Satellite Times

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Volume 2, Number 3 January/February 1996

Pillars of Creation ...

... A Closer Look at the M16 Eagle Nebula

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Satellite Times

Cover Story

Cover: This picture of M16 was taken on April 1, 1995 with the Hubble Space Telescope Wide Field and Planetary Camera 2. The color image is constructed from three separate images taken in the light of emission from different types of atoms. Red shows emission from singly-ionized sulfur atoms. Green shows emission from hydrogen. Blue shows light emitted by doubly-ionized oxygen atoms.

Pillars of Creation The M16 - Eagle Nebula

[Photo courtesy of Jeff Hester and Paul Scowen (Arizona State University), and NASA]

Undersea corral? Enchanted castles? Space serpents? These eerie, dark pillar-like structures are actually columns of cool interstellar hydrogen gas and dust that are also incubators for new stars. They are part of the "Eagle Nebula," a nearby star-forming region 7,000 light-years away in the constellation Serpens. Story starts on page 10.

Vol. 2, No. 3

CONTENTS

January/February1996

Captain Midnight: Ten years after midnight, and all is well...or is it?

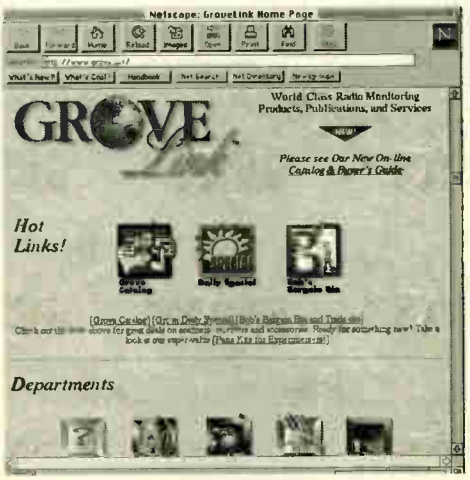
By Jeanne E. Prevett

As hundreds of thousands of movie lovers across the country watched *The Falcon and the Snowman* over HBO, the image on their screens abruptly shifted to a cryptic printed message: **"Good Evening HBO from Captain Midnight..."** Get the full story on this historic event starting on page 16.

Cyber-Satellites and Web DXing

By George Wood

Nowadays you can use the Internet to watch live video from the space shuttle, listen to radio stations around the world live, view WEFAX images from weather satellites, or find the latest news about new TV satellites and programs. George Wood, who's been putting *Sweden Calling DXers* and *MediaScan* online for the past ten years, explains what's waiting for you in Cyberspace. Story starts on page 20.



ST Satellite Profile

Milstar is a satellite system that is providing survivable worldwide tactical and strategic communications for U.S. military forces. Philip Chien of Earth News takes an detailed look at this new generation of military communications satellites that will see service well into the next century. Profile starts on page 84.

DEPARTMENTS

ST

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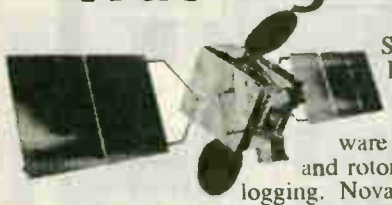

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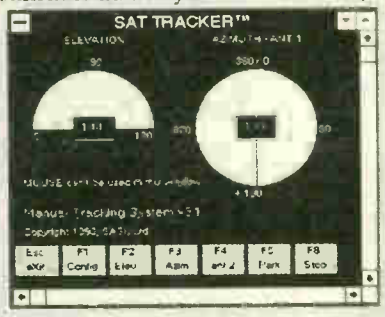

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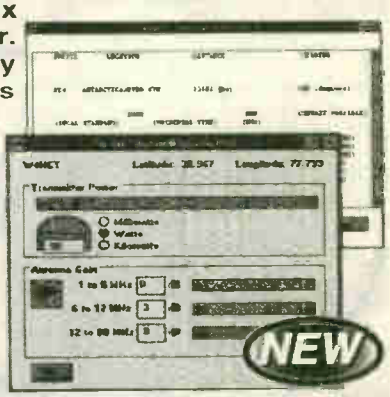

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By Larry Van Horn
Managing Editor

1995 - A Year to Remember

I hate to see a new year come to a close, mostly because I get another year older. But it is also a time when we look back and remember some of the major events that have occurred in the past year.

1995 was an exciting year in space. It was one I will long remember. Probably the most significant story of the year is presented in this issue's cover feature. The Hubble Space Telescope continues to amaze and discover. It keeps pushing the edge of research farther toward the edge of the universe itself. The images from M16 — The Eagle Nebula — taken by the Hubble and released in November made international news. Here in the U.S., all the major TV networks, newspapers, and magazines carried stories on these new and startling images.

What is most intriguing about these fantastic images is the fact that you are looking at M16 as it appeared over 7,000 years ago. One can only wonder what that region of space looks like today.

Another exciting story in 1995 involves the Galileo mission to Jupiter. As I wrote this column, the Galileo's atmospheric probe spent 57 minutes floating through the turbulent atmosphere of the Jovian giant. The probe and orbiter spent six years and traveled 2.3 billion miles to get to this point in time. Galileo's scientific instruments represent the most capable payload of experiments ever sent to another planet. The data they will return promises to revolutionize our understanding of the Jovian system and reveal important clues about the formation and evolution of our solar system.

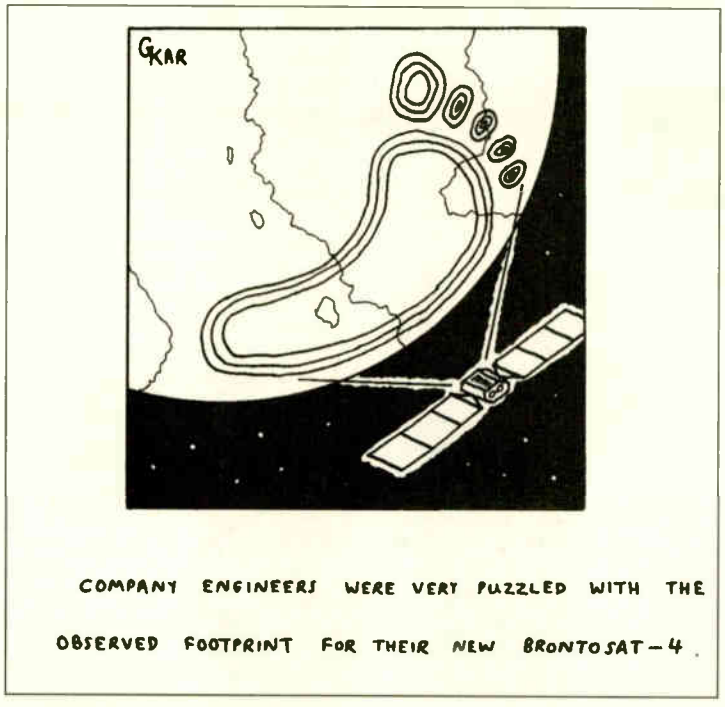
To the entire crew at JPL, and all those involved in this spectacular scientific mission, congratulations on your great success. The *ST* staff hopes that the next two years of your mission to Jupiter is just as rewarding. As information becomes available, we hope to have more on the discoveries from the Galileo mission in the pages of *Satellite Times* in 1996.

1995 will also be remembered as the year of the Internet. The Net has become a daily part of our lives. Everywhere you go you see something on the Net. TV commercials, articles in magazines and newspapers, shopping via the Net, news on the Net, hobbies on the Net and yes, space on the Net. Since space is a surprisingly big part of the Net, starting in this issue of *ST*, we will have a new column devoted to the Internet. I would like to welcome Bill Grove to our editorial staff. Bill is the computer services manager here at Grove Enterprises. He is also the driving force behind Grove's new presence on the Internet. Bill will be keeping you up-to-date in each issue of *ST* with the best of what is on the Net in space resources through his column — *SpaceNet.*

In our second story this month we take a look even further back in history at an event that occurred 10 years ago. This event changed the course of history in the TVRO field. While John MacDougall may not be a household name you remember, TVRO buffs everywhere know who Captain Midnight is. In Jeanne Prevett's feature story, *Ten Years After Midnight, and All is Well,* she explores exactly what happened and where John is today on the anniversary of TVRO's most famous 4-1/2 minutes.

As we look toward the new year, a lot is scheduled to happen in world of space. Amateur radio operators hope to launch their new Phase 3D spacecraft. We will see more missions to the Russian space station MIR by space shuttle astronauts. Galaxy 3R should offer more channels for TVRO buffs to watch. This will happen just in time for the start of the 1996 Summer Olympics in Atlanta and a hot U.S. election campaign in the fall.

As always, your space magazine of record — *Satellite Times* — will continue to cover it all. From the entire staff of *Satellite Times* and Grove Enterprises — have a safe and enjoyable new year. ST



If you would like to comment on Satellite Times, you can reach the editor at the following e-mail address: steditor@grove.net.

SATELLITE MONITOR

By Wayne Mishler, KG5BI

Space probe to reveal secrets of the Sun

As the curtain closes on 1995, the Sun was to be undergoing a physical exam that even TV's Chicago Hope wouldn't try.

Of course it was to be a house-call. And the attending physician, the European Space Agency (ESA), was to prod and probe the mystic innards of our precious star with a dozen sophisticated telescopes and space-age instruments developed under deadline pressure by a scientific consortia from 15 different nations.

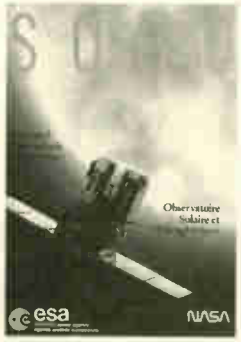
The exam was to be done from a spaceship in orbit at precisely the altitude where the gravities of the Sun and the Earth cancel each other.

"Never before have solar physicists had the opportunity to work with such a comprehensive observatory giving them access literally to the whole Sun," says Martin C. E. Huber, who heads the ESA Space Science Department.

The spaceship, owned and launched by ESA, goes by the name of SOHO. The name has a double meaning. It is an acronym for Solar and Heliospheric Observatory. It also was a medieval Anglo-French hunting cry, says the ESA. And in that context the name fits well with the exploratory ship's mission to hunt down answers to scientist's questions about solar mysteries.

"Each of the (instruments aboard SOHO) alone would be enough to make major breakthroughs in our understanding of the Sun. But what makes SOHO such an exciting mission is that we will operate all the instruments together and find possible links between various phenomena at different levels in the Sun and interplanetary medium," says Roger M. Bonnet, director of ESA's Scientific Program.

From its vantage point 1.5 million kilometers above the Earth, SOHO will have a continuous view of the Sun. Her instruments will examine the Sun's interior, atmosphere, and solar wind. They will gather data on the structure and dynamics of the solar interior, the heating mechanism of the multimillion-degree atmosphere, and the origin and acceleration processes of solar wind that reaches supersonic velocity.



Taking the Sun's Pulse

SOHO's instruments will record the "throbbing" motions of the Sun's surface. These oscillations are believed to be caused by sounds trapped inside the Sun. The sound waves cause gases to move back and forth inside the Sun's interior. Sounds from deep within the interior have longer periods of up to several hours. Those closer to the surface produce oscillations of shorter duration. By measuring the periods, SOHO will 'peel away' layers of the Sun and reveal physical properties of the interior beneath. The technique is similar to using seismic waves to read the Earth's interior. It is a process called helioseismology.

Those illusive neutrinos

In analyzing the Sun's interior, physicists hope to learn more about solar neutrinos – those tiny, insubstantial, subatomic particles believed to originate in the Sun's energy-creating core. Little is known about neutrinos except that they move at the speed of light and travel almost unimpeded through most everything, including the Sun, the Earth, and people.

The big mystery of neutrinos is that they sometimes don't behave according to scientific theory. That is, measurements on Earth have detected fewer of them than theory predicts, casting doubt on

the theory. Scientists believe the answer hinges on the temperature of the Sun's core. If the core is about a million degrees cooler than expected, then the nuclear reaction of the Sun would produce fewer neutrinos, which would explain the short count on Earth. But if the core is as hot as scientists think it is, then the neutrinos are being created but probably are changing in structure before reaching Earth, becoming invisible to detectors. SOHO should help clear up the mystery.

Sun's magnetic fields transcend any scale known on Earth

The Sun's magnetic field is generated by a phenomenon known as the "solar dynamo." The dynamo is believed to be located somewhere in the solar interior where hot, rotating material generates electricity and converts motion energy into magnetic energy. Magnetic fields spawned by the dynamo thread their way through the Sun's interior and escape into the solar atmosphere. The atmosphere is continuously being transformed by these magnetic fields. The result is magnetic activity on a scale unheard of on Earth.

The solar atmosphere

Scientists believe the Sun is a gaseous sphere compressed at the center and less dense toward the atmosphere. Theoretically there is no surface. The apparent sharp visible edge of the Sun is believed to be an illusion. The solar mass gradually blends into a thin gaseous atmosphere.

The innermost, densest level of the Sun's atmosphere is the photosphere. That is, the sphere that radiates visible light. Above that there is a relatively thin layer called the chromosphere. Chromos is the Greek word for color. Above that is the corona, or crown. This outermost layer of the solar atmosphere extends into space to the planets and beyond.

The corona is believed to reach temperatures of several million degrees, and herein lies one of the great mysteries of the sun. On Earth, temperatures decrease with distance from the planet's core. But the Sun's corona is many times hotter than its photosphere. This violates the second law of thermodynamics, which says that heat should not flow outward from a cooler to a hotter region. Sunlight passes through the corona without transferring significant energy to it, so radiation has been ruled out as the cause. One possible explanation might involve kinetic energy imparted to the corona by moving materials and/or magnetic fields. But no one can be sure – yet. A major goal of the SOHO mission is to explain the mechanisms that heat the corona.

Investigating solar wind

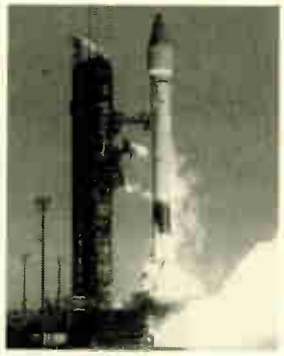
The corona dissipates into interplanetary space, filling the solar system with a steady flow of electrified matter called solar wind. This is not like the wind we know on Earth. Rather, it is a rarefied mixture of protons, electrons, and magnetic fields, streaming radially outward from the Sun. So the space between planets is not really empty. It is actually filled with solar wind – charged pieces of the Sun.

At increasing distances from the Sun, where solar gravity weakens, hot coronal material exerts an outward pressure that exceeds solar gravity. It escapes the Sun and races into space as solar wind, accelerating to supersonic speeds. Spacecraft have measured solar wind velocities as high as 800 kilometers per second.

Fortunately for life on Earth, the terrestrial magnetic field shields us from the full blast of the solar wind, deflecting it away from Earth and hollowing out a cavity in its flow. This magnetic cocoon, known as the magnetosphere, is constantly being buffeted and distorted by variations in the solar wind, which sometimes penetrates the Earth's magnetic defense at weak points.

Exploding the mysteries of solar wind – what causes it, what accelerates it, where it originates — are high on the agenda of the SOHO exploration.

Command and control of SOHO



ESA was to oversee the SOHO mission, but NASA was to provide launch, tracking and control. The space ship, accompanied by three other vessels, was to be launched from Cape Canaveral by an Atlas IIAS rocket. The satellite was to maintain contact with the ground through NASA's Deep Space Network – three radio antennas strategically located in the U.S., Spain, and Australia. The antennas are there to provide continuous links to the SOHO fleet wherever the ships happened to be in relation to the Earth.

Data from the DSN was to be routed to NASA's Goddard Space Flight Center in Greenbelt, Maryland, which served as command center for the SOHO mission. The data is to be stored there in an archive. Researchers from all over the world will be permitted to access the information electronically, via computer.

Hams turn ears to space...in search of aliens?!

The government listened for ET to call (from) home for years. If the Earthlings heard anything, they were tight-lipped about it. Eventually Congress cut funding for the project. But now the search is on again, with thousands of ham radio operators being invited to join in the effort.

It will go down in amateur radio history as Project Argus – a renewed search for signs of extraterrestrial intelligence, beginning on Earth Day, April 21.

The SETI League, no longer funded by NASA's budget, hopes to involve 5,000 radio amateurs in their vigil to hear ET's voice, if it comes.

If you happen to be a ham radio operator with a fancy for such things, you can get in touch with SETI by telephoning 1-800-TAU-SETI. Shhh. What's that?

INTELSAT to carry the first pan-Russian VSAT network

Beginning in May, subscribers in all parts of the Russian Federation will have access to voice, fax, data, and video conferencing via a switched digital satellite network. Moscow Teleport-TP will launch the pan-Russian multipurpose VSAT network – a first – through an INTELSAT satellite.

Teleport-TP, an authorized direct access customer of INTELSAT, has leased 36 MHz of capacity on the global beam of the INTELSAT 704 spacecraft, positioned in orbit at 66 degrees East longitude.

The network will be administered by a new Earth station installed in Moscow, and eventually will include about 125 Very Small Aperture Terminals (VSATS) at various locations in that country. The hub station and the peripheral terminals will be manufactured by Scientific Atlanta.

"We expect that banks, government offices, and large corporations doing business in Russia will be among the first customers of this new network," says Bruno d'Avanzo. INTELSAT executive vice president and CEO.

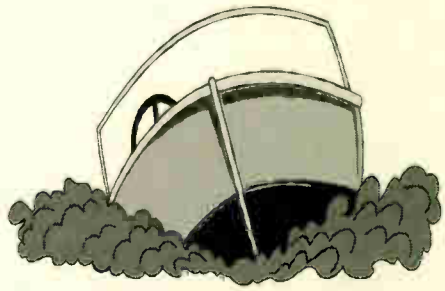
INTELSAT is offering more than capacity on its spacecraft. "We also helped in the network design, the preparation of the request for proposal, and evaluation of the equipment bids," says INTELSAT's Yuli Wexler. "INTELSAT has been in Russia for a long time, primarily as an international service provider. This new telecommunications infrastructure will foster economic development within the country. For the first time we are offering domestic service in Russia."

TracVision marine antenna now offered with RCA receivers

The TracVision marine satellite antenna, previously reported in *ST's What's New* column, is now available as a licensed component for the RCA Brand DSS (Digital Satellite System) receiving equipment, KVH Industries, Inc., has announced.

The availability of a complete marine satellite TV package, including programming from two DSS giants, was announced in a meeting of marine dealers, reporters, and members of DIRECTV, USSB, RCA and KVH.

The hardware package will enable boaters to receive up to 200 channels of television programming while at sea – a luxury previously unavailable to most boaters. The system consists of a satellite antenna, set atop a decoder box that receives DIRECTV and USSB programming which features "near laser disk sharpness" and "CD quality sound."



The TracVision antenna can track satellite signals from a moving platform, enabling moving vessels to receive digital-quality signals from three high-power satellites located at 101 degrees West longitude.

The use of small antenna systems on boats is a relatively new innovation for the satellite industry, stemming from the DBS satellites developed by Hughes Electronics Corporation. The TracVision antenna measures 24 inches in diameter.

The TracVision system measures the pitch, roll and heading of a boat and moves the antenna in exactly the opposite direction of the boat. This keeps the antenna trained on the target satellite with 1 degree accuracy, necessary to assure uninterrupted satellite TV reception even

when rolling and pitching in rough waters

Hughes to ease C-band shortage

In a move to help alleviate the severe shortage of C-band satellite capacity in the U.S., and to meet immediate customer demand, Hughes Communications, Inc., has leased the C-band Brasilsat A1 satellite from its owner, Embratel, of Rio de Janeiro, Brazil.

Embratel is a Brazilian government agency that operates that nation's domestic satellite system, which currently consists of the Brasilsat A1, A2, B1 and B2 satellites.

Terms of the agreement were not disclosed.

Launched in 1985, the Hughes-built HS 376 spin-stabilized Brasilsat A1 satellite is now operating in an inclined orbit mode at 63 degrees West longitude. The 24 C-band transponders aboard the satellite have been optimized to provide full coverage of the continental U.S., Central America, and much of Canada. Each transponder offers 36 MHz of bandwidth and 10 watts of power per channel, accommodating the range of video services currently distributed through Hughes' C-band Galaxy satellites.

"Even with the launch of AT&T's Telstar 402-R and Galaxy III-R satellites, there remains enormous demand for C-band capacity because both of these satellites are already sold out," says Carl A. Brown, senior vice president of Galaxy Satellite Services.

"Especially hard hit are the occasional users who require C-band time on an as-needed basis for transmission of live remote news, sports and entertainment events. Capacity will be particularly important in 1996, as both the Olympics and the U.S. presidential election campaign will dramatically increase demand."

Hughes put Brasilsat A1 through rigorous testing to ensure acceptable power output and transponder performance. The satellite has never had a service interruption. Its remaining life span is expected to be two to five years.

Televised football game pirates beware!

The National Football League and NFL Enterprises have sued 17 different establishments in the Buffalo-Rochester area in New York, and another 15 bars in the Ontario, Canada, area for illegally intercepting NFL game telecasts, according to a recent NFL press statement.

All of the bars were accused of showing blacked-out Buffalo Bills games.

NFL investigators are also eyeing suspected violators in the Cleveland, Ohio, area who may be next on the docket.

Piracy has been a problem for the NFL. During the 1994 season, it filed 16 lawsuits against 111 establishments in 14 markets that were found to be illegally showing NFL games. And that doesn't count the negotiated settlement with 58 other establishments.

The League has litigated dozens of signal piracy cases over the last 15 years, and has won every case with awarded damages as high as $40,000 against individual establishments.

"We are going full force with our signal piracy effort," says NFL's Michael Schlesier. "We have swept several markets so far and are planning to investigate additional markets to protect the investment that our NFL Sunday Ticket customers have made."

And finally...

When people find out you write for magazines, they tell you the darndest things. Like the other day an employee of a major aircraft firm told me about a new quality control procedure his company had developed.

"We test our windshields by slamming chickens into them at supersonic speeds," he said.

While I was trying to think of a response, he continued.

"It is so effective that another company in Europe copied it. But they didn't have all the facts and tried it with chickens that were still frozen. Not only did the windshield fail, so did the pilot's seat and the partition behind it," he said with a straight face.

I don't know about all that. But the next time I'm dining in the cafeteria of an aerospace plant, I'll skip the chicken pot pie, thank you. ST

"Eggs" Give Birth to New Stars

M16, the Eagle Nebula (Photo courtesy of SEDS - University of Arizona)

NASA's Space Telescope Institute recently released some of the most dramatic pictures ever imaged from the Hubble Space Telescope. These eerie, new pictures from Hubble show newborn stars emerging from "eggs" — not the barnyard variety — but rather dense, compact pockets of interstellar gas called evaporating gaseous globules (EGGs). Hubble found the "EGGs," appropriately enough, in the Eagle nebula, a nearby star-forming region 7,000 light-years away in the constellation Serpens.

"For a long time astronomers have speculated about what processes control the sizes of stars — about why stars are the sizes that they are," said Jeff Hester of Arizona State University, Tempe, AZ. "Now in M16 we seem to be watching at least one such process at work right in front of our eyes."

Striking pictures taken by Hester and co-investigators with Hubble's Wide Field and Planetary Camera 2 (WFPC2) resolve the EGGs at the tip of finger-like features protruding from monstrous columns of cold gas and dust in the Eagle nebula (also called

This eerie, dark structure, resembling an imaginary sea serpent's head, is a column of cool molecular hydrogen gas (two atoms of hydrogen in each molecule) and dust that is an incubator for new stars. The stars are embedded inside finger-like protrusions extending from the top of the nebula. Each "fingertip" is somewhat larger than our own solar system. The picture was taken on April 1, 1995 with the Hubble Space Telescope Wide Field and Planetary Camera 2 [Photo courtesy of Jeff Hester and Paul Scowen (Arizona State University), and NASA]

Undersea corral? Enchanted castles? Space serpents? These eerie, dark pillar-like structures are actually columns of cool interstellar hydrogen gas and dust that are also incubators for new stars. The pillars protrude from the interior wall of a dark molecular cloud like stalagmites from the floor of a cavern. They are part of the "Eagle Nebula" (also called M16 — the 16th object in Charles Messier's 18th century catalog of "fuzzy" objects that aren't comets), a nearby star-forming region 7,000 light-years away in the constellation Serpens. The tallest pillar (left) is about a light-year long from base to tip. [Photo courtesy of Jeff Hester and Paul Scowen (Arizona State University), and NASA]

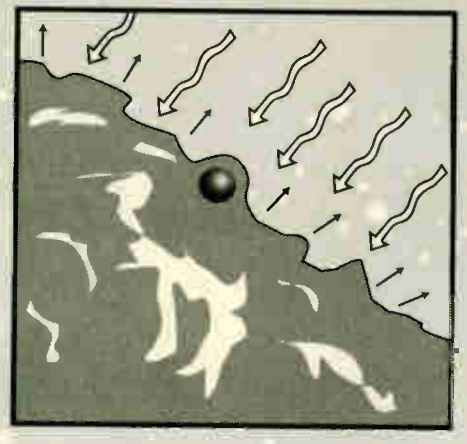
M16 — 16th object in the Messier catalog). The columns — dubbed "elephant trunks" — protrude from the wall of a vast cloud of molecular hydrogen, like stalagmites rising above the floor of a cavern. Inside the gaseous towers, which are light-years long, the interstellar gas is dense enough to collapse under its own weight, forming young stars that continue to grow as they accumulate more and more mass from their surroundings.

Hubble gives a clear look at what happens as a torrent of ultraviolet light from nearby young, hot stars heats the gas along the surface of the pillars, "boiling it away" into interstellar space — a process called "photoevaporation." The Hubble pictures show photoevaporating gas as ghostly streamers flowing away from the columns. But not all of the gas boils off at the same rate. The EGGs, which are denser than their surroundings, are left behind after the gas around them is gone.

"It's a bit like a wind storm in the desert," said Hester. "As the wind blows away the lighter sand, heavier rocks buried in the sand are uncovered. But in M16, instead of rocks, the ultraviolet light is uncovering the denser egg-like globules of gas that surround stars that were forming inside the gigantic gas columns."

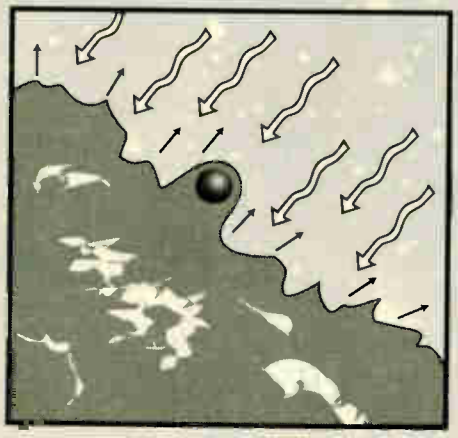
Some EGGs appear as nothing but tiny bumps on the surface of the columns. Others have been uncovered more completely, and now resemble "fingers" of gas protruding from the larger cloud. (The fingers are gas that has been protected from photoevaporation by the shadows of the EGGs). Some EGGs have pinched off completely from the larger column from which they emerged, and now look like teardrops in space.

By stringing together these pictures of EGGs caught at different stages of being uncovered, Hester and his colleagues from the Wide Field and Plan-

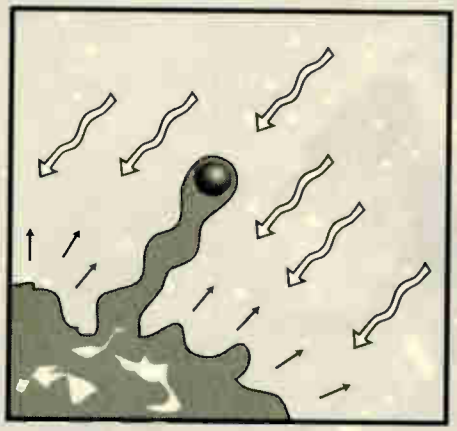


Stellar Eggs in M16

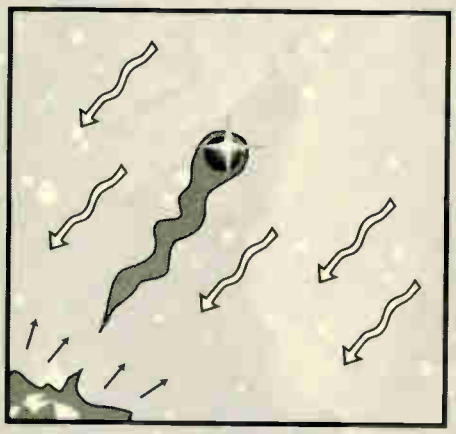
The surface of a molecular cloud is illuminated by intense ultraviolet radiation from nearby hot stars. The radiation evaporates material off the surface of the cloud.



