spring sky. But what you probably haven't seen is the scientifically significant nature of the comet which has presented astronomers with several enlightening surprises. One mystery emerged when it was discovered that the different ices in the comet's nucleus seem to be isolated from each other. That was not expected. Another is that there appear to be unexpectedly brief and intense bursts of activity in the nucleus. No one knows why. And scientists are discovering that the comet's nucleus seems to be about 19 to 25 miles in diameter. That's 30 to 40 kilometers—much larger than expected.

The findings were to be published in the March 28 issue of the *Journal of Science*.

Astrophysicist Harold Weaver reports that "Hale-Bopp will probably provide the most revealing portrait of the workings of a cometary nucleus since the spacecraft missions to comet Halley in 1986. We have never had the chance to examine a comet in this much detail, over this large a range of distance from the Sun."

To their surprise, astronomers found that water ice in the nucleus appears to have sublimated (changed directly from a frozen solid to a gas) at a different rate than trace ices and seem to be separated from each other. This result is contrary to previous models for a comet's nucleus which suggested that the trace components, such as carbon disulfide ice, are contained inside of water ice, which is more abundant in the nucleus. As water sublimates, the trace components and dust should be released at similar rates, but this is not what the Hubble telescope revealed.

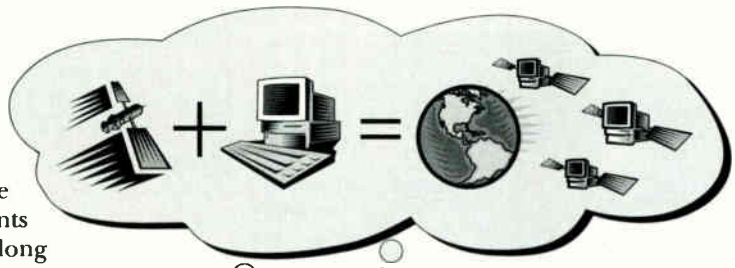
During the observations, which began in August 1995, astronomers unexpectedly caught the comet going through a sudden brief outburst where, in little more than an hour, the amount of dust spewed from the nucleus increased eight-fold.

The comet appears to be much larger than the one that is believed to have struck the earth 65 million years ago, possibly causing the extinction of the dinosaurs. Scientists believe that comet was six to nine miles in diameter. Hale-Bopp is perhaps four times that size.

Comets are believed to be remnants from the formation of the solar system 4.6 billions years ago.

## Satellite TV weds computers in worldwide ceremony

There's big news in the satellite television industry this month. It comes in the form of an unusual wedding announce-



ment. Symbolically speaking, that is. The bridegroom-personal computers; the bride-satellite television. The necessary components are in place for a long and remarkable union. The arrangements have been made. The betrothed are being prepared for presentation to the world. The ceremony is imminent. And the reception will be a worldwide event with a lasting impact on world trade, world economics, global communications, and online computing.

Adding to its apparent urgency, the wedding announcement came to me by Federal Express from a company known as Adaptec, headquartered in Milpitas, Calif. The announcement described a new-age concept conceived jointly by Adaptec, Microsoft, and DirecTV. They have come together to offer the world an altogether new pedigree of DBS services, featuring programming and online computing via satellite television receiver cards in a new breed of personal computer. Similar announcements from several other companies involved in the inevitable linking of satellites and computers have crossed my desk in recent weeks as well, including urgent communiqués from PanAmSat and Intelsat. The coming satellite cyberspace wedding promises to deliver a whole new progeny of communications and computing services for the home and office.

DirecTV hosted a two-day developers' conference in Los Angeles this February. Attendees included Microsoft and other prospective content providers. The conference unveiled a prophetic new broadcast satellite technology for personal computers in the home entertainment market.

More than 40 of America's leading companies in entertainment, sports, interactive TV, news and information, and programming were given an overview and treated to a demonstration of a new interactive marriage of computers and satellite television technology. Participants received tools, including special software, for developing new content for the new platform.

The concept is summarized in a well-written white paper by Marjorie Costello, a writer for the Adaptec Corporation.

"The explosion in online communications and the growing popularity of the World Wide Web are two of the defining trends in today's information age," Costello writes. The number of U.S. households with access to the Internet reached 14.7 million during 1996 — up 9.4 million from 1995. Market researchers are predicting the number will climb to 21 million this year.

The result, as we all know, is that the World Wide Web is rapidly becoming the world wide wait. Crystal ball gazers are predicting a system "meltdown" as millions more people go online and venture into cyberspace in the future.

The limited bandwidth of today's phone lines (their ability to carry data), has led to frustration among users. Consumers sit and wait, burning online time, as audio, video and sophisticated graphics trickle into their super-fast computers at a snail's pace. It's like taking a Ferrari for a spin in rush-hour traffic.

Cable companies say they are trying to clear the bottleneck, but large-scale deployment of cable modems are moving slowly. Cable modems are currently available only in certain markets. Many companies have been unwilling to invest in the plant and home hardware costs required to send data via coaxial cable. Faster phone line access via ISDN is either too expensive, unavailable, or too complex for the average consumer. The long-awaited arrival of a nationwide fiber optics network is an expensive dream. The end result is a molasses-in-January transfer of online data.

The fiasco is complicated by a concurrent increase in the amount of information to be transferred. The number of Web sites is increasing geometrically. The number is approaching one million, according to the *Wall Street Journal.* They are coming at the rate of about 85,000 per month. *Wired* estimates the number of individual Web pages to be about 150 million, and they are predicting a billion pages by the year 2000.

A recent approach to simplifying data delivery is the so-called "push" technologies intended to make the Web more like television broadcasting. Proponents call it "Webcasting." Popular content is sent continuously and seamlessly via dedicated phone lines to a PC's hard drive, through services and software offered by companies like PointCast, BackWeb, and Marimba. Once on the hard drive, the data is available for instant access by the computer operator.

Webcasting is available on Microsoft's Internet Explorer 4.0, and on Netscape's Constellation software. Terms associated with television, such as channels, transmitters, and tuners, are being used to describe push technology. The problem, however, is that the push solution relies on conventional phone lines with all of their limitations. It also must deal with computer limits in receiving and displaying more than a few channels.

Anyone who has ever done a "net search" knows that even though there are a million Web sites, few have relevant value in a search. Computer operators are beginning to see the solution in a broadcasting-like approach; that is, the ability to choose from many well-organized and well-indexed channels of information to find what they want.

This is where the DBS-PC concept shines. The technology, service, and content of the DBS-PC comes from leading companies in the computer, consumer electronics, entertainment, information, and satellite industries. DirecTV's 2.3

million subscribers receive more than 175 channels of clear video and audio with 18-inch dishes connected to set-top receivers built to support digital reception. And now, with the installation of a simple digital board on the mother board, a modern personal computer can use existing satellite links for near-instant access to the Internet and World Wide Web, greatly reducing the world wide wait.

DBS signals, of course, are transmitted through the air, not oozed through crowded phone lines. They are instantly relayed via satellite transponders directly to homes throughout the nation. Consumers can select from hundreds of channels, using easy-to-read programming guides. Unlike phone lines or cable systems, new channels can be added easily and inexpensively, and made immediately available to subscribers.

One of DBS' greatest strengths is its huge bandwidth combined with ultra-high transmission speeds. It is capable of transferring large amounts of computer data very quickly — up to 30 megabits per second. Compare that to the 28 kilobits per second offered by conventional phone lines. This combination of speed and bandwidth makes it possible to transmit more channels of multimedia-rich content to more homes in less time — without bottlenecks or busy signals.

Another great strength of DBS is its digital capability. In transferring data by conventional phone lines, computers must convert their native digital information to analog tones that can be sent as audio. Then the audio must be reconverted on the other end back into digital information that the receiving computer can read. It is a relatively slow process. In DBS digital data transfer, there would be no need for converting data to and from analog tones, greatly increasing the speed of transfer.

Until now, the worlds of satellites and the Web have followed separate paths. Each has grown and thrived and drawn attention, and each has proven its value in separate arenas. Now they are poised to come together in a synergetic relationship that promises to deliver drastically more information, more quickly, and more efficiently to home PCs than ever before.

The DBS-PC is scheduled to emerge on the market later this year with capabilities exceeding those available through push technologies. Web resources will be developed specifically for delivery via satellite television. It is expected to be well received by current DBS subscribers. Nearly half of DirecTV's subscribers own a personal computer. A significant number of them are online subscribers. The new service is also expected to increase sales of new home DBS equipment and new computers designed to receive datacasts.

In the online world of the future, DBS data users will be able to create individual profiles of their specific interests. Their computers, using these profiles as guides, will seek out and gather relevant information for them and save it on their computer disks. Users will be able to access the information at their leisure. They will also be able to use their computers to receive Web pages related to television shows they watch.

New services developed specifically for reception via DirecTV's broadcast links will include multimedia magazines and real-time news, sports, financial, and weather "tickers." Also on the drawing board are data-enhanced television programming, electronic distribution of software and games, and children's programming.

Special content will be developed for this new technology by entertainment and information companies like the National Broadcasting Corporation, Paramount, Fox Broadcasting, Time, Bloomberg, Sony, Universal Studios, the National Football League, and the National Basketball Association.

Using a graphical interface designed for the DBS-PC, consumers will be able to interact and select data they want to view on their computer monitors.

The emerging generation of DBS-PCs will include special new software for downloading, organizing, and displaying data — in addition to the entertainment channels currently available for conventional

viewing. Selection will be an interactive process.

DirecTV has been working with Microsoft and other companies in developing these new services. Microsoft has developed special broadcast extensions for Windows 95 that will operate with the PC, software, and receiver board. They have designed a graphical front end for Windows 95 known as Television Explorer. This serves as an electronic programming guide, enabling users to interact with their computers, to navigate among the many data and video channels that will become available via satellite.

Adaptec has developed complete satellite receivers on computer boards that can be plugged into computers like internal modems. These receivers will be controlled by system software and will function like a set-top box, but without the box. This is one of the first of many products the company plans to announce in its broadband initiative. There are plans to add receivers compatible with other DBS services as well.

DirecTV will uplink its data transmissions from the company's Castle Rock Broadcast Center in Colorado. This is the same site from which the company's current video and audio entertainment programming are transmitted. The transmissions will be compatible with current 18-inch DSS satellite dishes, which are to be connected to the computer through terminals on the receiver board.

The DBS-PC system will be truly interactive. Users will be able to make selections, such as pay-per-transaction downloads, through the conventional telephone system. An internal modem in the computer will dial into DirecTV's billing system to upload transactions. The modem can also be used to connect with Internet Web sites not included in the service.

There will be monthly fee for the basic service, with additional charges for subscribing to premium data channels, and making pay-per-download transactions, such as buying software or games delivered via satellite.

The approach of the DBS-PC revolution promises an end to long waits on the Internet, busy signals, and service outages borne of information overload. This new service is scheduled to begin and quickly spread nationwide sometime this year. Compatible computers are to be available soon from leading manufactures such as IBM and Gateway. At the same time we are to see the development of new satellite-delivered data channels. Virtually speaking, the world wide wait is virtual history.

## IntelSat building world's largest intranet

Intelsat has begin building what they call the world's largest satellite-based frame relay intranet network through which customers around the world can communicate with digital voice, electronic mail, a Web page, and file transfer in HTML format.

INTELSAT

They are converting their existing analog network to an all digital 64 kilobit per second frame relay network with voice and data capability. The finished product will allow desktop-to-desktop computer connectivity between IntelSat and customer earth stations.

"We use our own satellite capacity to help us manage our business and improve our level of customer service and responsiveness. In the process, this new network demonstrates to our customers around the world that voice and frame relay work (together), and that Internet protocols can work via geostationary satellites," says IntelSat vice president Conny Kullman.

The new network capitalizes on low cost and easy-to-use Internet technology.

"The beauty of this network," says IntelSat manager of communication operations Michael Wheeler, "is that all these additional applications are being supported within the same amount of satellite capacity as the old analog network, and our ability to provide rapid access to this information improves the overall performance of the earth stations and IntelSat's global network.

The new network is scheduled to go on line in mid-1997.

## PanAmSat announces new satellite-based Internet service

The PanAmSat Corporation has announced a new satellite-based Internet service known as "Spotbytes" Which offers Internet Service Providers (ISPs) high-speed satellite access and dedicated links to an Internet backbone in the United States and in other countries.

For example, Spotbytes could pass Internet traffic from an overseas ISP to one of PanAmSat's U. S. teleport facilities, via satellite. The traffic could then be routed to an ISP in the United States.

PanAmSat owns and operates teleport facilities in Napa, Calif., Homestead, Fla., and Ellenwood, Ga.

Using Spotbytes, the corporation's high-powered satellites will provide high-speed pipelines for Internet traffic between ISPs around the world. The service features wide bandwidth, and promises to be especially valuable for ISPs in underdeveloped areas, providing them with reliable communications and access to information.

In case you're wondering, the name is based on the cartoon character in "My Dog Spot" created by PanAmSat's late founder Rene Anselmo.

## TV Guide now printing special edition for DSS viewers

The Digital Satellite System (DSS) and *TV Guide* are jointly launching a new exclusive weekly edition of *TV Guide* for DSS owners.

"*TV Guide* will provide DSS families with the most comprehensive, timely, and authoritative guide to what's on DSS (and will) highlight the best program choices for adults and children," says USSB president and CEO Stanley E. Hubbard.

The first edition of *TV Guide* for DSS went on sale in February. ST

*Sources: Adaptec, DirecTV, PanAmSat, Intelsat*

# SAT TRACKER ©

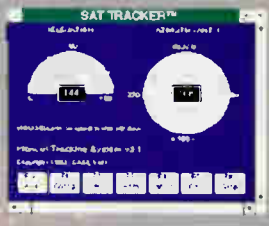
**Full-featured, state-of-the-art, computerized operation of Yaesu and Emoto rotators has never been easier or less expensive... The SATTRACKER© is here!**

FAST - Parallel data processing (not serial like others) that is fast enough for low earth orbit LEO Sats and digital weather satellites! Compatible with ALL popular tracking software: RealTrak, Instant Track, etc., plus it runs in the background as a TSR (Terminate & Stay Resident) program which allows the user to do other things on a computer while SAT TRACKER© is in full operation. Full support and fully upgradeable. Future upgrades could include: Optional transmitter Doppler shift frequency control.

EASY - No need to use or tie-up a computer's expansion slots. SAT TRACKER© will run with laptops and notebooks which, of course, have no expansion slots. No complicated, on-board calibration adjustments required! Calibrations and setup is quick & easy using the computer's keyboard, making it simple for the user to make changes at any time allows accessing full manual override and complete manual control, in a matter of seconds!

NO EXTERNAL POWER NEEDED - No power cubes or 12VDC hookups to fuss with as SAT TRACKER© gets its power from the rotator's control box. SAT TRACKER© is completely plug-in-and-play with models for both Emoto and Yaesu AX/EL rotators. AZ-only control with compatible rotators.

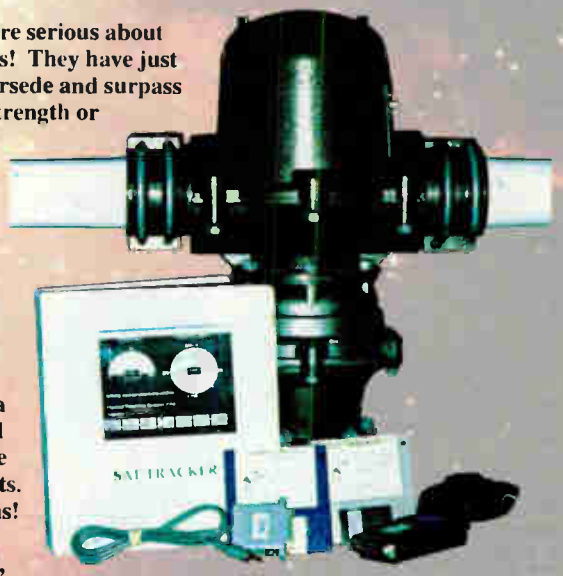
- 8 bit multiplex A to D converter for an accuracy of .72° Elevation and 1.44° Azimuth
- Parallel interface for maximum data transfer and timely control
- Completely laptop compatible for portable operation
- Requires no slots, serial ports or power from your PC
- Fully compatible w/ "Instant Track™", "Real Track™" and other software interface specs
- Runs in the background as a TSR (Terminate and Stay Resident) program
- DOS and WINDOWS™ 3.1 compatible
- Complete user and programmer documentation available




The SAT TRACKER© is a combination of hardware and software which allows you to accurately track all types of satellites or celestial objects from Horizon to Horizon. The system will even assist in accurately tracking rapidly moving low orbit satellites such as the military "LEO" Satellites or Amateur radios' "MICROSAT" Satellites. The SAT TRACKER© can be used in multitude of applications, besides satellite tracking, which require real time computer control of antenna systems.

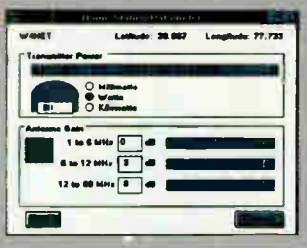
# EMOTO - EV800X & EV800DX

Good News for all you amateur satellite, moonbounce and microwave dish operators. You're serious about your modes of communications and Emoto is serious about meeting your AZ-EL rotator needs! They have just released the long awaited EV800DX and EV800X AZ-ELs. The beefed-up units actually supersede and surpass Emoto's already legendary EV700D5X. The new "EMOTATORS" simply have no equal for strength or accuracy! Emoto's secret is its new unified, single body construction elevation section head along with a newly developed running mechanism. The EV800DX should hold almost anything still! The EV800DX version offers a high-tech digital controller with unmatched, almost zero backlash, +/-1° accuracy for both elevation and horizontal rotation, which is very important for the precise aiming of your dishes and satellite arrays! Remote terminals on the rear panel of both the EV800DX and EV800X are included as standard. These allow for automatic computer control using your compatible computer and commercial or user-written software. By the way, as an added convenience, after rotator and array installation, all calibration adjustments may be done in the shack, at the control box. No need to go outside, climb the tower and tweak the dish or antennas in to exact position. If needed, the EV800DX may be separated into its two component parts. For example, the elevation head at the top of a mast and the horizontal section from within the tower, if you should feel this application would be helpful in your installation. Of course, all units include, as standard, the extras you've come to expect from Emoto: complete mounting hardware, all connectors and weather proofing boots. When you erect a large AZ-EL antenna system, the very last thing you need is rotator problems! With Emoto, the bottom line is rugged, long term reliability, user-friendly operation and cost effectiveness. With the new EV800DX AZ-EL and EV800X elevation rotators here at long last, we can tell you they were certainly worth the wait! Check with your favorite dealer today or call us for the authorized dealer nearest you!




## Skywave Propagation Prediction Software for Windows 3.1/Windows 95 is Available

**CALL FOR DETAILS!**



SKYCOM

EDCO

**Electronic Distributors**
**325 Mill Street**
**Vienna, VA. 22180**
**703.938.8105**
**FAX: 703.938.4525**

# Deep Black

## *ST Looks at America's Military Space Programs*

**(First of two parts)**

*By Philip Chien, Earth News*

Since 1984 the Department of Defense has given "USA" designations to most military satellites. This generic term makes it possible to reference satellites and satellite launches in non-classified documents. For satellite monitors they also give some insight into how the military system works, and clues to potential payloads.

Many of the USA designations are given to unclassified programs such as Global Positioning System (GPS), Milstar, Defense Satellite Communications System (DSCS), the Navy communications satellites, and the Defense Meteorological Satellite Program (DMSP) weather satellites. In addition, semi-classified projects like DSP and some research and development satellites earn USA designations.

There are some quirks and surprises though. The following examples are just some of the more interesting exceptions to the rule of all U.S. military satelllites must carry the USA designations.

The NATO 4B has been given the designation USA 98, even though it is not a classified military program; the identical NATO 4A satellite did *not* receive one, and NATO 4 is not even a U.S. military program! This unique case makes it the only non-American manufactured satellite to earn a U.S. military designation!

While GPS (Navstar) satellites (*Satellite Times* March/April 1996 page 10) launched since September 8, 1984, have received USA designations, the Transit series of military navigation satellites has not, nor have some experimental navigation satellites.

A USA designation is only earned when the satellite reaches orbit. If there's a launch vehicle failure, then the number which would have been assigned to that satellite is reassigned.

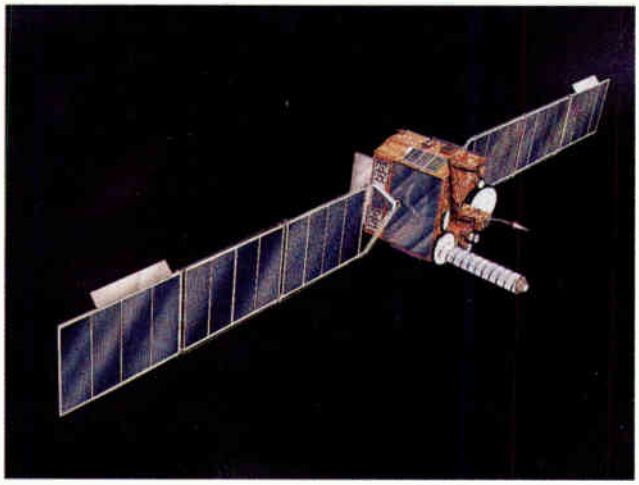
The space shuttle does not get a USA designation, nor do any payloads which remain within the shuttle's cargo bay. However, shuttle deployed military payloads do get USA designations.

A couple of experimental research military satellites did not get USA designations, including ALEXIS and STEP 2.

In the case of the Navy's UFO series (*Satellite Times* September/October 1995 page 14) the Navy takes ownership of the satellites from Hughes aircraft only after they've been put into orbit and checked out. The UFO-1 satellite ended up in an improper orbit due to a launch vehicle malfunction, so it was never turned over to the Navy and never received a USA designation.

## Revealing Information from Public Sources

Unclassified military satellites come in several different categories—communications, meteorology, navigation, treaty verification, and research and development. Classified satellites also include some communications satellites, and also signals intelligence (listening to radio signals), imaging intelligence (visible and radar photographs—what most people think of when the term spy satellite is used), and research satellites. The term research is extremely broad and can cover development of instruments for future spacecraft, pure scientific research, and experimental satellites for new applications, among other applications.



***The British made NATO IV communications satellite demonstrates a quirk of the U.S. military classification system. The NATO 4B has a "USA" classification, while the NATO 4A does not. Neither are actually part of the U.S. military program.***

Much of the information about the USA satellites comes from public, unclassified sources. Many of the satellites themselves are unclassified and the Department of Defense gladly distributes data about the spacecraft's purposes. Some of the data comes from leaks, either intentional or through acts of espionage which have unintentionally opened up the veil of secrecy. In several well publicized incidents, double-agents sold classified information on U.S. satellites to the Soviet Union. It seems ironic that while the Soviet Union has a full manual describing the functions and operating procedures for the KH-9 photo reconnaissance satellites, that information is still unavailable to the U.S. taxpayer which paid for the system's development.

Some of the information about classified satellites comes from industry sources. All satellites, even classified ones, have to obey the laws of physics, and classified and unclassified satellites share similar purposes. The unclassified Landsat and classified Keyhole satellites only differ in how their data is used and the maximum resolution of their sensors.

On the other hand, much information is just speculation by the media and their sound byte experts—people who speak authoritatively without any actual information. So it's important to take any public description of a classified military system with a grain of salt. If the system's description violates the laws of physics or stretches the limits of plausibility, then it probably isn't true. Keeping that in mind, here's a look at each of the satellites which have been given a USA designation, sorted by the first time a USA designation was assigned to each particular type of spacecraft.

## Navstar

The first satellite to be given a USA designation was Navstar 9, the ninth of the first-generation GPS satellites. The previous Navstar Block I satellites were identical, but were not given USA designations. Other Navstar Block I satellites with USA designations were USA 5 and 10.

Navstar Block II satellites, launched on Delta 6925 launch vehicles, were given the designations USA 35, 38, 42, 47, 49, 50, 54, 63, and 64. The more capable Block IIA satellites, launched on Delta 7925, were USA 66, 71, 79, 80, 83, 84, 85, 87, 88, 90, 91, 92, 94, 96, 100, 117, 126, and 128. USA 130 would have been assigned to the Block IIR-1 satellite launched on Delta 241, but that satellite was lost due to the launch vehicle failure (*Satellite Times* March/April 1997 page 22).

***Artist's rendition of a NAVSTAR satellite orbiting 11,000 miles above the Earth.***

## Keyhole

USA 2 was assigned to KH 9-19, the last of the ninth generation keyhole camera, photographic reconnaissance satellites. This particular satellite was a ground-spare which had to be upgraded to flight status due to problems with the Keyhole constellation. Early Keyhole series from Corona through Lanyard (pre 1972) were declassified a couple of years ago, and their images are available on the Internet at the WWW address: **http://edcwww.cr.usgs.gov/dclass/dclass.html**. The KH-9 series used a set of reentry capsules to return film exposed in space, plus a video camera system for quick-look images.

There never was a KH-10 series. The Manned Orbiting Laboratory (MOL) program would have featured the Keyhole 10 camera. MOL was to use a space station based on an empty Titan III upper stage. Two military astronauts would fly to and from the space station on Gemini spacecraft.

MOL was canceled due to its high cost, the war in Vietnam, and the expanded capabilities of the KH-11 series. Unlike the KH-9 series, KH-11 used a digital charge-coupled device (CCD) detector, and returned all of its images digitally, eliminating the necessity of film capsules.

KH-11 spacecraft launched before 1984 did not receive USA designations. KH 11-6 became USA 6, 11-7 became USA 27, and 11-8 became USA 33. All of the KH-11 series were launched on Titan 34D launch vehicles from Vandenberg Air Force base in California.

A next-generation Keyhole series was planned, using the capabilities of the space shuttle. By this point the code name "Keyhole" (and even project names "Kennan" and "Crystal"), had been accidentally released to the public to the extent that their usefulness as designations for classified projects had been compromised. Hence, there was never any spacecraft designated "KH-12." We'll use the designation KH-11A (Advanced?) used by some industry sources, although if such designation ever existed, it's almost certainly been changed.

Under the original plan KH-11A would have been launched from Vandenberg Air Force Base's Space Launch Complex 6 (Slick-6), a launch pad originally built for the Titan III and then adapted for the shuttle. The new KH-11A series would include a 2.4 meter diameter primary mirror and adaptive optics for better resolution, and the capability to be refueled by the space shuttle. The unclassified Orbiting Refueling System (ORS) experiment on the 41-G space shuttle mission in October 1984 proved that spacesuited astronauts could hook up propellant lines to a spacecraft—even one which wasn't originally intended to be refueled in space—and safely transfer hazardous propellants to a simulated spacecraft.

The *Challenger* accident changed the future of the Keyhole program. The high cost of the shuttle and the many delays brought the whole concept of servicing spacecraft in orbit into question. It would be less expensive to build several "disposable" spacecraft on an assembly line than to maintain one or two refuelable models. The Air Force decided that there was no absolute requirement for shuttle launches from Vandenberg Air Force Base and SLC-6 was mothballed.

The decision was made to launch future photo reconnaissance satellites on Titan IV expendable launch vehicles, without any plans to refuel them in orbit. Three known KH-11As have been launched—USA 86, 116, and 129. They are extremely popular targets for visible satellite observers, and fairly easy to see at medium to high latitudes.

USA 3 was the 45th Hitchhiker spacecraft, a small electronics reconnaissance satellite launched with a KH-9 spacecraft. Unclassified sources list its mass as 60 kgs. which would make it a fairly small spacecraft. With the end of the KH-9 program it appears that the Hitchhiker program has gone away and been replaced by more capable spacecraft.

## Satellite Data System

USA 4 was the ninth launch of a Satellite Data System (SDS) spacecraft. SDS spacecraft are communications relays in highly elliptical "Molniya" orbits. Molniya, the Russian word for "lightning" is the name of a series of Soviet/Russian communications satellites which use these highly elliptical orbits.

A satellite in Molniya orbit spends most of its time in the Northern hemisphere

***Of the experimental research military satellites, STEP 2 did not get USA designation.***

and is more useful than geosynchronous satellites for viewing high latitude locations (e.g. Northern Russia). Some of the potential applications for these satellites include constant communications with U.S. bombers traveling over the North Pole on their way to the Soviet Union, and relaying data from the Keyhole satellites in near real-time back to the U.S. ground stations. Understandably, these capabilities make SDS missions very sensitive, and they are the only operational classified communications satellites.

USA 21 was the last SDS satellite launched by a Titan 34D. Two SDS series satellites were launched by the space shuttle—USA 40 on STS-28 and USA 89 on STS-53. The Titan IV-Centaur has the capability to put up to 10,000 lbs. into a Molniya orbit, and two classified military satellites—USA 103 and USA 112—have been placed in those orbits. In the case of USA 103, the Centaur burn was observed by many amateur astronomers in Europe who initially mistook it for a giant comet.

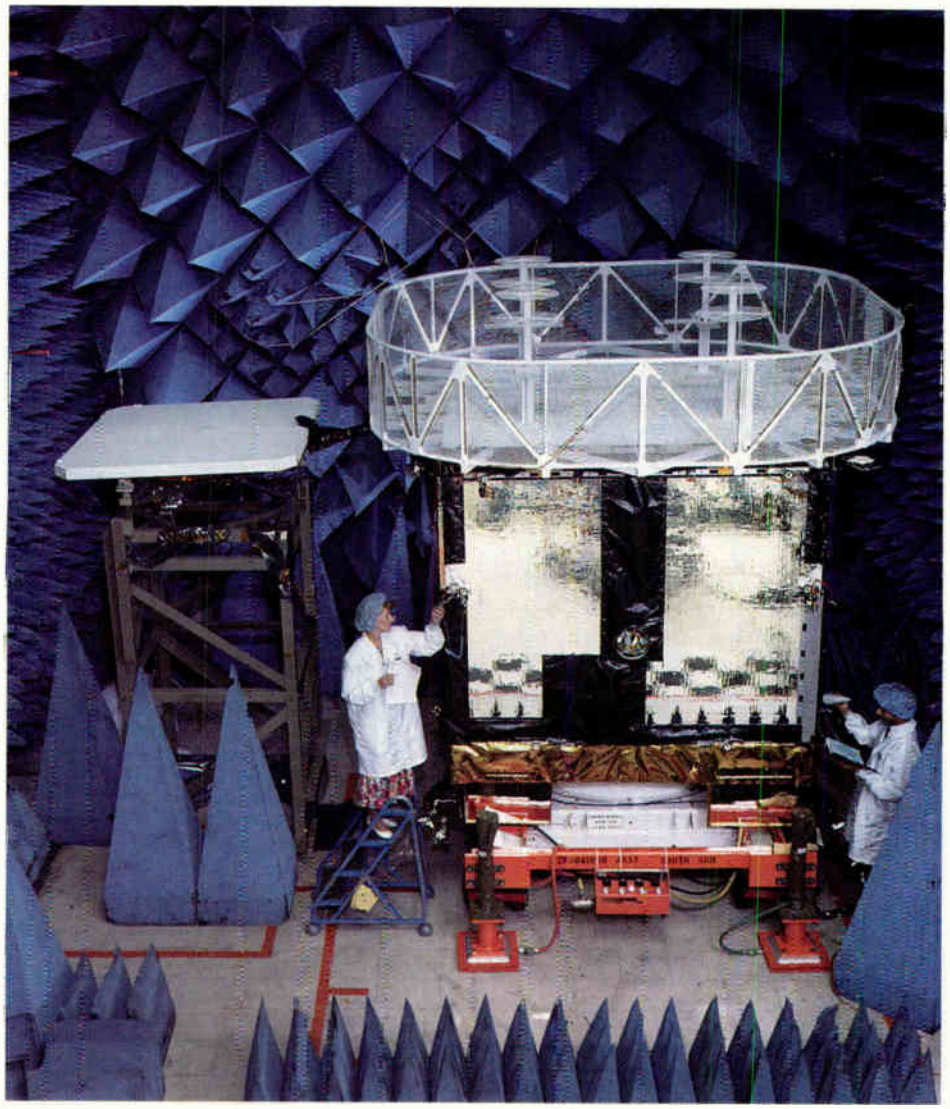
## Media Misinformation

USA 40 is one of the best examples of how media speculation can jump to incorrect conclusions, and cause a disservice to everybody involved. It was fairly well known that the space shuttle would launch on a northeast trajectory into an orbit with an inclination of 57 degrees. This is the highest inclination which is practical from the Kennedy Space Center without going over land. Coincidentally the orbit also goes over much of the Soviet Union.

Without any solid facts, media sources claimed that the payload was a next generation Keyhole spy satellite. This was clearly not the case, simply because the Keyholes are designed to use sun-synchronous orbits which must be launched from Vandenberg Air Force Base in California for safety reasons. If a Keyhole was launched from Florida, it would severely degrade its capabilities.

More importantly, there was no corroboration evidence of any kind to indicate that it was a Keyhole. Nevertheless the rumors persisted, making the circle until most of the press claimed that it was a Keyhole satellite.

The satellite was quickly spotted by visual observers around the world who noticed that it wasn't a steady object like previous Keyhole satellites. USA 40 was clearly flashing which indicated that it was



*The UHF Follow-On satellite, built for the Department of Defense by Hughes Space and Communications Company, is a USA designated satellite.*

either out of control or it was not a Keyhole satellite. The spin rate gradually decreased over time. If its spin rate were to go back up to its original value then that would indicate that the satellite was still under active control; however, if the spin rate continued to go down, that would indicate that the spacecraft was dead. Well, neither case occurred.

The spacecraft disappeared, as many separate observers around the world independently verified. The next edition of the satellite situation report included an interesting surprise: an additional object was cataloged from that launch—an empty rocket body (1989 61D). So either the spacecraft split in two and both objects magically disappeared from sight, or the spacecraft transferred to another orbit and then ejected its spent rocket body.

The launch of USA 89, a/k/a "DoD-1," on the STS-53 shuttle mission solved the remaining missing facts in the USA 40 mystery. It was the last classified spacecraft launched by the space shuttle, and many of the flight's aspects were declassified. When the standard, one-month-before-flight press conference was held, lead flight director Rob Kelso feared that all he might be allowed to say was, "Hi, I'm Rob Kelso, the lead flight director of STS-53. Do you have any questions?" It turned out that enough information was declassified to give a fairly normal mission overview, without giving any specifics on the payload. He did confirm that Discovery did not have the RMS (Remote Manipulator System—the shuttle's robot arm) installed. The astronauts held their normal interviews but, of course, could not talk about DoD-1.

One key unclassified item was the launch windows, which decreased by 4.46 minutes per day. It was clear that this was a significant number for the orbit of the primary payload.

Amateur satellite observer Sean Sullivan and myself went over the data for several days before the answer became obvious—it clearly had to be a Molniya-style orbit. At that point the rest of the pieces fell into place. USA 40's reported mass was very close to the DOD-1 mass. Other parameters such as the shuttle's altitude also matched. Sean and I predicted that the visual characteristics would be identical to USA 40—a steadily flashing object which would disappear after spending a period of time in its parking orbit. And after the object disappeared,

***This Titan IV is carrying a classified U.S. Air Force payload into orbit. What is it? We may never know for sure. (US Air Force photo)***

another item would appear in the NORAD catalog (the spent rocket body).

Some newspapers, including the *Washington Post*, reported claims that it was a radar spy satellite, while others like the *Miami Herald* agreed with us. Other papers presented both sides of the argument. Well, the observed characteristics matched our descriptions perfectly—including the additional rocket body in the NORAD catalog.

*Discovery* was launched on December 2, 1992, at 8:24 a.m. Eastern Standard Time. At 3:50 p.m. NASA public affairs officer James Hartsfield reported "DoD-1 was deployed on time with all activities proceeding as planned." Some time between Dec 15, 1992, 1419 and Dec 16 0527 UTC, the spacecraft's upper stage fired and took it above an altitude where it could be observed by the amateur spacecraft watching community. Their times mark the last confirmed sighting and first confirmed non-sighting.

In part two of *Deep Black*, we'll look at the Defense Support Program satellites, electronic listening satellites, more communications satellites, and the rest of the USA military satellites. ST

# Need to Communicate from Anywhere to Anywhere?

# NOW YOU CAN!

## Introducing the First Hand-Held WORLDWIDE SATELLITE COMMUNICATOR!

*The first hand-held global satellite communicator with integrated **e-mail** and **GPS** is available from Magellan and Grove Enterprises. Winner of the 1997 Consumer Electronics Manufacturers Association's Innovations '97 Award at the Winter CES Show in Las Vegas.*


Over the horizon? Beyond the reach of civilization?

There are places in this world that few others have ever seen, or can even imagine. These places have no telephone lines, cell towers, couriers or mailboxes—only you and your need to communicate.

Despite this need, there has been no affordable or practical way to communicate from remote areas...until now.

Magellan has created the GSC 100, the world's first hand-held global satellite communicator. The GSC 100 gives you the ability to **send and receive e-mail messages to and from anywhere on Earth**. It lets you stay in touch wherever life takes you. And, with its **integrated GPS receiver**, the GSC 100 not only lets you know where you are, it guides you anywhere you want to go. You can also relay that position to anyone, anywhere—no matter how remote you may be—with a GSC 100 e-mail message.

The GSC 100 utilizes the **ORBCOMM network**—the world's first wireless, two-way satellite personal communications system, providing true global coverage. Because the GSC 100 uses standard e-mail protocols, sending and receiving messages is easy. Communicate to any e-mail (Internet) address or another GSC 100. **Added services will allow you to send your message via fax or voice.**

The GSC 100 communicates with the satellites on a standard narrow-band VHF frequency. Your e-mail message goes up to an ORBCOMM satellite and then down to a gateway station and is routed to its final destination via traditional methods. Retrieving your incoming e-mail is just as easy.

Unlike traditional land-line, cellular, and paging systems, the space-based ORBCOMM network offers global coverage, eliminating dead zones and providing seamless worldwide communications. The GSC 100 is a **convenient, reliable, and affordable solution for your global communication and navigation needs.**

*Deliveries of the GSC 100 from Magellan are expected to begin soon. Reserve yours now! Your credit card will not be billed until the unit is shipped!*

## All this—for only $999.95 from Grove Enterprises!

Order Code GPS 100. Please add $10 2nd Day Air UPS Shipping.

GROVE

**GROVE ENTERPRISES, INC.**
1-800-438-8155 US & Canada, 704-837-9200; FAX 704-837-2216
7540 Highway 64 West, Brasstown, NC 28902
E-mail: order@grove.net; World Wide Web: www.grove.net

# Granddaddy Longlife

*PART ART, PART REAL: The world which looms beyond this drawing of an ATS satellite is actually the first color photo ever taken of Earth from a geosynchronous satellite (the elements were digitally synthesized by ST). The earth image was received at NASA's Goodard Space Flight Center in Maryland on November 10, 1967 from ATS-3, stationed in orbit above Brazil.*

***Considering that the normal life of communications satellites is 10-15 years, the longevity of ATS-3, now pushing 30, is a splendid aberration.***

# ST SATELLITE PROFILE

**By Philip Chien**

How long do communications satellites last—five years, ten years, more? Today a typical geostationary communications satellite is designed to last about 10 to 15 years. But can you imagine a satellite which has been in continuous operation for almost three decades? Sure you can! Applications and Technology Satellite-3 (ATS-3) was launched on November 5, 1967. It's been in continuous operation, and continues to be used every day.

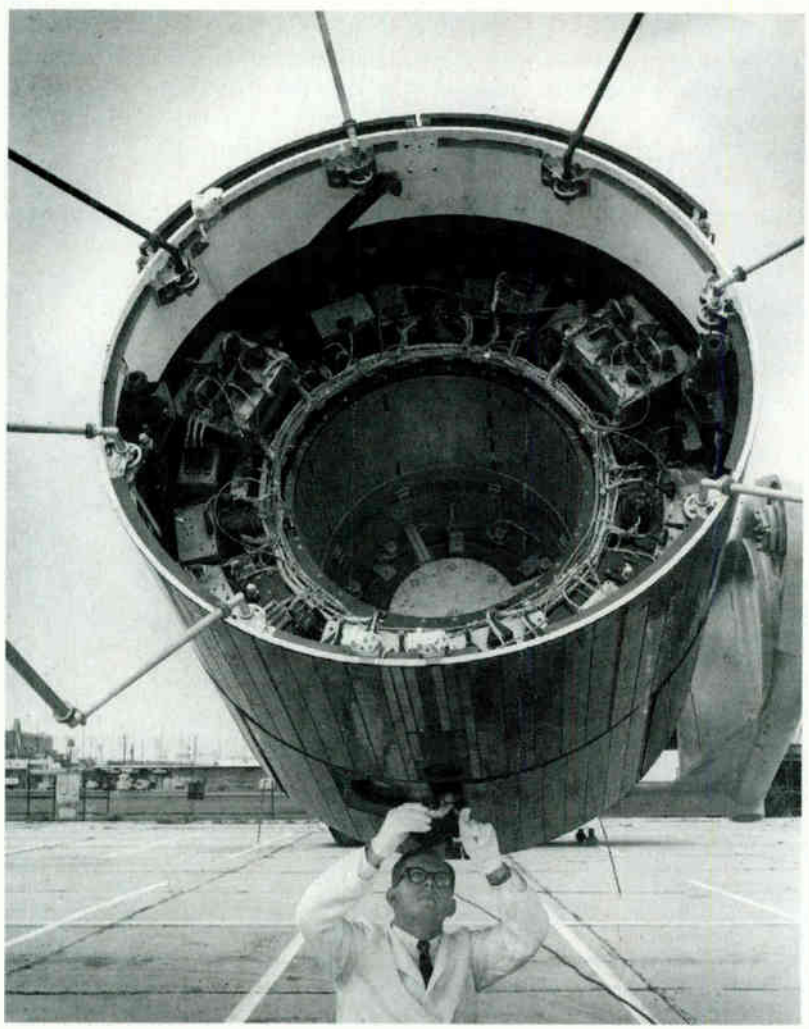
ATS-3 was the ninth artificial satellite in geosynchronous orbit. The only previous geosync satellites were the early Syncom, Early Bird, Intelsat II series, and ATS-1. The ATS series consisted of six satellites to develop new technologies and techniques for future spacecraft. ATS-1 through 5 were built by Hughes Aircraft, and ATS-6 was built by Fairchild. The first three ATS satellites were launched on Atlas-Agena launch vehicles. ATS-4 and ATS-5 were launched on more powerful Atlas-Centaurs, and ATS-6 used a Titan III.

ATS-1 (1966-110A) was the first geosynchronous satellite with a "camera" which could take photos of the Earth, showing the capabilities which would become commonplace on the geosynchronous weather satellites within a couple of years. During the Apollo 11 recovery operations ATS-1 was the primary communications link between the recovery aircraft carrier *Hornet* and the White House.

ATS-2 (1967-31A) was a medium altitude spacecraft designed to evaluate a "gravity gradient" design. In gravity gradient spacecraft the spacecraft's shape stabilizes it with the long axis of the spacecraft pointed towards the center of the Earth. The upper end of the spacecraft is "moving" slightly faster than the lower end due to the difference in gravitational pull caused by the small difference in distance from the Earth's gravitational center. It's enough of a force to keep the spacecraft stable, and a very inexpensive technique for spacecraft stabilization which requires no fuel.

Spacecraft which have used gravity gradient stabilization to save money or propellant have included the entire UoSat series of mini spacecraft, the Long Duration Exposure Facility (LDEF), and the space shuttle when it's flying microgravity experiments. With the shuttle a gravity gradient attitude also ensures a very benign microgravity environment since thruster firings are minimized.

ATS-2 was launched on April 5, 1967, with an Atlas-Agena launch vehicle. Unfortunately the Agena stage didn't produce enough thrust and ATS-2 was left in an elliptical orbit instead of the planned circular orbit. Some of the experiments were performed, but the spacecraft had a premature reentry on September 2, 1969, after about two and a half years in space.



***ATS-3 undergoes an adjustment to its gas jet by a Hughes engineer prior to its Nov. 5, 1967 launch.***

ATS-3 (1967-111A) was launched on November 5, 1967. It had a launch mass of 386 kg (850 lb). It was similar in design to ATS-1, but it featured a dual-spin design with the main spacecraft body spinning like a gyroscope for stability and the C-band antenna platform spun the opposite direction with a motor. From the point of view of a user on the ground, the antenna platform appears stable and always pointed at the Earth while the main spacecraft body is spinning. This gives a spacecraft the advantages of an inexpensive stabilization mode with very benign thermal requirements and a stable antenna platform with the antennas always fac-

ing the Earth.

The dual-spin design has been an extremely popular feature in Hughes's spin-stabilized communications satellites, and has also been used for the Galileo spacecraft which has a spin-stabilized body and non-spun scientific instrument platform. ATS-3 also featured a color "camera," which returned the first color picture of an entire hemisphere of the Earth on November 10, 1967, just one week after its launch.

Another early ATS-3 experiment featured a montage of photos showing the track of a solar eclipse as the moon's shadow moved across the Eastern United States on March 7, 1970. When it was launched ATS-3 had a planned lifetime of three years, with enough hydrogen peroxide propellant to keep it in position for that period.

ATS-4 (1968-68A) was launched on August 10, 1968, to test out the concept of gravity gradient spacecraft at geosynchronous altitudes. It had a similar launch vehicle problem as ATS-2 and didn't reach geosynchronous orbit. Again some experiments were done, but the mission's primary objectives were not achieved. ATS-4 reentered the Earth's atmosphere on October 17, 1968.

ATS-5 (1969 69A) was launched on August 12, 1969, into geosynchronous orbit. However, its spin was in the reverse (counter clockwise) direction, so the gravity gradient mission was not possible. Nine of the other 13 experiments did return data, even with the incorrect spin. ATS-5 was retired in March 1984.

ATS-6 (1974 39A) was a significantly different spacecraft. Besides a different contractor, ATS-6 was a giant satellite—even by today's standards. In orbit it had a mass of 1406 kg (3,100 lb) with 907 kg (2,000 lb) of electronics. The main antenna measured 9.1 meters (30 ft) in diameter. With its two solar arrays extended it had a span of 15.85 meters (52 ft). Due to its large size ATS-6 required a Titan III launch vehicle, at the time it was the only civilian satellite to use the Air Force's heavy lift launch vehicle.

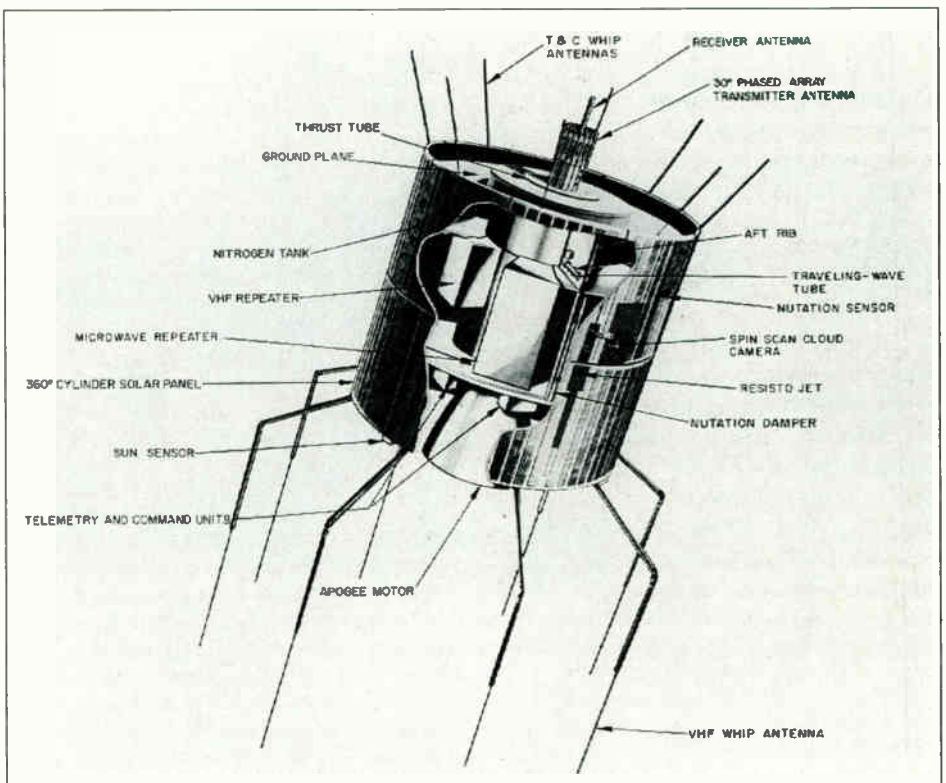
With ATS-6's extremely high power, very simple, inexpensive ground stations could be used for communications. Villages in India built antennas out of chicken wire and wood frames. Other small communities in the Appalachian mountains, Alaska, and Rocky Mountain states also used inexpensive equipment for distance-education and other satellite applications. Non-communications experiments included a Cesium ion engine, a heat pipe, and meteorological sensors.

The success of ATS-6's direct broadcast experiments to Indian villages led to the Insat program with India's own domestic satellites. Insat 1A was launched in April 1982, and has been followed by an additional six communication satellites to date.

One of the more significant experiments with long-term applications was to use ATS-6 as a satellite relay. Satellites in low orbits are only in contact with their ground stations for a short period each day. If a relay platform is placed at an extremely high altitude—for example, a satellite in geosynchronous orbit—then it can keep in contact for almost half of the lower altitude spacecraft's orbit. ATS-6 tested this concept with the Apollo spacecraft during the joint U.S.-Soviet Apollo-Soyuz project. It proved to be capable of keeping in almost continuous communications with low altitude spacecraft—the concept which today forms the basis of NASA's Tracking Data and Relay Satellite System (TDRSS). ATS-6 was retired on June 30, 1979.

The ATS series experienced two launch vehicle partial failures and one spacecraft stabilization problem. But, overall, the series was extremely successful. ATS-3 has far outshined its counterparts—lasting far beyond what was considered possible (or even dreamable) when it was built. Nobody could have predicted that ATS-3 could have outlasted its planned lifetime by an order of such magnitude. The camera's mechanical parts have failed, and the C-band transponder was shut off a long time ago. Its platform is now free-wheeling, making ATS-3 just a plain spin-stabilized satellite with a VHF transponder.

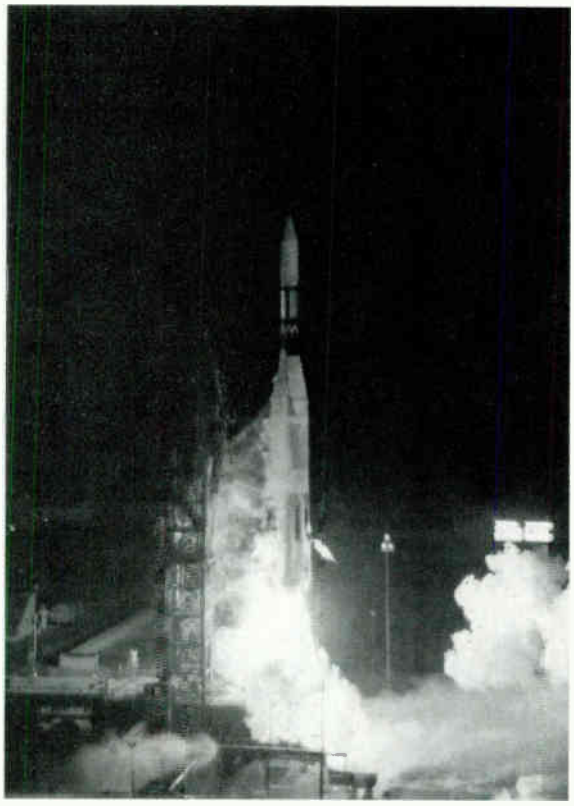
ATS-3 continues to be used because of its unique capabilities. Most geosynchronous satellites hug the Earth's equator with an inclination of zero degrees. Ninety percent of a geostationary satellite's propellant supply is used for North-South thrusts to keep its inclina-




APPLICATIONS TECHNOLOGY SATELLITE (ATS-B)

tion under control. Ten percent of the propellant is required for East-West control to keep the satellite in its proper geosynchronous slot. This orbital maintenance permits a fixed stationary antenna to be used for communications.

If a geosynchronous satellite has a non-zero inclination then it moves in a figure-eight shaped orbit above and below the equator. Ground stations need tracking antennas to follow the spacecraft's path through the sky. For broadcast communications, inclined satellites are a disadvantage. However, the higher the inclination the further to the North and South it can see. A normal geostationary satellite can only view latitudes between 65 degrees North and 65 degrees South, but a satellite with a geosynchronous inclined orbit can view the Earth's polar regions.



*Few would have predicted ATS-3's extended lifespan when the satellite was launched Nov. 5, 1967 by an Atlas-Agena rocket at Cape Kennedy, Fla.*

So the National Science Foundation (NSF) considers ATS-3 and a handful of other inclined orbit "surplus" geosynchronous satellites extremely valuable to support its Antarctic research.

As a general rule ATS-3 communications during the week are scientific data and voice communications, and personal communications during the weekend. The satellite is used for Internet communications, with E-mail, worldwide web, and other resources.

Special projects are also supported. In the Cycledome project an aircraft flew over ice-covered areas and used a synthetic aperture radar to look through the ice at the ancient continent.

ATS-3's highly inclined orbit also benefits arctic studies. It's been used to support Coast Guard aircraft for their studies of the North Pole region.

If the Earth were a perfectly homogeneous sphere then satellites would remain in place permanently, without any need for stationkeeping propellant. However, the Earth's actual shape—and to a lesser degree the gravitational forces from the Sun and Moon—result in a hill-and-valley shaped orbit. There are two semi-stable hills at 163 degrees West and 18 degrees East, and two very stable valleys at 105 degrees West and 75 degrees East. Satellites placed in the valleys will remain there permanently without any thruster firings. Satellites on the hills will stay there until outside perturbations by the Sun and moon eventually cause the satellite to "slip" downhill.

ATS-3 is located in the gravitational valley at 105 degrees West. Its current inclination is 14.91 degrees, which results in six hours each day where the satellite's command station in Florida and the South Pole can communicate directly. The more northern Palmer station at 65 degrees South has 18 hours of communications each day.

Since ATS-3 is in a geosynchronous orbit with no inclination control and no East-West stationkeeping required, it has no propellant requirements—in fact its thrusters haven't been used in over two decades!

However, unlike most geostationary satellites which only have small eclipse periods every six months, ATS-3's highly inclined orbit travels through the Earth's shadow each day. So its batteries have been through thousands of charge-discharge cycles—far more than what was originally anticipated. In its original geostationary (non-inclined orbit) ATS-3 experienced a maximum shadow period of 1.15 hours, and the "eclipse season" lasted 45 days every six months. So for the nominal three year mission ATS-3 was only expected to encounter 270 eclipses!

NASA ran out of funds to operate ATS-3 in the mid 1980s. So NASA made arrangements to contract out the satellite operations for government uses. NASA and the National Science Foundation have contracted out the satellite's maintenance and operations to the University of Florida. Paul Eden operates the satellite out of his home in Malabar, Florida, just south of the Kennedy Space Center. Macintosh and DEC computers control the ground station's antennas and send up the proper spacecraft maintenance and control commands automatically. The only additional requirements are for maintenance and repairs. In addition to ATS-

3, the site is also a ground station for semi-retired GOES and LES satellites.

Paul's 10 acre site includes two parabolic dishes—one for uplink to the older GOES satellites and one to receive satellite television—and several sets of motorized azimuth-elevation Yagi antennas which track the satellites. Each pair of rotors is individually addressable via a serial RS-232 bus.

NASA's popular *Live from Antarctica* series used the Malabar, Florida, ground station as its primary link. From the South Pole, communications were digitally transmitted to Malabar via a geosynchronous satellite. A Ku-band uplink truck retransmitted the signal on a domestic communications satellite to the Goddard Spaceflight Center in Greenbelt, Maryland, the hub of NASA's communications network. From there an additional Ku-band hop sent the signal over to NASA's Ames Research Center in Northern California, which was responsible for the educational project. At that point it was transmitted to the NASA TV satellite, Spacenet 2, where it could be received by schools in the United States—for a total of four geosynchronous hops!

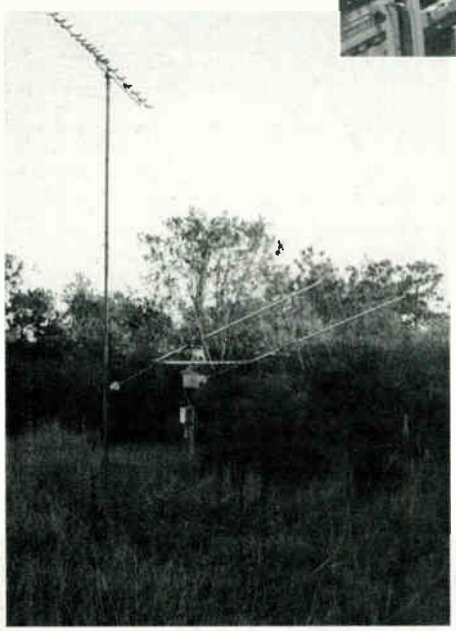
ATS-3 transmits its telemetry on 136.470 and 137.350 MHz with an output power of 2.1 watts. The VHF transponder has a transmit power of 5 watts. The phased array consists of eight whip antennas fed in phase, with a peak antenna gain of 10 dB. The effective radiated power is 22.5 dBw. The spacecraft transmits on 135.6 MHz and receives on 149.22 MHz with a bandwidth of 100 kHz. It's important to note that these frequencies are in the government bands, and it's only legal to transmit on the uplink frequency if you're been authorized by the National Science Foundation or the University of Florida.

It's quite legal to listen to the 135.6 MHz downlink, and many radio enthusiasts have done so. OSCAR 2-meter Yagi antennas, designed for use with amateur radio spacecraft, are adequate for listening at these frequencies, even though they're outside of the 2-meter band. ST

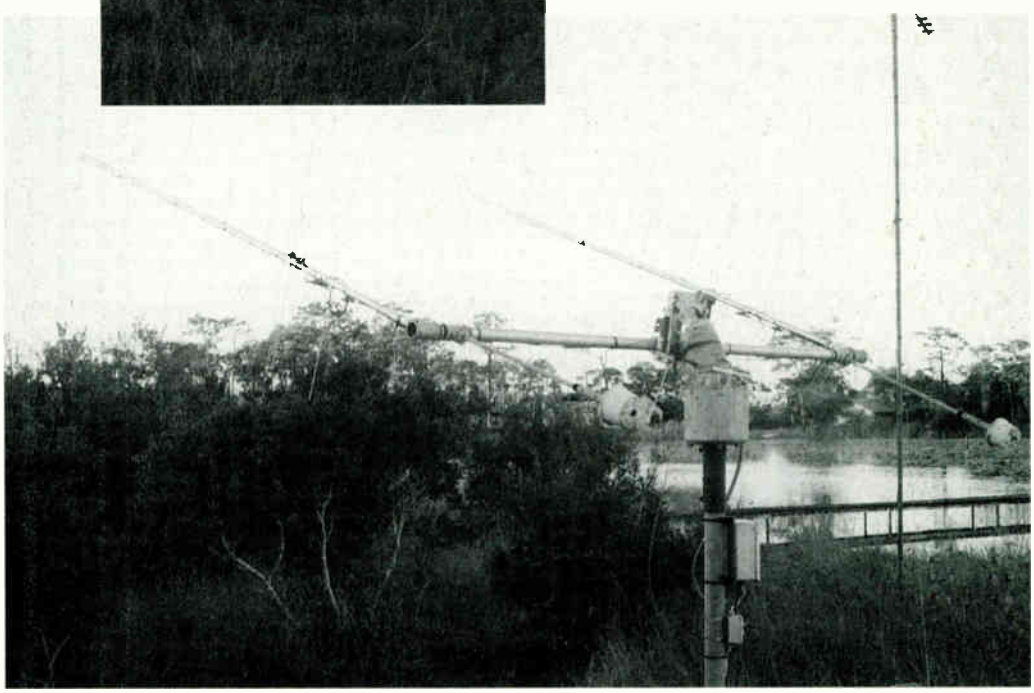
## CURRENT KEPLERIAN ELEMENT SET FOR THE ATS-3

1 03029U 67111A 97090.33541764 -.00000118 00000-0 10000-3 0 6383
2 03029 14.9026 356.6946 0011752 276.9083 290.6616 1.00273473107643

***After NASA's funding for operating the satellite ran out, the job was turned over to the University of Florida. Paul Eden operates the satellite out of his home in Malabar, Fla.***



***Paul's 10-acre site includes two parabolic dishes (not shown) and several sets of motorized azimuth-elevation Yagi antennas which track a number of satellites—not just the ATS-3.***



# Monitoring Meteor Activity by Radio

*By Bill Black, K4BSN*

*The author's channel 3 and 4 antennas. The meteor drawing in the background is actually a woodcut depicting the 1833 Leonid meteor storm.*

With the expected firestorm of Leonids meteors coming sometime in the next four years (see *Satellite Times* March/April 1997, page 10, *Bracing for the Leonids Firestorm*), amateurs all over the world are looking at monitoring the event. One way to accomplish this task is via radio.

The amateur looking for an interesting and useful project in the broad realm of radio and astronomy has so many options to choose from it is almost like Christmas shopping without having to pay for anything (until later). Almost all of the programs require skill, dedication, and money. However, beyond all the interesting things to do and the attendant costs, another aspect of the hobby is the fact that there are always related organizations looking for your data.

One such involvement is known as radio meteor monitoring. It is a fascinating project for the amateur, and like all the other things you can do in the various amateur communities, this one will cost money, time, and commitment. This specialty does offer one aspect that no other amateur endeavor has—a continuous input. Unless you are monitoring WWV, most amateur projects involve waiting for the weather to clear or, as in SETI, not even knowing what you are waiting for. In radio meteor monitoring you never wait; there are always meteors. Millions impact the ionosphere. They can be heard day and night, in almost all weather. If you want to get involved in an amateur project that will interest and challenge you, try this one.

This article is an overview of much of the progress to date in amateur radio meteor monitoring. It is more about what can and has been done than about how to do it. Radio meteor monitoring does not need another "how to" article, but it does need a comprehensive summary of references that present books and detailed articles written by workers who have been successful. Hopefully, our next such summary will include the accomplishments of some of you after reading this article.

## Individual Profile for Success

This is a difficult but necessary subject to discuss, because it is so easy to inadvertently imply that radio meteor astronomy is not for the inexperienced amateur. This is intrinsically absurd, because everybody, at some point in their lives, is inexperienced. It does mean that the newcomer has more ground to cover, but we all had to start somewhere, and what the newcomer lacks in experience can be compensated by a more aggressive approach to the learning curve.

That having been said, we need to glean the obvious from a famous line, "We hold these truths to be self-evident": it has to be stated that a review of the past thirty years or so has shown that those who succeed with radio meteor work are those who are well versed in the associated scientific fields and who brought their credentials with them. Those who don't succeed are the inexperienced who are discouraged by the difficulties in setting up an observing station, as well as the complexities of the mixing of radio, astronomy, electronics, ionospheric physics, and computers.

You should be encouraged by the fact that most of us are somewhere between these extremes. We consider the things we don't know enough about as challenges, not stumbling blocks. We consider our projects as the light at the end of the tunnel, not the tunnel. Success is a preassumed conclusion, not a victim of excuses when the going gets rough.

What emerges from all this is that there are three general types of amateurs that can be profiled the newcomer at ground zero, the very experienced, and the rest of us. Many of the experienced have contributed to the contents of this article. If you

are experienced and have not yet tried radio meteor monitoring, you will find it another piece of cake. If you are truly a rank newcomer, you are in for a rough ride, but you can get there - you Just have a longer breaking in period to gain the experience. If you are somewhere in between these extremes, you will probably derive more benefit from this article, since it intentionally targets amateurs who already have a working knowledge of things covered in the referenced articles.