As the cloud is slowly eaten away by the ultraviolet radiation, a denser than average globule of gas begins to be uncovered. Because this globule of gas — dubbed an "EGG" — is denser than its surroundings it is not evaporated as quickly and so is left behind. Forming within at least some of the EGGs are young stellar objects.



The EGG has now been largely uncovered. The shadow of the EGG protects a column of gas behind it, giving it a finger-like appearance.



Eventually the EGG may become totally separated from the molecular cloud in which it formed. As the EGG itself slowly evaporates the star within is uncovered, and may appear sitting on the front surface of the EGG.

etary Camera Investigation Definition Team are getting an unprecedented look at what stars and their surroundings look like before they are truly stars.

"This is the first time that we have actually seen the process of forming stars being uncovered by photoevaporation," Hester emphasized. "In some ways it seems more like archaeology than astronomy. The ultraviolet light from nearby stars does the digging for us, and we study what is unearthed."

"In a few cases we can see the stars in the EGGs directly in the WFPC2 images," says Hester. "As soon as the star in an EGG is exposed, the object looks something like an ice cream cone, with a newly uncovered star playing the role of the cherry on top."

Ultimately, photoevaporation inhibits the further growth of the embryonic stars by dispersing the cloud of gas they were "feeding" from. "We believe that the stars in M16 were continuing to grow as more and more gas fell onto them, right up until the moment that they were cut off from that surrounding material by photoevaporation," said Hester.

This process is markedly different from the process that governs the sizes of stars forming in isolation. Some astronomers believe that, left to its own devices, a star will continue to grow until it nears the point where nuclear fusion begins in its interior. When this happens, the star begins to blow a strong "wind" that clears away the residual material. Hubble has imaged this process in detail in so-called Herbig-Haro objects.

Hester also speculated that photoevaporation might actually inhibit the formation of planets around such stars. It is not at all clear from the new data that the stars in M16 have reached the point where they have formed the disks that go on to become solar systems," said Hester, "and if these disks haven't formed yet, they never will."

Hester plans to use Hubble's high resolution to probe other nearby star-forming regions to look for similar structures. "Discoveries about the nature of the M16 EGGs might lead astronomers to rethink some of their ideas about the environments of stars forming in other regions, such as the Orion Nebula," he predicted. ST

Article courtesy of the Space Telescope Science Intitute. The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc. (AURA), for NASA, under contract with the Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency (ESA).

(Photo courtesy of C.R. O'Dell Rice University, and NASA)

Crucible of Creation: Hubble Mosaic Zooms in on Maelstrom of Star Birth

This spectacular color panorama of the center the Orion nebula is one of the largest pictures ever assembled from individual images taken with NASA's Hubble Space Telescope. The picture, seamlessly composited from a mosaic of 15 separate fields, covers an area of sky about five percent the area covered by the full Moon.

The seemingly infinite tapestry of rich detail revealed by Hubble shows a churning turbulent star factory set within a maelstrom of flowing, luminescent gas. Though this 2.5 light-years wide view is still a small portion of the entire nebula, it includes almost all of the light from the bright glowing clouds of gas and a star cluster associated with the nebula. Hubble reveals details as small as 4.1 billion miles across.

Hubble Space Telescope observing time was devoted to making this panorama because the nebula is a vast laboratory for studying the processes which gave birth to our own Sun and solar system 4.5 billion years ago. Many of the nebula's details can't be captured in a single picture — any more than one snapshot of the Grand Canyon yields clues to its formation and history. Like the Grand Canyon, the Orion nebula has a dramatic surface topography — of glowing gasses instead of rock — with peaks, valleys and walls. They are illuminated and heated by a torrent of energetic ultraviolet light from its four hottest and most massive stars, called the Trapezium, which lie near the center of the image.

Located 1,500 light-years away, along our spiral arm of the Milky Way, the Orion nebula is located in the middle of the sword region of the constellation Orion the Hunter, which dominates the early winter evening sky, at northern latitudes.

M16 ~ Star Birth in the Nest of the Eagle

Stars are born from the gas of interstellar space. When they eventually burn-out and die, they bequeath their legacy back to the interstellar medium from which they formed. The signposts marking this ongoing cycle of birth, death, and renewal would be easily visible to any casual observer who had a bird's-eye view of our pinwheel-shaped galaxy. Spread across our galaxy such an observer would see majestic spiral arms, highlighted by bright young stars and the glowing clouds of gas that those stars illuminate.

On a clear, dark summer night earth-based observers can see these glowing clouds, called nebulae, scattered along the track of the Milky Way. Many can be found by looking in the direction of the great star clouds in the summer constellation, Sagittarius.

One of the most unique star-birth regions is the Eagle Nebula, (also called M16 because it is in the Messier Catalog of "fuzzy" permanent objects in the sky, that was compiled more than 200 years ago by French astronomer Charles Messier) it is visible in binoculars near the border between the constellations of Sagittarius and Serpens. The nebula is actually a bowl-shaped blister on the side of a dense cloud of cold interstellar gas.

Most of this cloud is so dense and cool that its hydrogen atoms are bound as molecules. This "molecular hydrogen" is the raw material for building new stars. The cloud contains microscopic dust particles of carbon (in the form of graphite), silicates and other compounds similar to those found in terrestrial and lunar rocks. Though this trace dust accounts for only a fraction of the nebula's mass, it's enough dust to absorb visible light — cloaking some of the visual details of star birth.

A cluster of about 100 newborn stars glitters inside the open "bowl" of the nebula. A few of these stars are much more massive than our Sun is, and so are tremendously hotter and brighter than the Sun. The brightest of these stars may be 100,000 times brighter than the Sun and have temperatures of nearly 90,000 degrees Fahrenheit (50,000 degrees Kelvin).

These young stars emit intense ultraviolet radiation which is so energetic it heats the surrounding gas, causing it to glow like the gas inside a fluorescent light bulb. When this ultraviolet light hits the bowl-shaped surface of the molecular cloud, it heats that gas, causing it to "evaporate" and stream away from the surface. If one could watch the process for more than a million years, they would see the bowl grow increasingly larger as the radiation from the stars eats deeper into the molecular cloud.

Unlike other stellar nebula which we see face-on — like the great Orion Nebula — M16 presents astronomers with a unique side view of the structure of a typical star-birth region: the cluster of hot, young stars in the center of the cavity, the evaporating surface of the cloud, and finally the great cold mass of the cloud itself.

The Eagle Nebula's name comes from its symmetrical appearance which is reminiscent of a bird of prey with outstretched wings and talons bared. The Eagle's "talons" are actually a series of dense columns of gas that protrude into the interior of the nebula. These columns form as a result of the same process that causes the bowl to grow. Because the columns are denser than their surroundings, they are not evaporating as rapidly as the surrounding gas, and so remain. The process is analogous to the formation of towering buttes and spires in the deserts of the American Southwest. These geological features formed when wind and rain eroded away softer ground, but places where the rock was harder resisted erosion and were left behind.

Inside these interstellar columns, the gas density can get so high that gravity takes over and causes the gas to start collapsing into ever-smaller clumps. As more and more gas falls onto these growing clumps they get further compressed by their own weight, until finally they trigger nuclear fusion reactions in their cores, and "turn on" as stars.

However, in M16 this process may not get a chance to go on to completion. If a forming star and the gas cloud that surrounds it are "uncovered" by photoevaporation before the star finishes growing, the mass of the young star may be "frozen." The star can't grow any more simply because the cloud from which it was drawing material is gone. In M16 Hubble Space Telescope's high resolution seems to have caught about 50 stars in this situation.

These are called EGGs "evaporating gaseous globules." The acronym is appropriate because these EGGs are objects within which stars are being born and are now emerging.

M16 is where the action is today, but it won't remain so forever. Within another few million years, star formation will have exhausted or dispersed the available raw material, and the massive stars that illuminate the Eagle will have lived out their short lives and died in spectacular supernova explosions. But even though the "birth cloud" nebula will be gone, most of the stars that formed there will remain.

The offspring of the Eagle will "take wing" among the rest of the hundreds of billions of stars that make up our galaxy.

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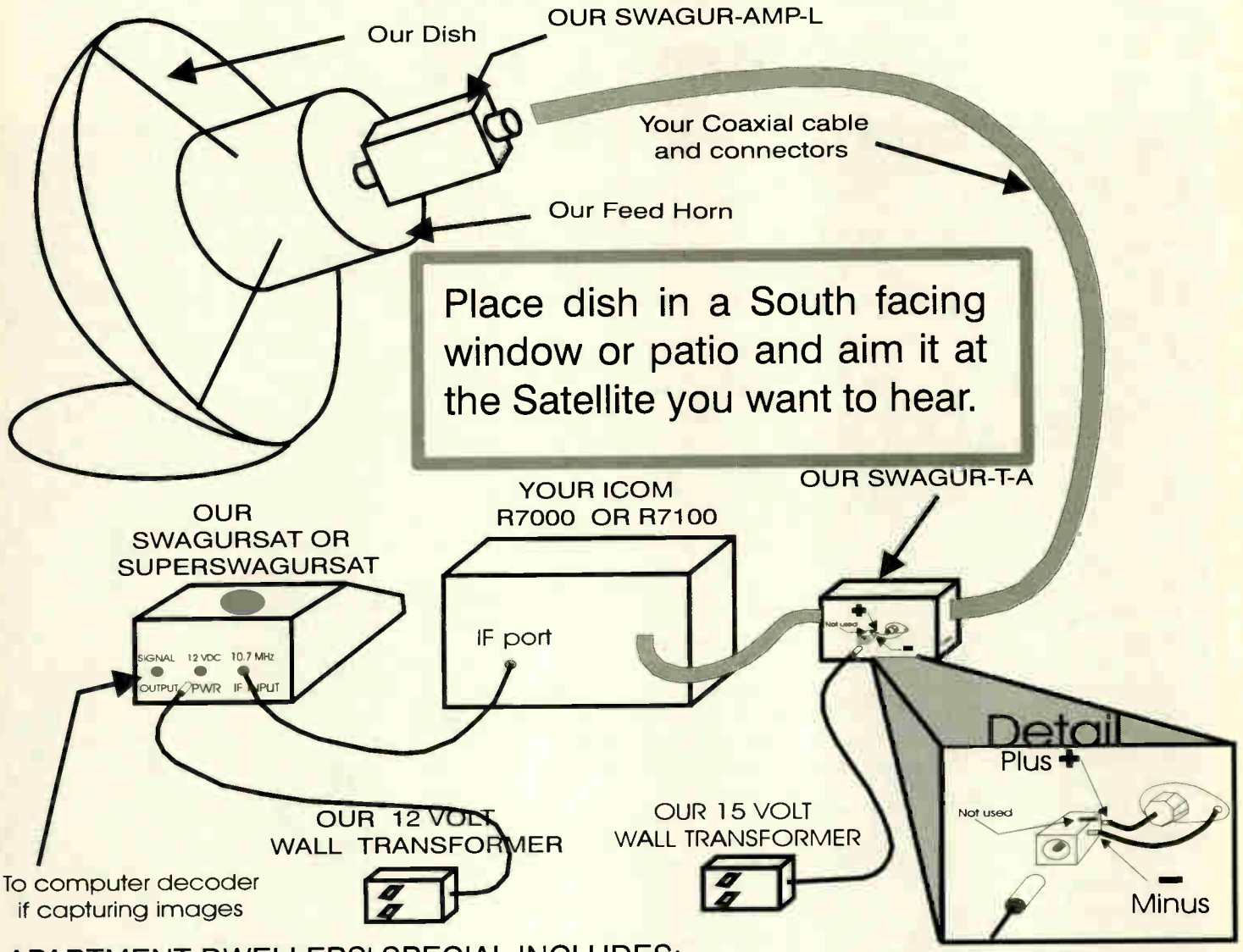

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Ten years after midnight, and all is well... or is it?

By Jeanne E. Prevett

April 27, 1996 marks the 10th anniversary of a memorable moment in satellite TVRO history. As hundreds of thousands of movie lovers across the country watched *The Falcon and the Snowman* over HBO, the image on their screens abruptly shifted to a cryptic printed message:

"Good Evening HBO from Captain Midnight. $12.95 a month? No way! (Showtime/ the Movie Channel beware.)"

Reaction to the intrusion was intense and divided. The media leaped to conclusions of video terrorism by one or more "techno guerrillas," while many from the home satellite TV industry applauded what they perceived as a brilliantly executed protest against signal scrambling of home movie services such as HBO.

Who was Captain Midnight? What really motivated his act of piracy? And could it happen again? The following account presents the real Captain Midnight's version of why and how he committed the crime, how he got caught and what he foresees for the TVRO industry.

The Stage is Set

In 1985, the satellite TVRO industry was growing by leaps and bounds. Business was brisk for John R. MacDougall, a savvy electronics engineer and owner of

Captain Midnight — John MacDougall (Photo courtesy of Bud Prevett

MacDougall Electronics of Ocala, Florida, dealing in sales, service and installation of TVRO systems.

An estimated million and a half homes nationwide were accessing cable TV programming via their backyard satellite dishes for free. While most programmers seemed to welcome the increase in viewers which helped their advertising, premium movie services such as HBO and Showtime balked at the practice, calling it unfair because cable companies were paying a per-customer fee to provide those services to their subscribers.

In 1985 the cable TV industry lashed out with a major advertising campaign clearly aimed at muscling out the competing satellite dish industry. Cartoons depicting useless overturned backyard satellite dishes began appearing in newspapers, along with press releases predicting "the skies would go dark" as home TVRO faded into oblivion.

"It gave the impression to people that the only thing their satellite dish was good for was a big, ten foot diameter bird bath," said MacDougall. "Well, I didn't know that many people who were going to spend three or four thousand dollars for a bird bath. Besides, I wasn't in the bird bath business," he stated.

Letters to lawmakers in Washington had little effect on the situation. Neither did MacDougall's substantial efforts to mobilize other local satellite dealers and promote balanced press coverage about the industry. Within two months, MacDougall's business dropped 80%. "The phone didn't ring. No one came in. The general public thought satellite TV was either illegal or a rip-off. Business was in the toilet," he said.

So in December, 1985, MacDougall accepted a part time job at the Central Florida Teleport in Ocala, broadcasting movies for "The People's Choice" - a satellite-delivered, pay-per-view movie service that went out to hotels and motels around the country. MacDougall became familiar with the equipment and learned the job quickly, using the extra income to keep his own business afloat.

The operation required only two people at night - one to run the tapes and man the controls, the other to monitor the transmitter in case anything went wrong. Once the last movie reel was rolling, one person could easily handle both jobs. That person was often MacDougall. "I usually liked to stay anyway, even if I wasn't needed, because I just liked hanging around to look at electronics." he explained.

By January, 1986, HBO and Cinemax were scrambling their signals and charging backyard satellite dish owners many times more what they charged the cable companies to provide the same services. When would-be TVRO consumers tallied those fees on top of equipment and installation costs, many adopted a wait and see attitude. MacDougall's business sank deeper, while others went under completely.

Flash of Insight

Then, one night at the teleport, MacDougall had a fleeting thought that would come back to haunt him. "I was sitting there one night knowing that I had the power to basically take any channel off of any satellite I wanted and replace it with anything I wanted," he recalled. Although, he said, the idea "didn't really strike me as something that I would or should do," it settled somewhere in the back of his mind.

Then a couple more months of frustration passed. "Here I was, making $250 a week doing nothing, and losing $500 a week in my office working my ass off trying to make a living," said the businessman. On the evening of April 27, as MacDougall sat alone in the control room gazing at the equipment before him, he thought again about the power within his grasp. "What better way to send a message to the industry as a whole, than to send it over the satellite? " he mused.

The Crime

So MacDougall pointed his finger to the "G" on the character generator and began typing. "Good evening HBO," he punched in, then hesitated. "Now, I gotta give them a name," he explained. "I can't give them my name, I mean -I'm not stupid. I didn't want to get caught." At age 25, MacDougall was too young to remember the early TV series called Captain Midnight, but recalled a more recent movie about a teenage radio pirate who'd borrowed the name. So he typed, "from Captain Midnight."

Then came the key part of the message: "$12.95 a month? - No way." That referred to HBO's making $1 to $2 a month per household (gross income) from the Cable TV industry, while charging $13 a month per household from the satellite TV industry. "That was my protest. My protest was not about them scrambling, not about them trying to make money -it was about their completely outrageous gouging of the consumers," he would later emphasize.

When he'd completed the message he transmitted it up to the satellite using only enough power to overcome HBO's signal. There on the monitoring screen, MacDougall watched HBO's signal fade as the bold white lettering of his message barged through.

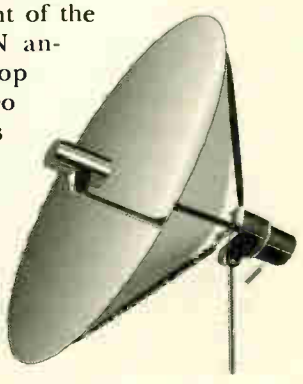
"I knew it was illegal. I knew it was wrong," he said. "But I never imagined anybody would ever care about it. I imagined it would be just a little blip in one of our trade magazines - Something that would make them say, 'Who is this guy? What happened? We need to take control of our industry.' "

But as MacDougall admired his handiwork, his signal began to fade. HBO was trying to elbow its way back in. The engineer surmised that the operators at HBO's uplink had realized the interference, taken a moment to determine whether it was an in-house prank, then turned up the power once they'd confirmed the signal was coming from the satellite.

"They did not completely override my signal, but our two signals were interfering with each other to the point where my signal looked pretty poor," he recalled. "And me being a perfectionist . . .that was like slapping me in the face." So MacDougall let pride get the better of him. He tweaked up the power. HBO did the same. Then so did MacDougall. And again, HBO. Finally MacDougall cranked it - and the message again read loud and clear. After four and a half minutes of air time, "Captain Midnight" slowly and deliberately faded into the night.

The Reaction

The next day at home on a Sunday afternoon, MacDougall was relaxing in front of the TV when CNN announced its top news story: "Video Terrorist takes over Home Box Office." Similar headlines would dominate two of the three major networks. MacDougall



was flabbergasted.

"I'll tell you, you could have knocked me over with a feather when I saw that. I was scared out of my ever lovin' mind!" he exclaimed.

That night at work, he had to pretend he didn't know anything. He worked frantically to cover all his tracks, triple checking that he'd deleted the message from the character generator and making certain that the transmitters were dialed back to the right channels. Convinced he'd left no trace and had gotten away with it, he breathed a sigh of relief and vowed never to pull such a stunt again.

Tracking down the pirate

By Monday, the incident was the talk of the satellite industry, and a full scale federal investigation was under way. Because of the strength of Captain Midnight's signal, the FCC knew it must have originated from one of 580 commercial uplink facilities. "Had I let the transmitter stay at the power I had originally set, I probably wouldn't have gotten caught," claims MacDougall.

The make and model of the character generator helped narrow the search, according to reports, and investigators further determined that only about a dozen facilities in the running were not engaged in other broadcasting at the time of the interference.

Still, it took an odd set of coincidences to reel in the right suspect. According to MacDougall, an acquaintance whom he described as a big fan of an extreme satellite-delivered radio talk show made a call from a pay phone, claiming to be a participant in a major Captain Midnight conspiracy. A couple of booths away, a vacationer overheard the conversation and reported the man's license plate number to the police. The impostor had no actual connection to the crime or an uplink, but because he lived near the Ocala facility, federal investigators focused their attention there. They eventually learned that MacDougall was the only employee at the uplink with any connection to the satellite industry, and that the two men knew each other. Both suspects were subpoenaed to stand before a federal grand jury in Jacksonville.

Seriously threatened with imprisonment, an admittedly angry and self-righteous MacDougall consulted an attorney, and within a few days turned himself in.

He was arraigned in Jacksonville on July 22, 1986. Six hours of detailed testimony finally convinced officials from the FCC, the U.S. justice department in Washington, and U.S. attorneys in Jacksonville that MacDougall posed no serious threat to society, and a plea bargain agreement was reached. MacDougall got off with one year's probation, a one-year suspended jail sentence, and a $5,000 fine.

The Impact

Today, the satellite TVRO industry is enjoying a robust comeback. MacDougall reports a 50% increase in sales for 1995 and predicts a rosy future ahead for C-band (large dish) TVRO, despite some initial confusion over expanding Ku-band (small dish) options.

It's difficult to assess whether MacDougall's deed had any real effect on the inequities he was protesting. TVRO dealers still complain that while home movie services such as HBO, Showtime and Cinemax cost far less than they did a decade ago, the cable companies still pay substantially less for the services. The justification that movie providers must cover the cost of billing to individual TVRO customers does not add up to a 300-500% markup, maintains MacDougall.

Fair or not, consumers have accepted the rates, and it would appear that MacDougall's stunt did little more than create something of a folk hero of himself for a brief period of time. "We thought it was great when it happened, and we were all disappointed when they figured out who it was," recalls Jim Teates, a veteran home TVRO dealer from Peterborough, New Hampshire. But the more serious implications of MacDougall's deed hang in the air even now. They raise the question of just how vulnerable satellite communications are to hacking. Has security been tightened, or could the same thing happen today? MacDougall's answer is succinct: "Security has not been tightened at all. Without question, the exact same thing could happen again and again and again." Stiffer penalties are the primary deterrent, he said, but "to prevent it from a technological means is for all practical purposes, impossible."

Automatic Transmitter Identification Systems (ATIS), and other technology aimed at preventing such interference can be easily circumvented by any hacker knowledgeable enough to switch a switch, unplug a wire, or bypass a couple circuits, asserts MacDougall.

Even a newer satellite with onboard ability to pinpoint transmissions to a 300-500-mile radius on the ground constitutes "another superficial way which they've instituted to help the industry cope with what could be a public relations nightmare," he said.

What can be done to improve satellite communications security? "I think that in the coming years, we will have satellites launched that will have onboard processing, where the information transmitted up to the satellites will be received, demodulated, decoded, processed, determined what that information is and who it's going to, and then transmitted back out of the satellite, all within a few microseconds," predicts the engineer. That might prevent a lot of future interference.

For now, those who depend upon satellite to communicate sensitive government, medical, or financial information must endure the disquieting memory of McDougall's act. For regardless of his intentions, "Captain Midnight" stole more than just a block of air time. He swiped the false security blanket away from satellite communications technology. ST

Jeanne E. Prevett is a freelance writer living in Fitzwilliam, New Hampshire. She has written for local, regional and national publications.

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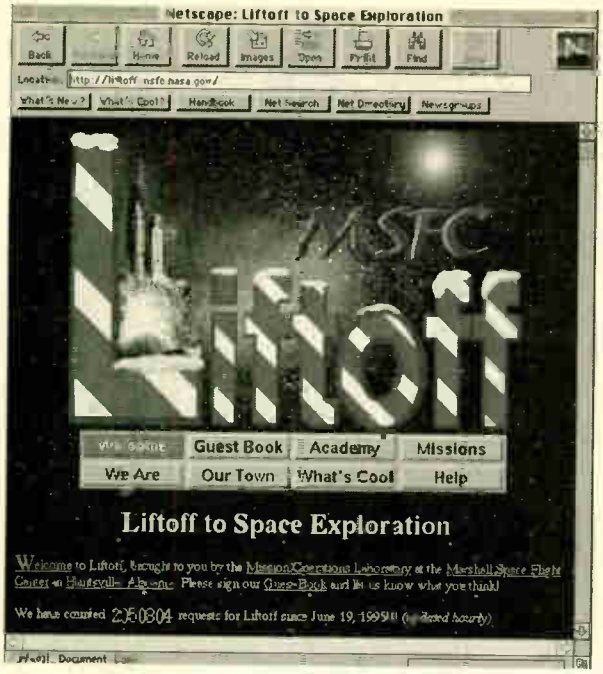

Space Shuttle missions: *http://liftoff.msfc.nasa.gov*

Cyber-Satellites and Web DXing

by George Wood

Nowadays you can use the Net to watch live video from the space shuttle, listen to radio stations around the world live, view WEFAX images from weather satellites, or find the latest news about new TV satellites and programs. George Wood, who's been putting "Sweden Calling DXers" and "MediaScan" online for the past ten years, explains what's waiting in Cyberspace.

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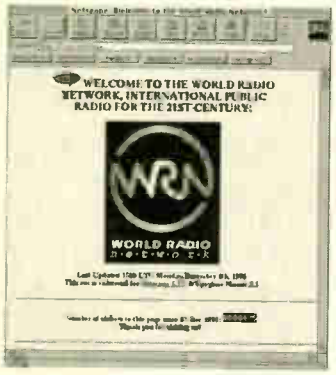
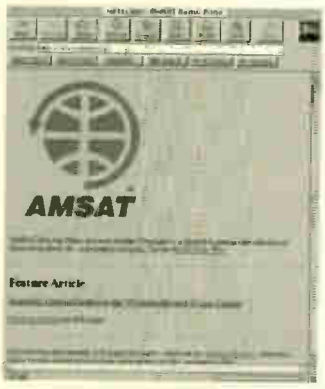


World Radio Network: *http://www.wrn.org*



AMSAT: *http://www.amsat.org*

Right now I'm listening to KOA-AM 850 kHz in Denver. No big deal, almost anybody in North America can probably listen to KOA any evening on their car or portable radio. But I'm in Sweden, and I listened to the live broadcast over the Internet—on my PC. A little while ago, I used my computer to watch video of a space shuttle mission from NASA Select TV.

There's a lot out there in Cyberspace.

Back in the mid-80's, when Radio Sweden hosted the annual conference of the European DX Council, we started what was to become a tradition, the workshop on *Computers in DXing*. Those were exciting times. I'd just gotten my first modem, and I was desparately trying to get it to work during the conference. Soon afterward Radio Sweden began publishing *The DXers Guide to Computing*. The publication outlined all the ways computers could be used to aid the radio listening hobby.

The Guide soon grew from a couple of pages to more than 50, and the chapters stabilized around a few basic applications: programs for logging and satellite tracking; decoding digital modes like RTTY, WEFAX, SSTV, and packet; computer control of receivers; and exchanging information over computer bulletin boards or online systems like CompuServe.

There things have largely remained. The programs have gotten bigger, better, and faster as the computers have improved. Programs have integrated, so you can use one package now to control virtually any suitable receiver, decode packet or RTTY, and keep track of your logs. But this has just been a gradual improvement in existing applications.

Enter the Internet

But in the last couple of years things have changed radically, as the global computer network of networks—the Internet, has grown from being the backwater of academics and defence contractors to a new communications medium for any company and any individual. Today you can use the Net to exchange electronic messages with other hobbyists, follow news and help each other in online conferences, get information directly from organzations and broadcasters on their Web pages, and even listen to radio from around the world, or watch video from above it.

The most important development has been the World Wide Web, a way of creating "pages" of information carrying not just text, but also images and sound. Through mouse-clickable links you can move like Alice falling through the rabbit hole from one page to other pages, which can be from the same source or from another computer around the world, a seamless network to explore and investigate, or *Net surf*.

Some Basics

Internet access is divided into three levels. Level 1 is simple electronic mail, or

e-mail. It's a great advantage to be able to send a message to someone instantly, and have it waiting there for them to read when they want to. It's especially useful when communicating across time zones, and couples the speed of the telephone with the convenience of ordinary letters.

E-mail has been around for some time, initially over bulletin boards and through online systems like CompuServe and America Online. But with BBS's and online systems connecting to the Internet, it's now possible to reach 30 or 40 million people around the world with e-mail, without worrying which service they subscribe to. Of course the hard part is knowing your friends' e-mail addresses. Sometimes the easiest way is to just call up and ask!

E-mail can be a very useful tool. Recently Karl Miosga of the World Radio Network and I arranged the relay of Radio Sweden's Swedish service over WRN2 on Galaxy 5 to North America, completely using e-mail. For several years now e-mail contributions to MediaScan/Sweden Calling DXers have outnumbered letters, with the advantage of being much more timely, and capable of being loaded directly into word processing programs without my having to do a lot of retyping.

E-mail is also used for mailing lists, either one-way newsletters like *Tele-satellit* or my own *MediaScan*, or lists where anyone can send in a contribution, and all the messages are sent either individually or gathered together in a daily compilation to everyone on the list. You subscribe (for free) to a mailing list by sending a message to a particular e-mail address, sometimes with certain key words in the subject line or the body of the message. Usually you get a message back welcoming you to the list, and it contains the all-important information on how to remove yourself from the list, should it not turn out to be what you expected.