Just as knowing the exit pupil size of your eyes is useful in selecting eyepieces for your telescope, a self-examination of which profile best fits you will help you decide what sort of mindset is needed to enter into any new endeavor.

## Progress to Date in the Radio Meteor Community

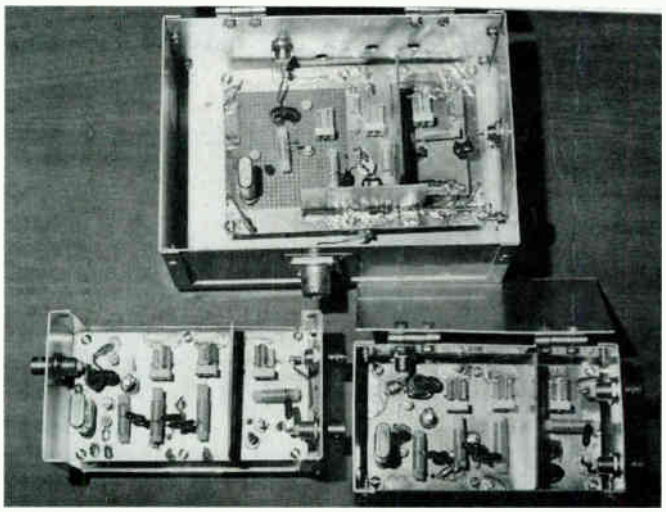
The books and articles referenced in the next section provide interesting and informative coverage of many aspects of meteor astronomy and the people, amateurs and professionals, who have been noteworthy contributors. Professionals such as Dr. John Evans and Dr. Fred Whipple have made major contributions to our knowledge of meteor astronomy, while the expertise and competent leadership of Dr. Charles Olivier interfaced with the amateur community to provide the primary data collection force during the middle years of the 20th century.

After portions of the VHF spectrum were opened to the ham radio community, radio amateurs became active in using meteor showers to set new long distance contact records. This is known as "meteor scatter," and whereas the radio amateur's primary interest is more in communications than in the meteors, great strides were made in meteor detection technology which have greatly benefited current workers who are more interested in the meteor showers.

Observations of meteor activity have been carried out by two relatively separate and distinct groups of amateurs: those who observe visually and those who observe by radio. The visual observers are an avid and competent legion of meteor enthusiasts. Their observing sessions are limited to clear nighttime skies, but all meteor parameters such as color, trajectory, event times (for fireballs), magnitude, radiant, trail length, fragmentation, possible impact, etc., can be accurately observed and recorded. The visual observer also experiences such amenities as loss of sleep, frostbite, mosquitoes, getting lost, etc. The dedicated visual observer will always swear that any inconvenience and discomfort is worth obtaining quality data.

The other unique meteor enthusiast is the amateur who uses radio techniques to monitor meteor activity. This approach cannot provide as many event parameters as visual observing, but the monitoring can run continuously to provide relatively accurate qualitative hourly counts. If the observer has progressed to the stage where the observing station has been mechanized to run continuously, remarkably accurate hourly counts can be collected to generate a count profile of the meteor shower as seen from that station.

The last three decades have seen a huge upsurge, nationally and internationally, in both radio and visual meteor observing. The radio community has benefited from spectacular advances in several forms of electronics technology, including precision receivers, sophisticated signal processing, and high speed computers and software. This Is a very broad evaluation of where we are today, but most of the details will be well covered as the reader explores the articles and books referenced in the following section.



*Video IF subcarrier converters.*

## Reference Books and Articles

This list provides a basic library for someone getting started in radio meteor work, as well as far more in-depth coverage of advanced topics:

(1) *Meteor Showers: A Descriptive Summary* by Gary W. Kronk
(2) *Meteors* by Neil Bone
(3) *Fireballs, Meteors and Meteorites* by Harold R. Povenmire
(4) *An Amateur Radio Telescope* by G. W. Swenson, Jr.
(5) *The ARRL Handbook*
(6) *Observe Meteors* by David H. Levy & Stephen J. Edberg

All of the above books are quality publications. They all contain large amounts of informational overkill, in addition to the basics of what this article is all about.

Items 1, 2, and 3 are very readable and useable as reference texts. 1 is particularly good for the meteor worker who closely follows activity all year. Number 4 has a detailed description of the radio astronomy converter which can be modified to cover several TV channels and the FAA 75 MHz beacons described later.

*Operating stations.*

Number 5 is a gold mine of information about virtually every aspect of radio, and provides necessary information on things like antennas and feed lines. Number 6 is primarily about visual observing.

Many articles have been written on how to set up and use a monitoring station, what modes and frequencies to use, and the types of output that are obtainable. Rather than present an endless listing of articles and authors, we are going to start the ball rolling by listing three articles which basically cover just about every approach the amateur can use to set up a station and monitor meteors, while at the same time referencing other authors and articles.

*Three for the Money* by W. H. Black, K4BSN (*SARA Journal* May 1989)
*Radio Detection of Meteors* by Philip Gebhardt (*SARA Journal* March/April 1996)

The first referenced article, written by the author of this article, is a comprehensive review of radio meteor monitoring using TV and beacon frequencies. This article in particular references other valuable resources for workers electing to use ham radio and communications type receivers, and who have considerable building and experimenting capabilities.

The second article is primarily well suited for those who choose to design their monitoring station using FM techniques.

If you choose to extend your search for additional details and ideas, try the following leads:

Joe Reisert, W1JR, has published numerous excellent articles in *Ham Radio* magazine on using radio meteor detection techniques to enhance VHF communications capabilities. Check your local library for an interlibrary loan of previous *Ham Radio* articles.

Contact the American Radio Relay League for a subject index from the past ten years or more to locate meteor articles. There have been some fine articles published in *QST*, particularly one in 1989 by Michael Owen, W9KP.

A somewhat more obscure source is the International Meteor Organization. They are headquarted in Europe, but you can contact them through *Sky & Telescope*. A subject index covering the publications in *Sky & Telescope* will turn up several articles about both radio and visual meteor monitoring.

If you are going to be a successful radio meteor worker, you will have to become proficient at organizing your station and your programming. Here is a good place to start. There is no cookbook to tell you what to buy or exactly how to do everything. It is a matter of trial and error until the pieces come together.

## List of Beacon Frequencies

The successful radio meteor station must have a continuous input signal. This is why around-the-clock TV and FM stations are used. In addition to these, beacon signals can be used, such as the FAA beacons on 75 MHz. Also, many beacons

### TABLE 1: 10-Meter Amateur Radio Beacons Suitable for Meteor Reception Work

**NCDXF/IARU International Beacon Network on 28.200 MHz**
This table gives the minute and second within each hour of the start of the first transmission on 10-meters. Each transmission is repeated every three minutes. A transmission consists of the callsign of the beacon sent at 22 words per minute followed by four one-second dashes. The callsign and the first dash are sent at 100 watts. The remaining dashes are sent at 10 watts, 1 watt and 0.1 watts. The actual starting time of each transmission is approximately twenty milliseconds after the nominal time due to the keying delay of the transmitter. Equipment used at each beacon site includes a Kenwood TS-50S transmitter, a Cushcraft R-5 vertical antenna, a Trimble Navigation GPS receiver, and a controller built by the NCDXF. For more information, contact the Northern California DX Foundation, Post Office Box 2368, Stanford, CA 94309-2368, USA.

| Slot | Country | Call | 28.200 | Operator | Status |
|---|---|---|---|---|---|
| 1 | UN | 4U1UN | 00:40 | UNRC | On the air, temp ant |
| 2 | Canada | VE8AT | 00:50 | RAC | On the air, temp site |
| 3 | USA | W6WX | 01:00 | NCDXF | On the air |
| 4 | Hawaii | KH6WO | 01:10 | UHRC | On the air, temp site |
| 5 | New Zealand | ZL6B | 01:20 | NZART | Expected on air 4/97 |
| 6 | Australia | VK6RBP | 01:30 | WIA | On site in VK6, expected on air soon |
| 7 | Japan* | JA2IGY | 01:40 | JARL | On the air |
| 8 | Russia | UA.. | 01:50 | ? | Locating site |
| 9 | China | BY... | 02:00 | CRSA | Locating site |
| 10 | Sri Lanka | 4S7B | 02:10 | RSSL | On the air |
| 11 | South Africa | ZS6DN | 02:20 | ZS6DN | On the air |
| 12 | Kenya | 5Z4B | 02:30 | RSK | On the air |
| 13 | Israel | | 4X6TU | 02:40 | U Tel Aviv On the air |
| 14 | Finland | OH2B | 02:50 | U Helsinki | On the air |
| 15 | Madeira | CS3B | 00:00 | ARRM | On the air |
| 16 | Argentina | LU4AA | 00:10 | RCA | On the air |
| 17 | Peru | OA4B | 00:20 | RCP | Ready to ship |
| 18 | Venezuela | YV5B | 00:30 | RCV | On the air |

*Notes: The JA2IGY beacon is currently licensed only for 14.100 MHz operation.
The complete time table and frequencies of operation for these beacons can be obtained from the NCDXF, P.O. Box 2368, Stanford, CA 94309-2368, USA, or on the World Wide Web at URL: **http://www.ncdxf.org/beacon.htm**. We are only interested in the 10-meter beacons for meteor reception work.
There are also other amateur radio beacons that operate continuously on 10 meters. A good list to consult is on the worldwide web is at URL: **http://www.lehigh.edu/lists/tenten-l/beacons.html** This list is maintained by Russ Gauthier, N5EJS in Pollock, Louisiana.

are authorized for usage by ham radio operators. These are usually low power beacons, generally in the one to ten watt power level, and although designed for testing for propagation path openings, they may provide a workable source for meteor detection's. All of the frequencies are within the authorized ham bands, and are listed in Tables 1/2/3.

## Helpful Affiliations

Even after reading this article and acquiring some of the suggested books and articles, anyone deciding to become actively involved in radio meteor work may still be confronted with many perplexing loose ends, and the less experienced newcomer types may not even know how and where to get started.

Since the primary subject matter is radio, joining a radio club can open a lot of doors. The vast majority of successful radio meteor enthusiasts are hams, so getting into ham radio is a great place to start. You may luck out and be able to find some on-hands help from hams who have themselves played around with radio meteor work. At the very least, you can get help with receivers, antennas, terminology, etc., and that is important, as the single most important entity in being a radio meteor observer is understanding and operating the receiving station. If you need help in identifying the nearest ham radio club, contact the American Radio Relay League.

The same thing applies to adding some slope to the learning curve into the astronomical aspects of this new project. You will learn faster and enjoy it more by affiliating with an astronomy club. Beyond basic radio in the ham clubs and basic meteors in the astronomy clubs, there is an incredible world out there of interesting things to do and interesting people who will share your enthusiasm.

Some organizations, such as the Society of Amateur Radio Astronomers, have mentor groups available to their members.

If you live in Podunk, USA, and a club affiliation is out of the question, start your own club, or search for people in the area with kindred interests. If you are many miles from a big city, spend more time observing meteors visually.

Some of this might sound a bit sarcastic, but it is intended only to emphasize that getting into new, relatively established projects usually requires innovative approaches. Few, if any, areas of amateur activity are so devoid of black-and-white guidelines, or force the participants to fend for themselves as much as does radio meteor work.

## The Future of Radio Meteor Monitoring

Predicting the future of anything involves going out on a limb, and that is always risky business. The last twenty years or so have seen radio meteor monitoring make inroads into the amateur community as more of an interesting toy than a scientific tool. Not everyone will agree with that, but the truth is that the usage of amateur radio techniques to detect meteors is currently stuck on a very broad plateau: without the support of either the amateur or the professional community, it will likely stay there indefinitely.

How does one take something which appears to be so interesting and useful and say that it is more of an interesting toy than a scientific tool? This distinction was alluded to earlier, but in case it got by you, remember that radio detections cannot absolutely certify a meteor event to the same degree of certainty that the visual observer can. Hearing a ping tells you almost nothing except that a meteor event probably occurred. The uncertainties inherent in such a detection system have gained radio work little or no acceptance in the visual community.

There are tons of debris in orbit around the earth, and any piece, large or small, that falls to earth will sound like a meteor if detected by an amateur radio detection system. It might also look like a meteor to a visual observer, but the visual observer could see things such as velocity, trajectory, etc., which might help identify it as something other than a meteor.

The bottom line is that, although radio meteor work is an interesting and even a useful hobby, the establishment of its credibility is going to have to come from within the amateur community. Somehow, someday, someone is going to have to come up with a reliable detection system that enables the system to do all the things that visual observers can do. When coupled with the existing ability of the current systems to run continuously, that accomplishment will bring considerable recognition to some amateur. It will most certainly move the radio meteor monitoring community off that very broad plateau. ST

**TABLE 2**

**2-Meter Amateur Radio Beacons Suitable for Meteor Reception Work**

| Frequency (MHz) | Amateur Radio Call | Grid Location |
|---|---|---|
| 144.126 | OE3XAA | JN88BA |
| 144.150 | OZ3VHF | JO55HL |
| 144.180 | UZ3PWJ | KO93BD |
| 144.399 | UB5R | KO51HU |
| 144.805 | IT9A | JM67LX |
| 144.810 | IS0A | JN40SX |
| 144.815 | I4A | JN54LG |
| 144.820 | I7A | JN71UR |
| 144.825 | I0A | JN61ES |
| 144.830 | 9H1A | JM75FV |
| 144.830 | I1G | JN35SH |
| 144.840 | IT9G | JM68QE |
| 144.845 | IX1A | JN35OQ |
| 144.845 | PI7PRO | JO22NC |
| 144.846 | DB0KI | JO50WC |
| 144.852 | DL0UB | JO62QL |
| 144.852 | OH2VHF | KP10VJ |
| 144.855 | DB0FAI | JN58IC |
| 144.855 | LA5VHF | JP77KI |
| 144.855 | OE5XFO | JN77 |
| 144.858 | FX2VHF | JO10EQ |
| 144.859 | FE6BPB | |
| 144.860 | LA1VHF | JO49GT |
| 144.865 | HB9HB | JN37NE |
| 144.865 | LA6VHF | KP59AL |
| 144.867 | EA1VHF | IN53UG |
| 144.870 | I2M | JN55AD |
| 144.870 | LA2VHF | JP53EG |
| 144.870 | OK0EJ | JN99FN |
| 144.870 | PI7ZWL | JO32BM |
| 144.875 | DB0GD | JO50AL |
| 144.875 | HB9W | JN47GJ |
| 144.875 | I2G | JN45ST |
| 144.875 | SK2VHF | JP94TF |
| 144.877 | EA4VHF | |
| 144.880 | IV3A | JN65 |
| 144.880 | LA3VHF | JO38RA |
| 144.885 | OK0ED | JN99BO |
| 144.885 | OY6VHF | IP62OA |
| 144.887 | EA7VHF | |
| 144.890 | I8A | JM78WD |
| 144.890 | SK2VHG | KP07MV |
| 144.907 | EA8VHF | |
| 144.910 | DL0PR | JO44JH |
| 144.911 | F6KJD | JN26QE |
| 144.915 | DB0JW | JO30DU |
| 144.915 | GB3MCB | IO70OJ |
| 144.916 | OK0EA | JO70UP |
| 144.917 | EA6VHF | JM08PV |
| 144.920 | EI2WRB | IO62IJ |
| 144.920 | FX9VHF | JN23RH |
| 144.920 | SK7VHF | JO65KJ |
| 144.925 | GB3VHF | JO01DH |
| 144.927 | DB0JT | JN67JT |
| 144.927 | EA9VHF | |
| 144.930 | OZ7IGY | JO55VO |
| 144.930 | YU2V? | JN83HG |
| 144.935 | DB0LBV | JO61EH |
| 144.935 | PI7CIS | JO22DC |
| 144.936 | SK0VHF | JO99AK |
| 144.937 | TF3VHF | HP84PA |
| 144.940 | DL0UH | JO41RD |
| 144.940 | SK3VHF | JP80 |
| 144.943 | FX7THF | JN37KU |
| 144.945 | GB3EGI | IO74 |
| 144.945 | OH9VHF | KP36OI |
| 144.945 | SP3VHG | JO71SW |
| 144.950 | CT0SAT | IM59SK |
| 144.950 | S55ZRS | JN76MC |
| 144.950 | SK1VHF | JO97CJ |
| 144.955 | FX4VHF | JN05SD |
| 144.957 | YO2KHP | KN05OS |
| 144.960 | SK4MPI | JP70NJ |
| 144.965 | DF0ANN | JN59PL |
| 144.965 | GB3LER | IP90JD |
| 144.965 | OK0EB | JN78DU |
| 144.968 | SP6VHF | JO70VP |
| 144.970 | OK0EO | JN89QQ |
| 144.970 | SP8VHA | KO11FF |
| 144.970 | TF1VVV | IP04 |
| 144.975 | DL0SG | JN68EQ |
| 144.975 | GB3ANG | IO86LN |
| 144.978 | OK0ET | KN08SU |
| 144.980 | OK0EC | JO60CF |

**By John A. Magliacane**
magliaco@email.njin.net

# Feeling "Experimental"?

Haven't got a callsign? Are routine communications via OSCAR satellites getting boring? As it turns out, there's still plenty the amateur satellite program has to offer those without amateur radio licenses or satellite uplink capabilities.

For nearly 16 years, at least one OSCAR satellite—and for a five year period, two OSCAR satellites—have been available for educational and scientific purposes. These spacecraft, known officially as UoSAT-OSCAR-9 and UoSAT-OSCAR-11, were designed and built by the Electrical Engineering Department at the University of Surrey, in Guilford (England) to meet educational, research, and scientific objectives.

The first satellite, UoSAT-1 (later named UoSAT-OSCAR-9 after successful launch), was launched in 1981 and decayed in the Earth's atmosphere in 1989. The second satellite, UoSAT-2 (later named UoSAT-OSCAR-11 after successful launch), was launched in 1984 and is still operational after 13 years of service.

## The UoSATs

OSCARs 9 and 11 were launched in the 1980s when a number of Phase II OSCAR satellites were in operation. All OSCAR satellites at that time had been launched free of charge because of their potential value for scientific work, educational applications, and disaster communications. Rather than duplicate the efforts of the existing OSCAR fleet, the early UoSAT satellites were instead designed with the following educational and scientific mission objectives in mind:

- To provide radio amateurs and professional scientists with a readily available tool to carry out studies of the near-earth electromagnetic environment and the relationship between solar and geomagnetic disturbances and their effect on radiowave propagation between HF and microwave frequencies.

- To stimulate a greater degree of interest in space sciences in schools, colleges, and universities by active participation, by ensuring that the experiments and housekeeping data are transmitted in such a manner that they are easily available, not only to professional scientists, but also those users with very simple, low-cost ground stations.

- To broaden the scope of the amateur space program and to cater to the interests of the "amateur scientist."

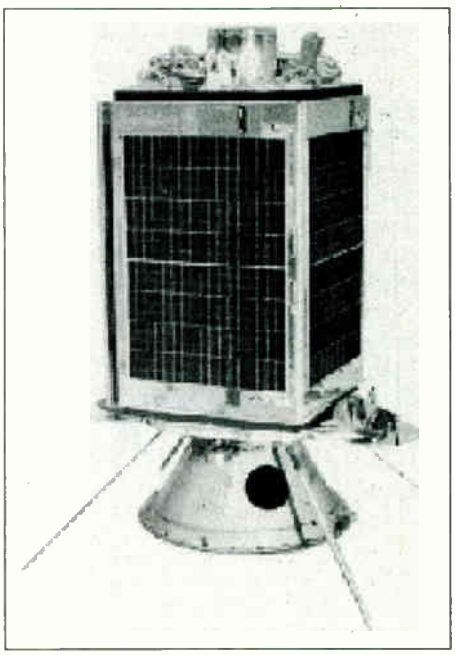
- To evaluate novel methods and new frequencies for use with later amateur spacecraft.

- To examine and demonstrate the feasibility of the design and construction of a relatively small and inexpensive spacecraft capable of a significant contribution to the scientific, engineering, amateur, and educational communities.

## UoSAT-OSCAR-9

UoSAT-OSCAR-9 was launched into a low-altitude sun-synchronous circular orbit by NASA on October 6, 1981, on a Thor Delta 2910 rocket from the Vandenberg Air Force Base (NASA's Western Test Range) in Lompoc, California, as a secondary payload to the Solar Mesosphere Explorer satellite. The orbit achieved by this launch allowed groundstation access to OSCAR-9 during the early afternoon hours, permitting reception by schools as well as scientists employed during regular business hours.

UoSAT-OSCAR-9 carried phase-locked 100 milliwatt HF beacon transmitters on the 10, 15, 20, and 40 meter bands for the purpose of carrying out ionospheric propagation studies. Microwave propagation studies were carried out through beacon transmitters on 2.401 GHz and 10.47 GHz. A three axis flux gate magnetometer was used for attitude determination, while a separate multi-range magnetometer was used to detect geomagnetic disturbances around the earth.



***Photograph of UoSAT-OSCAR-9 prior to launch. The CCD camera is located at the bottom of the spacecraft within a protective cone. The VHF turnstile antenna is also visible at the bottom. (Photo via SSTL Web Site)***

Finally, two LND type Geiger-Mueller tubes were used to detect and measure levels of ionizing radiation that were particularly useful in monitoring the activity of the sun and the effects solar storms have on the near-earth environment. An earth pointing CCD (charge coupled device) video camera rounded out the experimental payloads carried on-board the UoSAT-OSCAR-9 spacecraft.

The results of these experiments were relayed to groundstations through FM beacon transmitters operating on 145.825 MHz, 435.025 MHz, and 2.401 GHz. Data was available either in real-time or as Whole Orbit Dumps (WODs) that contained the readings of selected sensors archived over several earth orbits. A speech synthesizer designed around National Semiconductor's "Digitalker" chip set was also available to allow the reception of telemetry in plain

***UoSAT-OSCAR-9 was the first OSCAR satellite to use an on-board computer for battery and attitude management, remote control of experiments, and generation of whole orbit telemetry. Its mission ... demonstrated the viability of small, low-cost, yet sophisticated satellites to both the amateur and the commercial satellite world.***

English using nothing more than a handheld receiver and whip antenna. More traditional data formats used by UoSAT-OSCAR-9 included ASCII, Morse telegraphy, and 45.5 baud Baudot RTTY.

Table 1 shows on-board computer status information and a short news bulletin received from UoSAT-OSCAR-9 on February 8, 1988. The computer generated telemetry shown in Table 2 was captured n August 1989, just two months prior to OSCAR-9's fiery decay in the Earth's atmosphere.

UoSAT-OSCAR-9's on-board computer (OBC) was designed around an 8-bit RCA COSMAC 1802 microprocessor. After proving itself in OSCAR-9, the same processor was selected for use in several other OSCAR satellites, including AMSAT-OSCAR-10, AMSAT-OSCAR-13, and the new Phase III-D spacecraft scheduled for launch later this year.

The OBC supported eight parallel ports, two serial ports, and 16 kilobytes of dynamic RAM. A 16-bit Ferranti F100L processor was included as part of a backup computer, but was never placed into service as the primary computer never experienced a single failure. The on-board computer supported multi-tasking operating software written in IPS, a programming language developed by Dr. Karl Meinzer, DJ4ZC.

UoSAT-OSCAR-9 provided a powerful opportunity to evaluate IPS before the launch of AMSAT-OSCAR-10 and later satellites that used IPS to control their respective Integrated Housekeeping Units (IHUs).

UoSAT-OSCAR-9 was launched into an orbit having a mean altitude of only 550 kilometers. The expected lifetime of the spacecraft in such a low orbit is only about three and a half years. OSCAR-9, however, remained fully functional until its decay in the Earth's atmosphere more than eight years after launch. Its telemetry was received, decoded, and analyzed by thousands of radio amateurs, students, researchers, and scientists worldwide. Its Geiger counters were used not only to measure the high radiation levels that naturally occur over the Earth's poles, but were also used to monitor levels over Chernobyl after the nuclear power plant accident that occurred there in 1986.

## TABLE 1

1200 baud ASCII computer status information and news bulletin copied from UoSAT-OSCAR-9 on 145.825 MHz by KD2BD on February 8, 1988.

```
***UOSAT 1 COMPUTER STATUS INFORMATION***
COMMAND DIARY V1.1 IN OPERATION
UNIVERSAL TIME IS 00:04:16
DATE 08/02/88
AUTO MODE IS SELECTED
MEMORY WASH POINTER AT 18B3H
LAST CMD SENT BY COMPUTER WAS 29H TO 1
LAST CMD RECD BY COMPUTER WAS 7DH TO 0 WITH DATA 00H
CURRENT WOD COMMENCED AT 00:00:00
DATE 08/02/88
SURVEY INCLUDES CHANS 03,23,43,
WHOLE ORBIT DATA COLLECTION IN PROGRESS

****  UOSAT-OSCAR-9 Bulletin-220a  4th February 1988  ****

                UoSAT Spacecraft Control Centre,
              University of Surrey, England

                ** Operations **
Hopefully you received the CCD image taken and transmitted on Wednesday. This Wednesday (10th) we
shall be transmitting a plain carrier in order to carry out some doppler range measurements. There should be
another picture next week.
                                G1VRL

              ** UoSAT 'USER' SURVEY **
PLEASE REMEMBER to send a postcard/QSL/letter to UoS if you receive UO-9 or 11.

                ** UO-1 SCHEDULE **
The Diary will transmit a sequence of TELEMETRY, BULLETIN, & WOD except at the following times:-

        100288 0600 - 1100 UTC when CW commands are sent
        100288 1100 - 2359 UTC when CW is on
        110288 0000 - 1500 UTC when digitalker is on
        110288 1500 - 2000 UTC when housekeeping commands are sent
        170288 0600 - 1100 UTC when a CCD picture is taken
        170288 1100 - 2359 UTC when the picture is transmitted
        180288 0000 - 1500 UTC when digitalker is on
        180288 1500 - 2000 UTC when the new diary is loaded

WOD surveys will be as follows:-

050288 18,22,30     060288 3,13     070288 3,13     080288 3,23,43
090288 1,3,13       120288 8,30,39  130288 3,13     140288 3,13,28
150288 3,13         160288 3,13,28

The 21 MHz beacon is ON. The 2.4GHz beacon will remain OFF.
```

## TABLE 2

**ASCII telemetry transmission received from UoSAT-OSCAR-9 by KD2BD on August 10, 1989, two months prior to orbital decay.**

```
UOSAT-1     8908100013659     COMPUTER GENERATED TELEMETRY
0010010112020267650300030400040578 1B06655007586C08511D09646D
1010001111001200031300021402341533151638591772651852 0E19647D
2020002139092258492313562400532542672643302727332853592962 96
3027063111023266013325 8F34010635269B36334137485D38543939665F
40080C4112064273134300074419 5D450001460013475350485559495811
5006035111045226 9A53090F5469865541365644565752365855 1C595595
```

***Before GPS became a household word, UoSAT-OSCAR-11, along with American and Russian search and rescue satellites, was used in support of a transpolar SkiTrek expedition across the Arctic continent. The expedition began on March 3, 1988, and was tracked via OSCAR-11's Digitalker by thousands of people worldwide, including the skiiers themselves.***

UoSAT-OSCAR-9 was the first OSCAR satellite to use an on-board computer for battery and attitude management, remote control of experiments, and generation of whole orbit telemetry. Its mission was a success on all accounts, and it clearly demonstrated the viability of small, low-cost, yet sophisticated satellites to both the amateur and the commercial satellite world.

## *UoSAT-OSCAR-11*

After UoSAT-OSCAR-9 had been in orbit for about two years, the UoSAT team learned that NASA's LANDSAT-4 Earth resources satellite was suffering a series of problems and a replacement satellite was urgently needed. The time scale for the replacement satellite was such that it was possible to launch a secondary payload along with the LANDSAT replacement only if the payload could be built and interfaced with the launcher in just five months. The University of Surrey rose to the challenge, successfully designed and built a second UoSAT satellite in record time, and had it launched from Vandenberg Air Force Base on March 1, 1984, along with the spacecraft that was later known as LANDSAT-5.

UoSAT-OSCAR-11 was designed to complement UoSAT-OSCAR-9 and expand the set of experiments available for radio amateurs, students, and scientists. Although similar in construction, UoSAT-OSCAR-11 is 40 percent smaller and 20 percent heavier than UoSAT-OSCAR-9. UoSAT-OSCAR-11 carries new experiments such as a Digital Communications Experiment (DCE), a Space Dust Experiment, a Digital Store and Readout Experiment (DSR), digital sun and Earth horizon sensors, particle detectors, and Particle Wave Correlator and Electron Spectrometer experiments.

Unlike UoSAT-OSCAR-9, UoSAT-OSCAR-11 does not contain HF beacon transmitters, but it does contain a CCD Earth imaging camera, a Digitalker, a navigation magnetometer, a telemetry subsystem, and data beacon transmitters similar to its predecessor.

## *Command Diary Software*

Like OSCAR-9, UoSAT-OSCAR-11 is controlled by an Integrated Housekeeping Unit (IHU) designed around an RCA COSMAC 1802 8-bit processor.

This processor controls all operations on the spacecraft under the direction of a "Diary" operating system written in IPS. IPS, or Interpreter for Process Structures, is a Forth-like threaded programming language developed specifically for multi-tasking industrial control-type operations. The language is fast, flexible, powerful, and efficient in terms of memory use. However, IPS does not lend itself too easily to math-intensive attitude control algorithms needed to control complicated spacecraft.

In November 1988, the Diary operating system on UoSAT-OSCAR-11 was replaced with one written in the high-level programming language Forth. The Forth Applied Diary (FAD) operating system has been working successfully ever since.

Whole Orbit Data transmissions are somewhat slower compared to what they were when IPS was used because the Forth operating system uses greater and longer interrupts. In addition, there is less memory available for Whole Orbit Data, and in order to store the same amount of data as was done under the IPS Diary, data compression techniques are used, therefore, all whole orbit data must go through a software decompression filter prior to transmission. Several new packetized binary telemetry data format transmissions were added under the Forth Applied Diary, and these new transmissions share downlink time with the older ASCII formats.


***The UoSAT-OSCAR-11 satellite and official project logo. (Photo via SSTL Web Site)***

## *OSCAR-11 in Real Life*

Before GPS became a household word, UoSAT-OSCAR-11, along with American and Russian search and rescue satellites, was used in support of a transpolar SkiTrek expedition across the Arctic continent. The expedition began on March 3, 1988, and was tracked via OSCAR-11's Digitalker by thousands of people worldwide, including the skiiers themselves. Educational packages were also developed so that students around the world could follow the progress of the skiiers across the polar region.

Members of the 1988 SkiTrek team carried emergency locator transmitters (ELTs) with them on their expedition. During their mission, they periodically keyed their ELTs so their positions could be recorded and calculated through the COSPAS/SARSAT constellation of search and rescue satellites. The positional information obtained through these satellites was relayed by Telex to UoSAT Control where it was programmed into the UoSAT-11 Digitalker. Members of the SkiTrek team could then hear their latitude and longitude information read out to them in plain English by tuning into UoSAT-OSCAR-11 with handheld 2-meter receivers during passes

**TABLE 3**

UoSAT-OSCAR-11 on-board computer status information received by KD2BD on March 22, 1997.

**** UoSAT-OSCAR-11 OBC ****
Diary Operating System V3.7

Date: 22 /3 /97 (Saturday)
Time: 20 :14 :17 UTC
Auto Mode is selected
Spin Period: - 363
Z Mag firings: 81
+ SPIN firings: 0
- SPIN firings: 35
SEU count -23401
RAM WASH pointer at B73B
WOD commenced 22 /2 /97 at 0 :0 :5
with channels 40 ,50 ,52 ,63 ,
Last Command 109 to 0 , 0
Attitude control initiated, Mode 3

***A number of demodulators have been developed for the reception of UoSAT-OSCAR-11 telemetry data and news bulletins. Simple designs are generally affected more by noise than those using synchronous detectors and correlation decoders.***

that occurred every 98 minutes.

UoSAT-OSCAR-11 also carries a Digital Communications Experiment (DCE) that acted as the precursor to the present constellation of "Pacsat" satellites. The DCE was designed around a National Semiconductor NSC-800 processor with 128 kilobytes of memory dedicated for its use. The Digital Communications Experiment was used by selected individuals in geographically diverse locations as a digital store-and-forward mailbox. Several DCE groundstations were also set up as gateways to the amateur Packet radio Network, and would pass between OSCAR-11 and the terrestrial packet radio network. The DCE has since grown obsolete now that a number of Pacsat satellites are available to service the general amateur radio community worldwide.

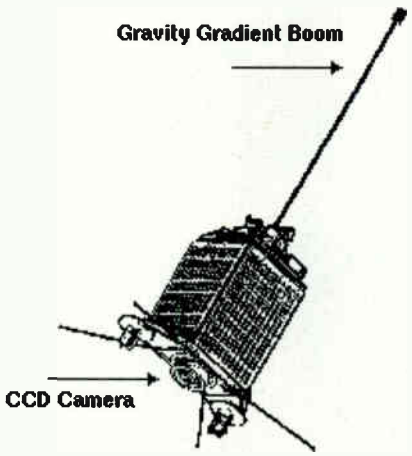
## Decoding UoSAT Data

UoSAT-OSCAR-11 transmits a wealth of news and telemetry data in a variety of different formats. Transmissions are usually made at a data rate of 1200 bits per second using synchronous AFSK modulation. The VHF downlink employs FM modulation on a frequency of 145.826 MHz through a left-hand circularly polarized antenna system.

Spacecraft transmissions may be received using a standard narrow-band VHF-FM receiver, a data demodulator, and a computer, serial printer, or data terminal. Data is conveyed using audio frequency tones of 1200 Hz and 2400 Hz.

A binary '0' (space) is transmitted as one cycle of a 1200 Hz tone, while a binary '1' (mark) is transmitted as two cycles of a 2400 Hz tone. ASCII data is sent using seven data bits, even parity, and two stop bits. Most terminal programs capable of "7E1" safely ignore the extra stop bit and function satisfactorily when copying UoSAT transmissions. UoSAT-OSCAR-9 used a similar transmission format, except the binary meaning of the audio tones were reversed from what they are for OSCAR-11.

A number of demodulators have been developed for the reception of UoSAT-OSCAR-11 telemetry data and news bulletins. Simple designs are generally affected more by noise than those using synchronous detectors and correlation decoders. An excellent UoSAT demodulator using such techniques was developed by James Miller, G3RUH, and described in the May 1983 issue of *Wireless World* magazine.




***Drawing of UoSAT-OSCAR-11 showing the CCD camera at the bottom and a gravity gradient boom at the top of the satellite structure.***

An actual UoSAT-OSCAR-11 telemetry frame is shown in Table 4. Each frame consists of a header followed by 70 channels of data. Each channel consists of six digits. The format for each channel is "NNDDDC" where "NN" is the channel identifier (00 to 59), "DDD" is the raw data value (000 to 999), and "C" is a checksum digit (0 to F).

The header consists of the satellite name followed by the date and time in "YYMMDDWHHMMSS" format, where "W" is the day of the week expressed in a number between 0 and 6.

The remaining lines contain telemetry data with 10 channels of data appearing per line. The three digit raw data value ("DDD") following the "NN" channel identifier may be substituted into appropriate calibration equations to convert the raw telemetry data into appropriate units of temperature, current, or voltage. Such equations may be found in *The Satellite Experimenter's Handbook*, published by the ARRL (available at Grove Enterprises), or the *UoSAT Spacecraft Data Booklet*, published by the University of Surrey.

The checksum character "C" provides a method of determining the integrity of the received data by adding a small amount of redundancy to the transmitted data. If all six characters of each channel (NNDDDC) are exclusive-ORed with one another, a zero result indicates a high probability the data was received correctly. Anything other than a zero result is cause for suspicion.

Channels 00 through 59 contain analog telemetry data, while channels 60 through 67 contain binary data representing 96 status points contained within the satellite telemetry subsystem. Channels 68 and 69 are not used and are normally set to zero.

Channel 66 contains the results of a space dust experiment carried on UoSAT-OSCAR-11. This experiment was built by a group of students at the University of Kent, and is similar to an experiment flown on the Giotto spacecraft. It consists of a dielectric diaphragm, which when punctured by large particles, discharges the capacitance associated with it, thereby indicating an impact. It is used in conjunction with a

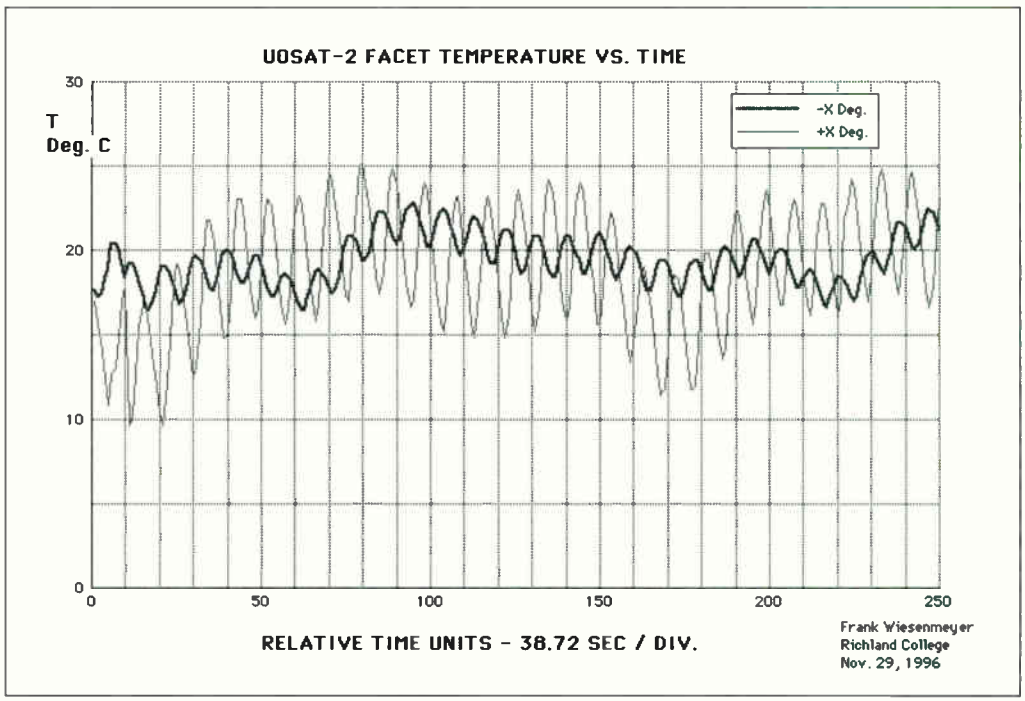
***Clive Wallis's monthly OSCAR-11 status reports are available in SpaceNews as well as AMSAT News Service bulletins. He has created a World Wide Web site that offers OSCAR-11 telemetry, whole orbit data, and software that can be used to decode and analyze the results of many of the experiments carried on the UoSAT-OSCAR-11 satellite.***

piezoelectric crystal microphone that detects smaller sized particles. The space dust count is always an interesting parameter to watch, particularly around the time of meteor showers and during periods of high solar activity.

Whole Orbit Data is generated from standard frames of telemetry data sampled every 4.84 seconds by a hard-wired telemetry system. WOD reports contain telemetry data for a selected number of telemetry channels taken over a period of time. Figure 4 shows the result of graphing such data as a function of time.

Telemetry decoding programs for a variety of computing platforms are available to decode raw telemetry from UoSAT-OSCAR-11, as well as many other OSCAR satellites. The software used to decode the telemetry shown in Table 4 and to produce the output shown in Table 5 was written by KD2BD for execution under the Linux operating system. It is available free of charge for non-commercial use via anonymous FTP from **ftp.amsat.org**.

Clive Wallis, G3CWV, authors a regular column on UoSAT-OSCAR-11 in *OSCAR News*, the newsletter of AMSAT-UK. Clive's monthly OSCAR-11 status reports are available in SpaceNews as well as AMSAT News Service bulletins. He has created a World Wide Web site that offers OSCAR-11 telemetry, whole orbit data, and software that can be used to decode and analyze the results of many of the experiments carried on the UoSAT-OSCAR-11 satellite. Clive's OSCAR-11 Web page may be accessed at: **http://www.users.zetnet.co.uk/clivew/oscar11.htm**.




***WOD data plot showing UoSAT-OSCAR-11's facet temperatures taken by K9CIS on November 24, 1996. This plot covers about half of the entire WOD survey. From this data, the spin period can be easily determined.***

**TABLE 4**

Raw telemetry received from UoSAT-OSCAR-11 on March 22, 1997 at approximately 20:06 UTC. Note that the time/date stamp on the telemetry header is incorrect in that it is two days ahead and several minutes fast.

```
UOSAT-2                    9703246201543
00179F01303102325603482D0404000503060601700704030803 5E090328
10507311289312000313057014170315613016192D173885183921194590
20445721228B22662223000124000625000726087B2740322841 2D294179
30515231033232286D335858340061352141362744373557383954394 30D
40750641114142647343060144162545000146000247407048427D493970
50569F5112615265265326 8A5469865556475619 0B57415258350B59417E
60A2A4615FC1625F4A633314644402651E0C661E8767F00E68000E69000F
```

## The future of UoSATs

The UoSAT program has been a tremendous success. In 1985, personnel and facilities at the Electrical Engineering Department at the University of Surrey were used to form a company called Surrey Satellite Technology Limited (SSTL). Since its inception, SSTL has expanded both its personnel and facilities to administer more than ten full-scale spacecraft projects. In May 1993, SSTL moved into the University's newly built Center for Satellite Engineering Research (CSER). CSER offers research facilities, post-graduate teaching in Satellite Communications and Satellite Engineering in addition to commercial satellite engineering activities.

Work is currently underway in the development of UoSAT-12, a mini-satellite due for launch later this year. UoSAT-12 will carry a sophisticated Earth Observation package that will include a high resolution mono-chromatic camera, as well as a set of multi-spectral cameras. An L-Band to S-Band "Merlion" digital communications transponder will also be carried on-board UoSAT-12.

## Conclusion

As one can see, there's more to amateur satellites than just two-way communications between groundstations. Although they don't often receive the media attention they truly deserve, UoSAT satellites play a very important role in the evolution of OSCAR satellite technology. They provide a superb platform for research and development that is crucial to the future of the amateur satellite program, and are valuable to educators, students, scientists, and researchers, all of whom are potential hams.

ST

*As one can see, there's more to amateur satellites than just two-way communications between groundstations. Although they don't often receive the media attention they truly deserve, UoSAT satellites play a very important role in the evolution of OSCAR satellite technology.*

## TABLE 5: OSCAR-11 telemetry report generated from raw data listed in Table 4

**UoSAT-2 Analog Status Channels:**

| | |
|---|---|
| [10] Solar Array Current (+Y) | 17.10 mA |
| [00] Solar Array Current (-Y) | 640.30 mA |
| [30] Solar Array Current (+X) | 1.90 mA |
| [20] Solar Array Current (-X) | 134.90 mA |
| [50] Battery Chrg/Dischg Curr. | 492.80 mA |
| [51] +14 Volt Line Current | 630.00 mA |
| [21] +10 Volt Line Current | 221.16 mA |
| [41] + 5 Volt Line Current | 110.58 mA |
| [31] -10 Volt Line Current | 15.84 mA |
| [33] 1802 Comp. Current (+10v) | 122.85 mA |
| [34] Digitalker Current (+ 5v) | 0.78 mA |
| [54] Telemetry Current (+10v) | 13.96 mA |
| [44] Command RX Current | 149.04 mA |
| [43] DSR Current (+5v) | 12.60 mA |
| [23] P/W Logic Current (+ 5v) | 0.00 mA |
| [24] P/W Geiger Current (+14v) | 0.00 mA |
| [25] P/W Elec Sp. Curr (+10v) | 0.00 mA |
| [26] P/W Elec Sp. Curr (-10v) | 8.09 mA |
| [14] DCE RAMUNIT Current | 14.87 mA |
| [15] DCE CPU Current | 212.95 mA |
| [16] DCE GMEM Current | 33.67 mA |
| [01] Navigation Mag X Axis | -23.13 uT |
| [03] Navigation Mag Y Axis | -0.98 uT |
| [02] Navigation Mag Z Axis | -20.02 uT |
| [04] Sun Sensor # 1 | 40.00 |
| [05] Sun Sensor # 2 | 30.00 |
| [06] Sun Sensor # 3 | 17.00 |
| [07] Sun Sensor # 4 | 40.00 |
| [08] Sun Sensor # 5 | 35.00 |
| [09] Sun Sensor # 6 | 32.00 |
| [35] 145 MHz Beacon Pwr O/P | 260.00 mW |
| [36] 145 MHz Beacon Current | 60.28 mA |
| [37] 145 MHz Beacon Temp. | 25.00 C |
| [45] 435 MHz Beacon Pwr O/P | Range? |
| [46] 435 MHz Beacon Current | 0.00 mA |
| [47] 435 MHz Beacon Temp. | 14.60 C |
| [55] 2.4 GHz Beacon Pwr O/P | 785.41 mW |
| [56] 2.4 GHz Beacon Current | 85.50 mA |
| [58] 2.4 GHz Beacon Temp. | 26.00 C |
| [52] Battery Voltage (+14v) | 13.69 V |
| [22] PCM Voltage (+10v) | 9.93 V |
| [42] PCM Voltage (+ 5v) | 5.43 V |
| [32] PCM Voltage (-10v) | -10.30 V |
| [17] Facet Temperature +X | 18.40 C |
| [27] Facet Temperature -X | 15.40 C |
| [18] Facet Temperature +Y | 17.60 C |
| [28] Facet Temperature -Y | 13.60 C |
| [19] Facet Temperature +Z | 4.20 C |
| [29] Facet Temperature -Z | 12.60 C |
| [38] Command Decoder Temp +Y | 17.00 C |
| [49] BCR Temperature -Y | 16.60 C |
| [39] Telemetry Temperature +X | 10.00 C |
| [48] P/W Temperature -X | 10.60 C |
| [59] CCD Imager Temperature | 12.60 C |
| [57] Battery Temperature | 13.00 C |
| [11] Nav Mag (Wing) Temperature | 11.88 C |
| [12] Horizon Sensor | 0.00 |
| [40] Solar Array Voltage (+30v) | 23.40 V |
| [53] Battery Cell Volts (MUX) | 5.63 V |
| [13] 435 MHz Beacon VCO Control | 0.28 V |

**UoSAT-2 Digital Status Channels:**

| | |
|---|---|
| Channel 60: | |
| 145 MHz General Beacon Power | On |
| 435 MHz Engineering Beacon | Off |
| 2401 MHz Engineering Beacon | On |
| Telemetry Mode Select | Run |
| TLM Dwell Address Load | Off |
| TLM Dwell Address Source | Gnd |
| Primary s/c Computer Power | On |
| Primary s/c Computer Errors | 3 |
| Primary s/c Computer Bootstrap | UART |
| Primary s/c Computer Bootstrap | A |
| Channel 61: | |
| G. Gradient Boom Deploy Pyros | Safe |
| G. Gradient Boom Deploy Pyros | Hold |
| G. Gradient Boom Deployment | Safe |
| G. Gradient Boom Deployment | Hold |
| G. Gradient Boom Deployment | Retract |
| Attitude Control Magnetorquers | Arm |
| Attitude Control Magnetorquer -X | Off |
| Attitude Control Magnetorquer -Y | Off |
| Attitude Control Magnetorquer -Z | Off |
| Attitude Control Magnetorquer | Fwd |
| 435 MHz Beacon PSK Mode | NRZI |
| 2401 MHz Beacon PSK Mode | NRZI |
| Channel 62: | |
| Attitude Control Magnetorquers | Hi Pwr |
| Digitalker Experiment Power | On |
| CCD Camera Experiment Power | Off |
| CCD Camera Integration Period | 3 |
| CCD Camera Video Amplifier Gain | 3 |
| Digital Store & Readout Power | On |
| Digital Store & Readout Mode | Read |
| Digital Store & Readout Mode | Reset |
| Rad. Detector Geiger-A EHT Power | Off |
| Rad. Detector Geiger-B EHT Power | Off |
| Channel 63: | |
| Rad. Detector Geiger-C EHT Power | Off |
| Electron Spectrometer EHT Power | Off |
| DCE Experiment Power | On |
| DCE Experiment | Run |
| DCE Experiment PROM Select | A |
| DCE Experiment CPU Clock | 0.9 MHz |
| Navigation Magnetometer Power | On |
| Space Dust Experiment Power | On |
| Status Calibrate | 0 |
| BCR Status | A |
| 435 MHz Beacon Modulation Select | AFSK |
| 2401 MHz Beacon Modulation Select | PSK |
| Channel 64: | |
| Command Watchdog | Enable |
| Command Watchdog Reset | Run |
| Channel 65: | |
| 435 MHz Beacon Data Rate | A |
| 435 MHz Beacon Data Rate | B |
| 435 MHz Beacon Data Rate | C |
| Particle Wave Counter Control | Reset |
| VHF/UHF Beacon Lockout Protect | Disable |
| Engineering Data | 2H |
| Channel 66: | |
| P/W Channel Plate Control | 0 |
| Space Dust | 244 |
| DSR Write Cycle Complete? | No |
| Channel 67: | |
| 1802 CWO Output | 1 |
| 1802 Telemetry Port | 700H |

## TABLE 6

Current UoSAT-OSCAR-11 operating schedule. The sequence repeats continuously, 24 hours a day. The satellite may be copied on 145.826 MHz FM when the satellite is in range, usually around 3 AM and 3 PM local time.

| | |
|---|---|
| ASCII Status | 210 seconds |
| ASCII News Bulletin | 60 seconds |
| Binary Single Upset Data | 30 seconds |
| ASCII Telemetry | 90 seconds |
| ASCII Whole Orbit Data | 120 seconds |
| ASCII News Bulletin | 60 seconds |
| Binary Engineering Data | 30 seconds |

By Larry Van Horn,
steditor@grove.net

# End of an Era

The U.S. Navy Navigation Satellite System, also known as TRANSIT, concluded its functional mission as a precise navigation aid on December 31, 1996.

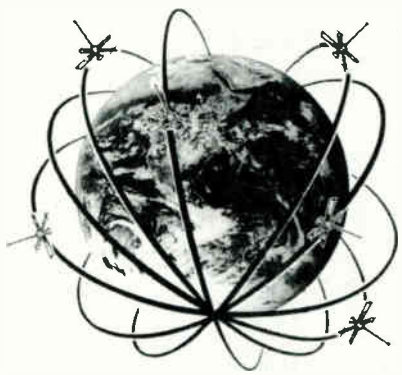
Developed in the 1960s, the TRANSIT constellation was the longest continuously operating satellite system placed in orbit by the United States. The navigation function of the TRANSIT system has been replaced by the Global Positioning System (GPS). The GPS system affords the U.S. military greater navigation accuracy and availability.

The installation of GPS receivers in all of the Navy Fleet Ballistic Missile (FBM) submarines was completed in December 1996, thus leading to the Navy's termination of the TRANSIT program.

The number of military and civilian users of the TRANSIT system is impossible to assess. However, in addition to military users, surveys indicated that over 80,000 receivers were manufactured for use by commercial and pleasure vessels.

The aging system presented specialized operations management concerns. Each satellite had the potential to develop unique anomalies, and dated ground equipment required on-going maintenance. Still, the TRANSIT system remained fully operational, providing uniform global coverage which met or exceeded system specifications, through the end of 1996.

The constellation consisted of two types of spacecraft designated as Oscar and Nova (see Table 1). The final constellation consisted of six satellites in a polar orbit with a nominal 600 nautical mile altitude, three ground control stations, and receivers (i.e., the system's users). Of the six satellites, three Oscars provided navigation service while three other Oscars were "stored-in-orbit" spares. The last TRANSIT satellite launch was in August 1988.



While TRANSIT will no longer broadcast navigation information, the satellites will continue to be used by the Navy. Beginning in January, the TRANSIT constellation was reconstituted as the space segment of the Navy Ionospheric Monitoring System (NIMS) project managed by the Naval Information Warfare Activity (NIWA). NIWA is an element of the Naval Security Group Command (NAVSECGRUCOM). NIWA will continue tracking the TRANSIT/NIMS satellites for NAVSECGRUCOM which has been tracking TRANSIT satellites since the early 1960s in support of on-going ionospheric refraction studies.

The unexpected loss of two satellites in 1996 reduced the operational TRANSIT constellation to three spacecraft. However, an additional three satellites stored in orbit are potential replacements.

TRANSIT/NIMS satellites can be heard on the following frequencies:

| | |
|---|---|
| 149.9787/399.9434 MHz | Testing Frequencies |
| 149.9873/399.9662 MHz | Operational TRANSIT Frequencies |
| 149.9880/399.9680 MHz | Operational TRANSIT Frequencies |

To aid you in searching for TRANSIT/NIMS activity, Table 2 is the latest list of Keplerian elements for the active satellites in the constellation. Good luck, and be sure to report your results to *ST's Satellite Listening Post.*

## Last LEASAT Retired

In addition to the TRANSIT satellites, another military satellite constellation has been retired. The last operational spacecraft within the constellation of LEASAT communications satellites used for over a decade by the U.S. military, was retired in February.

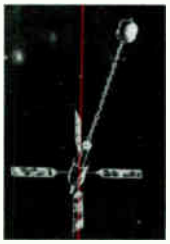
LEASAT was developed to augment the Navy's Fleet Satellite (FLTSAT) Communications System. The LEASAT program was a pioneering effort to provide dedicated communications services through a long-term lease arranged by the Navy for the Department of Defense. The lease provided that the U.S. military would pay for the use of communications channels aboard each spacecraft, but not until the system was built and placed into service.

The contract also specified that the LEASAT spacecraft be launched by the space shuttle. Built by Hughes Communications, Inc., the "wide body" satellites were designed with a 14-foot diameter to take full advantage of the room available in the space shuttle orbiters' cargo bay.

LEASATs were the first geosynchronous communications to incorporate integral propulsion. This innovation, when coupled with the satellite's folding antenna, made it possible for the spacecraft to fit comfortably in the cargo bay of the space shuttle, reducing the launch costs.

**TABLE 1: TRANSIT CONSTELLATION STATUS — 1996**

| Payload Designation | NAVSOC | Date Launched | Status | NSSC Number |
|---|---|---|---|---|
| NOVA 3 | 30500 | 10/12/84 | Power failure 11/8/93 | 15362 |
| NOVA 2 | 30490 | 6/16/88 | Operational | 19223 |
| NOVA 1 | 30480 | 5/15/81 | Power failure 3/3/91 | 12458 |
| SOOS 1 Lower | 30240 | 8/3/85 | Power system failed 9/1/90 | 15936 |
| SOOS 1 Upper | 30300 | 8/3/85 | Lost attitude, last pass 4/17/94, silent and not usable | 15935 |
| SOOS 2 Lower | 30270 | 6/16/88 | Operational | 18362 |
| SOOS 2 Upper | 30290 | 6/16/88 | Stored-in-Orbit | 18361 |
| SOOS 3 Lower | 30230 | 4/25/88 | Operational | 19070 |
| SOOS 3 Upper | 30320 | 4/25/88 | Stored-in-Orbit | 19071 |
| SOOS 4 Lower | 30250 | 8/24/88 | Operational | 19419 |
| SOOS 4 Upper | 30310 | 8/24/88 | Stored-in-Orbit | 19420 |
| Oscar 20 | 30200 | 10/30/73 | Power failure 1/25/95 | 6909 |
| Oscar 13 | 30130 | 5/18/67 | Power failure 1/10/89 | 2807 |
| Oscar 11 | 30110 | 10/27/77 | Power failure 04/08/88 | 10457 |



***The aging system presented specialized operations management concerns. Each satellite had the potential to develop unique anomalies, and dated ground equipment required on-going maintenance.***

The first two LEASATs were launched into geosynchronous orbit aboard the space shuttle *Discovery* in August and November 1984. LEASAT 3 was deployed in April 1985, but failed to boost itself into geosynchronous orbit. The spacecraft remained dormant until it was retrieved and repaired in orbit by another *Discovery* crew four months later.

The same mission launched LEASAT 4, but that spacecraft malfunctioned and became unusable. LEASAT 5, deployed in 1990 from space shuttle *Colombia*, completed the constellation by providing four geosynchronous communications satellites approximately 90 degrees apart.

**TABLE 2: Keplerian Elements of Active TRANSIT Satellites**

```
OSCAR 27/SOOS 2 Upper
1 18361U 87080A  97097.58282812  .00000046  00000-0  66429-4 0  2657
2 18361  90.3459 104.2185 0108619 313.3657  45.8479 13.43274377468528
OSCAR 29/SOOS 2 Lower
1 18362U 87080B  97097.56755233  .00000041  00000-0  56662-4 0  5676
2 18362  90.3492 104.2259 0110783 316.8931  42.3579 13.43007298468446
OSCAR 23/SOOS 3 Lower
1 19070U 88033A  97097.53180886  .00000026  00000-0  33522-4 0  2574
2 19070  90.3502  48.6011 0192941 127.3105 234.5795 13.26495635433248
OSCAR 32/SOOS 3 Upper
1 19071U 88033B  97098.41264707  .00000059  00000-0  10000-3 0  2568
2 19071  90.3462  48.7390 0190798 121.4122 240.5832 13.26714297433424
NOVA 2
1 19223U 88052A  97100.91479071  .00000038  00000-0  69746-4 0  5741
2 19223  90.0190  74.2648 0032834  56.7863 303.6393 13.21940571425566
OSCAR 25/SOOS 4 Lower
1 19419U 88074A  97099.03325342  .00000066  00000-0  10000-3 0  5629
2 19419  89.8090 103.2485 0095315 213.8015 145.7026 13.41020471421933
OSCAR 31/SOOS 4 Upper
1 19420U 88074B  97101.19255426  .00000066  00000-0  10000-3 0  2668
2 19420  89.8048 103.1467 0093984 204.1173 155.5559 13.41184687422273
```

Each LEASAT spacecraft provided 13 UHF communications channels, including a 500-kHz wideband channel. The satellites provided high-priority global communications for the Fleet as well as the former Air Force Strategic Air Command (SAC), and various Army combat units. Naval Space Command served as the operational manager for the system.

UHF satellite communications for U.S. forces are now being provided by a new constellation of UHF Follow-On (UFO) spacecraft, also built by Hughes. (Story courtesy of Gary Wagner, editor-Naval Space Command *Space Tracks* newsletter)

## *Air Force Launches New DMSP Weather Satellite*

The U.S. Air Force launched the latest Defense Meteorological Satellite Program (DMSP) spacecraft aboard a Lockheed Martin Titan II launch vehicle on April 4, 1997. Lockheed Martin Missiles and Space built the satellite under contract to the U.S. Air Force.

DMSP, operated by the Air Force, is used for strategic and tactical weather prediction to aid the U.S. military in planning operations at sea, on land, and in the air. Equipped with a sophisticated sensor suite that can image visible and infrared cloud cover, the satellite collects specialized meteorological, oceanographic, and solar-geophysical information in any weather conditions.

"The success of this launch and of the DMSP program are indicative of the long-term relationship that Missiles and Space has with the Air Force," said Missiles and Space President Mike Henshaw. "For more than 30 years, the Lockheed Martin-Air Force team has ensured that commanders have access to environmental data critical to the preparation and execution of military operations."

Within two hours of launch, the DMSP early-orbit team at Offutt Air Force Base, Omaha, Nebraska, began checkout procedures of the spacecraft, which were completed in mid-April. Once checkout was completed the satellite was turned over to the Air Force 6th Satellite Operation Squadron at Offutt Air Force Base, which has operational control of the DMSP constellation.

More than 30 DMSP spacecraft have provided strategic and tactical weather data for the U.S. military since 1966. A backlog of six satellites will be shipped to Missiles and Space for storage and functional testing and then shipped to Vandenberg when requested by the Air Force.

This launch marks the last of the Block 5D-2, the designation of the current generation of DMSP satellites. The next series, Block 5D-3, is in production at the Missiles and Space facility in East Windsor, New Jersey. Block 5D-3 satellites can accommodate larger sensor payloads. They also feature a larger power supply; a more powerful on-board computer with increased memory, which allows greater spacecraft autonomy; and increased battery power that will extend the life of the satellites from the current four years to five years.

Satellite F14 was completed and provided to the Air Force in 1990 and had been in storage in East Windsor since then. DMSP 5D-2 F14's international designator is 1997-012A, and the launch time was 8:47 p.m. Pacific Standard Time (0547 UTC April 5), according to Brian Webb in his *Astronomy/Space Alert* bulletin dated April 9, 1997.

Each of the above satellites is located at geosynchronous orbit, approximately 22,300 nautical miles in altitude over the equator. From geosynchronous orbital positions over the continental United States (CONUS), Atlantic, Pacific, and Indian Oceans, these spacecraft provide worldwide satellite communications for U.S. military forces. UHF frequency bandplans for the FLTSAT and UFO satellite constellations can be found on the Utility World web site at URL: **http://www.grove.net/~larry/uteworld.html** ST

**TABLE 3: U.S. Military UHF Communications Satellites**

The following satellites are currently active in providing U.S. military and National Command Authority users with ultra-high-frequency (UHF) worldwide communications.

| Satellite | Intl Desig/Cat No | Launch Date | Assigned Position |
|---|---|---|---|
| FLTSAT 7/USA 20 | 86-096A/17181 | Dec 5, 1986 | CONUS (100° West) UHF/EHF |
| UFO 6/USA 114 | 95-057A/23696 | Oct 22, 1995 | CONUS (105° West) UHF/EHF |
| FLTSAT 8/USA 46 | 89-077A/29253 | Sep 25, 1989 | Atlantic (23° West) UHF/EHF |
| UFO 7/USA 127 | 96-042A/23967 | Jul 25, 1996 | Atlantic (23° West) UHF/EHF |
| UFO 3/USA 104 | 94-035A/23132 | Jun 24, 1994 | Atlantic (15° West) UHF |
| FLTSAT 4/OPS 6394 | 80-087A/12046 | Oct 31, 1980 | Pacific (172° East) UHF |
| UFO 4/USA 108 | 95-003A/23467 | Jan 28, 1995 | Pacific (177° West) UHF/EHF |
| FLTSAT 1/OPS 6391 | 78-016A/10669 | Feb 9, 1978 | Indian Ocean (72° East) UHF |
| UFO 2/USA 95 | 93-056A/22787 | Sep 2, 1993 | Indian Ocean (72° East) UHF |
| UFO 5/USA 111 | 95-027A/23589 | May 31, 1995 | Indian Ocean (72.5° East) UHF/EHF |

By Donald E. Dickerson, N9CUE

# Space Odyssey

An odyssey, by definition, is an adventure of epic proportions. This makes the name that TRW chose for its new personal communication satellite system all the more appropriate. Not only is TRW's proposed system an odyssey in the type of service it hopes to provide, but also in the method chosen to deliver this service.

The mission is to provide truly worldwide personal communications via satellite. Odyssey will provide subscribers with voice, data, paging and messaging services to portable/mobile customers around the world via a small, cellular compatible flip-phone—a SpacePhone, if you will.

TRW hopes to begin launching elements of their Odyssey system by 1997 and has set a 1999 date for operations to begin in the industrialized world. With the traditional delays involved in space systems planning and development, they may make the symbolic date of 2001 if all goes well.

This 2001 space odyssey is based on a series of satellites placed into a medium earth orbit (MEO). This is the unique feature of Odyssey. With as few as 12 spacecraft, TRW could provide world wide coverage to their subscribers. The spacecraft will fly in three planes with 55 degrees inclination, at roughly 10,000 km or 8,000 miles. This constellation would keep two satellites visible at all times from any place in the world. Each spacecraft would be insight for approximately two hours and provide a high enough elevation angle to avoid interference from terrain, trees, buildings and other manmade objects. Minimum elevation is expected to be near 30 plus degrees.

It's the MEO that made Odyssey the unique system it is. This orbit allows you to provide world wide coverage with the smallest number of satellites. A LEO system would take between 48 and 77 spacecraft. The altitude also allows you to avoid atmospheric drag which can shorten the life span of a spacecraft in LEO.

Low altitude satellites can also encounter high levels of radiation from the Van Allen Belt while over the South Atlantic. In fact, this is known as the South Atlantic Anomaly. Radiation bombardment can damage spacecraft systems or completely destroy them in the blink of an eye.


***Qualcomm's new QCP series of DCDMA digital phones include their first dual-band, dual mode 1900 MHz CDMA digital PCS/800 MHz analog phone.***

The main advantage MEO systems have over GEO is considerable savings in launch cost, lower power requirements, better propagation characteristics and the most important item of all—a low cost, low power, lightweight, omnidirectional, handheld transceiver that customers can carry and use just like their cellular phone. These transceivers will use both terrestrial and satellite phone systems, truly making them a user friendly Space Phone. When the customer is out of range of ground based cellular systems, his handset will automatically access one of the waiting spacecraft of the Odyssey system.

Well, just how does this system work? Let's first take a look at the spacecraft. It is based on TRW's very successful Fltsatcom spacecraft which provides communications for the U.S. Navy, Air Force, and the National Command Authority. The Odyssey spacecraft will weigh in at over 2,500 pounds with a power capability of 1,800 watts. TRW plans to use the Ariane and Atlas launch vehicles to place the 12 spacecraft into orbit.

Even though the spacecraft will be in an orbit that avoids some of the radiation problems encountered at lower orbits, each satellite will be radiation hardened against both the Van Allen Belt and solar flare radiation. This, along with improvements in microelectronics, should help each spacecraft realize a life expectance of 10 years.

The spacecraft is a square with two solar wings. The top issued by the apogee engine, the bottom is covered with K-, C-, S-, and L-band omni antennas. Either side has an S- and L-band reflector respectively. Each has a 19 element configuration attached.

This 19 beam array is steerable and will allow phone conversations to continue without cell-to-cell handoff interruptions other systems might incur.

Each of the beams will have a five degree beamwidth. Each beam will also be assigned one third of the frequency allocation for this service (MSS or Mobile Satellite Service). This means that the 16.5 MHz wide satellite band will have three 5.5 MHz channels, three channels for uplink and three channels for downlink.

OK! so now you think you've found a weakness in the system, or at least a bottle neck, right? Well, think again. The three down link channels will be in the S-band. They will be centered at 2486.42, 2491.75, and 2497.06 MHz. The uplink channels will be centered on 1612.32, 1618.25, and 1623.58 MHz in the L-band.

I say "centered" because Odyssey will use Spread Spectrum techniques (SST). These SST transmissions from the space craft will use a CDMA (Code Division Mul-

***The main advantage MEO systems have over GEO is considerable savings in launch cost, lower power requirements, better propagation characteristics and the most important item of all—a low cost, low power, lightweight, omnidirectional, handheld transceiver that customers can carry and use just like their cellular phone.***

tiple Access) format. SST/CDMA was chosen over TDMA (Time Division Multiple Access) and FDMA (Frequency Division Multiple Access) because it does not require complicated and expensive frequency coordination between multiple users.

Another smart design feature of the Odyssey spacecraft is that they will not process any signals, but simply relay them between ground stations—both users and gateways—which interface terrestrial systems as needed. This keeps the system simple and inexpensive to design and operate.

TRW's system calls for the use of two gateway stations: One on the East Coast, the other on the West Coast. These stations are to provide control of the spacecraft systems, monitor telemetry, and process the signals from the users as needed and interface with ground telephone systems, computer networks etc. Each ground station (gateway) will be equipped with four ten foot tracking antennas. They will be spaced 30 km apart. Three of the antennas will be used to the main satellite passing overhead. The fouth antenna will track a second satellite so handover, when necessary, will take place without notice to the user. The antenna spacing is an important factor in this diversity reception technique. Rain can attenuate signals considerably at these frequencies. Rain cells are usually smaller than 30 km. This should keep two of the antennas in the clear no matter what the weather, assuring proper signal strength.

The ground stations will control the beam and frequency assignments for each caller by way of an order wire. This is an industry name for the control channel, possibly in the C-band. Each of the 19 beams have their own channel assignments and CDMA code. The typical cell or area covered by a single beam antenna is approximately 500 miles in diameter. Both channel coordination and satellite handoff, during long telephone conversations, are performed without the customer noticing.

***Qualcomm's "Q" phone is said to be the world's smallest and lightest CDMA digital PCS 1900 MHz phone, weighing about 5 ounces.***

The Odyssey handsets will look much like any cellular telephone handset and will work on either ground based cellular systems or TRW's satellite system. The handset will use an antenna of a quadrifilar helix design and have a 0.5 watt RF output for both voice and data modes.

## *Using the System*

So now let's take a walk through the system as we place a call from our Odyssey Space Phone. You turn the phone on and punch in your number. If you are out of range of ground based cellular, your handset will access one of the two Odyssey spacecraft overhead. You will be uplinking a signal on the order wire for coordination of your call at the same time your voice/data channel will be uplinked in spread spectrum techniques on a frequency in the L-band ( 1.6 GHz) with half a watt RF output. You will be assigned the beam with the strongest signal to a ground station.

The spacecraft will then downlink your signal using the frequency division multiplex (FDM) format at 20 GHz. The groundstation will then access another spacecraft with a 30 GHz FDM signal if you're calling Europe, for example. If the party on the other end is using a Space Phone the signal will be downlinked in SST/CDMA on a 2.4 GHz frequency. Your handset will then receive a 2.4 GHz S-band signal from the spacecraft to complete the loop. If the party you were calling has a regular telephone. The groundstation will dump your signal into a public switched telephone network (PSTN).

Odyssey, with two satellites in view, will be able to provide up to 4600 voice channels simultaneously and do it with cellular compatible, portable handheld units. The Odyssey Space Phone will provide world wide coverage with greater flexibility and lower cost than most other systems that have been proposed for this service. They can do it with fewer satellites, with longer life expectancy and fewer launch vehicles, which lowers the over all system cost considerably over LEO systems.

Odyssey is the first personal communications satellite system we have looked at in detail. Now that we have reviewed some of the ground breaking research and development that NASA/JPL and their contractors have done in this area. We will, in future PCS columns, consider other proposed mobile satellite services. Odyssey was chosen to be presented first because of its unique, flexible, practical, and intelligent design.....see ya next time around. ST

**By Keith Stein**
*kstein@erols.com*

# The International Band

Good to see everyone survived that spectacular explosion during the Delta/Global Positioning System launch on January 17, 1997. That was a bad one. About 13 seconds into flight the Delta exploded, raining the launch complex with debris. The GPS satellite lost in the failure is part of U.S. Air Force constellation of 24 satellites which provides highly accurate navigation data to military and civilian users around the world. GPS handheld receivers have been a big hit in the hobby community for driving, flying, biking, hiking—you name it. As long as you can see the satellites, you'll always know your latitude and longitude.

International use and development of satellite systems has exploded (no pun intended, McDonnell Douglas). In the mid-1980's it was strange to even think of a country like India having a space program: Well, they did, and still do. Taking a look at the 400-500 MHz band, you could nickname this "the international band," since everyone uses this area for satellite downlinks and more.

## COSMOS NAVSATs

Yep, here they are again. Seems we are always bumping into these Russian Musson navigation satellites during our surveys of the radio spectrum. Here is a look at the current Musson constellation, and a lot has changed since our last update in the March/April 1997 issue of *Satellite Times*:

## MUSAT

MUSAT is an Argentine satellite, designed to develop low cost technologies and promote space education. A CW (Morse code) signal can be heard on its VHF downlink, but its UHF downlink (400.950 MHz) has been reported to be coming from its onboard imaging system.

**THE RUSSIAN "MUSSON" NAVIGATION SATELLITE CONSTELLATION**

| | | |
|---|---|---|
| Military Navigation Satellites | | |
| Plane 1-149.97/399.92 MHz | Cosmos 2266 (22888) | Reactivated to replace failed Cosmos 2334 |
| Plane 2-149.91/399.76 MHz | Cosmos 2310 (23526) | Reactivated to replace Cosmos 2184 Feb 1997 |
| Plane 3-149.94/399.84 MHz | Cosmos 2218 (22207) | |
| Plane 4-149.97/399.92 MHz | Cosmos 2336 (24677) | Replaced Cosmos 2173 on Dec 25, 1996 |
| Plane 5-150.03/400.08 MHz | Cosmos 2142 (21230) | |
| Plane 6-149.94/399.84 MHz | Cosmos 2279 (23092) | |
| Civilian Navigation Satellites | | |
| Plane 11-150.00/400.00 MHz | Cosmos 2315 (23603) | |
| Plane 12-150.00/400.00/1544.5 MHz | Nadezhda 3 (21152) | |
| Plane 13-150.00/400.0 MHz | Tsikada (23463) | |
| Plane 14-150.00/400.00/1544.5 MHz | Nadezhda 4 (23179) | |

Note 1: Planes 1-6 are spaced 30 degrees apart to cover one Earth hemisphere. Planes 11-14 are spaced 45 degrees apart to cover the other hemisphere. Only one satellite is active in each plane.
Note 2: Signal is 50 bits/sec. There are three sidebands at 3, 5, and 7 kHz either side of the carrier. A "1" data bit is transmitted by a frequency shift from 3 to 5 kHz. The 7 kHz sideband produces timing.
Note 3: Nadezhda satellites carry COSPAS-SARSAT transponders with a 1544.50 MHz downlink. This downlink should only be active when the satellite is receiving a distress beacon on 121.5/243.0/406 MHz.

Contributors: Larry Van Horn (*Satellite Times*), Ivan Artner, *The Satellites Encyclopedia* (Jean-Phillipe Donnio), Geoff Perry (Kettering Group), NSSDC *Spacewarn Bulletin* and monitoring by the HearSat Newsgroup.

## NASA Deployed Operations Team

The following frequencies are used by NASA team members for administrative and logistical support of the deservicing and mating operations in the space shuttle program:
407.1, 407.325, 408.15, 408.8, 409.125, & 409.175 MHz

## NASA Headquarters

Located in southwest Washington, D.C., is the head management of the United States space program—the headquarters of the National Aeronautics and Space Administration (NASA).

U.S. space efforts are managed by a single building of approximately 1,100 government employees, not including contractors. The current administrator, Daniel S. Goldin, exercises overall management of the U.S. space program, fighting serious budget and job cuts. Broken up into 20 different lead divisions, the employees of headquarters have their hands full in coordinating the programs we radio hobbyists monitor.

Positioned in the west lobby, east lobby, and loading dock area is a contractor force of security guards handling visitors and package inspection.

A group of animal rights activists made a scary appearance on Halloween last year when they slipped into a public meeting inside the building chanting "Hey Dan Goldin, what do you say, how many monkeys have you killed today." Their objective was to get NASA to stop funding a joint U.S./Russian space mission using monkeys as test subjects.

Here are some frequencies used at NASA HQ and details on the security force;

| | |
|---|---|
| 170.305 | Wireless Mic |
| 171.045 | Wireless Mic |
| 171.905 | Wireless Mic |
| 408.400 | Security |
| 418.075 | Security |
| 463.625 | Maintenance |

***International use and development of satellite systems has exploded (no pun intended) Taking a look at the 400-500 MHz band, you could nickname this "the international band," since everyone uses this area for satellite downlinks and more.***

*NASA Headquarters Security Force Radio Callsigns:*

| CALL SIGN | DESCRIPTION |
|---|---|
| YANKEE 1 | Head Facilities Management and Security Section |
| FACILITIES | Headquarters Security Section Westside |
| OPERATIONS | Project Manager's Office |
| SILO 7 | Room CX40 |
| DRAGONS LAIR | Locksmith's Office |
| MACH 1 | Security Vehicle |

Other callsigns noted in use: ALPHA 1-7, ADAM 12, BRAVO 5, DELTA 1, PAPA 16, QUEEN 16, SIERRA 1, CENTRAL, DISPATCH, METROCOM, and RADIOMAN

*NASA HQ Security Levels (Security Alerts):*
1 Normal 2 Medium 3 High

*NASA HQ Codes (Performance/Appearance Level):*
1 Normal 2 Medium 3 High

*NASA Headquarters Security 10 Codes:*

| | |
|---|---|
| 10-2 | Transmit/receive well |
| 10-4 | Acknowledge/OK |
| 10-6 | Busy |
| 10-7 | Out of service |
| 10-8 | In service |
| 10-9 | Repeat transmission |
| 10-12 | Stand by |
| 10-13 | Officer in trouble |
| 10-14 | Request a Supervisor at |
| 10-17 | Meet complainant at |
| 10-18 | Meet officer/Supervisor at |
| 10-19 | Return to _____ |
| 10-20 | Present location |
| 10-21 | Call by phone |
| 10-22 | Disregard |
| 10-23 | On scene |
| 10-24 | Assignment complete |
| 10-25 | Report in person to _____ |
| 10-31 | Suspicious person/circumstances |
| 10-36 | Time/date check |
| 10-44 | Leave assigned area/request relief |
| 10-46 | Citizen assist |
| 10-61 | In the area |
| 10-65 | On meal break |
| 10-66 | Call home next break |
| 10-74 | Negative |
| 10-85 | Report Number |
| 10-89 | Bomb threat at _____ |
| 10-93 | Investigating the area |
| 10-97 | Alarm at _____ |
| 10-99 | Subject barred from premises/wanted by police |
| 10-100 | Parking Meter |
| 10-400 | Begin random inspections |
| 2665 | On portable on meal break |

## Amateur Radio Satellites

One of the best ways for a country to begin developing its own space program is to put together an amateur radio satellite project. Most of these microsats originate from small university groups, providing experience for students in a variety of fields.

These microsats use several different modes of communications; continuous wave (CW) telegraphy, radioteletype (RTTY), ASCII, and packet radio, just to name a few. With the limited space in *Satellite Listening Post*, we will go into these different modes some other time, but I did want to provide the following chart:

**MICROSATS**

| Name | Downlink (MHz) | Country |
|---|---|---|
| PACSAT | 437.025 | U.S. |
| | 437.050 | U.S. |
| WEBERSAT | 437.075 | U.S. |
| | 437.100 | U.S. |
| LUSAT | 437.125 | ARGENTINA |
| | 437.150 | ARGENTINA |
| JAS-1B | 435.795 | JAPAN |
| JAS-1B & FUJI/OSCAR 29 | 435.800-435.900 | JAPAN |
| JAS-1B & FUJI/OSCAR 29 | 435.910 | JAPAN |
| OSCAR 22 | 435.120 | U.S. |
| KITSAT A | 435.173 | SOUTH KOREA |
| EYESAT/AMRAD | 436.800 | U.S. |
| IT-AMSAT | 435.820 | ITALY |
| | 435.867 | ITALY |
| KITSAT B | 435.175 | SOUTH KOREA |
| | 436.500 | SOUTH KOREA |
| POSAT | 435.250 | PORTUGAL |
| | 435.280 | PORTUGAL |
| OSCAR 30 | 437.138 | MEXICO |
| | 437.206 | MEXICO |
| *MIR** SPACE STATION | 437.925, 437.95, 437.975 MHz | |

* Last year, Russia setup a new 70-cm amateur radio system aboard their Mir space station. The new radio gear is being used for voice and tape recorded messages transmitted from the crew on the above frequencies.

## FSW-2

FSW-2 is a Chinese microgravity satellite that debuted in August 1992 as an advancement from the FSW-0 and FSW-1 systems.

The FSW-2 model (479.97 MHz) carries 350 kg of experiments for earth resources and reconnaissance imaging.

## NASA's 26 Meter Subnet Closing Down

It appears that the last mission support provided by NASA's 26 meter antennas at Madrid (Spain) and Canberra (Australia) tracking stations will be space shuttle mission STS-86. Due to major budget reductions imposed by NASA Headquarters and a NASA proposal for a commercial ground network (CGN), the Jet Propulsion Laboratory (JPL) has developed a preliminary plan to decommission the use of their 26 meter antennas.

A third antenna, at Goldstone (California), will provide support through October 1997 to allow time for NASA's Dryden Flight Research Center (DFRC) upgrades and to complete the transition phase for STS operations from Goldstone to DFRC.

## NASA Mir/VHF Support

Currently, NASA's Wallops Flight Facility (WFF), Virginia, and Dryden Flight Research Center (DFRC), California, are providing *Mir*/VHF voice support 24 hours a day.

All DFRC weekend support is considered overtime, which includes controllers monitoring dead air time while the crew is asleep. A recommendation has been made that all weekend support be allocated to WFF only, since they are already manned on weekends and do not require overtime to support.

Radio frequency interference (RFI) has become a problem at WFF, probably originating from a local emergency service. Currently, 139.208/143.625 MHz (known as VHF 1) are the frequencies being used by *Mir*. There is some question as to whether 121.750/130.167 MHz (VHF 2) would be a good alternate set of frequencies to use; my advice is to stay tuned ...

***In March, Goddard Space Flight Center's Networks Division announced they have plans to put together a third Mir/VHF relay station located at the White Sands Missile Range, New Mexico.***

One side note: DFRC's dual Yagi antennas now being used for *Mir* VHF support will be upgraded to quads sometime this summer.

In March, Goddard Space Flight Center's Networks Division announced they have plans to put together a third *Mir*/VHF relay station located at the White Sands Missile Range, New Mexico.

## Rocket Launches from Virginia

Orbital Sciences Corporation (OSC) conducted two successful suborbital rocket launches for the U.S. Air Force's National Air Intelligence Center (NAIC) in February. The launches were carried out on February 12 and 23, 1997, from NASA's Wallops Flight Facility, Virginia. I was present at the Feb. 23 launch.

A 58-foot-long, three stage vehicle consisting of a Talos, Sergean,t and M57A1 stage was used. Liftoff occurred at 5:06 a.m. Eastern Time (1006 UTC) Feb. 23, reaching an altitude of 393 km and traveling 270 km down-range.

The rockets were carrying experiments designed to address a variety of issues related to national missile defense. The liftoff times and dates were planned to coincide with the Midcourse Space Experiment (MSX) satellite passing overhead so that it could provide optimal space-based viewing of the experiments.

Once the rockets reached their apogee, a green cloud of electrically charged particles of plasma was released which was visible to the naked eye.

With scanner in hand, I was able to log the following active frequencies:

| | |
|---|---|
| K760 | Wallops Information Station (AM) |
| M121.950 | NASA 432 (Fokker-27 aircraft, tail# N432NA), performing radar surveillance of ships in the water off the coast (AM). |
| M126.500 | Wallops Flight Facility Tower (AM) |
| M156.600 | NASA Control and Coast Guard units monitoring ship movements in the local area (NFM) |
| M156.800 | Coast Guard repeating "Notice to Mariners" to stay clear of launch area (NFM) |
| M164.700 | Range Safety Net (callsigns: Skyscreen 1, 2, and 3). Provided pre-launch countdown, launch, and post-launch status reports (NFM) |
| M170.400 | Voice paging system (NFM) |
| M171.000 | Security and fire units clearing the island of all personnel (NFM) |
| M171.150 | Security Net (NFM) |
| M425.000 | Flight Termination System (FTS) dead carrier heard (NFM) |

## NASA Supports White House Communications Agency

The White House Communications Agency (WHCA) has presented NASA with a certificate of appreciation for the outstanding manner in which the Agency provided the first Advanced Space Communications support to a train for the President of the United States through Ohio, West Virginia, Kentucky, Indiana, and Michigan. NASA provided critical command and control communications for the President and the White House staff.

## New Amateur Radio Satellites

A new Russian amateur radio satellite named *Radio Sputnik 16* (RS-16), was launched from Russia's new Svobodny launch site. The spacecraft reportedly has an average orbital altitude of 276 miles high.

Only hours after launch, listening posts around the world reported hearing strong signals from RS-16's CW beacon on 29.408 MHz. It's the first Russian satellite to have a 70-cm beacon. Beacon frequencies are 29.408, 29.451, 435.504, and 435.548 MHz.

| | |
|---|---|
| Uplink | 145.915-145.948 MHz |
| Downlink | 29.415-29.448 MHz |
| Beacons | 29.408/29.451 MHz |
| Power | 1.2/4 watts |
| Beacon 1 | 435.504 MHz |
| Beacon 2 | 435.548 MHz |
| Power | 1.6 watts |

Now let's take a look at what satellite communications you've been monitoring in the past two months.

| | | | |
|---|---|---|---|
| CW | Morse code | NASA | National Aeronautics and Space Administration |
| ER-2 | Earth Resources-2 aircraft | NFM | narrow FM |
| HALO | balloon/rocket launch vehicle | RS | Radio Sputnik |
| K | kilohertz | S-# | signal strength |
| KSC | Kennedy Space Center | UHF | Ultra High Frequency |
| LSB | lower side band | USB | upper side band |
| M | Megahertz | | |

| | |
|---|---|
| K3871.0 | High Altitude Lift-Off (HALO) Net heard from Cerro Gordo, NC, 1130, LSB (Ralph Wallio-W0RPK, Des Moines-Iowa) *They switched to K7155 LSB after propagation died-Keith* |
| K29408.0 | CW signal heard from newly launched RS-16 amateur radio satellite "RS16 P160 O0 N0 M12 L17 K92 J0 I0 H2 G0 F157 E10 N13 C7 B10 A7 RS16," USB, 0639 (Cliff Buttschardt K7RR-Morro Bay, CA) |
| M126.650 | Shuttle Landing Facility working NASA 945 and 947, shooting approaches to shuttle runway, AM mode (George Bortle KD4CBV-Florida) |
| M128.550 | KSC shuttle landing facility tower working with NASA search 3, simulcasting on M243.000 (Bortle-FL) |
| M261.475 | FLTSATCOM 8 (24 deg. West), S2W calling any station, sounded like a danish accent (Magnus Hammarstedt-Ostersund, Sweden) |
| M261.525 | FLTSATCOM 8 (24 deg. West), S8T working V1E with a radio check, had some problem with the crypto unit. Mentioned that they would try again on Friday (Hammarstedt-Sweden) |
| M261.625 | FLTSATCOM 8 (24 deg. West), Tripwire 40 calling Tripwire Base with no joy (Hammarstedt-Sweden) |
| M261.700 | FLTSATCOM 8 (24 deg. West), sounded like Workhorse calling Workhorse 6 with no joy (Hammarstedt-Sweden) |
| M294.600 | Cape Radio up with aircraft "1 Romeo," AM mode, then switched to 142.125 NFM (range safety during Atlas/Tempo 2 satellite launch) (Bortle-FL) |
| M296.700 | NASA 706 (ER-2 aircraft, tail# N706NA) heard at 2008 above 60,000 feet, AM mode (Rick-Sacramento, CA) |
| M435.504 | Beacon heard from amateur radio satellite RS-16 at 1740, also on M435.548. The M435.504 beacon was very strong, S-9, and the M435.548 beacon was very weak, S-1 (BJ Arts-Minnesota) |

---

Keith Stein is a freelance writer based in Woodbridge, Virginia. You can contact him through his Internet World Wide Web home page at: http://www.newspace.com/casr ST

# INTRODUCTION

***The Satellite Services Guide (SSG) is designed to keep the satellite listening enthusiasts up to date with the latest information available on a wide variety of hard-to-obtain space and satellite information. Many hours of personal observations and contributor reports have been compiled into this section. Errors are bound to happen, especially since services and elements sets change often, and geostationary satellites constantly change orbital positions. Care has been taken to check the accuracy of the information presented and it does represent the most current information available at press deadline.***

## How to Use the Satellite Service Guide

***The various sections of the SSG include:***

1. **Satellite Radio Guide** — This is a listing of audio subcarrier services that can be heard with a standard C-band (3.7 - 4.2 GHz) and in some cases a Ku-band (11.7-12.2 GHz) TVRO satellite system (no additional equipment is required). Services are broken down into various categories and provide the user with the satellite/transponder number and frequencies in megahertz of the various audio channels. These audio subcarriers are broadcasting on active TV channels that are either scrambled or not scrambled. You do not need a subscription for any of the radio services listed. Tuning in to an audio subcarrier will disrupt the TV sound, but not the TV picture. Listings with a 'N' are narrow bandwidth, 'DS' indicates discrete stereo.

2. **Single Channel Per Carrier (SCPC) Services Guide — A** SCPC transmitted signal is transmitted with its own carrier, thus eliminating the need for a video carrier to be present. Dozens of SCPC signals can be transmitted on a single transponder. In addition to a standard TVRO satellite system, an additional receiver is required to receive SCPC signals. Most SCPC signals will be found in the C-band.

3. **International Shortwave Broadcasters via Satellite** — This section of the SSG list all the various shortwave radio broadcasters currently being heard via satellite audio channels. Most of the channels listed are audio subcarriers and only require a C-band TVRO satellite system to monitor these broadcasts.

4. **DSS/USSB/Primestar Channel Listings** — This is a complete channel guide at press deadline of the channels and services found on the various direct broadcast satellite systems transmitting in the Ku-band (12.2-12.7 GHz). Addresses and telephone numbers are provided so that the reader can obtain additional information direct from the providers. We would be grateful if you would mention to these providers that you heard about their service from *Satellite Times* magazine.

5. **Satellite Transponder Guide** — This guide list video services recently seen from satellites transmitting in C-band located in the U.S. domestic geostationary satellite arc. A standard TVRO satellite system is required to view these services. White boxes indicated video services in the clear or non-video services. Gray shaded boxes indicated video services that are scrambled using the VideoCipher 2+ encryption system and are only available via subscription. Black boxes are video services that are scrambled using various other types of encryption schemes and are not available in the U.S. Transponders that are encrypted have the type of encryption in use listed between the brackets (i.e. - [Leitch]). O/V indicates that wild feeds, network feeds and other random video events have been monitored on that transponder. (none) means that no activity of any kind has been observed on the transponder indicated.

6. **Ku-band Satellite Transponder Services Guide** — This section of the SSG performs the same service as the C-band Satellite Transponder Guide listed above, but covers signals found in the Ku-band from 11.7 to 12. 2 GHz.

7. **Amateur and Weather Satellite Two Line Orbital Element Sets** — This section of the guide presents the current (as of press deadline) two line orbital element sets for all of the active amateur and weather satellites. These element sets are be used by computerized orbital tracking programs to track the various satellites listed.

8. **Geostationary Satellite Locator Guide** — This guide shows the space catalog object number, International payload designator, common name, location in degrees east/west and type of satellite/frequency bands of downlinks for all active geostationary satellites in geostationary orbit at publication deadline.

9. **Amateur Satellite Frequency Guide** — This guide list the various amateur radio satellites (hamsats) and their frequency bandplans. Most of the communications you will hear on these satellites will utilize narrow bandwidth modes of operation (i.e- upper and lower sideband, packet, RTTY, morse code). *Satellite Times* would like to thank the officers and staff of AMSAT for this use of this chart in the magazine.

10. **Satellite Launch Schedules** — This section presents the launch schedules and proposed operating frequencies of satellites that will be launched during the cover date of this issue of the magazine.

# Satellite Radio Guide

*By Robert Smathers and Larry Van Horn*

## AUDIO SUBCARRIERS

An audio sub-carrier requires the presence of a video carrier to exist. If you take away the video carrier, the audio sub-carrier disappears as well. Most TVRO satellite receivers can tune in audio subcarriers and they can be found in the range from 5.0 to 9.0 MHz in the video carrier.

Audio frequencies in MHz, All satellites/transponders are C-band unless otherwise indicated. DS=Discrete Stereo, N=Narrowband, W=Wideband

### Classical Music

| | | |
|---|---|---|
| SuperAudio—Classical Collections | G5, 21 | 6.30/6.48 (DS) |
| WFMT-FM (98.7) Chicago, IL. | G5, 7 | 6.30/6.48 (DS) |
| WQXR-FM (96.3) New York, NY, ID-*96.3 FM* | C4, 15 | 6.30/6.48 (DS) |

### Satellite Computer Services

| | | |
|---|---|---|
| Planet Connect, Planet Systems, Inc 19.2 kbps service | G4, 6 | 7.398 |
| | T402R, 4 | 7.398 |
| Planet Connect, Planet Systems, Inc 100 kbps service | G1, 9 | 7.80 |
| | T402R, 4 | 7.80 |
| Skylink, Planet Systems, Inc | G1, 9 | 7.265 |
| | T402R, 4 | 7.264 |
| | G4, 6 | 7.264 |
| Storyvision | G5, 3 | 7.30 |
| Superguide | G5, 7 | 5.48 |

### Contemporary Music

| | | |
|---|---|---|
| Radio Romance (from Philippines) | G4, 24 (Ku-band) | 6.20 |
| SuperAudio—*Light and Lively Rock* | G5, 21 | 5.96, 6.12 (DS) |
| Unidentified station —Upbeat music | C4,5 | 5.58 |
| WYEZ-FM 96.9 South Bend, IN | G4, 15 | 6.48, 7.30 (DS) |

### Country Music

| | | |
|---|---|---|
| SuperAudio—*American Country Favorites* | G5, 21 | 5.04/7.74 (DS) |
| Transtar III radio network | S3, 9 | 5.76/5.94 (DS) |
| WOKI-FM (100.3) Oak Ridge-Knoxville, TN., ID-*The Hit Kicker* | G6, 7 | 6.20 |
| WSM-AM (650) Nashville, TN | C4, 24 | 7.38, 7.58 |

### Easy Listening Music

| | | |
|---|---|---|
| IAM Radio-easy listening music | G4, 6 | 7.69 |
| SuperAudio—*Soft Sounds* | G5, 21 | 5.58/5.76 (DS) |
| Unidentified station-easy listening music | E2, 5 | 6.20, 6.80 (DS) |
| United Video—easy listening music | C4, 8 | 5.895 (N) |

### Foreign Language Programming

| | | |
|---|---|---|
| Arab Network of America radio network | GE-2, 22 | 5.80 |
| CBC Radio-East (French) | E2, 1 | 5.38/5.58 (DS) |
| | E2, 1 | 7.36 |
| DZMM-Radyo Patrol (from Philippines) | G4, 24 (Ku-band) | 6.80 |
| French language audio service | E2, 11 | 6.12 |
| Indian Sangeet Sager | E2, 16 (Ku-band) | 6.12 |
| KAZN-AM (1300) Pasadena, CA—Asian Radio | GE-1, 22 (Ku-band) | 6.20 |
| Northern Native Radio (Ethnic) | E2, 26 (Ku-band) | 6.43/6.53 (DS) |
| RAI Satelradio (Italian) | G7, 14 | 7.38 |
| Radio Canada (French) | E2, 11 | 5.40/5.58 (DS), 5.76 |
| Radio Dubai (Arabic) | G7, 10 | 7.48 |
| Radio Maria (Italian-Religious programming) | G7, 10 | 5.80 |
| Radio Maria | G7, 10 | 8.03 |
| Radio Sedeye Iran (Farsi) | S3, 15 | 6.20 (N) |
| Russian-American radio network | SBS5, 12 (Ku) | 6.20 |
| WLIR-AM (1300) Spring Valley, NY (Ethnic) | GE-1,18 (C-band) | 7.60 |
| WOPA-AM (1200) Chicago, IL (Spanish) | GE-1, 8 (C-band) | 6.80 |
| WROL-AM (950) Boston, MA—Irish music (Sat 1430-0000 UTC) | S3, 3 | 6.20 |
| XEW-AM (900) Mexico City, Mexico (Spanish), ID-*LV de la America Latina* | M2, 14 | 7.38 |
| XEW-FM (96.9) Mexico City, Mexico (Spanish), ID-*W-FM 96.9* | SD1, 7 | 7.38 |
| XEWA-AM (540) Monterrey, Mexico (Spanish), ID-*Super Estelar*—contemporary music | M2, 8 | 7.38 |

### Jazz Music

| | | |
|---|---|---|
| Jazz Worldbeat Radio (2300-0500 UTC) | T402R, 6 | 6.20 |
| KLON-FM (88.1) Long Beach, CA., ID-*Jazz-88* | G5, 2 | 5.58/5.76 (DS) |
| Superaudio—*New Age of Jazz* | G5, 21 | 7.38/7.56 (DS) |

### News and Information Programming

| | | |
|---|---|---|
| Business Radio Network | C4, 10 | 8.06 (N) |
| Cable Radio Network | C3, 23 | 7.24 (N) |
| CNN Headline News | G5, 22 | 7.58 |
| CNN Radio News | S3, 9 | 5.62 |
| | G5, 5 | 7.58 |
| Standard News | S3, 17 | 5.20 |
| WCBS-AM (880) New York, NY—news | G7, 19 | 7.38 |
| WCCO-AM (830) Minneapolis, MN | G6, 15 | 6.20 |

### Religious Programming

| | | |
|---|---|---|
| Ambassasor Inspirational Radio | S3, 15 | 5.96, 6.48 (DS) |
| Brother Staire Radio | G5, 6 | 6.48 |
| CBN Radio Network/Standard News | G5, 11 | 6.12 |
| Christian Music Network Lakeland, FL | GE-1, 14 | 6.20, 7.60 |
| KHCB-FM (105.7) Houston, TX | C1, 10 | 7.28 |
| Trinity Broadcasting radio service | G5, 3 | 5.58/5.78 (DS) |
| WHME-FM (103.1) South Bend, IN, ID-*Harvest FM* | G4, 15 | 5.58/5.78 |
| WROL-AM (950) Boston, MA (occasional Spanish) | S3, 3 | 6.20 |
| WWRL-AM (1600) New York City—Black Gospel | S3, 9 | 6.30/6.48 (DS) |
| Z-musis—Christian rock | G1, 6 | 7.38/7.56 |

### Rock Music

| | | |
|---|---|---|
| SuperAudio—*Classic Hits*-oldies | G5, 21 | 8.10/8.30 (DS) |
| SuperAudio—*Prime Demo*-mellow rock | G5, 21 | 5.22/5.40 (DS) |
| WCNJ-FM (89.3) Hazlet, NJ/Skylark Radio network—Oldies | GE-1, 6 | 5.80 |

### Sports

| | | |
|---|---|---|
| Fox Sports Pittsburgh audio | C1, 24 | 7.58 |
| Minnesota Twins MLB radio network (noted when MSC was carrying a Twins game) | G6,15 | 6.20 |
| Prime Sports Radio—sports talk and information | S3, 24 | 5.80 |

### Speciality Formats

| | | |
|---|---|---|
| Aries In Touch Reading Service | C4,10 | 7.87 |
| California State Legislature audio | S4, 24 | 6.80 |
| In-Store Networks | S3, 24 | 5.04, 5.21, 5.40 |
| Ozarkana Satellite Radio network | G4, 6 | 7.96 |
| SuperAudio—Big Bands (Sun 0200-0600 UTC) | G5, 21 | 5.58/5.76 (DS) |
| The Weather Channel-USA—part-time program audio | C3, 13 | 6.80 |
| The Weather Channel-USA—classical music | C3, 13 | 7.78 |
| Voice Print Reading Service | E2, 6 | 7.44 (N) |
| Yesterday USA—nostalgia radio | G5, 7 | 6.80 |
| | G1R, 24 | 7.38 |

### Talk Programming

| | | |
|---|---|---|
| American Freedom Radio network | GE-1, 7 | 5.80 |
| American Urban Radio network | S3, 9 | 6.30/6.48 (DS) |
| Amerinet Broadcasting | G1R, 17 | 8.10 |
| Orbit 7 radio network | C1, 14 | 7.48 |
| Talk America Radio Network #1—talk programs | S3, 9 | 6.80 |
| Talk America Radio Network #2—talk programs | S3, 9 | 5.41 |
| Talk Radio Network—talk programs | C1, 5 | 5.80 |
| United Broadcasting Network | C1, 2 | 7.50 |
| WOKIE Network (tech talk) network on when Megabingo is present) | SBS6, 13B (Ku) | 6.20 (occasional |
| World Web News Network | G7, 14 | 7.70 |
| Worldwide Freedom Radio network | GE-1, 7 | 7.56 |
| WWTN-FM (99.7) Manchester, TN—news and talk | G5, 18 | 7.38, 7.56 |

### Variety Programming

| | | |
|---|---|---|
| CBC Radio (English) | E2, 6 | 5.40/7.58, 5.58 |
| CBC Radio (occasional audio) | E2, 1 | 5.78 |
| CBC-FM Atlantic (English) | E2, 6 | 6.12/6.30 (DS) |
| CBC-FM Eastern (English) | E2, 6 | 5.76/5.94 (DS) |
| CBM-AM (940) Montreal, PQ Canada—variety/fine arts | E2, 1 | 6.12 |
| CJRT-FM (91.1) Toronto, ON Canada—fine arts/jazz-nights | E2, 26 (Ku-band) | 5.76/5.94 (DS) |
| KBVA-FM (106.5) Bella Vista, AR., ID-*Variety 106.5* | G4, 6 | 5.58/5.76 (DS) |
| KSL-AM (1160) Salt Lake City, UT—news/talk/country-overnight | C1, 6 | 5.58 |
| WUSF-FM (89.7) Tampa-St. Petersburg, FL (Public Radio), ID-*Concert 90* | C4, 10 | 8.26 (N) |

# Satellite Radio Guide/SCPC Services Guide

## FM SQUARED (FM²) AUDIO SERVICES

Another type of satellite audio carrier is known as FM Squared. FM Squared signalsdo not require a video carrier to exist. These signals are similar to audio subcarriers as we know it except that they are normally located below the 5.00 MHz audio subcarrier frequency that a normal satellite receivers can tune to. The new Universal SC-50 can tune these frequencies and was used to update this section.

### Spacenet 3 Transponder 13 (C-band)

Ambassador Inspirational Radio: 1.410, 4.470, and 4.650 MHz
Blank audio carriers: 1.050, 3.390, 3.570, and 3.750 MHz
Data transmissions: 4.160 MHz
Focus on the Family: 510 (ch. 1), .780 (ch. 2), and 1.230 MHz
International Broadcasting Network: 4.830 MHz
USA Radio Network: .330, 5.010 (ch 1), 5.200 MHz (ch. 2)

### Spacenet 3 Transponder 17 (C-band)

Blank audio carriers: .330 and 3.570 MHz
Childrens Sunshine Network: 1.300 MHz
Data Transmission: .800 MHz
Focus on the Family: 1.050 and 1.410 MHz
In-Touch—religious: 4.470 MHz
Salem Satellite Network: 4.650, 4.840, 5.010 (ch.1), and 5.200 Mhz (ch. 2)
Skylight Radio Network—religious: 1.770 and 4.280 MHz

### Spacenet 3 Transponder 18 (C-band)

Data Transmissions: 4.800 MHz

### Galaxy 4 Transponder 3 (Ku-band)

Blank Audio Carriers: 1.150, 2.060, 3.250, 3620, 4340, 4.400, and 4.450 MHz
Data transmissions: 1.000, 2.950, 3.070, and 3.190 MHz
Generic News: 3.530 MHz
In-Store audio network ads (various companies): .710, .810, .910, 1.260, 3.440, 3.700, 3.800, 3.880, and 3.970 MHz
Muzak Services .150, .270, .390, .510, 1.360, 1.480, 1.600, 1.720, 1.840, 1.960, 2.190, 2.310, 2.440, 2.560, 2.680, 2.800, 3.340, 4.080, and 4.200 MHz

### Galaxy 4 Transponder 4 (Ku-band)

Data transmissions: .100, .700, 1.250, 2.190, 2.360 MHz
Music: .150, .270, .410, .750, .870, .990, 1.110, 1.350, 1.470, 1.590, 1.710, 1.830, 1.950, 2.070 MHz
Tone: 2.270 MHz

### Anik E1 Transponder 7 (Ku-band)

Nova Network FM Squared Services

## FM CUBED (FM³) AUDIO SERVICES

This audio is digital in nature and home dish owners have not been able to receive it by normal decoding methods yet. The only satellite that FM Cubed transmissions have been discovered on so far is Galaxy 4, transponder 1. WEFAX transmissions and Accu-Weather (for subscribing stations) are transmitted on this transponder.

## Single Channel Per Carrier (SCPC) Services Guide

*By Robert Smathers*

The frequency in the first column is the 1st IF or LNB frequency and the second column frequency (in parentheses) is the 2nd IF for the SCPC listing. Both frequencies are in MHz.

### Spacenet 3 Transponder-Horizontal 13 (C-band)

| | |
|---|---|
| 1207.90 (52.1) | Wisconsin Voice of Christian Youth (VCY) America Radio Network—religious |
| 1207.20 (52.8) | Good News Radio Network—christian radio |
| 1207.00 (53.0) | Good News Radio Network—christian radio |
| 1206.70 (53.3) | Data Transmission |
| 1204.45 (55.55) | KJAV-FM (104.9) Alamo, Tex—spanish language religious *Nuevo Radio Christiana Network* |
| 1204.25 (55.75) | Wisconsin Voice of Christian Youth (VCY) America Radio Network—religious |
| 1201.50 (58.5) | Wisconsin Voice of Christian Youth (VCY) America Radio Network—religious |
| 1201.30 (58.7) | Wisconsin Voice of Christian Youth (VCY) America Radio Network—religious |

### Galaxy 4 Transponder 1-Horizontal (C-band)

| | |
|---|---|
| 1443.80 (56.2) | Voice of Free China (ISWBC) Taipei, Taiwan |
| 1443.60 (56.4) | KBLA-AM (1580) Santa Monica, CA—*Radio Korea* |
| 1443.40 (56.6) | Voice of Free China (ISWBC) Taipei, Taiwan |
| 1438.30 (61.7) | WWRV-AM (1330) New York, NY—Spanish religious programming and music, ID - *Radio Vision Christiana de Internacional* |
| 1436.50 (63.5) | West Virginia Metro News |
| 1436.30 (63.7) | KGIL-AM (1260) Beverly Hills, CA—All-Beatles Radio |

### Galaxy 4 Transponder 3-Horizontal (C-band)

| | |
|---|---|
| 1405.00 (55.0) | Illinois News Network |
| 1404.80 (55.2) | KOA-AM (850)/KTLK-AM (760) Denver, Colo—news and talk/Colorado Rockies MLB radio network |
| 1404.60 (55.4) | WGN-AM (720) Chicago, IL—news/talk/Chicago Cubs MLB radio network |
| 1404.40 (55.6) | Illinois News Network |
| 1404.20 (55.8) | Tribune Radio Networks |
| 1404.00 (56.0) | KFRC-AM (610) San Francisco, CA—oldies/Oakland Athletics MLB radio network |
| 1403.00 (57.0) | KSJN-FM (99.5) Minneapolis/St. Paul, MN—Minnesota Public Radio classical music service |
| 1402.70 (57.3) | WLAC-AM (1510) Nashville, TN—news/talk |
| 1402.10 (57.9) | KNOW-FM (95.3) St. Paul, MN—fine arts, Minnesota Public Radio |
| 1401.80 (58.2) | Michigan News Network |
| 1401.50 (58.5) | Occasional Audio/Agrinet/USA Radio Network |
| 1399.60 (60.4) | Talk America Radio Network 1 |
| 1399.20 (60.8) | Talk America Radio Network 2 |
| 1399.00 (61.0) | Sports Byline USA/Sports Byline Weekend/*On Computers* radio show |
| 1398.80 (61.2) | United Broadcasting radio network—talk |
| 1398.50 (61.5) | Occasional audio |

(Continued on Page 42)

# Single Channel Per Carrier (SCPC) Services Guide

*By Robert Smathers*

(Continued from Page 41)

1398.30 (61.7) WSB-AM (750) Atlanta, GA—news/talk/Atlanta Braves MLB radio network
1398.00 (62.0) Occasional audio
1397.80 (62.2) Occasional audio
1397.50 (62.5) Minnesota Talking Book network
1397.30 (62.7) Occasional audio
1397.10 (62.9) WTMJ-AM (620) Milwaukee, WI - talk/Milwaukee Brewers MLB radio network/Wisconsin Radio Network
1396.90 (63.1) Occasional audio
1396.40 (63.4) Georgia Network News (GNN)
1396.20 (63.8) WCNN-AM (680) Atlanta, GA—all sports talk radio
1396.00 (64.0) WHO-AM (1040) Des Moines, IA—talk/Iowa News Network
1395.80 (64.2) WTMJ-AM (620) Milwaukee, WI - talk/Milwaukee Brewers MLB radio network/Wisconsin Radio Network
1395.60 (64.4) WGST-AM/FM (640/105.7) Atlanta, GA—news/talk
1395.40 (64.6) Michigan News Network
1395.00 (65.0) Occasional audio
1394.70 (65.3) WJR-AM (760) Detroit, MI—news/talk/Detroit Tigers MLB radio network
1394.50 (65.5) XEPRS-AM (1090) Tijuana, Mexico—Spanish language
1394.00 (66.0) KSJN-FM (99.5) Minneapolis/St. Paul, MN—Minnesota Public Radio classical music service
1391.00 (69.0) Occasional audio
1388.90 (71.1) Data transmissions (burst)
1387.80 (72.2) Data transmissions (constant)
1384.40 (75.6) KOA-AM (850)/KTLK-AM (760) Denver, CO—news/talk/Colorado Rockies MLB radio network
1384.20 (75.8) WSB-AM (750) Atlanta, GA—news and talk/Atlanta Braves MLB radio network
1383.70 (76.3) Motor Racing Network (occasional audio)
1383.40 (76.6) United Broadcasting Network—talk
1382.90 (77.1) Michigan News Network
1382.60 (77.4) Soldiers Radio Satellite (SRS) network—U.S. Army information and entertainment
1382.00 (78.0) Tennessee Radio Network
1381.80 (78.2) WHO-AM (1040) Des Moines, IA - news/talk/Iowa News Network
1381.60 (78.4) KEX-AM (1190) Portland, OR—news/talk
1381.40 (78.6) Occasional audio
1381.20 (78.8) KJR-AM (950) Seattle, WA - sports talk
1381.10 (78.9) KIRO-AM (710) Seattle, WA— news/talk/Seattle Mariners MLB radio network
1377.40 (82.6) Data transmission (packet burst/tones)
1377.10 (82.9) In-Touch—reading service for blind
1376.90 (83.1) Data Transmissions
1376.50 (83.5) KRLD-AM (1080) Dallas, TX—talk radio
1376.00 (84.0) Kansas Audio Reader Network
1375.40 (84.6) USA Radio Network/Agrinet Ag service

## Anik E2 Transponder 1-Horizontal (C-band)

1446.00 (54.0) Canadian Broadcasting Corporation (CBC) Radio—North (Quebec) service

## Anik E2 Transponder 13-Horizontal (C-band)

1206.00 (54.0) Canadian Broadcasting Corporation (CBC) Radio—southwestern Northwest Territories service
1205.50 (54.5) Canadian Broadcasting Corporation (CBC) Radio—Yukon service

## Anik E1 Transponder 17-Horizontal (C-band)

1126.00 (54.0) Canadian Broadcasting Corporation (CBC) Radio—northern Northwest Territories service
1125.50 (54.5) Canadian Broadcasting Corporation (CBC) Radio—Newfoundland and Labrador service

## Anik E2 Transponder 23-Horizontal (C-band)

1006.00 (54.0) Radio Canada International (ISWBC)
1005.50 (54.5) Canadian Broadcasting Corporation (CBC) Radio

## Anik E1 Transponder 21-Horizontal (C-band)

1024.30 (75.7) Canadian weather conditions and warnings
1036.70 (63.3) In-store music
1037.00 (63.0) In-store music
1037.50 (62.5) In-store music

## SBS5 Transponder 2-Horizontal (Ku-band)

1013.60 (80.4) Wal-Mart in-store network (English)
1013.20 (80.8) Wal-Mart in-store network (English)
1012.80 (81.2) Sam's Wholesale Club in-store network (English)
1004.00 (90.0) Wal-Mart in-store network (English)
1003.60 (90.4) Wal-Mart in-store network (English and Spanish ads)
1003.20 (90.8) Wal-Mart in-store network (English)

## RCA C5 Transponder 3-Vertical (C-band)

1404.80 (55.2) RFD Radio Service
1404.60 (55.4) Wyoming News Network
1400.60 (59.4) Learfield Communications
1400.40 (59.6) Learfield Communications/Missouri Net
1400.20 (59.8) Occasional audio/Data transmissions
1400.00 (60.0) Learfield Communications
1396.60 (63.4) Kansas Information Network/Kansas Agnet
1396.40 (63.6) Nebraska Agriculture Network/University of Nebraska sports
1396.20 (63.8) Missouri Network/St. Louis Cardinals MLB radio network
1396.00 (64.0) Occasional audio
1395.90 (64.1) Wyoming News Network
1395.70 (64.3) Missouri Net/WIBW-AM (580) Topeka, KS—news and talk/Kansas City Royals MLB radio network
1386.40 (73.6) Learfield Communications
1386.20 (73.8) Radio Iowa
1384.60 (75.4) Capitol Sports Network
1384.00 (76.0) Occasional audio/ABC Direction Network
1383.80 (76.2) Occasional audio
1383.40 (76.6) Capitol Sports Network
1382.90 (77.1) Missouri Net
1382.30 (77.7) Virginia News Network
1382.10 (77.9) Learfield Communications/Missouri Net
1378.10 (81.9) Occasional audio

## RCA C5 Transponder 21-Vertical (C-band)

1045.00 (55.0) Occasional audio
1043.60 (56.4) Unistar Music Radio — *Today's Hits, Yesterday's Favorites*
1043.40 (56.6) CNN Radio Network
1043.20 (56.8) Unistar Music Radio — *Today's Hits, Yesterday's Favorites*
1042.80 (57.2) Unistar Music Radio — *Greatest Music of All Time*
1042.60 (57.4) Unistar Music Radio — *Greatest Music of All Time*
1042.40 (57.6) Unistar Music Radio — *Good Times and Great Oldies*
1042.20 (57.8) Data transmissions
1042.00 (58.0) Unistar Music Radio — *Good Times and Great Oldies*
1041.80 (58.2) CNN Radio Network
1034.40 (65.6) Unistar Music Radio — *Hits from 60s, 70s, 80s, and Today*
1034.20 (65.8) Data transmissions
1034.00 (66.0) Unistar Music Radio — *Hits from 60s, 70s, 80s, and Today*
1033.20 (66.8) Unistar Music Radio — *Country and Western*
1032.80 (67.2) Data transmissions
1032.40 (67.6) Unistar Music Radio — *Country and Western*

# Direct Broadcast Satellite (DBS) Systems

*By Larry Van Horn*

## *Alphastar (United States)*

Alphastar is a new medium power Direct-to-Home satellite service for the United States. The service uses some of the Telstar 402R (Ku-band 11.7-12.2 GHz) segment. The satellite is located at 89° West. Channel assignments were not available at presstime.

Alphastar Digital Television, 208 Harbor Drive, Building One, First Floor, Stamford, CT 06904. Telephone: (203) 359-8077. Web site: **http://www.teecomm.com**

Programming: A&E Network, ABC (WJLA Washington DC), Alpha Preview Channel, Asian Television Network, C-Span 1 (US House), C-Span 2 (US Senate), Cartoon Network, CBS (WRAL Raleigh, NC), Cinemax, Cinemax 2, Cinemax West, Classic Sports Network, CNBC, CNN, CNN International/CNN fn, Comedy Central, Country Music Television, Court TV, Discovery Channel, Disney Channel (E), Disney Channel (W), E! Entertainment Television, Egyptian Satellite Channel, Encore, Encore Plus, ESPN, ESPN2, Family Channel, FOX Network (Foxnet), Fox Sports Southwest, Fox Sports Northwest, Fox Sports Rocky Mountain, Fox Sports Midwest, Fox Sports West, Fox Sports Pittsburgh, Fox Sports Americas, Galavision, GEMS TV, Golf Channel, HBO, HBO 2, HBO 2 West, HBO 3, HBO West, Headline News, History Channel, International Channel, Learning Channel, Lifetime, Madison Square Garden, MSNBC, MTV, Nashville Network, NBC (WNBC New York), Nickelodeon / Nick at Nite, Nike Drama, Nile TV, PBS Network (National), Playboy TV, 10 PPV Channels, RE/MAX Satellite network-private business channel, Sci-Fi Channel, Showtime, Showtime 2, Showtime West, Starz!, Sundance Film Channel, Sunshine Network, TBS Atlanta, The Movie Channel, The Movie Channel West, Turner Classic Movies, Turner Network Television (TNT), TV Land, USA Network, Venus (adult), VH-1, Weather Channel, WGN-Chicago, 30 DMX Channels

## *DirecTV and USSB (United States)*

These two DBS services are carried on the Hughes high power DBS-1/2/3 satellites located at 101° West (Ku-band 12.2-12.7 GHz).

DirecTV, 2230 East Imperial Highway, El Segundo, Calif. 90245, 1-800-DIRECTV (347-3288), Web site: **http://www.directv.com**

| | | |
|---|---|---|
| 100 | Direct Ticket Previews (DTV) Previews | |
| 101-199 | Direct Ticket Pay Per View (DTV) | PPV |
| 120/121 | Letterbox (LTBX) | |
| 140-142 | Unknown service (LC) | |
| 200 | Direct Ticket Previews (DTV) | Previews |
| 201 | DirecTV Information Updates (DTV) | Promo |
| 202 | Cable Network News (CNN) | News |
| 203 | Court TV (CRT) | Speciality |
| 204 | CNN Headline News (HLN) | News |
| 205 | DirecTV Special Events Calendar (DTV) | Promo |
| 206 | ESPN 1 (ESPN) | Sports |
| 207 | ESPN Alternate (ESNA) | Sports |
| 208 | ESPN 2 (ESN2) | Sports |
| 210 | DirecTV Sports Schedule (DTV) | Promo |
| 212 | Turner Network Television (TNT) | TV programming |
| 213 | Home Shopping Network (HSN) | Home Shopping |
| 214 | Home and Garden TV (HGTV) | Home Improvement |
| 215 | TV Food Network | Speciality |
| 216 | MuchMusic (MUCH) | Music Videos |
| 217 | E! Entertainment TV (E!) | Speciality |
| 220 | American Movie Classics (AMC) | Movies |
| 221 | Turner Classic Movies (TCM) | Movies |
| 222 | Romance Classics | Movies |
| 224 | Direct Ticket Previews | Promos |
| 225 | STARZ! (East) | Movies |
| 226 | STARZ! (West) | Movies |
| 227 | STARZ! 2 (East) | Movies |
| 229 | STARZ! 2 (West) | Movies |
| 230 | Encore (East) | Movies |
| 231 | Encore (West) | Movies |
| 232 | Encore 2—Love Stories | Movies |
| 233 | Encore 3—Westerns | Movies |
| 234 | Encore 4—Mysteries | Movies |
| 235 | Encore 5—Action | Movies |
| 236 | Encore 6—True Stories! | Movies |
| 237 | Encore 7—WAM! | Movies |
| 238 | Bravo (BRAV) | Arts |
| 240 | Arts and Entertainment (A&E) | TV |
| 241 | The History Channel (THC) | History Documentaries |
| 242 | Disney Channel (East) | Movies/Kids |
| 243 | Disney Channel (West) | Movies/Kids |
| 245 | Discovery Channel | Science/TV Documentaries |
| 246 | The Learning Channel | Science/TV Documentaries |
| 247 | Cartoon Channel | Cartoons |
| 248 | Animal Planet | Nature Programming |
| 253 | USA Network | TV |
| 254 | The Sci-Fi Channel (SCFI) | Science Fiction |
| 256 | WGN-TV Chicago | Superatation |
| 258 | The Family Channel (FAM) | TV |
| 259 | WTBS-Ind Atlanta, Ga.(TBS) | Superstation |
| 261 | QVC | Home Shopping |
| 262 | The Nashville Network (TNN) | Country/Outdoors |
| 263 | Country Music TV (CMT) | Country Music Videos |
| 265 | Access Television | Infomercials |
| 267 | Platinum Presents Channel | TV |
| 268 | Black Entertainment TV (BET) | Entertainment |
| 269 | MuchMusic | Music videos |
| 271 | C-SPAN 1 (CSP1) | Congress-House of Representatives |
| 272 | C-SPAN 2 (CSP2) | Congress-U.S. Senate |
| 274 | Bloomberg Information Television (BIT) | News |
| 275 | CNBC (CNBC) | Financial/Talk |
| 276 | MSNBC (MSNBC) | News |
| 277 | The Weather Channel (TWC) | Weather |
| 278 | FOX News Channel | News |
| 279 | CBC Newsworld International (NWI) | News |
| 280 | Trio | TV |
| 281 | CNN International (CNNI)/CNN fN | News/Financial |
| 283 | Channel Earth | Environmental |
| 286 | Trinity Broadcasting (TBN) | Religious |
| 289 | America's Health Network | Health |
| 290 | WRAL Raleigh, NC (CBS) | Network TV |
| 291 | KPIX San Francisco, CA (CBSW) | Network TV |
| 292 | WNBC New York, NY (NBC) | Network TV |
| 293 | KNBC Los Angeles, CA (NBCW) | Network TV |
| 294 | PBS National Feed (PBS) | Network TV |
| 295 | WJLA Washington, DC (ABC) | Network TV |
| 296 | KOMO Seattle, WA (ABCW) | Network TV |
| 297 | FoxNet. (FOX) | Network TV |
| 299 | In-store dealer info channel (DTV) | Retailers only |
| 300 | DirecTV Sports Offers (DTV) | Promo |
| 301 | Sports Special Events Calendat (DTV) | Promo |
| 302 | Special Events Calendar (DTV) | Promo |
| 303 | Newsport (NWSP) | Sports |
| 304 | The Golf Channel (GOLF) | Sports |
| 305 | Classic Sports Network (CSN) | Sports |
| 306 | Speedvision (SV) | Sports |
| 307 | Outdoor Life Channel (OL) | Sports |
| 308 | Platinum Presents Channel | TV |
| 309 | SportsChannel New England (SCNE) | Sports |
| 310 | Madison Square Garden (MSG) | Sports |
| 311 | New England Sports Network (NESN) | Sports |
| 312 | SportsChannel New York (SCNY) | Sports |
| 313 | Empire Network (EMP) | Sports |
| 314 | SportsChannel Philadelphia (SCPH) | Sports |
| 315 | Fox Sports Pittsburgh (PKBL) | Sports |
| 316 | Home Team Sports (HTS) | Sports |
| 317 | Fox Sports South (SPTS) | Sports |
| 318 | Sunshine (SUN) | Sports |
| 319 | SportsChannel Florida | Sports |
| 320 | Pro AM Sports (PASS) | Sports |
| 321 | SportsChannel Ohio (SCOH) | Sports |
| 322 | SportsChannel Cincinnati (SCCN) | Sports |
| 323 | SportsChannel Chicago (SCCH) | Sports |
| 324 | Midwest SportsChannel (MSC) | Sports |
| 325 | Fox Sports Southwest (PSSW) | Sports |
| 326 | Fox Sports Rocky Mountain (PS) | Sports |
| 329 | Fox Sports Arizona | Sports |
| 330 | Fox Sports Northwest (PSNW) | Sports |

# Direct Broadcast Satellite (DBS) Systems

*By Larry Van Horn*

| | | |
|---|---|---|
| 331 | Fox Sports West (PSW) | Sports |
| 332 | Fox Sports West 2 (PSW2) | Sports |
| 333 | SportsChannel Pacific (SCP) | Sports |
| 334-399 | Direct Ticket | Pay Per View |
| 401 | Spice (SPCE) | Adult |
| 402 | Playboy (PBTV) | Adult |
| 501 | Music Choice — Hit List (MC1) | Audio |
| 502 | Music Choice — Dance (MC2) | Audio |
| 503 | Music Choice — Rap (MC3) | Audio |
| 504 | Music Choice — R&B Hits (MC4) | Audio |
| 505 | Music Choice — Reggae (MC5) | Audio |
| 506 | Music Choice — Blues (MC6) | Audio |
| 507 | Music Choice — Jazz (MC7) | Audio |
| 508 | Music Choice — Lite Jazz (MC8) | Audio |
| 509 | Music Choice — New Age (MC9) | Audio |
| 510 | Music Choice — Eclectic Mix (MC10) | Audio |
| 511 | Music Choice — Alternative Rock (MC11) | Audio |
| 512 | Music Choice — Metal (MC12) | Audio |
| 513 | Music Choice — Classic Rock (MC13) | Audio |
| 514 | Music Choice — The 80s (MC14) | Audio |
| 515 | Music Choice — The 70s Super Hits (MC15) | Audio |
| 516 | Music Choice — Solid Gold Oldies (MC16) | Audio |
| 517 | Music Choice — Soft Rock (MC17) | Audio |
| 518 | Music Choice — Today's Country (MC18) | Audio |
| 519 | Music Choice — Country Horizons (MC19) | Audio |
| 520 | Music Choice — Classic Country (MC20) | Audio |
| 521 | Music Choice — Easy Listening (MC21) | Audio |
| 522 | Music Choice — Big Bands (MC22) | Audio |
| 523 | Music Choice — Singers and Standards (MC23) | Audio |
| 524 | Music Choice — Show Tunes (MC24) | Audio |
| 525 | Music Choice — Classics Favorites (MC25) | Audio |
| 526 | Music Choice — Classical Masterpieces (MC26) | Audio |
| 527 | Music Choice — Contemporary Christian (MC27) | Audio |
| 528 | Music Choice — For Kids Only (MC28) | Audio |
| 529 | Music Choice — Sounds of the Seasons (MC29) | Audio |
| 530 | Music Choice — Spectrum I (MC30) | Audio |
| 531 | Music Choice — Spectrum II (MC31) | Audio |
| 550 | Music Choice — Lite Classical | Audio |
| 551 | Music Choice — EE - Vocals | Audio |
| 552 | Music Choice — Soft Album Mix | Audio |
| 553 | Music Choice — The Trend | Audio |
| 554 | Music Choice — Tropical | Audio |
| 555 | Music Choice — Mexicana | Audio |
| 599 | NRTC Radio Service (NRTC) For private use only | |
| 757 | Microsoft TV | |
| 790 | RealNet — Real Estate Channel (REAL) | |

## USSB (United States)

USSB, 3415 University Avenue, St. Paul, Minn. 55114, 1-800-204-USSB (8772)

| | | |
|---|---|---|
| 899 | USSB Programming Higlights | Promo |
| 900 | Special Event programming (BIG 1) | Special Events |
| 910 | Special Event Programming (BIG 2) | Special Events |
| 960 | TVLand (TVLD) | Variety |
| 963 | All New Channel (ANC) | News |
| 965 | Video Hits One (VH1) | Rock Music Videos |
| 967 | Lifetime (LIFE) | TV |
| 968 | Nickelodeon (NICK) | TV/Kids |
| 970 | Flix (FLIX) | Movies |
| 973 | Cinemax East (MAX) | Movies |
| 974 | Cinemax 2 (MAX2) | Movies |
| 975 | Cinemax West (MAXW) | Movies |
| 977 | The Movie Channel East (TMC) | Movies |
| 978 | The Movie Channel West (TMCW) | Movies |
| 980 | HBO East (HBO) | Movies |
| 981 | HBO 2 East (HBO2) | Movies |
| 982 | HBO 3 (HBO3) | Movies |
| 983 | HBO West (HBOW) | Movies |
| 984 | HBO 2 West (HB2W) | Movies |
| 985 | Showtime East (SHO) | Movies |
| 986 | Showtime 2 (SHO2) | Movies |
| 987 | Showtime West (SHOW) | Movies |
| 989 | MusicTV (MTV) | Rock Music Videos |
| 990 | Comedy Central (COM) | Comedy |
| 995 | Sundance Channel (SUND) | Movies |
| 999 | USSB Programming Highlights | Promo |
| TBA: M2 | Music Television | |

## EchoStar (United States)

The new Echostar 1/2 high power DBS (Ku-band 12.2-12.7 GHz) satellites are now operational at 119° West. Echostar's service is called "TheDISH (Digital Satellite Network) Television Network.