Level 2 consists mainly of the so-called newsgroups of the Usenet, a complementary network to the Internet. The name is missleading, newsgroups are not really about news, but are rather ongoing online conferences, similar to the HamNet Forum on CompuServe or the SWL Echo on Fidonet. What is astounding is their number. The last time I checked there were more than fourteen thousand newsgroups. They range from esoteric computer languages and Net development, and hobbies like raising pets and favorite TV shows like *Star Trek*, to the infamous handful of sex groups that the press loves to write about.

There aren't that many newsgroups carrying pornography, but they do exist. It isn't easy to just stumble into them, and it takes some doing to actually view images, as they are encoded. There are also commercial programs parents can install on their systems that can screen out offensive areas of the Internet so children can't gain access to these groups.

There are a number of newsgroups of interest to radio hobbyists. Living in Europe, my favorite is *alt.satellite.tv.europe*. When I want to know what is happening in radio back home in the San Francisco Bay Area, I check out *ba.broadcast*. See the box for a list of relevant newsgroups about radio and television.

Level 3

Level 3 is the Worldwide Web itself. The Web was created in 1991 by Tim Berners-Lee at the European Particle Physics Laboratory CERN, to make information on the Internet more accessible. Initially it was text-based, and you navigated through it with the cursor keys on your keyboard. The text included hyperlinks, underlined words you could click on (by hitting the right cursor key), which would take you to another document on another Web page, anywhere in the world.

The big break-through came a couple of years ago at the National Center for Supercomputing Applications at the University of Illinois Urbana-Champaign. Marc Andreesen designed NCSA Mosaic, the first graphic-based program, or "browser", to access the Web. Initially available only for UNIX workstations running X-Windows, the NCSA eventually developed Windows and Macintosh versions of the program, and best of all, made them available for free over the Net.

Suddenly the dull text-based Web was full of colorful images and sounds! As more and more people discovered the Net, major corporations realized the potential, and starting building their own Web sites, initally for advertising their products, but with an eye for the eventual introduction of mail order-type commerce.

Marc Andreesen left the NCSA, and together with Jim Clarke of Silicon Graphics, founded Netscape, which currently produces the best and most popular Web Net browser.

What's on the Web

Today there are hundreds of thousands of Web sites around the world, ranging from IBM, Microsoft, and Coca-Cola at one end of the scale to class projects by engineering school students devoted to favorite film or rock stars at the other. On the Web you can check out images and the latest reports from the Hubble Space Telescope or an on-going space shuttle flight, look at a picture of the corner of Hollywood and Vine taken a minute ago, or order a pizza (if you happen to live near Santa Cruz, California).

What's on the Web for radio hobbyists? Naturally the first stop for *Satellite Times* readers is the Grove Enterprises web address at:

http://www.grove.net

Web addresses, or Uniform Resource Locators, or URLs, usually begin with *http://* although there are some alternatives like *ftp://* for access to file archives or *news:* for Web access to Usenet newsgroups. Most contain an ending like *com* for commercial sites, *edu* for education sites, or *org* for organizations. Sites outside the United States carry country codes, like *uk* for Britain, *se* for Sweden, or *au* for Australia. Often the initial URL will be followed by some backslashes (/) with a lot of strange letters in between. Those are the computer directories containing the pages being accessed. Be sure to get all that stuff correct, the slightest mistake will result in error messages. The Internet can be very unforgiving.

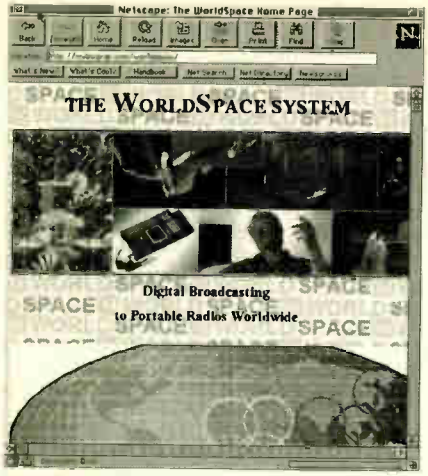
The Grove site is filled with information about *Satellite Times* and *Monitoring Times*, as well as the various offerings from the Grove catalog, the Grove Communications Expo show (October 18,19,20, 1996 in Atlanta, Georgia), and forms for sending e-mail to different Grove offices.

Nowadays, many radio and television stations offer Web sites, ranging from KQED in San Francisco to the BBC in London. There are also pages from satellite operators like Intelsat, organizations like AMSAT and NASA, and even a growing number of clubs. Check the box for a few examples of interest.

Cyberradio

But the most exciting development on the Web right now is radio, both live and on-demand. A lot has changed recently. In November, 1994, I wrote an article for *Monitoring Times* called *Radio in Cyberspace*. Back then, just over a year ago, the good news was that more and more radio stations around the world were putting programs on the Net. The bad news was that this was in the form of humongous files that took ages to download.

For example, this article is around 20



WorldSpace Global Satellite Digital Audio Broadcasting: *http://webworqs.com/worldspace/*

kilobytes in length. A GIF picture splashed across a couple of pages of *Satellite Times* would be maybe 200 kilobytes. But a sound file of someone reading this text out loud would probably be more than ten times that size, several Megabytes.

A year ago, even six months ago, if you wanted to listen to *TechNation* from National Public Radio over the Internet, you accessed the right file site, and downloaded the entire program (which could take an hour for every ten minutes of sound using a then-state-of-the-art 14,000 bps modem) before you could play the program back.

All this changed in April, 1995 when Progressive Networks in Seattle introduced *RealAudio*, the first program that allows you to listen to a sound file while it downloads. The basic requirements were a 14,400 modem connected to a 486/33 PC (or equivalent Mac) connected to the Net using an SLIP or PPP connection.

Many radio stations and other organizations suddenly began offering audio programs over the Net. A number of rival systems have also appeared, notably *Streamworks* and *iWave*. Indeed, you could follow the progress of the new technology by following the Internet radio station *iRock*, which started with *RealAudio*, dumped it in favor of *Steamworks*, and most recently has switched to *iWave*. The nicest thing is that the programs for tuning in are provided free for the downloading from various Web sites. These companies make their money selling server software to would-be Netcasters.

So far, *RealAudio* is the most developed of these systems. While most of them are supposed to work from within Netscape or another browser, as so-called "helper applications", *RealAudio* is the only one I've found that actually works well. First you find a *RealAudio* link (these can be found easily from the *RealAudio* Web pages), click on it, and within 30 seconds you can be listening to Internet Radio Hawaii, the most recent edition of ABC radio news, *All Things Considered*, or to one of the 20 international broadcasters available over the World Radio Network.

Live broadcasts are a more recent development. *Streamworks* seems to be the best at this, and has even developed stereo radio and Net video for users accessing over fast ISDN or network lines. *RealAudio* started live broadcasts of Seattle Mariner games and ABC relays of the OJ Simpson trial this summer. But when I tried to access a Mariners game, there were too many others trying to listen, you just couldn't get into the Web site.

Instead, I switched to *Streamworks* (which works best as a side program run outside your browser), accessed WBAL in Baltimore, and listened as Cal Ripken set his record for the most consecutive games played.

Other *StreamWorks* broadcasters include KPIG (rock), KOA (news and sports), KKAL (sports news), KWBR (rock), KXNG (classical music), CFRA (Expos baseball games), KMPS (country music), Telecom Finland, and ICRT in Taiwan. Another good live Internet broadcaster is KLIF in Dallas, which uses *RealAudio*.

Internet Wave, or *iWave*, was developed by Vocaltec, the Israeli company that created *iPhone*, the first program for using the Internet for phone calls to other Internet users (actually more like CB or ham radio). While the interface is nice, not many stations seem to be using the system yet. Mitsui & Co in Japan has launched a "virtual radio station" over the Internet using *iWave*. The biggest advantage to *iWave* is that while other companies sell their server software, and charge quite a bit for it, the *iWave* server is free, as the company is really trying to sell its *iPhone* technology. Another rival, called *Truespeech*, seems to have even fewer offerings.

To find out more about these systems, check their Web sites. There are also mailinglists covering this field. See the box.

Streamworks is working ambitiously to provide live video, and carries NBC programming at various bps rates. But there is in fact an older, more reliable system. Researchers at Cornell University developed a program for the Macintosh called *CUSeeMe* that makes it possible for people connected to the Net to send black and white video to each other. When using modems it looks like a slide show, and the picture is only a couple of inches square, but it works. The Mac version is supposed to include sound, and before *RealAudio* appeared a few college radio stations began broadcasting over the Net using *CUSeeMe*. The first Windows version of the program lacked audio, but even though the current version is supposed to have sound, I find it rarely works.

Probably the most exciting aspect of *CUSeeMe* is that NASA uses it to rebroadcast NASA Select-TV over the Net. While many of you can probably watch Select-TV on your cable systems or off your dishes, it is kind of a kick to sit here in Europe and watch this silent slide show in postage stamp-sized black and white, live from the space shuttle.

There's a lot to said for audio-on-demand as well. *The Tech Talk Radio Network* on Telstar 302, transponder 21, seems to have succeeded *Let's Talk Radio* as the satellite radio station for North American TVRO monitors. TTRN also has a Web page, at:

http://ttn.nai.net

Besides broadcast schedules, you can also access recordings of TTRN programs like Gary Bourgois *Friday Night Live* in both *RealAudio* and *iWave* formats. In fact, in one program I listened to, Gary encouraged listeners to go check out the new North American broadcasts from Brasilsat, and report back to the program, catching up on what they missed from the *RealAudio* version later.

The Bad News

All is not wonderful on the Internet, however. Besides the basic fact of life that nothing with computers ever works the first time, accessing the Net and the Web means hours of busy lines, inexplicable system crashes, and SLOW SLOW SLOW downloads, while you wonder where your computer went. Ten minutes on the Web at 14,000 or 28,000 bps and you'll probably wish you were accessing from a University or corporate network link, or feeling a strong urge to call the phone company to ask about getting ISDN line installed.

Sound and video are cutting edge technology for the Net, so lots of things can go wrong. The various helper programs are provided free for "beta" or testing purposes, and aren't always finished products. Weird things can happen. You can get "server not responding" messages from the station you were just listening to. Radio stations can disappear after a few minutes or seconds. If I want to crash the

winsock.dll program on my computer, effectively cutting myself off from my Internet provider, all I have to do is click on the *iRock* button in *Streamworks*. Works every time.

While writing this, I logged into the *Streamworks* Web site, and tried to access their newest feature, live video from clNet at less than 14,400 bps. My whole system just froze up.

The sound quality is not always FM stereo either. *RealAudio* at its best sounds like AM broadcast stations. Depending on your rate of Web access, *Streamworks* can deliver fairly high quality sound, but not over a 14,400 bps modem. Right now the amazing thing is that it works at all.

All this is bound to get better as the programs improve, providers add more capacity, and users move up to 28,000 bps, and eventually on to ISDN or even faster access over cable networks. But it can be very frustrating!

Back in November, 1994 I wrote: "Soon you'll be able to access the world's radio and TV networks, as you DX cyberspace on your PC". We've come a long way in just over a year. There's still only a relative handful of stations on the Net, but their number is increasing.

If you're into shortwave listening, monitoring WEFAX or amateur radio satellites, or TVRO, there's something for you on the Internet. The only problem is that when you start Net Surfing, you may discover you don't have any time left over for anything else! ST

Getting on the Net

The best way to get Net access to be a student or teacher at the right university, or to work for the right corporation. Lacking that, the easiest way to get on the Web is through CompuServe, America Online, Prodigy, or the Microsoft Network. All offer complete access. If you don't want to pay for an online service, there are hundreds of local Internet providers across the country. The easiest way to find one is to check out the ads in a computer magazine or even the classified ads in your local newspaper.

The provider or online service should make available the proper software for e-mail, newsgroups, and Web access. In many cases you can choose or change your browser. Compuserve, for example, gives away Spry Mosaic, since it owns Spry. Most users prefer Netscape, but you can always use Spry to access the Netscape site at: *http://home.netscape.com*

Be sure to download the latest free version. You may have to play around a bit to get Netscape to run instead of Spry Mosaic, but it is well worth the effort. Netscape includes many features not found on other web browsers, and since between 70 and 90 percent of Web users have Netscape, many Web sites are optimized for Netscape, and look worse with anything else.

Accessing the Net — Some Interesting Web Pages:

Yahoo is an excellent directory of WWW sites. You can access it by clicking on the "Net Directory" button in Netscape. From there, follow the links to find the information you are looking for. The URL is: *http://www.yahoo.com*

There are a number of radio station lists on the net. One of the best sources is Thorsten Koch's *Internet Guide to International Broadcasters*, which can be found at: *http://www.informatik.uni-oldenburg.de/~thkoch/* and *http://www.cs.cmu.edu/~jblythe/shortwave.html*

Another good list is *Radio Stations on the Internet* at: *http://www.mit.edu:8001/activities/wmbr/otherstations.html*

Of course, don't forget to check out Grove Enterprises new web site at: *http://www.grove.net* and Radio Sweden at: *http://www.sr.se/rs*

A multimedia version of the most recent *MediaScan* program from Radio Sweden can be found at: *http://www.sr.se/rs/english/scdx.htm*

Previous MediaScan interviews are also available for downloading.

Amateur and Shortwave Radio

Amateur Radio: *http://www.acs.ncsu.edu/HamRadio*
AMSAT: *http://www.amsat.org*
ARRL: *http://www.arrl.org*
Gerben's Radio Page: *http://www.cs.vu.nl/~gerben/radio.html*
Magliacane SpaceNews Home Page (John Magaliacane ST Staffer) *http://www.njin.net.80/~magliaco/*
Shortwave/Radio Catalog: *http://itre.uncecs.edu/radio/RadioCatalogPg1.html*
World Utility News: *http://sun-gabriel.aero.org:8800/*

Astronomy

Astronomy Virtual WWW Page: *http://www.w3.org/hypertext/DataSources/bySubject/astro/amateur.html*
Astronomy Magazine: *http://www.kalmbach.com*
Astroweb: *http://fits.cv.nrao.edu/www/astronomy.html*
SEDS Internet Space Warehouse: *http://www.seds.org*
Sky Online (Sky & Telescope): *http://www.skypub.com*

GPS/Navigation Satellites

Canadian Space Geodesy Forum: *http://degaulle.hil.unb.ca/CANSPACE.html*
GPS World Magazine: *http://www.advanstar.com*
Paul Tarr's GPS WWW Resource List: *http://www.inmet.com/~pwt/gps-gen.html*
USCG Navigation Center: *http://navcen.uscg.mil*

Satellite Broadcasting

A current list of geostationary satellites is available at: *http://hea-www.harvard.edu/QEDT/jcm/space/jsr/geo.log*
European Satellite Information: http://www.funet.fi/index/esi/
Infosearch Broadcasting Links-list of broadcast station links (Doug Jessop ST Staffer): *http://www.xmission.com/~insearch/links.html*
Intelsat: *http://www.intelsat.int:8080/*
Smathers Home Page-TVRO information site (Robert Smathers ST Staffer): *http://www.nmia.com/~roberts/robertext.html*
Satellite Channels Over Europe: *http://www.hf-fak.uib.no/smi/ksv/channels.html*
Tech Talk Radio Network: *http://ttn.nai.net*
Tele-satellit News: http://xan.esrin.esa.it:2602/satellite.html
The Satellite's Encyclopedia: *http://www.u-net.com/arrowe/tse/tse.htm*
World Radio Network: *http://www.wrn.org*
WorldSpace Global Satellite Digital Audio Broadcasting: *http://webworqs.com/worldspace/*

Sound and Video over the Net

CU-SeeMe: *http://cu-seeme.cornell.edu*
iWave: *http://www.vocaltec.com*
RealAudio: *http://www.realaudio.com*
StreamWorks: *http://www.xingtech.com*

Space Exploration

Hubble Space Telescope: *http://www.stsci.edu*
NASA Information Services via WWW: *http://www.nasa.gov*
NASA Newsroom: *http://www.hq.nasa.gov/office/pao/NewsRoom/today.html*
Space Shuttle missions: *http://liftoff.msfc.nasa.gov*

Space Information Resources

Community Air & Space Report-launch schedules/sat freqs (Keith Stein ST Staffer): *http://www.isso.org/publications/casr/home.html*
Jonathan's Space Report: *http://hea-www.havard.edu/QEDT/jcm/space/jsr/jsr.html*
Satellite Orbital Element Sets (TS Kelso ST Staffer): *ftp://archive.afit.af.mil*
SPACEWARN Bulletins: *http://nssdc.gsfc.nasa.gov/spacewarn/spacewarn.html*

Television Networks

ABC: *http://www.abctelevision.com*
BBC: *http://www.bbcnc.org.uk/*
CBC: *http://www.cbc.ca*
CBS: *http://www.cbs.com*
CNN: *http//www.cnn.com*
Fox: *http://www.foxnetwork.com*
International Channel: *http://www.i-channel.com*
NBC: *http://www.nbc.com*
PBS: *http://www.pbs.org*
The Discovery Channel: *http://www.discovery.com*
The Science Fiction Channel: *http://www.scifi.com/*
The Weather Channel: *http://www.weather.com*

Weather Satellites

Dallas Remote Imaging Group-space/weather satellite information (Jeff Wallach ST Staffer): *http://www.drig.com*

UseNet Newsgroups

alt.radio.digital
alt.radio.networks.npr
alt.radio.scanner
alt.satellite.tv.europe
ba.broadcast
rec.radio.amateur.digital.misc
rec.radio.amateur.misc
rec.radio.amateur.space
rec.radio.broadcasting
rec.radio.info
rec.radio.noncomm
rec.radio.pirate
rec.radio.scanner
rec.radio.shortwave
rec.video.cable-tv
rec.video.satellite.dbs
rec.video.satellite.europe
rec.video.satellite.misc
rec.video.satellite.tvro
sci.astro
sci.astro.amateur
sci.astro.hubble
sci.geo.satellite-nao
sci.space.news
sci.space.policy
sci.space.science
sci.spacw.shuttle
sci.space.tech

Mailing Lists

The German magazine *Tele-Satellit* magazine is making some of its news bulletins available for general subscription. To sign-up send a message to: *majordomo@tnet.de*
In the message body include the word "subscribe" followed by the name of one of the available lists:

ts-guide	English language news of satellite TV programmes
ts-news	*TELE-satellit's* weekly English language news
ts-sce	Satellite Club Europe, daily German language DX news
ts-tse	*The Satellite's Encyclopedia* list, satellite news

To get on Radio Sweden's MediaScan mailing list, send a message to: *subscribe@rs.sr.se*
To subscribe to *RealAudio's* RAPLay list, send an e-mail message to: *listserv@prognet.com*
To get on the *Streamworks* list, sending a message to: *majordomo@butterfly.net* with the words "subscribe streams" in the body of the message.
The Voice of the Net Digest provides coverage on all the audio carried over the Net and products. To subscribe, send e-mail to: *majordomo@pulver.com* and in the message body write "subscribe von-digest"

DOMESTIC
TVRO

By Doug Jessop

Sports in the Domestic Arc

In the last issue of *Satellite Times* we provided a parental lockout listing to the plethora of adult programming available on satellite (of course, neither myself or the managing editor of *Satellite Times* live in areas that adult programming is allowed). In this issue, lets take a look at what is generally given as one of the top reasons for parking a BUD (Big Ugly Dish) in the backyard....SPORTS!

As you may or may not know, the NBA has been looking to protect their backhaul feeds for quite some time and have decided to encrypt this season using Leitch.

For the fourteen consecutive year, Hughes Television Network/HTN, the sports division of Keystone Communications will be providing broadcasting services for the NBA's 1995-1996 season. This NBA season will have the added service of scrambling equipment being acquired by Keystone from Leitch Incorporated. More that (US) $1 million of Leitch equipment will be installed at various NBA team cities.

The NBA has agreed to use Leitch's Viewguard ® and more than 150 decoders. The design is a combination of sophisticated hardware techniques and digital signal processing.

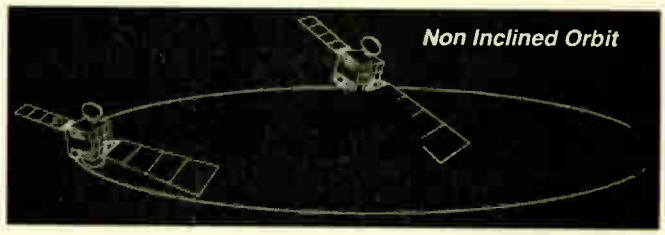
So now what do we do you say....well there are couple of different angles to look at this. First, while the entire NBA will eventually use the system there are still those team locations that will take a while to get the equipment in place. Secondly, a fair number of the teams are carried by their local stations and then broadcast via satellite. Thirdly, you can chose from an enormous number of sports packages that are out there that carry NBA programming (See Table 1).

DirecTV delivers up to 175 channels on 18-inch digital satellite dishes. For one year you have the option to buy 200 NFL games ($139), 700 NBA games ($149), 500 NHL games ($119), 425 college basketball games ($79), 22 regional sports networks across the country ($79.95), and a full slate of college football games ($9.95 per day). The baseball package would take another page to examine. Jim Ramo, executive producer of DirecTV doesn't recommend buying every package. "If you did, you'd never talk to your wife, your family would split up, and you'd spend the rest of your life in your pajamas."

Inclined Orbit Use Increasing

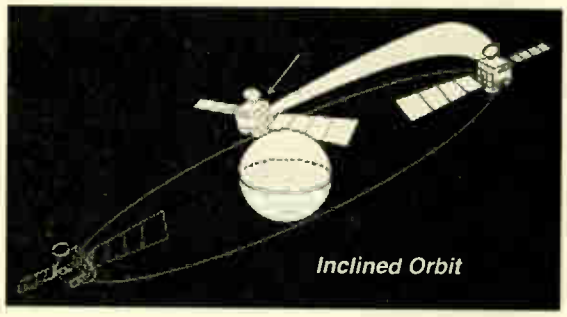
The satellite industry is seeing the increased use of inclined orbit satellites to help take some pressure off the very tight inventory of occasional use satellite time, for example Telstar 302 and Telstar 303. To get a quickie explanation of inclined orbit operations here is an example of a standard satellite orbit:

To lengthen the life of satellites Telstar 302 and Telstar 303, the occasional firing of the propulsion engines for north-south (latitudinal) station-keeping is discontinued electronically by AT&T engineers. This allows the natural gravitational forces of the sun and moon to pull the satellite's orbit into an inclined plane at a



rate of about 0.85 degrees (+- 0.1 degrees) annually. Conversely, the occasional firing of the propulsion engines for east-west (longitudinal) station-keeping continues to keep the satellite positioned in its proper longitudinal orbital location.When viewed from the earth and any earth station, an inclined-orbit satellite no longer appears to be stationary in the sky.

Rather, it appears to move in a very definite "figure 8" pattern that repeats itself every 24 hours. Because the satellite's inclined-orbit motion is both predictable and reliable, it offers A great opportunities to provide bridge capacity and to conserve fuel. In



the years surrounding 1995, due to the unusual and favorable alignment of the sun and moon with respect to the earth, the inclination grows at the smaller rate within the above range ... about 0.75 to 0.8 degrees annually.

The use of inclined satellites came to the forefront recently with the announcement that Hughes Communications had leased the Brazilsat A1 satellite from Brazilian telecommunications leader Embratel.

Brazilsat A1 is a C-band satellite that uses the HS-376 bus built by Hughes Space and Communications. According to Carl Brown, senior vice president of Hughes Communications Galaxy Services, the satellite has 24 C-band transponders (only 16 for lease) and has enough fuel left for six to eight years of operations. The satellite is located at 65 degrees West Longitude and has a relatively good CONUS (Continental United States) footprint. The satellite is operating currently at approximately 0.8 degrees of inclination and is expected to grow at about 0.9 degrees of inclination each year.

According to sources in the satellite industry, even though the satellite is at 65 degrees the satellite can be seen with an approxi-

"We look forward to fighting with anybody who wants to get in the ring with us. We're going to squash Rupert like a bug!"

mate 20 degree elevation from the West Coast and 55 degrees from the East Coast. Hughes has indicated that the satellite will be used for Galaxy 3R backup as well as for the 1996 Summer Olympics. In general the use of inclined orbit satellites is only effective for feeds lasting under one hour. However, with all NBC affiliates set up with tracking satellite dishes using inclined orbit satellites can be considered a cheap de facto encryption system.

Studio of Cable News Network (CNN)

International Satellites Authorized for Domestic Service

A number of special events including the Atlanta Summer Olympics, Democratic and Republican National Conventions and Presidential Election, are planned for 1996. As mentioned earlier, Brazilsat A1, Telstar 302 and Telstar 303 are currently available to provide domestic occasional service. Due to the current capacity crunch, the Federal Communications Commission (FCC) has authorized international satellite systems such as Orion, Columbia and PanAmSat to use their transponders for domestic service. This capacity could be easily accessed with satellite news gathering (SNG) or flyaway stations which can adapt to the non domestic orbital positions.

Turner Gets SBS 6 Capacity

Turner Broadcasting System (TBS) recently announced that they have acquired long-term SNG capacity on SBS 6 for use by the Cable News Network (CNN).

According to the agreement, TBS has acquired two Ku-band transponders on SBS 6 to meet the growing news gathering requirements of CNN, CNN Headline News, CNN International and the soon to be launched CNN Financial News.

TBS assumes control of its SBS 6 transponders on January 2, 1996. Operating from an orbital position at 74 degrees West longitude, SBS 6 has nineteen 41 watt Ku-band transponders and is generally used for SNG services. The bird is a HS-393 spin stabilized model that is designed to provide twice as much power per channel as the older HS 376 model used for Brazilsat A1.

In a related note, Australian media mogul Rupert Murdoch and none other than Ted Turner have been exchanging niceties in the press about Murdochs' plan to start another news channel to compete with CNN. Ted Turner welcomed Rupert Murdochs' plans to launch a 24-hour news channel , saying "We look forward to fighting with anybody who wants to get in the ring with us. We're going to squash Rupert like a bug!"

Ted Turner had refused buyout offers by Murdoch over the years. "He's tried to figure out a way to compete with CNN for years. He tried to buy us and we wouldn't sell to him," he said. Turner added that a bonus to his recent merger with Time Warner was that the media conglomerate was larger than Murdochs' operation. Ah, just another day at the office...

While we are remotely on the subject of Atlanta, WXIA is no longer carried on PT24 East. More than a couple viewers are livid. *Satellite Times* Managing Editor Larry Van Horn talked with a supervisor at PT24 and they explained the reason for WNBC being carried versus WXIA had something to do with network preemption by Atlanta and Raleigh (they are under a long term contract so one would imagine that one will not change for awhile longer, but it would be a good bet we will see WCBS-New York at some point in the future). It would seem that network politics are involved

to pull the switch a year out from the Olympics in Atlanta. The team news coverage on WXIA of the Olympics is second to none. Logic would dictate that the local flavor of WXIA would shine through over the "big boy" attitude that a New York station would provide. Not to say that WCBS isn't a powerhouse station...just count me on the side of the underdog.

New Programs for the Dishhead

Lifetime is developing four new one-hour series for 1996: *Telling Secrets*— an "emotional" reality series produced by Henry Winkler; *The Cold Squad* —about a team of police detectives who try to crack long unsolved crimes, *Byline; Sarah Stark* — which focuses on a crime reporter in New York City who also is a housewife and a mother; and *The Glass House*— which follows a female assistant US attorney who specializes in tough cases.

UPN has reportedly developed two hour long dramas for their new Wednesday night line up. One drama centers around a scientist that gets involved in some kind of industry accident in the jungle that gives him heightened sensory perceptions. The other UPN show is rumored to be a cop drama that centers around an officer that operates "out of the system." UPN generally airs their programs in the clear, so this should be some nice fare for the dishhead.

With all the noise from Hughes you don't seem to hear much from the folks at GE even though they are planning to launch GE-1 sometime late spring of 1996. At a recent satellite industry conference, sources indicated that the bird will carry a fair amount of digital programming as well as a smattering of business television. At press time, it appeared that the satellite was nearly sold out. What kind of video traffic will show up on GE-1 for the backyard dish owner will have to wait until color bars show up sometime early this summer.