Echostar, 90 Inverness Circle East, Englewood, CO 80112, Telephone: (303) 799-8222, Fax: (303) 799-3632. Web Site: **http://www.echostar.com**

| | | |
|---|---|---|
| 100 | DISH on Demand Previews | Promo |
| 102 | USA Network | TV |
| 104 | Comedy Central | Comedy |
| 106 | TVLand | Variety |
| 108 | Lifetime | TV |
| 110 | TV Food Network | Food |
| 112 | Home and Garden Network | Speciality |
| 114 | E! Entertainment TV | TV |
| 116 | Game Show Network | TV |
| 118 | Arts and Entertainment | TV |
| 120 | History Channel | History |
| 122 | Sci-Fi Channel | Science Fiction |
| 124 | Black Entertainment TV | TV |
| 132 | Turner Classic Movies | Movies |
| 138 | Turner Network Television | TV |
| 140 | ESPN | Sports |
| 141 | ESPN Alternate | Sports |
| 142 | ESPN2 | Sports |
| 143 | ESPN2 Alternate | Sports |
| 144 | ESPNews | Sports |
| 160 | MusicTV (MTV) | Music Videos |
| 162 | VH-1 | Music Videos |
| 166 | Country Music Television | Music Videos |
| 168 | The Nashville Network | Country |
| 170 | Nickelodeon | Kids |
| 172 | The Disney Channel | Movies/Kids |
| 176 | The Cartoon Network | Cartoons |
| 178 | The Learning Channel | Science/TV Documentary |
| 180 | The Family Channel | TV |
| 182 | The Discovery Channel | Science/TV Documentary |
| 184 | Animal Planet | Specialty |
| 200 | Cable News Network | News |
| 202 | CNN Headline News | News |
| 204 | Court TV | Speciality |
| 206 | CNN International/CNNfn | News/Financial |
| 208 | CNBC | Financial/Talk |
| 210 | C-SPAN | Government |
| 212 | C-SPAN 2 | Government |
| 214 | The Weather Channel | Weather |
| 216 | National Empowerment TV (NET) | Politics |
| 220 | The Travel Channel | Travel Shows |
| 222 | Home Shopping Network (HSN) | Home Shopping |
| 226 | QVC Shopping Network | Home Shopping |
| 230 | WTBS Atlanta, GA | Superstation |
| 232 | KTLA Los Angeles, CA | Superstation |
| 234 | WPIX New York, NY | Superstation |
| 236 | WSBK, Boston | Superstation |
| 240 | WGN Chicago, IL. | Superstation |
| 241 | WNBC-NBC New York, NY | Network TV |
| 242 | KNBC-NBC Los Angeles, CA | Network TV |
| 243 | WRAL-CBS Raleigh, NC | Network TV |
| 244 | KPIX-CBS San Francisco, CA | Network TV |
| 245 | WJAL-ABC Washington, DC | Network TV |
| 246 | KOMO-ABC Seattle, WA | Network TV |
| 247 | FOXNet | Network TV |
| 249 | PBS | Network TV |
| 260 | Trinity Broadcasting Network | Religious |
| 261 | Eternal Word TV Network | Religious |
| 267 | American Family Radio | Sky Angel |
| 268 | Calvary Chapel Radio | Sky Angel |
| 269 | Bob Jones University Radio | Sky Angel |
| 270 | The Worship Channel | Sky Angel |

# Direct Broadcast Satellite (DBS) Systems

| | | |
|---|---|---|
| 271 | Praise TV | Sky Angel |
| 272 | FamilyNet | Sky Angel |
| 273 | Cornerstone TV | Sky Angel |
| 274 | 100 Plus Ministries | Sky Angel |
| 275 | Dominion Variety/International Home School Ch. | Sky Angel |
| 300 | HBO East | Movies |
| 301 | HBO2 East | Movies |
| 302 | HBO3 East | Movies |
| 303 | HBO West | Movies |
| 304 | HBO2 West | Movies |
| 310 | Showtime East | Movies |
| 311 | Showtime West | Movies |
| 312 | Showtime East 2 | Movies |
| 318 | Sundance | Movies |
| 319 | FLIX | Movies |
| 320 | Cinemax East | Movies |
| 321 | Cinemax East 2 | Movies |
| 322 | Cinemax West | Movies |
| 330 | The Movie Channel East | Movies |
| 331 | The Movie Channel West | Movies |
| 401 | The Golf Channel | Sports |
| 412 | Madison Square Garden (MSG) | Sports |
| 414 | Fox Sports Rocky Mountain | Sports |
| 416 | Fox Sports Southwest | Sports |
| 417 | Fox Sports West | Sports |
| 418 | Fox Sports Midwest | Sports |
| 420 | Fox Sports South | Sports |
| 422 | Sunshine Network | Sports |
| 424 | Home Team Sports | Sports |
| 426 | Fox Sports Northwest | Sports |
| 428 | Fox Sports Pittsburgh | Sports |
| 430 | Pro-Am Sports (PASS) | Sports |
| 432 | Empire Sports Network | Sports |
| 434 | New England Sports Network | Sports |
| 436 | Midwest Sports Channel | Sports |
| 500 | PPV 1 DISH-on-Demand (events) | Pay per view |
| 501 | PPV 2 DISH-on-Demand | Pay per view |
| 502 | PPV 3 DISH-on-Demand | Pay per view |
| 503 | PPV 4 DISH-on-Demand | Pay per view |
| 504 | PPV 5 DISH-on-Demand | Pay per view |
| 505 | PPV 6 DISH-on-Demand | Pay per view |
| 506 | PPV 7 DISH-on-Demand | Pay per view |
| 507 | PPV 8 DISH-on-Demand | Pay per view |
| 508 | PPV 9 DISH-on-Demand | Pay per view |
| 509 | PPV 10 DISH-on-Demand | Pay per view |
| 600 | RAI (Italy) | International |
| 602 | ART (Arab Radio and Television) | International |
| 604 | Antenna TV Greece | International |
| 620 | MTV Latino | International |
| 626 | Fox Sports Americas | International |
| 628 | Telemundo | International |
| 700 | DISH 2 (Showroom Promo Channel) | Promo |
| 900 | Business TV 1 | Financial |
| 901 | Business TV 2 | Financial |

TBA: M2 (Music Television) and Lawyers Communications Network

**DISH CD ‡**

| | | |
|---|---|---|
| 950 | Young Country | Audio |
| 951 | Country Classics | Audio |
| 952 | Country Currents | Audio |
| 953 | Jukebox Gold | Audio |
| 954 | 70's Song Book | Audio |
| 955 | Adult Favorites | Audio |
| 956 | Adult Contemporary | Audio |
| 957 | Adult Alternative | Audio |
| 958 | HitLine | Audio |
| 959 | Classic Rock | Audio |
| 960 | Modern Rock Alternative | Audio |
| 961 | Power Rock | Audio |
| 962 | Non-Stop Hip Hop | Audio |
| 963 | Urban Beat | Audio |
| 964 | Latin Styles | Audio |
| 965 | Fiesta Mexicana | Audio |
| 966 | Eurostyle | Audio |
| 967 | Jazz Traditions | Audio |
| 968 | Contemporary Jazz Flavors | Audio |
| 969 | Americana | Audio |
| 970 | Contemporary Instrumentals | Audio |
| 971 | Concert Classics | Audio |
| 972 | Light Classical | Audio |
| 973 | Easy Instrumentals | Audio |
| 974 | Big Band Era | Audio |
| 975 | Contemporary Christian | Audio |
| 976 | Kid Tunes | Audio |
| 977 | New Age | Audio |
| 978 | Blues | Audio |
| 979 | Reggae | Audio |
| 980 | LDS Radio Network | Audio |

## *ExpressVu (Canada)*

Canadian digital medium power direct-to-home satellite TV service. The service will provide Canadian, American, and international video and audio programs. The service will be offered using Canada's Anik E2 (Ku-band 11-.7-12.2 GHz) satellite at 107.3° West. Channel assignments were not available at presstime. This service is forecasted to start in the summer of 1997.

ExpressVu Inc, 1290 Central Parkway West, Suite 1008, Mississauga, ON L5C 4R3, Telephone 1-800-339-6908 in Canada. Web Site: **http://www.expressvu.com**

Programming: CBC Network, SRC Network (French), TV Ontario, La Chaine Francaise de TV Ontario, Open Learning Agency-Knowledge Network, Saskatchewan Communications Network, Alberta Access-Access Network, Radio Quebec, CTV Network, Global, Quartre Saisons, CFTM-TVA, Atlantic Satellite Network, CPAC (English/French), Television Northern Canada, CFMT-Multicultural TV, CTEQ-Multicultural TV, ExpressVu Electronic Programming Guide, ExpressVu PPV Marketing Channel, ExpressVu Marketing Channel, CFCF (CTV), BCTV (CTV), CFTO (CTV), ATV (CTV), CHCH-Hamilton, CITY-Toronto, CITV-Edmonton, WXYZ-ABC, WTOL-CBS, WUHF-FOX, WDIV-NBC, WTVS-PBS, The Sports Network, Reseau des Sports (French), MuchMusic, Musique Plus, Vision TV, Weather Network, Meteo Media, Canadian Home Shopping Network, Discovery Channel, Showcase, Life Network, Bravo!, WTN, CBC Newsworld, RDI-SRC, Canal Famille, Canal D, TV-5, New Country Network, YTV, Fanily Channel, A&E, Learning Channel, CNN, Headline News, CNBC, Nashville Network, Black Entertainment TV, WGN-Chicago, WPIX-NY, KTLA-Los Angeles, TBS-Atlanta, WSBK-Boston, WWOR-NY, Fairchild TV, Telelatino, The Movie Network, Superchannel, Super Ecran, MoviePix, MovieMax, PPV-30 channels, Allego Audio channels: 16 channels, Galaxy audio channels: 30 channels, Canadian Radio Stations: 18 channels.

## *Galaxy Latin America (Mexico, Central and South America)*

Ft. Lauderdale, FL
Web site: **http://www.sattv.com**

New Latin American DBS service carried on Galaxy 3R at 95° West (Ku-band, 11.7-12.2GHz). Medium power Direct-to-Home service for Mexico, Central and South America. Galaxy Latin America will have 144 channels of video (72 channels in Spanish/72 channels in Portuguese). Pay-per-view movies and events will also be provided. A 1.1-meter dish will be needed to utilize the service. Channel assignments were not available at presstime.

Programming: GLA Coming Attractions/Programming, TNT Latin America, TeleUno, Sony Entertainment TV (SET), WBTV (The Warner Channel), MAS Mexican Channel, GEMS, TVE Television Espanola, Antena 3 Espana, RAI Italia, Deutsche Welle, RTPI, TVN Chile, TV Azteca Canal 7 Mexico, TV Azteca Canal 13 Mexico, Cartoon Network, ZAZ, Locomotion, MTV Latino, ESPN International, CBS Telenoticias, BBC World Service, CNN International, Bloomberg, Travel Channel, Discovery Channel, MultiPremier, Bravo, MultiCinema, Cine Latino, HBO Ole West, HBO Ole East, HBO Ole 2, Cinemax West, Cinemax East, AdultVision, CL@SE Educational channel for Latin America, CineCanal 1, CineCanal 2, Telecine 1, Telecine 2, Playboy, ABC, NBC, CBS, HBO Brasil, HBO Brasil 2, ESPN South, TV Senado, CMT, MTV Brasil, Bravo Brasil, E! Entertainment, Mundo, National Geographic, CNA - Canal de Noticias de TVA, Canal de Noticias NBC, Bloomberg Business TV in Portuguese, Cinemax Brasil, CNN en Espanol, RBN News (Brasil), Televen International, Univision, Venevision International, Zeta, 60 CD-Quality audio channels, ESPN Dos

# Direct Broadcast Satellite (DBS) Systems

*By Larry Van Horn*

## *Primestar (United States)*

Primestar is a medium power Direct-to-Home satellites service carried on GE-2 satellite at 85° West (Ku-band 11.7-12.2 GHz). Primestar uses GE-2 satellite transponders 1-6 and 8-24 transponders).

Primestar Partners, 3 Bala Plaza West, Suite 700, Bala Cynwyd, PA 19004, 1-800-966-9615

| | | |
|---|---|---|
| 1 | HBO (East) | Movies |
| 2 | HBO 2 (East) | Movies |
| 3 | HBO 3 | Movies |
| 7 | Cinemax (East) | Movies |
| 8 | Cinemax 2 | Movies |
| 13 | TV Japan (English) | Not included in $50 a month package |
| 14 | TV Japan (Japanese) | Not included in $50 a month package |
| 15 | Future service (Also 15/17/19/56/149) | |
| 27 | Starz! | Movies |
| 31 | Encore 3 — Westerns | Movies |
| 32 | Encore 4 — Mystery | Movies |
| 33 | Encore | Movies |
| 34 | The Disney Channel (East) | Movies/Kids |
| 35 | The Disney Channel (West) | Movies/Kids |
| 40 | The Golf Channel | Sports |
| 47 | C-SPAN | Congress |
| 48 | CNBC—occasional service | Financial/Talk |
| 49 | The Weather Channel (TWC) | Weather |
| 50 | CNN International (CNNI)/CNN fN | News/Financial |
| 51 | Cable Network News (CNN) | News |
| 52 | CNN Headline News | News |
| | Ingenius News Service | Data Wire Services |
| 53 | Upcoming Channels Prevview (also 54) | Promo |
| 55 | PreVue Channel | Program Guide |
| 58 | Turner Network Television (TNT) | TV |
| 59 | Turner Classic Movies (TCM) | Movies |
| 60 | TV Land | TV |
| 61 | Comedy Central | TV |
| 63 | WTBS-Ind Atlanta, GA (TBS) | Superstation |
| 65 | The Discovery Channel (TDC) | Science/TV documentary |
| 66 | The Learning Channel (TLC) | Science/TV documentary |
| 68 | Arts & Entertainment (A&E) | TV |
| 70 | USA Network | TV |
| 71 | The Sci-Fi Channel | Science Fiction |
| 72 | The Family Channel | TV |
| 73 | The Cartoon Channel | Cartoons |
| 74 | Nickelodeon/Nick at Nite | Kids |
| 75 | E! Entertainment Network | Speciality |
| 76 | Lifetime | TV |
| 77 | The Nashville Network (TNN) | Country/Outdoors |
| 78 | Country Music TV (CMT) | Country music videos |
| 80 | MTV | Music Videos |
| 83 | Odyssey | Religious |
| 84 | QVC—occasional service | Home Shopping |
| 111 | WHDH-NBC Boston, MA | Network TV |
| 112 | WSB-ABC Atlanta, GA | Network TV |
| 117 | WUSA-CBS Washington, DC | Network TV |
| 120 | KTVU-FOX Oakland/San Francisco, CA | Network TV |
| 124 | WHYY-PBS Philadelphia, PA | Network TV |
| 131 | ESPN | Sports |
| 132 | ESPN2 | Sports |
| 133 | ESPN2 | Sports |
| 137 | Classic Sports Network (occ) | Sports |
| 138 | Mega+1 | Sports |
| 141 | New England Sports Network (NESN) | Sports |
| 142 | Madison Square Garden Network (MSG) | Sports |
| 143 | Empire Sports Network | Sports |
| 144 | Fox Sports Pittsburgh | Sports |
| 145 | Home Team Sports (HTS) | Sports |
| 146 | Fox Sports South | Sports |
| 147 | Sunshine | Sports |
| 148 | Pro American Sports (PASS) | Sports |
| 152 | Fox Sports Midwest | Sports |
| 153 | Fox Sports Rocky Mountain | Sports |
| 154 | Fox Sports Southwest | Sports |
| 156 | Fox Sports Northwest | Sports |
| 157 | Fox Sports Arizona | Sports |
| 158 | Fox Sports West | Sports |
| 159 | Midwest SportsChannel | Sports |
| 181 | HBO en Espanol | Movies |
| 182 | HBO2 en Espanol | Movies |
| 183 | HBO3 en Espanol | Movies |
| 187 | Cinemax Selecciones | Movies |
| 188 | Cinemax2 Selecciones | Movies |
| 190 | Univision | Spanish language |
| 201 | Viewer's Choice | PPV |
| 202 | Request 1 | PPV |
| 203 | Request 5 | PPV |
| 204 | Hot Choice | PPV |
| 205 | Continuous Hits 1 | PPV |
| 207 | Continuous Hits 3 | PPV |
| 208 | Request 2 | PPV |
| 210 | Request 4 | PPV |
| 221 | Playboy—occasional service | Adult |
| 301 | Superadio—Classical Hits | Audio |
| 302 | Superadio—America's Country Favorites | Audio |
| 303 | Superadio—Lite 'n' Lively Rock | Audio |
| 304 | Superadio—Soft Sounds | Audio |
| 305 | Superadio—Classic Collections | Audio |
| 306 | Superadio—New Age of Jazz | Audio |
| 311 | DMX Audio—Lite Jazz | Audio |
| 312 | DMX Audio—Classic Rock | Audio |
| 313 | DMX Audio—70's Oldies | Audio |
| 314 | DMX Audio—Adult Contemporary | Audio |
| 315 | DMX Audio—Hottest Hits | Audio |
| 316 | DMX Audio—Modern Country | Audio |
| 317 | DMX Audio—Traditional Blues | Audio |
| 318 | DMX Audio—Salsa | Audio |
| 527 | Testing Channel | Tests |

TV Food Network, Court TV, 16 more music services, Outdoor Life, Speedvision, VH1, History Channel, Black Entertainment TV, CNN/SI, Showtime, Showtime 2, Sundance Channel, Home and Garden TV, WGN, Game Show Network, MSNBC, World Satellite Network, C-SPAN 2, KABC-ABC Los Angeles, KSTW-CBS Seattle, KCRA-TV Sacramento, WTXF-FOX Philadelphia, MuchMusic, Independent Film Channel, American Movie Classics, Romance Classics, SportsChannel New England/NY/Philadelphia/Florida/Ohio/Cincinatti/ Chicago/Pacific, Spanish language: Cartoon Network/Family Channel/Showtime/Encore, The People's Network (TPN)-private business channel.

## *StarChoice (Canada)*

Canadian digital medium power direct-to-home satellite TV service. The service will provide English and French language Canadian broadcast networks, specialty and multi-cultural channels, eligible U.S. broadcast networks and specialty channels, and licensed Canadian pay-per-view channels. The receive system must be purchased (manufactured by Echostar) and uses a 24-inch dish. Channel assignments were not available at presstime. This service was formerly known as Direct Choice TV.

Fredericton, New Brunswick Canada
Telephone: 1-888-554-STAR (7827)/506-328-4608
Web site: **http://www.compuweb.nb.ca/allenc/StarChoice/home.htm**

Programming: CTV, CBC, SRC, CBC Newsworld, RDI, CNN, Headline News, ABC, CBS, NBC, TSN, Fox Sports, WTBS, WSBK, WGN, Youth TV, Family Channel, Canal Famille, Pay-per-view channels, The Movie Network, SuperChannel, MoviePix, MovieMax, A&E, Discovery, Bravo, The Learning Channel, PBS, MuchMusic, The Nashville Network, CD-quality, commercial free music channels.

# Ku-band Satellite Transponder Services Guide

*By Robert Smathers*

H = Horizontal polarization, V = Vertical polarization, Occ video = Occasional Video, [ ] = Type of encryption or video compression

### Spacenet 2 (S2) 69° West

| | | |
|---|---|---|
| 19 | 11740-H | Data transmissions |
| 21 | 11900-H | Occ video |
| 22 | 11980-H | Occ video |
| 23 | 12060-H | Occ video |
| 24 | 12140-H | Occ video |

### SBS 6 (SBS6) 74° West

| | | |
|---|---|---|
| 1 | 11717-H | Data transmissions/FamilyNet [digicipher] |
| 2 | 11749.5-V | FOX SNG feeds |
| 3 | 11774-H | MSNBC feeds |
| 4 | 11798.5-V | Occ video |
| 5 | 11823-H | Occ video |
| 6 | 11847.5-V | Occ video |
| 7 | 11872-H | Occ video |
| 8 | 11896.5-V | Occ video/digital video (occ) |
| 9 | 11921-H | Occ video |
| 10 | 11945.5-V | Occ video/CONUS Communications (occ)/ CONUS digital video (upper half) |
| 11 | 11963-H | CONUS Communications (half transponders) |
| 12 | 11994.5-V | CONUS Communications (half-transponders) |
| 13 | 12019-H | CONUS Communications (half transponders) |
| 14 | 12043.5-V | Occ video |
| 15 | 12075-H | Occ video |
| 16 | 12092.5-V | Occ video |
| 17 | 12110-H | Digital video (unknown user) |
| 18 | 12141.5-V | Occ video |
| 19 | 12174-H | CNN Newsbeam (occ) |

### SBS 4 (SBS4) 77° West (Inclined orbit)

| | | |
|---|---|---|
| 1 | 11725-H | Data transmissions |
| 2 | 11780-H | NBC feeds |
| 3 | 11823-H | NBC feeds |
| 4 | 11872-H | NBC feeds |
| 5 | 11921-H | NBC feeds |
| 6 | 11970-H | NBC feeds |
| 7 | 12019-H | NBC feeds |
| 8 | 12068-H | NBC feeds |
| 9 | 12117-H | NBC feeds |
| 10 | 12166-H | NBC feeds |

### GE-2 (GE2) 85° West

| | | |
|---|---|---|
| 7 | 11840-V | TV Asahi feeds [LEITCH] |

Transponders 1-6 and 8-24 consists of Primestar programming encrypted and compressed using the Digicipher system. A complete Primestar channel guide is presented in the DBS section of *Satellites Times* Satellite Service Guide.

### Spacenet 3R (S3) 87° West

| | | |
|---|---|---|
| 19 | 11740-H | Data transmissions |
| 21 | 11900-H | Data transmissions |
| 22 | 11980-H | SUNY Ed Net/NY Lottery feeds/Occ video (East spot beam) |
| 23 | 12060-H | Occ video (West spot beam) |
| 24 | 12140-H | Occ video (East spot beam) |

### Telstar 402R (T402) 89°West

Alphastar DBS uses T402 Ku-band transponders 6, 9-14, and 16

| | | |
|---|---|---|
| 1 | 11730-V | AT&T Tridom [digital] |
| 2 | 11743-H | AT&T Tridom [digital] |
| 3 | 11790-V | AT&T Tridom [digital] |
| 4 | 11803-H | AT&T Tridom [digital] |
| 5 | 11850-V | Data transmissions |
| 7 | 11910-V | PBS (analog lower half/ digicipher upper half) |
| 8 | 11923-H | Data transmissions |
| 15 | 12157-V | DMX for Business [digital data] |

### Galaxy 7 (K7) 91° West

| | | |
|---|---|---|
| 1 | 11720-V | TCI Headend in the Sky [digicipher] |
| 2 | 11750-H | Data transmissions |
| 3 | 11750-V | Indiana Higher Education [Spectrumsaver] |
| 4 | 11780-V | TCI Headend in the Sky [digicipher] |
| 5 | 11810-H | Data transmissions |
| 6 | 11810-V | TCI Headend in the Sky [digicipher] |
| 7 | 11840-V | TCI Headend in the Sky [digicipher] |
| 8 | 11870-H | Data transmissions |
| 9 | 11870-V | TCI Headend in the Sky [digicipher] |
| 10 | 11900-V | TCI Headend in the Sky [digicipher] |
| 11 | 11930-H | Wescott Communications? [Spectrumsaver] |
| 12 | 11930-V | TCI Headend in the Sky [digicipher] |
| 13 | 11960-V | TCI Headend in the Sky [digicipher] |
| 14 | 11990-H | Occ video (half transponders common) |
| 15 | 11990-V | TCI Headend in the Sky [digicipher] |
| 16 | 12020-V | The People's Network (TPN) |
| 17 | 12050-H | Westcott Communications [Spectrumsaver] |
| 17 | 12050-H | Westcott Communications ASTN [B-MAC]/National Weather Networks (occasional) |
| 18 | 12050-V | Westcott Communications [Spectrumsaver] |
| 19 | 12080-V | TCI Headend in the Sky [digicipher] |
| 20 | 12110-H | Data transmissions |
| 21 | 12110-V | TCI Headend in the Sky [digicipher] |
| 22 | 12140-V | TCI Headend in the Sky [digicipher] |
| 23 | 12170-H | Data transmissions |
| 24 | 12170-V | Data transmissions |

### Galaxy 3R (G3R) 95° West

Ku-band side of this satellite is used entirely for the Galaxy Latin American DBS System.

### Galaxy 4 (K4) 99° West

| | | |
|---|---|---|
| 1 | 11720-H | FM³ services/Data transmissions |
| 2 | 11750-V | Data transmissions |
| 3 | 11750-H | FM² services/Muzak/Data transmissions |
| 4 | 11780-H | FM² services/Planet Connect computer service (19.2 kbps)/ Other data transmissions |
| 5 | 11810-V | Data transmissions |
| 6 | 11810-H | Video Plus Contract Channel (occ video) |
| 7 | 11840-H | Chinese Television Network *Chung Ten* - Chinese/Taiwan all-news service |
| 8 | 11870-V | Data transmissions |
| 9 | 11870-H | Data transmissions |
| 10 | 11900-H | CNN Airport Network [Powervu]/Data transmissions |
| 11 | 11930-V | Occ video (half-transponders common)/The Asian Network (TAN) |
| 12 | 11930-H | Occ video |
| 13 | 11960-H | Digital video (unknown user) |
| 14 | 11990-V | Data transmissions |
| 16 | 12020-H | FM² services/Data transmissions |
| 17 | 12050-V | CBS Newsnet and affiliate feeds (half-transponders) |
| 18 | 12050-H | Honk Kong TVB Jade Channel (Chinese) [videocrypt] |
| 19 | 12080-H | Data transmissions |
| 20 | 12110-V | Data transmissions |
| 21 | 12110-H | Asian-American TV Network (occ)/Occ video |
| 22 | 12140-H | Data transmissions |
| 23 | 12170-V | CBS Newsnet and affiliate feeds (half-transponders-lower half usually in CBS Newsnet digital video transmissions) |
| 24 | 12170-H | The Filipino Channel [Oak] |

### Spacenet 4 (S4) 101° West

| | | |
|---|---|---|
| 19 | 11740-H | Failed transponder |
| 20 | 11820-H | Data transmissions |
| 21 | 11900-H | Failed transponder |
| 22 | 11980-H | Data transmissions |
| 24 | 12140-H | Georgia Public TV [digicipher] (lower half) |
| 24 | 12140-H | E.M.G. courses [digicipher] (upper half) |

### DBS-1 101.2° W/DBS-2 & DBS-3 100.8° W

A complete DIRECTV‡ and USSB channel guide is presented in the DBS section of *Satellites Times* Satellite Service Guide. These satellites operate in the 12.2-12.7 GHz range.

### GE-1 (GE1) 103° West

| | | |
|---|---|---|
| 1 | 11720-H | Qualcomm data [digital] |
| 2 | 11740-V | Data transmissions |
| 3 | 11760-H | NBC Eastern Time Zone programming |
| 4 | 11780-V | Data transmissions |
| 5 | 11800-H | Qualcomm data [digital] |
| 6 | 11820-V | Empire Sports [Wegener digital]/Kentucky Educational TV (KET) [digicipher] |
| 7 | 11840-H | NBC Pacific Time Zone programming |
| 8 | 11860-V | Qualcomm data [digital] |
| 9 | 11880-H | NBC Mountain Time Zone programming |
| 10 | 11900-V | Qualcomm data [digital] |
| 11 | 11920-H | NBC feeds [digital]/Data transmissions |
| 12 | 11940-V | Microspace Velocity [digital] |
| 13 | 11960-H | NSN data transmissions [digital] |
| 14 | 11980-V | Qualcomm data [digital] |
| 15 | 12000-H | NBC Contract Channel |
| 16 | 12020-V | Spectravision? [Spectrumsaver] |
| 17 | 12040-H | NBC Contract Channel |
| 18 | 12060-V | Starnet [digital video] |
| 19 | 12080-H | NBC News Channel |
| 20 | 12100-V | Cyclesat [analog/digital]/Occ video |
| 21 | 12120-H | NBC/MSNBC/CNBC/NBC NewsChannel SNG feeds [Wegner digital] |
| 22 | 12140-V | Chinese Communications Channel (CCC) [Oak] |
| 23 | 12160-H | NBC Newschannel SNG/NBC Contract Channel |
| 24 | 12180-H | Fed Ex TV [BMAC]/Occ video |

### GSTAR-4 (GST4) 105° West

| | | |
|---|---|---|
| 1 | 11730-H | Data transmissions |
| 2 | 11791-H | Data transmissions |
| 3 | 11852-H | CNN Newsource (Primary) [Leitch]/some feeds in clear |
| 4 | 11913-H | Data transmissions |
| 5 | 11974-H | Occ video/Court TV Backhauls (occ video) |
| 6 | 12035-H | CBS NewsNet SNG feeds |
| 7 | 12096-H | CNN Newsbeam/Occ video |
| 8 | 12157-H | CNN Newsbeam (occ video)/ CNN Newsource International |
| 9 | 11744-V | Data transmissions |
| 10 | 11805-V | Data transmissions |
| 11 | 11866-V | Absat (ABC) SNG feeds |
| 12 | 11927-V | Data transmissions |
| 13 | 11988-V | CNN Newsbeam/occ video |
| 14 | 12049-V | Data transmissions |
| 15 | 12110-V | CNN Newsource (secondary)/ occ video |
| 16 | 12171-V | Data transmissions |

### Anik E2 (A1) 107.3° West

| | | |
|---|---|---|
| 1 | 11717-V | Telesat Canada DVC: MovieMax!, Family Channel E&W, SuperChannel [digital video compression] |
| 2 | 11743-V | ExpressVu DBS (summer 1997) |
| 3 | 11778-V | CanCom [digital video compression] |
| 4 | 11804-V | Shaw [digital video compression] |
| 5 | 11839-V | Canadian Parliamentary Access Channel, Youth TV E&W, Vision TV, CHSC Shopping [digital video compression] |
| 6 | 11865-V | Moviepix!; The Movie Network [digital video compression] |
| 7 | 11900-V | Rogers Network [digital video compression] |
| 8 | 11926-V | Rogers Network [digital video compression] |
| 9 | 11961-V | Star Choice DBS |
| 10 | 11987-V | Star Choice DBS |
| 11 | 12022-V | ExpressVu (summer 1997) |
| 12 | 12048-V | Saskarchewan CommunicaNetwork [digital] |
| 13 | 12083-V | ExpressVu DBS (summer 1997) |
| 14 | 12109-V | ExpressVu DBS (summer 1997) |
| 15 | 12144-V | Telesat Canada stationkeeping (GLACS) |
| 16 | 12170-V | Knowledge Network |
| 17 | 11730-H | Bravo Canada, MuchMusic [digital video compression] |
| 18 | 11756-H | Showcase E&W/Discovery Channel Canada/Life Network/ The Sports Network [digital] |
| 19 | 11791-H | Telesat [digital video compression] |
| 20 | 11817-H | CBC feeds |
| 21 | 11852-H | ExpressVu DBS (summer 1997) |
| 22 | 11878-H | ExpressVu DBS (summer 1997) |
| 23 | 11913-H | ExpressVu DBS (summer 1997) |
| 24 | 11939-H | Ontario Legislature |
| 25 | 11974-H | La Chaine (TV Ontario's French lanaguage service) |
| 26 | 12000-H | TV Ontario (English) |
| 27 | 12035-H | Star Choice DBS |
| 28 | 12061-H | Star Choice DBS |
| 29 | 12096-H | Atlantic Satellite Network (ASN) |
| 30 | 12122-H | Telesat Canada stationkeeping (GLACS) |
| 31 | 12157-H | CBC feeds |
| 32 | 12183-H | ExpressVu DBS (summer 1997) |

### Solidaridad 1 SO1 109.2° West

(No video has been seen on any Ku transponder)

### Anik E1 (A2) 111° West

Note: Due to loss of power from the satellite south solar panel on March 26, 1996, Anik E1 Ku-band transponders 7-8, 11-16, 21-28, and 31-32 are off indefinitely according to Telesat officials.

| | | |
|---|---|---|
| 1 | 11717-V | Data transmissions |
| 2 | 11743-V | Data transmissions |
| 3 | 11778-V | Data transmissions |
| 4 | 11804-V | Data transmissions |
| 5 | 11839-V | DirectPC [digital] |
| 6 | 11865-V | NovaNet FM² Services |
| 9 | 11961-V | Occ video |
| 10 | 11987-V | Occ video |
| 17 | 11730-H | Woman's Television Network E&W [digital video compression] |
| 18 | 11756-H | Data transmissions |
| 19 | 11791-H | Data transmissions |
| 20 | 11817-H | SCPC/Data transmissions/ Shaw: New Country Network, Access Network of Alberta [digital video compression] |
| 29 | 12096-H | Occ video |
| 30 | 12122-H | RDI feeds |

### Solidaridad 2 (SO2) 112.9° West

(No video has been seen on any Ku-band transponder)

### Anik C3 (C3) 114.9° West (Inclined Orbit)

(This satellite rarely has video transmissions)

| | | |
|---|---|---|
| 7 | 11900-V | Occ video |

### Morelos 2 (M2) 116.8° West

(No video has been seen on any Ku-band transponder)

### EchoStar 1/2 & Tempo 1 119°West

A complete channel guide for TheDISH Television Network is presented in the DBS section of *Satellites Times* Satellite Service Guide. These satellites operate in the 12.2-12.7 GHz BSS band.

### SBS 5 (SBS5) 123° West

| | | |
|---|---|---|
| 1 | 11725-H | On Command Video [Spectrumsaver] |
| 2 | 11780-H | SCPC services/Data transmissions/National Tech University [Spectrumsaver] |
| 3 | 11823-H | Data transmissions |
| 4 | 11872-H | On Command Video [Spectrumsaver] |
| 5 | 11921-H | Data transmissions |
| 6 | 11970-H | Data transmissions |
| 7 | 12019-H | Data transmissions |
| 8 | 12068-H | Data transmissions |
| 9 | 12117-H | Data transmissions |
| 10 | 12166-H | WalMart [V2+]/Occ video |
| 11 | 11748-V | Data transmissions |
| 12 | 11898-V | WMNB Russian-American TV [inverted video] |
| 14 | 12141-V | Occ video |

### GSTAR-2 (GST2) 125° West

| | | |
|---|---|---|
| 6 | 12035-H | Occ video |
| 9 | 11744-V | Data transmissions |
| 11 | 11866-V | GSTAR-2 ID slate |
| 13 | 11988-V | Occ video |
| 14 | 12049-V | Occ video |
| 15 | 12110-V | Occ video |
| 16 | 12171-V | Occ video |

# Satellite Transponder Guide

*By Robert Smathers*

| | Galaxy 6 (G6) 74° | GE-2 (GE2) 85° | Spacenet 3 (S3) 87° | Telstar 402R (T4) 89° | Galaxy 7 (G7) 91° | Galaxy 3R (G3R) 95° | Galaxy 4 (G4) 99° | Spacenet 4 (S4) 101° | GE-1 (GE1) 103° | Anik E2 (A1) 107.3° | Solidaridad 1 (SD1) 109.2° | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Tokyo BS New York feeds | Data Transmissions | Data Transmissions | FOX feeds | Sega Channel Interactive [digital] | TVN Theatre 1 [V2+] | SCPC services | Data Transmissions | ASCI o/v | CBC-H English Eastern | Data Transmissions | Da |
| 2 | o/v | ABC feeds/o/v | American Independent Network (AIN) [Spectrumsaver] | Data Transmissions | CBS West [occ VC1] | TVN Theatre 2 [V2+] | Buena Vista TV distribution | STARZ! 2 [V2+] | Data Transmissions | The Sports Network (TSN) slate | Data Transmissions | |
| 3 | o/v | o/v | WSBK-UPN Boston [V2+] | XXXplore TV (adult) [V2+] | Action PPV [V2+] | TVN Theatre 3 [V2+] | SCPC services | Data Transmissions | (none) | CBC [digital] | SCPC services | Da |
| 4 | o/v | o/v | Nebraska Educational TV (NETV) [Digicipher] | Shop at Home | fX East [V2+] | TVN Theatre 4 [V2+] | Data Transmissions | Encore-Westerns [V2+] | SC Ohio/Cincinnati [V2+] | Cancom [PowerVu] | Data Transmissions | Da |
| 5 | CNN feeds/o/v | NASA Contract Channel | Univision [V2+] | FOX feeds | fX West [V2+] | TVN Theatre 5 [V2+] | 4 Media Company feeds | Data Transmissions | Hero Teleport [digital] | True Blue (adult) [V2+] | Multivision DBS [Digicipher] | Da |
| 6 | NHK (TV Japan) feeds | o/v | (none) | The X! Channel (adult) [V2+] | Game Show Network [V2+] | TVN Theatre 6 [V2+] | Shepherd's Chapel Network (Rel) | KNBC-NBC Los Angeles (PT24W) [V2+] | WNBC-NBC New York (PT24E) [V2+] | CBC Newsworld | Data Transmissions | |
| 7 | Video Catalog Channel (VCC) | o/v | Data Transmissions | Cable Video Store (adult) [Digicipher] | The Golf Channel [V2+] | Guthy-Renker TV (infomercials) | Warner Brothers Dom TV/WB Network | Bas!! Bassett Bingo | Cornerstone TV (Rel) | CBC-M English | XEQ-TV canal 9 | Da |
| 8 | Horse Racing [digital] | Data Transmissions | Data Transmissions | ABC feeds East [LEITCH] | o/v | Pandamerica Home Shopping | Telemundo [PowerVu] | KOMO-ABC Seattle (PT24W) [V2+] | SC Chicago [V2+] | Global TV [Leitch]/Global feeds | Data Transmissions | |
| 9 | MuchMusic U.S. [V2+] | NASA TV | WPIX-Ind New York [V2+] | Horse Racing [digital]/Fashion Network TV/o/v | Eye on People/WI Sports Networks [PowerVu] | TVN Theatre 9 [V2+] | Syndicated Program feeds | Data Transmissions | Fox Sports South [V2+] | CBC-B English Atlantic | o/v | |
| 10 | o/v | Data Transmissions | Data Transmissions | FOX News Edge | United Arab Emirates TV Dubai | TVN Theatre 10 - adultTVision (adult) [V2+] | Paramount TV Distribution/UPN network feeds | FOXNet (PT24E/W) [V2+] | WJLA-ABC Washington (PT24E) [V2+] | Cancom [PowerVu] | Mexican Government Channel | |
| 11 | o/v | (none) | CNN/SI | Xxxcite (adult) [V2+] | Encore [V2+] | o/v | o/v | STARZ! East [V2+] | Univision [digital] | CBC-A French | Multivision DBS [Digicipher] | |
| 12 | TV Asia [PowerVu] | Data Transmissions | Data Transmissions | Horse Racing [digital]/AIN (occ) | Romance Classics [V2+] | MCI Andover o/v/RAI TV | Syndicated Program feeds | Florida Public TV (occ)/o/v | TurnerVision Promo Channel (occ)/o/v | Cancom [PowerVu] | (none) | |
| 13 | RTPI | Data Transmissions | SCPC/FM2 services | FOX feeds West | Ovation/CSN/Kaleidoscope/Bloomberg/-Box [Digicipher] | Horse Racing [digital]/o/v | Syndicated Program feeds | Data Transmissions | Fox Sports/SC Alternate (occ)/o/v | CBC-C English Pacific | Multivision DBS [Digicipher] | |
| 14 | Gospel Music TV | Data Transmissions | (none) | ABC NewsOne Channel | Independent Film Channel [V2+] | XXXplore Promo (adult) [Fixed Key V2+] | o/v | WWOR-UPN New York [V2+] | SC New England [V2+] | Cancom [PowerVu] | Data Transmissions | |
| 15 | Midwest Sports Channel [V2+] | o/v | KTLA-Ind Los Angeles [V2+] | o/v [digital]/o/v | Your Choice TV [Digicipher] | o/v | World Harvest TV (Rel) | Data Transmissions | ABC East hot backup [LEITCH] | o/v | Multivision DBS [Digicipher] | |
| 16 | Horse Racing [digital] | Data Transmissions | CNN International/CNN fN [V2+] | Eurotica (adult) [V2+] | Access Television [Digicipher] | HBO 2 East [V2+] | CBS West [occ VC1] | NPS Promo Channel | SC Pacific [V2+] | Cancom [PowerVu] | Data Transmission | |
| 17 | o/v | Data Transmissions | FM2 services | FOX feeds | ESPN Intl Pacific Rim [B-MAC] | Cinemax 2 East [V2+] | CBS East [occ VC1] | (none) | SC Philly/NY Plus/Alternates (occ)/o/v | CBC-D feeds | o/v | |
| 18 | Horse Racing [digital] | (none) | (none) | PBS Schedule X | Teleport Minnesota/CBS Backhaul feeds/o/v | Inforamerica TV (Infomercials) | CBS Backhaul feeds/Eyemark Syndicated feeds | STARZ! West [V2+] | SC New York [V2+] | Telesat [digital] | (none) | |
| 19 | University Network-Dr. Gene Scott (Rel) | Data Transmissions | SSN Extra [V2+] | Exxxtasy (adult) [V2+] | CBS East [occ VC1] | HBO 3 [V2+] | CBS East [occ VC1] | (none) | National Empowerment TV (Net) | Telesat [digital] | Data Transmissions | |
| 20 | CNN Headline News Clean Feed [V2+] | Data Transmissions | La Cadena de Milagro | FOX feeds | FOX News Channel | HBO 2 West [V2+] | CBS East [occ VC1] | Data Transmissions | AFRTS [digital] | o/v | (none) | |
| 21 | o/v | o/v | SSN Pro Am Sports (Pass) [V2+] | ABC feeds West [LEITCH] | BET on Jazz | o/v | CBS feeds/o/v | Data Transmissions | Univision feeds (occ) | Telesat [digital] | (none) | |
| 22 | Horse Racing [digital] | Arab Network of America (ANA) | American Collectibles Network (ACN) | ABC feeds East [LEITCH] | WBIS NY Superstation o/v | Horse Racing [digital] | Paramount feeds/o/v | Data Transmissions | o/v | Venus (adult) [V2+] | (none) | |
| 23 | Worship TV/Praise TV (Rel) [Nokia] | NHK Secondary Feeds | SSN Home Teams Sports (HTS) [V2+] | FOX feeds East | fX Movies [V2+] | 3 Angels Broadcasting | SCOLA [Wegener]/Blue & White Network (occ) | Data Transmissions | ABC West hot backup [LEITCH] | CBC-E English | Data Transmissions | |
| 24 | Horse Racing [digital]/o/v | o/v | America One | ABC feeds East | Intl Channel/Encore ThemedChannels [Digicipher] | Horse Racing [o/v digital]/ACN o/v | CBS Newspath | KPIX-CBS San Francisco (PT24W) [V2+] | WRAL-CBS Raleigh (PT24E) [V2+] | (Inactive) | (none) | |

# Satellite Transponder Guide

*By Robert Smathers*

| Iesat E1 (A2) 111° | Solidaridad 2 (SD2) 112.9° | Morelos 2 (M2) 116.8° | Galaxy 9 (G9) 123° | Galaxy 5 (G5) 125° | Satcom C3 (F3) 131° | Galaxy 1R (G1) 133° | Satcom C4 (F4) 135° | Satcom C1 (F1) 137° | |
|---|---|---|---|---|---|---|---|---|---|
| Transmissions | Data Transmissions | Data Transmissions | Reuters newsfeeds o/v | Disney East [V2+] | Family Channel West [PowerVu] | Comedy Central West [V2+] | American Movie Classics (AMC) [V2+] | Prime Network [V2+] | 1 |
| (Inactive) | Data Transmissions | (none) | BBC Breakfast News (occ) o/v | Playboy (adult) [V2+] | The Learning Channel [V2+] | Univision/Galavision [PowerVu] | Request TV PPV [Digicipher] | KMGH-ABC Denver [V2+] | 2 |
| a Transmissions | Data Transmissions | Data Transmissions | NiiK TV | Trinity Broadcasting (Rel) | Viewer's Choice PPV [digital] | Encore Themed Services [Digicipher] | Nickelodeon East [V2+] | KRMA-PBS Denver [V2+] | 3 |
| a Transmissions | Data Transmissions | Data Transmissions | General Communication [digital] | Sci-Fi [V2+] | Lifetime West [V2+] | TV Food/Outdoor Life Networks [Digicipher] | Lifetime East [V2+] | o/v | 4 |
| a Transmissions | o/v | Data Transmissions | Showtime/MTV (West) [Digicipher] | CNN [V2+] | Odyssey (Rel) | Classic Arts Showcase | Deutsche Welle TV (German) | KDVR-Fox Denver [V2+] | 5 |
| (Inactive) | Data Transmissions | Data Transmissions | o/v | WTBS-Ind Atlanta [V2+] | Court TV/NW Cabe News [Digicipher] | Z-Music | Madison Square Garden [V2+] | KCNC-CBS Denver [V2+] | 6 |
| a Transmissions | o/v | Data Transmissions | TVN Video [digital] | WGN-Ind Chicago [V2+] | C-SPAN 1 | Disney West [V2+] | Bravo [V2+] | FOX Sports West [V2+] | 7 |
| (Inactive) | Data Transmissions | XHGC canal 5 | General Communication [digital] | HBO West [V2+] | Q2 QVC-2 Fashion Channel | Cartoon Network [V2+] | Prevue Guide | NBC-East | 8 |
| (Inactive) | (none) | Data Transmissions | TVN Video [digital] | ESPN [V2+] | Music Choice [digital] | ESPN2 Blackout [V2+] | QVC Network | FOX Sports Net | 9 |
| (Inactive) | (none) | XEIPN canal 11 | TVN Video [digital] | MOR Music | Home Shopping Club Spree | MSNBC [V2+] | Home Shopping Network (HSN) | FOX Sports SW [V2+] | 10 |
| (Inactive) | Data Transmissions | Data Transmissions | TVN Video [digital] | Family Channel East [V2+] | Newsport [V2+] | Eternal Word TV Network (Rel) | SpeedVision [V2+] | Network One 'N1 | 11 |
| (Inactive) | (none) | Data Transmissions | General Communication [digital] | Discovery West [V2+] | History Channel [V2+] | Valuevision | Global Shopping Network | Data Transmissions | 12 |
| (Inactive) | (none) | Data Transmissions | TVN Video [digital] | CNBC [V2+] | The Weather Channel [V2+] | Encore Themed Service [Digicipher] | Travel Channel [V2+] | Fox Sports Midwest [V2+] | 13 |
| o/v | (none) | XEW canal 2 | Sundance Channel [V2+] | ESPN2 [V2+] | New England Sports Network [V2+] | ESPN Alternate [V2+] | Fit TV | KUSA-NBC Denver [V2+] | 14 |
| (Inactive) | (none) | Digital Video | Showtime West [V2+] | HBO East [V2+] | Showtime East [V2+] | Turner Broadcasting [digital] | Animal Planet [V2+] | SC Florida [V2+] | 15 |
| CTV Network [PowerVu] | (none) | XEIMT Canal 22 | General Communication [digital] | Cinemax West [V2+] | M2 Music Television | Turner Classic Movies [V2+] | Request TV 1 [V2+] | FOX Sports Arizona Americas [Digicipher] | 16 |
| (Inactive) | (none) | Digital Video | Nickelodeon West [V2+] | TNT [V2+] | Movie Channel East [V2+] | The New Inspirational Network (Rel) | MTV East [V2+] | FOX Sports (alternates) [V2+] | 17 |
| (Inactive) | (none) | Clara Vision (Rel) | The Movie Channel West [V2+] | TNN [V2+] | TVLand | HBO Multiplex [Digicipher] | Viewer's Choice [Digicipher] | FOX Sports Rocky Mountain [V2+] | 18 |
| Northern Canada [digital] | Data Transmissions | Digital Video | MTV West [V2+] | USA East [V2+] | Showtime/MTV (East) [Digicipher] | Cinemax East [V2+] | C-SPAN 2 | FOXNet [V2+] | 19 |
| o/v | (none) | Data Transmissions | General Communication [digital] | BET [V2+] | Jones Services [Digicipher] | Home and Garden Network [V2+] | Showtime 2 [V2+] | Unknown User [digital] | 20 |
| SCPC services/ Data Transmissions | (none) | Mexican Cable [Digicipher] | ESPNews [V2+] | Knowledge TV | Comedy Central East [V2+] | USA West [V2+] | Discovery East [V2+] | FOX Sports West 2 [V2+] | 21 |
| (Inactive) | (none) | XHIMT canal 7 | o/v | CNN/HN [V2+] | Discovery Channel Services [Digicipher] | Nostalgia Channel | FLIX [V2+] | FOX Sports NW [V2+] (occ) | 22 |
| (Inactive) | Data Transmissions | Mexican Cable [Digicipher] | Computer Network TV | A&E [V2+] | E! Entertainment TV [V2+] | Unknown user [digital] | VH-1 [V2+] | KWGN-Ind Denver [V2+] | 23 |
| (Inactive) | (none) | XHDF canal 13 | General Communication [digital] | Showtime/Movie Channel [PowerVu] | Digital Music Express Radio (DMX) [digital] | Outdoor Channel | CMT [V2+] | Sunshine Network [V2+] | 24 |

## *Other Satellites:*

**Spacenet 2 (S2) 69°**
Hero Teleport Contract
Channel: 21
Data Transmissions: 17, 20, 22, 23, 24

**Brasilsat A1 (BA1) 79°**
Occasional video: 3 and 4

**Telstar 302 (T2) 97°**
Occasional video: all transponders

**Telstar 303 (T3) 120°**
Occasional video: 4 and 16
ABC feeds: 19

**Satcom C5 (C5) 139°**
SCPC services:
3, 4, 10, 14, 16, 21
DART services: 15
SEDAT services: 19, 21
Occasional video: 18
Alaskan TV Services:
24 [PowerVu]

## *LEGEND:*

Unscrambled/non-video

Subscription

Not available in U.S.

o/v = occasional video

# International Shortwave Broadcasters via Satellite

*By Larry Van Horn and Robert Smathers*

## AFRICA NO. 1

B.P. 1, Libreville, Gabon. Telephone +241 760001 (voice), +241 742133. Intelsat 601 (27.5 west) Tr 23B (3915 MHz RHCP). 8.20 MHz audio (French).

## ARAB REPUBLIC OF EGYPT RADIO

(Arabic ID: Idha'at Jumhuriyat Misr al-Arabiyah min al-Qahirah) P.O. Box 1186, Cairo, Egypt. Eutelsat II F3 (16.0 east) Tr 27 (11176 Mhz V) 7.02 MHz audio.

## BRITISH BROADCASTING CORPORATION (BBC)

Bush House, The Strand, London, WC2B 4PH. Telephone: +44 171 240 3456 (voice), +44 171 240 8760 (fax)
English BBC World Service transmissions can be found on the following satellites: Astra 1B (19.2 east) Tr 23 (11552 MHz H) 7.38 MHz audio, Eutelsat II F1 (13.0 east) Tr 25 (10987 MHz V) 7.38 MHz audio, Intelsat 601 (27.5 west) Tr 73 (11155 MHz V east spot) 7.56 MHz audio, Asiasat 1 (105.0 east) Tr 5 (3900 MHz V south beam) 7.20 MHz audio, and Satcom C3/F3 (131.0 west) Tr 7 (3840 MHz V) 5.41 MHz audio

## C-SPAN AUDIO SERVICES

C-SPAN Audio Networks, 400 North Capitol Street, NW, Suite 650, Washington, D.C. 20001 Attn: Tom Patton. Telephone: (202) 626-4649 (voice)

### C-SPAN Audio 1

Satcom C3/F3 (131.0 west) Tr 7 (3840 MHz.V) 5.20 MHz audio. A complete schedule of C-SPAN 1 audio services can be found in the November-December, 1995 issue of *Satellite Times.*

### C-SPAN Audio 2

Satcom C3/F3 (131.0 west) Tr 7 (3840 MHz.V) 5.40 MHz audio. The BBC World Service in English is broadcast continuously 24-hours a day on this audio subcarrier.

## CHINA RADIO INTERNATIONAL

China Radio International, Beijing, China 100866. Telephone +86-10-6092274/6092760 (voice), +86-10-8513174/5 (fax). Asiasat-1(105.5 east) FDM transmission centered on 4160 MHz

## DEUTSCHE WELLE (DW)

P.O.Box 100 444, 50968 Cologne, Germany. Telephone: +49 221 389 4563 (voice), +49 221 389 3000 (fax)
Deutsche Welle services are available on the following satellites: Satcom C4/F4 (135 west) Tr 5 (3800 MHz V) 7.02, 7.22, 7.38/7.56, 7.74 MHz audio, Astra 1A (19.2 east) on Tr 2 (11229 MHz V) 7.38/7.56 MHz audio, Eutelsat (13.0 east) Tr 27 (11163 MHz V) 7.02/7.20 MHz. audio, Intelsat K (21.5 west) Tr H7 (11605 MHz H), 7.38/7.56 MHz audio, and Intelsat 707 (1.0 west) Tr 23B (3.911 MHz RHCP) digital MPEG-2 subcarrier.

## ISLAMIC REPUBLIC OF IRAN BROADCASTING (IRIB)

External Service, P.O. Box 3333, Tehran, Iran. Telephone: +98 21 291095 (fax). Intelsat 602 (63.0 east) Tr 71 (11002 MHz V) for IRIB Radio 2 Farsi service using 5.60/6.20 MHz. audio. IRIB Radio 1 in various languages uses 5.95 MHz and Tr 73 (11155 MHz V) 6.20 MHz audio..

## ISRAEL RADIO

P.O. Box 1082, Jerusalem 91010, Israel. Intelsat 707 (1.0 west) Tr 73 (11178 MHz V) 7.20 MHz audio.

## LA VOIX DU ZAIRE

Station Nationale, B.P. 3164. Kinshasa-Gombe, Zaire. Telephone +243 12 23171-5. Intelsat 510 (66.0 east) Tr 12 (3790 MHz RHCP) 7.38/7.56 MHz audio with French.

## RADIO ALGIERS INTERNATIONAL

21 Blvd des Martyrs, Alger, Algeria. Eutelsat II F3 (16.0 east) Tr 34 (11678 MHz H) 7.38 MHz audio with Spanish at 1900-2000 UTC and English 2000-2100 UTC.

## RADIO AUSTRALIA

GPO Box 428G, Melbourne, Vic. 3001, Australia. Telephone: +613 9626 1800 (voice), +613 9626 1899 (fax)
Palapa C1 (113.0 east) Tr 9 (3880 MHz H) 7.20 MHz audio

## RADIO BELGRADE

Hilandarska 2, 11000 Beograd, Serbia. Telephone: +381 11 344 455 (voice), +381 11 332014 (fax)
Eutelsat II F4 (7.0 east) Tr 22 (11181 MHz H) 7.02 MHz audio with Serb/English.

## RADIO BUDAPEST

Body Sandor u. 5-7, 1800 Budapest, Hungary. Telephone: +36 1 138 7224 (voice), +36 1 138 8517 (fax) E-mail: *h9563mes@ella.hu.* Eutelsat II F3 (16.0 east) Tr 33 (11596 MHz H) 7.02 MHz audio from 2300-0500 UTC

## RADIO CANADA INTERNATIONAL

P.O. Box 6000, Montreal, Canada H3C 3A8. Telephone: (514) 597-7555 (voice), (514) 284-0891 (fax). Eutelsat II F6 (Hot Bird 1 at 13 east) 11265 MHz H 7.20 MHz audio for Canadian troops in Bosnia.

## RADIO EXTERIOR DE ESPANA (REE)

Apartado 156202, Madrid 28080, Spain. Telephone +34 13461083/1080/1079/1121 (voice); 34 13461097 (fax).
Eutelsat II F6 (Hot Bird 1 at 13.0 east) (11220 MHz H) 7.92 MHz audio, Hispasat 1A/B (31.0 west) Tr 6 (12149 MHz RHCP) 7.92 MHz audio, and Asiasat-2 (100.5 east) 4000 MHz H. MPEG-2.

## RADIO FRANCE INTERNATIONAL (RFI)

B.P. 9516, Paris F-75016, France. Telephone: +33 1 42 30 30 62 (voice), +33 1 42 30 40 37 (fax)
RFI broadcast can be heard in French, 24-hours a day.on the following satellites: Intelsat 601 (27.5 west) Tr 23B (3915 MHz RHCP) 6.40 MHz audio to Africa/Middle east, and Palapa B2P (113 east) Tr 8 (3860 MHz V) 6.15 MHz audio to Asia.

## RADIO MEDITERRANEE INTERNATIONALE

3 et 5, rue Emisaliah (B.P. 2055), Tanger, Morocco. Intelsat 513 (53.0 west) Tr 14 (3990 MHz RHCP) 7.20/8.20 MHz audio in Arabic/French.

## RADIO NETHERLANDS

P.O..Box 222, 1200JG Hilversum, The Netherlands. Telephone +31 35 724222 (voice), +31-35-724252 (fax) E-mail: *letters@rnw.nl.* Various languages are relayed via Astra 1C (19.2 east) Tr 64 (10935 MHz V) 7.74 and 7.92 audio.

## RADIOSTANTSIYA MAYAK

The Mayak radio service consists of light music, sports, news and weather on the hour and half hour in Russian. On the air continuously. The service can be found on Tr 6 (3675 MHz RHCP) 7.50 MHz audio on the following satellites: Gorizont 27 (53.0 east), Gorizont 22 (40.0 east), Gorizont 26 (11.0 west), Gorizont 18 (140.0 east), Gorizont 19 (96.5 east), Gorizont 28 (90.0 east), and Gorizont 24 (80.0 east).

## RADIO SWEDEN

S-10510 Stockholm, Sweden.. Telephone: +46 8 784 7281 (voice), +46 8 667 6283 (fax). E-mail: *wood@stab.sr.se* Tele-X (5.0 east) Tr 40 (12475 MHz) 7.38 MHz audio and Astra 1B (19.2 east) Tr 33 (10964 MHz H) 7.38 or 7.56 MHz audio.

## RADIOTELEVISIONE ITALIANA (RAI)

Viale Mazzini 14, 00195 Roma, Italy. Telephone: +39 6 5919076. Selected programs of RAI's external service are carried on Eutelsat II F6 (Hot Bird 1 @ 13.0 east) (11446 MHz V) 7.56 MHz audio. This is a feed to the BBC Atlantic relay station on Ascension Island. Galaxy 7 (91.0 west) Tr 14 (3980 MHz V) 7.38 MHz audio.

## RADIO VLAANDEREN INTERNATIONAL

P.O. Box 26, B-1000, Brussels, Belgium. Telephone: +32 2 741 3802 (voice), +32 2 734 7804 (fax) E-mail: *rvi@brtn.be* Astra 1C (19.2 east) Tr 63 (10921 MHz H) 7.38 MHz audio.

## RDP INTERNATIONAL

Av. 5 de Outubro 197, 1000 Lisbon, Portugal. Telephone: +351 1 535151 (voice), +351 1 793 1809 (fax).
RDP International uses the following satellites for various broadcast to the indicate coverage areas:
Asiasat 2 (service due to start on this satellite in September 1995), Eutelsat II F2 (10.0 east) Tr 39 (11658 MHz V) 7.02/7.20 MHz audio to Europe. Express 2 - Russian Statsionar 4 (14.0 west) on 4025 MHz (RHCP) 7.0 MHz audio to South America, Africa, the US east coast and southern Europe, Gorizont 22 - Russian Statsionar 12 (40 east) Tr 11 (3925 MHz RHCP) 7.02 MHz audio to Africa, southern Europe, and the Indian Ocean region.

# International Shortwave Broadcasters via Satellite

### *SWISS RADIO INTERNATIONAL*

Giacomettstrasse 1, CH-3000 Bern 15, Switzerland. Telephone: +41 31 350 9222 (voice), +41 31 350 9569 (fax). SRI uses the following satellites for its external services: Astra 1A (19.2 east) Tr 9 (11332 MHz H) 7.38 MHz audio Multilingual/7.56 MHz English 24-hours, Eutelsat II (13.0 east) (11321 MHz V) 7.74 MHz audio, and Intelsat K (21.5 west) Tr 7 (11605 MHz H) 8.10 MHz audio multilingual 24 hours.

### *TRANS WORLD RADIO (TWR)*

Astra 1A (19.2 east) Tr 16 (11436 MHz V) 7.38/7.56 MHz audio with German language programming from Evangeliums Rundfunk and TWR-UK. Astra 1C (19.2 east) Tr 38 (11038 MHz V) 7.38 MHz audio Multilingual from TWR-Europe.

### *TUNIS INTERNATIONAL RADIO*

71 ave de la Liberte, Tunis, Tunisia. Eutelsat II F2 (16.0 east) Tr 39 (11658 MHz V) 7.20 MHz audio.

### *VATICAN RADIO*

I-00120, Vatican City State, Italy. Telephone: +396 6988 3551 (voice), +396 6988 3237 (fax)
Eutelsat Hotbird (13 east) 10987 MHz V; Intelsat 603 (34.5 west) 4097.75 MHz LHCP; and Intelsat 704 (66 east) 4152.45 MHz RHCP.

### *VOICE OF THE ARABS*

P.O. Box 566, Cairo 11511, Egypt. Transmissions from this external radio service have been heard on Arabsab 1C at 31 east on 3882 MHz (LHCP) FDM at 1440 MHz. Broadcast have also been noted on Eutelsat II-F3 at 16 east, Tr 27 (11176 MHz V) 7.20 MHz audio.

### *VOICE OF SAHEL*

Niger Radio and Television Service. Transmissions of the domestic radio shortwave service have been reported on Intelsat 707 at 1.0 west. No other details are available at this time.

### *VOICE OF THE IRAQI PEOPLE (CLANDESTINE)*

Programming has been reported on Arabsat 1C at 31.0 east on a FDM tranmission centered at 3940 MHz RHCP. Transmissions have been noted from 24.5 kHz to 2700 kHz in USB between 1300-0100 UTC.

### *WORLD HARVEST INTERNATIONAL RADIO, WHRI-South Bend, Indiana*

P.O. Box 12, South Bend, IN 46624. Religious broadcaster WHRI/KHWR uses audio subcarriers to feed their three shortwave broadcast transmitters as follows: Galaxy 4 (99.0 west) Tr 15 (4000 MHz.H) 7.46/7.55 MHz audio with WHRI programming relayed to their broadcast transmitters in Indianapolis, Ind. for shortwave transmissions beamed to Europe and Americas and 7.64 MHz audio for KHWR programming relayed to their broadcast transmitter in Naahlehu, Hawaii for shortwave transmissions beamed to the Pacific and Asia.

### *WORLD RADIO NETWORK*

Wyvil Court, 10 Wyvil Road, London, SW8 2TG, England, Telephone: +44 171 896 9000 (voice), +44 171 896 9007 (fax). In North America, call at local rates on (202) 414-3185. E-mail via Internet: *online@wrn.org*. WRN can also be heard live on the World Wide Web to users with high speed connections at: http//town.hall.org/radio/wrn.html. WRN schedules are subject to change. Complete schedules for North America (WRN2), Europe (WRN1 and WRN2), and the new Africa/Asia-Pacific (WRN1) services are listed in page 92 of this issue of *Satellite Times*.

#### WRN 1 North American English Program Schedule

Galaxy 5 (125 deg West) tr 6-3.820 GHz V (TBS) 6.8 MHz audio. WRN is also available on cable and local radio stations. WRN program details can be heard at 0625, 1425 and 1955 Eastern Time, and are also available on TBS text page 204. All times below are Eastern Daylight (UTC +4 hours)

| | |
|---|---|
| 0000 | RTE Dublin, Ireland-*Irish Collection* |
| 0100 | SABC Channel Africa, Johannesburg (Mon-Sat) |
| | Copenhagen Calling (Sun) |
| 0130 | *BBC Europe Today* (Mon-Fri) |
| | Glenn Hauser's *World of Radio* (Sat) |
| | UN Radio from New York (Sun) |
| 0200 | Polish Radio-Warsaw |
| 0230 | Radio Canada International |
| 0300 | ABC Radio Australia |
| 0400 | Voice of Russia-Moscow |
| 0500 | Radio Prague, Czech Republic |
| 0530 | Radio Netherlands-Hilversum |
| 0630 | YLE Radio Finland |
| 0700 | ABC Radio Australia |
| 0800 | RTE Dublin, Ireland |
| 0900 | Radio Prague, Czech Republic |
| 0930 | SABC Channel Africa (Mon-Sat) |
| | UN Radio from New York (Sun) |
| 1000 | YLE Radio Finland |
| 1030 | Radio Vlaanderen-Brussels Calling |
| 1100 | Radio France International-Paris |
| 1200 | Caribbean Tempo from CANA Radio (Mon-Fri) |
| | Glenn Hauser's *World of Radio* (Sat) |
| | SABC Network Africa (Sun) |
| 1215 | Vatican Radio World News (Mon-Fri) |
| 1230 | ORF Radio Austria International |
| 1300 | BBC Europe Today (Mon-Fri) |
| | UN Radio from New York (Sat) |
| | Copenhagen Calling (Sun) |
| 1330 | RTE Dublin, Ireland |
| 1400 | Radio Vlaanderen-Brussels Calling |
| 1430 | Radio Netherlands-Hilversum |
| 1530 | Radio Sweden |
| 1600 | Voice of Russia-Moscow |
| 1630 | Polish Radio-Warsaw |
| 1700 | RTE Dublin, Ireland-*Ireland Tonight* at 1800 |
| 1900 | Radio Netherlands, Hilversum |
| 2000 | ABC Radio Australia |
| 2100 | YLE Radio Finland-Helsinki |
| 2130 | Radio Sweden |
| 2200 | Radio Prague, Czech Republic |
| 2230 | ORF Radio Austria International |
| 2300 | Polish Radio-Warsaw |
| 2330 | Radio Budapest, Hungary |

#### WRN 2 North American Multilingual Program Schedule

Galaxy 5 (125.0 west) Tr 6 (3820 MHz V) 6.20 MHz audio. New 24 hour multi-lingual channel for North America designed for the re-broadcasting of programs in a variety of languages for domestic FM/AM relays and cable distribution.

#### WRN European Service

**WRN1** - Astra 1B (19.2 east) Tr 22 (11538 MHz V) 7.38 MHz audio. All broadcasts are in English. Program information is available on Astra 1B VH-1 text page 222, 223 and 224. WRN network information can be heard on the European service daily at 0125, 1025 and 2050 BST.
**WRN2** - Eutelsat II F-1 (13 east) Tr 25 (10987 MHz V) 7.38 MHz. Multi-lingual programming.

#### WRN Asia-Pacific Service

AsiaSat-2 (100.5 deg East) 4.000 GHz V, MPEG2 DVB, Symbol Rate 28.125 Mbaud, FEC 3/4, Select WRN1 from audio menu.

#### WRN Middle East and Africa Service

Intelsat 707 (1 deg West) 3.9115 GHz, RHCP, Symbol Rate 8.022 Mbaud, FEC 3/4, MPEG2 Audio Stream. "WRN1"
PanAmSat 4 (68.5 deg East). MultiChoice digital direct-to-home service, audio channel 51

### *WORLDWIDE CATHOLIC RADIO - WEWN*

P.O. Box 176, Vandiver, AL 35176 USA. Telephone: (205) 672-7200 (voice), (205) 672-9388 (fax). WWW URL: http://www.ewtn.com. WEWN broadcasts are available on: Galaxy 1R (133 west) Tr 11 (3920 MHz H) 5.40 MHz (English) and 5.58 MHz (Spanish). WEWN is also available internationally on Intelsat 601 (27.5 west) Tr 22.7, 5.59 MHz (English) and 5.68 MHz (Spanish).

### *YLE RADIO FINLAND*

Box 10, SF-00241 Helsinki, Finland. Telephone: +358 9 1480 4320 (voice), +358 9 1481 1169 (fax). Toll free in the US 800-221-YLEX (9539). WWW URL: www.yle.fi/fbc/radiofin.html. E-mail: *rfinland@yle.fi* Most of YLE's broadcasts to Europe are available on Eutelsat II F1 (13.0 east) Tr 27 (11163 MHz V) 8.10 MHz. audio, and Asiasat 2 (100.5 east) Tr 10B (4000 MHz H) early this year.

# Geostationary Satellite Locator Guide

*By Larry Van Horn*

This guide shows the orbital locations of 249 active geostationary/synchronous satellites at publication deadline. Synchronous satellite location information is supplied to *Satellite Times* by NASA's Goddard Space Flight Center-Orbital Information Group (Mr. Adam Johnson). We are particularly grateful to the following individuals for providing payload information and analysis: Earth News: Philip Chien; Molniya Space Consultancy/Janes *Spaceflight Directory* Editor: Mr. Phillip Clark; Baylin Publications: Dr. Frank Baylin; JSC NASA: Dr. Nicholas Johnson; University of New Brunswick: Mr. Richard B. Langley; Havard-Smithsonian Center for Astrophysics: Jonathan McDowell; U.S. Space Command/ Public Affairs; Naval Space Command/Public Affairs; NASA NSSDC/WDC-A, Goddard Space Flight Center; and the *Satellite Times* staff.

*d* indicates that satellite is drifting (moving into a new orbital slot or at end of life). *i* indicates an orbital inclination greater than 2 degrees. # indicates that the satellite has started into an inclined orbit.

**Radio Frequency Band Key**

| | |
|---|---|
| VHF | 136-138 MHz |
| P band | 225-1,000 MHz |
| L band | 1.4-1.8 GHz |
| S band | 1.8-2.7 GHz |
| C band | 3.4-7.1 GHz |
| X band | 7.25-8.4 GHz |
| Ku band | 10.7-15.4 GHz |
| K band | 15.4 -27.5 GHz |
| Ka band | 27.5-50 GHz |
| Millimeter | > 50 GHz |

**Satellite Service Key**

| | |
|---|---|
| BSS | Broadcast Satellite Service |
| Dom | Domestic |
| DTH | Direct to Home |
| FSS | Fixed Satellite Service |
| Gov | Government |
| Int | International |
| Mar | Maritime |
| Met | Meteorology |
| Mil | Military |
| Mob | Mobile |
| Reg | Regional |

| OBJ NO. | INT-DESIG/COMMOM NAME | LONG (DEG) | TYPE SATELLITE |
|---|---|---|---|
| 22912 | 1993-073B Meteosat 6 (MOP 3) (ESA) | 0.6E# | Met (L) |
| 23730 | 1995-067A Telecom 2C (France) | 2.9E | Dom FSS/Gov-Mil (X/C/Ku) |
| 23712 | 1995-060A USA 115 (Milstar-2) (US) | 4.0E/i | Mil-Comm (P/S/K) |
| 19919 | 1989-027A Tele X (Sweden) | 4.8E | Reg BSS (Ku) |
| 20193 | 1989-067A Sirius/Marcopolo 1(BSB R-1) | 5.1E | Reg BSS (Ku) |
| 22921 | 1993-076A USA 98 (NATO 4B) | 6.1E/i | Mil-Comm (P/S/X) |
| 22028 | 1992-041B Eutelsat II F4 | 6.9E | Reg FSS (Ku) |
| 21056 | 1991-003B Eutelsat II F2 | 10.3E | Reg FSS (Ku) |
| 19596 | 1988-095A Raduga 22 (Russia) | 11.7E/i | Dom FSS/Gov-Mil (X/C) |
| 22557 | 1993-013A Raduga 29 (Russia) | 12.0E# | Dom FSS/Gov-Mil (X/C) |
| 22269 | 1992-088A Cosmos 2224 (Russia) | 12.0E# | Mil-Earl Warning (X) |
| 24208 | 1996-044A Italsat 2 (Italy) | 13.0E | Dom-Telephone/Mob (L/S/ K/Ka) |
| 20777 | 1990-079B Eutelsat II F1 | 13.0E | Reg FSS (Ku) |
| 21055 | 1991-003A Italsat 1 (Italy) | 13.1E | Dom-Telephone (S/K/Ka) |
| 24665 | 1996-067A Eutelsat II F7 (Hot Bird 2) | 13.2E | Reg BSS (Ku) |
| 21803 | 1991-083A Eutelsat II F3 | 16.1E | Reg FSS (Ku) |
| 23537 | 1995-016B Eutelsat II F6 (Hot Bird 1) | 18.1E | Reg BSS (Ku) |
| 23842 | 1996-021A Astra 1F | 19.2E | Reg BSS (Ku) |
| 22653 | 1993-031A Astra 1C | 19.3E | Reg BSS (Ku) |
| 23686 | 1995-055A Astra 1E | 19.5E | Reg BSS (Ku) |
| 23331 | 1994-070A Astra 1D | 21.1E | Reg BSS (Ku) |
| 19688 | 1988-109B Astra 1A | 21.3E | Reg BSS (Ku) |
| 19331 | 1988-063B Eutelsat 1 F5 (ECS 5) | 21.7E# | Reg FSS (VHF/Ku) |
| 21139 | 1991-015A Astra 1B | 22.1E | Reg BSS (Ku) |
| 22175 | 1992-066A DFS 3 (Germany) | 23.7E | Dom BSS (S/Ku/K) |
| 18351 | 1987-078B Eutelsat 1 F4 (ECS 4) | 25.4E/i | Reg FSS (VHF/Ku) |
| 23948 | 1996-040A Arabsat 2A (Arabsat) | 25.4E | Reg FSS/BSS (C/Ku) |
| 20659 | 1990-054A Gorizont 20 (Russia) | 26.0E/i | Dom/Gov FSS (C/Ku) |
| 20706 | 1990-063B DFS 2/Kopernikus (Germany) | 28.6E | Dom BSS (S/Ku/K) |
| 24652 | 1996-062A Arabsat 2B (Arabsat) | 30.4E | Reg FSS/BSS (C/Ku) |
| 21894 | 1992-010B Arabsat 1C (Arabsat) | 31.2E | Reg FSS/BSS (S/C) |
| 23200 | 1994-049B Turksat 1B (Turkey) | 31.2E | Reg FSS (Ku) |
| 15629 | 1985-025A Intelsat 510 | 32.9E/i | Int FSS (C/Ku) |
| 20263 | 1989-081A Gorizont 19 (Russia) | 33.6E/i | Dom/Gov FSS (C/Ku) |
| 21821 | 1991-087A Raduga 28 (Russia) | 35.5E/i | Dom FSS/Gov-Mil (X/C) |
| 22963 | 1993-002A Gals 1 (Russia) | 36.0E | Dom BSS (Ku) |
| 23717 | 1995-063A Gals 2 (Russia) | 36.0E | Dom BSS (Ku) |
| 20929 | 1990-095A USA 65 (DSP F15) (US) | 37.4E# | Mil-Early Warning (S/X) |
| 23775 | 1996-005A Gorizont 31 (Russia) | 39.8E# | Dom/Gov FSS (C/Ku) |
| 23949 | 1996-040B Turksat 1C (Turkey) | 42.2E | Reg FSS (Ku) |
| 24742 | 1997-009A Intelsat 810 | 47.2E/d | Int FSS (C/Ku) |
| 22981 | 1994-008A Raduga 1-3 (Russia) | 48.8E# | Dom FSS/Gov-Mil (X/C) |
| 19687 | 1988-109A Skynet 4B (UK) | 52.8E/i | Mil-Comm (P/S/X/Ka) |
| 23880 | 1996-034A Gorizont 32 (Russia) | 52.9E# | Dom/Gov FSS (C/Ku) |
| 23305 | 1994-064A Intelsat 703 | 57.1E | Int FSS (C/Ku) |
| 13040 | 1982-006A DSCS II E15 (US) | 57.0E/i | Mil-IOR reserve operational (S/X) |
| 20203 | 1989-069B USA 44 (DSCS III A2) (US) | 57.0E/i | Mil-IOR primary operational (P/S/X) |
| 20667 | 1990-056A Intelsat 604 | 60.0E | Int FSS (C/Ku) |
| 22913 | 1993-074A USA 97 (DSCS III B10) (US) | 60.0E/i | Mil-IOR primary operational (P/S/X) |
| 20315 | 1989-087A Intelsat 602 | 62.8E | Int FSS (C/Ku) |
| 23839 | 1996-020A Inmarsat 3 F1 | 63.8E/i | Int Mar (L/C) |
| 21814 | 1991-084B Inmarsat 2 F3 | 65.0E# | Int Mar-POR (L/C) |
| 23461 | 1995-001A Intelsat 704 | 66.0E | Int FSS (C/Ku) |
| 13636 | 1982-106A DSCS II F16 (US) | 67.0E/i | Mil-IOR reserve operational (S/X) |
| 23636 | 1995-040A PanAmSat 4 (PAS 4) | 68.5E | Int FSS (C/Ku) |
| 13595 | 1982-097A Intelsat 505 | 69.9E/i/d | Int FSS/Mar (L/C/Ku) |
| 23448 | 1994-087A Raduga 32 (Russia) | 70.2E# | Dom FSS/Gov-Mil (X/C) |
| 10669 | 1978-016A Ops 6391 (FltSatCom 1) (US) | 71.2E/i | Mil-IOR Reserve (P-Alpha/S/ X) |
| 22787 | 1993-056A USA 95 (UFO-2) (US) | 71.7E/i | Mil-IOR primary (P/S) |
| 08882 | 1976-053A Marisat 2 (US) | 71.9E/i | Int Mar-IOR (P/L/C) |
| 20083 | 1989-048A Raduga 1-1 (Russia) | 72.0E/i | Dom FSS/Gov-Mil (X/C) |
| 23589 | 1995-027A USA 111 (UFO-5) (US) | 72.7E/i | Mil-IOR reserve (P/S/K) |
| 22027 | 1992-041A Insat 2A (India) | 74.0E | Dom FSS/BSS/Met (S/C) |
| 23327 | 1994-069A Elektro 1 (Russia) | 76.2E# | Met (L) |
| 23680 | 1995-054A Luch 1-1 (Russia) | 77.2E# | Tracking & Relay SDRN-2 (Ku) |
| 23314 | 1994-065B Thaicom 2 (Thailand) | 77.3E | Reg FSS (C/Ku) |
| 22931 | 1993-078B Thaicom 1 (Thailand) | 78.2E | Reg FSS (C/Ku) |
| 21759 | 1991-074A Gorizont 24 (Russia) | 79.9/i | Dom/Gov FSS (C/Ku) |
| 24435 | 1996-058A Express 2 (Russia) | 80.2E | Int FSS (C/Ku) |
| 23653 | 1995-045A Cosmos 2319 (Russia) | 80.3E# | Data Relay (C) |
| 20643 | 1990-051A Insat 1D (India) | 82.8E | Dom FSS/BSS/Met (S/C) |
| 19548 | 1988-091B TDRS F3 (US) | 85.1E/i | Gov-Tracking & Relay (C/S/ Ku) |
| 22836 | 1993-062A Raduga 30 (Russia) | 85.3E# | Dom FSS/Gov-Mil (X/C) |
| 18922 | 1988-014A PRC 22 DFH2-1(China) | 87.5E/i | Dom FSS (C) |
| 22880 | 1993-069A Gorizont 28 (Russia) | 90.0E# | Dom/Gov FSS (C/Ku) |
| 23731 | 1995-067B Insat 2C (India) | 90.2E# | Dom FSS/BSS/Met (S/C/Ku) |
| 23426 | 1994-082A Luch 1 (Russia) | 91.0E# | Tracking & Relay CSDRN (Ku) |
| 23765 | 1995-003A Measat 1 (Malaysia) | 91.4E | Dom FSS/BSS (C/Ku) |
| 22724 | 1993-048B Insat 2B (India) | 93.3E | Dom FSS/BSS/Met (S/C) |
| 22245 | 1992-082A Gorizont 27 (Russia) | 96.4E# | Dom/Gov FSS (C/Ku) |
| 20473 | 1990-011A PRC 26 DFH2A-1 (China) | 98.0E# | Dom FSS (C) |
| 22210 | 1992-074A Ekran 20 (Russia) | 98.4E# | Dom BSS (P) |
| 23723 | 1995-064A AsiaSat 2 | 100.5E | Reg FSS (C/Ku) |
| 21922 | 1992-017A Gorizont 25 (Russia) | 103.1E/i | Dom/Gov FSS (C/Ku) |
| 20558 | 1990-030A Asiasat 1 | 105.3E | Reg FSS (C/Ku) |
| 21668 | 1991-060A BS-3B (Yuri 3B)(Japan) | 107.3E | Dom BSS (Ku) |
| 20570 | 1990-034A Palapa B2R (Indonesia) | 108.0E | Reg FSS (C) |
| 20771 | 1990-077A BS-3A (Yuri 3A)(Japan) | 109.7E | Dom BSS (Ku) |
| 23176 | 1994-040B BS-3N (Japan) | 109.7E | Dom BSS (Ku) |
| 19710 | 1988-111A PRC 25 DFH2-2 (China) | 110.3E# | Dom FSS (C) |
| 23864 | 1996-030A Palapa C2 (Indonesia) | 112.9E | Reg FSS (C/Ku) |
| 23768 | 1996-003A Koreasat 2 (Mugunghwa 2) | 115.4E | Dom FSS/BSS (Ku) |
| 14985 | 1984-049A Chinasat 5 (Spacenet 1) | 115.5E# | Dom FSS (C/Ku) |
| 23639 | 1995-041A Koreasat 1 (Mugunghwa 1) | 115.7E | Dom FSS/BSS (Ku) |
| 21964 | 1992-027A Palapa B4 (Indonesia) | 117.2E | Reg FSS (C) |
| 20217 | 1989-070A GMS-4 (Himawari 4) (Japan) | 120.0E/i | Met (P/L) |
| 21132 | 1991-014A Raduga 27 (Russia) | 127.7E/i | Dom FSS/Gov-Mil (X/C) |
| 23649 | 1995-043A JCSAT 3 (Japan) | 127.9E | Dom FSS (Ku) |
| 23651 | 1995-044A N-Star A (Japan) | 131.7E | Dom/Mob FSS (S/C/Ku/Ka) |
| 23781 | 1996-007A N-Star B (Japan) | 133.3E | Dom/Mob FSS (S/C/Ku/Ka) |
| 23943 | 1996-039A Apstar 1A (China) | 133.9E | Reg FSS (C) |
| 19508 | 1988-086A CS 3B (Sakura 3B) (Japan) | 135.7E | Dom FSS (C/K) |
| 23185 | 1994-043A Apstar I (China) | 137.9E | Dom BSS (C) |
| 20953 | 1990-102A Gorizont 22 (Russia) | 139.9E/i | Dom/Gov FSS (C/Ku) |
| 23522 | 1995-011B GMS-5 (Himawari 5) (Japan) | 140.1E# | Met (P/L) |
| 24732 | 1997-007A JCSAT 4 (Japan) | 140.9E | Dom FSS (Ku) |
| 23108 | 1994-030A Gorizont 30 (Rimsat 2) | 142.1E# | Reg FSS (C/Ku) |
| 17706 | 1987-029A Palapa B-2P (Indonesia) | 143.9E# | Reg FSS (C) |
| 20923 | 1990-094A Gorizont 21 (Russia) | 144.7E/i | Dom/Gov FSS (C/Ku) |

# Geostationary Satellite Locator Guide

| OBJ NO. | INT-DESIG/COMMOM NAME | LONG (DEG) | TYPE SATELLITE |
|---|---|---|---|
| 20066 | 1989-046A USA 39 (DSP F14) (US) | 145.4E/i | Mil-Early Warning (S/X) |
| 24653 | 1996-063B Measat-2 (Malaysia) | 147.8E | Dom FSS/BSS (C/Ku) |
| 19874 | 1989-020A JCSAT 1 (Japan) | 149.9E | Dom FSS (Ku) |
| 23779 | 1996-006A Palapa C1 (Indonesia) | 150.4E | Reg FSS (C/Ku) |
| 18316 | 1987-070A ETS V/Kiku 5 (Japan) | 150.2E/i | Experimental (L/C) |
| 18350 | 1987-078A Optus A3 (Aussat K3) | 152.0E# | Dom FSS/BSS (Ku) |
| 20402 | 1990-001B JCSAT 2 (Japan) | 154.0E | Dom FSS (Ku) |
| 12474 | 1981-050A Intelsat 501 | 154.8E/i | Int FSS (C/Ku) |
| 23227 | 1994-055A Optus B3 (Australia) | 156.0E | Dom BSS/Mob (L/Ku) |
| 12994 | 1981-119A Intelsat 503 | 157.2E/i | Int FSS (C/Ku) |
| 22253 | 1992-084A Superbird A1 (Japan) | 158.0E | Dom FSS (Ku/K) |
| 22087 | 1992-054A Optus B1 (Aussat B1) | 159.9E | Dom BSS/Mob (L/Ku) |
| 22907 | 1993-072A Gorizont 29 (Rimsat 1) | 160.8E# | Reg FSS (C/Ku) |
| 21893 | 1992-010A Superbird B1 (Japan) | 161.9E | Dom FSS (Ku/K) |
| 16275 | 1985-109C Optus A2 (Aussat 2) | 164.0E/i | Dom BSS (Ku) |
| 23175 | 1994-040A PanAmSat 2 (PAS-2) | 169.0E | Int FSS (C/Ku) |
| 12046 | 1980-087A OPS 6394 (FltSatCom F4)(US) | 172.5E/i | Mil-POR reserve (P-Bravo/ S/X) |
| 22871 | 1993-066A Intelsat 701 | 173.9E | Int FSS (C/Ku) |
| 22719 | 1993-046A USA 93 (DSCS III B9) (US) | 175.0E/i | Mil-WPAC primary operational (P/S/X) |
| 23124 | 1994-034A Intelsat 702 | 177.1E | Int FSS (C/Ku) |
| 24674 | 1996-070A Inmarsat 3 F3 | 178.0E/i | Int Mar (L/C) |
| 20918 | 1990-093A Inmarsat 2 F1 | 178.9E# | Int Mar-IOR (L/C) |
| 16117 | 1985-092C USA 12 (DSCS III B5) (US) | 180.0E/i | Mil-WPAC reserve operational (P/S/X) |
| 15873 | 1985-055A Intelsat 511 | 179.9E/i | Int FSS (C/Ku) |
| 23467 | 1995-003A USA 108 (UFO-4) (US) | 177.3W/i | Mil-POR (P/S/K) |
| 19121 | 1988-040A Intelsat 513 | 177.0W# | Int FSS (C/Ku) |
| 21639 | 1991-054B TDRS F5 (US) | 174.4W | Int FSS/Gov-Tracking & Relay (C/S/Ku) |
| 23613 | 1995-035B TDRS F7 (US) | 170.7W# | Int FSS/Gov-Tracking & Relay (C/S/Ku) |
| 20499 | 1990-016A Raduga 25 (Russia) | 170.4W/i | Dom FSS/Gov-Mil (X/C) |
| 18631 | 1987-100A Raduga 21 (Russia) | 169.8W/i | Dom FSS/Gov-Mil (X/C) |
| 21392 | 1991-037A Satcom C5 (Aurora II)(US) | 139.1W | Dom FSS (C) |
| 20945 | 1990-100A Satcom C1 (US) | 136.8W | Dom FSS (C) |
| 23581 | 1995-025A GOES 9 (US) | 135.1W | Met (P/L/S) |
| 22096 | 1992-057A Satcom C4 (US) | 135.0W | Dom FSS (C) |
| 21873 | 1992-006A USA 78 (DSCS III B14) (US) | 135.0W/i | Mil-EPAC primary operational (P/S/X) |
| 23016 | 1994-013A Galaxy 1R (US) | 133.0W | Dom FSS (C) |
| 22117 | 1992-060B Satcom C3 (US) | 130.8W | Dom FSS (C) |
| 13637 | 1982-106B DSCS III A1 (US) | 130.2W/i | Mil-EPAC reserve operational (P/S/X) |
| 16649 | 1986-026A Gstar 2 (US) | 125.0W# | Dom FSS (Ku) |
| 21906 | 1992-013A Galaxy 5 (US) | 125.0W | Dom FSS (C) |
| 23877 | 1996-033A Galaxy 9 (US) | 123.1W | Dom FSS (C) |
| 19484 | 1988-081B SBS 5 (US) | 123.0W | Dom FSS (Ku) |
| 22988 | 1994-009A USA 99 (Milstar 1) (US) | 120.0W | Mil-Comm (P/S/K) |
| 15826 | 1985-048D Telestar 3D (303) (US) | 119.9W# | Dom FSS (C) |
| 24313 | 1996-055A Echostar 2 (US) | 119.1W | Dom BSS (Ku) |
| 23754 | 1995-073A EchoStar 1 (US) | 119.0W | Dom BSS (Ku) |
| 16274 | 1985-109B Morelos 2 (Mexico) | 116.8W | Dom FSS (C/Ku) |
| 13652 | 1982-110C Anik C3 (Canada) | 114.8W/i | Dom FSS (Ku) |
| 23313 | 1994-065A Solidardad 2 (Mexico) | 113.0W | Dom FSS (L/C/Ku) |
| 21726 | 1991-067A Anik E1 (Canada) | 111.1W | Dom FSS (C/Ku) |
| 24748 | 1997-011A Tempo 2 (US) | 109.8W# | Dom BSS (Ku) |
| 22911 | 1993-073A Solidaridad 1 (Mexico) | 109.2W | Dom FSS (L/C/Ku) |
| 21222 | 1991-026A Anik E2 (Canada) | 107.3W | Dom FSS (C/Ku) |
| 08697 | 1976-017A Marisat 1 | 106.8W/i | Int Mar-AOR (P/L/C) |
| 23846 | 1996-022A MSAT M1 (Canada) | 106.5W | Dom Mobile (L/X) |
| 19483 | 1988-081A Gstar 3 (US) | 106.0W/i/d | Dom FSS/Mob (L/Ku) |
| 03029 | 1967-111A ATS 3 (US) | 105.3W/i | Experimental (VHF/C) |
| 15677 | 1985-035A Gstar 1 (US) | 105.3W# | Dom FSS (Ku) |
| 20946 | 1990-100B Gstar 4 (US) | 105.0W | Dom FSS (Ku) |
| 08747 | 1976-023B LES 9 (US) | 104.9W/i | Mil-Experimental (P/Ka) |
| 23696 | 1995-057A USA 114 (UFO-6) (US) | 104.7W/i | Mil-CONUS (P/S/K) |
| 24315 | 1996-054A GE-1 (US) | 103.1W | DOM FSS (C/Ku) |
| 23435 | 1994-084A USA 107 (DSP F17) (US) | 103.0W# | Mil-Early Warning (S/X) |
| 22930 | 1993-078A DBS 1 (US) | 101.2W | Dom BSS (Ku) |
| 21227 | 1991-028A Spacenet 4 (US) | 101.0W | Dom FSS (C/Ku) |
| 23598 | 1995-029A DBS 3 (US) | 101.0W | Dom BSS (Ku) |
| 23553 | 1995-019A AMSC 1 (US) | 101.0W | Dom Mobile (L/X) |
| 23192 | 1994-047A DBS 2 (US) | 100.8W | Dom BSS (Ku) |
| 22796 | 1993-058B ACTS (US) | 100.0W | Experimental (C/K/Ka) |

| OBJ NO. | INT-DESIG/COMMOM NAME | LONG (DEG) | TYPE SATELLITE |
|---|---|---|---|
| 17181 | 1986-096A USA 20 (FltSatCom F7)(US) | 99.6W/i | Mil-CONUS (P/S/X/K) |
| 22694 | 1993-039A Galaxy 4 (US) | 99.0W | Dom FSS (C/Ku) |
| 08746 | 1976-023A LES 8 (US) | 97.4W/i | Mil-Experimental (P/Ka) |
| 15237 | 1984-093D Telestar 3C (302) (US) | 97.0W# | Dom FSS (C) |
| 23741 | 1995-069A Galaxy 3R (US) | 95.1W | Dom/BSS (C/Ku) |
| 16650 | 1986-026B SBTS 2 (Brazil) | 92.1W | Dom FSS (C) |
| 22205 | 1992-072A Galaxy 7 (US) | 91.1W | Dom FSS (C/Ku) |
| 23670 | 1995-049A Telstar 402R (US) | 89.0W | Dom FSS (C/Ku) |
| 18951 | 1988-018A Spacenet 3R (US) | 87.0W | Dom FSS (L/C/Ku) |
| 16482 | 1986-003B Satcom K1 (US) | 85.2W# | Dom FSS (Ku) |
| 24713 | 1997-002A GE-2 (US) | 85.1W | Dom FSS (C/Ku) |
| 16276 | 1985-109D Satcom K-2 (US) | 85.0W | Dom FSS (Ku) |
| 15561 | 1985-015B SBTS 1 (Brazil) | 79.1W# | Dom FSS (C) |
| 15235 | 1984-093B SBS 4 (US) | 77.1W/i | Dom FSS (Ku) |
| 12309 | 1981-018A Comstar D4 (US) | 76.2W/i | Dom FSS (C) |
| 14133 | 1983-059B Anik C2 (Argentina) | 76.0W/i | Dom FSS (Ku) |
| 23051 | 1994-022A GOES 8 (US) | 74.9W# | Met (P/L/S) |
| 20872 | 1990-091A SBS 6 (US) | 74.0W | Dom FSS (Ku) |
| 20873 | 1990-091B Galaxy 6 (US) | 74.0W | Dom FSS (C) |
| 24714 | 1997-002B Nahuel 1A (Argentina) | 71.8W | Dom FSS (Ku) |
| 15642 | 1985-028B Nahuel II (Anik C1) (Argentina) | 71.4W | Dom FSS (Ku) |
| 23199 | 1994-049A Brazilsat B1 (Brazil) | 70.2W | Dom FSS (C) |
| 21805 | 1991-080B USA 75 (DSP F16) (US) | 70.0W# | Mil-Early Warning (S/X) |
| 15385 | 1984-114A Spacenet 2 (US) | 69.2W | Dom FSS (C/Ku) |
| 23536 | 1995-016A Brasilsat B2 (Brazil) | 65.1W | Dom FSS (C/X) |
| 16101 | 1985-087A Intelsat 512 | 55.6W/1 | Int FSS (C/Ku) |
| 21149 | 1991-018A Inmarsat 2 F2 | 54.9W/i | Int Mar-AOR-W (L/C) |
| 21940 | 1992-021B Inmarsat 2 F4 | 54.2W/i | Int Mar-AOR-W (L/C) |
| 23571 | 1995-023A Intelsat 706 | 53.1W | Int FSS (C/Ku) |
| 23628 | 1995-038A USA 113 (DSCS III B4) (US) | 52.5W/i | Mil-WLANT primary operational (P/S/X) |
| 23915 | 1996-035A Intelsat 709 | 50.0W | Intl FSS (C/Ku) |
| 22314 | 1993-003B TDRS F6 (US) | 47.1W | Int FSS/Gov-Tracking & Relay (C/S/Ku) |
| 19217 | 1988-051C PanAmSat 1 (PAS 1) | 44.9W | Int FSS (C/Ku) |
| 23764 | 1996-002A PanAmSat 3R (PAS 3R) | 43.0W | Int FSS (C/Ku) |
| 16116 | 1985-092B USA 11 (DSCS III B7) (US) | 42.5W/i | Mil-ATL reserve operational (P/S/X) |
| 19883 | 1989-021B TDRS F4 (US) | 41.1W# | Int FSS/Gov-Tracking & Relay (C/S/Ku) |
| 12089 | 1980-098A Intelsat 502 | 40.4W/i | Int FSS (C/Ku) |
| 23413 | 1994-079A Orion 1 (US) | 37.7W | Int FSS (Ku) |
| 20523 | 1990-021A Intelsat 603 | 34.6W | Int FSS (C/Ku) |
| 20401 | 1990-001A Skynet 4A (UK) | 34.1W/i | Mil-comm (P/S/X/Ka) |
| 14077 | 1983-047A Intelsat 506 | 31.4W/i | Int FSS/Mar (L/C/Ku) |
| 22723 | 1993-048A Hispasat 1B (Spain) | 30.1W | Dom BSS/FSS (Ku) |
| 22116 | 1992-060A Hispasat 1A (Spain) | 30.0W | Dom BSS/FSS (Ku) |
| 21765 | 1991-075A Intelsat 601 | 27.6W | Int FSS (C/Ku) |
| 15386 | 1984-114B Marecs B2 | 26.0W/i | Int Mar-AOR (L) |
| 21653 | 1991-055A Intelsat 605 | 24.6W | Int FSS (C/Ku) |
| 23967 | 1996-042A USA 127 (UFO-7) (US) | 23.5W/i | Mil-AOR (P/S/K) |
| 20253 | 1989-077A USA 46 (FltSatCom 8) (US) | 22.6W/i | Mil-AOR (P-Charlie/S/X/K) |
| 21989 | 1992-032A Intelsat K | 21.6W | Int FSS (Ku) |
| 19772 | 1989-006A Intelsat 515 | 21.4W | Int FSS (C/Ku) |
| 15391 | 1984-115A NATO III D | 19.1W/i | Mil-Comm (P/S/X) |
| 20705 | 1990-063A TDF 2 (France) | 18.9W | Dom BSS (Ku) |
| 23528 | 1995-013A Intelsat 705 | 18.1W | Int FSS (C/Ku) |
| 21047 | 1991-001A NATO IV A | 17.9W/i | Mil-Comm (P/S/X) |
| 20391 | 1989-101A Cosmos 2054 (Russia) | 16.0W/i | Tracking & Relay WSDRN (Ku) |
| 23132 | 1994-035A USA-104 (UFO-3)(US) | 15.7W/i | Mil-AOR primary (P/S) |
| 24307 | 1996-053A Inmarsat 3 F2 | 15.5W/i | Int Mar (L/C) |
| 23319 | 1994-067A Express 1 (Russia) | 14.1W | Int FSS (C/Ku) |
| 23267 | 1994-060A Cosmos 2291 (Russia) | 13.7W# | Dom Data Relay (C) |
| 22009 | 1992-037A USA 82 (DSCS III B12) (US) | 12.0W | Mil-ELANT primary operational (P/S/X) |
| 22041 | 1992-043A Gorizont 26 (Russia) | 10.9W/i | Dom/Gov FSS (C/Ku) |
| 21813 | 1991-084A Telecom 2A (France) | 8.1W | Dom FSS/Gov-Mil (X/C/Ku) |
| 21939 | 1992-021A Telecom 2B (France) | 5.0W | Dom FSS/Gov-Mil (X/C/Ku) |
| 24209 | 1996-044B Telecom 2D (France) | 4.8W | Dom-FSS/Gov-Mil (C/X/Ku) |
| 23865 | 1996-030B Amos 1 (Israel) | 4.0W | Dom FSS (C) |
| 21140 | 1991-015B Meteosat 5 (MOP 2) (ESA) | 2.2E#/d | Met (L) |
| 23816 | 1996-015A Intelsat 707 | 1.1W | Int FSS (C/Ku) |
| 20776 | 1990-079A Skynet 4C (UK) | 1.0W# | Mil-comm (P/S/X/Ka) |
| 20762 | 1990-074A Thor 1/Marcopolo 2 (BSB R-2) | 0.9W | Reg BSS (Ku) |
| 20168 | 1989-062A TV Sat 2 (Germany) | 0.4W | Dom BSS (Ku) |

# Amateur Satellite Frequency Guide

*The Radio Amateur Satellite Corp.*

| Satellite | Mode | Frequencies |
|---|---|---|
| **OSCAR 10** (AO-10) (Notes 1 & 12) | B (u/V) | Dn 145.825 835 845 855 865 875 885 895 905 915 925 935 945 955 965 145.975<br>Up 435.179 169 159 149 139 129 119 109 099 089 079 069 059 049 039 435.029 |
| | Bcn | 145.810 (Steady unmodulated carrier) |
| **RS 10/11** (Notes 2, 3, 4 and 12) | | Dn 29.360 370 380 390 29.400 29.403<br>Up 145.860 870 880 890 145.900 (CW) 145.820 |
| | Bcn | 29.357 (CW) |
| **RS-12/13** (Notes 2, 5 & 6) | | Dn 29.410 420 430 440 29.450 29.454<br>Up 21.210 220 230 240 21.250 (CW) 21.129 |
| | Bcn | 29.408 |
| **RS-15** (Note 12) | A (v/a) | Dn 29.354 29.364 29.374 28.384 29.394<br>Up 145.858 145.868 145.878 145.888 145.898 |
| **UoSat 11** (UO-II) (Note 13) | Bcns | Dn 145.826 435.025 2401.500<br>Up None |
| **PACSAT** (AO-16) (Notes 7, 8 & 10) | [a] | Dn 437.025 (Sec)437.050<br>Up 145.900 145.920 145.940 145.960 |
| **DOVE** (DO-17) (Notes 9 & 10) | [b,c] | Dn 145.825 2401.220<br>Up None |
| **WEBERSAT** (WO-18) (Note 10) | [a] | Dn 437.075 437.100 (Sec)<br>Up None |
| **LUSAT** (LO-19) (Notes 7 & 10) | [a] | Dn 437.125 437.150 (Sec)<br>Up 145.840 145.860 145.880 145.900 |

NOTES

1. The AO-10 beacon is an unmodulated carrier. This satellite has suffered computer damage making it impossible to orient the satellite for optimum service or solar illumination. In order to preserve it as long an possible, do not transmit to it when you hear the beacon FMing.
2. RS-10/11 and RS-12/13 are each mounted on common spaceframes, along with comunication and navagation packages.
3. RS-10 has been in Mods A for some months, but also has capability for Mode T (21.160-21.200 Uplink, 145.860-145.900 Downlink), Mode K (21.160-21.200 Uplink, 29.360-29.400 Downlink) as well as combined Modes K/A and K/T using these same frequency combinations.
4. RS-11 is currently turned off. If activated, it has capability for Mods A (145.910-145.950 Uplink, 29.410-29.450 Downink), Mode T (21.210-21.250 Uplink, 145.910-145.950 Downlink), Mode K (21.210-21.250 Uplink, 29.410-29.450 Downlink) as well as combined Modes K/A and K/T using these same frequency combinations.
5. RS-12 has been in Mode K for some months, but also has capability for Mode A (145.910-145.950 Uplink, 29.410-29.450 Downlink), Mode T (21.210-21.250 Uplink, 145.910-145.950 Downlink) an well as combined Modes K/A and K/T using these same frequency combinations.
6. RS-13 is currently turned off. If activated, it has capability for Mode A (145.960-146.000 Uplink, 29.460-29.500 Downlink), Mode K (21.260-21.300 Uplink, 29.460-29.500 Downlink), Mode T (21.210-21.250 Uplink, 145.960-146.000 Downlink) as well as combined Modes K/A and K/T using these same frequency combinations.
7. Transmitters on both AO-16 & LU-19 are currently using Raised Cosine Mode.
8. AO-16 users are encouraged to select 145.900, 145.920 and 145.940 for uploading and 145.960 for directory and/or file requests.
9. DOVE is designed to transmit digital voice messages, but due to hardware and software difficulties, it has not yet met this objective except for a few short tests. Recently, it has been transmitting telemetry in normal AX-25 AFSK packet.
10. Letters in [ ] represent digital formats, as follows:
    [a] 1200 bps PSK AX-25
    [b] 1200 bps AFSK AX-25
    [c] 9600 bps FSK
    [d] Digitized voice (Notes 8 & 9)
11. PO-28 is available to amateurs on an intermittent, unscheduled basis.
12. Modes of operation used include: CW,/USB/FAX/Packet/RTTY
13. Modes of operation used include: FM (AFSK) & PSK Data.
14. Modes of operation used include: Packet & FM Voice.

# Amateur Satellite Frequency Guide

*The Radio Amateur Satellite Corp.*

| Satellite | Mode | Frequencies |
|---|---|---|
| **JAS-1b** (FO-20) (Notes 10 & 12) | JA Linear | Dn 435.800 810 820 830 840 850 860 870 880 890 435.900<br>Up 146.000 990 980 970 960 950 940 930 920 910 900 |
| | Bcn | 435.795 (CW) |
| | JD [a] Dgtl | Dn 435.910<br>Up 145.850 145.890 145.910 |
| **OSCAR 22** (UO-22) (Note 10) | [c] | Dn 435.120<br>Up 145.900 145.975 |
| **KITSAT A** (KO-23) (Note 10) | [c] | Dn 435.173<br>Up 145.850 145.900 |
| **KITSAT B** (KO-25) (Note 10) | [c] | Dn 435.175 436.500<br>Up 145.870 145.980 |
| **IT-AMSAT** (IO-26) (Note 10) | [a,c] | Dn 435.820 (Sec.) 435.867<br>Up 145.875 145.900 145.925 145.950 |
| **EYESAT /AMRAD** (AO-27) (Note 10) | [b,a] | Dn 436.800<br>Up 145.850 |
| **POSAT** (PO-28) (Notes 10 & 12) | [c] | Dn 435.250 435.280<br>Up 145.925 145.975 |
| **FUJI/ OSCAR 29** (FO-29) (Notes10 &12) | JA Linear | Dn 435.800 810 820 830 840 850 860 870 880 890 435.900<br>Up 146.000 990 980 970 960 950 940 930 920 910 145.900 |
| | JD Digtl (b,c) | Dn 453.910<br>Up 145.850 145.870 145.890 145.910 |
| **MEXICO/ OSCAR 30** (MO-30) (Note 10) | (b) | Dn 437.138 (sec) 437.206 (pμ) BCN:<br>Up 145.815 145.835 145.855 145.875 40.997 MHz |
| **MIR** (Note 14) | [b] | Up & Dn & FM voice 145.550 |
| **SHUTTLE** (SAREX) (Note 14) | [b] | Dn 145.840<br>Up 144.450 144.470 |

*Compiled by*
**AMSAT**
The Radio Amateur Satellite Corp.
PO Box 27 Washington, DC 20044

# Amateur and Weather Satellite Two-Line Orbital Element Sets

Below is an example of the format for the elements sets presented in this section of the Satellite Service Guide. The spacecraft is named in the first line of each entry. Illustration below shows meaning of data in the next two lines.

OSCAR 10
1 14129U 83058B 94254.05030619 -.00000192 00000-0 10000-3 0 3080
*2 14129 26.8972 308.5366 6028238 209.9975 94.5175 2.05881264 56585*


*Notice that there is no decimal point printed for eccentricity. The decimal point goes in front of the number. For example, the number shown above for eccentricity would be entered into your computer tracking program as .6028238.*

**AMATEUR RADIO SATELLITES**
OSCAR 10 (AMSAT OSCAR 10, AO-10)
1 14129U 83058B 97093.37359418 .00000271 00000-0 10000-3 0 4695
2 14129 25.8008 154.8960 6070423 105.4827 325.6918 2.05876463 75843
OSCAR 11 (UoSAT 2, UoSAT 11, UOSAT OSCAR-11, UO-11)
1 14781U 84021B 97090.07124011 .00000070 00000-0 19673-4 0 9613
2 14781 97.8269 74.4608 0010691 255.1308 104.8717 14.69536168699780
Russian Mir Space Station
1 16609U 86017A 97094.16812071 .00002696 00000-0 37827-4 0 1669
2 16609 51.6515 97.7707 0010672 255.7085 104.2721 15.60835588635473
RS-10/11 (Radio Sputnik 10/11, Cosmos 1861)
1 18129U 87054A 97093.58730496 .00000047 00000-0 34845-4 0 3370
2 18129 82.9247 293.8816 0013351 68.2363 292.0202 13.72376463490005
OSCAR 16 (PACSAT, AMSAT OSCAR-16, AO-16 )
1 20439U 90005D 97092.75583347 .00000016 00000-0 22904-4 0 552
2 20439 98.5344 178.8135 0012245 69.8107 290.4391 14.30002804375455
OSCAR 17 (DOVE, DOVE OSCAR-17, DO-17)
1 20440U 90005E 97092.18958411 -.00000006 00000-0 14559-4 0 578
2 20440 98.5426 179.0693 0012546 72.5379 287.7175 14.30145160375403
OSCAR 18 (WEBERSAT, WEBERSAT OSCAR-18, WO-18)
1 20441U 90005F 97093.23520716 .00000020 00000-0 24542-4 0 601
2 20441 98.5406 180.0026 0012981 68.5307 291.7252 14.30113231375554
OSCAR 19 (LUSAT, LUSAT OSCAR-19, LO-19)
1 20442U 90005G 97092.78874179 .00000008 00000-0 19796-4 0 573
2 20442 98.5455 180.1947 0013207 71.2408 289.0205 14.30226770375514
OSCAR 20 (JAS 1B, FUJI 2, FUJI OSCAR 20, FO-20)
1 20480U 90013C 97092.95072614 -.00000021 00000-0 24533-4 0 9566
2 20480 99.0361 68.7202 0540890 187.7178 171.5342 12.83236851335052
RS-12/13 (Radio Sputnik 12/13, Cosmos 2123)
1 21089U 91007A 97090.23180555 .00000067 00000-0 54677-4 0 9672
2 21089 82.9217 336.4673 0028630 151.1676 209.1070 13.74078929308458
OSCAR 22 (UoSAT-F, UoSAT-5, UOSAT OSCAR 22, UO-22)
1 21575U 91050B 97093.18854638 -.00000008 00000-0 11588-4 0 7620
2 21575 98.3129 156.3518 0008352 111.9358 248.2713 14.37062852299712
OSCAR 23 (KITSAT-A, KITSAT-1, KITSAT OSCAR-23, KO-23)
1 22077U 92052B 97094.03755541 -.00000037 00000-0 10000-3 0 6526
2 22077 66.0805 300.4884 0012476 232.4782 127.5103 12.86301574218210
OSCAR 27 (EYESAT-A, EYESAT-1, AMSAT OSCAR-27, AO-27
1 22825U 93061C 97090.76403359 -.00000016 00000-0 10926-4 0 5479
2 22825 98.5507 166.6871 0009381 105.0711 255.1508 14.27721207183029
OSCAR 26 (ITAMSAT, ITAMSAT OSCAR-26, IO-26)
1 22826U 93061D 97092.21001585 .00000010 00000-0 21276-4 0 5458
2 22826 98.5502 168.3294 0009988 102.4185 257.8109 14.27830853183240
OSCAR 25 (KITSAT-B, KITSAT-2, KITSAT OSCAR-25, KO-25)
1 22828U 93061F 97094.22418476 .00000003 00000-0 18656-4 0 5241
2 22828 98.5432 170.3733 0011065 81.1371 279.1059 14.28172691151655
OSCAR 28 (POSAT, POSAT OSCAR-28, PO-28)
1 22829U 93061G 97090.74148278 .00000045 00000-0 35402-4 0 5395
2 22829 98.5492 167.0532 0011002 92.2539 267.9902 14.28156002183073
RS-15 (Radio Sputnik 15)
1 23439U 94085A 97090.55501124 -.00000039 00000-0 10000-3 0 2085
2 23439 64.8130 278.3774 0150963 146.7682 214.2832 11.27525964 93186
OSCAR 29 (FUJI 3, FUJI OSCAR-29, FO-29)
1 24278U 96046B 97092.17457875 -.00000075 00000-0 -40890-4 0 685
2 24278 98.5507 143.7436 0352090 23.2701 338.3953 13.52628640 30847
OSCAR 30 (MEXICO OSCAR-30, MO-30)
1 24305U 96052B 97093.89423774 .00000204 00000-0 20364-3 0 881
2 24305 82.9308 49.4768 0032250 52.8236 307.5812 13.73091339 28861
RS-16 (Radio Sputnik 16)
1 24744U 97010A 97091.57448784 .00003067 00000-0 10479-3 0 251
2 24744 97.2807 358.0681 0008796 14.4703 345.6785 15.31012823 4363

**WEATHER/IMAGING SATELLITES**
**Geostationary Satellites**
GOES 7 (Standby Geostationary Spacecraft-USA)
1 17561U 87022A 97090.37146503 -.00000167 00000-0 10000-3 0 3367
2 17561 3.6199 67.5584 0015949 243.4484 276.7437 1.00264000 20182
GOES 8 (Operational East-USA)
1 23051U 94022A 97093.68927098 -.00000274 00000-0 10000-3 0 6585
2 23051 0.1414 266.6312 0000531 71.7729 26.8971 1.00265708 18282
GOES 9 (Operational West-USA)
1 23581U 95025A 97093.61059376 .00000063 00000-0 10000-3 0 3475
2 23581 0.1916 93.5698 0002501 275.4407 267.7666 1.00283231 6832
ELEKTRO (Operational-Russia)
1 23327U 94069A 97091.66912940 -.00000118 00000-0 00000+0 0 2676
2 23327 0.6174 94.9009 0002391 341.3540 70.9544 1.00270822 8899
Meteosat 5 (Operational ESA, aka MOP-2)
1 21140U 91015B 97088.13617720 -.00000037 00000-0 00000+0 0 3324
2 21140 1.1137 78.3325 0001078 218.4938 297.0631 1.00220522 24460
Meteosat 6 (Operational-ESA)
1 22912U 93073B 97092.10435194 -.00000018 00000-0 00000+0 0 6123
2 22912 0.1726 335.4441 0000902 11.4806 241.8079 1.00280264 10756
GMS 4 (Standby-Japan, aka Himawari 4)
1 22912U 93073B 97092.10435194 -.00000018 00000-0 00000+0 0 6123
2 22912 0.1726 335.4441 0000902 11.4806 241.8079 1.00280264 10756
GMS 5 Operational-Japan, aka Himawari 5)
1 23522U 95011B 97093.66671079 -.00000304 00000-0 10000-3 0 2254
2 23522 0.4591 13.1582 0001443 183.8364 15.2283 1.00273191 7361

**Near Polar/Polar Orbiting Imaging Spacecraft**
NOAA 12 (Operational morning spacecraft-USA 137.500 MHz)
1 21263U 91032A 97093.81436981 .00000046 00000-0 39342-4 0 3334
2 21263 98.5436 110.3440 0013142 145.2864 214.9175 14.22698172305789
NOAA 14 (Operational afternoon spacecraft-USA 137.620 MHz)
1 23455U 94089A 97093.89126637 .00000150 00000-0 10727-3 0 9939
2 23455 98.9819 45.0394 0009816 136.1669 224.0284 14.11657686116461
Meteor 2-21(Off at last report)
1 22782U 93055A 97093.22949423 .00000023 00000-0 74400-5 0 5560
2 22782 82.5480 117.2889 0020762 244.0826 115.8172 13.83071446181225
Meteor 3-5 (Operational-Russia 137.850 MHz)
1 21655U 91056A 97091.47155579 .00000051 00000-0 10000-3 0 9674
2 21655 82.5540 116.8701 0013668 164.5968 195.5573 13.16852609270614
Meteor 3-6 (Off at last report)
1 22969U 94003A 97091.43300231 .00000051 00000-0 10000-3 0 3338
2 22969 82.5568 57.1222 0013978 239.6834 120.2904 13.16743768152985
DMSP B5D2-7 (DoD meteorological polar orbiter: downlink encrypted)
1 23233U 94057A 97093.73960874 .00000059 00000-0 55279-4 0 1729
2 23233 98.7889 153.6739 0013566 76.9343 283.3339 14.12790458133853
DMSP B5D2-8 (DoD meteorological polar orbiter: downlink encrypted)
1 23533U 95015A 97093.66824979 .00000030 00000-0 39779-4 0 9245
2 23533 98.8481 98.4795 0006731 320.3709 39.6963 14.12781872104641

**EARTH RESOURCES IMAGING SATELLITES**
OKEAN 1-7 (Okean 4-Russia 137.400 MHz)
1 23317U 94066A 97091.46437948 .00000091 00000-0 10464-4 0 2321
2 23317 82.5466 153.8260 0024568 222.0729 137.8597 14.74087152133009
SICH-1 (Oceanographic satellite-Russia 137.400 MHz)
1 23657U 95046A 97091.26005479 .00000043 00000-0 31370-5 0 1589
2 23657 82.5322 295.3946 0026479 191.5820 168.4775 14.73541185 85256
IRS-1C (Remote Sensing-India)
1 23751U 95072A 97093.23359272 -.00000044 00000-0 00000+0 0 1857
2 23751 98.6933 169.4161 0001470 31.4501 328.6758 14.21637920 65647
IRS-P3 (Remote Sensing-India)
1 23827U 96017A 97093.20732147 -.00000044 00000-0 00000+0 0 1371
2 23827 98.7686 172.6169 0001401 139.7279 220.4017 14.21605654 53697
TOMS-EP (Total Ozone Mapping Spectrometer-USA)
1 23940U 96037A 97090.55784755 .00002587 00000-0 11547-3 0 998
2 23940 97.4214 358.4746 0014758 54.7405 305.5254 15.22186052 41331
ADEOS (Advanced Earth Observation Satellite-Japan 467.7, 2200, 8150, 8250, and 8350 MHz)
1 24277U 96046A 97091.71991121 -.00000044 00000-0 00000+0 0 1578
2 24277 98.6072 170.4524 0001606 68.7194 291.4158 14.27647949 32454

# Satellite Launch Schedules

*By Keith Stein*

## *Space Transportation System (STS-NASA)*

Space Shuttles are launched from the Kennedy Space Center, Florida.

| Mission Number | Launch Date/ Orbiter | Inclination Altitude | Mission Duration | Mission/Cargo Bay/Payloads |
|---|---|---|---|---|
| STS-84 | May 1997 Atlantis* | 51.6/213 | 9+1 days | S/MM-06 |
| STS-85 | Jul 1997 Discovery** | 57.0/160 | 11+1 days | CRISTA-SPAS-02 |

*Crew Assignment: CDR: Charles J Precourt, PLT: Eileen M Collins, MS: C Michael Foale (U), MS: Carlos I Noriega, MS: Edward T Lu, MS: Jean-Francois Clervoy (ESA), MS: Elena Kondakova (Russia).

**Crew Assignment: CDR: Curtis L Brown, PLT: Kent V Rominger, MS: N Jan Davis, MS: Robert L Curbeam, MS: Stephen K Robinson, PS: Bjarni Tryggvason (CSA)

| **STS** | **Downlink Frequency Assignments:** |
|---|---|
| UHF Voice | 243.0 (AM), 259.7 (AM), 279.0 (AM), and 296.8 (AM) |
| UHF Boosters | 240.0, and 242.0 MHz (recovery beacons) |
| S-band TLM | 2217.5, 2250.0, and 2287.5 MHz. |
| C-band TRK | 5400-5900.0 MHz |

| **Mir** | **Downlink Frequency Assignments:** |
|---|---|
| VHF Voice | 130.167, 143.625, 145.2, 145.8 MHz |

## *U.S. Expendable Launch Vehicles*

| Launch Date | Launch Vehicle | Launch Site | Payload |
|---|---|---|---|
| May 1997 | LMLV | VAFB | LEWIS |
| May 1997 | Pegasus XL | VAFB | SeaWIFS |
| May 1997 | Atlas IIA | CCAS | Telstar-5 |
| May 1997 | Delta II | VAFB | Iridium #1 (3) |
| May 1997 | Delta II | CCAS | THOR-IIA |
| June 1997 | Taurus | VAFB | GeoSat-FO |
| June 1997 | LMLV | VAFB | CLARK |
| June 1997 | Atlas II | CCAS | UHF-F8 |
| July 1997 | Delta II | VAFB | Iridium #2 (3) |
| July 1997 | Atlas IIA | CCAS | Superbird-C |

| **LMLV** | **Downlink Frequency Assignments** |
|---|---|
| S-band | 2208.5, and 2210.5 MHz |
| C-band | 5765.0 MHz |

| **LEWIS** | **Downlink Frequency Assignments** |
|---|---|
| S-band | 2275.300 MHz |

| **Pegasus XL** | **Downlink Frequency Assignments** |
|---|---|
| S-band TLM | 2269.500, and 2288.500 MHz |
| C-band TRK | 5765.000 MHz |

| **L-1011 A/C** | **Downlink Frequency Assignments** |
|---|---|
| L-band | 1480.5 and 1727.5 MHz |
| S-band | 2250.5 MHz |
| C-band | 4583.5 and 5765.0 MHz |

| **SeaWIFS** | **Downlink Frequency Assignments** |
|---|---|
| L-band | 1702.5 MHz |
| S-band | 2272.5 MHz |

| **Atlas** | **Downlink Frequency Assignments** |
|---|---|
| S-band TLM | 2202.5, 2206.5, 2210.5, 2211.0, and 2215.5 MHz |
| C-band TRK | 5765.0 MHz |

| **Delta II** | **Downlink Frequency Assignments** |
|---|---|
| S-band TLM | 2244.500, 2241.500, and 2252.500 MHz |
| C-band TRK | 5765.000 MHz |

| **Iridium** | **Downlink Frequency Assignments** |
|---|---|
| L-band | 1616 - 1626.500 MHz |
| Ka-band | 19.4 - 19.6 GHz |

| **Thor-IIA** | **Downlink Frequency Assignments** |
|---|---|
| Ku-band | 11.786 - 12.091 GHz |

| **CLARK** | **Downlink Frequency Assignments** |
|---|---|
| X-band | 8032.250 MHz |

| **UHF F-8** | **Downlink Frequency Assignments** |
|---|---|
| UHF-band | 243.915 - 269.95 MHz |

| **Superbird-C** | **Downlink Frequency Assignments** |
|---|---|
| Ku-band | 11.70 - 12.70 GHz |
| Ku-band | 12.25 - 12.75 GHz |

## *Russian Expendable Launch Vehicles*

| Launch Date | Launch Vehicle | Launch Site | Payload |
|---|---|---|---|
| May 1997 | Soyuz | Baikonur | Progress M-35 |
| May 1997 | Proton | Baikonur | Telstar-5 |
| June 1997 | Proton | Baikonur | Iridium (7) |
| June 1997 | Start-1 | Svobodny | EARLY BIRD |
| July 1997 | Proton | Baikonur | PAS-5 |

| **Progress M-35** | **Downlink Frequency Assignments** |
|---|---|
| VHF-band | 166.000 MHz |

# Satellite Launch Schedules

| **Iridium** | **Downlink Frequency Assignments** |
|---|---|
| L-band | 1616 - 1626.5 MHz |
| Ka-band | 19.4 - 19.6 GHz |

## *European Expendable Launch Vehicles*

| **Launch Date** | **Launch Vehicle** | **Launch Site** | **Payload** |
|---|---|---|---|
| May 1997 | Ariane 44L | Kourou | INMARSAT 3F4 & INSAT 1D |
| May 1997 | Ariane 4 | Kourou | PAS-6 |
| June 1997 | Ariane 44P | Kourou | INTELSAT 802 |
| July 1997 | Ariane 4 | Kourou | Sirius-2 |

| **Ariane 4** | **Downlink Frequency Assignments** |
|---|---|
| S-band | 2203.0, 2206.0, and 2218.0 MHz |

| **Sirius-2** | **Downlink Frequency Assignments** |
|---|---|
| S-band | 2209.006 MHz |

## *List of Abbreviations and Acronyms*

| | |
|---|---|
| C-band | 3700 to 6500 MHz. |
| CCAS | Cape Canaveral Air Station, FL |
| CDR | Commander |
| CLARK | This high resolution satellite will locate utility pipelines & cables, and help town planners at construction sites. |
| CRISTA | Cryogenic Infrared Spectrometer Telescope for Atmosphere, a U.S./German joint aeronomy payload to explore the variability of the atmosphere and to provide measurements that will complement those provided by Upper Atmosphere Research Satellite (UARS). |
| CSA | Canadian Space Agency |
| (D) | Crew member coming down from Russian Space Station MIR. |
| EarlyBird | Earth imaging satellite. |
| ESA | European Space Agency |
| INMARSAT | International Maritime Satellite, commercial satellite series providing global maritime and aviation communications. |
| INSAT 1D | Indian satellite, communication and meteorological satellite for the government of India. |
| Iridium | The Iridium system is a planned commercial communications network comprised of 66 low earth orbiting satellites. The system will use L-band to provide global communications services through portable handsets. |
| Intelsat | The International Telecommunications Satellite Organization is a non-profit commercial co-operative of 133 member nations. |
| GEOSAT-FO | The GEOSAT Follow-On program is the Navy's initiative to develop an operational series of radar altimeter satellites to maintain continuous ocean observation from the GEOSAT Exact Repeat Orbit. |
| LEWIS | This spacecraft will carry a 384-channel HSI Hyper Spectral Imager that will have commercial applications in forestry, agriculture, water, land-use management & environmental monitoring. |
| LMLV | Lockheed Martin Launch Vehicle. |
| MHz | Megahertz |
| MS | Mission Specialist, a member of Shuttle flight crew primarily responsible for Orbiter subsystem and payload activities. |
| PAS | U.S. telecommunications satellite for Pan American Satellite of Connecticut. |
| PLC | Payload Commander, a member of the Shuttle crew having overall crew responsibility for planning, integration, and on-orbit coordination of payload mission activities. |
| PLT | Pilot, a member of the Shuttle crew whose primary responsibility is to pilot the Orbiter. |
| Progress | Unmanned resupply satellite for crew aboard Russian Space Station MIR. |
| PS | Payload Specialist, a member of the Shuttle crew, who is not a NASA astronaut, but whose presence is required to perform specialized functions with respect to one or more payloads or other mission unique activities. |
| S-band | 2000 to 2300 MHz |
| SeaWIFS | To estimate ocean color, and derive from these measurements, various biological indicators and other useful scientific products. |
| Sirius-2 | A telecommunications satellite for Nordiska Satellitaktiebolaget (NSAB) to be placed at 5 degrees East longitude. |
| S/MM-06 | Shuttle mission to the Russian Space Station MIR to support design and assembly of the International Space Station. |
| SUPERBIRD | The Superbird-C Ku-band communications payload supports 24 simultaneously active channels with flexible switching capability between antenna coverage areas. |
| Telstar | AT&T communications satellite, provides communication services to the continental U.S., Alaska, Hawaii, and Puerto Rico. |
| THOR-IIA | U.S. Hughes built telecommunications satellite for the country of Norway. |
| TLM | Telemetry |
| TRK | Tracking |
| (U) | Crew member going up to Russian Space Station MIR. |
| UHF | Ultra High Frequency (390 to 499 MHz) |
| UHF F-8 | U.S. Navy communications satellite replacing the Fleet Satellite Communications Network (FLTSATCOM). |
| VAFB | Vandenberg Air Force Base, Calif. |
| VHF | Very High Frequency (30 to 300 MHz) |
| WBFM | Wide-band FM |

Keith Stein is a freelance writer based in Woodbridge, Virginia. You can contact him through his Internet World Wide Web home page at: **http://www.newspace.com/casr**

# ST SATELLITE LAUNCH REPORT

**By Phillip Clark,** *Molniya Space Consultancy*

## How to Use the Satellite Launch Report

The "Satellite Launch Report" is a complete list of satellite launches which took place during November/December 1996 and January/February 1997. The format of the listing is as follows:

First line: launch date and time (UTC), international designation of the satellite, satellite name and satellite mass.