In the correction department, thank you to Rick Cooper of Lockheed-Martin to point out that the launch vehicle for Galaxy 3R was provided by Lockheed-Martin. General Dynamics sold the space systems division to Martin Marietta who of course in turn renamed the division when it merged with Lockheed. The launch was scheduled for the evening of December 14th (December 15th UTC). Lets hope that the satellite is well on its way through operational testing when you read this. ST

Doug Jessop runs a web and FTP site at Web: http://www.xmission.com/~insearch and FTP: ftp.xmission.com /pub/users/i/insearch. These sites provide technical information services for consumers & businesses. You can reach Doug via e-mail at INFOSEARCH E-mail: insearch@xmission.com.

Table 1: Sports Channels via Satellite

Satellite	West Longitude	Transponder	Service
Satcom C1	137	1	New Sports
Satcom C1	137	4	Sportschannel Pacific
Satcom C1	137	7	Prime Sports West
Satcom C1	137	9	SSN
Satcom C1	137	10	Prime Sports Southwest
Satcom C1	137	13	Sportschannel Chicago
Satcom C1	137	15	Sports Channel C.F.O.
Satcom C1	137	16	New Sport (alternate channel)
Satcom C1	137	17	Prime Sports
Satcom C1	137	18	Prime Sports Showcase
Satcom C1	137	21	La Cadena Deportiva (Spanish language)
Satcom C1	137	22	Prime Sports Northwest
Satcom C1	137	24	Sunshine Network
Galaxy 1R	133	9	ESPN2 (alternate channel)
Galaxy 1R	133	14	ESPN (alternate channel)
Satcom C3	131	11	Prime Network
Satcom C3	131	14	North East Sports Network
Galaxy 5	125	9	ESPN
Galaxy 5	125	14	ESPN2
Anik E1(C)	111.1	1B	The Sports Network
Anik E2(C)	107.3	5A	Empire Sports
DBS	101.2	206	ESPN
DBS	101.2	207	ESPN (alternate channel)
DBS	101.2	208	ESPN2
DBS	101.2	211	DirecTV Sports Billboard
DBS	101.2	304	The Golf Channel
DBS	101.2	305	Prime Sports Network
DBS	101.2	306	Prime Sports Network
DBS	101.2	307	New England Sports
DBS	101.2	308	Prime Sports Network
DBS	101.2	309	Prime Sports Network
DBS	101.2	310	KBL, Pittsburgh Sports Network
DBS	101.2	311	Home Team Sports
DBS	101.2	312	Sports South
DBS	101.2	314	Sunshine Network
DBS	101.2	316	PASS Sports Network
DBS	101.2	317	Prime Sports Network
DBS	101.2	319	Prime Sports Network
DBS	101.2	322	Home Sports Entertainment
DBS	101.2	323	Prime Sports Rocky Mountain
DBS	101.2	325	Prime Ticket
DBS	101.2	326	Prime Network
DBS	101.2	350	NBA League Pass Schedule
DBS	101.2	351-360	NBA Games
Galaxy 7(C)	91	7	The Golf Channel
Galaxy 7(K)	91	22	Classic Sports Network
Spacenet 3(C)	87	10	Sports South
Spacenet 3(C)	87	11	PASS Sports
Spacenet 3(C)	87	12	Home Team Sports
K1	85	40	Primestar- The Golf Channel
K1	85	131	Primestar- ESPN
K1	85	141	Primestar- New England Sports Network
K1	85	142	Primestar- Madison Square Garden Network
K1	85	143	Primestar- Empire Sports Network
K1	85	144	Primestar- KBL Sports Network
K1	85	145	Primestar- Home Team Sports
K1	85	146	Primestar- Sports South
K1	85	147	Primestar- Sunshine Sports
K1	85	148	Primestar- Pro American Sports
K1	85	151	Primestar- Prime SportsNetwork
K1	85	152	Primestar- Prime Sports Network
K1	85	153	Primestar- Prime Sports Network
K1	85	154	Primestar- Home Sports Entertainment
K1	85	155	Primestar- Prime Sports Network
K1	85	156	Primestar- Prime Sports Network
K1	85	158	Primestar- Prime Ticket
Galaxy 6	74	8	Worldwide Broadcasting
Galaxy 6	74	15	Midwest Sports Channel
Spacenet 2(C)	69	1	Sportschannel New York
Spacenet 2(C)	69	6	Sportschannel Philadelphia
Spacenet 2(C)	69	11	Sportschannel New England
Spacenet 2(C)	69	18L	NewSport

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INTERNATIONAL
TVRO

By George Wood

Kanli 7 Moves to Turksat

The Turkish Kanli 7 has moved from its test position on Eutelsat II-F3, and is now broadcasting on Turksat on 11.010 GHz. This is supposed to be the European beam, but signals are extremely weak in northern Europe, home of many of the Turkish immigrants who are the presumed audience.

Turkish officials have announced they are planning to launch a second Turksat in June, and a third satellite in 1999. Agreements have been signed with France's Aerospatiale. One hopes the new satellites will have better European beams than the current Turksat.

Egypt has also signed an agreement with a French consortium led by Matra Marconi Espace to build and launch Egypt's first satellite. NileSat will begin operating in mid-1997, and is supposed to cover the Arab world, the Americas, and Asia. That seems a bit exaggerated, as there's hardly a single position in the Clarke Belt that permits that kind of coverage.

The new satellite will offer 16 channels of sports, movies, children's and cultural programs. Egypt currently has two channels on Eutelsat II- F3 at 16 degrees East. The all-Arabic language Egyptian Space Channel puts a powerful signal into northern Europe (where there are unlikely to be many viewers), while Nile TV, which carries programs about Egypt in English and French, uses a weak half transponder, and is barely visible.

While some Middle Eastern countries are embracing satellite technology, others reject it. Bahrain has become the latest country to ban reception of satellite television and radio.

In April, Iran made ownership of satellite equipment an offence. The Iranian police are reported to have made around thirty arrests so far over production of satellite reception equipment and dishes. A local newspaper said police seized 226 satellite dishes from a workshop just outside Tehran. Some dishes are reported to have been placed back on roofs and disguised with air conditioners and other equipment. There are no reports of arrests for individual possession of satellite reception equipment.

Other Islamic country that's outlawed satellite television is Malaysia. But all that is about to change. Malaysia's Measat-1 satellite is about to be launched Ariane. The satellite will begin broadcasting sometime next March, before which the government is expected to rescind current laws restricting satellite reception in the country.

PanAmSat

PanAmSat's new PAS-4 has entered operation at 68.5 degrees East. According to *Tele-Satellit* monitors, the following transponders are already in use:

Monitored in South Africa (courtesy Michael Cookson, *TELE-satellit* South Africa):

12.5375 V	M-Net South Africa
12.6645 V	SABC TV 1
12.6975 V	SABC CCV
12.7245 V	SABC NNTV
12.7405 V	CDAT

Monitored in Australia (courtesy Nathan Kopel, International Radio Monitors and Peter Merrett):

3.905 V	Sony Entertainment Television
3.912 H	Carrier
3.935 H	Test Pattern - "PAS 2 SYLMAR, CA."
3.965 V	CNN International
3.995 V	CNN Newsource
4.035 V	NHK TV-Japan
4.111 H	CNBC Asia

Also reported, from Europe, are the following channels, all in clear PAL:

3790 MHz	Asian Business News
3870 MHz	ESPN
3910 GHz	Sony
4040 GHz	Unknown Indian channel
4085 GHz	CNN International
4115 GHz	Cartoon Network/TNT
4190 GHz	MTV Asia
12.6 GHz	NHK

Other channels reported from PAS-4 in South Asia include Indian channels EETV and YES, and Discovery.

South Africa's SABC says it hopes to have 14 pay TV channels on the air by the end of next year. The SABC says the system could eventually be expanded to as many as 21 channels.

Japan's NHK is using the satellite to link Tokyo to Paris and India's Doordarshan has also announced it will be using the satel-

"That is our strategy — to dominate in four key program categories: sports, music, movies and general entertainment," Murdoch explained.

lite for services to Asia and Europe. Hong Kong Telecom also says it will begin using PAS-4.

Other planned broadcasters include China Central Television, Disney, HBO, Liberty Media Corp., and Viacom.

As part of its ongoing expansion program, PanAmSat Corp. has requested U.S. government approval to operate several new international communications satellites that will expand its broadcast and telecommunications services throughout the Americas by the year 2000.

PanAmSat has applied to the FCC to operate international communications satellites in orbital locations that traditionally have been used for domestic U.S. satellites, 79 and 103 degrees West in both the C-band and the Ku-band.

In addition to these orbital slots, PanAmSat has requested FCC approval to operate two new satellites that will provide international communications services over Ka-band frequencies. These satellites would be located at 58 degrees West Longitude and 79 degrees West Longitude.

PanAmSat currently operates three satellites: PAS-1 serving the Atlantic Ocean Region; PAS-2 serving the Pacific Ocean Region; and PAS-4 serving the Indian Ocean Region. Three additional Atlantic Ocean Region satellites are under construction, including the soon to be launched PAS-3 replacement. The company also plans in 1997 to launch PAS-7 over the Indian Ocean Region and PAS-8 over the Pacific Ocean Region.

Still in Asia

There's a new Indian broadcaster seeking to establish a global presence. Apna-TV is actually based in London, but it broadcasts Hindi- language films for South Asians around the world. The European service is using Russia's Statsionar 11 satellite at 11 degrees West, on its Ku-band transponder on 11.525 GHz, as well as the nearby Ekspress 2 satellite at 14 degrees West, on C-band 3.825 GHz. The channel also says it is relayed over the Russian Ekran satellite at 90 degrees East to South Asia, using the L-band.

Meanwhile, in another corner of his far-flung media empire, Rupert Murdoch's Star-TV is getting ready to take the plunge into digital TV to Asia. The upcoming Asiasat-2 will boost coverage of Star-TV into Eastern Europe and Australia.

Asia Satellite Telecommunications Co. says China's state launching company is ready to send Asiasat-2 into orbit, after a delay of almost a year, following the failure of a Lockheed satellite in September, 1994 and the explosion of the Apstar 2 satellite during launch in China in January this year.

Addressing the News Corp annual meeting, in Adelaide, Australia, Rupert Murdoch said Star-TV would experience "great growth" during the next 12 months, noting that the Hong Kong-based broadcaster would launch a package of 15 movie channels into Indonesia in six months, while working on its first venture into Japan.

Murdoch said that during the next six months Star would broadcast movie channels in five languages — Mandarin, Hindi, English, Bahasa Indonesia and Tagalog — and within 12 months would add Cantonese and Japanese. Sports would remain a key element of Star's television strategy and Star was looking to develop more youth-oriented services based on the format of India's Channel V.

"That is our strategy — to dominate in four key program categories: sports, music, movies and general entertainment," Murdoch explained.

Murdoch is expanding in Australia as well. Foxtel, a 50-50 joint venture group between Murdoch's global media machine News Corp Ltd and state-owned telecom group Telstra Corp, has announced a tie-up with pay-TV group Australis Media Ltd. The deal would create the most powerful pay-television group in Australia, combining Australis' microwave and satellite services with Foxtel's plans to roll out a 20-channel cable pay-TV service. Analysts estimate the enlarged group would have access to 90 percent of Australian homes.

Most analysts expect Foxtel to effectively take over Australis, giving the Murdoch pay-TV service a so-called back-door listing on the local exchange. The enlarged Foxtel would strike a harsh blow to the third player in Australia's pay-TV industry, Optus Vision, which is partly financed by Australia's richest man and long-time Murdoch rival Kerry Packer.

But their rivalry didn't prevent Rupert Murdoch and Kerry Packer from reaching an uneasy truce in late September when Murdoch's British Sky Broadcasting formed an alliance with Packer's Nine Network to launch a 24 hour news channel for Australia. Packer's Optus Vision and Murdoch's Foxtel have both agreed to carry the service, which will be called News Channel. Domestic and international news will be provided in part by Sky News in London and Nine Network's news resources.

Digital broadcasting is also coming to Japan. Japan's JCSAT 3 satellite was launched on a Lockheed Martin Atlas 2AS on August 29 from Cape Canaveral. JCSAT 3 is the first Japanese digital TV broadcasting satellite, and programming will be operated by Digital Multi-Channel Planning, a partnership of JSAT, Itochu Corp, Mitsui and Co, Ltd, Nissho Iwai Corp and Sumitomo Corp. The satellite will also provide data and fax transmission services. The hybrid 3-axis stabilized payload has 28 Ku-band and 12 C-band transponders.

Thirty-nine companies, mostly non-broadcasting firms, reportedly plan to join Japan's first multichannel digital satellite broadcasting service due to start late next year. The Nihon Keizai Shimbun business daily said the companies include Nippon Television Network Corp (NTV), Television Tokyo Channel 12 Ltd (TV Tokyo), Pioneer Electronic Corp major movie distributing

"Meanwhile Intersputnik has reached agreed with the Kingdom of Tonga for the use of the orbital slots... Since Intersputnik is now authorized by both the satellite owner and the slot owner it claims to be the operator of both Gorizont 29 and 30." Curiouser and curiouser.....

firm Shochiku Co Ltd and Daiichi Kosho Co, which sells and leases karaoke machines.

The initial 40-channel service will start next September after a test run beginning in April, the daily said. The newspaper said NTV and other TV stations will provide satellite channels carrying the same programs as their non-satellite broadcasting, and TV Tokyo will provide an economic news channel.

Companies which make TV programs will have their own channels for travel and English conversation programs, the daily said. New channels will also feature foreign languages, cars, coaching for examinations, stock prices, shopping and adult programs, as well as sports and movie programs, it said.

Hughes Communications, operators of DirecTV in North America, is also planning to open another digital satellite broadcasting service to Japan. The 100 channel DirecTV Japan could be operational within two years. Hughes has signed contracts with three leading Japanese companies to assess its feasibility.

August 29 was a good day for Japanese TVRO. Besides JCSAT 3, on that same day Arianespace successfully placed into orbit Japan's N-STAR satellite. It will provide Japan with telecommunications services in the C-, Ku-, S- and Ka-bands from its orbital position above New Guinea.

On the other hand, thousands of satellite TV viewers in South Korea and China lost access to Japanese DBS transmissions for at least a week in late October. On October 24 what was described as a "positioning error" caused BS-3A, Japan's primary direct broadcast satellite, to be taken out of service. The back-up satellite, BS-3N, is less powerful. Japanese viewers noticed little difference in reception of the four channels involved, but fringe viewers in farther off areas of Asia could no longer see the programming, until BS-3A was repositioned. Rupert Murdoch has made a big move in his homeland of Australia. He seems to have sewn up a $ 760 million (US) merger of his Foxtel pay-TV group with a budding rival, a deal likely to let him dominate Australia's industry.

Rimsat

Here's the latest in the confused Rimsat saga, which we've reported on before in this column, thanks to Jean-Phillipe Donnio, writing in *Tele-Satellit*:

"Rimsat, Ltd., of Fort Wayne, Indiana, is a US company which leased the use of 2 satellites from Russia's Informcosmos: Gorizont 29 launched on 18 Nov 1993 and located at 130 degrees East, and Gorizont 30 launched on 20 May 1994 and located at 142.5 degrees East. Those 2 slots were leased to the Kingdom of Tonga and are now also known as Statsionar-R1 and Statsionar-R2. "The dispute between Rimsat and several Russian agencies is fairly complex. First of all the 2 satellites were manufactured by NPO-PM, the prime contractor for the Informcosmos agency. Intersputnik is the operator of the Raduga, Gorizont, Gals and Ekspress Russian satellites on behalf of Informcosmos. Those agencies are subsidiaries of the Russian Space Agency (RSA).

"The first agreement between Rimsat and Informcosmos was to build and launch the 2 satellites, and this contract was honored and paid for. Things get mixed up because Rimsat also has an agreement with Informcosmos to build and launch a new generation satellite (possibly in the Ekspress series) and several others with Intersputnik for the lease of aged satellites.

"Rimsat says it stopped paying for the construction of the new satellite in May 1994 because Informcosmos was unable to give details on the construction and launch dates, and another leased satellite wasn't made available in mid-1994 by Intersputnik, even though Rimsat had paid for the satellite.

"After obscure negotiations, Informcosmos decided to take over the 2 Rimsat satellites (Gorizont 29 and 30). This was blocked by NPO-PM, which in turn led to the RSA revoking Informcosmos' license under which Rimsat operated, and giving it to Intersputnik!

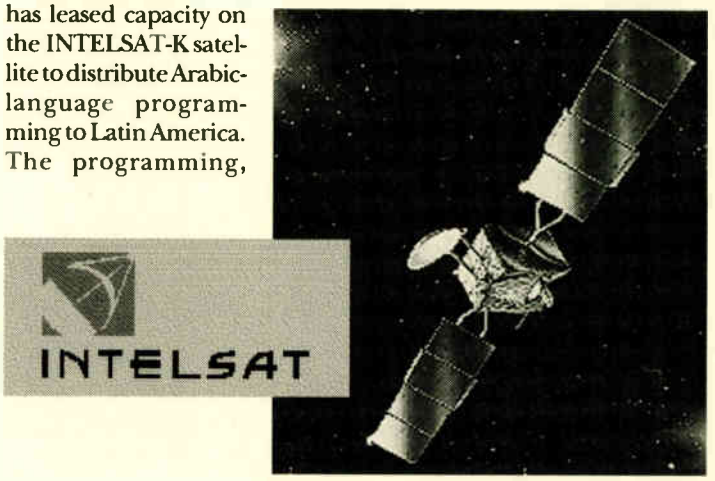
"On August 21, 1995 Rimsat's clients were ordered to make payments to Intersputnik otherwise they would lose service by midnight August 31. An American Federal Court blocked the seizure on August 30 and US Senators protested against the Russian action.

"Meanwhile Intersputnik has reached an agreement with the Kingdom of Tonga for the use of the orbital slots... Since Intersputnik is now authorized by both the satellite owner and the slot owner it claims to be the operator of both Gorizont 29 and 30."

Curiouser and curiouser.....

Latin America

Kelly Broadcasting has leased capacity on the INTELSAT-K satellite to distribute Arabic-language programming to Latin America. The programming,



Teleport London International has signed a 10 year contract with the BBC World Service to distribute multiple digital radio services from Britain.

supplied by Emirates Dubai Television, is the first 24-hour Arabic-language satellite television service available on the continent.

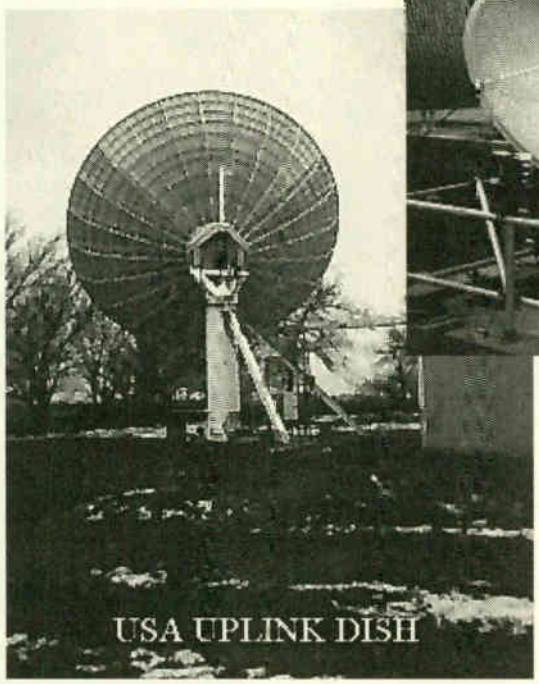
It will provide the 27 million people of Arab descent living in Latin America with Middle Eastern information and entertainment that was previously unavailable.

This new service to Latin America adds to Kelly's menu of foreign-language program offerings. From its Orange, N.J. facility, Kelly distributes Arab-, Greek-, Irish-, Italian-, Polish-, Portuguese-and Russian-language programming throughout the U.S. to foreign nationals eager for news from their country of origin.

General Instrument Corporation and Turner Broadcasting System have announced that TBS will use GI's DigiCipher II equipment to provide compressed video/audio and data services to Latin America. Turner Broadcasting will use GI's DigiCipher II MPEG-2 compatible digital compression system to eventually reach over 1,500 different sites throughout Latin America.

The service will be transmitted over the new PanAmSat 3 which is scheduled to become operational in February 1996.

France's Canal Plus has cancelled plans to begin broadcasts to Latin America, but this is another market that's attracted Rupert Murdoch. His News Corporation is talking to Brazil's biggest broadcaster, the Globo group, about a TVRO service to the Caribbean and Latin America.



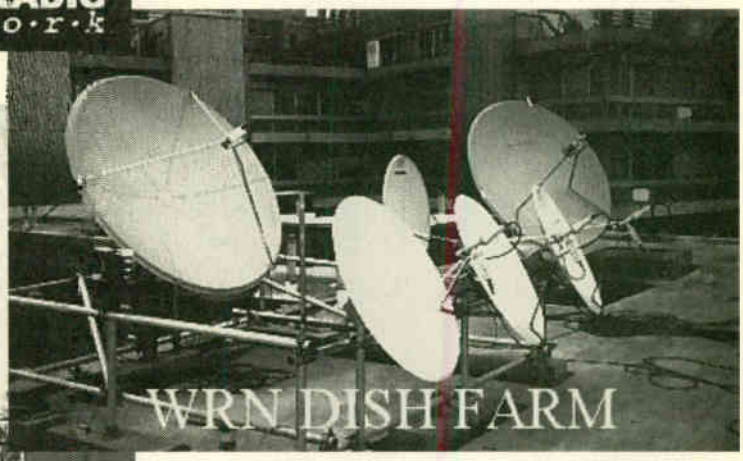
Satellite Radio

Teleport London International has signed a 10 year contract with the BBC World Service to distribute multiple digital radio services from Britain. The service, which began on October 1, involves the supply of uplink services and satellite capacity on the Intelsat 702 satellite. 9 MHz of transponder capacity is being used to relay programming to the BBC's planned Asiasat 2 uplink in Cyprus, and for broadcast to the Middle East and Africa.

Alcatel Alsthom says its Alcatel Espace unit has started to construct and deliver the WorldSpace global audio satellite system. WorldSpace said in the same statement that it had closed its $650 million long-term financing.

The system includes the in-orbit delivery of three satellites — Caribstar, Afristar, and Asiasat. The system, using digital audio broadcasting to reach Third World countries, is due to start in 1998. The portable radio receivers are expected to cost initially less than $100.

The America One 24 hour European service from National Public Radio and Public Radio International is set to go on the air in January, most likely on the same transponder as the World Radio Network, Astra transponder 22, with sound at 7.74 MHz. NPR/PRI programming on WRN will drop from 10 to 8 hours a day, which will be simulcast on the new service, which will offer an additional 16 hours a day of American public radio programming.



While this is technically outside the geographic range of the International TVRO column, if no one minds, I'd just like to point out that Radio Sweden's Swedish service has joined Radio Finland on the World Radio Network's new WRN2 service to North America. Other WRN2 broadcasters include RTE in Ireland and Radio Vlaandern International. Like WRN1, the new service is on Galaxy 5, transponder 6, which is WTBS. The audio is 6.2 MHz, and you can hear Radio Sweden in Swedish there daily at 2:00 PM Eastern Time, 11:00 AM Pacific.

That's it for this time. You send contributions or corrections by e-mail directly to: *wood@rs.sr.se.* Radio Sweden's World Wide Web site is up and running at: *http://www.sr.se/rs* and includes multimedia versions of the MediaScan programs, sound archives of past interviews, and a page of links to radio and TV Web sites around the world.

Thanks to James Robinson, Curt Swinehart, Nils Sundstroem and Frank Ostergren of the newspaper *Aftonbladet*, Bertil Sundberg, the *Tele-satellit* newsletter, *What Satellite TV*, and Kauto Huopio for their many contributions. ST

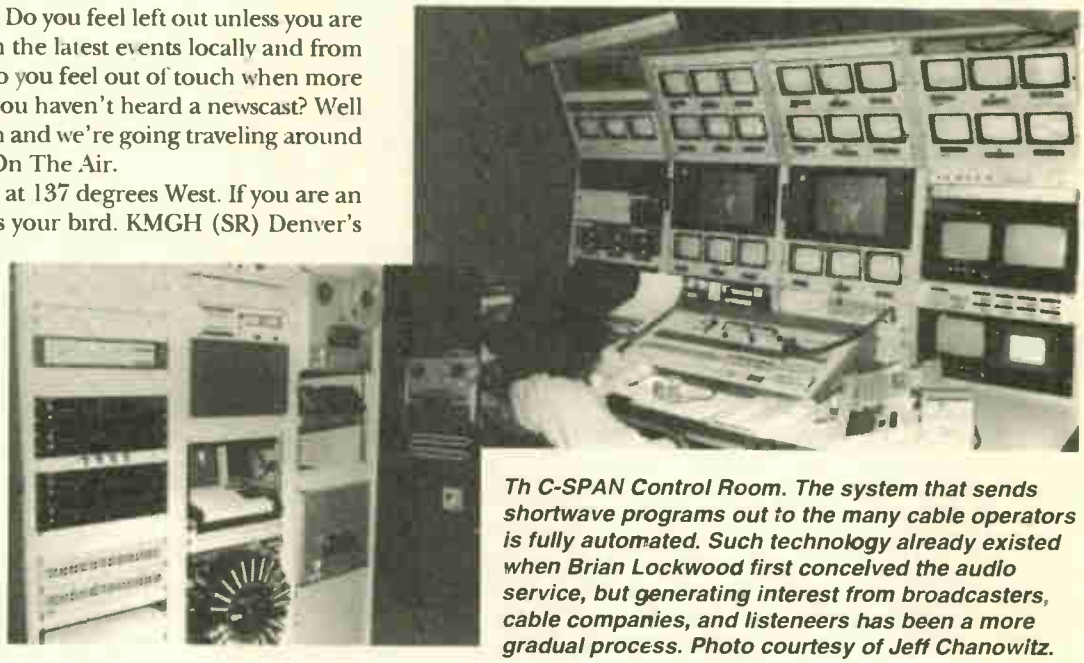
ON THE AIR

By Steve Handler

OTA Guide to Satellite News

Are you a news junkie? Do you feel left out unless you are able to be kept up on the latest events locally and from around the world? Do you feel out of touch when more than a half hour goes by and you haven't heard a newscast? Well news buddy, crank up that dish and we're going traveling around the satellite arc to find news, On The Air.

Our first stop is Satcom C1 at 137 degrees West. If you are an expatriate from Denver, this is your bird. KMGH (SR) Denver's ABC affiliate can be found on channel 3. KCNC (SR) the CBS affiliate hangs out on channel 6. NBC affiliate KUSA (SR) makes its home on channel 14. Finally, independent Denver station KWGN (SR) is on channel 23. If it's local Denver news you are looking for then C-1 is the place to be. Start by checking the normal morning, noon and evening news time slots, there is no shortage of local Denver coverage on satellite. Just remember that these stations are in the mountain time zone so plan your viewing accordingly.



Th C-SPAN Control Room. The system that sends shortwave programs out to the many cable operators is fully automated. Such technology already existed when Brian Lockwood first concelved the audlo service, but generating interest from broadcasters, cable companies, and listeneers has been a more gradual process. Photo courtesy of Jeff Chanowitz.

As we move East in the domestic arc, our next stop is Satcom C4 at 135 degrees West. If your high school German is up to par, hit channel 5 on your remote. There you will find Deutsche Welle TV from Germany. Even if your German is not quite at the conversational level, Deutsche Welle's programming also includes English language news coverage. On a recent Saturday evening I was treated to a half hour English newscast. It's interesting to note the subtle differences between American news coverage and that offered by journalists in European countries.

For those of you that dream of being on Broadway, park your dish on C-4 channel 15. WWOR (SR) is in New York and local news is broadcast at 10 p.m.

If you are having trouble falling asleep, then flip to C-SPAN 2 on channel 19. Day and night, C-SPAN 2 provides not only live coverage of the U.S. Senate when it is in session, but numerous other public affairs programs. While some of C-SPAN 2's programming is quite interesting, some people find that it provides just the touch needed to nod off and catch 20 winks.

As we move further east along the arc, our next stop is Galaxy 1R at 125 degrees West. This bird is home to Ted Turner's "global" news station, CNN International (SR) on channel 15. If it's world news you want, this is the right place to be. Although similar in many ways to CNN on Galaxy 5 channel 5, CNN International has more of a world flavor during their newscast.

As we move it up and head 'em out we continue east to Satcom C3 at 131 degrees West. This bird is home of the U.S. House of Representatives (C-SPAN 1) and that can be found on channel 7. Yes, you to can watch your tax dollars at work with live coverage of the U.S. House of Representatives. Congressional hearings also abound along with one of my favorites — coverage of National Press Club meetings. You can bet that the speakers at the National Press Club are movers and shakers talking about events that affect this country and the world.