Second line: date and time (in decimals of a day, UTC) of the orbital determination, orbital inclination, period, perigee and apogee. In some cases where a satellite has manoeuvred, more than one set of orbital data will be listed.

This data is followed by a brief description of the satellite's planned mission, the launch vehicle, launch site, etc. '*' next to satellite's mass indicates that the mass has been estimated, and that no official information has been published.

The *Satellite Times* "Satellite Launch Report" is extracted from more detailed monthly listings, "Worldwide Satellite Launches", compiled by Phillip S. Clark and published by Molniya Space Consultancy, 30 Sonia Gardens, Heston Middx TW5 0LZ United Kingdom. Phillip is also the editor of *Jane's Space Directory.*

| Launch Date/Time | Int Des | Satellite | Mass |
|---|---|---|---|
| Epoch | Incl | Period | Perigee | Apogee |
| **Launches in 1996** | | | | |
| 1996 Nov 4/1709 | 1996-061A | SAC-B + HETE + Pegasus-XL third stage | 480 kg? |
| 1996 Nov 4.89 | 37.97 deg | 95.07 min | 488 km | 556 km |

SAC-B (Satelite de Aplicaciones Cientificas) is a science satellite, carrying both Argentinean and NASA instruments: launch mass was 182.7 kg. HETE (High Energy Transient Experiment) is a U.S. science satellite: launch mass was 118 kg. Pegasus-XL third stage mass is 176 kg. After launch from Wallops Island, the Pegasus-XL third stage and the payloads reached the planned orbital altitude but the two payloads failed to separate from the third stage. It was originally hoped that SAC-B would have been able to deploy its solar panels and perhaps four out of the five on-board experiments could have returned data: although the solar panels deployed the assembly was tumbling and the satellite was unable to charge its batteries. HETE was unable to deploy its solar panels since it was contained inside the Dual Payload Attach Fixture and it died due to a lack of power.

| | | | |
|---|---|---|---|
| 1996 Nov 7/1701 | 1996-062A | Mars Global Surveyor | 1,060 kg |
| Entered Trans-Mars Heliocentric Orbit | | | |

Mars Global Surveyor (MGS) is a Mars orbiter and carries a camera, laser altimeter, electron reflectometer, thermal emission spectrometer, Mars relay radio system (to be used in conjunction with future Mars landers) and a magnetometer system. Spacecraft is planned to reach Mars orbit September 11, 1997 and will use aerobraking to reach a 93 deg, 350-410 km orbit by January 1998. After two years of operations in Mars orbit the spacecraft will be used as a data relay spacecraft for later lander missions. Launched by a Delta-2 (7925) from Cape Canaveral: Detla-2 second stage left in a 25.32 deg, 137.45 min, 182-4,707 km orbit, third stage (PAM-D) in heliocentric orbit.

| Launch Date/Time | Int Des | Satellite | Mass |
|---|---|---|---|
| Epoch | Incl | Period | Perigee | Apogee |
| 1996 Nov 13/ 2040 | 1996-063A | ARABSAT 2B | 2,661 kg |
| 1996 Nov 13.74 | 3.99 deg | 633.59 min | 266 km | 35,850 km |
| 1996 Dec 3.06 | 0.11 deg | 1,436.05 min | 35,742 km | 35,829 km |
| 1996 Nov 13/2040 | 1996-063B | MEASAT 2 | 1,512 kg |
| 1996 Nov 14.62 | 3.98 deg | 632.48 min | 264 km | 35,795 km |
| 1996 Nov 22.98 | 0.08 deg | 1,436.03 min | 35,777 km | 35,794 km |

ARABSAT 2B is a telecommunications satellite, launched for ARABSAT mass quoted is at launch on station the mass is 1,610 kg at the beginning of operations, 1,108 kg dry. The satellite was located over 31-32 deg E.

MEASAT 2 is a telecommunications satellite, launched for Binariang (Kuala Lumpur, Malaysia): mass quoted is at launch on station the mass is 900 kg at the beginning of operations and 680 kg dry. Satellite located over 148 deg E.

Both satellites launched from Kourou using an Ariane-44L: Ariane third stage (H-10-3) left in a geosynchronous transfer orbit, similar to the first orbits listed for the satellites.

| | | | | |
|---|---|---|---|---|
| 1996 Nov 16/2049 | 1996-064A | Proton-K fourth stage | | 14,300 kg? |
| 1996 Nov 17.22 | 51.53 deg | 87.43 min | 139 km | 155 km |
| 1996 Nov 16/2049 | | Mars 8 (Mars-96) | | 6,825 kg |
| 1996 Nov 17.00 | 51.6? deg | 100.7? min | 87? km | 1,500? km |

Spacecraft known as Mars-96 prior to launch, Mars 8 after launch. Spacecraft was box-shaped and carried two rough-landing surface stations (mass of each 90 kg at launch, 34 kg on the martian surface) planned for deployment 3-5 days prior to Mars orbit injection and two surface penetrators (mass 75 kg each) planned for deployment after Mars orbit injection. Mars 8 was planned to reach Mars orbit September 12, 1997, entering an initial 12-hour eccentric orbit permitting data relay from the surface probes and then manoeuvring to a 101.1 deg, 300-22,000 km orbit where it would operate for about two years. Spacecraft dry mass was 1,750 kg.

The launch profile called for the Block D-2 (11S824F) Proton-K fourth stage to perform injection into an initial 51.6 deg, 160 km orbit. The Block D-2 would then re-ignite (separating the two ullage motors at this point) to perform a 2,850 m/s manoeuvre resulting in an eccentric Earth orbit reaching out to approximately 100,000 km. The spacecraft would then separate and perform a small manoeuvre, resulting in a heliocentric trans-Mars orbit. Control of the Block D-2 would be via the Mars 8 spacecraft since the rocket stage does not carry its own instrument unit (unlike the Block DM series, used for geosynchronous and GLONASS missions).

After launch, the first burn of the Block D-2 was performed successfully and Russian data indicate that the assembly entered a 160 km near-circular orbit. When the time for re-ignition came the assembly was pointing in the wrong direction and a small burn of 20 m/s was completed, resulting in a 146-171 km orbit (Russian parameters): this could have been produced simply from the firing of the two ullage motors rather than the Block D-2 main engine. The spacecraft's on-board sequencer ensured that the spacecraft separated from the Block D-2 and the spacecraft's Fregat-based main propulsion system completed what should have

been the final trans-Mars injection manoeuvre since the spacecraft was not in the planned highly-eccentric orbit at this time the manoeuvre resulted in changing the orbit to 87 km perigee, >1,500 km apogee (Russian estimated parameters), from which Russian data suggest it decayed during its third orbit, close to the perigee pass over the southern part of the Pacific Ocean, although other Russian data suggest that re-entry was sometime between 0030 and 0130 UTC on November 17, a time interval which does not permit any pin-pointing of the re-entry co-ordinates. There are some reports that re-entry was seen at 0050 UTC over South America. Although tracked by the Russians, Mars 8 was not tracked by USSPACECOM and thus an international designator was not issued for it.

The Block D-2 (dry mass approximately 1,900 kg) continued in orbit and was catalogued as 1996-064A. The western media initially thought that this was the Mars 8 spacecraft. Russian data suggest that it decayed from orbit Nov 18.05 (0113 UTC) with debris falling into the southern Pacific Ocean close to 50.9 deg S, 191.9 deg E at about 0120 UTC. USSPACECOM data suggests re-entry was at 0132 UTC close to 32 deg S, 264 deg E.

| Launch Date/Time | Int Des | Satellite | Mass |
|---|---|---|---|
| Epoch | Incl | Period | Perigee | Apogee |
| 1996 Nov 19/1957 | 1996-065A | Columbia (STS-80) | 102,946 kg |
| 1996 Nov 20.13 | 28.47 deg | 91.60 min | 347 km | 358 km |
| 1996 Dec 7.16 | 28.47 deg | 91.47 min | 318 km | 375 km |
| 1996 Dec 7.44 | 28.53 deg | 88.68 min | 41 km | 377 km |
| 1996 Nov 19/1957 | 1996-065B | ORFEUS-SPAS 2 | 3,573 kg |
| 1996 Nov 20.38 | 28.46 deg | 91.58 min | 349 km | 356 km |
| 1996 Nov 20.64 | 28.48 deg | 91.60 min | 347 km | 359 km |
| 1996 Nov 19/1957 | 1996-065C | Wake Shield Facility 3 | 2,109 kg |
| 1996 Nov 23.06 | 28.47 deg | 91.60 min | 347 km | 359 km |

Piloted mission carrying five astronauts: K D Cockrell (commander), K V Rominger (pilot), T E Jernigan (mission specialist, MS-1 and EVA astronaut, EV-1), T D Jones (MS-2 and EV-2) and S Musgrave (MS-3). Mass quoted is that projected for the time of landing. Planned EVAs were cancelled due to a stuck hatch. Columbia landed at the Kennedy Space Center Dec 7, 1996 at 1149 UTC. This was the longest shuttle flight to date, with a duration of 17 days 15 hours 53 minutes.

ORFEUS-SPAS 2 (Orbiting Retrievable Far and Extreme Ultraviolet spectrometer—Shuttle PAllet Satellite) is an astrophysics payload designed to investigate the far- and extreme-ultraviolet regions of the electromagnetic spectrum, and study the very hot and very cold matter in the universe. Deployed from the orbiter's payload bay Nov 20, 1996 at 0411 UTC and Dec 4 at 0823 UTC returned to Earth aboard the orbiter Dec 7, 1996.

Wake Shield Facility (WSF) is a carrier of microgravity experiments. Deployed from the orbiter's cargo bay Nov 22, 1996 at 2038 UTC, re-captured Nov 26 at 0203 UTC and re-berthed at 0236 UTC. WSF 3 returned to Earth aboard Columbia Dec 7, 1996.

On a statistical note, this is Musgrave's sixth flight into space, equalling the number of flights for any human jointly with John Young and at 61 years old he is the oldest person to fly into space.

| | | | | |
|---|---|---|---|---|
| 1996 Nov 19/2321 | 1996-066A | Progress-M 33 | 7,250 kg? |
| 1996 Nov 20.39 | 51.65 deg | 90.11 min | 250 km | 309 km |
| 1996 Nov 23.81 | 51.65 deg | 92.16 min | 371 km | 390 km |

Unmanned cargo freighter, carrying supplies to the cosmonauts and astronaut aboard the Mir complex. Docked with the Mir complex at the -X (rear longitudinal port) on Kvant 1 Nov 22, 1996 at 0101:30 UTC. Launched from Tyuratam using a Soyuz-U: third stage (Block I) from the launch vehicle decayed from orbit Nov 22, 1996.

| | | | | |
|---|---|---|---|---|
| 1996 Nov 21/2047 | 1996-067A | Hot Bird 2 | 2,912 kg |
| 1996 Nov 21.66 | 23.91 deg | 626.56 min | 175 km | 35,579 km |
| 1996 Dec 22.67 | 0.09 deg | 1,435.97 min | 35,776 km | 35,792 km |

Hot Bird 2 is a telecommunications satellite, built by Matra Marconi Space for Eutelsat. Mass quoted is at launch. Satellite is located over 12-13 deg E. Launched from Cape Canaveral using an Atlas-2A: second stage (Centaur) left in a geosynchronous transfer orbit.

| Launch Date/Time | Int Des | Satellite | Mass |
|---|---|---|---|
| Epoch | Incl | Period | Perigee | Apogee |
| 1996 Dec 4/0658 | 1996-068A | Mars Pathfinder | 890 kg |
| Entered Trans-Mars Heliocentric Orbit | | | |

Mars Pathfinder is designed to perform a soft-landing on Mars directly from heliocentric orbit. Spacecraft comprises a cruise stage, backshell, lander module and front heatshield. Planned landing site is Ares Vallis, located at 19.5 deg N, 327.2 deg E (850 km south-east of the 1976 Viking 1 landing site) Mars arrival/landing is scheduled for July 4, 1997, when the tetrahedron lander will rough-land on Mars, the landing being cushioned with the aid of airbags: at atmospheric entry the mass will be approximately 570 kg. On the martian surface the lander will have a mass of 360 kg and will unfurl three petals, with a mast with a camera and other equipment extended above the base. A small six-wheeled rover called Sojourner will be deployed: mass 10 kg. Primary lander mission should last for 30 sols (1 sol = a martian "day") and for the rover the primary mission is seven sols. The mission for the lander can extended by approximately a year is the equipment permits.

Launched from Cape Canaveral using a Delta-2 (7925): second stage left in a 36.40 deg, 118.96 min, 180-3,089 km orbit, third stage (PAM-D) entered heliocentric orbit with the spacecraft.

| | | | | |
|---|---|---|---|---|
| 1996 Dec 11/1200 | 1996-069A | Cosmos 2335 | 3,000 kg? |
| 1996 Dec 11.62 | 64.99 deg | 92.75 min | 404 km | 415 km |
| 1996 Dec 11.87 | 65.04 deg | 92.79 min | 403 km | 419 km |

US-P EORSAT (ELINT Ocean reconnaissance SATellite), operating with Cosmos 2313 (1995-028A) and Cosmos 2326 (1995-071A). Satellite is virtually co-planar with Cosmos 2313 and phased to cross the equator 120 deg (as measured around the orbit) ahead of this satellite. Launched from Tyuratam using a Tsyklon-M vehicle: second stage decayed from orbit Dec 12, 1996.

| | | | | |
|---|---|---|---|---|
| 1996 Dec 18/0157 | 1996-070A | INMARSAT-3 3 | 2,074 kg |
| 1996 Dec 17.86 | 22.73 deg | 648.41 min | 1,044 km | 35,831 km |
| 1996 Dec 25.23 | 2.68 deg | 1,436.15 min | 35,698 km | 35,877 km |

Maritime communications satellite, operated by INMARSAT, London (UK). Mass quoted is at launch: mass on-station is approximately 1,100 kg at the beginning of its life, dry mass is 860 kg. Satellite located over 157-158 deg E. Launched from Cape Canaveral using an Atlas-2A: second stage (Centaur) left in a geosynchronous transfer orbit.

| | | | | |
|---|---|---|---|---|
| 1996 Dec 20/0644 | 1996-071A | Cosmos 2336 | 795 kg? |
| 1996 Dec 20.55 | 82.95 deg | 105.03 min | 979 km | 1,012 km |

Military navigation satellite in the Parus system: co-planar with Cosmos 2173. Launched from Plesetsk using a Cosmos-3M:second stage in an orbit similar to the satellite.

| | | | |
|---|---|---|---|
| 1996 Dec 20/1804 | 1996-072A | USA 129 | 13,000 kg? |
| No orbital data issued | | | |

Classified payload with no details of its mission being announced and no orbital data issued:it is believed to be a large photoreconnaissance satellite in the Improved Crystal series. Launched from Vandenburg using a Titan-4: second stage discarded in low Earth orbit.

| | | | | |
|---|---|---|---|---|
| 1996 Dec 24/1350 | 1996-073A | Bion 11 | 6,000 kg? |
| 1996 Dec 24.68 | 62.80 deg | 90.48 min | 217 km | 379 km |

Twelfth launch in the Russian series of biological satellites, the first not to be given the name "Cosmos". Spacecraft based upon Vostok/Zenit design: stubby cylinder (either a battery module or non-recoverable science package) + spherical descent module + double-cone retrorocket. Satellite carried two macaque monkeys (Lapik

and Multik), newts, snails, drosophila flies and other insects and bacteria. Spacecraft landed 130 km north of Kustani Jan 7, 1997 at 0504 UTC. It was subsequently reported that Multik had died after landing in an "unrelated accident" at the Institute of Biomedical Problems. Launched from Plesetsk using a Soyuz-U: third stage (Block I) discarded in an orbit similar to that of the satellite.

| Launch Date/Time | Int Des | Satellite | Mass |
|---|---|---|---|
| Epoch | Incl | Period | Perigee | Apogee |
| **Launches in 1997** | | | | |
| 1997 Jan 12/0928 | 1997-001A | Atlantis (STS-81) | 113,370 kg |
| 1997 Jan 12.42 | 51.66 deg | 89.02 min | 157 km | 295 km |
| 1997 Jan 15.29 | 51.65 deg | 92.29 min | 381 km | 392 km |

Fifth Shuttle-Mir Mission (SMM-5), carrying six astronauts: M A Baker (commander), B Jett (pilot), P J K Wisoff (mission specialist, MS-1), J M Grunsfeld (MS-2), M S Ivins (MS-3) and J Linenger (MS-4 at launch through to docking with the Mir complex). Linenger was left aboard Mir and the shuttle orbiter returned to Earth carrying John E Blaha in his place: Blaha had been taken to Mir aboard the STS-79/SMM-4 flight. Orbiter payload bay carried a double-SPACEHAB module (mass 4,774 kg) and the docking system (mass 1,822 kg). Mass quoted is that projected for landing. Atlantis docked with the Docking Module attached to the Kristall module of the Mir complex Jan 15 at 0355 UTC: undocked from Mir Jan 20 at 0216 UTC and landed at the Kennedy Space Center two days later at 1422 UTC. Linenger is due to remain on board the Mir complex until the STS-84/SMM-6 mission in May 1997.

| | | | |
|---|---|---|---|
| 1997 Jan 17/1628 | | Navstar 28 | 2,032 kg |
| Failed to reach orbit | | | |

First launch of a Navstar Block 2R navigation satellite (20 are planned for launch) in the Global Positioning System (GPS). Mass quoted is at launch: on-station at the beginning of operations it would be 1,075 kg. Delta-2 vehicle launched from Cape Canaveral at 1628 UTC and 12 seconds later an anomaly was discovered in one of the solid rocket boosters and the launch vehicle self-destructed 21 seconds after launch. This is the first failure of a Delta-2 launch vehicle to place a payload into Earth orbit.

| | | | | |
|---|---|---|---|---|
| 1997 Jan 30/2002 | 1997-002A | GE 2 | | 2,469 kg |
| 1997 Jan 30.74 | 6.52 deg | 636.11 min | 258 km | 35,988 km |
| 1997 Feb 5.50 | 0.06 deg | 1,435.90 min | 35,737 km | 35,828 km |
| 1997 Jan 30/2002 | 1997-002B | Nahuel 1A | | 1,790 kg |
| 1997 Jan 30.72 | 6.77 deg | 631.92 min | 196 km | 35,834 km |
| 1997 Feb 10.88 | 0.10 deg | 1,436.02 min | 35,777 km | 35,793 km |

GE 2 is a telecommunications satellite launched for GE American Communications Inc. Mass quoted is at launch: mass on-station is 1,454 kg and at the end of the satellite's life it will be 1,310 kg. Satellite initially located over 277 deg E, but to be operated over 275 deg E. GE 2 appears to have been manoeuvred off-station over 277 deg E approximately Feb 26.

Nahuel 1A is a television distribution and telecommunications satellite launched for DASA in Germany for Nahuelsat in Argentina. Mass quoted is at launch: mass on-station is 1,100 kg and at the end of the satellite's life it will be 831 kg. Satellite is located over 288 deg E.

Both satellites launched by an Ariane-44L from Kourou.

| | | | | |
|---|---|---|---|---|
| 1997 Feb 10/1409 | 1997-003A | Soyuz-TM 25 | | 7,150 kg? |
| 1997 Feb 10.63 | 51.61 deg | 88.69 min | 188 km | 231 km |
| 1997 Feb 18.02 | 51.65 deg | 92.28 min | 378 km | 394 km |

Piloted spacecraft, carrying three cosmonauts to the Mir complex: V V Tsibliev (commander), A I Lazutkin (flight engineer) and R Ewald (German cosmonaut-researcher, flying the MIR-97 mission). Spacecraft docked with the Mir complex at the front longitudinal port (+X) Feb 12 at 1551 UTC. Tsibliev and Lazutkin are scheduled to remain on board the Mir complex for approximately six months, while Ewald returned to Earth aboard Soyuz-TM 24 after approximately 20 days in orbit. Launched from Baikonur (Tyuratam) using a Soyuz-U vehicle.

| Launch Date/Time | Int Des | Satellite | Mass |
|---|---|---|---|
| Epoch | Incl | Period | Perigee | Apogee |
| 1997 Feb 11/0855 | 1997-004A | Discovery (STS-82) | 96,758 kg |
| 1997 Feb 11.40 | 28.47 deg | 93.89 min | 350 km | 579 km |
| 1997 Feb 11.62 | 28.47 deg | 95.23 min | 480 km | 579 km |
| 1997 Feb 13.11 | 28.47 deg | 96.51 min | 589 km | 594 km |
| 1997 Feb 18.53 | 28.47 deg | 96.88 min | 599 km | 620 km |
| 1997 Feb 21.31 | 28.47 deg | 91.28 min | 658 km | 617 km |

Piloted mission carrying seven astronauts on the second Hubble Space Telescope (HST) servicing mission: K D Bowersox (commander), S J Horowitz (pilot), J R Tanner (mission specialist, MS-1, EVA crewman EV-4), S A Hawley (MS-2), G J Harbaugh (MS-3, EV-3), M C Lee (MS-4, EV-1) and S L Smith (MS-5, EV-2). Mass quoted is that projected for landing. Orbiter completed a rendezvous with HST (1990-037B) Feb 13, with HST being grappled at 0834 UTC and berthed in the orbiter's payload bay approximately half an hour later. During a series of five EVAs the astronauts replaced equipment on board HST and completed some unplanned repairs to its insulation cover. Orbiter increased
its altitude prior to the release of HST, with an unplanned manoeuvre being required because of a predicted close approach of a piece of debris (1994-029HU) from the disintegration of a Pegasus fourth stage. HST was released back into orbit Febb 19 at 0641 UTC and Discovery landed at the Kennedy Space Center two days later at 0832 UTC.

| | | | | |
|---|---|---|---|---|
| 1997 Feb 12/0540 | 1997-005A | Haruka (Muses-B) | | 823 kg |
| 1997 Feb 12.44 | 31.34 deg | 374.36 min | 247 km | 21,409 km |
| 1997 Feb 26.86 | 31.32 deg | 379.59 min | 573 km | 21,402 km |

Haruka (means "far away", known as Muses-B before launch) is a radio telescope, operating as the space segment of the VSOP (VLBI Space Observatory Programme), with the telescope antenna having a diameter of 8 metres deployed on orbit.Maiden flight of the M-5 launch vehicle, flown from ISAS Uchinoura site.

| | | | | |
|---|---|---|---|---|
| 1997 Feb 14/0347 | 1997-006A | Gonets-D 4 | | 225 kg? |
| 1997 Feb 14.85 | 82.60 deg | 114.18 min | 1,413 km | 1,423 km |
| 1997 Feb 14/0347 | 1997-006B | Gonets-D 5 | | 225 kg? |
| 1997 Feb 14.77 | 82.61 deg | 114.24 min | 1,413 km | 1,429 km |
| 1997 Feb 14/0347 | 1997-006C | Gonets-D 6 | | 225 kg? |
| 1997 Feb 15.56 | 82.60 deg | 114.04 min | 1,409 km | 1,414 km |
| 1997 Feb 14/0347 | 1997-006D | Cosmos 2337 | | 225 kg? |
| 1997 Feb 14.53 | 82.60 deg | 113.96 min | 1,402 km | 1,414 km |
| 1997 Feb 14/0347 | 1997-006E | Cosmos 2338 | | 225 kg? |
| 1997 Feb 15.72 | 82.60 deg | 114.09 min | 1,413 km | 1,415 km |
| 1997 Feb 14/0347 | 1997-006F | Cosmos 2339 | | 225 kg? |
| 1997 Feb 15.56 | 82.60 deg | 114.09 min | 1,412 km | 1,415 km |

Second launch of three Gonets-D civil/commercial communications satellites with three Strela-3 Cosmos military communications satellites. The satellites were launched into the same orbital plane as Cosmos 2252-2257 (1993-038A-F). It is not clear which of the six payloads are the Gonets-D satellites and which are the Cosmos satellites, and therefore the names shown might be subject to revision. Satellites launched from a single Tsyklon vehicle, flown from Plesetsk.

| | | | | |
|---|---|---|---|---|
| 1997 Feb 17/0142 | 1997-007A | JCSAT 4 | | 3,105 kg |
| 1997 Feb 17.17 | 23.22 deg | 2,065.67 min | 224 km | 94,476 km |
| 1997 Mar 2.94 | 0.36 deg | 1,664.92 min | 35,785 km | 44,524 km |
| 1997 Mar 5.78 | 0.05 deg | 1,436.18 min | 35,772 km | 35,804 km |

Telecommunications satellite, launched for Japan Satellite Systems Inc. Mass quoted is at launch: on station the mass is approximately 1,820 kg. Initially located over 140 deg E, but to be operated over 124 deg E. Launched from Cape Canaveral by an Atlas-2AS.

| | | | |
|---|---|---|---|
| 1997 Feb 24/2020 | 1997-008A | USA 130 (DSP 18) | 2,400 kg? |
| No orbital data issued - Geosynchronous orbit | | | |

Payload is a Defense Support Program satellite, designed to provide advance

warning of missile and space launches, as well as nuclear explosions. Maiden flight of Titan-4B launch vehicle. Launched from Cape Canaveral with an two-stage IUS assembly for manoeuvred from low Earth orbit to geosynchronous orbit.

## *Updates for Previous Launches*

Note: During February 1997 a significant number of "spurious" element sets were issued for satellites in geosynchronous orbits, suggesting that some relocations had taken place when they had not. It is hoped that in the details which follow all of the incorrect orbital data have been removed, but in a few cases this is not known with certainty.

| International Designation | Comment |
|---|---|
| 1976-101A | It has been confirmed that MARISAT 3 has been manoeuvred into a drift orbit and retired: however, USSPACECOM has continued through to early December 1996 to release the orbital data for this satellite under MARISAT 2 (1976-053A/8882), with the stabilised MARISAT 2 orbital data issued under the catalogue number for MARISAT 3. |
| 1978-016A | FltSatCom 1 had its orbital period reduced and drifted off-station over 344-345 deg E approximately Dec 23, 1996 and was relocated over 72 deg E at the end of January 1997. |
| 1978-012A | Add the following retirement orbit for the International Ultraviolet Explorer (IUE):<br>Oct 10.37, 1996: 35.64 deg1, 439.04 min, 30,216 km, 41,472 km |
| 1981-050A | INTELSAT 501 was manoeuvred off-station over 71-72 deg E approximately Feb 4, 1997.. |
| 1981-105A | Molniya-3 17 decayed from orbit Jan 9, 1997. |
| 1982-097A | INTELSAT 505 was manoeuvred off-station over 33 deg E approximately mid-December 1996. |
| 1983-058A | EUTELSAT-1 1 was manoeuvred off-station over 35-36 deg E approximately Dec 11, 1996. It is possible that the satellite has been retired. |
| 1984-093D | Telstar 303 was manoeuvred off-station over 275 deg E approximately Jan 21, 1997, and was relocated over 262-263 deg E approximately Feb 21, 1997. |
| 1985-025A | INTELSAT 510 was relocated over 32-33 deg E approximately Oct 28, 1996. |
| 1985-087A | INTELSAT 512 was relocated over 304 deg E approximately Feb 6, 1997. |
| 1986-049A | Molniya-3 29 decayed from orbit Nov 10, 1996. |
| 1988-012A | Sakura 3A was manoeuvred off-station over 132 deg E approximately Sep 28, 1996, and appears to have entered a retirement orbit. Add the following orbital data:<br>1996 Nov 5.01, 0.40 deg, 1,467.33 min, 36,350 km, 36,441 km |
| 1988-051B | OSCAR 13 decayed from orbit Dec 6, 1996. |
| 1988-108A | Ekran-M 4 performed its final station-keeping manoeuvre over 99 deg E during Aug 21-23, 1996. Approximately Oct 4, 1996, a small end-of-life manoeuvre was performed and the satellite drifted off-station. Add the following retirement orbital data:-<br>1996 Nov 9.76, 5.14 deg, 1,436.44 min, 35,770 km, 35,817 km |
| 1989-004A | Gorizont 17 appears to have been manoeuvred to a retirement orbit towards the end of January 1997: confirmation from further orbital data is currently awaited. |
| 1989-081A | Gorizont 19 was manoeuvred off-station over 96 deg E Oct 30, 1996, and was relocated over 33 deg E on Nov 20, 1996. |
| 1990-037B | Add the following orbital data for the Hubble Space Telescope before and after its orbital boost as part of the Discovery/STS-82 (1997-004A) servicing mission:-<br>1997 Feb 11.00, 28.47 deg, 96.57 min, 590 km, 599 km<br>1997 Feb 19.27, 28.47 deg, 96.88 min, 599 km, 620 km<br>During the servicing mission HST was captured by Discovery 1997 Feb at 0834 UTC and it was released back into orbit Feb 19 at 0641 UTC. |
| 1991-018A | INMARSAT-2 2 was manoeuvred off-station over 344 deg E approximately Dec 1-2, 1996, and was relocated over 304-305 deg E during early January 1997. |
| 1992-059A | Cosmos 2209 started to drift off-station over 335 deg E in late October 1996 and might have "died" on-station. |
| 1993-072A | Gorizont 29 was manoeuvred off-station over 130 deg E approximately Feb 1-2, 1997. |
| 1993-073B | METEOSAT 6 was manoeuvred off-station over 350 deg E approximately Jan 26, 1997, and was relocated over 359-0 deg E approximately Feb 7. |
| 1993-077A | A surge in electromagnetic radiation following an event on the Sun's surface on January 6, 1997, resulted in serious damage to the Telstar 401 satellite four days later when that radiation reached the Earth's environment. The electronics on board the satellite appear to have short-circuited and it has not been possible to regain control of the satellite. The satellite was operating over 262-263 deg E. |
| 1994-040B | BS-3N had its location stabilised over 109 deg E approximately mid-January 1997. |
| 1996-043A | Progress-M 32 undocked from the Mir complex Nov 21, 1996, at 1944 UTC and the de-orbit took place the same day at 2242 UTC. |
| 1996-044B | Telecom 2C was manoeuvred off-station over 2-3 deg E approximately Oct 30, 1996, and had its longitude stabilised over 354-355 deg E approximately Dec 3, 1996. |
| 1996-047A | Soyuz-TM 24 with crew Korzun, Kaleri and Linenger undocked from the front longitudinal port (+X) of the Mir complex Feb 7, 1997, at 1628 UTC and redocked at 1651 UTC at the rear longitudinal port (-X) of the complex. The spacecraft carrying Korzun, Kaleri and Ewald (who flew to Mir aboard Soyuz-TM 25, 1997-003A) finally undocked from the Mir complex Mar 2 at 0325 UTC and landed Mar 2 at 0644 UTC near Arkelyk. |
| 1996-059A | The FSW-2 3 descent module landed Nov 4, 1996, at 0259 UTC. |
| 1996-066A | Progress-M 33 undocked from the Mir complex Feb 6, 1996, at 1214 UTC and retreated from the station. A re-docking attempt on Mar 4 failed and Progress-M had too little propellant to make a further docking attempt: it is planned to de-orbit the spacecraft. |
| 1996-070A | INMARSAT-3 3 was relocated over 177-178 deg E in late January 1997. |

ST

ST THE BEGINNER'S COLUMN

*By Ken Reitz, KS4ZR*

# How to Protect Your Satellite System from Lightning

It's a balmy late spring night and you're sound asleep. You keep having these bizarre dreams about salvos of cannons and disco lights. Slowly you awaken to the reality of a thunder storm breaking around you. You stagger to your feet, bark your shins on a nearby chest of drawers, stub your toes on a nearby table leg. Cursing freely and reeling about the house you desperately try to disconnect your most valuable electronics from the hazards of the storm. In the back of your mind your saying to yourself, "There's got to be a better way!"

While the rest of humanity is cheering the onset of warm weather, electronics hobbyists are dreading the season of thunderstorms and the constant threat of lightning damage. It's the time of year when you have to reprogram your VCR and TV's on a daily basis; when your favorite TV shows will go unwatched as you unplug the dish and hunker down until the storm passes. It's enough to make you long for those long, cold, winter nights when the furnace ran in high gear all night and you could watch TV without a care in the world.

## What Causes the Damage

It would seem obvious that, whether you're using a DBS or C-band satellite system, the vulnerability comes from having an antenna outside the house apparently trying to attract lightning. However, talks with satellite TV installers and my own experience with an uncountable tally of lightning hits over the last 13 years, indicate that the damage comes mostly from AC line surges in nearby strikes.

Lightning loves those power lines—and don't think underground wires are the solution! Lightning travels on them just as easily. Just last year we had a dandy hit on the power pole in front of our house. The lightning blew out the transformer on the pole, raced into the house via the underground power lines and found the *one* thing which I had neglected to unplug. The FAX machine was still plugged into the telephone line which, of course, was connected to the computer. You guessed it: Even though everything was disconnected from the wall outlets, the surge blew out the FAX machine and the computer. It also took out the phone modem on the satellite receiver (we still can't order pay-per-view, which in retrospect is probably a blessing in disguise).

Traveling at the speed of light, these powerful voltage spikes ride the convenient power line path into your house and race around your AC circuits in search of vulnerable electronic gadgets. Wham! In less time than it takes to mute an obnoxious commercial, your satellite receiver can be on its way to a six week repair holiday.

The only absolute protection to ensure total immunity from a lightning hit is to have your receiver unplugged from any outside connection and pulled from the wall socket, sitting off by itself and no wires within a three foot radius of it. Now it's protected. But how realistic is that. What are the chances that instead of getting up, you'll sleep right through that storm and be in ignorant bliss the next morning until you turn on the receiver. Yes, friends, if you value your sleep, you'll look to other solutions.

## More Gadgets to the Rescue

It turns out that there are a good number of devices on the market which can help guard against lightning damage. The first thing to do is check with a local electrical contractor on the cost of installing a lightning arrester at the point where the power line enters the house. This may cost a bit but could be a valuable first line of defense. Still, this won't guard against spikes on the telephone line, but we'll get to that later.

The next line of defense is to install Ground Fault Interrupter (GFI) outlets where your expensive electronic devices are plugged into when you're having a storm. These GFI outlets look just like regular outlets except that they have a fast acting circuit breaker built-in. In the event of a surge, the outlet breakers pop and power is prevented from leaving the outlet. GFI's are also available as replacement breakers in your circuit box. Certainly the combination of a lightning arrester at the box, GFI's in the circuit box, and GFI's in the outlets should give expensive, triple protection.

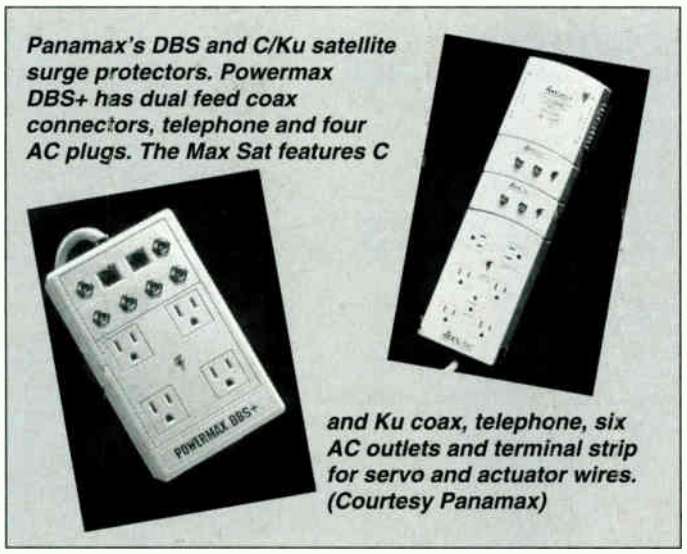
But, what about the phone line, antenna feed lines, polarotor and actuator control wires for your DSS or C-band system? There are phone/FAX protectors which have phone jacks in addition to electrical outlets and serve the same function as the GFI outlets. For C/Ku and DBS installations, there are special products made which are designed to be used specifically for each.

## C/Ku/DBS Solutions

DBS satellite systems have different requirements for lightning protection because they don't have dish control mecha-


***Newpoint's DBS500 features connections for DBS dual feed and CATV input as well as telephone jack and seven AC plugs. (Courtesy Newpoint)***

nisms. A surge protector designed for DBS systems will be inadequate for your C/Ku system as the DBS version has jacks only for telephone, coax feed line (two if using a dual feed) and electric power. The C/Ku version also has "F" connectors for both C and Ku band LNBs and a power strip with screw terminals to which are attached the servo and actuator motor wires. Some surge protection makers offer lightning protection insurance plans while others have extensive warranty features.




*Panamax's DBS and C/Ku satellite surge protectors. Powermax DBS+ has dual feed coax connectors, telephone and four AC plugs. The Max Sat features C and Ku coax, telephone, six AC outlets and terminal strip for servo and actuator wires. (Courtesy Panamax)*

Another solution is found at the dish side of your system. Some surge protection makers offer products designed to prevent lightning damage at the dish from getting back to your receiver. This is done either through a system of lightning rods and ground wires or through surge protectors at the dish site. Of course, such protection must be in addition to in-house protection in order to protect electronics there from power line surge entry.

## Let's Use Our Common Sense

Meteorologists tell us that if you can hear thunder, you're close enough to have a lightning strike. Lightning can strike a half hour before and after a storm passes and it may strike the same place several times. There's nothing predictable about it. I once had a neighbor who never unplugged anything as the summer storms came and went. For years he was lucky and then one afternoon his luck ran out. After blowing out another neighbor's well pump (120 feet under ground) and blowing out our transformer (again), it took out everything he had hooked to his satellite receiver. The result was about a two months wait to get all the equipment repaired and back.

There are some things that you can do to avoid lightning problems. First, if you are planning on going away (summer vacation, for example) for any length of time, you should simply unplug everything. Be sure to check that phone lines and servo/actuator wires are disconnected too. There's no reason to tempt fate by keeping everything plugged into hot outlets while you're away. Also, if you're planning on going away (even just for a long weekend) at the peak of the thunderstorm season, unplug everything. And, when you're at home, even if you have surge protection devices in place, when a severe thunderstorm approaches turn everything off and disconnect. Sure it's a pain in the neck, but it won't hurt to be safe.

## Now the Paperwork

As we dig in for the season of night-time fireworks, now is a good time to check your insurance policy. Find out now (before you have to) what is and what isn't covered in the event of a severe thunderstorm. Look at your deductible. If you have more than a five hundred dollar deductible, you may end up footing all the repair bills. See if there's a dollar limit to the amount of electronic gear you can cover. If you add up all the sophisticated electronics in your house, you may be surprised at how much needs to be covered. Those projection TVS, amateur transceivers, and computers can add up. Find out if your policy covers the cost of purchasing new replacement equipment or if you'll be given a pro-rated amount based on how old your equipment is. Keep a list of equipment make, model, and serial numbers or proof of purchase.

And, finally, find out beforehand which dealer your insurance company uses for equipment repair. Chances are that dealer may not be the best one or the cheapest one to go to. And, you can bet that when a severe storm rips through your area, you won't be the only one hit. Hundreds more consumers may be jamming local repair shops. If your insurance company agrees, you may be able to send it away to a competent repair shop and have it returned in less time than waiting locally.

### Lightning Protection Equipment Makers

Delta Consumer Electronics
13803 N. Florida Avenue
Tampa, FL 33613
Phone: 800-472-8778
FAX: 800-727-1745

Evergood Fabrication Co., Inc.
P.O. Box 1509
Welcome, NC 27374-1509
Phone: 704-731-6962
800-472-1746

Newpoint Corp.
6370 Nancy Ridge Drive
San Diego, CA 92121-3212
Phone: 619-677-5700
FAX: 619-558-1408

Panamax
150 Mitchell Blvd.,
San Rafael, CA 94903
Phone: (U.S./Canada) 800-472-5555
FAX: 415-472-5540

PolyPhaser Corp.
P.O. Box 9000
Minden, NV 89423-9000
Phone: 702-782-2511

ST



By Steve Dye, gpsyes@aol.com

# White GPS Antennas Everywhere

Greetings to you all—in fact, *very* warm greetings—from Fruit Cove in Florida. This is the third town in which I have lived since I started writing this column: first Chicago, then Atlanta, and now Jacksonville, Florida. Driving between these towns in the last year I have noticed an ever increasing presence of those little white hemispherical GPS antennas you see on a variety of vehicles such as long haul trucks, emergency vehicles, delivery trucks, and utility vehicles.

The Automatic Vehicle Location (AVL) industry represents just one of many industries that GPS has created, allowing certain time-consuming or previously impossible tasks to be automated with startling efficiency. AVL applies itself in many areas of vehicle tracking, be it for personal, industrial, or government use, with all applications using a combination of GPS, wireless data communications, and software. This area of technology is a growing segment of the continually expanding GPS market, and is just one of the many applications that would benefit greatly with the removal of Selective Availability (SA).

Another area in which GPS is changing our daily lives is with Personal Navigation Systems (PNS). These systems are essentially tiny GPS receivers connected to a laptop computer while displays the user's position relative to surrounding streets, parks and other reference points, making it virtually impossible to get lost. In this edition, we will take a closer look at the application of AVL and PNS in our daily lives.

## Tracking a freight truck.

In a previous article, I briefly mentioned DGPS being used to pinpoint an emergency or freight vehicle's location. The data output from a GPS receiver in the vehicle is coupled to a modem's data port, that is further coupled to a transmitter—be it a cellular radio transceiver or similar trunked communications system radio equipment. A freight vehicle will use either a cellular radio or two-way paging network to convey the information back to base.

Systems in the United States use a cellular technology known as AMPS (Advanced Mobile Phone System). This technology, normally used for analog speech, can also be used for data transmission, using CPDP—the Cellular Packet Data Protocol. Suitable data communications equipment in the truck, cellular network, and at the operator's console, enables multiple users to send and receive data over vast areas.

At the operator's end, typical equipment consists of a landline connection, a modem, and a desk-top microcomputer, loaded with the software that will display vehicle position information as illustrated in figure 1. The software application is known as GIS (Graphical Information Systems), and is another powerful GPS related technology.

GPS and GIS are two technologies that work in tandem, and AVL is one application that exemplifies this. In short, Geographic Information Systems are software applications that enable users to visualize, analyze, and locate geographically distributed data. GIS software interacts with databases to create, edit, view, query, and produce maps based upon this spatial data. Virtually any database or set of physical features can be geographically represented using GIS.

In the case of AVL, it is the position of one or more fleet vehicles that is represented in the spatially distributed data that is instantly available to the user. An operator using the software has the ability to carry out a variety of tasks, such as locating a specific vehicle—a simple case of pointing and clicking a mouse at the vehicle's ID field and assessing a vehicle's alarm status, speed, position and direction of travel. Using this system, fleet operators have dynamic control over the whereabouts and status of their vehicles, all thanks to GPS.

GPS, with its global footprint, allows systems such as these to be easily implemented in any vehicle for any part of the world. Some adaptation of cellular/data communications equipment may be necessary to suit the system offered by that country. Other than that, GPS allows for global availability, and easy deployment of this system.

## Drivers in Distress

We are all familiar with the newspaper advertisements for some of the upper range cars, that offer an option in the form of a very different rescue service. According to the advertisements, "Help is 11,000 miles away." The rescue service in question is, as can be guessed, GPS based and packs a host of features that center around the fact that GPS is once again extremely dynamic in its ability to serve a wide applications base.

Vehicles adopting this system are equipped (similar to the freight trucks described above) with a cellular phone, a data modem, an alarm/fault diagnosis system and, of course, a GPS receiver as seen in figure 2. In the event of a breakdown, the driver simply dials the number for the rescue service. The GPS receiver and data modem are able to send a burst of data over the voice channel used by the driver, informing the rescue service center of the vehicle's location, and any alarm indications that may appear.

The alarm status of the vehicle could represent a variety of situations, be it an engine fault, a theft alarm, or even airbag deployment. As can be seen, the power of

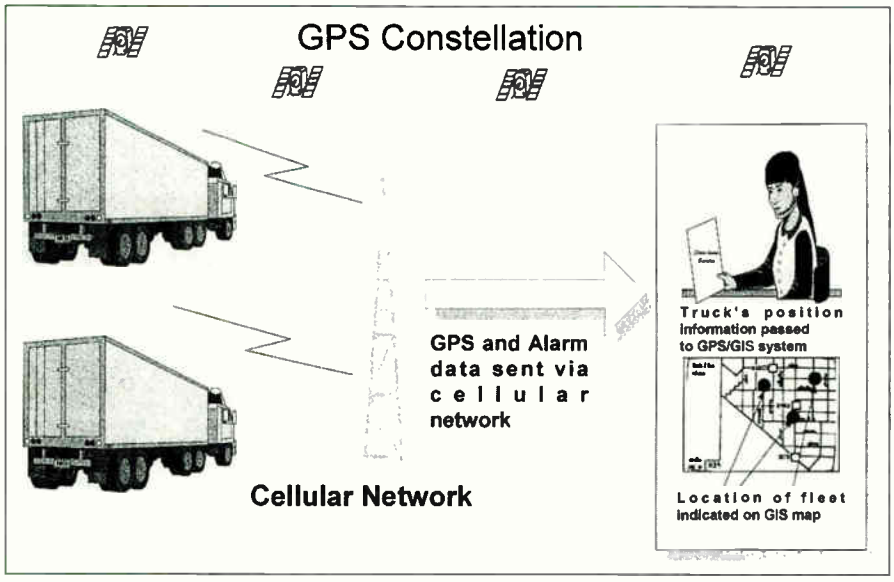



**FIGURE 1.** *Using GPS and GIS to locate a freight truck's position.*

converging GPS, wireless data communications, and GIS technologies enables lives to be saved and it enables a quicker response times from rescue/breakdown service. In this type of application GPS comes to the fore again; any other vehicle location method would not reliably pinpoint the vehicle's location so quickly and accurately on a global basis as GPS can.

Since the rescue system relies on a duplex communications system to convey the conversation between the driver and the rescue service center, it is logical that certain features of a car can also be remotely controlled—such as the locks and power windows, for example. This feature, in fact, is available to users of the system who may find themselves in the unfortunate predicament of being locked out. A call is simply placed to the control center, and the driver quotes his or her password for authentication purposes. The system then establishes a communications link to the vehicle, queries it, and obtains its GPS coordinates and status. Once the operator is satisfied with the information, a system message is then routed to the closest cell site that will remotely activate the windows or door locks of the car, allowing the driver to enter the vehicle. Close, at-hand help was a mere 11,000 miles away.

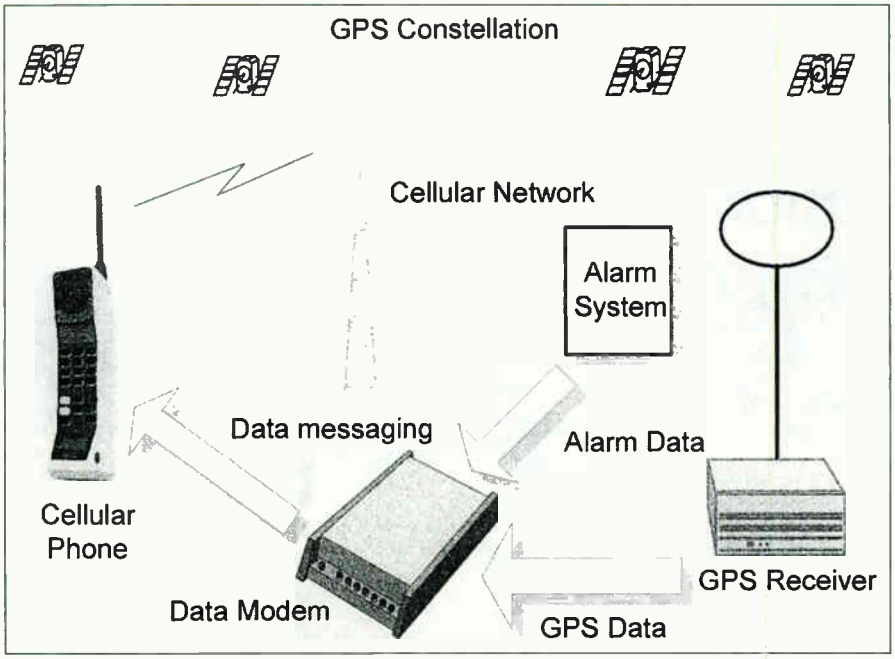



**FIGURE 2.** ***Help is 11000 miles away.***

Finally, one other important feature of this system is the ability of the control center to track the vehicle, should it be stolen or driven without the entry alarm having first been disabled. The alarm status and the GPS coordinates are sent to the control center, allowing them the ability to alert law enforcement agencies of the exact whereabouts of the vehicle. The cellular phone can be activated by the control center enabling the operator to listen-in on conversation within the vehicle to assist in ascertaining whether the owner is driving or whether foul play is in progress.

## *Personal Navigation Systems*

Another growing market segment is PNS or personal navigation systems. We'll cover more of this next issue when we feature a review of a new product that retails for a mere $175. The setup consists of a GPS receiver and a CD ROM containing road maps for the entire USA. Essentially, these systems allow a driver to locate his or her position at any time in any area of the USA. All that is required is a laptop computer, the GPS receiver, and a data file pertaining to the area the driver will be in. This can be obtained from the CD ROM, or, if the laptop does not have one, a multi-media desktop PC can be used to dump the data file to the laptop using laplink software. This application serves many useful functions, be it for business or personal use. It essentially navigates you to your destination first time around, without the need for maps, directions, or any other assistance.

The laptop display will feature a street map of the area local to your position, with a subtle difference: the map moves as you do, keeping you position in the center of the screen. The user's position is indicated by an arrow or similar pointer, indicating the direction of travel. Don't forget, the navigation processor on a GPS receiver can calculate your direction of travel or bearing since the receiver is always moving towards and or away from up to 12 satellites whose position in the sky is always known.

Having a system that enables a user to visualize his or her position relative to other streets and features is the surest way to navigate in unknown territory. The merits of using PNS speak for themselves, and can mean all the difference between a straightforward journey or a magical mystery tour. As mentioned, we will take a closer look at this in the next issue with a review of the Delorme Tripmate.

## *Finally...*

I am receiving a steady stream of inquiries these days via email, asking all sorts of GPS related questions. Please keep them coming in; it is my pleasure to answer your questions and I am happy to be of any assistance. I have now been writing this column for a year, and would like to thank Larry Van Horn for all his help, assistance, and encouragement, and of course, I thank you the readers, who have very kindly passed on some very positive comments to me.

For more navsat information I also have a new web page up and running at: **http://members.aol.com/SDye99/index.html.**

Last but not least, my new book entitled *The GPS Manual-Applications and Principles* is now available from Grove Enterprises. You can get more information by calling their toll free line in the U.S. 1-800-438-8155 or for international calls at 01-704-837-9200.

Until the next issue, happy navigating.

ST

# Destination Direct Flight Planning For Windows

**By Haskell L. Moore KB5WIX**
**KB5WIX@AOL.COM**

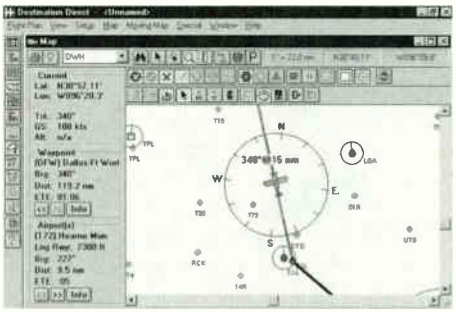
Global Position System (GPS) technology has become a useful tool to just about anyone who travels the vast expanses of the great outdoors. However, pilots probably stand to benefit from this revolutionary technology more than any other group of users. As the tools which integrate GPS technology continue to proliferate and mature, their ability to enhance both the efficiency and safety of general aviation will increase.

One such tool is Destination Direct Flight Planning For Windows by Delta Technology International, Inc. Destination Direct is a Windows (3.1 or 95) based flight planning software package which integrates an external GPS receiver to provide not only comprehensive flight planning, but a moving map as well.

As any pilot will attest, one of the most labor-intensive duties in aviation is flight preparation. Calculation of weight and balance, the effects of winds aloft, and the actual plotting of the intended flight path can take many hours tedious work. Destination Direct can reduce this time significantly by automating these, and most other phases of flight preparation.

Destination Direct is available on either floppy diskettes (ten for the Professional version) or CD-ROM. Having the option of floppy disk installation is particularly handy for those who have a computer without a CD reader, which is often the case with older technology laptops. Delta Technology recommends a minimum system configuration of any speed 486 processor with eight megabytes of RAM.

Before using Destination Direct, a few setup items such as pilot, aircraft and phone book default information should be entered. Multiple pilots, aircraft and weather



***Screen print of the moving map in with the GPS connection activated.***

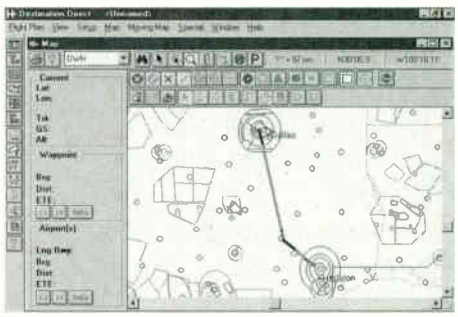
services may be specified, allowing several pilots flying various aircraft to share Destination Direct.

In addition to the pilot's weight, which is automatically factored into the weight and balance calculations, reminders for biennial flight review, pilot's medical, and chart renewal may be entered. All pertinent weight and balance information as well as performance specifications for aircraft ranging from a Cessna 152 to a Citation is provided. Of course, the program offers the ability to customize these settings or add new aircraft.

Another noteworthy feature of Destination Direct is the way weather acquisition has been simplified. The pilot can choose from AccuWeather, GTE DUATS, or DTC DUATS as the weather service provider. Before downloading the weather data, the pilot can also select which components are needed. When using either DTC DUATS or AccuWeather, up to seven different types of weather maps may also be downloaded. Once the weather data has been obtained, it may be viewed in a scrolling window or printed out. Then, the winds aloft can be applied to the flight plan with the touch of a button. When the pilot is satisfied with the flight plan, just a few more keystrokes and it is automatically filed with the FAA via DUATS.

The way in which Destination Direct automatically plans a flight is one of the most impressive features of the product. First, the departure airport is selected (which defaults to the pilot's base airport). Next, the destination airport must be selected. If the airport identifier of the destination is unknown, it may easily be located with a highly flexible and powerful search tool. Simply enter the city name and all airports within a specified radius are returned. From the hit list, you may review each airport to determine its suitability, such as instrument approach information, runway length, lighting, and fuel availability.

After the departure and destination airport has been entered, depressing the Plan Flight button opens the Plan Flight Preferences screen. At this point, the pilot may select between a host of options including VFR or IFR, the navigation method, such as VOR or GPS, as well as the preferred altitude and power setting. The pilot may also opt to have the program automatically route around Terminal Control Areas, Restricted or Prohibited airspace, or bodies of water greater than a specified size. When the Continue button is selected, the automatic flight planning process begins. For a hypothetical test case, I had Destination Direct plan an IFR flight from Houston Intercontinental to Los Angeles International. Total elapsed time: fifty-three seconds!

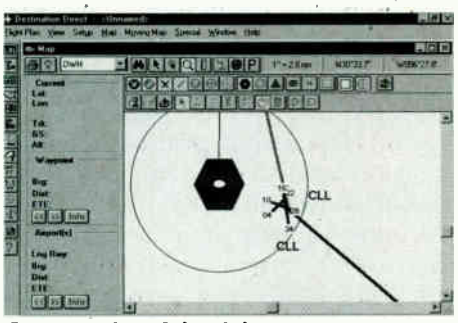


***Screen print of the map showing the entire route.***

Another outstanding feature of Destination Direct is the mapping section, which is based on the Jeppeson North American database. By depressing any combination of fifteen pushbuttons, the pilot may customize the map using a wide variety of options. For example, the VFR pilot can turn off the airways and intersections for a much less cluttered view of the area. Or in the case of a corporate pilot, only those components needed for IFR flight may be selected.

The map may be viewed at one of eleven

zoom levels, ranging from all of North America, down to the point where the runways numbers are shown. Clicking on the left or right mouse button zooms in and out, respectively, and centers the map under the cursor. Double-clicking on any object such as an airport, navaid or intersection will bring up an information box about that objects. By employing the Measuring Tool, the distance and bearing between any two selected objects on the map is automatically calculated.




***Screen print of the tightest zoom possible where even the numbers of the runways are shown.***

The map may even be modified dynamically to change the route. By selecting the Route Mode, the pilot may "rubber band" the route to include other stops or waypoints. The route may then be recalculated at the touch of a button to include the changes. And when going from point "A" to point "B" where "B" doesn't exist on the map, user-defined waypoints may be easily added to the map.

One final bit of high-tech wizardry is the Global Positioning System coupled with the moving map option. This combines the powerful mapping features with the most sophisticated positioning technology available. When activated, an aircraft symbol on the moving map corresponds to the actual path of the aircraft. Alongside the moving map, the first of three boxes in the real time information display indicates latitude, longitude, track, and groundspeed. The second box indicates the bearing, distance and estimated time enroute to the next waypoint. The third box displays the same data for the next airport.

The map even incorporates what could potentially be a life saving Emergency feature. When activated, all airports in the vicinity, sorted from closest to farthest distance are presented. The pilot may then select the desired airport, and the course information to the new destination is immediately displayed.

## *Overall Impression*

After having used Destination Direct to plan a number of flights, I have to admit, I'm hooked. The software is rich with features and highly intuitive. Additionally, Destination Direct is easily customizable for various pilot skill levels and aircraft types. This review can only begin to scratch the surface of the features and functionality of this package.

Unfortunately, using a laptop computer in the cockpit of a small aircraft is quite a challenge. Vibration, aircraft movement (especially in turbulence), changing lighting conditions, and the logistics of securing the computer to the seat proved to be almost more trouble than it was worth. However, if a passenger is available to help, or a laptop mount is utilized, the moving map feature is really great to have.

During tests, the moving map tracked right along on course. A compass rose can be superimposed around the aircraft which also displays the aircraft heading. The map may also be configured to display Track Up, where the aircraft always moves toward the top of the display, or North Up, where North is at the top.

Almost as impressive as the software is the technical support. Delta Technology provides technical support via a toll-free number. Each time a call is received it is religiously logged into their database, allowing subsequent calls to be handled more effectively. Each of my calls to technical support was handled quickly and efficiently. In one particular instance, they certainly went the extra mile in helping diagnose a sticky problem with my GPS connection. Unlike many larger software companies these days, support seems to be a very high priority with Delta Technology.

Delta Technology provides a subscription service by which the map data is updated approximately once per month. These periodic updates also often include software enhancements and corrections.

Destination Direct is available on either floppy diskette or CD-ROM. One advantage of CD is that all of the products are included on every CD. To receive the activation key, just call Delta Technology and charge it on your credit card. Within minutes, you can be using the product. Various product demos are also available on the CD


version. Destination Direct is available in a variety of configurations, ranging in price from $199 to $399, and comes with a forty-five day money back guarantee.

## *Future Enhancements*

With the combined power of Global Positioning Systems and laptop computers, the future of flight planning and navigation is very bright. Delta Technology is leveraging this technology to create even more sophisticated products. For example, they have just signed an agreement to integrate Destination Direct with selected Rockwell Collins Flight Management Systems. With this new system, flight planning is performed on a personal computer, then loaded into the FMS via floppy diskette.

The author, Haskell Moore, is a private pilot in Houston, Texas. This evaluation of Destination Direct Professional was done on a Compaq Presario with an eighty-three MHz Pentium processor and sixteen megabytes of RAM. Moving map tests were performed with a Compaq LTE 486/33 connected to a Magellan 3000 GPS utilizing an external antenna.

Delta Technology may be reached at 1-800-515-6900 or 715-832-0700. You can also visit their site on the Web at **http://www.flightplan.com/index.html.** ST

ST ON THE AIR

*By Steven J. Handler*

# *Wall $treet Week*, Right On The Money

Why settle for one of the myriad mediocre programs dealing with business and investing, when you can tune in to the best, *Wall $treet Week* with Louis Rukeyser? Each week the show (to quote its announcer), covers "the economy, people, and their money."

The program is a production of Maryland Public Television and can be seen on the PBS Network. The show's host, Louis Rukeyser, is charming, witty, and exudes an air of confidence and intelligence without being pretentious or stuffy.

Rukeyser has been educating his viewers since the program began on November 20, 1970. Each week he opens the show with a commentary. His snappy monolog reviews the week's important business, investment, and stock market events. Avoiding the dry presentation often found on other shows, he injects humor and wit, but you have to stay alert: he is quick with his puns.

It is obvious that Rukeyser is extremely bright and talented, yet he never boasts or brags, and is always prepared to learn from his guests.

His shows include expert panelists from the investment and business communities. They discuss important topics raised by Rukeyser in his commentary as well as answer questions submitted by viewers. Rukeyser also asks his panelists the probing questions which viewers may be hesitant to ask.

The climax of the show is the special weekly guest. In the first 25 years of the show, 887 guests have appeared, among them the movers and shakers from the world of investments, business, and economics. Notable guests include government economic officials, such as Federal Reserve Chairman Alan Greenspan, to famous business personalities such as John Templeton, John Kenneth Galbraith, Paul Samuelson, and Malcolm S. Forbes. The weekly guests have often included analysts experienced in a particular industry or sector, who share insights and opinions on their area of expertise. The guests are questioned by the panelists as well as by Rukeyser, eliciting information that is insightful, educational, and useful to the viewers.

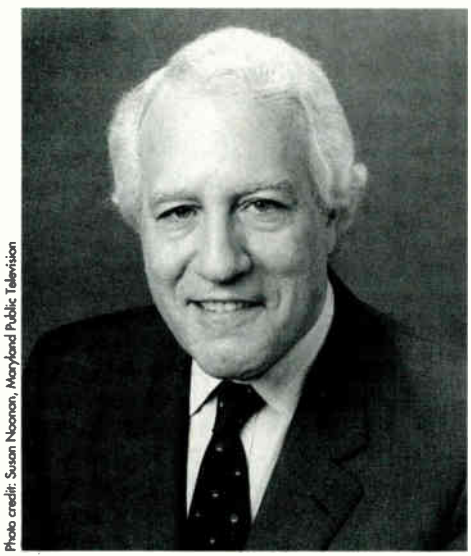


Photo credit: Susan Noonan, Maryland Public Television

***Louis Rukeyser, host of Wall $treet Week.***

WALL $TREET WEEK WITH LOUIS RUKEYSER

Rukeyser is no intellectual lightweight. A graduate of Princeton's Woodrow Wilson School of Public and International Affairs, Rukeyser spent 11 years as a correspondent for the *Baltimore Sun* papers. From there he moved to television as a correspondent and commentator for ABC News. In 1970, he started *Wall $treet Week* from Maryland Public Television. Rukeyser's skills go beyond broadcast journalism and include authoring investment books and writing a syndicated column, (which he gave up in 1993 in order to devote more time to his own investment newsletter).

The program is available to C-band satellite viewers at 8:30 p.m. EST each Friday via the PBS feed located on Telstar 402R, channel 18. In addition, for those who subscribe, the program also can be seen at 10 p.m. EST over Denver's PBS station, KRMA, using Satcom C-1, channel 3.