Rain today? Find out by tuning into channel 13, home of the Weather Channel. Is it raining in Maine? Are hurricanes expected in Florida? Is it foggy in San Francisco? Find out on the Weather Channel.

Tickle that rotor and continue to move east to Galaxy 5 at 125 degrees West. Our first stop is on channel 5, home of CNN (SR). In my mind Turner's flagship news channel is one of the giants of the news business. When I want in depth news coverage of a breaking story, this is where I look first.

If you like your news in bite size chunks, try Turner's CNN Headline News on channel 22. Top news stories and weather air from the top of the hour to 14 minutes after each hour and from the half hour to 44 minutes after the hour. *Dollars and Sense*, can be seen from 14 to 20 minutes, and from 44 to 50 minutes after the hour. For the sports fans — sports news airs from 20 to 24 minutes, and from 50 to 54 minutes after each hour. For those that like stars and style, tune in at 24 and 54 after each hour to CNN HN's *Stars and Style* segment. WTBS (SR), Ted Turner's Atlanta superstation on channel 6, also carries a feed from CNN Headline news during its 5:35 a.m. weekdays newscast.

If news about the royal family and the United Kingdom is your cup of tea, then switch to channel 13. About 3:00 a.m. weekdays you should see a feed of the BBC News from London.

Do you hail from the Windy City? Yes, there is plenty of hail, snow and sleet in my kind of town, Chicago. To find out what's happening in Chicago, try WGN (SR) on channel 7. They play hardball in Chicago and I'm not talking about the Cubs and Sox. If politics is your interest, Chicago is your place. WGN's weekday news coverage at 8:00 a.m., 1:00 p.m. and 10:00 p.m. takes you to the heart of Chicago's news. On Saturdays it's at 9:00 a.m. and 10:00 p.m. and on Sundays at 10:00 p.m.

Want to mind your business, then try Channel 13. CNBC (SR) is a business news channel has some of the finest news coverage on today's business and financial news. Whether it is the stock market, investing or general business news that you crave, CNBC is worth looking at.

Off we go again, and by heading further east in the domestic arc, our travels take us north to Canada and Anik E-1 at 111 degrees West. On channel 9 you will find the Canadian Weather Network. If you want information on weather conditions in Canada, this is the place to look first. If the temperatures look a little on the low side, remember that Celsius is used, not Fahrenheit.

If news about the royal family and the United Kingdom is your cup of tea, then switch to channel 13. About 3:00 a.m. weekdays you should see a feed of the BBC News from London.

SNG Truck for KOBTV NEWSTAR. Photo courtesy of B.W. Battin.

Satellites are Threathened

The signs are ominous. In November of 1998 and again in 1999, the earth is likely to encounter the worst meteor storm in 33 years that could threaten the over 250 satellites in geostationary orbit.

Canada and several other countries are under the biggest risk since their satellites carry all of national TV networks, but anyone that has a satellite in geostationary orbit will be under the gun.

The approaching meteor storm, known as the Leonids, 'presents about three years' worth of debris in about an hour, says Don Kessler of the National Aeronautics and Space Administration (NASA).

Satellite Times contacted Dr. Nicholas Johnson at Kaman Sciences in Colorado Springs, and he confirmed that the satellite industry, particularly the space insurance agencies are concerned about this future event. "We could see debris entering our atmosphere at a rate 30-40,000 times of the normal background," Johnson said. "We will have meteors streaking toward earth at 70 km per second. That can cause a lot of damage to a satellite in geostationary orbit."

Report courtesy of the BBC Monitoring Service and Satellite Times staff.

For some cool news from Canada, try CBC-East on channel 23. News is aired weekdays from 2:00 to 6:00 a.m., and 9:00 to 10:30 p.m. Sunday news airs from 10:00 to 10:30 p.m. For western Canada, CBC-West on channel 11 airs news from 8:00 a.m. to 12:00 noon, 9:00 to 10:00 p.m., and 1:00 to 1:30 a.m. Sunday news airs from 2:00 to 2:30 a.m. For an English speaking station in the heart of French Canada, try CBMT, CBC's Montreal station. Broadcasting on channel 20, news on weekdays can be viewed from 7:00 to 9:00 a.m., 6:00 to 7:00 p.m., and 10:00 to 11:30 p.m.. Saturday news airs from 6:00 to 7:00 p.m.

Our next stop is the other Canadian satellite — Anik E-2 at 107.3 degrees West. Try channel 20 for NTV from Newfoundland. Weekday news broadcasts starts at 6:30 a.m. with *Canada AM* and airs for two hours. At 10:30 a.m. another half hour of news airs on NTV. From 4:30 to 5:30 p.m., and 11:00 p.m. to midnight you can see more news from Canada on NTV. On Saturday, *Canada AM Weekend* airs from 11:00 a.m. to Noon. A half hour of news at 4:30 p.m. airs followed at 11:00 p.m. with an hour newscast. *Sunday Edition* airs at noon with news following for an hour at 11:00 p.m.

Now grease up that actuator arm and move that dish east to Spacenet 4 at 101 degrees West. This bird is a dream for expatriates from several larger cities. Do you call Bunker Hill your home? Then channel 2 should be just what your looking for. There you'll find WHDH (SR) Boston's NBC affiliate station an Atlantic 3

network station. If you grew up in Washington, D.C., WUSA (SR) shines like a monument on channel 4 (Atlantic 3 network). On channel 8 is KOMO (SR) the Seattle ABC affiliate (PrimeTime 24 West) and, although you won't find Frasier, you will find local Seattle news. Fox's Chicago affiliate WFLD (SR) is on channel 10 (PrimeTime 24). If you miss Walter Jacobson, you may find him here. WPLG (SR), is the local Miami ABC affiliate (Atlantic 3 network) and you can find it on channel 18. For news about the streets of San Francisco, channel 24 plays host to KPIX (SR), the CBS affiliate (PrimeTime 24) in San Francisco. If local news from any of these cities is what you crave, you should be able to fill your desires by tuning in during the traditional early morning, noon and evening news time slots.

Once again we continue to the east to Galaxy 4 at 99 degrees West. Here will will find the three Primetime 24 East network stations. The Big Apple's ABC station, WABC (SR), is on channel 10 as is the NBC flagship station WNBC on channel 22. WNBC recently replaced WXIA in Atlanta (see Domestic TVRO in this issue-ed) as PT24's East Coast NBC affiliate. PT24's CBS affiliate WRAL (SR) is from Raleigh, North Carolina, and it is on channel 14. Like most network affiliate stations, try for local newscasts during the normal morning, noon and evening news time slots.

Channel 24 on G-4 might also be of interest to the news hound. This is the CBS Newspath channel and is broadcast in the clear. It does not appear to be intended for the casual TVRO viewer. Newspath carries news stories for use by the network and local CBS affiliates. CBS affiliates can tune into this channel and record news stories from other CBS affiliates nationwide for use on their own local news programs.

Next we stop at Spacenet 3 at 87 degrees West. This bird will bring you news from both coasts. UPN affiliate WSBK (SR), Boston can be found on channel 3 with news weekdays at 10:00 p.m. On channel 9 is Warner Brothers affiliate WPIX (SR), from New York City with a local weekday newscast at 10:00 p.m.and 1:30 a.m. On the west coast you will find superstation KTLA (SR), from Los Angeles on channel 15. Beside being able to watch the morning news show for three hours staring at 9:00 a.m., their weekday news also airs at 3:00 p.m., 1:00 and 3:00 a.m. Saturday and Sunday newscast are available at 1:00 a.m.

I found KTLA to be a wonderful source for news during the recent California earthquake in L.A. When the Los Angeles earthquake hit, my wife immediately turned to CNN. I remembered that KTLA was in Los Angeles and in a battle for the remote control, I prevailed. [As a side note, my wife's memory is that I wanted CNN and she wrestled the remote away and turned on KTLA, but since this is my column, my version will prevail]. KTLA's earthquake coverage was not only impressive, but coming from a station that was from Los Angeles, it had a quality of personal journalism that can't be described. It definitely added a lot to the coverage of this event. By the way, when major news breaks from any of the cities who have local stations available in our domestic arc, you might tune in these local stations to get the "local" view of a breaking news story.

For those who speak Portuguese we'll make a quick stop at the new Telstar 402R at 87 deg West. On Channel 18 you will find RTPi with news in Portuguese. Since my knowledge of the Portuguese language is non existent at best, all I can say it that the station is there and if you can speak Portuguese, give it a try.

Go a little further east and you will arrive at Galaxy 6 at 74 degrees West. Recently, I have seen the fore mentioned CBS Newspath on channel 1 using 6.2 wide audio. I am not sure how long it has been here, nor how long it will stay. It appears to carry news stories similar to those seen on channel 24, Galaxy 4. For those brushing up on their Japanese, NHK — the Japanese TV network, is on channel 6. You can see them in the early morning and early to late evening hours with newscasts. The Fox network news service was recently using channel 11 as a news feed channel. These feeds appeared to be destined for Fox affiliates for use during their local news broadcasts.

As we reach the end of our journey, we arrive at Satcom SN-2 (also known as Spacenet S-2) at 69 degrees West. Channel 3 on this bird has a mixed bag of goodies. Depending on the time of day you will find the U.S. Information Agency's *Worldnet* broadcasting on this channel. From the same people that bring you the Voice of America, the USIA's *Worldnet* is programming for viewers outside the USA. C-SPAN and Deutsche Welle programs also air on this channel.

Last and certainly not least, is NASA TV on channel 9. NASA TV carries all space shuttle launches live from prelaunch coverage through to post touchdown activities. This is one of my personal favorites. Whether it's watching the launch of the space shuttle, in orbit activities, live spacewalk coverage, or watching a shuttle landing, you are watching not only history in action, but America's continuing exploration of space. It's your tax dollars at work and one heck of a bargain, so give NASA TV a view.

Had your fill of news yet? If not, there are a number of stations that I have not touched on. You have a remote control, take control of that dish and see what you can find — *On The Air.*

Note: Although we have tried to be accurate, information contained herein may contain errors and is also subject to change. Other newscasts air beside those listed in this column. All times mentioned in this column are Eastern Time. The abbreviation (SR) indicates that the station requires a subscription to view their programs. For details on the costs or charges for these stations, contact a programming provider. Subscription to network stations does require the customer to be outside the Grade B coverage zone of local network affiliates by law. ST

By Keith Stein
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Exploring Satellites in the VHF Band

Go ahead and say it. "Another year has gone by?" That's right, but don't let it get you down. Take a moment to think about all the great things you learned by reading this magazine. Think of yourself as being a year smarter, not a year older.

The end of 1995 was actually the beginning column. We started you off in the November/December issue with a look at the high frequency (HF) radio spectrum — scoping out the few satellites and space operations still active in that area of the spectrum. In this edition of *Listening Post* we will step up into the very high frequency (VHF/ 30-300 MHz) spectrum, and investigate some of the easier satellite signals to receive and decode.

For years satellites have filled the VHF spectrum with all types of telemetry downlinks. There are some voice channels to hear in this region as well. One of the best known voice satellites is the U.S. Applied Technology Satellites (ATS). Several of these birds were launched in the series, but only ATS-3 is still active. It is currently located at 106.5 degrees West in a highly inclined orbit. Look for downlink signals in the satellite's bandpass of 135.550-135.650 MHz. A variety of modes have been reported in use on the ATS birds. In fact, rumors have circulated in the hobby press over the years that the DEA/U.S.Customs service have used the ATS birds for communications. Reports on what you are hearing now from ATS-3 are always appreciated.

Russian air-to-ground voice from the Mir space station is also located in this portion of the VHF spectrum. Check out 143.825 MHz narrowband FM.

Transmissions in the 135.555-144.000 MHz region favor narrowband FM, but other modes are used as well. Weather satellite FAX signals are widely heard in this range and can readily be demodulated. The majority of the rest of the satellite signals consist of telemetry data signals.

In the two meter ham band from 145.8-146.0 MHz you will find amateur radio satellite downlinks. CW, RTTY, Packet, and SSB voice transmissions are the major modes in use. The UoSat satellites can be widely heard on the simplest of equipment using narrowband FM. These satellites even carry digital voice downlinks.

U.S. and Russian navigation satellites also send telemetry in the 149.9-150.100 MHz area. The Russian navsats can be found on the following frequencies: 149.910 (military), 149.940 (military), 149.970 (military), 150.000 (civilian), and 150.030 (military). U.S. Navy Transit navsat frequencies include: 149.9873 (testing frequency), 149.9787 (testing frequency), and 149.988 (operational frequency).

Starting at the low end of the VHF band, we will take a look at some satellites we have not received reports on. These should give you a few new targets to listen for.

Interplanetary Monitoring Platform-8 (IMP-8)

Also known as Explorer 50, IMP-8's mission objective is to study the cislunar radiation environment over a solar cycle and to measure the interplanetary magnetic field and the Earth's magnetosphere. The spacecraft was launched in 1973 and is currently in an orbit of 189,024 km x 247,267 km, inclined 29 degrees with a period of 17,646.5 minutes. Real time telemetry is transmitted on the following frequencies using a 32-kbps data signal:

136.020 136.800 137.580 137.980 138.000

Russian Plasma Physics Satellite

We need your help identifying this one. Currently, the only information known about this spacecraft is its downlink frequencies and its mission, but what is its real name? I've done some research and can only guess that it is one of Russia's Intercosmos satellites of which 25 or more have been launch. If you can find more concrete information on this nongeostationary orbiter, please let us know. The only lead I can provide is that it is a Russian satellite conducting space plasma physics experiments in a 1,875 km by 376 km orbit inclined 82.6 degrees. Here are the downlink frequencies:

136.070 136.350 137.450

Navy Radiation Experiment Spacecraft

Here is another good research project, the Navy's Solar Radiation Satellite (SOLRAD). This spacecraft is very old, but reports seem to indicate that it is still operational. Not much is known about this orbiter and again your help is needed in investigating the unknown. This spacecraft is circling the earth in a 931 km by 897 km orbit, inclined 70.1 degrees with a period of 103.2 minutes. Here are the downlink frequencies:

136.320	136.380	136.520	136.770	136.800
136.830	137.020	137.050	137.080	137.380
137.410	137.440	137.590	137.710	137.730
137.740	137.770	137.800	137.820	137.980

APT Weather Satellites

I'm not going to spend too much time on these systems since *ST* has this area is covered by Dr. Jeff Wallach in his *View From Above* column.

Weather satellites are very helpful tools in forecasting storms, jet streams, upper-level winds, fog, ice, and snow systems. Currently there are three polar orbiting weather birds available to the beginning satellite monitor. These are some of the easiest spacecraft to hear in this part of the VHF band. Here are some selected APT frequencies to try for:

136.770 (NOAA) 137.500 (NOAA) 137.620 (NOAA) 137.770 (NOAA)
137.850 (METEOR)

One other frequency to note would be the downlink for Europe's METEOSAT-3 geostationary weather satellite. It can be monitored on 137.080 MHz.

Orbcomm Satellite Launched

In 1992 Orbital Sciences Corp. (OSC), based in Dulles, Virginia, surprised the commercial satellite industry with the secret launch of their first ORBCOMM test satellite. The Orbital Communications Corporations (ORBCOMM) constellation of 26 satellites will provide person-to-person global messages, automotive and maritime communications, remote industrial asset monitoring, emergency rescue, remote recreation, stolen vehicle recovery, radio determinations and cargo location services.

Known as OXP-1, the first ORBCOMM satellite was launched with a Brazilian satellite onboard an OSC's Pegasus air-launched vehicle. The launch wasn't announced until the spacecraft was already in orbit. Engineers are continuing to conduct tests to demonstrate the communications capabilities of OXP-1 which is still operational after 2 years of service. Here are the downlink frequencies for OXP-1 and two other ORBCOMM's that were launched this year:

137.050 137.225 137.575 137.985

High Energy Transient Experiment (HETE)

Here is something you can get ready for since its not in orbit yet. NASA's HETE spacecraft is scheduled to be launched in March onboard a Orbital Sciences Pegasus XL booster. Once in orbit, HETE will investigate and attempt to understand the basic nature of cosmic gamma-ray bursts. After achieving a 500-km orbit inclined 38-degrees, the spacecraft will transmit telemetry on 137.960 MHz. Stay tuned to the *Satellite Listening Post* for details on this mission as we get closer to launch.

This is the first part in a series in the Listening Post on the various VHF radio bands currently used by satellites. In the next issue of *ST* (March/April 1996), we will take an in-depth look at the 2-meter amateur radio spectrum (145.8-146.0 MHz).

That's it for this issue, and now it is time to see what you've been hearing at your satellite listening post.

Satellite Intercepts

All times in UTC. All voice transmissions in English unless otherwise noted. Abbreviations used in this column

AMSAT	Amateur Radio Satellite Corp.
CW	Continous Wave or Morse Code
E	East
FLTSATCOM	Fleet Satellite Communications
FM	Frequency Modulation
G	Gigahertz
ITC	In the clear
K	Kilohertz
LSB	Lower Sideband
M	Megahertz
METEOR	Multiple Experiments to Earth Orbit and Return
NASA	National Aeronautics and Space Administration
NFM	Narrow FM
R0MIR	Amateur Radio Callsign
RTTY	Radioteletype
SSB	Single Sideband
STS	Space Transportation System
TDRS	Tracking & Data Relay Satellite
USB	Upper Sideband
UTC	Coordinated Universal Time
W	West

K3860	WA3NAN-Goddard Amateur Radio Club, MD, retransmission of space shuttle air-to-ground communications (Mission STS-73) at 2248 in LSB. (Keith Stein-Woodbridge, VA)
K10780	Cape Radio working Antigua Radio at 1538 in USB "TMS is still down." "Ok its changing here stand by..." "however I still have an alarm on the TMS." (David Stein-Springfield, VA)
K14295	W5RRR-NASA Johnson Space Center heard at 1813 in USB conducting Shuttle Amateur Radio Experiment (SAREX) coordination net for STS-74 (K.Stein-VA)
K20390	Cape Radio working KING52 for a radio check at 1509 in USB (D.Stein-VA)
K21394	WA3NAN-Goddard Amateur Radio Club, MD, retransmission of space shuttle air-to-ground communications (Mission STS-73) at 1637 in USB (D.Stein-VA)
M103.300	WESR-FM, Onley-Onacock, VA, heard at 2130 providing "LIVE COVERAGE" of Conestoga/METEOR launch at Wallops Island, VA. Vehicle was launched at 2202 and exploded 46 seconds later (K Stein-VA)
M121.950	NASA432 (Fokker-27) radar surveillance aircraft heard at 2145 in AM. Reporting on ship positions in the area of Wallops Island, VA. This was during the Conestoga/METEOR mission launch countdown.Vehicle was launched at 2202 and exploded 46 seconds later. (K Stein-VA)
M145.550	Packet radio contact between R0MIR (Russian cosmonauts aboard Mir space station) and KF0QS (Bernard Poskus) at 0610. (Bernard Poskus-Broomfield,CO) German Cosmonaut Thomas Reiter (callsign DP0MIR) at 2015 in NFM. This was right around their normal bedtime.(K Stein-VA)
M145.840	Brent Taylor (VE1JH) made a voice contact with Mission Specialist William MacArthur (KC5ACR) aboard space shuttle Mission STS-74. The contact was made at 1253 in NFM (Brent Taylor-New Brunswick, Canada)
M146.835	Washington DC Area AMSAT Information Net at 0200 in NFM with WD8LAQ (Pat) as Net Control. Some stations checking into the net included KC4YER (Phil), N8FGV (Dan), KA3PVM (Dan) (K Stein-VA)
M147.450	WA3NAN-Goddard Amateur Radio Club, MD, retransmission of space shuttle launch countdown (STS-73) at 1300 in NFM. Launch was scrubbed due to equipment failure aboard shuttle (K Stein-VA)
M254.150	Callsign Night01 asking Social (or Sokal) if he has "obtained any contraband and does he have any traffic for the Embassy?" Social responds with a "negative, just checking out the towns on the border and making liaisons." Believed to be from MARISAT 1 (106.4 deg W) in NFM (Mil Watcher-NM)
M259.700	Heard several air-to-ground voice transmissions from space shuttle Atlantis (Mission STS-74) during its launch phase at 1234 in AM mode. (William Marchant-Washington D.C.).
M262.350	FLTSATCOM channel Charlie being used for plain and encrypted traffic with 262.300 as a back up at 0100 in NFM. Tactical callsigns noted. (Bill Merrell-Hallstead, PA)
M408.400	NASA Headquarters Security units, Alpha4, Alpha5, Alpha11, and Dispatch conducting routine patrols of building at 1330 in NFM (K Stein-DC)
G3.8600	A beautiful NTSC slate was displayed on Brasilsat 1A (near 63.5 deg W) at 2231. Video bars seen on ch. 8, 10 vertical (domestic video frequencies). Seems to have comparable signal strength to TDRS - hotter than nearby Intelsats. Hughes has re-directed the footprints of this satellite for sending newsfeeds, etc.to North America (Curt Swinehart-East Kingston, NH)
G4.0200	Telstar 401 (97 deg. W) providing "Live" video of Titan IV launch of Milstar 1-2 from Cape Canaveral, FL at 0315 on transponder 16. (Swinehart-NH)
G11.4920	There is a new channel ITC called Ecclesia on Hot Bird 1 (Eutelsat II F6, 12.8 deg. E), vertical. Audio on subcarrier 6.65 MHz. It's Italian and shows some religious ceremony at 0930. An onscreen logo is present all the time (Robin Clark-United Kingdom).
G11.7200	BBC Breakfast News found on PanAmSat 1 (45 deg. W) at 0805. Program ended abruptly at 0825. Audio on 6.2 and 6.8 MHz (Jeremy Forster-Halifax, Canada).
G11.8425	Intelsat K satellite (21.5 deg. W) carried a long series of Science Fiction Channel promos on the Reuters Television London channel, ending at 2100 (J. Forster-Halifax, Canada).
G11.8500	Seeing some CONUS activity on SBS 5 (123 deg. W) vertical at 1839 (Ed Thomas-Canton, OH).
G11.9200	NHK Paris had a slate up on Panamsat 1 (45 deg. W) at 0241. This is the first analog video to be seen on this bird in a while. (Brian Litzenberger-Garden City, KS).

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

CLASSICAL

Classical music	E1, 9	6.32 (N)
Classical music	E2, 22	6.30
KUCV-FM (90.9) Lincoln, Neb. (Nebraska Public Radio)	S3, 2/4	5.76/5.94 (DS)
SuperAudio — Classical Collections	G5, 21	6.30/6.48 (DS)
WFMT-FM (98.7) Chicago, Ill.	G5, 7	6.30/6.48 (DS)
WQXR-FM (96.3) New York, N.Y., 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
Planet Connect, Planet Systems, Inc 100 kbps service	G1, 9	7.80
Skylink, Planet Systems, Inc	G1, 9	7.265
	G1, 14	7.265
	G4, 6	7.264
Storyvision	G5, 3	7.30
Superguide	G5, 7	5.48

CONTEMPORARY

Safeway In-Store Radio — contemporary	S3, 18	5.78, 5.96, 6.48
SuperAudio — *Light and Lively Rock*	G5, 21	5.96, 6.12 (DS)
WVTY-FM (96.1) Pittsburgh, Pa.	C1,18	7.28

COUNTRY

CINC-FM (96.3) Thompson, Manitoba	E1, 2	6.40
Safeway In-Store Radio — country	S3, 18	6.12
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, Tenn., ID-*The Hit Kicker*	E2, 18	6.20
WSM-AM (650) Nashville, Tenn.	G5, 18	7.38, 7.56
WSM-FM (95.5) Nashville, Tenn.	C4, 24	7.38, 7.56

EASY LISTENING

Easy listening music, unidentified station	G4, 6	7.69
Safeway In-Store Radio — easy listening	S3, 18	6.32, 7.22, 7.40
SuperAudio — *Soft Sounds*	G5, 21	5.58/5.76 (DS)
United Video — easy listening	C4, 8	5.895 (N)

FOREIGN LANGUAGE

CBC Radio-East (French)	E1, 20	5.38/5.58 (DS)
	E1, 20	7.36
CHIN-AM/FM (1540/100.7) Toronto, Ontario Canada, ID-*CHIN* — multilingual	E1, 2	7.89
CITE-FM (107.3) Montreal, Quebec Canada (French) — soft adult contemporary	E1, 21(Ku-band)	6.12, 6.20
CKAC-AM (730) Montreal, Quebec Canada (French) — adult contemporary	E1, 21(Ku-band)	6.43, 6.55
Cosmos FM, Hellenic Public Radio, New York, N.Y. (Greek)	S2, 11	8.30
DZMM-Radyo Patrol (from Philippines)	G4, 24 (Ku-bd.)	6.80
French language audio service	E1, 15	6.12
India ethnic radio	E1, 2	7.61
Indian Sangeet Sager	E1, 15 (Ku-bd.)	6.12
Irish music (Sat 1430-0000 UTC)	S3, 3	6.20
Northern Native Radio (Ethnic)	E2, 26 (Ku-bd.)	6.43/6.53 (DS)
RAI Satelradio (Italian)	C1, 15	7.38
Radio Canada (French)	E1, 15	5.40/5.58 (DS), 5.76
Radio Dubai (Arabic)	G7, 10	7.48
Radio Energie	E1, 24 (Ku-bd.)	6.12/6.30 (DS)
Radio Maria (Italian-Religious programming)	G7, 10	5.80
Radio Sedeye Iran (Farsi)	S3, 15	6.20 (N)
Radio Sonora-Mexico (Spanish)	SD1, 6	6.80
Radio Tropical (Haitian Creole)	S2, 11	7.60
Religious music (unid language)	G7, 10	8.03
Russian-American radio network	SBS5, 14 (Ku-bd.)	6.20
The Clanny Channel (Spanish) — Anti-Castro Cuban clandestine programming-occasional audio	S2, 4	5.80
The Weather Network-Canada (French)	E1, 9	5.94
Trinity Broadcasting radio service (Spanish) SAP — religious	G5, 3	5.96
WCMQ-FM (92.3) Hialeah, Fla. (Spanish), ID-*Mega 92* — contemporary hit radio	S2, 4	7.74, 7.92
WCRP-FM 88.1, Guyama, P.R. (Spanish) — religious	G4, 6	6.53
WLIR-AM (1300) Spring Valley, N.Y. (Ethnic)	S2, 1	7.60
WNTL-AM (1030) Indian Head, Md./Arab Network of America radio network (Arabic)	G6, 10	5.80
WNWK-FM (105.9) Newark, N.J.(Ethnic)	S2, 11	8.30
XEW-AM (900) Mexico City, Mexico (Spanish), ID-*LV de la America Latina*	M2, 8	6.80
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
XEX-AM (730) Mexico City, Mexico (Spanish), ID-*Frecuencia Libre*	M2, 14	6.80

JAZZ

KLON-FM (88.1) Long Beach, Calif., ID-*Jazz-88*	G5, 2	5.58/5.76 (DS)
Superaudio — *New Age of Jazz*	G5, 21	7.38/7.56 (DS)
WQCD-FM (101.9) New York City, N.Y., ID-*CD 101.9, Cool FM*	C4, 6	6.20

NEWS AND INFORMATION

Arkansas Radio Network	G4, 6	6.20
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
USA Radio Network — news, talk and information	S3, 13	5.01 (Ch 1), 5.20 (Ch 2)
WCBS-AM (880) New York, N.Y. — news	G7, 19	7.38
WCCO-AM (830) Minneapolis, Minn.	G6, 15	6.20
WGN-AM (720) Chicago, Ill./Interstate Radio Network (overnight) — talk	E1, 2	5.22

Satellite Radio Guide

RELIGIOUS

Ambassasor Inspirational Radio	S3, 15	5.96, 6.48 (DS)
American Spirit Network/KYND-AM (1520) Houston, Tex. — Religious/variety (weekends)	S3, 24	7.40
Brother Staire Radio	G5, 6	6.48
CBN Radio Network/Standard News	G5, 11	6.12
	C3, 1	6.20
Heaven Radio Network	G1, 17	7.92
KILA-FM (90.5) Las Vegas, Nev. — SOS radio network	C4, 8	7.38/7.56 (DS)
Salem Radio Network	S3, 17	5.01
Trinity Broadcasting radio service	G5, 3	5.58/5.78 (DS)
WCIE-FM (91.1) Lakeland, Fla.	S2, 21	6.20,7.60
WHME-FM (103.1) South Bend, Ind, ID-*Harvest FM*	G4, 15	5.58/5.78
WROL-AM (950) Boston, Mass. (occasional Spanish)	S3, 3	6.20
Z-music — Christian rock	G1, 6	7.38/7.56

ROCK

CHOZ-FM (94.7) St. John's, Newfoundland Canada, ID-*Oz FM*	E2, 20	5.76/5.96 (DS)
CILQ-FM (107.1) Toronto, Ontario Canada, ID-*Q-107*	E1, 2	5.76/5.94 (DS)
Safeway In-Store — oldies	S3, 18	5.20, 5.40, 7.58
Seltech Radio Syndicated service — classic rock	E1, 2	5.40/5.58 (DS)
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, N.J. (Skylark Radio Network) — oldies	G4,22	5.80

SPECIALITY FORMATS

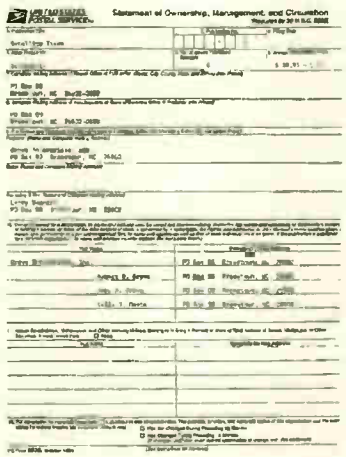
Aries In Touch Reading Service	C5, 24	6.48
	C4,10	7.87
Colorado Talking Book Network	C1, 2	5.58
C-SPAN I ASAP (program schedule)	C3, 7	5.58
C-SPAN II ASAP (program schedule)	C4, 19	5.58
Georgia Radio Reading Service	T401, 14 (Ku-bd.)	5.76
Nebraska Talking Book Network	S3, 4	6.48
Starsound Gold Radio Network	S3, 24	5.80
SuperAudio — Big Bands (Sun 0200-0600 UTC)	G5, 21	5.58/5.76 (DS)
The Weather Channel-USA — occasional audio	C3, 13	6.80
The Weather Channel-USA — classical music	C3, 13	7.78
The Weather Network-Canada (English)	E1, 9	5.41, 5.58, 5.76, 6.80
Voice Print Reading Service	E1, 16	7.44 (N)
Yesterday USA — nostalgia radio	G5, 7	6.80
	T402R, 11	5.80

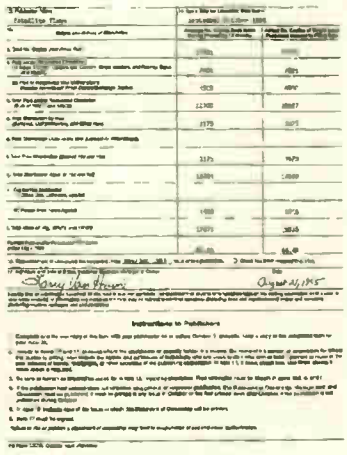
TALK

AEN Michael Reagan (0100-0700 UTC)	C3, 1	6.20
Burlington Broadcast Network	G6, 14	7.56
For the People radio network — (Chuck Harder) talk and information	C1, 2	7.50
KTRT-AM (1270) Claremore, OK	T2, 2	5.60
Marinet Broadcasting	G6, 23	8.10
Mutual Broadcasting Network — talk show feeds	E1, 2	7.54
One on One Sports radio network — sports talk	E1, 2	7.45
Practical Radio Communications (audio distribution circuit)	T2, 2	7.90
Prime Sports Radio — sports talk and information	C1, 10	7.20
	S3, 24	7.78
Sun Radio Network — talk programs (backhauls)	C1, 15	7.58
Talk America — talk programs	S3, 9	6.80
Talk Radio Network — talk programs	C1, 5	5.80
Tech Talk Network	G6, 15	6.20
(Note: TTR Network will follow Skyvision Channel video uplink to G7 or other occasional video spots in the arc that Skyvision will use in the future)		
USA Patriot Radio Network	G6, 14	5.80

VARIETY

American Urban Radio — news/features/sports	S3, 9	6.30/6.48 (DS)
CBC Radio (English)	E1, 16	5.40/7.58, 5.58
CBC Radio (occasional audio)	E1, 20	5.78
CBC-FM Atlantic (English)	E1, 16	6.12/6.30 (DS)
CBC-FM Eastern (English)		E1, 16
5.76/5.94 (DS)		
CBM-AM (940) Montreal, Quebec Canada — variety/fine arts	E1, 20	6.12
CBU-AM (690) Vancouver, British Columbia Canada	E1, 10	7.42
CFR-FM	E2, 19 (Ku-bd.)	6.12/6.30
CJRT-FM (91.1) Toronto, Ontario Canada — fine arts/jazz-nights	E2, 26 (Ku-bd.)	5.76/5.94 (DS)
KBVA-FM (106.5) Bella Vista, Ark., ID-*Variety 106.5*	G4, 6	5.58/5.76 (DS)
KSKA-FM (91.1) Anchorage, Alaska — variety/fine arts	C5, 24	7.38/7.56 (DS)
KSL-AM (1160) Salt Lake City, Utah — news/talk/country-overnight	C1, 6	5.58
Peach State Public Radio (Georgia PBS)	T401, 14 (Ku-bd.)	5.40/5.58 (DS)
WUSF-FM (89.7) Tampa-St. Petersburg, Fl. (Public Radio), ID-*Concert 90*	C4, 10	8.26 (N)


Statement of Ownership, Management, and Circulation



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 2 Transponder 12-Vertical (C-band)

1202.30 (77.7) U.S.Information Agency *Radio Marti* (ISWBC), Spanish language broadcast service to Cuba

Galaxy 6 Transponder 3-Horizontal (C-band)

1405.60 (54.4) KIRO-AM (710) Seattle, Wash — news, talk, and sports talk radio/Seattle Seahawks NFL radio network
1405.40 (54.6) Sports Byline USA/Sports Byline Weekend
1404.60 (55.6) Talk America Radio Network
1404.00 (56.0) Occasional audio
1403.80 (56.2) Occasional audio/Free Enterprise Radio Network/University of Wisconsin college sports/Green Bay Packers NFL radio network
1403.20 (56.8) Motor Racing Network (MRN)
1400.80 (59.2) WBAL-AM (1090) Baltimore, Md
1398.30 (61.7) WGN-AM (720) Chicago, Ill — talk radio/Chicago Bears NFL radio network
1397.20 (62.8) WTMJ-AM (620) Milwaukee, Wis — talk radio/Green Bay Packers NFL radio network/Univ. of Wisconsin college sports/Milwaukee Bucks NBA radio network
1394.50 (65.5) WSB-AM (750) Atlanta, Ga. — news and talk/Univ. of Georgia college sports/Atlanta Hawks NBA radio network
1393.40 (66.6) WGN-AM (720) Chicago, Ill — talk radio/Chicago Bears NFL radio network/Interstate Radio Network (IRN)/other occasional audio
1393.20 (66.8) Wisconsin Radio Network/Illinois Radio Network/Tribune Radio Network
1392.70 (67.3) WGN-AM (720) Chicago, Ill — talk radio/Chicago Bears NFL radio network/Interstate Radio Network
1391.60 (68.4) XEPRS-AM (1090) Tijuana, Mexico — Spanish language programming, ID - *Radio Express*
1389.70 (70.3) Occasional audio/data transmissions (burst)
1389.50 (70.5) Data transmissions (burst)
1388.90 (71.1) Occasional audio
1387.50 (72.5) KWKW-AM (1330) Los Angeles, Calif — Spanish language programming, ID - *Radio Lobo*/Spanish Information Service
1387.00 (73.0) Michigan News Network (MNN)/Univ. of Michigan college sports/Detroit Red Wings NHL radio network
1386.70 (73.3) Michigan News Network (MNN) /Detroit Lions NFL radio network/Detroit Pistons NBA radio network
1386.50 (73.5) WJR-AM (760) Detroit, Mich — talk radio
1386.30 (73.7) Illinois News Network/Chicago Blackhawks NHL radio network
1385.80 (74.2) WMAQ-AM (670) Chicago, Ill — news/Chicago Bulls NBA radio network
1385.10 (74.9) For the People Radio Network
1384.20 (75.8) KMPC-AM (710) Los Angeles, Calif — talk radio
1383.80 (76.2) KJR-AM (950) Seattle, Wash — sports talk radio/Washington State college sports/Seattle Supersonics NBA radio network
1377.90 (82.1) Los Angeles Lakers NBA radio network
1376.70 (83.3) Occasional audio
1375.40 (84.6) USA Radio Network
1374.10 (85.9) Northwest Direct — news and talk/Oregon State college sports/Portland Trailblazers NBA radio network

Satcom K2 Transponder 2-Vertical (Ku-band)

1010.60 Foreign language audio service identifying as *Radio Tejan*

Satcom K1 Transponder 12-Vertical (Ku-band)

1313.10 Customized IGA spots

Spacenet 3 Transponder-Horiz.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
1206.55 (53.45) ABC Satellite Music Network — adult contemporary *Starstation*
1206.30 (53.7) ABC Satellite Music Network — adult contemporary *Starstation*
1206.00 (54.0) ABC Satellite Music Network — modern country *Country Coast-to-Coast*
1205.85 (54.15) ABC Satellite Music Network — modern country *Country Coast-to-Coast*
1205.65 (54.35) ABC Satellite Music Network — traditional music format *Stardust*
1205.40 (54.6) ABC Satellite Music Network — traditional music format, *Stardust*
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
1202.25 (57.75) ABC Satellite Music Network — golden oldies format *Pure Gold*
1202.10 (57.9) ABC Satellite Music Network — golden oldies format *Pure Gold*
1201.90 (58.1) Occasional audio
1201.70 (58.3) ABC Satellite Music Network — modern rock *The Heat*
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

Spacenet 3 Transponder 17-Horiz. (C-band)

1123.50 (56.5) Salem Radio Network — religious
1123.30 (56.7) Salem Radio Network — religious
1123.10 (56.9) Salem Radio Network — religious

Galaxy 4 Transponder 1-Horizontal (C-band)

1445.00 (55.0) WPGC-FM (95.5) Morningside, Md. — R&B format
1444.45 (55.55) Data transmissions
1443.80 (56.2) Voice of Free China (ISWBC) Taipei, Taiwan
1443.60 (56.4) WYFR (ISWBC) Oakland, Calif. — religious programming and talk, ID - *Family Radio Network*
1443.40 (56.6) Voice of Free China (ISWBC) Taipei, Taiwan
1438.30 (61.7) WWRV-AM (1330) New York, N.Y. — Spanish religious programming and music, ID - *Radio Vision Christiana de Internacional*
1436.50 (63.5) Radio Labio, Los Angeles, Calif — spanish talk radio
1436.30 (63.7) KOJY-AM (540) Costa Mesa, Calif/KJQI-AM (1260) Beverly Hills, Calif — all news
1436.00 (64.0) KUSC-FM (91.5) Los Angeles, Calif — fine arts, National Public Radio (NPR) affiliate
1435.70 (64.3) KUSC-FM (91.5) Los Angeles, Calif — fine arts, National Public Radio (NPR) affiliate
1435.20 (64.8) National Public Radio (NPR) feeds
1429.00 (71.0) Occasional audio

Galaxy 4 Transponder 2-Vertical (C-band)

1402.60 (77.4) WVAQ-FM (101.9) Morgantown, W Va — West Virginia Metro News
1402.00 (78.0) WVAQ-FM (101.9) Morgantown, W Va — West Virginia Metro News/West Virginia college sports
1399.00 (81.0) Oklahoma News Network/Texas A&M college sports/Univ. of Oklahoma college sports/San Antonio Spurs NBA radio network
1398.80 (81.2) Progressive Farmers Network
1398.00 (82.0) Oklahoma News Network
1397.20 (82.8) Oklahoma News Network/Univ. of Oklahoma college sports/San Antonio Spurs NBA radio network

Galaxy 4 Transponder 3-Horizontal (C-band)

1405.00 (55.0) Mutual Broadcasting System (MBS)/Georgia Southern college sports/Atlanta Falcons NFL radio network
1404.80 (55.2) KOA-AM (850)/KTLK-AM (760) Denver, Colo — news and talk/Denver Broncos NFL radio network/Univ. of Colorado college sports
1404.40 (55.6) Tennessee Radio Network (TRN)/Univ. of Tennessee college sports
1404.00 (56.0) South Carolina Radio Network/South Carolina State college sports
1403.50 (56.5) International Broadcasting Network (IBN) — Lutheran religious programming/Home Front program (Sat 10a-2p Eastern Time)
1403.00 (57.0) Minnesota Public Radio Network
1402.40 (57.6) KNOW-FM (95.3) St. Paul, Minn — fine arts, Minnesota Public Radio (occasional audio)
1402.10 (57.9) KNOW-FM (95.3) St. Paul, Minn — fine arts, Minnesota Public Radio
1401.80 (58.2) BBC World Service (ISWBC)
1398.50 (61.5) Colorado Avalanche NHL radio network
1398.30 (61.7) WSB-AM (750) Atlanta, GA — news/talk/Atlanta Hawks NBA radio network/Univ. of Georgia college sports
1398.00 (62.0) Tennessee Radio Network/Vanderbilt college sports
1397.80 (62.2) Colorado Avalanche NHL radio network
1397.50 (62.5) Minnesota Talking Book network
1397.30 (62.7) WORD-AM (910) Spartanburg, SC — news/talk/Clemson college sports
1396.90 (63.1) KRLD-AM (1080) Dallas/Ft Worth, TX - talk/Texas State Network flagship
1396.40 (63.4) Georgia Network News (GNN)
1396.20 (63.8) WCNN-AM (680) Atlanta, GA — all sports talk radio/Georgia Tech college sports
1396.00 (64.0) WHO-AM (1040) Des Moines, Iowa — talk/Iowa News Network/Iowa college sports
1395.80 (64.2) Kentucky News Network/Univ. of Kentucky college sports
1395.50 (64.5) American Public Radio (APR) - Monitor Radio programming
1395.10 (64.9) National Public Radio (NPR) channel 12
1394.60 (65.4) WHAS-AM (840) Louisville, Ky — adult contemporary music/Univ of Louisville college sports
1394.40 (65.6) National Public Radio (NPR) channel 11
1394.00 (66.0) National Public Radio (NPR) channel 10/American Public Radio (APR) carrying Monitor Radio programming
1393.50 (66.5) WSB-AM (750) Atlanta, GA — news/talk/Univ. of Georgia college sports/Atlanta Hawks NBA radio network
1392.90 (67.1) Minnesota News Network
1392.60 (67.4) National Public Radio (NPR) channel 9/American Public Radio (APR)
1392.30 (67.7) National Public Radio (NPR) channel 8
1392.00 (68.0) Minnesota Public Radio
1391.70 (68.3) National Public Radio (NPR) channel 7
1388.90 (71.1) Data transmissions (burst)
1388.40 (71.6) KSJV-FM (91.5) Fresno, Calif — spanish programming, ID - *Radio Bilingue* (network serves Spanish stations in several western states)
1388.10 (71.9) National Public Radio (NPR) channel 6

Single Channel Per Carrier (SCPC) Services Guide

1387.80 (72.2) Data transmissions (constant)
1387.50 (72.5) National Public Radio (NPR) channel 5
1387.20 (72.8) National Public Radio (NPR) channel 4
1386.80 (73.2) National Public Radio (NPR) feeds
1386.20 (73.8) KSJV-FM (91.5) Fresno, Calif — Spanish programming, ID - *Radio Bilingue* (network serves Spanish stations in several western states)
1385.80 (74.2) National Public Radio (NPR) channel 3
1385.40 (74.6) U.S. Naval Observatory Master Clock and National Public Radio (NPR) channel 2
1385.10 (74.9) National Public Radio (NPR) Special Events Channel
1384.70 (75.3) National Public Radio (NPR) channel 1
1384.40 (75.6) KOA-AM (850)/KTLK-AM (760) Denver, Colo — news and talk/Denver Broncos NFL radio network/Univ. of Colorado college sports
1384.20 (75.8) WSB-AM (750) Atlanta, Ga. — news and talk/Univ. of Georgia college sports/Atlanta Hawks NBA radio network
1383.70 (76.3) Minnesota Network News (MNN)/Midwest Radio Sports
1383.10 (76.9) VSA Radio Network — Ag news/Texas A&M college sports
1382.90 (77.1) Minnesota News Network (MNN)/ Minnesota Vikings NFL radio network/ Minnesota Timberwolves NBA radio network
1382.60 (77.4) Soldiers Radio Satellite (SRS) network — U.S. Army information and entertainment/ Army college sports
1382.30 (77.7) Motor Racing Network (occasional audio)
1382.00 (78.0) WFAE-FM (90.7) Charlotte, N.C. — NPR affiliate/Univ. of South Carolina college sports
1381.80 (78.2) WHO-AM (1040) Des Moines, Iowa — talk radio/Iowa News Network/Iowa college sports
1381.60 (78.4) Alabama Radio Network/Univ of Alabama-Birmingham college sports
1381.40 (78.6) Various talk shows (No network ID)
1377.40 (82.6) Data transmission (packet burst/tones)
1377.10 (82.9) In-Touch — reading service for blind
1376.00 (84.0) Kansas Audio Reader Network

Galaxy 4 Transponder 4-Vertical (C-band)

1387.50 (52.5) Dakota Sports network/Dakota News network
1381.80 (58.2) Data transmissions
1379.00 (61.0) Louisiana Network/Louisiana Ag Network/ New Orleans Saints NFL radio network
1378.80 (61.2) WLAC-AM (1510) Nashville, Tenn. — news and talk/Road Gang truck driver radio network (overnight)/Louisiana State Univ. college sports
1378.60 (61.4) Arkansas Radio Network/Univ. of Arkansas college sports
1378.10 (61.9) Data transmissions
1377.50 (62.5) Mid-America News Network/Mid-America Ag Network
1377.30 (62.7) WLAC-AM (1510) Nashville, Tenn. — news and talk/Road Gang turck driver radio network (overnight)/Univ. of Tennessee college sports
1376.00 (64.0) Data transmissions
1375.60 (64.4) KISN-AM (570) Salt Lake City, Utah — sports talk/Utah Jazz NBA radio network

Galaxy 4 Transponder 6-Vertical (C-band)

1346.90 (53.1) WCRP-FM (88.1) Guayama, P.R. — religous/educational (Spanish)

Galaxy 4 Transponder 1-Horizontal (Ku-band)

959.20 ABC Satellite Music Network — country and western *Real Country*
959.00 ABC Satellite Music Network — country and western *Real Country*
957.50 Russian-American Radio Network — Russian language audio service

Anik E2 Transponder 19-Horizontal (C-band)

1086.00 (54.0) TV Northen Canada network program audio

Anik E1 Transponder 11-Horizontal (C-band)

1246.00 (54.0) Radio Canada International (ISWBC)
1245.50 (54.5) Canadian Broadcasting Company (CBC) Radio — Yukon service

Anik E1 Transponder 12-Vertical (C-band)

1226.00 (54.0) CKRW-FM (90.5) Whitehorse, Yukon Territory, Canada — adult contemporary music
1225.50 (54.5) CHON-FM (90.5) Whitehorse, Yukon Territory, Canada — variety

Anik E1 Transponder 13-Horizontal (C-band)

1206.00 (54.0) Canadian Broadcasting Company (CBC) Radio — southwestern Northwest Territories service

Anik E1 Transponder 14-Vertical (C-band)

1185.50 (54.5) CKLB-FM (101.9) Yellowknife, NWT Canada — country music

Anik E1 Transponder 15-Horizontal (C-band)

1166.00 (54.0) Canadian Broadcasting Company (CBC) Radio — eastern Northwest Territories service

Anik E1 Transponder 17-Horizontal (C-band)

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

Anik E1 Transponder 19-Horizontal (C-band)

1086.00 (54.0) Canadian Broadcasting Company (CBC) Radio — Quebec and Labrador service

Anik E1 Transponder 21-Horizontal (C-band)

1024.30 (75.7) Canadian weather conditions and warnings

SBS5 Transponder 2-Horizontal (Ku-band)

1010.60 (83.4) Wal-Mart in-store network (English)
1010.20 (83.8) Wal-Mart in-store network (English)
1009.80 (84.2) Sam's Wholesale Club in-store network (English)
1001.40 (92.6) Wal-Mart in-store network (English)
1001.00 (93.0) Wal-Mart in-store network (English and Spanish ads)
1000.60 (93.4) 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/Univ of Wyoming college sports
1400.60 (59.4) Indiana Radio Network
1400.40 (59.6) Missouri Net/St. Louis Rams NFL radio network
1400.20 (59.8) Occasional audio
1400.00 (60.0) Indiana Radio Network/Purdue college sports
1396.60 (63.4) Kansas Information Network/Kansas Agnet/Kansas State college sports
1396.40 (63.6) Nebraska Ag Network/Univ of Nebraska college sports/S.W. Missouri State college sports
1396.20 (63.8) Missouri Network/Univ. of Illinois college sports
1396.00 (64.0) Occasional audio
1395.70 (64.3) Missouri Net/WIBW-AM (580) Topeka, Kan — news and talk/Kansas City Chiefs NFL radio network
1387.50 (72.5) Capitol Sports Network/Charlotte Hornets NBA radio network
1387.30 (72.7) WPTF-AM (680) Raleigh, N.C. — news and talk/North Carolina News Network
1386.40 (73.6) ABC Direction Network/Brownfield Network/Occasional audio/Univ. of Kansas college sports/Kansas City Chiefs NFL radio network
1386.20 (73.8) Radio Iowa
1384.60 (75.4) North Carolina News Network/Capitol Sports Network/Washington Redskins NFL radio network
1384.40 (75.6) Capitol Sports Network/Univ of Duke college sports/Washington Bullets NBA radio network
1384.20 (75.8) Capitol Sports Network/East Carolina college sports
1384.00 (76.0) Occasional audio/ABC Direction Network
1383.80 (76.2) Occasional audio
1383.60 (76.4) WPTR-AM (1540) Albany, N.Y. — talk radio/Univ. of Albany college sports/New York Jets NFL radio network
1382.80 (77.2) Missouri Network/Univ. of Missouri college sports
1382.60 (77.4) North Carolina News Network
1382.30 (77.7) Virginia News Network/Univ. of Virginia college sports
1382.10 (77.9) Occasional audio
1378.80 (81.1) Radio Pennsylvania Network/Philadelphia Flyers NHL radio network
1378.70 (81.3) Radio Pennsylvania Network/Philadelphia Eagles NFL radio network
1378.50 (81.5) Radio Pennsylvania Network/Philadelphia 76ers NBA radio network
1378.30 (81.7) Radio Pennsylvania Network

RCA C5 Transponder 21-Vertical (C-band)

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 — *Original Hits*
1042.60 (57.4) Unistar Music Radio — *Original Hits*
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
1034.80 (65.2) Unistar Music Radio — *Country and Western*
1034.60 (65.4) Unistar Music Radio — *Country and Western*
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*
1033.70 (66.3) Occasional audio
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*

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.

ARMED FORCES RADIO AND TELEVISION SERVICE (AFRTS)

AFTRS-BC, 10888 La Tuna Canyon Road, Sun Valley, CA 91352-2098. AFRTS radio service carries a variety of radio network news and sports programming for servicemen overseas aboard Navy ships. Satellites carrying AFTRS transmissions include: Spacenet 2 (69.0 west) Tr 20 (4100 MHz V) 7.41 MHz audio and Intelsat 703 (177.0 east) Tr 38 (4177 MHz LHCP) 7.41 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.

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) 7.38/7.56 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 702 (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 702 (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: +61 3 616 1800 (voice), +61 3 626 1899 (fax)
Palapa B2P (133.0 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) 7.56 MHz audio and Hispasat 1A/B (31.0 west) Tr 6 (12149 MHz RHCP) 7.92 MHz audio.

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, Palapa B2P (113 east) Tr 8 (3860 MHz V) 6.15 MHz audio to Asia, and Spacenet 2 (69.0 west) Tr 4 (3780 MHz V) 7.38 MHz. audio to the Americas.

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. Satcom C1 (137.0 west) Tr 15 (4000 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, Telstar 302 (85 west) Tr 5 (3880 MHz V) 8.00 MHz audio to North America.

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, 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 II F1 (13.0 east) Tr 32 (11554 MHz H) 7.74 MHz audio. Reports at presstime indicate that Vatican Radio will be downlinking on two Intelsat C-band birds (34.5 wesr and 66 east) by the fourth quarter of 1995.

International Shortwave Broadcasters via Satellite

VOICE OF AMERICA (United States Information Agency)

Washington, D.C. 20547. The Voice of America (VOA) transmits a variety of audio programs in various languages on the following satellites and audio subcarriers:.

Eutelsat II F1	13.0 east	Tr 27	11163 MHz.	PAL system
Intelsat 510	66.0 east	Tr 38	4177.5 MHz.	PAL system
Intelsat 601	27.5 west	Tr 14	3995 MHz.	PAL system
Intelsat 601	27.5 west	Tr 81	3742 MHz.	PAL system
Spacenet 2	69.0 west	Tr 2H	3760 MHz.	NTSC system
Intelsat 511	180.0 west	Tr 14	3974 MHz.	PAL system

NTSC system baseband subcarrier frequencies

Primary Television Audio (USIA Worldnet)	6.80 MHz
Channel 1	5.94 MHz
Channel 2	6.12 MHz
Channel 3	7.335 MHz
Channel 4	7.425 MHz
Channel 5	7.515 MHz
Channel 6	7.605 MHz
Wireless File (data)	6.2325 MHz
E-mail (data)	6.2775 MHz

PAL system baseband subcarrier frequencies

Primary Television Audio (USIA Worldnet)	6.60 MHz
Channel 1	7.02 MHz
Channel 2	7.20 MHz
Channel 3	7.335 MHz
Channel 4	7.425 MHz
Channel 5	7.515 MHz
Channel 6	7.605 Mhz
Wireless File (data)	6.2325 MHz
E-mail (data)	6.2775 MHz

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 702 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

BCM, London, WC1N 3XX, 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.

North American Service Schedule

WRN1 — Galaxy 5 (125.0 west) Tr 6 (3820 MHz V) 6.80 MHz audio.

UTC/EST/PST	SERVICE/PROGRAM
0000/1900/1600	Radio Netherlands - Hilversum
0200/2100/1800	YLE Radio Finland - Helsinki*+
0230/2130/1830	Radio Sweden - Stockholm
0300/2200/1900	Radio Prague (Slovakia)
0330/2230/1930	Radio Austria International - Vienna
0400/2300/2000	Polish Radio - Warsaw
0430/2330/2030	Radio Budapest (Hungary)
0500/0000/2100	Radio Sweden - Stockholm
0530/0030/2130	BBC Europe Today (Mon-Sat) BBC International Call (Sun)
0600/0100/2200	Deutsche Welle - Cologne (Germany)
0700/0200/2300	Swiss Radio International - Berne
0730/0230/2330	Radio Canada International - Montreal
0800/0300/0000	ABC Radio Australia - Melbourne*+
0900/0400/0100	KBS Radio Korea International - Seoul*+
1000/0500/0200	Voice of Russia - Moscow*
1030/0530/0230	Radio Netherlands - Hilversum
1130/0630/0330	Channel Africa - Johannesburg, South Africa (Mon-Fri) BBC International Call (Sat) BBC Intl Money Prog & Health Watch (Sun)
1200/0700/0400	Radio Australia - Melbourne*+
1300/0800/0500	Radio Telefis Eireann (RTE) - Dublin, Ireland+
1400/0900/0600	KBS Radio Korea International - Seoul*
1500/1000/0700	YLE Radio Finland - Helsinki*
1530/1030/0730	Radio Vlaanderen International - Brussels Calling*
1600/1100/0800	Radio France International - Paris*
1700/1200/0900	Voice of Russia - Moscow*
1830/1230/0930	Radio Netherlands - Hilversum*
1830/1330/1030	Radio Telefis Eireann (RTE) - Dublin, Ireland*
1900/1400/1100	ABC Radio Australia - Melbourne*
2000/1500/1200	Blue Danube Radio - Vienna (Mon-Fri) Glen Hauser's World of Radio (Sat) BBC Intl Money Prog & Sports Zone (Sun)
2030/1530/1230	Radio Vlaanderen International - Brussels Calling
2100/1600/1300	BBC Europe Today (Sun-Fri) BBC International Call (Sat)
2130/1630/1330	Polish Radio - Warsaw
2200/1700/1400	Radio Telefis Eireann (RTE) - Dublin, Ireland/News and Both Sides Now

WRN2 — 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. This is a provisional schedule and subject to change.