Some may tune in looking for stock market tips. I, however, enjoy the program because it provides my brain with a healthy selection of gourmet food for thought, rather than the fast "junk food," devoid of intellectual nourishment, found on some business programs. Whether you are a neophyte or sophisticated investor, *Wall $treet Week* with Louis Rukeyser is my pick for the best program on television covering business and investing.

## *Time to Watch*

Lee Jackson is becoming a fixture in the hobby of vintage watch collecting. Jackson blends the vintage status of his product with state of the art technology to communicate his message. His programs air live four days a week and are carried over the PandaAmerica Shopping Network, which broadcasts via Galaxy 3 satellite, channel 8. Program times are Mondays from 10 p.m. to 1 a.m., Wednesdays from 4 to 7 p.m., Fridays from 6 to 9 p.m. and Saturdays from 1 to 4 p.m. EST.

The PandaAmerica Shopping Network programming features collectables and merchandise for sale over the air.

***PandaAmerica Shopping Network airs Lee Jackson's programs about vintage watches. Photo courtesy of Game Show Network.***

***Lee Jackson brings vintage watch collecting to viewers of the PandaAmerica Shopping Network. Photo Courtesy of Lee Jackson.***

The flamboyant Jackson generally sports a brightly colored print shirt and bolo tie, but his formula ssems to be successful: a press release from Jackson indicates that he sells an average of $200,000 to $300,000 worth of watches a month.

Although Jackson's TV pitch is to sell watches, he also provides the viewer with an education about vintage watches. Those of you who have old watches hidden away in dressers or jewelry boxes may find tuning in will help you find out whether that family heirloom has economic as well as sentimental value. Viewers discover that watches are described not only in terms of the manufacturer but by other criteria. Body type is one such criteria. Is the watch round, square, or another shape? What is the watch's style: dress, casual, diving/underwater, chronograph, or something else? What is the case made of? Is it a precious metal such as gold, silver, or platinum, or one of the more common metals such as nickel or stainless steel?

Jackson's fondness for watches dates back to his childhood when he began noticing some of his father's and grandfather's fine Swiss watches. Starting simple, Jackson began to collect the less costly brands and progressed. Eventually his avocation became a vocation, including retail stores in Los Angeles and Laguna Beach, California. In addition to broadcasting via satellite, Jackson publishes a newsletter and maintains a web site.

I seldom wear a watch and, when I do, it tends to be one of those $9.95 digital jobs with a plastic bands. However, for those whose tastes and appreciation of fine watches are not as stunted as mine, tune in — you may have a "good time."

## *The Hound of the Bingo Hall*

If bingo's your game, take a peek at Spacenet 4, channel 7. In case you've been in a cave for the last year, now you know: C-band satellite viewers now have the opportunity to play bingo in their own homes for cash prizes.

This bingo game is hosted by an animated computer generated dog, named Basil. Although Basil is an electronic puppet, the prizes are real. Since we last visited Basil in this column, the jackpots have increased. Each month over $150,000 in cash prizes are awarded.

To play, you must obtain a bingo card from the program providers. The cards and more details are available for free by calling (800) 474-1043. There is one catch: your card will only be valid for the specific day assigned to that card. After your free day has expired, you can call their "EZ" Activation 800 phone number and, for a processing fee, reactivate your bingo card. That's right; you may have to pay if you want to play. For those who are cheap (a classification I find myself in), it can't hurt to ask the program provider if they will honor requests for free cards if you send them one each day.

To help ward off nasty letters and make our attorney happy, my editor requests that I remind you that the inclusion of information about the games Basil plays is not and should not be considered an endorsement by the author, publisher or staff of *Satellite Times* magazine, of Basil Basset Bingo, or of any type or manner of gambling. Further, the game may be subject to federal, state, and local


***Dave Nemeth and Nancy Sullivan, hosts of GameTV. Photo courtesy of Game Show Network***

laws and regulations.

### *Game Show Network Premiers GAME TV*

The Game Show Network of Culver City, California — a Sony Entertainment Company — has debuted a new half hour program that blends a game with a talk show. Although the network has been previously featured in this column we find it such an entertainment treasure that I believe it deserves another mention. Game Show Network broadcasts over Galaxy 7, channel 6. Viewing requires a subscription available through many of the satellite programming providers.


Their new program, called *Game TV*, airs live weekdays at 12 noon EST and repeats at 2 a.m. and 8 a.m. EST. It's hosted by Dave Nemeth and Nancy Sullivan. *Game TV* provides viewers the interactive ability to participate by calling in to play games. Besides celebrity guests, a unique part of the program is the behind-the-scenes segments of current game shows. Debut week included a three-part series about the *Wheel of Fortune*'s visit to Phoenix, Arizona. Game Show Network's website is at: **http://www.sony.com.**

### *Help Wanted, Game Show Host*

The Game Show Network has kicked off their "Coast to Coast Search For A Host." For those who always wanted to host a game show, now is your chance. The Game Show Network will be combing the nation for game show talent. Contenders will be selected to compete in an original Game Show Network game show to be held in local shopping malls.

Finalists selected from the tour will participate in the national finals scheduled for November at Sony Picture Studios in Los Angeles. The winner will receive an estimated $30,000 prize package

GAME SHOW NETWORK

*A Sony Pictures Entertainment Company*

and a game show hosting assignment on the Game Show Network. Tune in to the Game Show Network for more details.

The Game Show Network features more than 50,000 episodes of popular, vintage, and nostalgic shows, including *Wheel of Fortune, Jeopardy,* and *Password.* My personal favorites include the old black and white shows from the early 1950s, including *I've Got A Secret* and *What's My Line.* Their 50s charm and innocence is refreshing. These early game show gems are just some of the wonderful things you can find *On The Air.*

When he is not surfing with the TV remote control clicking away in his hand, On The Air's Steve Handler can be reached via e-mail at: **ontheair@grove.net.**

ST

*By George Wood*
*wood@rs.sr.se*

# European Space News

It appears that Astra has successfully outflanked Eutelsat over Astra's planned second satellite location at 28.2 degrees East. Eutelsat had tried to block Astra's use of that position, which it claimed it had registered first, by carrying out high-profile tests of Hot Bird 2 at 29 degrees East, establishing prior (albeit short-lived) use at that position.

Now Deutsche Telekom has decided to replace its DFS-Kopernikus satellites with Astra relays. The two Kopernikus satellites are located at 23.5 and 28.5 degrees East, so DT's prior use of those locations is unquestioned. DT would be allocated bandwidth between 12.5 and 12.75 GHz on Astra 2B, which is scheduled to be launched to 28.2 degrees East in the fall of 1998. DFS-2 Kopernikus at 28.5 degrees would remain in orbit as a back-up.

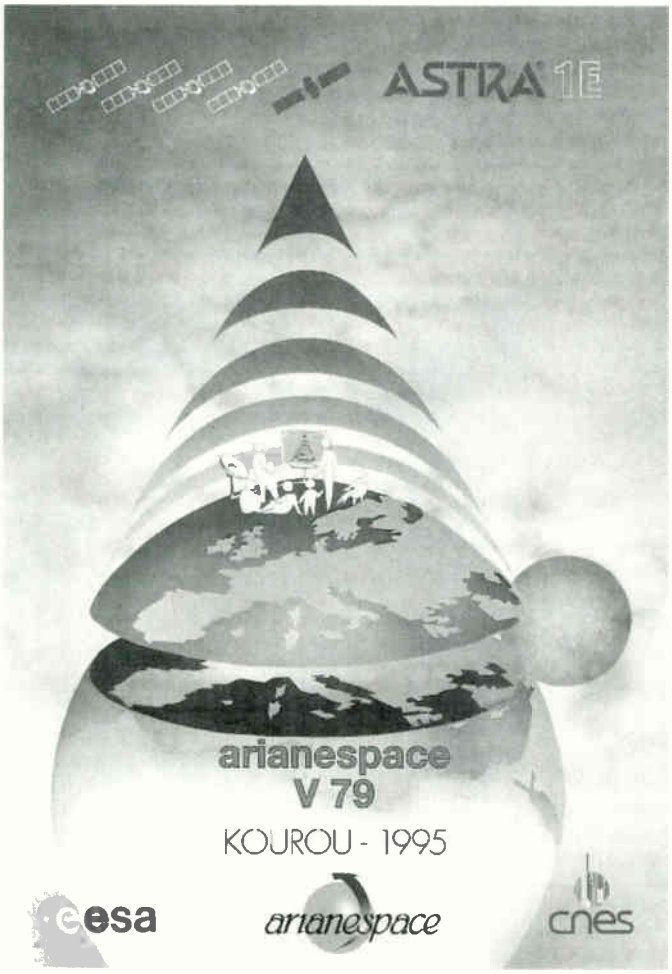
Astra 2A is scheduled to launch to 28.2 degrees East in October this year. It will carry 28 transponders between 11.7 and 12.5 GHz, most of which will probably be operated by British Sky Broadcasting for a new digital services to Britain and Ireland.

There have been a number of changes among the Astra analog channels. Several have changed format and name. The Paramount Channel, which was essentially Nick-at-Nite, has changed its name to the Paramount Comedy Channel, to reflect a new direction. This includes daily doses of Monty Python.

A youth-oriented channel called "Trouble" has started on transponder 42 (otherwise home of Bravo, HSN, and Playboy). Bravo, which has featured classic TV shows from the past, has changed direction as well, and now focuses on rather weird "cult" shows.

The Family Channel has been renamed Challenge TV. Instead of the wholesome family entertainment that failed to attract an audience, viewers can watch hours of mindless game shows.

The Learning Channel (TLC), which shares Astra transponder 41 with Discovery, has changed its name to Discovery Home and Leisure. The new name pits the channel in direct competition with Granada's Home and Garden, which broadcasts during the same afternoon hours.




Turner Broadcasting has confirmed that "WBTV: The Warner Channel" has been scrapped. Rupert Murdoch stopped the planned launch as part of his Sky Multichannels because Time Warner refused to put Murdoch's Fox News Channel on its New York cable system. But the launch of a separate WBTV European entertainment channel is still possible. Unfortunately Murdoch seems to have control over Astra transponder 57, which was to be the home of WBTV. A new channel outside the BSkyB umbrella may have to wait for a digital launch.

The Hallmark Entertainment Channel, currently available digitally from Nethold in Scandinavia, intends to launch as part of Sky Multichannels this fall. Hopes that the Irish entertainment channel Tara would soon become part of Sky Multichannel's package have been dashed, following the cessation of talks between the broadcasters. According to a Tara spokesman, its very unlikely Tara will be available on satellite until Sky's digital package starts later this year.

Astra's rival, Eutelsat, has awarded the launch contract for its W3 satellite to Arianespace. W3 is the third in a family of new generation satellites that will replace the Eutelsat II series. Each Eutelsat W is equipped with 24 transponders, and will provide telecommunications and TV distribution services throughout Europe, the Mediterranean, and as distant as Central Asia. Each includes two steerable spotbeams and one fixed spotbeam. Eutelsat's Hot Bird 3 is to be launched this summer, Hot Bird 4 in the fall, Hot Bird 5 in early 1998, W2 in the fall of 1998, and W3 in the Spring of 1999. (There doesn't seem to be a Eutelsat W1.)

Serbia's RTS-Sat has moved from Eutelsat II-4 to Eutelsat II-F2 (10 degrees West), acquiring its own transponder on 11.658 GHz (Formerly used by AFRTS). The audio signals remain the same: TV audio on 6.65 MHz and Radio Belgrade on 7.02 MHz. The schedule remains 18:00-24:00 hrs (presumably local time), with rebroadcasts of TV Pink on Sundays at

12:00-18:00 hrs.

On Rupert Murdoch's German channel Vox on Eutelsat II-F1 (11.589 GHz), Klassik Radio can now be heard on 7.74/7.92 MHz. DLF has disappeared, but continues on Astra 1B.

Canal Plus Poland has ceased broadcasts on Eutelsat II-F3 11.617 GHz. It remains on Hot Bird 1 on 11.515 GHz. Polsat2 has started on Hot Bird 1 on 11.345 GHz.

On Hot Bird 1 on the EBN transponder (11.262 GHz), Radio Canada International has moved from 7.20 to 7.56 MHz.

Euronews is to change to a headline news service, in an effort to increase viewership. The channel avoids on-air anchors, and accompanies news video with sound tracks in English, French, German, Italian, and Spanish. Arabic was added in April.

VOA Europe has stopped transmissions over Eutelsat II-F1 on the Deutsche Welle transponder on 11.163 GHz. The 7.38/7.56 MHz sound channels have been taken over by DW.

Intelsat's orbital position at 27.5 degrees West has been extremely important for the development of European satellite broadcasting. But with the development of Astra and Eutelsat's "Hot Bird" position, broadcasters have been leaving 27.5 degrees East, at least as far as Ku-band broadcasting to Europe is concerned (C-band transmissions to Africa and the Americas continue, along with Ku-band feeds).

In April CMT Europe ended its PAL broadcasts on the current satellite at that position, Intelsat 601. CMT continues as part of the Sky Multichannels package on Astra transponder 51.

The final European broadcaster on Intelsat 601, BBC Prime, ends its D2-MAC service in October, to be replaced by digital MPEG-2 relays on Eutelsat II-F1. Following an experiment some months back, the BBC will become the first broadcaster to transmit channels in both analog and digital format on a regular basis from a single transponder. Beginning in May, the analog BBC World signal on Eutelsat II-F1 11.620 GHz will be joined by a digital version of BBC Prime.

The doubled up analog/digital service means the analog relays of the BBC World Service radio on that transponder are closing down. According to an announcement on the BBC World transponder (on 7.56 MHz), all World Service radio relays there are switching to digital form. The only exception will be the English language relay on Astra on the UK Gold transponder 23, 7.38 MHz.

BBC Prime is also carried in D2-MAC for Scandinavia on Intelsat 707. This is scheduled to switch to digital MPEG-2 later this year.

The new generation Intelsat 801 has been testing at 47 degrees East. When the tests are over, it will be moved to 64 degrees East. Intelsat 512 has been relocated to 55.5 degrees West.

France Supervision ended its clear widescreen D2-MAC transmissions from Telecom 2A (8 degrees West) at the end of March. Canal Plus and Cine Cinemas will also cease broadcasting from 8 degrees West later this year.

Gorizont 19 has replaced Gorizont 17 at 34 degrees East.

## Digital

Rupert Murdoch has dealt a severe blow to his would-be partner Leo Kirch. Murdoch's British Sky Broadcasting and the German media mogul's Kirch Gruppe have cancelled their plans to create a jointly-owned digital TV platform in Kirch's DF-1. According to a joint statement, the agreement has been terminated "because of failure to agree (on) a number of fundamental issues."

After months of indecision, British Sky Broadcasting has finally gone ahead with plans for its own digital broadcasts. Perhaps to cover up its previous equivocation, BSkyB issued a statement emphasizing its commitment to digital television, and warned that Britain is falling behind its European neighbors in the move into the new era.

"Our clear and unambiguous aim is to be in the vanguard of the digital era," BSkyB deputy managing director David Chance told a *Financial Times* conference on New Media and Broadcasting

BSkyB has plans to launch a 200-channel digital satellite service in Britain from Astra 2A later this year. But the company has also formed a digital terrestrial television (DTT) alliance with leading commercial broadcasters Carlton Communications and Granada Group. The three have teamed up to form British Digital Broadcasting and are applying for licences to run DTT networks when the service comes on air in mid-1998. While BSkyB's digital satellite service would offer 200 channels, the DTT service would provide 30 terrestrial channels.

However, BSkyB faces some heavy competition in the digital world. TCI's British subsidiary Flextech and the BBC announced on March 17 that they are forming two joint television ventures. One will develop several new subscription TV channels. The BBC calls this plan to break into the domestic commercial television market "historic."

Eight new subscription channels are planned, called Horizons, Showcase, Style, One-TV, Arena, Learnings, Catch-up TV, and Sports Entertainment Network. They will carry factual programs, comedy and drama, leisure and lifestyle, the "youthful spirit of (the pop channel) Radio 1 on TV," music and arts, education, sports news and analysis, and early reruns of programs from BBC1 and BBC2. The new channels would be on the air by September, at the earliest.

The second venture will develop, first in analog and later in digital formats, what is currently UK Gold (which offers classic programs from the BBC archives). As part of the deal, Flextech will acquire a share of UK Gold (and companion channel UK

Living) it does not already own in a stock swap with Cox Communications, Pearson, and the BBC.

Sogecable, the Spanish Canal Plus digital service, is on the following Astra frequencies (all vertical polarization):

Transponder 76 11.934 GHz
Transponder 78 11.973 GHz
Transponder 92 12.246 GHz
Transponder 94 12.285 GHz

The Hungarian, Czech, and Polish versions of HBO have begun digital tests from Israel's Amos-1 (4 degrees West). The 8 channel MPEG-2 package is to replace videotape distribution. HBO is remaining cable-only and the package will not be available for DTH reception.

## *Scandinavia*

Shock of shocks....according to a report from Bert Dahlstrom in *Elektronikvaerlden*, Norway's Telenor has plans to relay BSkyB channels on the upcoming Thor 2A. Mostly likely this would be part of a digital package. If true, this marks a massive change. The popularity of the BSkyB channels has led to a plethora of pirated Sky cards in Scandinavia.

Filmnet's arch-rival Kinnevik looks like it will lose its license to broadcast from Britain, following a ruling by the European Court of Justice that the "place of establishment" is the more appropriate basis for exercising jurisdiction over satellite channels instead of "the location where signals are uplinked to a satellite." Britain's Independent Television Commission will no longer license satellite services transmitted from the UK unless they are based in Britain.

Up to a dozen European satellite channels face losing their licenses, including Kinnevik's TV3 services to Sweden, Denmark, and Norway (and presumably TV1000 and TV1000 Cinema as well). Kinnevik started uplinking its channels from Britain in order to avoid Swedish laws regulating satellite broadcasting. While these have eased in recent years, if it were to move back to Sweden, TV3 would have to follow Swedish law restricting commercials to blocks between programs, and forbidding advertising aimed at children.

Scandinavia's first pay-per-view event has been hailed as a success after 43,000 viewers paid to watch live coverage of Danish boxing champion Brian Nelson's win over former title holder Larry Holmes on Kinnevik's TV1000 on January 24. Almost 16 percent of the (Danish satellite) audience bought the event, making it one of Europe's most popular PPVs so far.

Denmark's new TVS-Sportskanalen (not to be confused with Kinnevik's discontinued Sportkanalen) has appeared on satellite, on Intelsat 707, on 11.592 GHz. It is the third channel in a digital package of three, with DR1 and DR2. TVS-Sportskanalen has also started on Tele-X, on 12.637 GHz, in clear D2-MAC, as well as on 11.592 GHz, in MPEG-2. TVS is owned by public broadcaster Danmarks Radio, the private TV2 Denmark, and the Danish (Soccer) Football Association.

The new commercial Danish station Radio 2 can be heard among the D2-MAC sound channels behind BBC Prime on Intelsat 707 11.133 GHz. Public service radio channel Danmarks Radio 2 is also on the BBC Prime transponder. This station can be found in several other places: as sound to the DR2 test pattern on 11.667 GHz (in D2-MAC) and 11.592 GHz (in MPEG-2), as well as the test pattern for TVS. It can also be found by itself as a radio channel in MPEG-2 on 11.592 GHz.

On Tele-X the horse racing channel TotoLine has moved from 12.628 GHz to 12.602 GHz.

The Sci-Fi Channel has disappeared from TV-Sat 2 (1 degrees West) 12.054 GHz, due to a transponder fault. The transponder has been declared dead, and a new home for the Nordic version of the Sci-Fi Channel is being sought.

The Scandianvian Broadcasting System (owned largely by ABC/Disney) is planning to start a new Danish entertainment channel similar to its existing (Swedish) Kanal 5 and (Norwegian) TV Norge. It would be carried at 1 degree West.

Radio Sweden now has a new satellite channel to Europe on Eutelsat II-F1 10.987 GHz (NBC Europe), audio 7.56 MHz. Transmissions from Astra and Tele-X have ended, except for relays via the World Radio Network on Astra transponder 22 (VH-1) audio 7.38 MHz.

Suddenly there are two blocks fighting for Scandinavia's digital television future. But everything hinges on the launch of two new satellites. Back on November 22nd, Nethold, owner of Filmnet, announced it was launching digital satellite television to Scandinavia from the Astra satellites. But since that date, there hasn't been a single advertisement marketing the new service. Then in January, Nethold Nordic announced it was working with Norway's telcoms operator Telenor to start digital services from the Thor 2 satellite. That was due to be launched in February, but after a Delta-2 rocket failure at Cape Canaveral, the Thor 2 launch has been delayed.

According to Per John Jensen (head of Nethold's subsidiary Multichoice in Denmark and Sweden), because of the deal with Telenor, Nethold/Multichoice decided to downplay the Astra digital service and is concentrating instead on a more extensive service via Thor 2. While the Astra service uses Nethold's propriety IRDETO coding system, the Thor 2 package is supposed to use open standard "common interface" MPEG-2/DVB decoders.

While Nethold is establishing itself with Telenor on the upcoming Thor 2, Kinnevik has found partners for a rival Scandinavian digital package at 5 degrees East, on Sweden's Sirius 2 satellite, due to launch with Ariane in July.

Kinnevik's subsidiarary MTG is working with public broadcaster Swedish Television (SVT), the private TV4, and Telia (Swedish Telecom) to develop a common standard for digital satellite reception. The system is to be open, and decoders will work for

satellite, cable, and terrestrial digital TV. They may or may not be compatible with the Multichoice/Telenor system. The package would also be carried on Telia Kabel-TV's networks (the largest in the country) as well as via MTG's Kabelvision.

Per Appelquist, Assistant Director for Corporate Development at Swedish Television, says SVT is hoping to launch an all-news and sports channel via the new digital service. SVT also hopes to resume control over the planned "Gold Channel" (Guldkanalen) consisting of programming from the archives. This is to be similar to the BBC's UK Gold and BBC Prime.

Swedish Television will also broadcast its SVT4 service in digital form over Sirius 2. This channel combines original programming from SVT1 and SVT2 and is already broadcast to parts of Finland. However, the decision to carry it on Sirius 2 to Swedes in Europe is a separate deal from the MTG/Telia package. Broadcasts would begin in the fall.

SVT4's planned co-operation with Finland's FTV has fallen through. FTV will be using Intelsat 707 for its new service to Europe. YLE has signed a contract with Telenor for digital relays of FTV and the YLE radio stations. FTV will be a pay channel, while the radio stations will be free.

Telia Kabel TV (formerly Svenska Kabel TV, and Sweden's largest cable operator) has signed a deal that gives Telia the right to use six transponders on Sirius 2. These will carry around 10 digital TV channels each, and are primarilly intended for distribution to several smaller cable networks in Denmark owned by Telia. Telia will not be using Eutelsat's Hot Bird 2 as previously planned.

The new Swedish business channel TV8 will be broadcasting from 1 degree West (presumably Thor 2), with the start now scheduled for September. Besides business news, TV8 will carry documentaries about politics, social issues, nature, science, and technology. A youth program is also planned.

## The Rest of the World

The channels in the digital package Arabesque on Hot Bird 2 on 12.015 GHz are: ART Europe, ART 4, ART 5, LBC Plus, and ART test channel

Israel's IBA Channel 2 has started on Amos-1 on 11.596 GHz. Channel 2 has also started on Intelsat 707 on 11.013 GHz, and remains on 11.174 GHz. IBA channels 1 and 3 have left 11.134 and 11.013 GHz on Intelsat 707. They are now only on Amos 1 (10.968 and 11.015 GHz).

The French Co-operation Ministry is backing a digital TV package for Africa. The package is initially carrying five channels, including: TV5 Afrique, Canal France International, the music channel MCM, and Canal Horizon (Canal Plus' African service). The fifth channel could be Euronews or the children's channel AB Infant. From September the offering could include three more channels as it switches to the more powerful Intelsat 803.


Rupert Murdoch's Star-TV is planning to launch a DTH pay-TV package aimed at India. The launch would follow the granting of a license from the Indian government. The new package, called in the Murdoch tradition "India Sky Broadcasting," would probably include the Fox Kids Network; Star World; NBC Europe; CNBC; a Granada channel; The History Channel and The Computer Channel from the BSkyB package; Bloomberg Information Television; and an Indian version of Sky News. The service would be broadcast from PAS-4 (68.5 degrees East), on seven of that satellite's 24 Ku-band transponders. PAS-4, which also has 16 C-band transponders, is also used for DTH packages to South Africa and the Middle East.

Playboy has formed a partnership with Daewoo Corp to launch a Playboy TV network in South Korea on June 15. The 24 hour service will initially be offered to hotels and motels, with plans for cable and DTH satellite services shortly thereafter.

Communications Minister Richard Alston says Australia's state-owned satellite TV service is up for sale. A government inquiry recommended in January that the public service Australian Broadcasting Corporation sell Australia Television. The ABC faces a USD 43 million funding cut in the government's next budget. Australia Television, broadcasting to Southeast Asia and the Pacific, was set up by the previous Labour Party government. There's been widespread criticism that selling off the service would weaken Australian interests in the region.

The first of a new generation of satellites, Intelsat 801, was successfully launched on March 1. It will be placed above the Indian Ocean, probably at 64 degrees East. It provides a capacity of three TV channels, 22,500 telephone circuits, and up to 112,500 digital telephone circuits.

Japan's JCSAT 4 was successfully launched with Atlas on February 17. It will replace JCSAT 1 at 150 degrees East, but will be moved to 124 degrees East when JCSAT 5 is launched.

Japan's Posts and Telecommunications Ministry says it will allow Rupert Murdoch's Japan Sky Broadcasting to beam digital satellite TV programs on nine channels, instead of the 12 JSkyB had applied for. The ministry will formally qualify 27 broadcasters, including JSkyB, to broadcast via the JCSAT-3 satellite. JSkyB is set to start full-scale broadcasts by April 1998.

The Burmese army-owned station, Myawaddy Television, is leasing transponder space on the Asiasat-2 satellite. The station broadcasts news and entertainment four hours a day, sharing a terrestrial channel with the state-run television. The agreement will allow Myawaddy Television to broadcast on its own channel.

## Cyperspace

Swedish Space Corporation expert Sven Grahn has a new Web site that is a must for those interested in space programs and projects: **http://www.users.wineasy.se/svengrahn/**

Arianespace has unveiled its new Web site at: **http://www.arianespace.com**

Thanks to *Tele-satellit News*, James Robinson, Curt Swinehart, SATCO DX Chart Update, *Elektronikvaerlden*, and *What Satellite TV* for contributions. ST

*By Doug Jessop*

# Where Oh Where Has USIA Gone...?

"Blackout Bingo" continues to be played on the North American C-band satellite spectrum. Just before deadline, *ST* managing editor Larry Van Horn informed me that the United States Information Agency Worldnet TV (USIA) broadcasts on Spacenet 2, transponder 2, had either played a cruel April Fool's joke or had made the nonsensical move of going digital.

Let's examine this a bit more carefully: The USIA satellite feed is analogous to the video version of Radio Marti, a.k.a. U.S. propaganda aimed at Cuba and other non-democratic nations. Going digital with this feed begs the question of "what the *&^% do you think you are doing?" The idea behind a channel of this nature is to get the word out, right? Am I the only person out there that thinks that GI digital decoders aren't exactly widespread, especially in the target area of the USIA feeds? To add insult to injury, the USIA is an agency of the United States government that is supported by taxes of people like you and me. The situation becomes even more convoluted.

Larry Van Horn suggests that a letter or two to the folks in Congress may be in order. In that vein (and to check how closely you are reading this column), I am challenging each and every *Satellite Times* reader within reach of the Internet to go to a site called "Mr. Smith E-Mails Washington(sm)" at **http://www.mrsmith.com**. The site provides a graphical interface to send e-mail to members of the United States Congress as well as the President and Vice-President. While you are there you will also find "Mr. Smith E-Mails The Media(sm)" that lets you send an electronic "letter to the editor" to a variety of newspapers and magazines.

### New Kids on the Block

Speaking of the Internet, if you have a net connection I highly recommend checking out the various newsgroups for satellite viewers. I am the first to admit that I don't have time to park in front of a monitor 24 hours a day and check out all the changes that come down from 22,300 miles in space. On March 6 the following was posted to **rec.video.satellite.tvro**: "Test signal from the new GE 2 C-band satellite was noticed tonight on channel 23.The picture is excellent."



Photo courtesy NASA

Nine days later, on March 15, NASA Television began broadcasting via the new GE 2 satellite that will allow reception by a wider audience throughout the continental United States, Alaska, and Hawaii.NASA Television is designed to provide real-time coverage of agency activities and missions as well as resource video to the news media, and educational programming to teachers, students, and the general public.

Previously NASA TV was transmitted on the Spacenet 2 satellite, which is nearing the end of its life cycle.The GE-2 satellite, which was launched in January and is operated by GE Americom, will provide NASA TV with a larger "footprint," or coverage area.

NASA Television is broadcastingon GE-2, transponder 9C, at 85 degrees West longitude, vertical polarization, with a frequency of 3880 MHz, and audio of 6.8 MHz.

For more information about NASA Television, including program scheduling, please visit the NASA Television home page on the World Wide Web at URL:http://**www.hq.nasa.gov/ntv.html**

THE WEATHER CHANNEL®

**No place on Earth has better weather.™**

CBS got into the business of cable television officially with the launch of its new cable network, Eye on People. The new service features many familiar CBS faces, including Mike Wallace, Mark McEwen, and Paula Zahn, but (say sources) the network will attempt to differentiate itself from other cable networks by focusing on new personalities. Unfortunately for the C-band dish owner, this is another digital compression channel (Galaxy 7, transponder 9).

Programming on the channel includes new material and archival footage from CBS News, including *I Remember*, hosted by Charles Kuralt, which will feature CBS correspondents talking about stories they've covered; *The Thing People Do*, hosted by Charles Osgood; and *Off Tenth*, a nightly live program about the days headlines hosted by Thalia Assuras and Richard Schlesinger.

NBC is launching a new weather service on satellite television to go after The Weather Channel. The venture is an expanded version of an on-line weather service that is now a part of MSNBC. Industry observers see it as a first step toward a challenge to The Weather Channel, a cable TV service with about 65 million subscribers (Satcom C3, transponder 13 at 131° West using VCII+).

MSNBC

The NBC service will be a graphics and text-dominated channel, without anchor people. By using remote controls, viewers will be able to call up local weather information, as well as national and international weather information. NBC hopes eventually to expand the service into cable, though initially it will be limited to direct satellite television. MSNBC currently broadcasts a digital signal on Galaxy 1R, transponder 10 at 133° West. It is expected that the new NBC weather service will piggyback on this digital feed.

## *Media Merger Mania*

Media merger mania continues on Wall Street with the announcement from CBS parent company Westinghouse Electric that they have taken over the nation's eighth largest cable property, The Nashville Network (TNN). (TNN is broadcast on Galaxy 5, transponder 18 at 125° West using VCII+).

Westinghouse's Group W already owned a chunk of the country franchise—along with its sister network, Country Music Television (CMT)—but this action puts the entire TNN/CMT operation under CBS control. CBS already owns eight country music radio stations in some of the nation's largest markets, and CBS television broadcasts the Country Music Awards each year. While TNN is the eighth largest cable property in the United States, its Canadian reach gives it a total of 70 million households in both countries, making it the second largest cable network in North America. The move brings CBS closer in line with rivals ABC, NBC, and FOX, which each own several cable outlets. Group W was a minority partner with Gaylord Entertainment, which programmed the two cable entities.

Gaylord's chairman, Edward L. Gaylord, will join newly-named CBS Cable as President, TNN and CMT. Gaylord shareholders will receive some $1.55 billon dollars in Westinghouse/CBS stock. The Westinghouse/Gaylord merger is still subject to regulatory approval.

In a recent issue of this column, we took a look at the roller coaster stock value of DBS player EchoStar (119° West, Ku-band 12.2-12.7 GHz). We also examined the recent activities of Aussie media mogul Rupert Murdoch. It was bound to happen: this time the two items melted into one, much to the delight of stockholders in EchoStar Communications. Value in the company NASDAQ stock jumped $9 to $27 in one afternoon after the company announced its DBS alliance with News Corp.

At the end of the day, DISH shares settled to $26.75. The closing was a 78 percent increase in the stock's price from two days earlier, when company shares were trading at a 52-week low of $15. News Corp.'s stock was up 5/8 at $21.87 on the New York Stock Exchange.

Under the deal announced recently, Rupert Murdoch's News Corp. will contribute cash, satellites, and other assets worth $1 billion from its American Sky Broadcasting unit in return for a 50 percent stake in EchoStar. The alliance promises to take on cable TV in its effort to obtain subscribers and offer local broadcast stations.

Sony Corp. announced that it will soon be an equal partner in the direct-broadcast-satellite TV service in Japan. According to sources, Sony has reach a tentative agreement with (who else?) Rupert Murdoch's News Corp. and Japan's Softbank Corp., which formed the service. The direct-broadcast venture, JSkyB, is expected to launch more than 150 channels in 1998 and will serve the entire Japanese market. A participant like Sony, a major manufacturer and content supplier—was deemed crucial for the venture to be successful, because JSkyB will be competing with at least two similar satellite services in Japan. Spokesmen for Sony and News Corp. confirmed that they had made progress in negotiations but had yet to finalize the structure of the deal.

SONY

News Corp. CEO Chase Carey confirmed to *USA Today* that recent rumors about News Corp. buying a stake in the Family Channel (Galaxy 5, transponder 11 at 125° West using VCII+) are accurate. He said News Corp. is in talks with International Family Entertainment, the Family Channel's parent company, but added that News Corp. is but one of a number of companies eyeing a buy. CBS and NBC are also rumored to be looking at a stake. News Corp. would like to find another outlet for its Fox Kids Network programming, and is reportedly seeking a 40% stake in International Family Entertainment. *USA Today* valued such an investment as worth about $600 million. Fox Kids announced plans last year to launch a children's cable network in 1998.

THE Family CHANNEL

Steven Brill, the founder of Court TV

and *American Lawyer* magazine, is walking away from his legal media empire and selling his stake to partner Time Warner Inc., which plans to sell off the magazine and Brill's chain of legal newspapers. The *Wall Street Journal* reports that Time Warner plans to sell the legal publications and the lawyers' online service as part of its efforts to reduce its debt, but will retain its stake in Court TV, which is co-owned by Time Warner, NBC and Liberty Media. Brill will reportedly receive more than $20 million for his interest in the legal empire. Brill told staffers that he had nearly inked a buyout of Court TV with America Lawyer Media more than a year ago, but the deal fell through when Time Warner announced its plans to merge with Turner Broadcasting System.

COURT TV

Court TV is broadcast on Satcom C3, transponder 6 (131° West) using digital broadcasting. The signal had been in the clear since its inception. Sources indicated that Court TV went digital for financial reasons.

Consolidation in the DBS satellite business, like the deal between EchoStar and News Corp.'s American Sky Broadcasting, has begun north of the border.

Star Choice and HomeStar (also see the DBS section in the *Satellite Services Guide* in this issue), the proposed DBS service from Calgary-based Shaw Communications, will join satellite television operations through the merger of Star, partnership both say will become a strong Canadian competitor.

"This alliance is great news for Canadians," said Brian Neill, Star Choice Communications chairman and CEO. "Our team is now stronger and able to offer the most comprehensive, high quality DTH service available to Canadians. Our partnership with Shaw will allow us to build on the momentum we have already established and will ensure that we launch the best possible service for Canadians."

The combined operations of Star Choice and HomeStar have an approximate value of $110 million. HomeStar will contribute up to $55 million in cash, satellite space, and uplink facilities to Star Choice so that upon completion of the transaction, Shaw will own approximately 50 percent of the common shares of Star Choice Communications on a fully diluted basis.

"This is a very powerful combination," said Jim Shaw, Jr., president and chief operating officer of Shaw Communications. "Our experience in delivering programming services to Canadians combined with the operational and marketing capability of Star Choice will make this an unbeatable team. Shaw Communications is totally committed to the development of a competitive direct-to-home satellite business in Canada and this partnership will strengthen our ability to do this."

Comcast Corp. announced that it has completed the acquisition of a majority interest in E! Entertainment Television (broadcast on Satcom C3, transponder 23 at 131° West using VCII+) from Time Warner. The channel will now come under the control of C3 (Comcast Content & Communication, kind of ironic given their satellite broadcast location), a programming arm of the company that also runs QVC (Satcom C4, transponder 9 at 135° West in the clear). E! Entertainment is seen in more than 42 million homes.

## Satellite Audio

In an area that is often overlooked by satellite dish users, federal regulators said recently that they might soon approve a plan that would create a new breed of radio stations. Following five years of work, the Federal Communications Commission is expected to set aside a portion of airwaves for the first pay radio—a service that can be heard from anywhere in the country. According to FCC officials, the service will be transmitted nationally or regionally by satellite. The plan's approval also cleared the way for four companies (CD Radio of Washington, American Mobil Satellite Corp. in Reston, Va., Digital Satellite Broadcasting in Seattle, and Primosphere in New York), which requested the FCC action, to bid on licenses to provide the pay radio service. In making the statement, the FCC assured local broadcast stations that the new service will not divert so many listeners as to jeopardize them.

*Old Fashion Radio*

You might find it interesting to note that while a lot of video satellite broadcasts may use some kind of encoding for subscription services, a large number of them broadcast the audio subcarrier in the clear (which, gosh, just might be really useful for hearing, uh, maybe, various sporting events....?).

## New Bird is Hatched

Congratulations to INTELSAT on the recent launch of its 801 satellite—the first of the consortium's next generation spacecraft in the VIII series—from Arianespace's space center in Kourou, French Guiana.

The new generation bird features both high power C-band as well as high power capacity at Ku-band. The high power capability, combined with the ability to connect spot beams to global beams, will enhance satellite news gathering operations, VSAT networks, compressed digital video, and thin-route and remote communications.

The satellite, which will be deployed in the Indian Ocean Region at 64 degrees East longitude, also will provide high power voice/data and video services.

In addition to a variety of media folks with whom I chatted, I would like to also acknowledge the contribution of the following in developing this column: Cowles/Simba Media Daily, *LA Times*, MrSmith.com, *SF Chronicle*, SkyREPORT.COM, *USA TODAY*, the *Wall Street Journal* and my very patient wife.

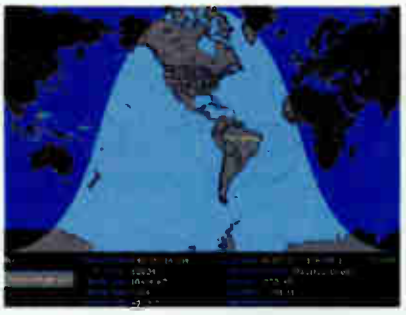
---

*Doug Jessop, the original architect and creator of the Keystone Communications North American Satellite Guide, has been in the broadcasting industry since 1979. He can be reached at:* ***http://www.searcher.com/STcomments.html***

ST

# Micro Orbiter 3.0

The premier personal computer based tracking program for Earth-orbiting satellites.



- Track up to 20 satellites simultaneously, in real or simulated time, from a menu of up to 65,535 element sets.
- Use the SGP, SGP4, or SGP8 USSPACECOM analytical propagators for near-Earth satellites, SDP4 or SDP8 for deep-space satellites.
- Compute visible and line-of-sight pass tabular listings in seconds using the fastest closed-form solution available anywhere.
- Track satellites on ten map projections: Mercator, Orthographic, Alber's Equal Area Conic, Littrow, Gnomonic, Oblique Aspect Vertical Perspective, Aitoff, Lagrange, Armadillo, and Star Chart. The Star Chart projection includes outlines for all 88 constellations.
- Display sensor footprints. Generate satellite separation graphs to predict satellite close encounters.
- Display and print the complete osculating Keplerian and Cartesian state for any object, including geocentric and topodetic data.
- Real-time data display includes azimuth, elevation, range, range rate, Doppler shift, latitude, longitude, orbit count, and more.
- Celestial object data base features the Sun, Moon, and the 9000+ objects in the Bright Star Catalog.

Only $49.95

Micro Orbiter 3.0 has the features professionals expect in their tracking software, but in a package appealing to both the novice and expert alike!

To order: send $49.95 U.S. + 4.00 S&H to
Precision Software Solutions
PO Box 975
League City, Texas 77574
Visa/MasterCard orders 713-538-1694

Orders may also be placed by calling
The Aviator Shop at 800-846-4097

Visit the Micro Orbiter home page at
http://www.infocom.net/~pss

System requirements:
IBM PC or compatible, 80386 DX (Pentium recommended), MS-DOS 5.0 (or Windows 3.1 or 95), VGA, 3.5" floppy

# The World is in your Pocket...

## When you travel with a Magellan GPS Position-Determining Receiver

SHIPPING FOR EACH
$9 UPS
$13 US Priority Mail
$15 Canadian APP
$16.50 Canadian UPS

These compact Magellan navigational satellite receivers earned their renown for reliability during Desert Storm. Now this accurate position-determining instrument can be yours at a fraction of its original cost. Ruggedly built and waterproof, yet barely more than 6" high and weighing only 10 ounces, this pocket precision receiver homes in on 1.2-1.5 GHz global positioning satellites, using their signals to establish your exact location within a few feet in as little as 2-1/2 minutes from a cold start (35 seconds warm start), even your altitude, and allows you to plot and track your motion as well, so you can find your way back if necessary.

Ideal for pinpointing campsites, fishing holes, boating, travelers, trailheads, map locations, landmarks. Selectable graphic screens assist you in tracking and plotting where you've been, where you're going, and where you *ought* to be going! Shows distances, directions, times, speed, course corrections, latitude/longitude coordinates, all on a backlit LCD display.

Up to 17 hours of continuous use on one set of standard alkaline AA cells. Operates over a 14 to 140 degree Fahrenheit temperature range. Lanyard strap included.

All these features make the GPS 2000 Satellite Navigator an incredible value. Or select the upgraded GPS 3000 and get two additional navigation screens, a data port (RTCM 104 in, NMEA out), OSGB coordinates, 100 additional waypoints, 5 more routes, external antenna capability, celestial calculations, swivel mounting bracket, batteries, manuals, and a carrying case.

**(shown at right)**
**Order GPS 2000**
*Only* $149.95

**(not shown; see text)**
**Order GPS 3000**
*Only* $249.95

| | | |
|---|---|---|
| ***ACCESSORIES FOR BOTH*** | | |
| ACC 13 | INSTR. VIDEO FOR 2000 | $14.95 |
| ACC 14 | INSTR. VIDEO FOR 3000 | $14.95 |
| CAS 7 | CARRYING CASE (GPS 2000 ONLY) | $9.95 |
| BAT 1 | AA ALKALINE BATTERIES | $.79 |
| BAT 13 | AA ENERGIZER BATTERIES | $2.75 |
| ***GP 3000 EXTRA ACCESSORIES*** | | |
| ACC 11 | POWER/ DATA MODULE AND EXTERNAL ANTENNA KIT, 20' COAX | $149.95 |

**GROVE ENTERPRISES, INC.**
**1-800-438-8155 US & Canada**
**704-837-9200**
**FAX 704-837-2216**
**7540 Highway 64 West**
**Brasstown, NC 28902**
**www.grove.net**

By Philip Chien

# Crisis on Mir

Recently the Russian space station *Mir* has been in the news, due to several failures in its environmental control and life support system (ECLSS).

On February 23, at 10:35 p.m. Moscow time a fire broke out in the Kvant 1 module. Two weeks later one of *Mir*'s oxygen generators failed. And a week after that a gyro failed. Is *Mir* about to fall apart?

*Mir viewed from the Space Shuttle during STS-79. (NASA photo)*

*Mir* has three separate ways to generate breathing oxygen. Normally the Elektron system uses electrolysis to separate water into hydrogen and oxygen. The oxygen is used by the crew and the hydrogen is dumped overboard as a waste product. Most of the water is "waste" water generated by the crew, including condensation, urine, and wash water. Each of the shuttle flights which docks with *Mir* drops off several thousand pounds of water, a waste product generated by the shuttle's fuel cells. There are two Elektron systems on *Mir*, located in the Kvant 1 and Kvant 2 modules.

The Elektron system only generates enough oxygen for the normal three person crew. When crews are swapped out there are up to six people on board for up to a month. During these periods additional oxygen is generated by the TGK (the Russian acronym for solid fuel oxygen generator). Lithium perchlorate candles are burned to generate oxygen. It may seem like a paradox burning something to generate oxygen, but there are many chemical reactions which produce more oxygen than they consume. Similar candles are sold in hardware stores as solid oxygen for welding work. Each lithium perchlorate candle burns for five to 20 minutes and generates enough oxygen for one person for a day. The candles are burned in an enclosed container because they generate a lot of heat.

In addition, there are ten tanks of compressed oxygen. These tanks are intended for spacewalks, but the oxygen is also available as an emergency supply if necessary. The ten tanks have enough oxygen for five days for a three person crew.

*Mir*'s fire involved the TGK oxygen candles. The cartridge which holds the candle caught fire, and smoke quickly spread through all of *Mir*'s habitable modules. The crew was alerted by the general alarm as well as the smoke. At this point there were two crews aboard *Mir*—the Mir 22 crew preparing to return to Earth and the Mir 23 crew adjusting to life aboard the space station. Besides the four Russians, the crew included German cosmonaut-researcher Reinhold Ewald who traveled to *Mir* with the Mir 23 crew and was scheduled to return with the Mir 22 crew, and American Jerry Linenger whose four month planned stay overlapped the Mir 22 and Mir 23 missions.

Mir 22 cosmonauts Valeri Korzun and Alexandr Kaleri fought the fire with fire extinguishers filled with a water-based cellulose foam mixture. American astronaut Jerry Linenger said, "We immediately went to oxygen breathing devices, and without that I don't think you would have been able to breathe." Jerry reported that the first mask he grabbed did not activate quickly enough so he grabbed another mask.

It took about 90 seconds to put out the fire. Due to *Mir*'s orbit, the next ground station pass was over the United States, and the crew reported the fire to the Russian Tsup Mission Control center via the Wallops Island, Virginia, ground station.

According to NASA, Russian officials believe the problem began when a crack in the oxygen generator's shell allowed the contents of the cartridge to leak into the hardware in which it was located. The crew reported that the damages were due to excessive heat rather than from open flame. The heat destroyed the hardware in which the device, known as a "candle," was burning, as well as the panel covering the device. The crew also reported that the outer insulation layers on various cables were melted by the heat.

The carbon dioxide levels remained fairly normal. The temperature and humidity levels increased due to the fire and the discharged fire extinguishers; carbon monoxide was also detected. *Mir*'s air cleansing system was able to clear out the atmosphere: however, the crew wore surgical masks for three days as a precaution.

*Mir*'s fire is certainly the greatest danger experienced in its eleven years of operation. It was certainly the worst fire to occur aboard a crewed spacecraft in orbit, but it was not the first. For years the Russians covered up previous smaller fires on the Salyut 1 and Salyut 7 space stations. During the classified STS-27 shuttle mission there was smoldering due to an electrical short, but the astronauts were able to smother the fire with no effect on the rest of the mission.

At no point were the crews preparing to evacuate *Mir*, although they were certainly

in a risky situation. While an uncontrolled fire in space is certainly one of a space traveler's worst nightmares, it isn't likely to continue for long. Spacecraft are manufacturered primarily from flame resistant materials, and it's difficult for a fire to burn for any length of time. However, Linenger did report that the smoke spread ten times faster than he would have expected.

Had it been necessary to abandon *Mir*, Linenger, along with cosmonauts Vasily Tsibliev and Alexander Lazutkin, would have retreated to the Soyuz TM-25 spacecraft docked to *Mir*'s node. The other three crewmembers, Korzun, Kaleri, and Ewald, would have had the more difficult task of going around the fire to reach their Soyuz TM-24 spacecraft.

After the fire normal work resumed. The crew was given permission to use the backup TGK system if necessary as long as they inspected the container thoroughly.

The Mir 23 crew continued normal operations with the Elektron system generating oxygen, until it failed on March 7th due to an excessive build-up of air within the system. With no other choice the crew went back to the TGK system, even though it had caused the previous fire.

Additional safety precautions were added, however. While one cosmonaut ignites the candle another remains close by with a fire extingnisher. Ground controllers have instructed the crews only to use newer candles, and avoid older ones which may have decayed over time. It's estimated that there are about 200 candles aboard *Mir*, of which about half are considered usable. Approximately 10 fire extinguishers remain aboard *Mir*.

On top of all of these problems wilth generating breathing oxygen, on March 19 at 7:48 a.m. Moscow time an "Omega" attitude rate sensor in the Spectr module failed. During the three minutes it took to automatically switch to the backup system the station's gyros started to rotate the *Mir* complex. By the time the backup system was in operation it was beyond the ability of the gyrodynes to restore the normal configuration. The crew shut off the gyrodynes and used thrusters to stabilize the attitude. Unfortunately, this resulted in less power generated by *Mir*'s solar arrays, and the crew had to shut down some equipment to save power. After flight controllers uplinked a new attitude maneuver, the crew was able to restore normal attitude control with the gyrodynes. Later, the crew routed electrical cables for another Omega to be used as a backup if that becomes necessary.

In spite of all of these problems, it must be remembered that *Mir*'s components were originally intended for a five year lifetime, and have far exceeded their planned operating durations. However, like an old car it must be coaxed into operation every now and then. But unlike an old car *Mir* still has several layers of backups and protection. So it isn't surprising for problems to occasionally occur.

If the remaining TGK system fails for any reason then the crew still has five days of oxygen remaining in the compressed chambers. Certainly under those circumstances the crew would be instructed to abandon *Mir*. But it wouldn't be a mad dash to get out; rather an orderly collection of experiment samples and computer data tapes over a couple of days followed by a shut down of components in an orderly manner, in case it is possible for a salvage mission to restart the space station in the future.

It should always be remembered that there is always—and has always been—a seat aboard a Soyuz spacecraft for every single person aboard *Mir*. Even in a worst-case scenario in which the cosmonauts are rushing to abandon the space complex due to a major systems failure, they would have enough time to get into Soyuz, put on their spacesuits, and perform an emergency re-entry. Perhaps the most unusual problem under this scenario would be returning the astronauts and cosmonauts to their respective countries—without passports.

The next shuttle-*Mir* docking mission is STS-84, scheduled for launch on May 15th. There are no thoughts about moving this mission forward, simply because it wouldn't be able to provide any assistance which couldn't be supplied more easily via the Progress resupply vehicle. There are plans to bring back the TGK system involved in the fire.

As we go to press the Russian Space Agency has asked NASA to carry a replacement Elektron unit. It weighs approximately 250 lbs and will arrive in Florida less than two weeks before launch. Since the shuttle will already be at the launch pad the Elektron unit will be lowered into the Spacehab. A technician wearing a harness in a trapeze-like mechanism will carry the components down through the tunnel from the shuttle's middeck into the Spacehab cargo module.

Some of the more rabid radio talk-shows have been making unsubstantiated claims about *Mir*'s situation, claiming that the cosmonauts are close to abandoning the twelve year old space station. On the March 13th edition of syndicated late night talk-show *Coast to Coast*, host Art Bell reported that all of the radios were completely dead and the *Mir* crew was using its amateur radio rig to talk to the flight controllers via a U.S. military base in Southern California. He said the crew was asking if the shuttle mission could be accelerated because over half of the Progress ships fail to dock with *Mir*, all of the fire extinguishers were used to fight the fire, the carbon dioxide removal system was destroyed in the fire, and the American doctor had to save the lives of two of the Russian cosmonauts.

These rather unbelievable stories have caused listeners to worry about whether or not *Mir*'s falling apart, and whether or not the cosmonauts lives are in danger. Art Bell's show is available on the internet page: **http://ww2.audionet.com/artbell/abell/9703/ab0312.ram** if you have the RealAudio plug-in for your web browser.

Art Bell's piece ended, "You're not hearing about this in the mainstream press. Wonder why?"

Wonder why? It's simple, Art—because it isn't true. ST

## ST WHAT'S NEW

*by Wayne Mishler, KG5BI*
*email: mishler@ipa.net*

# KVH makes world's smallest antenna for small boats

TracVision — the technology that brought satellite television to boats — now offers "the smallest, fully stabilized marine satellite television antenna" for small marine vessels docked or underway, according to a recent announcement by its maker, KVH Industries, Inc., of Middletown, R.I.


"TracVision II opens up satellite TV to a whole new segment of boaters. Our larger TracVision antenna appealed to owners of vessels greater than 70 feet. TracVision II answers the demand for a smaller, inexpensive unit on boats as small as 35 feet," says KVH president and CEO Martin Kits van Heyningen.

TracVision II is a compact stabilized antenna that receives up to 200 channels of DirecTV and USSB programming. It measures about 19 inches in diameter, weighs about 30 pounds, and sells for $5,495. The original TracVision measured 33 inches in diameter, weighed 82 pounds, and retailed for $7,995.

KVH points out that TracVision II is specifically engineered for the marine environment. All components are corrosion proof and weatherized. The antenna is fully stabilized to reliably receive optimum signals, even in rough seas.

The antenna works with DBS systems which require pinpoint aiming accuracy. It is kept in alignment with the satellite by gyro sensors which guide a robotics pedestal that compensates for boat movement. By keeping the antenna perfectly aligned, TracVision brings in exceptionally clear television video and audio.

Other satellite products offered by KVH include the AMSC Tracphone, and the Inmarsat Tracphone, for regional and worldwide marine telecommunication. AMSC uses powerful satellites that extend coverage hundreds of miles off the continental U.S., including Hawaii, Puerto Rico, the U. S. Virgin Islands, and Alaska. Inmarsat uses the new Inmarsat-3 generation of satellites for worldwide coverage.

## *Liquid Electrical Tape solves age-old problem*

Finally! Now there's a practical way to seal those difficult outdoor electrical connections to protect them from moisture and corrosion. It's called Star brite Liquid Electrical Tape. It comes in five colors including clear, in a one-ounce squeeze tube, four-ounce can, and 32-ounce can.

The new product is a liquid vinyl material that can be applied to wires or terminal junctions to totally seal out moisture and prevent corrosion.

Star brite Electrical Tape could not be easier to use. You simply squeeze or brush it onto a connection. It dries to a flexible protective coating which holds connections together and reduces loosening from vibration.

The Florida-based Star brite company says that UL testing shows the product to have dielectric properties that are better than those of conventional electrical tape. Unlike conventional electrical tape, this material is totally waterproof, and can be applied neatly to irregularly shaped or hard to reach areas. It resists acids, alkalis, petroleum-based chemicals, gasses and other corrosive materials.

If you cannot find the product in a local hardware or electronics store, you can get more information about it by telephoning the company at 800-327-8583, or by writing Star brite, 4041 S.W. 47th Ave., Davie FL 33314. Grove Enterprises also carries this product (in black) at $6.45. You can order at 1-800-438-8155.

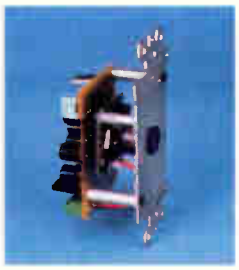
## *Home or business surveillance just became easier*

A small, discreet, powerful surveillance camera that displays its video on your home or office television set went on the market this year. This camera not only turns your TV into a surveillance monitor, it allows you to combine its signal with an existing cable service or other video within the home or business.

The unit, known as the CAModulator, sells for $399 and is distributed by NetMedia, Inc.

"This is the world's first and only black-and-white camera combined with a digital video channel modulator," says Settle Madden, of NetMedia.

The CAModulator requires only a single cable to the camera, providing both power inflow and video signal output. It weighs only 3.5 ounces and fits in an 18 cubic-inch junction box or mud ring. It comes with an external power supply — a 12 volt DC transformer — which powers the unit through the cable. You get your choice of clear, infrared, or smoke-gray lens cover, and a cover plate that covers the camera and prevents anyone from seeing it.



The unit works well in all security, surveillance, and monitoring applications, indoors and outdoors. Because of its use of 12 volt DC power, it is especially handy for travelers to use as a backup camera in their RVs. You can use it to monitor doors and even the baby if you wish.

The CAModulator's ability to see with infrared illumination makes it ideal for all forms of nighttime surveillance.

The CAModulator will be available in stores. To locate a dealer and get distributor price information, call NetMedia toll-free at 888-786-8772.

## Andrew Corp introduces new antennas, offers free software

The Andrew Corporation has announced two new families of antennas for cellular and personal communication systems. They are also offering free software for commercial antenna systems planning.

The company now offers a new line of polarized antennas for modern PCS and cellular base stations. There are three new models that feature slim profiles with light weight, easy installation, and low wind load.

Frequency coverage of the three models are 1710 to 1880 MHz, 1850 to 1900 MHz, and 870 to 960 MHz.

These antennas use dual polarization to eliminate the need for multiple receive antennas and unwieldy top structures on towers. This interprets into lower costs.

"By using 45 degree slant polarization, the equivalent of two antennas can be put in the same space as one vertically polarized antenna," says Robert Wilson of the Andrew company. "This means carriers can expand service without adding new towers. That's good news for consumers, carriers, and zoning boards."

Andrew this year also introduced a new series of microwave antennas for low to medium capacity systems such as rural telephone systems. These antennas are less expensive than solid parabolic antennas.

This new series of KPR Gridpak microwave antennas are shipped as kits to reduce shipping costs. They are easy to assemble and designed to last.

As the polarized versions, the Gridpak series feature good performance with only one-third the wind loading of solid parabolic antennas. For this reason they require lighter support structures.

They cover three frequency bands: 1.350 to 1.535 GHz, 1.427 to 1.535 GHz, and 2.3 to 2.5 GHz. For flexibility, the feed can accept any connector type that fits half-inch heliax coaxial cable.

Gridpak antennas are available in sizes up to 13 feet. The smallest diameter model is a rectangular shaped parabolic antenna measuring 3 x 2.6 feet. It has the least wind loading and, of course, the least gain.

Andrew is offering free software to help commercial providers in designing antenna

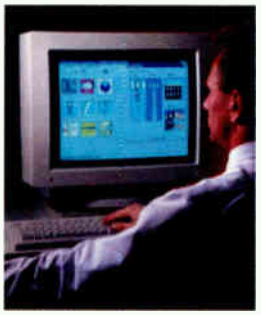
systems for cellular phone and personal communications services.

The software can be downloaded from the Andrew Corporation Web site at **http://www.andrew.com,** or obtained on disk by calling 800-255-1479, ext. 233.

"The Andrew Antenna Systems Planner takes the grind out of system design," says Andrew program manager John Tomczak. "All those catalogs, spreadsheets, bulletins, and product notices are transformed into a simple, point-and-click software program."

The software guides you through the process. It helps you with everything from choosing frequencies to shipping. The program makes sure everything works together and even generates a complete bill of materials.

It offers a text file output, which can be imported into spreadsheets or word processing applications, making it much easier to incorporate designs into system proposals and customer quotes. It enables you to create templates, to test "what-if" scenarios, design customized cover sheets, and make last minute specification changes.



## Inmarsat improves distress messaging for sailors

A faster, more reliable, and more accurate satellite distress alert system for sailors went into operation early this year, courtesy of Inmarsat, the London-based international mobile communications satellite operator.

Use of the system is free to customers.

It covers virtually all of the world's ocean areas, in compliance with the Global Maritime Distress and Safety System, and was developed jointly for marine safety by the German government, the European Space Agency, Nortel-dasa, Siemens, Nokia, MBB, and Inmarsat.

The system is capable of delivering distress calls within minutes instead of hours, as was previously the case. In tests the new system proved to be 100 percent reliable in delivering distress calls to Inmarsat land stations. "This is a great improvement on current satellite and radio systems," says Inmarsat manager Andy Fuller.

The technology of this new system combines GPS with Inmarsat's geostationary satellite technology. Since geostationary satellites are always within view, no time is lost in waiting for them to appear over the horizon. This accounts for faster delivery of emergency calls, which is essential for ships in distress.

## Drake announces new satellite television receivers

The R. L. Drake company has announced two new models of satellite receivers — ESR800XT PLUS and ESR2000XT PLUS.

The 800, says Drake, is possibly the most versatile satellite receiver on the international market. Built-in UHF capabilities and powerful software allow this receiver to be controlled from virtually any room in the house. It comes equipped for the addition of two internal decoder modules, such as VideoCrypt and Eurocrypt. It has 800 preprogrammed channel memories, providing users with a wide variety of programming options.

The 2000 is an advanced home satellite receiver that offers global operation through multi-voltage input selection, multi-standard operation, and dual remote controls. It can be used in almost all regions of the world because of its internal decoder capabilities and multi-lingual on-screen display menus. This receiver also accepts internal decoder modules.

The 2000's main features are built-in UHF remote control capabilities, and its vast bank of 2000 preprogrammed channel memories with video/audio and antenna settings. "We have designed this unit with maximum programming options in mind," says Drake sales manager Dan Albrecht.

For additional information on either the 800 or 2000, you can telephone the R.L. Drake Company at 513-746-4556, or visit their Web site at **http://www.rldrake.com.**

ST

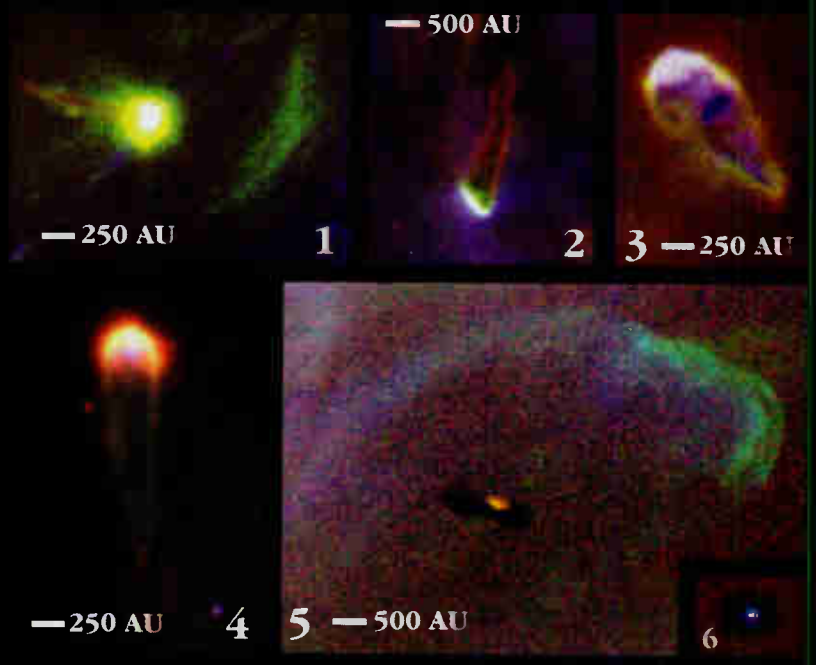
ST SPACE WATCH

By Larry Van Horn

# Orion's Cluster Stars Devour Proto-Planets

*An extended view of the Trapezium showing the four energetic massive stars and a plethora of Sun-like stars with surrounding extended emission. The Trapezium is located in the center of the Orion nebula seen here as a blue background glow. Note how the material surrounding the Sun-like stars produces a cometary structure with a bright head and a tail pointing directly away from the energetic central massive stars.*

*A false color image of the teardrop shaped HST 10 star-disk system and immediate neighbors, a silhouetted disk (top left) and a second star-disk system (bottom right). At the center of HST 10 lies a dark nearly edge-on disk with a diameter approximately the same as Pluto's orbit. Surrounding the system is diffuse hot gas which has been evaporated from the disk surface. We are witnessing the destruction of a circumstellar disk which if otherwise left alone would be a strong candidate for producing planets.*




*A gallery of star-disk systems in Orion's Trapezium. The first four objects are being evaporated by the central massive stars, while the last two disks are visible in silhouette against the background nebula.*

Theoretical models, coupled with NASA Hubble Space Telescope observations of the Trapezium cluster in the Orion nebula, suggest that disks around young cluster stars may not survive long enough for planets to form within them. This implies that there are certain hostile environments in star-forming regions that may inhibit planet formation.