0000/1900/1600	YLE Radio Finland - Helsiniki (News in Swedish)
0030/1930/1630	YLE Radio Finland - Helsiniki (News in English)
0100/2000/1700	YLE Radio Finland - Helsiniki (Light music in Finnish)
0200/2100/1800	YLE Radio Finland - Helsiniki (Documentaries in Finnish) Mon-Fri YLE Radio Finland - Helsiniki (Church belle & concert in Finnish) Sat YLE Radio Finland - Helsiniki (New classical releases in Finnish) Sun
0230/2130/1830	YLE Radio Finland - Helsiniki (Light music in Finnish) Fri only
0300/2200/1900	YLE Radio Finland - Helsiniki (News in English)
0330/2230/1930	YLE Radio Finland - Helsiniki (News in Finnish)
0400/2300/2000	YLE Radio Finland - Helsiniki (News in Finnish)
0410/2310/2010	YLE Radio Finland - Helsiniki (Religious programs in Finnish) Sun-Fri
0420/2320/2020	YLE Radio Finland - Helsiniki (News in Swedish)
0423/2323/2023	YLE Radio Finland - Helsiniki (Program preview in Finnish)
0430/2330/2030	WRN announcements**
0530/0030/2130	Radio Netherlands - Hilversum (Dutch)**
0625/0125/2225	WRN announcements**
1100/0600/0300	YLE Radio Finland - Helsiniki (News in Finnish)
1125/0625/0325	YLE Radio Finland - Helsiniki (News in Swedish)
1130/0630/0330	YLE Radio Finland - Helsiniki (News in English)**
1200/0700/0400	WRN announcements**
1300/0800/0500	Radio Telefis Eireann (RTE) - Dublin, Ireland (News in Irish)
1400/0900/0600	WRN announcements**
1500/1000/0700	YLE Radio Finland - Helsiniki (Regional broadcasts in Finnish)
1530/1030/0730	YLE Radio Finland - Helsiniki (News in Finnish)
1600/1100/0800	YLE Radio Finland - Helsiniki (Features in Finnish)
1620/1120/0820	YLE Radio Finland - Helsiniki (Slow speed Finnish)
1630/1130/0830	YLE Radio Finland - Helsiniki (News in English)
1700/1200/0900	WRN announcements**
1900/1400/1100	Radio Sweden - Stockholm (News in Swedish)**
1930/1430/1130	WRN announcements**
2030/1530/1230	Radio Netherlands - Hilversum (Dutch)**
2125/1625/1325	WRN announcements**
2300/1800/1500	Radio Vlaanderen International - Brussels Calling (Flemish)**
2330/1830/1530	YLE Radio Finland - Helsiniki (Rock music & talk in Finnish) Mon-Fri YLE Radio Finland - Helsiniki (Phone-in for children in Finnish) Sat & Sun

All broadcasts are daily unless otherwise indicated. WRN program information can be heard daily on North American WRN1 service at 1025 and 1725 UTC. * indicates program also carried by C-SPAN 1 audio service Monday-Friday. + indicates program also carried by C-SPAN 1 audio service Saturday-Sunday. ** indicates subject to pre-emption without notice.

European Service Schedule

Astra 1B (19.2 east) Tr 22 (11538 MHz V) 7.38 MHz audio. All broadcasts are in English and daily unless otherwise indicated. Program information is available on Astra 1B VH-1 text page 222/MTV text 535. WRN network information can be heard on the European service daily at 0525, 1225 and 1925 CET.

YLE RADIO FINLAND

Box 10, SF-00241 Helsinki, Finland. Telephone: +358 0 1480 4320 (voice), +358 0 1481 169 (fax) E-mail: rfinland@yle,mailnet.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.

DBS/Primestar Channel Guide

By Robert Smathers

DirecTV™ Channel Guide

DirecTV
2230 East Imperial Highway
El Segundo, Calif. 90245
1-800-DIRECTV (347-3288)

100	Direct Ticket Previews (DTV)	Previews
102-199	Direct Ticket Pay Per View (DTV)	PPV
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	E! Entertainment TV (E!)	Speciality
216	MuchMusic (MUCH)	Music Videos
217	Black Entertainment TV (BET)	Entertainment
219	American Movie Classics (AMC)	Movies
220	Turner Classic Movies (TCM)	Movies
221	Arts and Entertainment (A&E)	TV
222	The History Channel (HIST)	History
223	The Disney Channel East (DIS1)	Movies/Kids
224	The Disney Channel West (DIS2)	Movies/Kids
225	The Discovery Channel (DISC)	Science/TV documentary
226	The Learning Channel (TLC)	Science/TV documentary
227	Cartoon Network (TOON)	Cartoons
229	USA Network (USA)	TV
230	Trio (TRIO)	TV
232	The Family Channel (FAM)	TV
233	WTBS-Ind Atlanta, Ga.(TBS)	Superstation
235	The Nashville Network (TNN)	Country/Outdoors
236	Country Music TV (CMT)	Country Music Videos
240	The Sci-Fi Channel (SCFI)	Science Fiction
242	C-SPAN 1 (CSP1)	Congress-House of Representatives
243	C-SPAN 2 (CSP2)	Congress-U.S. Senate
245	Bloomberg Information Television (BIT)	News
246	CNBC (CNBC)	Financial/Talk
247	America's Talking (AT)	Talk
248	The Weather Channel (TWC)	Weather
250	Newsworld International (NWI)	News
252	CNN International (CNNI)	News
254	The Travel Channel (TRAV)	Travel Shows
258	Bravo (BRAV)	Arts
266	Independent Film Channel (IFC)	Movies
268	Direct Ticket Previews (DTV)	Previews
269	STARZ! - West (STZW)	Movies
270	STARZ! (STZE)	Movies
271	Encore (ENCR)	Movies
272	Encore-Love (LOVE)	Movies
273	Encore-Westerns (WSTN)	Movies
274	Encore-Mystery (MYST)	Movies
275	Encore-Action (ACTN)	Movies
276	Encore-True Stories (TRUE)	Movies
277	Encore-WAM! (WAM!)	Movies
278	Encore (ENC)	Movies
282	WRAL-CBS Raleigh, N.C. (CBS)	Network TV
284	WNBC-NBC New York, N.Y. (NBC)	Network TV
286	KRMA-PBS Denver, Colo. (PBS)	Network TV
287	WABC-ABC, New York, N.Y. (ABC)	Network TV
289	WFLG-FOX, Chicago, Ill. (FOX)	Network TV
298	TV Asia (TVA)	Ethnic Programming
299	In-store dealer info channel (DTV)	Retailers only
300-399	Regional and PPV Sports	Sports
300	DirecTV Sports Offers (DTV)	Promo
301	Sports Special Events Calendar (DTV)	Promo
302	Sunday Ticket 95 Promo/World League of American Football	Sports
303	DirecTV Sports Schedule (DTV)	Promo
304	The Golf Channel (GOLF)	Sports
305	SportsChannel New England (SCNE)	Sports
306	Madison Square Garden (MSG)	Sports
307	New England Sports Network (NESN)	Sports
308	SportsChannel New York (SCNY)	Sports
309	SportsChannel Philadelphia (SCPH)	Sports
310	Prime Sports KBL (PKBL)	Sports
311	Home Team Sports (HTS)	Sports
312	SportsSouth (SPTS)	Sports
314	Sunshine (SUN)	Sports
316	Pro AM Sports (PASS)	Sports
317	SportsChannel Ohio (SCOH)	Sports
318	SportsChannel Cincinnati (SCCN)	Sports
319	SportsChannel Chicago (SCCH)	Sports
320	Midwest SportsChannel (MSC)	Sports
321	Prime Sports Southwest Alternate (PSWA)	Sports
322	Prime Sports Southwest (PSSW)	Sports
323	Prime Sports Midwest/Upper Midwest/Rocky Mountain/Intermountain West (PS)	Sports
325	Prime Sports West (PSW)	Sports
326	SportsChannel Pacific (SCP)	Sports
328	Newsport (NWSP)	Sports
330-348	NFL Sunday Ticket	Sports
335	DirecTV Sports Schedule (DTV)	Promo
350	NFL Sunday Ticket/NBA League Pass	Sports
356	NFL Sunday Ticket/NBA League Pass	Sports
380	DirecTV Sports Schedule (DTV)	Promo
400	Unidentified Adult Channel (ADLT)	Adult
401	Spice	Adult
402	Playboy (PBTV)	Adult
501	Music Choice — Hit List (MC1)	Audio
502	Music Choice — Dance (MC2)	Audio
503	Music Choice — Hip Hop (MC3)	Audio
504	Music Choice — Urban Beat (MC4)	Audio
505	Music Choice — Reggae (MC5)	Audio
506	Music Choice — Blues (MC6)	Audio
507	Music Choice — Jazz (MC7)	Audio
508	Music Choice — Singers and Standards (MC8)	Audio
509	Music Choice — Contemporary Jazz (MC9)	Audio
510	Music Choice — New Age (MC10)	Audio
511	Music Choice — Electric Rock (MC11)	Audio
512	Music Choice — Modern Rock (MC12)	Audio
513	Music Choice — Classic Rock (MC13)	Audio
514	Music Choice — 80's Retro (MC14)	Audio
515	Music Choice — Metal (MC15)	Audio
516	Music Choice — Solid Gold Oldies (MC16)	Audio
517	Music Choice — Soft Rock (MC17)	Audio
518	Music Choice — Love Songs (MC18)	Audio
519	Music Choice — Progressive Country (MC19)	Audio
520	Music Choice — Contemporary Country (MC20)	Audio
521	Music Choice — Country Gold/Classic Country (MC21)	Audio
522	Music Choice — Big Bands Nostalgia (MC22)	Audio
523	Music Choice — Easy Listening (MC23)	Audio
524	Music Choice — Classic Favorites (MC24)	Audio
525	Music Choice — Classics in Concerts (MC25)	Audio
526	Music Choice — Contemporary Christian (MC26)	Audio
527	Music Choice — Gospel (MC27)	Audio
528	Music Choice — Big Kids Music (MC28)	Audio
529	Music Choice — Sounds of the Seasons (MC29)	Audio

DBS/Primestar Channel Guide

USSB Channel Guide

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

899	USSB Programming Higlights	Promo
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
999	USSB Programming Highlights	Promo

Primestar Channel Guide

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	
17	Future service	
19	Future service	
27	Starz!	Movies
30	Encore 2-Love Stories	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)	News
51	Cable Network News (CNN)	News
52	CNN Headline News	News
55	PreVue Channel	Program Guide
56	Future service	
58	Turner Network Television (TNT)	TV
59	Turner Classic Movies (TCM)	Movies
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	Future service	
77	The Nashville Network (TNN)	Country/Outdoors
78	Country Music TV (CMT)	Country music videos
80	Future Service	
84	QVC — occasional service	Home Shopping
111	WHDH-NBC Boston, Mass.	Network TV
114	WPLG-ABC Miami, Fla	Network TV
117	WUSA-CBS Washington, D.C.	Network TV
120	KTVU-FOX Oakland/San Francisco, Calif	Network TV
124	WHYY-PBS Philadelphia, Penn.	Network TV
131	ESPN	Sports
132	Future service	
138	Mega+1	Sports
141	New England Sports Network (NESN)	Sports
142	Madison Square Garden Network (MSG)	Sports
143	Empire Sports Network	Sports
144	Prime Sports KBL	Sports
145	Home Team Sports (HTS)	Sports
146	SportSouth	Sports
147	Sunshine	Sports
148	Pro American Sports (PASS)	Sports
149	Future service	
151	Prime Sports Upper Midwest	Sports
152	Prime Sports Midwest	Sports
153	Prime Sports Rocky Mountain	Sports
154	Prime Sports Southwest	Sports
155	Prime Sports Inter-Mountain West	Sports
156	Prime Sports Northwest	Sports
157	Future service	
158	Prime Sports West	Sports
159	Midwest SportsChannel	Sports
201	Viewer's Choice	PPV
202	Request 1	PPV
203	Request 5	PPV
204	Hot Choice	PPV
205	Continuous Hits 1	PPV
206	Continuous Hits 2 — occasional service	PPV
207	Continuous Hits 3	PPV
208	Request 2	PPV
209	Request 3	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
527	Testing Channel	Tests

New Services since October 1995:

Cinemax Selecciones
Classic Sports Network
DMX audio:
Lite Jazz, Classic Rock, 70's Oldies, Adult Contemporary, Hottest Hits, Modern Country, Traditional Blues, Salsa
E! Entertainment TV
ESPN2
Faith and Values Network
HBO 1 en Espanol
HBO 2 en Espanol
HBO 3 en Espanol
Lifetime
MTV
Nickelodeon/Nick at Nite
Univision

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) 69º West

19	11740-H	Data transmissions
20	11820-H	Occ video
21	11900-H	TV ASAHI [Leitch]
22	11980-H	Empire Sports Network [video compression]
23	12060-H	Kentucky Educational Television (half-transponders)
24	12140-H	Occ video

SBS 2 (SBS2) 71º West (Inclined Orbit)

4	11872-H	Occ video

SBS 6 (SBS6) 74º West

1	11717-H	Occ video
2	11749.5-V	Occ video
3	11774-H	Occ video
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
9	11921-H	Occ video
10	11945.5-V	Occ video
11	11963-H	CONUS Communications - occ video
12	11994.5-V	CONUS Communications - occ video (full & half-transponders)
13	12019-H	CONUS Communications - occ video (half transponders)
14	12043.5-V	Occ video
15	12075-H	Occ video
16	12092.5-V	Occ video
17	12110-H	Occ video
18	12141.5-V	Occ video
19	12174-H	Occ video

SBS 4 (SBS4) 77º West (Inclined orbit)

1	11725-H	NBC feeds
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

Satcom K2 (K2) 81º West

1	11729-H	NBC-East
2	11758.5-V	Pagesat computer service/Data transmissions
3	11788-H	NBC-Pacific (West spot beam)
4	11817.5-V	Cyclesat/occ video
5	11847-H	NBC contract channel
6	11876.5-V	Occ video
7	11906-H	NBC contract channel (network feeds)
8	11935.5-V	North American Chinese TV Network [Oak]
9	11965-H	NBC-Mountain
10	11994.5-V	[Compressed video]
11	12024-H	NBC contract channel (network feeds)
12	12053.5-V	FM² services
13	12083-H	NBC NewsChannel
14	12112.5-V	Occ video
15	12142-H	Data transmissions
16	12171.5-V	[Compressed video]

Satcom K1 (K1) 85º West

1	11729-H	Data transmissions
14	12112.5-V	(None)

Transponders 2-13 and 15-16 consists of Primestar programming encrypted and compressed using the Digicipher system. GE K1 uses the same frequency plan as GE K2. A complete Primestar channel guide is presented in the DBS section of *Satellites Times* Satellite Service Guide.

Spacenet 3R (S3) 87º West

19	11740-H	Data transmissions
20	11820-H	Data transmissions
23	12060-H	Oregon Educational Network (West spot beam)
24	12140-H	NYNET (SUNY) Ed Net/NY Lottery feeds (East spot beam)

Telstar 402R (T402) 89ºWest

9	11957.5-V	Occ video

14 transponders belong to the Alphastar DBS service. AT&T Tridom has some transponders, but it remains to be seen what, if any, analog video there will be on this satellite.

Galaxy 7 (K7) 91º West

1	11720-V	Occ video
2	11750-H	Data transmissions
3	11750-V	Indiana Higher Education [Compressed video]
4	11780-V	Occ video
7	11840-V	Occ video
8	11870-H	Data transmissions
9	11870-V	Data transmissions
10	11900-V	Hospitality TV [B-MAC]/Occ video
11U	11945-H	[Compressed video]
12	11930-V	Occ video
13	11960-V	Occ video
14	11990-H	Occ video
15	11990-V	Occ video
16	12020-V	Occ video/Microsoft TV (occasional)/Real Estate TV Network (occasional)/The People's Network (TPN)
17	12050-H	Westcott Communications ASTN [B-MAC]/ANTN (Half-transponders)/National Weather Networks (occasional)
18	12050-V	Occ video
19	12080-V	The Asia Network/Occ video
20	12110-H	Data transmissions
21	12110-V	TCI Promo Channel [B-MAC]
22	12140-V	Classic Sports Network
23	12170-H	Data transmissions

GSTAR-3 (GST3) 93º West (Inclined Orbit)

1	11730-H	Data transmissions
2	11791-H	Data transmissions
3	11852-H	Occ video/NBC Newsfeeds
4	11913-H	Occ video/NBC Newsfeeds
5	11974-H	Occ video/NBC Newsfeeds
6	12035-H	Occ video/NBC Newsfeeds
7	12096-H	Occ video/NBC Newsfeeds
8	12157-H	Occ video
9	11744-V	Occ video
11	11866-V	Occ video
12	11927-V	Occ video/Mayo Clinic teleconference [B-MAC]
13	11988-V	Occ video/Mayo Clinic teleconference [B-MAC]
14	12049-V	Occ video/Mayo Clinic teleconference [B-MAC]
15	12110-V	Gstar 3 ID Channel
16	12171-V	Occ video

Telstar 401 (T401) 97º West

1	11730-V	SCPC transmissions
2	11743-H	AT&T Skynet TV [compressed video]
3	11790-V	South Carolina Educational TV State Network [Digicipher]
4	11798-H	National Tech University [compressed video]
5	11845-V	PBS [Digicipher]
6	11855-H	SERC/PBS regionals/stations (half-transponders)
7	11902-V	PBS educational services (half-transponders)
8	11915-H	PBS stations/regionals and backhauls
9	11957.5-V	PBS digital video [Digicipher]/ VSAT traffic
10	11962.5-H	Louisiana Public TV State Network [Digicipher]/DMX for Business
11	12040-V	Occ video
12	12046-H	Occ video/Data transmissions (half-transponders)
13	12095-V	Spectradyne Hotel Hotel In-room movies [compressed video]
14L	12093-H	Peachstar Educational Network (Distance Learning)
14U	12123-H	Georgia Public TV State Network (GPTV)
15	12147-V	ABC network and affiliate feeds (half-transponders)
16	12167-H	ABC network and affiliate feeds (half-transponders)

Galaxy 4 (K4) 99º West

1	11720-H	SCPC 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)/Data transmissions
5	11810-V	Data transmissions
6	11810-H	Occ video
7	11840-H	*Jong Ten* - Chinese/Taiwan all-news service
8	11870-V	Occ video
9	11870-H	Occ video
10	11900-H	CNN Airport Network [SA MPEG]
11	11930-V	Occ video (half-transponders common)
12	11930-H	Occ video/Channel One (occ video)
13	11960-H	Occ video
14	11990-V	Occ video (half-transponders common)
15	11990-H	Occ video
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) [scrambled unknown system]
19	12080-H	Data transmissions
20	12110-V	Occ video (half-transponders common)
21	12110-H	Asian-American TV Network
22	12140-H	Family Net [Digicipher]
23	12170-V	CBS Newsnet and affiliate feeds (half-transponders)
24	12170-H	The Filipino Channel [Oak]

Spacenet 4 (S4) 101º West

20	11820-H	Occ video
22	11980-H	Occ video
24	12140-H	E.M.G. courses [digicipher]

DBS-1 101.2º W./DBS-2 & DBS-3 100.8º 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.

GSTAR-1 (GST1) 103º West

1	11730-H	Data transmissions
2	11791-H	Data transmissions
3	11852-H	Fed-X - occ video [B-MAC] /Occ video
4	11913-H	Data transmissions
5	11974-H	CourtTV feeds (half transponders)
6	12035-H	Data transmissions
7	12096-H	Healthcare Satellite [video compression]
8	12157-H	Data transmissions
9	11744-V	Data transmissions
10	11805-V	Data transmissions
11	11866-V	Data transmissions
12	11927-V	Data transmissions
13	11988-V	Occ video
14	12049-V	Data transmissions
15	12110-V	Data transmissions
16	12171-V	Data transmissions

GSTAR-4 (GST4) 105º 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	Occ video
5	11974-H	Occ video
6	12035-H	CNN feeds/Occ video
7	12096-H	CNN feeds/Occ video
8	12157-H	Occ video/CNN Newsource International
9	11744-V	Data transmissions
11	11866-V	Occ video
12	11927-V	Occ video
13	11988-V	CNN feeds/occ video
15	12110-V	CNN Newsource (secondary)
16	12171-V	CNN feeds/occ video

Anik E2 (A1) 107.3º West

1	11717-V	Data transmissions
2	11743-V	Data transmissions
3	11778-V	Data transmissions
4	11804-V	Occ video
5	11839-V	Canadian Parliamentary Access Channel [video compression]
6	11865-V	Moviepix!; The Movie Network [video compression]
7	11900-V	Rogers Network [video compression]
8	11926-V	Rogers Network [video compression]
9	11961-V	Data transmissions/DirecPC Canada
10	11987-V	Musique Plus
11	12022-V	Showcase TV (West)
12	12048-V	Saskarchewan CommunicaNetwork
13	12083-V	Data transmissions
14	12109-V	Data transmissions
15	12144-V	Telesat Canada stationkeeping (GLACS)
16	12170-V	(none)
17	11730-H	Discovery Channel Canada [Oak]
18	11756-H	New Country Network (NCN)
19	11791-H	Bravo! Canada
20	11817-H	Life Network
21	11852-H	Musique Plus
22	11878-H	Meteo Media
23	11913-H	Showcase TV (East)
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	Data transmissions/DirecPC Canada
28	12061-H	Canal D — French arts channel
29	12096-H	RaiUno
30	12122-H	Telesat Canada stationkeeping (GLACS)
31	12157-H	Super Ecran [V2+]
32	12183-H	Le Canal Famile [V2+]

Solidaridad 1 SD1 109.2º West

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

Anik E1 (A2) 111º West

1	11717-V	Data transmissions
2	11743-V	Data transmissions
3	11778-V	Data transmissions
4	11804-V	Data transmissions
5	11839-V	MuchMusic
6	11865-V	NovaNet FM² Services
7	11900-V	Rogers Network — CHSC, Youth TV, Vision [video compression]
8	11926-V	Occ video
9	11961-V	Expressvu DBS
10	11987-V	Expressvu DBS
11	12022-V	(none) — possible Expressvu
12	12048-V	Réseau de l information (RDI)
13	12083-V	CBC Newsworld feeds/Occ video
14	12109-V	RDI feeds/Occ video
15	12144-V	Knowledge Network
16	12170-V	Occ video
17	11730-H	Woman's Television Network East and West [video compression]
18	11756-H	Data transmissions
19	11791-H	Data transmissions
20	11817-H	SCPC/Data transmissions
21	11852-H	Radio Quebec
22	11878-H	Family Channel — East and West, MovieMax!, SuperChannel feeds [video compression]
23	11913-H	Expressvu DBS
24	11939-H	Expressvu DBS
25	11974-H	Expressvu DBS
26	12000-H	Expressvu DBS
27	12035-H	Expressvu DBS
28	12061-H	Expressvu DBS
29	12096-H	Reseau des Sports [V2+]
30	12122-H	(none) — possibly Expressvu
31	12157-H	Expressvu DBS
32	12183-H	Atlantic Satellite Network

Anik C3 (C3) 114.9º West (Inclined Orbit)

(This satellite rarely has video transmissions)

Morelos 2 (M2) 116.8º West

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

SBS 5 (SBS5) 123º West

1	11725-H	Comsat Video in-room programming [B-MAC] (half transponders) — Satellite Cinema 1/3
2	11780-H	SCPC services
4	11872-H	Comsat Video in-room programming [B-MAC] (half transponders) — Satellite Cinema 4/2
5	11921-H	Data transmissions
6	11970-H	Data transmissions
7	12019-H	Data transmissions
8	12068-H	Comsat Video in-room programming [B-MAC] (half transponders) — ESPN/Showtime
9	12117-H	Comsat Video in-room programming [B-MAC] (half transponders) — CNN Headline News/WTBS
10	12166-H	ID Channel/WalMart [V2+]/Occ video
11	11748-V	Data transmissions
12	11898-V	Occ video
13	11994-V	Occ video
14	12141-V	WMNB Russian-American TV [inverted video]

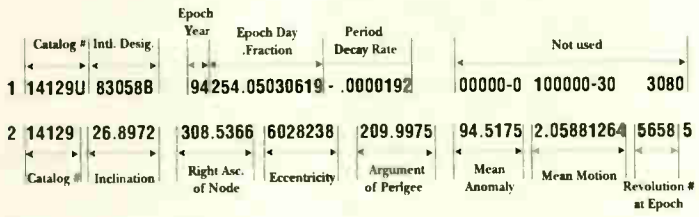
GSTAR-2 (GST2) 125º West

9	11744-V	Data transmissions
11	11866-V	GSTAR-2 ID slate/Occ video
13	11988-V	Occ video
14	12049-V	Occ video
16	12171-V	Occ video

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 95334.82392991 -.00000421 00000-0 10000-3 0 3916
2 14129 26.4097 235.9909 5978339 330.6728 6.2527 2.05883476 65766
OSCAR 11 (UoSAT 2, UoSAT 11, UO-11)
1 14781U 84021B 95335.02411313 +.00000136 +00000-0 +30872-4 0 08551
2 14781 097.7873 329.7883 0012262 013.6551 346.4984 14.69404129628406
COSMOS 1861 (Carries Radio Sputnik 10/11, RS-10/11)
1 18129U 87054A 95334.93902647 +.00000015 +00000-0 -11461-6 0 01447
2 18129 082.9227 295.8025 0012288 356.3968 003.7091 13.72359316422845
OSCAR 13 (AMSAT OSCAR 13, AO-13)
1 19216U 88051B 95334.90268617 +.00000135 +00000-0 +12582-3 0 01176
2 19216 057.4280 149.8219 7353179 025.1344 357.3474 02.09726631025663
OSCAR 14 (UoSAT 3, UoSAT 14, UO-14)
1 20437U 90005B 95335.18311741 +.00000017 +00000-0 +23242-4 0 01460
2 20437 098.5603 056.8008 0012010 066.5994 293.6445 14.29904882305614
OSCAR 16 (PACSAT, AMSAT OSCAR 16, AO-16)
1 20439U 90005D 95334.72870354 +.00000017 +00000-0 +23267-4 0 09589
2 20439 098.5725 058.2565 0012258 068.5099 291.7392 14.29959558305561
OSCAR 17 (DOVE, DO-17)
1 20440U 90005E 95334.77070003 +.00000043 +00000-0 +33618-4 0 09590
2 20440 098.5740 058.8355 0012400 067.7918 292.4579 14.30101582305599
OSCAR 18 (WEBERSAT, WO-18)
1 20441U 90005F 95334.75635818 +.00000020 +00000-0 +24609-4 0 09517
2 20441 098.5737 058.7786 0012955 067.4858 292.7694 14.30071731305591
OSCAR 19 (LUSAT, LU-19)
1 20442U 90005G 95335.25683108 .00000034 00000-0 30019-4 0 9415
2 20442 98.5755 59.6902 0013298 66.7669 293.4908 14.30176960205680
OSCAR 20 (JAS 1B, FUJI 2, FUJI OSCAR 20, FO-20)
1 20480U 90013C 95335.10118791 -.00000016 +00000-0 +39220-4 0 08469
2 20480 099.0603 032.5772 0540208 215.4629 140.9412 12.83232407272359
COSMOS 2123 (Carries Radio Sputnik 12/13, RS-12/13)
1 21089U 91007A 95335.03009838 +.00000039 +000 I-0 +24816-4 0 08528
2 21089 082.9217 337.0430 0031104 068.0319 292.4157 13.74062974241689
OSCAR 22 (UoSAT F, UoSAT 5, UoSAT 22, UO-22)
1 21575U 91050B 95335.19008077 .00000047 00000-0 30282-4 0 6483
2 21575 98.3789 42.2356 0007846 133.8370 226.3460 14.37002402229489
OSCAR 23 (KITSAT A, KITSAT 1, KO-23)
1 22077U 92052B 95335.13285972 -.00000037 +00000-0 +10000-3 0 05539
2 22077 066.0784 246.2251 0002908 354.4627 005.6358 12.86293184155207
OSCAR 25 (KITSAT B , KTSAT 2, KO-25)
1 22825U 93061C 95334.75991610 +.00000016 +00000-0 +24230-4 0 04447
2 22825 098.6047 048.7136 0009396 091.9063 268.3195 14.27680169113530
OSCAR 26 (ITAMSAT, IO-26)
1 22828U 93061F 95335.14958548 +.00000031 +00000-0 +29843-4 0 04146
2 22828 098.6009 049.2689 0010978 076.3329 283.9072 14.28121341081703
OSCAR 27 (EYESAT A, AMSAT OSCAR 27, AO-27)
1 22829U 93061G 95335.16354176 -.00000029 +00000-0 +57699-5 0 04505
2 22829 098.6004 049.3259 0010615 075.9026 284.3375 14.28101822113620
OSCAR 28 (POSAT 1, PO-28)
1 22826U 93061D 95334.70124654 +.00000025 +00000-0 +27734-4 0 04485
2 22826 098.6049 048.7825 0009875 091.7430 268.4877 14.27788330113533
RADIO ROSTO (Radio Sputnik 15, RS-15)
1 23439U 94085A 95335.06939057 -.00000039 +00000-0 +10000-3 0 00988
2 23439 064.8135 345.0953 0166465 233.6852 124.8588 11.27523683038337