The findings, presented by an international collaboration of astronomers at a meeting of the American Astronomical Society in Toronto, Canada, explain the destruction of circumstellar disks in Orion's Trapezium, a star cluster at the very center of the nebula.

The report was presented by Doug Johnstone, a Natural Sciences and Engineering Research Council (NSERC) Post-Doctoral Fellow at the Canadian Institute for Theoretical Astrophysics, University of Toronto. "For the first time we have a complete evolutionary picture for the stunning objects observed in the Trapezium," says Johnstone.

The team's results show the disks of dust and gas, which can be several billion kilometers across, are initially similar to the disk which is believed to have formed the planets in our own Solar system, but quickly evaporate in the glare of bright massive neighboring stars in the Trapezium. Radiation from these stars photoionizes, or heats and disperses, the cold gas. Within one million years the disk is eroded, a time scale shorter than the one to 10 million years it would take for planets to form according to current models.

"The theory of disk destruction predicts most efficient destruction at large distances from the embedded, central star. Near the center of the disk, perhaps even at the same distance as the Earth is from the Sun, the remnant disk might survive long enough to form planet embryos," says Johnstone. "Without a more detailed understanding of planet formation it is not possible to predict the future of these disks, but standard models based on our own Solar system suggest that giant planets like Jupiter and Saturn, at comparable distances from their central star, would be ruled out."

*The center of the Trapezium cluster showing the four massive energetic stars and a number of evaporating proto-planetary disks.*

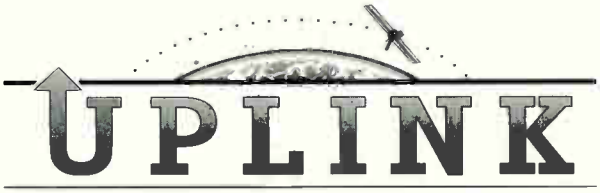
Using the Planetary Camera on the Hubble Space Telescope (HST), Johnstone's collaborators John Bally and Dave Devine of the University of Colorado, and Ralph Sutherland of the Australian National University observed the Trapezium, a young, million-year-old star-forming region just below the belt of the constellation Orion.

Located nearby, only fifteen hundred light years away, the Trapezium region is the closest star formation site containing both Sun-like stars and stars much more massive than the Sun. While ground-based observations have hinted at extended structures surrounding the Sun-like stars, HST has produced images with incredible detail revealing that these stars are embedded in circumstellar disks and surrounded by diffuse hot ionized gas.

The team reported that the disk surface is initially heated to temperatures in excess of 1,000 Celsius by the impinging radiation, evaporating the surface layer much like steam evaporates from the surface of boiling water. As this material flows away from the central star and disk, higher energy photons ionize the gas, heating it to temperatures reaching 10,000 degrees Celsius and in the process producing the nebulous glow seen in the images. "We are witnessing the destructive event through the illumination of the evaporated material," according to Johnstone.

Evaporation of the circumstellar disk erodes approximately three moon masses of material per year according to the theoretical model, a number which is verified by the HST observations. The exact evaporation rate from the circumstellar disk is directly related to the size of the disk and thus, as the disk evaporates and shrinks, the erosion rate decreases.

By using this knowledge, and fitting the evaporation model to the HST observations, the collaboration shows that the original circumstellar disks surrounding stars in the Trapezium were similar in appearance to disks around young stars in other systems, and more importantly to the hypothesized Solar proto-planetary disk from which our own nine planets formed.




*By Bob Grove, Publisher*
*E-mail address: st@grove.net*

# Speculation in Space: An Uneven Playing Field?

As traditional terrestrial communications look skyward with increasing interest, we see the same sort of gluttonous clamoring for spectrum as we have witnessed from earthbound investors. Some of these future-tech companies have been in the foray for the long term; contenders for the Digital Audio Radio Service (DARS), for example, have been waiting for their place in the space spectrum for more than four years. Other visionaries have even longer investments in time, as well as money.

Even without a single platform in orbit yet, Motorola has already requested the FCC's permission to modify its 66-satellite Iridium application to accommodate, in addition to its original Personal Communications Services (PCS) petition, aviation flight safety as well as passenger voice, data, and facsimile services.

We've previously discussed the ambitious Bill Gates (Teledesic) constellation; it will be well after the millenium before we see any hardware for this system, but the generous gift of bandwidth recently awarded by the International Telecommunications Union (ITU), and rubber stamped by the Federal Communications Commission (FCC), virtually assures this commercial magnate ownership of the Internet.

Other communications companies deserve to be bewildered, and probably more than slightly miffed, by the FCC's largesse in *giving* valuable spectrum to a what may be the world's richest commercial consortium when other domestic and international applicants have had to compete for the privilege of *buying* their spectrum.

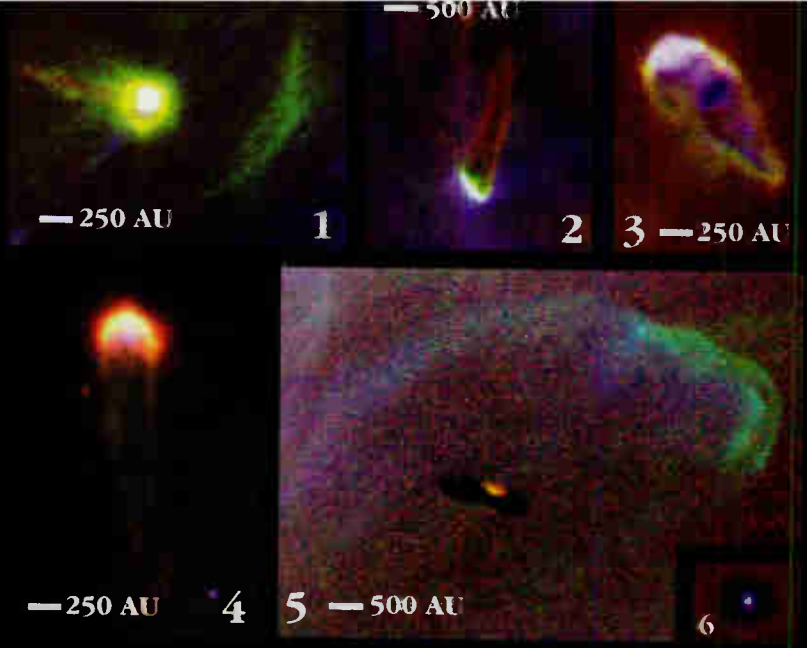
Was the freebie granted because Teledesic's proposed 840 non-geostationary satellites will provide virtually seamless Internet access to nearly 100% of the earth's population? Could this universal benefit be the compelling factor that tilted the balance of power, or were there other considerations?

The FCC uses the spectrum auction technique to decide who really needs, or is willing to pay, the most out of a field of competitors, and Teledesic was the only applicant!

Certainly the fact that Teledesic is an international system, and the FCC can only grant licenses to domestic applicants, played a major role in the assignment. There is some wisdom in this, for if the FCC were to require "landing rights" from every international satellite downloading signals over its land mass, other countries would have precedent to do the same. The cost to a satellite service provider would be astronomical (pun intended).

But if Teledesic can petition the ITU for spectrum with the FCC's blessing, then why couldn't international broadcasters, global air-to-ground and ship-to-shore services, and even worldwide amateur radio societies begin a diligent hunt for useful spectrum of their own?

This all seems much too simple. Did something else happen in Geneva at the World Administrative Radio Conference (WARC '96) which assigned Gates the 200 MHz plum? Are we to believe that other potential candidates knew that the allocation was available for assignment, and simply didn't want it? ST




*A gallery of star-disk systems in Orion's Trapezium. The first four objects are being evaporated by the central massive stars, while the last two disks are visible in silhouette against the background nebula.*

Theoretical models, coupled with NASA Hubble Space Telescope observations of the Trapezium cluster in the Orion nebula, suggest that disks around young cluster stars may not survive long enough for planets to form within them. This implies that there are certain hostile environments in star-forming regions that may inhibit planet formation.

The findings, presented by an international collaboration of astronomers at a meeting of the American Astronomical Society in Toronto, Canada, explain the destruction of circumstellar disks in Orion's Trapezium, a star cluster at the very center of the nebula.

The report was presented by Doug Johnstone, a Natural Sciences and Engineering Research Council (NSERC) Post-Doctoral Fellow at the Canadian Institute for Theoretical Astrophysics, University of Toronto. "For the first time we have a complete evolutionary picture for the stunning objects observed in the Trapezium," says Johnstone.

The team's results show the disks of dust and gas, which can be several billion kilometers across, are initially similar to the disk which is believed to have formed the planets in our own Solar system, but quickly evaporate in the glare of bright massive neighboring stars in the Trapezium. Radiation from these stars photoionizes, or heats and disperses, the cold gas. Within one million years the disk is eroded, a time scale shorter than the one to 10 million years it would take for planets to form according to current models.

"The theory of disk destruction predicts most efficient destruction at large distances from the embedded, central star. Near the center of the disk, perhaps even at the same distance as the Earth is from the Sun, the remnant disk might survive long enough to form planet embryos," says Johnstone. "Without a more detailed understanding of planet formation it is not possible to predict the future of these disks, but standard models based on our own Solar system suggest that giant planets like Jupiter and Saturn, at comparable distances from their central star, would be ruled out."

*The center of the Trapezium cluster showing the four massive energetic stars and a number of evaporating proto-planetary disks.*

Using the Planetary Camera on the Hubble Space Telescope (HST), Johnstone's collaborators John Bally and Dave Devine of the University of Colorado, and Ralph Sutherland of the Australian National University observed the Trapezium, a young, million-year-old star-forming region just below the belt of the constellation Orion.

Located nearby, only fifteen hundred light years away, the Trapezium region is the closest star formation site containing both Sun-like stars and stars much more massive than the Sun. While ground-based observations have hinted at extended structures surrounding the Sun-like stars, HST has produced images with incredible detail revealing that these stars are embedded in circumstellar disks and surrounded by diffuse hot ionized gas.

The team reported that the disk surface is initially heated to temperatures in excess of 1,000 Celsius by the impinging radiation, evaporating the surface layer much like steam evaporates from the surface of boiling water. As this material flows away from the central star and disk, higher energy photons ionize the gas, heating it to temperatures reaching 10,000 degrees Celsius and in the process producing the nebulous glow seen in the images. "We are witnessing the destructive event through the illumination of the evaporated material," according to Johnstone.

Evaporation of the circumstellar disk erodes approximately three moon masses of material per year according to the theoretical model, a number which is verified by the HST observations. The exact evaporation rate from the circumstellar disk is directly related to the size of the disk and thus, as the disk evaporates and shrinks, the erosion rate decreases.

By using this knowledge, and fitting the evaporation model to the HST observations, the collaboration shows that the original circumstellar disks surrounding stars in the Trapezium were similar in appearance to disks around young stars in other systems, and more importantly to the hypothesized Solar proto-planetary disk from which our own nine planets formed.

# A Big View of the Big Easy — New Orleans, LA

*By Larry Van Horn*

This image of the area surrounding the city of New Orleans, Louisiana in the southeastern United States demonstrates the ability of multi-frequency imaging radar to distinguish different types of land cover. The dark area in the center is Lake Pontchartrain. The thin line running across the lake is a causeway connecting New Orleans to the city of Mandeville (the light horizontal band intersecting the causeway is an aberration). Lake Borgne is the dark area in the lower right of the image. The Mississippi River appears as a dark, wavy line in the lower left. The white dots on the Mississippi are ships. The French Quarter is the brownish square near the left center of the image. The New Orleans Airport is the bright spot near the center, jutting out into Lake Pontchartrain.

The image was acquired by the Spaceborne Imaging Radar C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) during orbit 39 of space shuttle Endeavour on October 2, 1994. The area is located at 30.10 degrees north latitude and 89.1 degrees west longitude. The area shown is approximately 100 kilometers (60 miles) by 50 kilometers (30 miles).

The colors in this image were obtained using the following radar channels: red represents the L-band (horizontally transmitted and received); green represents the C-band (horizontally transmitted and received); blue represents the L-band (vertically transmitted and received). The green areas are primarily vegetation consisting of swamp land and swamp forest (bayou) growing on sandy soil, while the pink areas are associated with reflections from buildings in urban and suburban areas. Different tones and colors in the vegetation areas will be studied by scientists to see how effective imaging radar data is in discriminating between different types of wetlands. Accurate maps of coastal wetland areas are important to ecologists studying wild fowl and the coastal environment.

Spaceborne Imaging Radar-C and X-Band Synthetic Aperture Radar (SIR-C/X-SAR) is part of NASA's Mission to Planet Earth. The radars illuminate Earth with microwaves allowing detailed observations at any time, regardless of weather or sunlight conditions. SIR-C/X-SAR uses three microwave wavelengths: L-band (24 cm), C-band (6 cm) and X-band (3 cm). The multi-frequency data will be used by the international scientific community to better understand the global environment and how it is changing.

The SIR-C/X-SAR data, complemented by aircraft and ground studies, will give scientists clearer insights into those environmental changes which are caused by nature and those changes which are induced by human activity. SIR-C was developed by NASA's Jet Propulsion Laboratory. X-SAR was developed by the Dornier and Alenia Spazio companies for the German space agency, Deutsche Agentur fuer Raumfahrtangelegenheiten (DARA), and the Italian space agency, Agenzia Spaziale Italiana (ASI), with the Deutsche Forschungsanstalt fuer Luft und Raumfahrt e.v. (DLR), the major partner in science, operations, and data processing of X-SAR. ST

# A Wet and Wild History for Europa

Chunky ice rafts and relatively smooth, crater-free patches on the surface of Jupiter's frozen moon Europa suggest a younger, thinner icy surface than previously believed, according to new images from Galileo's spacecraft released recently.

The images were captured during Galileo's closest flyby of Europa on Feb. 20, 1997, when the spacecraft came within 363 miles of the Jovian moon. These features, which lend credence to the idea of hidden, subsurface oceans, also are stirring up controversy among scientists who disagree about the age of Europa's surface.

*This moderate-resolution view of the surface of one of Jupiter's moons, Europa, shows the complex icy crust that has been extensively modified by fracturing and the formation of ridges. The ridge systems superficially resemble highway networks with overpasses, interchanges and junctions. From the relative position of the overlaps, it is possible to determine the age sequence for the ridge sets.*

Dr. Ronald Greeley, an Arizona State University geologist and Galileo imaging team member, said the ice rafts reveal that Europa had, and may still have, a very thin ice crust covering either liquid water or slush.

"We're intrigued by these blocks of ice, similar to those seen on Earth's polar seas during springtime thaws," Dr. Greeley said. "The size and geometry of these features lead us to believe there was a thin icy layer covering water or slushy ice, and that some motion caused these crustal plates to break up."

"These rafts appear to be floating and may, in fact, be comparable to icebergs here on Earth," said another Galileo imaging team member, Dr. Michael Carr, a geologist with the U.S. Geological Survey. "The puzzle is what causes the rafts to rotate. The implication is that they are being churned by convection."

The new images of Europa's surface also have sparked a lively debate among scientists. Galileo imaging team member Dr. Clark Chapman is among those who believe the smoother regions with few craters indicate Europa's surface is much younger than previously believed. In essence, Chapman, a planetary scientist at Southwest Research Institute, Boulder, CO, believes the fewer the craters, the younger the region. Clark based his estimate on current knowledge about cratering rates, or the rate at which astronomical bodies are bombarded and scarred by hits from comets and asteroids.

"We're probably seeing areas a few million years old or less, which is about as young as we can measure on any planetary surface besides Earth," said Chapman. "Although we can't pinpoint exactly how many impacts occurred in a given period of time, these areas of Europa have so few craters that we have to think of its surface as young."

Chapman added, "Europa's extraordinary surface geology indicates an extreme youthfulness — a very alive world in a state of flux."

However, Carr sees things differently. He puts Europa's surface age at closer to one billion years old.

"There are just too many unknowns," Carr said. "Europa's relatively smooth regions are most likely caused by a different cratering rate for Jupiter and Earth. For example, we believe that both Earth's moon and the Jovian moon, Ganymede, have huge craters that are 3.8 billion years old. But when we compare the number of smaller craters superimposed on these large ones, Ganymede has far fewer than Earth's moon. This means the cratering rate at Jupiter is less than the cratering rate in the Earth-moon system."

Scientists hope to find answers to some of the questions surrounding Europa and its possible oceans as the Galileo spacecraft continues its journey through the Jovian system.

"We want to look for evidence of current activity on Europa, possibly some erupting geysers," Greeley said. "We also want to know whether Europa's surface has changed since the Voyager spacecraft flyby in 1979, or even during the time of the Galileo flybys."

The craft will return for another Europa flyby on Nov. 6, 1997, the final encounter of Galileo's primary mission. However, eight more Europa flybys are planned as part of Galileo's two-year extended mission, which also will include encounters with two other Jovian moons, Callisto and Io.

The Jet Propulsion Laboratory manages the Galileo mission for NASA's Office of Space Science, Washington, DC. ST

*Jeff Lichtman*

# Radio Detection of Meteor Infall

***An original article by Robert M. Sickles***

The following account may seem to affront any concept of common sense, but is nevertheless the accepted universe model:

No viable idea of the conditions before Big Bang can be imagined because of the absence of data. According to accepted theory today—fully supported by overwhelming data—the universe had its beginning about 15 billion years ago with the sudden and violent explosion of an incredibly dense, compact object, frequently referred to as the primordial egg. Insofar as present cosmology is concerned, space/time had its beginning with this event, commonly called "the Big Bang."

The tremendous heat resulted in pure radiation and continued until expansion of the fireball caused it to cool enough that the basic particles of today, (i.e., neutrons, protons, and electrons), could jell out in a process called *radiation to matter coupling*, We cannot suppose any reason why the laws of physics were then established as they presently exist.

Because of the attractive electrical nature of electrons and protons. further cooling of the fireball allowed solitary electrons and protons to unite into atoms of hydrogen. In an early and hot universe. this element was the only one that existed; even todays hydrogen is still the most prevalent element in the universe. It is likely that the initial explosion was not uniform. permitting local concentrations of hydrogen gas to collect in isolated pockets. Over many millions of years. these local condensations accreted into primordial hydrogen stars. It is inevitable that if enough hydrogen atoms are gravitationally bound. the resultant heat will ignite a nuclear oven. In this process. hydrogen is burned into helium—a somewhat more complex and denser gas.

If the original star matter concentration happened to be four times or more greater than our present sun. the primordial star quickly became unstable and eventually imploded from its own internal stress. We know these events today as novae and supernovae. It is widely accepted today (also supported by overwhelming data) that all of the heavier elements were formed in these chaotic processes. This includes not only the heavier gases but all of the elements from oxygen, calcium, carbon, iron, all the way up the table of stable elements to uranium.

About 6-1/2 billion years ago, a local condensation of hydrogen and these heavier elements in our own galaxy, permitted the accretion of our own sun. Uneven concentrations of matter in the rings around the newly forming sun also permitted the accretion of the planet with a considerable amount of freely associated matter, left over. In earlier days, the planets and their moons were bombarded with huge chunks of this left-over matter. The relatively undisturbed surface of our own moon today gives silent testimony about the bombastic nature of these events. Though much of this matter has been gravitationally swept up by the sun and planets—a considerable amount of it yet remains.

In eccentric orbits around the sun today, there remain massive collections of left-over matter. Some are large enough to be call asteroids. Some, of only a few tons mass, are called comets. They are believed to be dirty snowballs mainly comprised of water silicon and carbonaceous materials. Comets move at very high velocities and generally assume parabolic orbits about the sun. If a comet comes too close to the sun, it may be absorbed by the sun. If its path is more distant, it may melt and be torn apart, adding still more debris to outer space, moving in the orbital path of the original comet.

In the past, quite a few large comets have been fractured in the manner described above. The resultant debris occasionally falls seasonally to earth in small matter swarms. and these entities are called meteors. If one of these is large enough to make it all the way down to the earth surface, is properly called a *meteorite.*

The seasonal infall of meteor swarms take their names from the heavenly constellation from which they appear to be arriving. That is to say, if an annual swarm of meteors appears to be radiating from the constellation LYRA, they are called the Lyrids etc.

Another way of looking at these events is to realize that the earth didn't just accrete out of interstellar matter 4-1/2 billion years ago. The process is still going on, although much more slowly! The earth not only receives millions of these left-over bits of matter during recognized meteor radiants, but is also bombarded each day with millions of meteors not connected with any particular comet produced swarm. These stray meteors are properly called sporadics. It should be obvious from all of the above that the mass of the earth is increasing by quite a few tons each day.

The study of meteor infall, therefore, is a fascinating occupation and also viable

**Table 1: Selected Annual Meteor Showers**

| Name of Shower | Dates | Remarks |
|---|---|---|
| Quadrantids | 1 - 4 January | Usually a sharp maximum on the 3rd. |
| Lyrids | 19 - 22 April | Swift Meteors. |
| Aquarids | 1 - 13 May | Long paths: swift meteors. Possibly associated with Halley's comet. |
| Perseids | 27 July - 17 August | Rich consistent shower. |
| Orionids | 15 - 25 October | Swift Meteors. |
| Leonids | 17 November | Inconsistent; but a few can be seen around 17 November. |
| Andromedids | 26 Nov. - 4 December | Debris of Biela's comet. Not as rich of shower. |
| Geminids | 9 - 13 December | Rich consistent shower. |

Note: Meteor showers will vary in displays from year to year.

science. There is, in fact, a branch of amateur optical astronomy whereby visual meteor counts are made each season. This usually involves much neck-straining and observation very late at night as the earth motion carries it directly into the meteor swarm.

Table 1 shows the dates when recognized meteor swarms may be observed in the sky.

It has been noted that meteors arrive in the earth's upper atmosphere at considerable velocity. The typical speed is so great, in fact, that a small meteor no larger than a grain of sand packs the mass/energy of a 45 caliber bullet. Hence, a burst of light occurs from meteor friction heating in the upper atmosphere. If a known meteor radiant is present, most of the occurrences appear to originate from a particular constellation region of the sky.

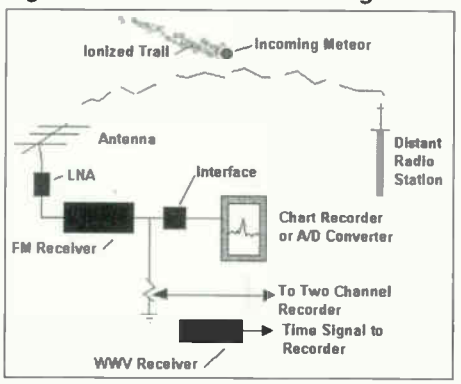
As noted, visual counts of these displays are regarded as viable scientific data, and are regularly collected and analyzed by the American Meteor Society. Their address is: Dr. David Meisel, Physics and Astronomy Dept., State University of New York, Geneseo, N.Y. 14454.

The obtaining of radio meteor infall counts by the radio method is about 10:1 more effective than the visual sighting method. This is because the moon frequently lights the sky during these events. making them hard to see and to count. By contrast, radio meteor counts may be made in a moon-lighted sky and even during the daytime hours... once one gets the hang of the technique.

There are several radio methods commonly used to detect meteor infall. One method involves tuning up an FM radio set on an unused portion of the dial and observing the sudden booming in of a distant FM station whose signal has been reflected from the ionization trail of the meteor. This method is schematically presented in Figure 1.

The detection of the meteor is observed as a sudden booming in of an otherwise undetectable. distant FM station, accompanied by a sort of *pingggrg* sound with duration of 1. to 10 seconds. This type of setup has been used for quite a few years by Japanese amateurs. It is also helpful in the data logging if time signals are simultaneously recorded to the second channel of a stereo cassette recorder. This makes possible the correlation of data with that of other remote observers.

***Figure 1. Meteor Radio Block Diagram***



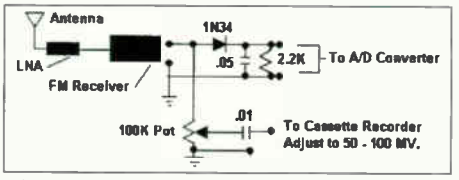




***Figure 2. Active Device Interface***

## An Opportunity for Radio Meteor Research

Those who get interested in this type of radio observing might wish to engage in a pure research project. Mr. Hal Povenmire, veteran meteor and occultation expert, believes that he may have discovered a brand new meteor radiant. and is very interested in correlative studies with others. The dates of this meteor swarm (peak 20 per hour) run between July 28 and August 11, with the anticipated peak around August 5th and 6th. Hal has worked this radiant for about 15 years and believes the shower is due to a large comet which was seen and then disappeared behind the sun in 1240 AD He has given this radiant the tentative name *Upsilon Pegasus*, because the stream appears to be originating from the Pegasus constellation.

Mr. Povenmire is interested in both optical and radio data concerning this established annual occurrence. These data would include infall count rates, relative size, calendar dates and event UTC timing. Mr. Povenmire's address is 215 Osage Drive, Indian Harbour Beach, Florida 32937.

## An Alternate Method

The FM radio meteor system has been discussed in detail, because it is such a simple system that practically anyone can assemble the instrumentation at low cost. There is another type receiver which is used by Mr.Bill Black and involves a Yagi antenna system resonated to 75 MHz. Mr. Black's system uses AM radio mode and in his observations he points the Yagi to a regular aircraft beacon in the general direction of the known meteor radiant, and perhaps about 80 to 100 miles distant. The Yagi system is fed to a low noise amplifier, then down converted from 75 to 30 MHz. (The LNA and shortwave down-converter were bought ready-made from *Advanced Receiver Research*, Box 1242. Burlington, Conn. 06013). He then uses a shortwave receiver tuned to 30 MHz as his intermediate frequency amplifier. No limiting circuits are used with this system (i.e., no AGC).

Mr. Black then connects the padded down audio output from the shortwave receiver to one channel of a stereo cassette recorder, the other channel of which is fed from a WWV time receiver. A meteor event is noted with this system as a sudden enhancement of aircraft beacon signal, accompanied by a pinging sound, quite plainly identifiable to the trained ear. Figure 3 gives the general wiring plan of Mr. Black's system.

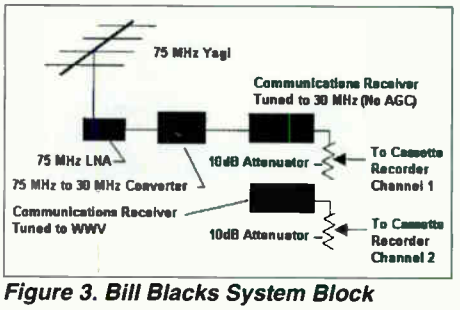



***Figure 3. Bill Blacks System Block Diagram***

*The above piece was originally published in the Radio Astronomy Handbook (1989 printing) by Robert M. Sickles (Deceased 9/93).*

*For those of you interested in this type of research, the Society of Amateur Radio Astronomers (SARA) is forming a Radio Meteor Section. For information on SARA, contact Vince Caracci, 247 N. Linden St., Massapequa, N.Y. 11758, or see their WEB page at:* ***http://wbs.net/sara.html.*** ST

# World Radio Network Schedules

**WRN 2 North American Multilingual Program Schedule**
Galaxy Five (125 deg West) transponder 6-3.820 GHz (TBS) vertical polarization, audio subcarrier 6.2 MHz. Please note that programs listed below are subject to pre-emption without notice. All times Eastern Daylight (UTC +4 hours).

| | |
|---|---|
| 0030 | WRN Announcements, until.... |
| 0200 | YLE Radio Finland (Mon-Sat) |
| 0255 | YLE, Church Service (Sunday only) |
| 0400 | WRN Announcements, until.... |
| 0600 | YLE Radio Finland, News in Finnish |
| 0625 | YLE, News in Swedish |
| 0630 | YLE, News in English |
| 0700 | WRN Announcements, until.... |
| 0800 | RTE News in Irish |
| 0900 | Radio Prague in Czech |
| 0927 | WRN Announcements, until.... |
| 1000 | YLE, Radio Finland, News in Finnish |
| 1005 | YLE, Regional News |
| 1030 | YLE, News in Finnish |
| 1100 | YLE, News in Swedish |
| 1130 | YLE, Easy Listening Music and Chat in Finnish |
| 1200 | Radio Netherlands in Dutch |
| 1400 | WRN Announcements, until.... |
| 1500 | Radio Vlaanderen International in Dutch |
| 1530 | WRN Announcements, until.... |
| 1630 | ORF Radio Austria International in German |
| 1700 | Radio Budapest in Hungarian |
| 1800 | Polish Radio Warsaw in Polish |
| 1830 | YLE Radio Finland, Devotional Music |
| 1855 | YLE, News in Swedish |
| 1900 | YLE, News in Finnish |
| 1930 | YLE, Easy Listening Music and Chat in Finnish |
| 2010 | YLE, Current Affairs in Finnish |
| 2030 | YLE, Documentaries in Finnish |
| 2030 | YLE, New Classical releases in Finnish (Sunday) |
| 2130 | YLE, Easy Listening Music in Finnish |
| 2230 | YLE, News in Finnish |
| 2300 | WRN Announcements, until.... |
| 2330 | ORF Radio Austria International in German |

**WRN 1 European English Program Schedule**
Astra 1B (19 deg East) transponder 22-11.538 GHz (VH-1) vertical polarization, audio subcarrier 7.38 MHz. WRN is also available on cable and local radio stations. WRN program information can be heard daily at 0125 and 1025 BST. It is also available on VH-1 text pages 222, 223, 224. All times BST/CET (British Summer Time/Central European Time). For UTC, subtract one hour from BST.

| BST/CET | |
|---|---|
| 0000/0100 | Radio Budapest |
| 0030/0130 | Radio Netherlands |
| 0127/0227 | *Earth and Sky* (Daily Science Series) |
| 0130/0230 | ORF Radio Austria International |
| 0200/0300 | NPR *All Things Considered* (repeat) |
| 0300/0400 | CBC *As It Happens* (Tue-Sat)<br>RCI News, and Features (Sun and Mon) |
| 0400/0500 | Polish Radio Warsaw |
| 0430/0530 | *BBC Europe Today* (Mon-Fri)<br>Glenn Hauser's *World of Radio* (Sat)<br>UN Radio From New York (Sun) |
| 0500/0600 | PRI *Market Place* (Tue-Sat)<br>SABC Channel Africa-Johannesburg (Sun)<br>UN Radio from New York (Mon) |
| 0530/0630 | ORF Radio Austria International |
| 0600/0700 | Voice of America World Wide (Mon-Fri)<br>VoA Saturday (Sat)<br>VoA Sunday (Sun) |
| 0700/0800 | NPR *All Things Considered* (repeat) |
| 0800/0900 | ABC Radio Australia |
| 0900/1000 | Polish Radio Warsaw (Mon-Sat)<br>*C-Span Weekly Radio Journal* (Sunday) |
| 0930/1030 | Radio Canada International (Mon-Fri)<br>UN Radio (Sat) |
| 1000/1100 | Radio Prague |
| 1030/1130 | Radio Netherlands |
| 1127/1227 | *Earth and Sky* (Daily Science Series) |
| 1130/1230 | SABC Channel Africa-Johannesburg (Mon-Sat)<br>Glenn Hauser's *World of Radio* (Sun) |
| 1200/1300 | NPR *Morning Edition* (Monday-Friday)<br>NPR *Fresh Air* (Sat)<br>NPR *Car Talk* (Sun) |
| 1300/1400 | NPR *Morning Edition* (Monday-Friday)<br>NPR *Weekend Edition* (Saturday and Sunday) |
| 1400/1500 | Radio France International |
| 1500/1600 | Voice of Russia (Mon-Fri)<br>UN Radio from New York (Sat)<br>Voice of America-*Communications World* (Sun) |
| 1530/1630 | ORF Radio Austria International |
| 1600/1700 | ABC Radio Australia |
| 1700/1800 | Caribbean Tempo from CANA Radio (Mon-Fri)<br>Glenn Hauser's *World of Radio* (Sat)<br>Copenhagen Calling (Sun) |
| 1715/1815 | Vatican Radio World News (Mon-Fri) |
| 1730/1830 | ORF Radio Austria International |
| 1800/1900 | SABC Channel Africa-Johannesburg (Mon-Sat)<br>UN Radio and Health Watch (Sun) |
| 1830/1930 | RTE News at Six |
| 1900/2000 | Radio Vlaanderen International |
| 1930/2030 | Radio Netherlands |
| 2025/2125 | News in Esperanto from Polish Radio Warsaw |
| 2030/2130 | Radio Sweden |
| 2100/2200 | YLE Radio Finland |
| 2130/2230 | Polish Radio Warsaw |
| 2200/2300 | Voice of America *World Report* (Mon-Fri)<br>VoA *Today* (Sat and Sun) |
| 2300/0000 | PRI *The World* (Mon-Fri)<br>NPR *All Things Considered* (Sat and Sun) |

**WRN2 Multilingual European Program Schedule**
Eutelsat II-F1 (13 deg East) transponder 25-10.987 GHz (NBC) vertical polarization, audio subcarrier 7.38 MHz. Please note that programs listed below with an asterisk (*) are subject to pre-emption without notice. All times British Summer Time (BST). For Central European Time (CET) add 1 hour

| BST | |
|---|---|
| 0000 | *WRN1 (Mon-Fri) |
| 0309 | Vatican Radio |
| 0745 | *WRN1 (NPR and ABC Radio Australia) |
| 0830 | Vatican Radio (Sun) until 1130 |
| 0930 | Vatican Radio (Mon-Sat) until 1130, except Wed to 1200 |
| 1130 | *WRN1 (SABC Channel Africa) except Wed |
| 1200 | Radio Studio Delta (Mon-Fri) until 1300 |
| 1200 | *WRN1 (NPR Sat and Sun) |
| 1300 | Vatican Radio |
| 1530 | Radio Studio Delta (Mon-Fri) |
| 1530 | *WRN1 (Sat and Sun Radio Vlaanderen-Brussels and ABC Radio Australia) |
| 1630 | Vatican Radio |
| 2230 | Radio Studio Delta (Mon-Fri) |
| 2230 | *WRN1 (Sat and Sun) |
| 2330 | Radio Prague |

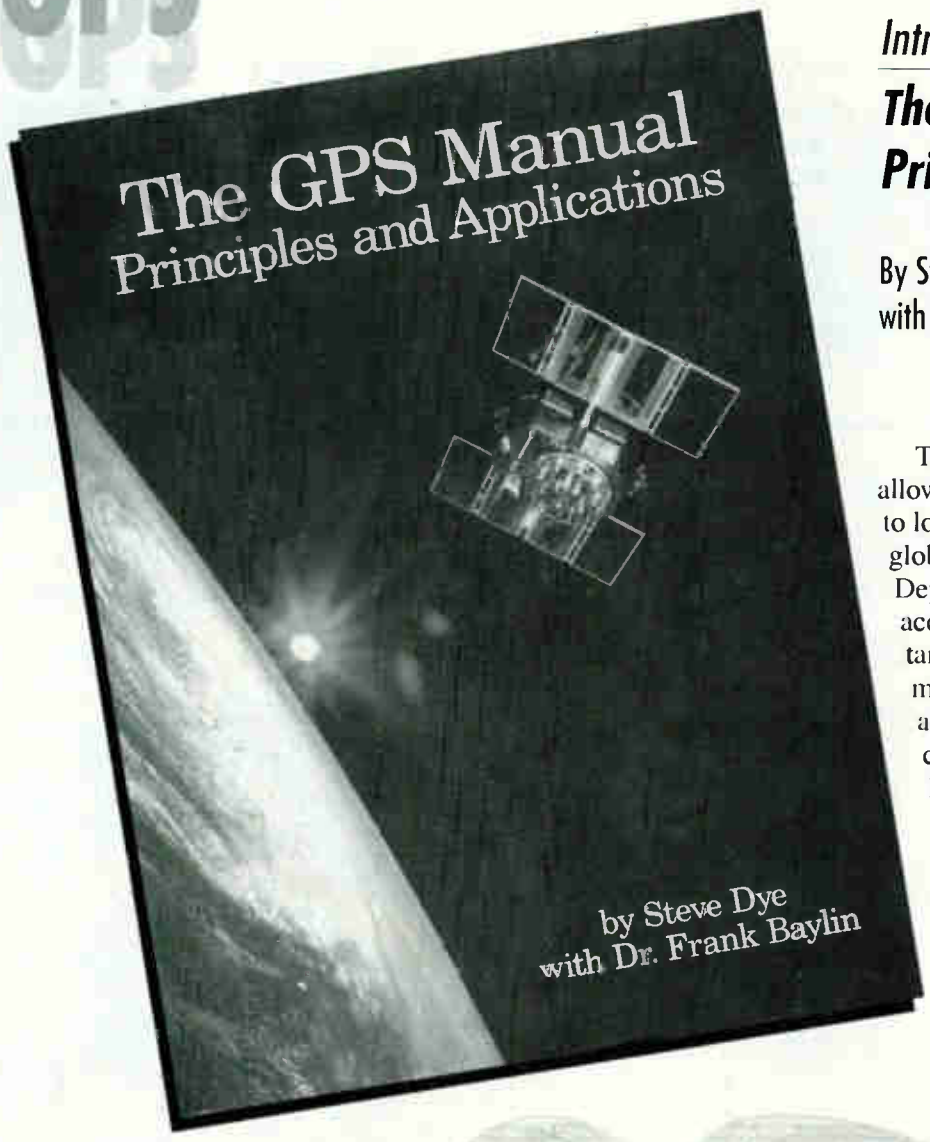
**WRN Asia-Pacific English Program Schedule**
AsiaSat-2 (100.5 deg East) 4.000 GHz, vertical polarization, MPEG2 DVB, Symbol Rate 28.125 Mbaud, FEC 3/4. Select WRN1 from audio menu. AET-Australian Eastern Time (UTC +10 hours).

| UTC/AET | |
|---|---|
| 0000/1000 | YLE Radio Finland (Mon-Fri)<br>UN Radio (Sat)<br>Copenhagen Calling (Sun) |
| 0030/1030 | ORF Radio Austria International (Mon-Fri)<br>Radio Sweden (Sat)<br>Polish Radio Warsaw (Sun) |
| 0100/1100 | NPR *All Things Considered* |
| 0200/1200 | PRI *The World* (Tue-Sat)<br>PRI *The Best of Our Knowledge* (Sun and Mon) |
| 0300/1300 | RTE Dublin *Irish Collection* |
| 0400/1400 | PRI *Market Place* (Tue-Sat)<br>UN Radio from New York (Sun)<br>Copenhagen Calling (Mon) |
| 0430/1430 | ORF Radio Austria International |
| 0500/1500 | NPR *All Things Considered* (Repeat) |
| 0600/1600 | Polish Radio Warsaw |
| 0630/1630 | Radio Vlaanderen International |
| 0700/1700 | RTE Dublin |
| 0900/1900 | Voice of Russia |
| 0930/1930 | Radio Netherlands |
| 1030/2030 | YLE Radio Finland |
| 1100/2100 | Radio Australia |
| 1200/2200 | Radio Canada International |
| 1300/2300 | RTE Dublin |
| 1400/0000 | Radio Sweden |
| 1430/0030 | ORF Radio Austria International |
| 1500/0100 | Radio France International |
| 1600/0200 | Caribbean Tempo from CANA Radio (Mon-Fri)<br>Glenn Hauser's *World of Radio* (Sat)<br>Copenhagen Calling (Sun) |
| 1615/0215 | Vatican Radio World News (Mon-Fri) |
| 1630/0230 | ORF Radio Austria International |
| 1730/0300 | Channel Africa (Mon-Sat)<br>Glenn Hauser's *World of Radio* (Sun) |
| 1730/0330 | RTE Dublin |
| 1800/0400 | Radio Vlaanderen International |
| 1830/0430 | Radio Netherlands |
| 1927/0527 | *Earth and Sky* |
| 1930/0530 | Polish Radio-Warsaw |
| 2000/0600 | Radio France International |
| 2100/0700 | RTE Dublin |
| 2200/0800 | RTE Dublin *Ireland Tonight* |
| 2300/0900 | Radio Netherlands |
| 2357/0957 | *Earth and Sky* (Daily Science Series) |

**WRN Middle East and Africa English Program Schedule**
Intelsat 707 (1 deg West) 3.9115 GHz, right-hand circular-polarization, Symbol Rate 8.022 Mbaud, FEC 3/4, MPEG2 Audio Stream "WRN1." WRN can be heard in South Africa on the MultiChoice digital direct-to-home service on PanAmSat 4 at 68.5 degrees West, audio channel 51. CAT-Central African Time (UTC +2 hours).

| UTC/CAT | |
|---|---|
| Next five hours can be heard in South Africa on SAfm 104-107 | |
| 2200/0000 | RTE Dublin *Ireland Tonight* |
| 2300/0100 | Radio Netherlands |
| 2357/0157 | *Earth and Sky* (Daily Science Series) |
| 0000/0200 | YLE Radio Finland (Mon-Fri)<br>UN Radio (Sat)<br>Copenhagen Calling (Sun) |
| 0030/0230 | ORF Radio Austria International (Mon-Fri)<br>Radio Sweden (Sat)<br>Polish Radio Warsaw (Sun) |
| 0100/0300 | NPR *All Things Considered* |
| 0200/0400 | PRI *The World* (Tue-Sat)<br>PRI *The Best of Our Knowledge* (Sun-Mon) |
| 0300/0500 | RTE Dublin *Irish Collection* |
| 0400/0600 | PRI *Market Place* (Tue-Sat)<br>UN Radio from New York (Sun)<br>Copenhagen Calling (Mon) |
| 0430/0630 | ORF Radio Austria International |
| 0500/0700 | NPR *All Things Considered* (repeat) |
| 0600/0800 | Polish Radio Warsaw |
| 0630/0830 | Radio Vlaanderen International |
| 0700/0900 | RTE Dublin |
| 0900/1100 | Voice of Russia |
| 0930/1130 | Radio Netherlands |
| 1030/1230 | YLE Radio Finland |
| 1100/1300 | Radio Australia |
| 1200/1400 | Radio Canada International |
| 1300/1500 | RTE Dublin |
| 1400-1600 | Radio Sweden |
| 1430/1630 | ORF Radio Austria International |
| 1500/1700 | Radio France International |
| 1600/1800 | Caribbean Tempo from CANA Radio (Mon-Fri)<br>Glenn Hauser's *World of Radio* (Sat)<br>Copenhagen Calling (Sun) |
| 1615/1815 | Vatican Radio World News (Mon-Fri) |
| 1630/1830 | ORF Radio Austria International |
| 1700/1900 | SABC Channel Africa (Mon-Sat)<br>Glenn Hauser's *World of Radio* (Sun) |
| 1730/1930 | RTE Dublin |
| 1800/2000 | Radio Vlaanderen International |
| 1830/2030 | Radio Netherlands |
| 1927/2127 | *Earth and Sky* |
| 1930/2130 | Polish Radio Warsaw |
| 2000/2200 | Radio France International |
| 2100/2300 | RTE Dublin |

# GPS: *The Definitive Guide*




*Introducing:*

## *The GPS Manual: Principles and Applications*

By Steven Dye
with Dr. Frank Baylin

The Global Positioning System (GPS) allows anyone equipped with a GPS receiver to locate their position anywhere on the globe. Originally intended by the U.S. Department of Defense as a means of accurately guiding their missiles to their targets, GPS has since assumed many more roles and applications. By releasing a frequency and an access code for civilain use, a plethora of applications have appeared which has created a billion dollar industry. GPS is in wide-spread use and users continue to find new applications every day. Some applications are as diverse as they are ingenious. Some save money, some save lives. 248 pages.

This book, written in a style understandable by any technically interested person, explores GPS technology and its applications. It serves as a useful guide for people wishing to familiarize themselves with GPS technology as well as those considering the purchase of a GPS receiver for personal use. *The GPS Manual* also serves as a useful tool for corporate business managers considering adopting GPS as a business strategy. *The GPS Manual* examines the principles behind GPS and points the reader to a variety of applications created by GPS. Simple charts, clearly written text, and many concise diagrams help the reader easily understand this exciting new technology.

## *Order Bok 36, only $39.95 from Grove Enterprises!*

Please add $6 2nd Day Air UPS Shipping; $3 Bookrate; $8.50 Canadian UPS or $6 Canadian APP

GROVE

**GROVE ENTERPRISES, INC.**
1-800-438-8155 US & Canada; 704-837-9200; FAX 704-837-2216
7540 Highway 64 West, Brasstown, NC 28902
E-mail: order@grove.net; World Wide Web: www.grove.net

# STOCK EXCHANGE

*Satellite Times assumes no responsibility for misrepresented merchandise.*

*Ads for **Stock Exchange** must be received 45 days prior to publication date. All ads must be paid in advance to Satellite Times.*
***Ad copy must be typed for legibility.***

*NON-COMMERCIAL SUBSCRIBER RATES: $.25 per word — Subscribers only! All merchandise must be personal and radio-related.*

*COMMERCIAL RATES: $1.00 per word. Commercial line ads printed in bold type.*

*1-3/4" SQUARE DISPLAY AD: $50 per issue. Send camera-ready copy or copy to be typeset. Photo-reduction $5 additional charge. For more information on commercial ads, contact Debbie Davis, 704-837-6412.*



## SATELLITE TIMES ADVERTISERS' INDEX



## *Save Time and Money. . . Subscribe to ST*

**To subscribe to *Satellite Times* send subscription form to:**
**Grove Enterprises, 7540 Hwy. 64 W.**
**Brasstown, NC 28902; or Call (800) 438-8155;**
**(704) 837-9200; FAX (704) 837-2216**

| | 1 Year | 2 Years | 3 Years |
|---|---|---|---|
| ❒ US 2nd Class Mail | $19.95 | $38.00 | $56.00 |
| ❒ US 1st Class Mail | $32.95 | $64.00 | $95.00 |
| ❒ Canada Surface | $28.50 | $55.00 | $81.50 |
| ❒ Canada Air | $33.00 | $64.00 | $95.00 |
| ❒ Foreign Int'l | $46.50 | $91.00 | $135.00 |
| ❒ Foreign Air | $68.00 | $133.40 | $200.00 |

*US funds drawn on US a bank only.*

Name _____
Address _____
City _____ State ____ Zip _____ - _____ Country _____
Phone _____
CC# _____ Exp.date _____

*Give Us Four !*

For fast, economical delivery of *Satellite Times*, the Post Office has informed us your label must contain your four-digit zip code extension. Rural routes must be replaced by 911 street addresses wherever they have been assigned. Without them, your mail may be delayed, and we cannot honor replacement requests for a month after non-delivery.

If your mailing label is missing the required information, please mail or e-mail your updated mailing address to us at P.O. Box 98, Brasstown, NC 28902-0098; <order@grove.net>

# SPACE GLOSSARY

The following are some terms used in the satellite business and are described in layman's terms.

**ALTITUDE (ALT):** The distance between a satellite and the point on the earth directly below it, same as height.

**AQUISITION OF SIGNAL (AoS):** The time at which a particular ground station begins to receive radio signals from a satellite.

**APOGEE:** The point in a satellite's orbit farthest from the Earth's center.

**ARGUMENT OF PERIGEE:** This value is the number of degrees from the ascending node the perigee point occurs. The perigee point is the point where the satellite is the closest to the earth (assuming an orbit which is elliptical to some degree). This number may be entered as a real value between 0.0 and 360.0.

**ASCENDING NODE:** Point at which the satellite crosses the equatorial plane from the southern hemisphere to the northern hemisphere. (See RIGHT ASCENSION OF THE ASCENDING NODE.)

**AZIMUTH (AZ):** The angle measured in the plane of the horizon from true North clockwise to the vertical plane through the satellite.

**CATALOG NUMBER:** A 5-digit number assigned to a cataloged orbiting object. This number may be found in the NASA Satellite Situation Report and on the NASA Two Line Element (TLE) sets.

**COORDINATED UNIVERSAL TIME (UTC):** Also known as Greenwich Mean Time (GMT). Local time at zero degrees longitude at the Greenwich Observatory, England. Uses 24 hour clock, ie. 3:00 pm is 1500 hrs.

**CULMINATION:** The point at which a satellite reaches its highest position or elevation in the sky relative to an observer. (Known as the Closest Point of Approach)

**DECAY RATE:** This is the rate of decay of the orbital period (time it takes to complete one revolution) due to atmospheric friction and other factors. It is a real number measured in terms of Revolutions per Day (REV/DAY).

**DECLINATION (DEC):** The angular distance from the equator to the satellite measured positive north and negative south.

**DIRECT BROADCAST SATELLITE (DBS):** Commerical satellite designed to transmit TV programming directly to the home.

**DOPPLER SHIFT:** The observed frequency difference between the transmitted signal and the received signal on a satellite downlink where the transmitter and receiver are in relative motion.

**DOWNLINK:** A radio link originating at a spacecraft and terminating at one or more ground stations.

**DRAG:** The force exerted on a satellite by its passage through the atmosphere of the Earth, acting to slow the satellite down.

**EARTH-MOON-EARTH (EMR):** Communications mode that involves bouncing signals off the moon.

**ECCENTRICITY (ECC):** This is a unitless number which describes the shape of the orbit in terms of how close to a perfect circle it is. This number is given in the range of 0.0 to less than 1.0. An perfectly circular orbit would have an eccentricity of 0.0. A number greater than 0.0 would represent an elliptical orbit with an increasingly flattened shape as the value approaches 1.0.

**ELEMENT SET:** (See ORBITAL ELEMENTS.)

**ELEVATION (EL):** Angle above the horizontal plane.

**EPHEMERIS:** A tabulation of a series of points which define the position and motion of a satellite.

**EPOCH:** A specific time and date which is used as a point of reference; the time at which an element set for a satellite was last updated.

**EPOCH DAY:** This is the day and fraction of day for the specific time the data is effective. This number defines both the julian day (the whole number part of the value) and the time of day (fractional part of the value) of the data set.
The julian day figure is simply the count of the number of days thatparticular date is from the beginning of the year. (January 1 would have a julian day of 1. Feb 28 would be 59.) This number may range from 1.0 to 366.999999999 (taking into account leap years).

**EPOCH YEAR:** This is the year of the specific time the rest of the data about the object is effective.

**EQUATORIAL PLANE:** An imaginary plane running through the center of the earth and the Earth's equator.

**EUROPEAN SPACE AGENCY (ESA):** A consortium of European governmental groups polling resources for space exploration and development.

**FOOTPRINT:** A set of signal-level contours, drawn on a map or globe, showing the performance of a high-gain satellite antenna. Usually applied to geostationary satellites.

**GROUND STATION:** A radio station, on or near the surface of the earth, designed to receive signals from, or transmit signals to, a spacecraft.

**INCLINATION (INC):** The angle between the orbit plane and the Earth's equatorial plane, measured counter-clockwise. 0 (zero) degrees inclination would describe a satellite orbiting in the same direction as the Earth's rotation directly above the equator (orbit plane = equatorial plane). 90 degrees inclination would have the satellite orbiting directly over both poles of the earth (orbit plane displaced 90 degrees from the equatorial plane). An inclination of 180 degrees would have the satellite orbiting again directly over the equator, but in the opposite direction of the Earth's rotation. Inclination is given as a real number of degrees between 0.0 and 180.0 degrees.

**INTERNATIONAL DESIGNATOR:** An internationally agreed upon naming convention for satellites. Contains the last two digits of the launch year, the launch number of the year and the piece of the launch, ie. A-indicates payload, B-the rocket booster, or second payload, etc.

**LATITUDE (LAT):** Also called the geodetic latitude. the angle between the perpendicular to the Earth's surface (plane of the horizon) at a location and the equatorial plane of the earth.

**LONGITUDE (LONG):** The angular distance from the Greenwich (zero degree) meridian, along the equator. This can is measured either east or west to the 180th meridian (180 degrees) or 0 to 360 degrees west. For example, Ohio includes 85 degrees west longitude, while India includes 85 degrees east longitude. But 85 degrees east longitude could also be measured as 275 degrees west longitude.

**LOSS OF SIGNAL (LoS):** The time at which a particular ground station loses radio signals from a satellite.

**MEAN ANOMALY (MA):** This number represents the angular distance from the perigee point (closest point) to the satellite's mean position. This is measured in degrees along the orbital plane in the direction of motion. This number is entered like the argument of perigee, as a value between 0.0 and 360.0.

**MEAN MOTION (MM):** This is the number of complete revolutions the satellite makes in one day. This number may be entered as a value greater than 0.0 and less than 20.0. (See DECAY)

**NASA:** U.S. National Aeronautics and Space Administration.

**ORBITAL ELEMENTS:** Also called Classical Elements, Satellite Elements, Element Set, etc. Includes the catalog Number; epoch year, day, and fraction of day; period decay rate; argument of perigee, inclination, eccentricity; right ascension of ascending node; mean anomaly; mean motion; revolution number at epoch; and element set number. This data is contained in the TWO LINE ORBITAL ELEMENTS provided by NASA.

**OSCAR:** Orbiting Satellite Carrying Amateur Radio.

**PERIOD OECAY RATE:** Also known as Decay. This is the tendency of a satellite to lose orbital velocity due to the influence of atmospheric drag and gravitational forces. A decaying object eventually impacts with the surface of the Earth or burns up in the atmosphere. This parameter directly affects the satellite's MEAN MOTION. This is measured in various ways. The NASA Two Line Orbital Elements use revolutions per day.

**PERIGEE:** The point in the satellite's orbit where it is closest to the surface of the earth.

**POSIGRADE ORBIT:** Satellite motion which is in the same direction as the rotation of the Earth.

**RETROGRAOE ORBIT:** Satellite motion which is opposite in direction to the rotation of the Earth.

**REVOLUTION NUMBER:** This represents the number of revolutions the satellite has completed at the epoch time and date. This number is entered as an integer value between 1 and 99999.

**REVOLUTION NUMBER AT EPOCH:** The number of revolutions or ascending node passages that a satellite has completed at the time (epoch) of the element set since it was launched. The orbit number from launch to the first ascending node is designated zero, thereafter the number increases by one at each ascending node.

**RIGHT ASCENSION OF THE ASCENDING NODE (RAAN):** The angular distance from the vernal equinox measured eastward in the equatorial plane to the point of intersection of the orbit plane where the satellite crosses the equatorial plane from south to north (asecending node). It is given and entered as a real number of degrees from 0.0 to 360.0 degrees.

**SATELLITE SITUATION REPORT:** A report published by NASA Goddard Space Flight Center listing all known man-made Earth orbiting objects. This report lists the Catalog Number, International Designator, Name, Country of origin, launch date, orbital period, inclination, beacon frequency, and status (orbiting or decayed).

**TLM:** Short for telemetry.

**TRANSPONDER:** A device aboard a spacecraft that receives radio signals in one segment of the radio spectrum, amplifies them, translates (shifts) their freuency to another segment and retransmits them.

**TELEVISION RECEIVE ONLY (TVRO):** A TVRO terminal is a ground station set up to receive downlink signals from 4-GHZ or 12-GHZ commerical satellites carrying TV programming.

**TWO LINE ORBITAL ELEMENTS (TLE):** See ORBITAL ELEMENTS.

**UPLINK:** A radio link originating at a ground station and directed to a spacecraft.

**VERNAL EQUINOX:** Also known as the first point of Aries, being the point where the Sun crosses the Earth's equator going from south to north in the spring. This point in space is essentially fixed and represents the reference axis of a coordinate system used extensively in Astronomy and Astrodynamics.


**By Bob Grove, Publisher**
*E-mail address: st@grove.net*

# Speculation in Space: An Uneven Playing Field?

As traditional terrestrial communications look skyward with increasing interest, we see the same sort of gluttonous clamoring for spectrum as we have witnessed from earthbound investors. Some of these future-tech companies have been in the foray for the long term; contenders for the Digital Audio Radio Service (DARS), for example, have been waiting for their place in the space spectrum for more than four years. Other visionaries have even longer investments in time, as well as money.

Even without a single platform in orbit yet, Motorola has already requested the FCC's permission to modify its 66-satellite Iridium application to accommodate, in addition to its original Personal Communications Services (PCS) petition, aviation flight safety as well as passenger voice, data, and facsimile services.

We've previously discussed the ambitious Bill Gates (Teledesic) constellation; it will be well after the millenium before we see any hardware for this system, but the generous gift of bandwidth recently awarded by the International Telecommunications Union (ITU), and rubber stamped by the Federal Communications Commission (FCC), virtually assures this commercial magnate ownership of the Internet.

Other communications companies deserve to be bewildered, and probably more than slightly miffed, by the FCC's largesse in *giving* valuable spectrum to a what may be the world's richest commercial consortium when other domestic and international applicants have had to compete for the privilege of *buying* their spectrum.

Was the freebie granted because Teledesic's proposed 840 non-geostationary satellites will provide virtually seamless Internet access to nearly 100% of the earth's population? Could this universal benefit be the compelling factor that tilted the balance of power, or were there other considerations?

The FCC uses the spectrum auction technique to decide who really needs, or is willing to pay, the most out of a field of competitors, and Teledesic was the only applicant!

Certainly the fact that Teledesic is an international system, and the FCC can only grant licenses to domestic applicants, played a major role in the assignment. There is some wisdom in this, for if the FCC were to require "landing rights" from every international satellite downloading signals over its land mass, other countries would have precedent to do the same. The cost to a satellite service provider would be astronomical (pun intended).

But if Teledesic can petition the ITU for spectrum with the FCC's blessing, then why couldn't international broadcasters, global air-to-ground and ship-to-shore services, and even worldwide amateur radio societies begin a diligent hunt for useful spectrum of their own?

This all seems much too simple. Did something else happen in Geneva at the World Administrative Radio Conference (WARC '96) which assigned Gates the 200 MHz plum? Are we to believe that other potential candidates knew that the allocation was available for assignment, and simply didn't want it? ST

# IT'S EASY TO CAPTURE REALTIME IMAGES LIKE THIS DIRECTLY FROM SPACE ON YOUR PC!

**◄ Section of a multi-spectral, false-colorized NOAA APT image of the Northeast US. This image was created directly from a raw image file using the MFCOLOR software from Weather Dynamics.**

**To find out more about the MFCOLOR software, log into the MultiFAX BBS at (716) 425-8759. Download dozens of images as well as software, demos, and up-to-date orbital elements.**

**There is no charge to use the MultiFAX BBS, it operates from 5PM-9AM ET (24 hours on weekends) and supports up to 28.8KB modems.**

***MultiFAX*** offers **two** professionally featured weather satellite demodulators: One model plugs directly into the expansion slot of your IBM compatible desktop PC, the other model interfaces to your PC (laptop, notebook, or desktop) through the parallel port - perfect for "crowded" computers or **portable** applications.

**Both units** offer the same powerful capabilities-PLL circuitry for perfectly straight edges on NOAA, GOES, and Meteosat images; 4800 8-bit samples per second-capture **ALL** the high APT resolution the NOAA satellites can provide (2-3 miles) in visible and infrared (simultaneously) with a full 12 minute recording.

**Version 7 Software Features Include:** Integrated Satellite Tracking • Kansas City Tracker Support • Capture Images to Hard Disk or Memory • PLL Sampling • NOAA, Meteor, GOES, Meteosat, HF Fax • "Point & Click" User Interface with Mouse Support • 1024x768x256 Colors/64 Gray Levels • Zoom • Simple, Powerful Image Enhancement • 10 User Definable Enhancement Palettes • False Colorization • Unattended Recording • Visible and IR • Animation • Calibrated IR Temperature Readout • "3D" Enhancement • Use Your Images with Hundreds of Other Programs • Printer Support • 2-3 Mile Resolution (NOAA) • 3.5 Million 8 Bit Pixels for full NOAA Recording • Latitude/Longitude and Map Overlay (US included) • Reference Audio Tape with Actual Satellite Signals • Clear, Complete 85+ page Illustrated User's Manual • Much More...

**MultiFAX MF-R1**
**Weather Satellite Receiver**

- ✔ Synthesized Tuning - 10 Programmable Memories
- ✔ 137-138 MHz in 5 KHz Steps
- ✔ NOAA & Meteor APT
- ✔ GOES & Meteosat Fine Tuning for Downconverter
- ✔ Two Independently Adjustable Audio Outputs
- ✔ 12 VDC (switchable) for Antenna Pre-Amp
- ✔ Price Only $249 plus S&H

**Call or Write for Complete Details**

**Minimum requirements:** IBM Compatible Computer with 640 KB Memory and either 1) An 8 or 16 bit ISA slot for the internal card **OR** 2) A parallel port (LPT1, LPT2, or LPT3) for the external unit • VGA Card and Monitor • Hard Drive or RAM Disk with 4MB Available Space • Receiver and Simple Antenna (dish not required for high resolution polar orbiting satellites)

**Internal demodulator with cable, software, manual, and audio tape of satellite signals just $289 plus S&H**
**Web site--http://www.vnet.net/users/syzygy/ Email us at multifax@frontiernet.com**

**MultiFAX • 321 Mason Road • Fairport, NY 14450 • 716-425-8759**
**FAX: 716-223-6198 BBS after 5PM ET: 716-425-8759**

# IC-821H

**"By far the easiest to use satellite radio on the market today.** In less than 10 minutes after unpacking the 821H, I was on the air at 9600 baud with KO-23."

*–Michael Wyrick, N4USI*
*AO-27 Control Operator*


## QST Magazine says:

"(The IC-821H) is a terrific dual-band multimode transceiver for all applications. Not only is the IC-821H an excellent VHF/UHF weak signal or contest radio, it is the cornerstone of a high-performance satellite station (digital or analog). Hams who have the Phase 3D satellite in mind will want to give serious consideration to the IC-821H. It also offers superb FM-voice and 9600-baud packet performance. Combine all of these features with the IC-821H's go-anywhere size and you have a radio that's ideal for almost any application above 144 MHz!"

– QST Magazine, March 1997
Reprinted with permission from the ARRL.

## 2M/440MHz All Mode Dual Band Base Station *More Satellite Fun for EVERY Ham!*

### Sub Band Transmit and Independent Main/Sub Band Reception

Enjoy cross band full duplex operation! The IC-821H is really two separate receivers within one compact case. Use the independent RF attenuators, RIT, IF shift circuits, and scan functions. Each band also has its own S-Meter, squelch, volume control, and independent mode selection.

### Continuous Adjustable Transmit Power

Better than just using a high/low setting, the continuous adjustable transmit power feature is satellite "friendly". You'll get precise power control while you help extend the life of amateur radio satellites by running the minimum power necessary.

### 9600 Baud Plug and Play*

Enjoy great 9600 baud packet operation right out of the box! There's a packet connection point right on the back of the rig. ICOM's famous CI-V serial communications port is included.

Visit your authorized ICOM dealer today, or call for a free brochure: (206) 450-6088


with select ICOM options

*Options required for PC operation:
CT-17 CI-V Level Converter,
third party serial cable with pins 1-8 & 20,
third party software

ICOM®
PC Powered!
http://www.icomamerica.com

Questions? Contact ICOM Technical Support in the HamNet forum on CompuServe @ 77540,525 (Internet:75540.525@compuserve.com) ©1997 ICOM America, Inc. The ICOM logo is a registered trademark of ICOM, Inc. All specifications subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. Photo of the Large Megellanic Cloud courtesy of NOAO. CompuServe is a registered trademark of CompuServe, Incorporated, an H&R Block Company. 821HST397Y