Weather Satellites

NOAA 9
1 15427U 84123A 95335.12615149 +.00000068 +00000-0 +59560-4 0 04966
2 15427 098.9790 034.6786 0015181 153.6765 206.5178 14.13746266465505
NOAA 10
1 16969U 86073A 95334.99560444 +.00000019 +00000-0 +26331-4 0 04141
2 16969 098.5152 332.8849 0012188 214.0311 146.0088 14.24965738378231
GOES 7
1 17561U 87022A 95334.33315885 .00000078 00000-0 10000-3 0 6568
2 17561 2.6633 71.0103 0000561 244.8273 97.5188 1.00272456 15298
METEOSAT 3
1 19215U 88051A 95326.93750000 -.00000072 00000-0 10000-3 0 2211
2 19215 2.8170 68.2720 0004390 129.8040 124.6270 0.96952553 15162
NOAA 11
1 19531U 88089A 95334.98435400 +.00000031 +00000-0 +41799-4 0 03069
2 19531 099.1952 342.8352 0012551 079.9770 280.2816 14.13073536270319
METEOSAT 4 (MOP 1)
1 19876U 89020B 95334.73905468 -.00000085 00000-0 10000-3 0 1637
2 19876 1.5765 71.8312 0018767 275.6634 92.6305 0.97109242 4688
HIMAWARI 4 (GMS 4)
1 20217U 89070A 95329.69278451 -.00000369 00000-0 10000-3 0 2734
2 20217 1.3586 75.6241 0001006 317.7365 39.8790 1.00258193 23360
METEOSAT 5 (MOP 2)
1 21140U 91015B 95329.64603545 -.00000007 00000-0 10000-3 0 1214
2 21140 0.1357 43.4074 0001940 212.4272 41.0354 1.00279989 19554
NOAA 12
1 21263U 91032A 95335.02443344 +.00000097 +00000-0 +62250-4 0 07339
2 21263 098.5753 354.7085 0013333 130.0978 230.1369 14.22579322136142
METEOR 3-5
1 21655U 91056A 95335.37016923 .00000051 00000-0 10000-3 0 8490
2 21655 82.5503 100.8869 0012699 312.4653 47.5376 13.16842873206505
METEOR 2-21
1 22782U 93055A 95335.54399067 .00000031 00000-0 14794-4 0 4450
2 22782 82.5462 144.5686 0022059 170.9536 189.2020 13.83043065113676
METEOSAT 6
1 22912U 93073B 95335.14526620 -.00000089 00000-0 10000-3 0 3849
2 22912 0.4743 280.7662 0002307 343.1371 207.9779 1.00274185 5869
METEOR 3
1 22969U 94003A 95335.13903868 +.00000051 +00000-0 +10000-3 0 02181
2 22969 082.5615 040.9451 0016104 020.1224 340.0532 13.16733209088854
GOES 8
1 23051U 94022A 95334.28076380 -.00000255 +00000-0 +00000-0 0 04310
2 23051 000.3647 085.1114 0004328 150.6953 218.1039 01.00254601013365
NOAA 14
1 23455U 94089A 95335.10522692 +.00000114 +00000-0 +87098-4 0 04134
2 23455 098.9212 276.4419 0010427 081.7413 278.4949 14.11551828047362
GOES 9
1 23581U 95025A 95334.56077640 -.00000189 00000-0 00000+0 0 976
2 23581 0.2099 269.8139 0004069 352.4053 278.6584 1.00266945 1925

Satellite Transponder Guide

By Robert Smathers

	Spacenet 2 (S2) 69°	Galaxy 6 (G6) 74°	Telstar 302 (T2) 85°	Spacenet 3 (S3) 87°	Telstar 402R (T4) 89°	Galaxy 7 (G7) 91°	Telstar 401 (T1) 97°	Galaxy 4 (G4) 99°	Spacenet 4 (S4) 101°	Anik E2 (A1) 107.3°
1	SC New York [V2+]	Tokyo BS New York feeds	XXXplore (adult) [V2+]	(none)	o/v	Sega Channel [digital]	Exxxtasy (Adult) [V2+]/VTC	SCPC services	Data Transmissions	o/v
2	GEMS TV (Spanish) [V2+]	BBC Breakfast News/o/v	A.I.N.	Nebraska Educational TV [digital]	TVN Promo Channel	CBS West [VC1]	Data Transmissions	SCPC services	WHDH-NBC Boston (Atlantic 3) [V2+]	o/v
3	USIA Worldnet TV	SCPC services	o/v	WSBK-Ind Boston [V2+]	o/v	Action PPV [V2+]	Parmount Syndication feeds/o/v	SCPC services	Data Transmissions	Data Transmissions
4	H.TV (Spanish)	o/v	o/v	Nebraska Educational TV (NETV)	Shop at Home	fX East	Fox feeds	SCPC services	WUSA-CBS Washington (Atlantic 3) [V2+]	o/v
5	NASA Contract Channel-o/v [Leitch]	NHK New York feeds	o/v	Univision [V2+]	o/v	fX West	4MC Syndicated feeds/o/v	o/v	Data Transmissions	Data Transmissions
6	Data Transmissions	NHK (TV Japan) feeds	o/v	(none)	o/v	Game Show Network [V2+]	Buena Vista TV feeds	Sheperd's Chapel Network (Rel)	KNBC-NBC Los Angeles (PT24W) [V2+]	o/v
7	o/v	National Empowerment TV	TurnerVision Promo	Data Transmissions	Cable Video Store [V2+]	The GoH Channel [V2+]	Fox feeds-East	o/v	Bassett Bingo	ABC East [Leitch]
8	Data Transmissions	(none)	o/v	Data Transmissions	(none)	HBD East 2 [V2+]	PBS X	Telemundo [GI Digicipher]	KOMO-ABC Seattle (PT24W) [V2+]	Global TV [Leitch] Global feeds
9	NASA TV	MuchMusic U.S. [V2+]	Exxxtreme/Climaxxx Promo	WPIX-Ind New York [V2+]	(none)	MCI (Andover) contract ch/RAI/o/v	Fox feeds East	o/v	Data Transmissions	o/v
10	Data Transmissions	Arab Network of America (ANA)	ABC West [Leitch]	Data Transmissions	XXXtreme/Climaxxx Promo [V2+]	United Arab Emirates TV Dubai	Fox feeds West	WABC-ABC New York (PT24E) [V2+]	FDXNet (PT24E) [V2+]	o/v
11	SC Philadelphia [V2+]	FDX News Feeds/o/v	XXXpose (adult) [V2+]	CNN feeds	The Outdoor Channel	Estacion Montellano (Spanish rel)/o/v	ABC feeds	N.C. Dpen Net/o/v	STARZ! [V2+]	Canadian Horse Racing/o/v
12	Data Transmissions	TV Asia [V2+]	XXXpose Promo	Data Transmissions	XXXotica (adult) [V2+]	International Channel [V2+]	ABC NewsDne feeds	o/v	H.TV	CTV (Blue)/Canadian Horse Racing/o/v
13	Data Transmissions	Independent Film Channel [V2+]	o/v	SCPC/FM2 services	o/v	CSN/Kaleidoscope/P-SS [Digicipher]	Fox East	o/v	Data Transmissions	Canadian Horse Racing/o/v
14	HERO Teleport [Digicipher]	Cornerstone TV WPCB-TV (Rel)	NPS Promo Channel	CNN [Leitch]	(none)	HBD West 2 [V2+]	Fox West	WRAL-CBS Raleigh (PT24E) [V2+]	Data Transmissions	adultVision (adult) [V2+]
15	Data Transmissions	Midwest Sports Channel [V2+]	XXXotica promos	KTLA-Ind Los Angeles [V2+]	Spice (adult) [V2+]	TV! [V2+]	Exxxtasy 2 (adult) [V2+]	World Harvest TV (Rel)	Data Transmissions	Global feeds/Exxxtasy promos/o/v
16	Data Transmissions	o/v	o/v	CNN International [Leitch]	Adam and Eve (adult) [V2+]	(none)	o/v	CBS West [VC1]	Data Transmissions	CTV (Green)
17	Data Transmissions	Keystone Comm Contract Channel-o/v	(none)	FM2/SCPC services	(none)	Via TV - home shopping	o/v	CBS East [VC1]/o/v	Data Transmissions	Climaxxx (adult) [V2+]
18	(none)	Merchandise and Entertainment TV (MET)/o/v	o/v	Shop-at-Home/ In-store audio	Radiotelevisao Portuguesa Internacional (RTPi)	CBS feeds [VC1]/o/v	o/v	CBS feeds [VC1]/o/v	WPLG-ABC Miami (Atlantic 3) [V2+]	Video Catalog Channel
19	Data Transmissions	University Network/Dr. Gene Scott (Rel)	(none)	SSN Sportsouth [V2+]/ American Collectables Network	Channel America	CBS East [VC1]	United Paramount Network/o/v	CBS East [VC1]/o/v	Data Transmissions	TV Northern Canada (TVNC)
20	Armed Forces Radio & Television Service [B-MAC]	CNN Headline News Clean Feed [V2+]	ABC East (contingency channel) [Leitch]	Shop-at-Home	(none)	o/v	ABC East [Leitch]	CBS East [VC1]	Data Transmissions	CJDN-TV Newfoundland TV (NTV)
21	SC New England [V2+]	o/v	(none)	SSN Pro Am Sports (Pass) [V2+]	(none)	o/v	ABC East [Leitch]	Warner Brothers Syndication-Network/ CBS feeds/o/v	Data Transmissions	o/v
22	Newsport [V2+]	(none)	o/v	Data Transmissions	(none)	NewsTalk Television	ABC West [Leitch]	WNBC-NBC New York (PT24E) [V2+]	Data Transmissions	3 Angels Broadcasting (Re
23	NHK TV Japan secondary feeds	Worship TV (Rel)	o/v	SSN Home Teams Sports (HTS) [V2+]	(none)	fX Movies [V2+]	ABC East [Leitch]	SCDLA [Wegener compression]	Data Transmissions	Exxxtreme TV/Th Cupid Network (adu [V2+]
24	SC New York Plus-o/v [V2+]	(none)	o/v	America One	PandaAmerica	HBO East 3 [V2+]	NASA TV highlights/o/v	CBS Newspath feeds	KPIX-CBS San Francisco (PT24W) [V2+]	CTV (Red)

Unscrambled/non-video | Subscription | Not available in U.S. | o/v = occasional video

Satellite Transponder Guide

By Robert Smathers

Solidaridad 1 (SD1) 109.2º	Telesat E1 (A2) 111º	Morelos 2 (M2) 116.8º	Telstar 303 (T3) 123º	Galaxy 5 (G5) 125º	Satcom C3 (F3) 131º	Galaxy 1R (G1) 133º	Satcom C4 (F4) 135º	Satcom C1 (F1) 137º	Satcom C5 (F5) 139º	
(none)	Data Transmissions	Data Transmissions	TVN 1 PPV [V2+]	Disney East [V2+]	Family Channel West [V2+]	Comedy Central West [V2+]	American Movie Classics (AMC) [V2+]	NewSport [V2+]	(none)	1
(none)	The Sports Network [Oak]	Data Transmissions	TVN 2 PPV [V2+]	Playboy (Adult) [V2+]	The Learning Channel	Spanish language networks [SA MPEG]	Request TV PPV [GI Digicipher]	KMGH-ABC Denver [V2+]	(none)	2
SCPC services	Data Transmissions	Data Transmissions	TVN 3 PPV [V2+]	Trinity Broadcasting (Rel)	Viewer's Choice PPV [V2+]	Encore [V2+]	Nickelodeon East [V2+]	KRMA-PBS Denver [V2+]	SCPC services	3
(none)	Data Transmissions	Data Transmissions	TVN 4 PPV [V2+]	Sci-Fi [V2+]	Lifetime West [V2+]	TV Food Network [GI Digicipher]	Lifetime East [V2+]	SC Pacific [V2+]	(none)	4
o/v	Data Transmissions	Data Transmissions	TVN 5 PPV [V2+]	CNN [V2+]	Faith and Values Channel/ACTS (Rel)	Classic Arts Showcase	Deutsche Welle TV (German)	KDVR-Fox Denver [V2+]	(none)	5
(none)	Cancom [SA MPEG]	Data Transmissions	TVN 6 PPV [V2+]	WTBS-Ind Atlanta [V2+]	Court TV [Digicipher]	Z-Music	Madison Square Garden [V2+]	KCNC-CBS Denver [V2+]	(none)	6
XEQ-TV canal 9	Data Transmissions	Data Transmissions	TVN 7 PPV [V2+]	WGN-Ind Chicago [V2+]	C-SPAN 1	Disney West [V2+]	Bravo [V2+]	SSN Prime Sports West [V2+]	(none)	7
(none)	Cancom (CHCH City TV WUHF CFTM) [SA MPEG]	XHGC canal 5/Q-CVC	TVN 8 PPV [V2+]	HBO West [V2+]	QVC-2 Fashion Channel	Cartoon Network [V2+]	Prevue Guide	NBC-East	(none)	8
o/v	The Weather Network	(none)	TVN 9 PPV/CVS [V2+]	ESPN [V2+]	Music Choice [digital]	ESPN2 Blackout [V2+]/SAH	QVC Network	Prime Sports Intl o/v/ Infomercials	(none)	9
Mexican Parliament	Cancom [SA MPEG	SEP	High Tech Channel/o/v	MOR Music	Home Shopping Club Spree	America's Talking [V2+]	Home Shopping Network (HSN)	Prime Sports SW [V2+]	(none)	10
(none)	CBC-North Pacific feed	XEIPN canal 11	Data Transmissions	Family Channel East [V2+]	Prime Network [V2+]	Eternal Word TV Network (Rel)	The Box	Network One 'N1'	(none)	11
Data Transmissions	Cancom [SA MPEG]	Data Transmissions	Data Transmissions	Discovery West [V2+]	History Channel [V2+]	Valuevision	Nustar (Promo Channel)	Data Transmissions	(none)	12
(none)	CBC feeds/o/v	(none)	(none)	CNBC [V2+]	The Weather Channel [V2+]	Encore [GI Digicipher]	Travel Channel [V2+]	SC Chicago [V2+]	(none)	13
Data Transmissions	Cancom [SA MPEG]	XEW canal 2	(none)	ESPN2 [V2+]	New England Sports Network [V2+]	ESPN Blackout [V2+]/SAH	Fit TV	KUSA-NBC Denver [V2+]	(none)	14
Multivision [GI Digicipher	CBFT-CBC (French)	Data Transmissions	Data Transmissions	HBO East [V2+]	Showtime East [V2+]	CNN International [V2+]	WWOR-Ind New York [V2+]	SC Cincinnati/Ohio [V2+]	DART Services	15
Data Transmission	CBC Newsworld [Oak]	Canal 22 o/v	Flix [V2+]	Cinemax West [V2+]	MTV West [V2+]	Turner Classic Movies [V2+]	Request TV 1 [V2+]	PS-SC Alt/o/v	(none)	16
(none)	CBC feeds/o/v	o/v	(none)	TNT [V2+]	Movie Channel East [V2+]	The New Inspirational Network (Rel)	MTV East [V2+]	SSN Prime Sports (various) [V2+]/Cal-Span/o/v	(none)	17
o/v	(none)	Clara Vision (rel)	Showtime 2 [V2+]	TNN [V2+]	Nickelodeon West [V2+]	HBO Multiplex [GI Digicipher]	Viewer's Choice [GI Digicipher]	Prime Sports Showcase	o/v	18
Multivision [GI Digicipher]	CBC feeds/o/v	(none)	(none)	USA East [V2+]	Showtime/MTV [GI Digicipher]	Cinemax East [V2+]	C-SPAN 2	FDXNet [V2+]	SEDAT Services	19
(none)	CBMT-CBC (English)	Data Transmissions	adultVision/TVN 10 PPV (Adult) [V2+]	BET [V2+]	Jones Intercable [GI Digicipher]	Home and Garden Network	Showtime West [V2+]	Syndicated Entertainment TV	(none)	20
(none)	SCPC services/ Data Transmissions	(none)	(none)	MEU	Comedy Central East [V2+]	USA West [V2+]	Discovery East [V2+]	Prime Sports West [GI Digicipher]	SCPC services	21
(none)	(none)	XHIMT canal 7	Antenna TV[V2+]/HRT Croatia TV o/v	CNN/HN [V2+]	Your Choice TV [Digicipher]	Nostalgia Channel	Movie Channel West [V2+]	SSN PSNW [V2+]/o/v	(none)	22
(none)	CBC-North Atlantic feed	(none)	(none)	A&E [V2+]	E! Entertainment TV [V2+]	Cinemax East 2 [V2+]	VH-1 [V2+]	KWGN-Ind Denver [V2+]	SEDAT Services	23
(none)	Cancom (BCTV CITV) [SA MPEG]	XHDF canal 13	TVN Preview/TVN PPV o/v [V2+]	Showtime/Movie Channel [SA MPEG]	Digital Music Express Radio [Digital]	(none)	CMT [V2+]	SSN Sunshine [V2+]	Alaska Rural TV Project	24

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Geostationary Satellite Locator Guide

By Larry Van Horn

This guide shows the orbital locations of active (227) geostationary satellites at publication deadline. 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 for providing satellite background information: Molniya Space Consultancy—Mr. Phillip Clark; Kaman Sciences Corporation—Dr. Nicholas Johnson; University of New Brunswick—Mr. Richard B. Langley; U.S. Space Command/Public Affairs—Major Don Planalp; Naval Space Command/Public Affairs— Gary Wagner; NASA NSSDC/WDC-A, Goddard Space Flight Center; NASA Headquarters—Mr. Keith E. Stein; and *Satellite Times* staff.

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

Service Key

BSS	Broadcasting 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

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

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
18952	1988-018B Telecom 1C (France)	2.9E	Dom FSS/Gov-Mil (C/Ku)
23712	1995-060A USA 115 (DFS-2/Milstar-2)	4.0E	Mil-Comm (P/S/K)
19919	1989-027A Tele X (Sweden)	5.2E	Reg DTH/FSS (Ku)
20193	1989-067A Sirius/Marcopolo 1(BSB R-1)	5.2E	Reg DTH (Ku)
22921	1993-076A USA 98 (NATO 4B)	6.0E/i	Mil-Comm (P/S/X)
22028	1992-041B Eutelsat II F4	6.9E	Reg FSS (Ku)
21056	1991-003B Eutelsat II F2	9.8E	Reg FSS (Ku)
19876	1989-020B Meteosat 4 (MOP 1)(ESA)	10.2E#	Met (L)
22269	1992-088A Cosmos 2224 (Russia)	11.3E#	Mil-Earl Warning (X)
22557	1993-013A Raduga 29 (Russia)	11.7E#	Dom FSS/Gov-Mil (X/C)
19596	1988-095A Raduga 22 (Russia)	12.5E/i	Dom FSS/Gov-Mil (X/C)
21055	1991-003A Italsat 1 (Italy)	13.2E	Dom-Telephone (S/K/Ka)
20777	1990-079B Eutelsat II F1	13.2E	Reg FSS (Ku)
23537	1995-016B Hot Bird 1 (Eutelsat II F6)	13.7E	DTH (Ku)
21803	1991-083A Eutelsat II F3	15.9E	Reg FSS (Ku)
23331	1994-070A Astra 1D	19.1E	Reg DTH (Ku)
22653	1993-031A Astra 1C	19.1E	Reg DTH (Ku)
19688	1988-109B Astra 1A	19.2E	Reg DTH (Ku)
23686	1995-055A Astra 1E	19.2E	Reg DTH (Ku)
21139	1991-015A Astra 1B	19.3E	Reg DTH (Ku)
14234	1983-077A Telstar 3A (301) (USA)	20.0E#	Dom FSS-Saudi Arabia (C)
19331	1988-063B Eutelsat 1 F5	21.5E#	Reg FSS (VHF/Ku)
13010	1981-122A Marecs 1 (ESA)	22.8E/i	Int Mar-EUR (L/C)
22175	1992-066A DFS 3 (Germany)	23.4E	Dom BSS (S/Ku/K)
18351	1987-078B Eutelsat 1 F4 (ECS 4)	25.4E/i	Reg FSS (VHF/Ku)
20706	1990-063B DFS 2 (Germany)	28.4E	Dom BSS (S/Ku/K)
21894	1992-010B Arabsat 1C	30.9E	Reg FSS/BSS (S/C)
20041	1989-041B DFS 1 (Germany)	33.5E	Dom BSS (SKu/K)
21821	1991-087A Raduga 28 (Russia)	35.3E#	Dom FSS/Gov-Mil (X/C)
20953	1990-102A Gorizont 22 (Russia)	39.8E/i	Dom/Gov FSS (C/Ku)
23200	1994-049B Turksat 1B (Turkey)	42.7E	Reg FSS (Ku)
19928	1989-030A Raduga 23 (Russia)	44.6E/i	Dom FSS/Gov-Mil (X/C)
14421	1983-105A Intelsat 507	47.1E/i	Int FSS/Mar (L/C/Ku)
21038	1990-116A Raduga 1-2 (Russia)	48.5E/i	Dom FSS/Gov-Mil (X/C)
22981	1994-008A Raduga 1-3 (Russia)	49.1E#	Dom FSS/Gov-Mil (X/C)
22245	1992-082A Gorizont 27 (Russia)	52.3E#	Dom/Gov FSS (C/Ku)
19687	1988-109A Skynet 4B (UK)	53.0E/i	Mil-Comm (P/S/X/Ka)
15629	1985-025A Intelsat 510	57.0E/i	Int FSS (C/Ku)
20667	1990-056A Intelsat 604	60.0E	Int FSS (C/Ku)
14675	1984-009A DSCS III A2 (USA)	60.0E/i	Mil-IOR primary (P/S/X)
20315	1989-087A Intelsat 602	62.8E	Int FSS (C/Ku)
20918	1990-093A Inmarsat 2 F1	64.5E#	Int Mar-IOR (L/C)
13595	1982-097A Intelsat 505	64.7E/i	Int FSS/Mar (L/C/Ku)
13636	1982-106A DSCS II F16 (USA)	64.9E/i	Mil-IOR reserve (S/X)
23461	1995-001A Intelsat 704	66.1E	Int FSS (C/Ku)
23636	1995-040A PanAmSat 4 (PAS 4)	68.6E	Int FSS (C/Ku)
23448	1994-087A Raduga 32 (Russia)	69.0E#	Dom FSS/Gov-Mil (X/C)
20083	1989-048A Raduga 1-1 (Russia)	70.3E/i	Dom FSS/Gov-Mil (X/C)
22963	1993-002A Gals 1 (Russia)	70.9E	Dom BSS (Ku)
23717	1995-063A Gals 2 (Russia)	71.0E	Dom BSS (Ku)
20410	1990-002B Leasat 5 (USA)	71.5E/i	Mil-IOR reserve (P/S/X)
08882	1976-053A Marisat 2	71.8E/i	Int Mar-IOR (P/L/C)
23589	1995-027A USA 111 (UFO-5)	71.9/i	Mil-IOR reserve (P/S/K)
22787	1993-056A USA 95 (UFO-2)	72.6E/i	Mil-IOR primary (P/S)
22027	1992-041A Insat 2A (India)	73.8E	Dom FSS/BSS/Met (S/C)
23327	1994-069A Elektro 1 (Russia)	75.9E#	Met (L)
23680	1995-054A Luch 1-1 (Russia)	76.5E	Tracking & Relay SDRN-2 (Ku)
22931	1993-078B Thaicom 1 (Thailand)	78.2E	Reg FSS (C/Ku)
23314	1994-065B Thaicom 2 (Thailand)	78.4E	Reg FSS (C/Ku)
21111	1991-010A Cosmos 2133 (Russia)	79.4E#	Mil-Early Warning (X)
21759	1991-074A Gorizont 24 (Russia)	79.5E#	Dom/Gov FSS (C/Ku)
23653	1995-045A Cosmos 2319 (Russia)	79.7E#	Data Relay (C)
20643	1990-051A Insat 1D (India)	82.8E	Dom FSS/BSS/Met (S/C)
22836	1993-062A Raduga 30 (Russia)	84.7E#	Dom FSS/Gov-Mil (X/C)
19548	1988-091B TDRS F3 (USA)	85.1E#	Gov (C/S/Ku)
18922	1988-014A PRC 22 (China)	87.5E#	Dom FSS (C)
22880	1993-069A Gorizont 28 (Russia)	90.2E#	Dom/Gov FSS (C/Ku)
12474	1981-050A Intelsat 501	91.2E/i	Int FSS (C/Ku)
22724	1993-048B Insat 2B (India)	93.4E	Dom FSS/BSS/Met (S/C)
23426	1994-082A Luch 1 (Russia)	95.9E/i	Tracking & Relay CSDRN (Ku)
20263	1989-081A Gorizont 19 (Russia)	96.3E/i	Dom/Gov FSS (C/Ku)
19683	1988-108A Ekran 19 (Russia)	97.7E/i	Dom BSS (P)
20473	1990-011A PRC 26 (China)	97.9E	Dom FSS (C)
22210	1992-074A Ekran 20 (Russia)	98.9E#	Dom BSS (P)
21922	1992-017A Gorizont 25 (Russia)	103.0E#	Dom/Gov FSS (C/Ku)
20558	1990-030A Asiasat 1	105.4E	DTH (C/Ku)
20570	1990-034A Palapa B2R	107.9E	Reg FSS (C)
23176	1994-040B BS-3N (Japan)	109.0E	Dom BSS (Ku)
20771	1990-077A BS-3A (Yuri 3A)(Japan)	109.3E	Dom BSS (Ku)
21668	1991-060A BS-3B (Yuri 3B)(Japan)	109.9E	Dom BSS (Ku)
19710	1988-111A PRC 25 (China)	110.6E	Dom FSS (C)
17706	1987-029A Palapa B-2P	112.9E	Reg FSS (C)
14985	1984-049A Chinasat 5 (Spacenet 1)	115.5E	Dom FSS (C/Ku)
23639	1995-041A Koreasat 1 (Mugunghwa 1)	116.0E	Dom FSS (Ku)
21964	1992-027A Palapa B4	118.0E	Reg FSS (C)
21132	1991-014A Raduga 27 (Russia)	127.5E/i	Dom FSS/Gov-Mil (X/C)
23649	1995-043A JCSAT 3 (Japan)	127.5E	Dom FSS (Ku)
22907	1993-072A Gorizont 29 (Rimsat 1)	129.8E#	Reg FSS (C/Ku)
18877	1988-012A CS 3A (Sakura 3A)(Japan)	131.8E	Dom FSS (C/K)
23651	1995-044A N-Star A (Japan)	131.9E	Dom/Mob FSS (S/C/Ku/Ka)
14134	1983-059C Palapa B1 (Indonesia)	133.7/i	Reg FSS (C)
19508	1988-086A CS 3B (Sakura 3B) (Japan)	135.9E	Dom FSS (C/K)

Geostationary Satellite Locator Guide

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
23185	1994-043A Apstar A1 (China)	137.9E	DTH (C)
20107	1989-052A Gorizont 18 (Russia)	139.5E/i	Dom/Gov FSS (C/Ku)
23522	1995-011B GMS-5 (Himawari 5)	140.0E#	Met (P/L)
23108	1994-030A Gorizont 30 (Rimsat 2)	142.3E#	Reg FSS (C/Ku)
20923	1990-094A Gorizont 21 (Russia)	145.0E/i	Dom/Gov FSS (C/Ku)
19874	1989-020A JCSAT 1 (Japan)	149.9E	Dom FSS (Ku)
18316	1987-070A ETS V (Japan)	150.2E/i	Experimental (L/C)
18350	1987-078A Optus A3 (Aussat K3)	151.9E	DTH (Ku)
20402	1990-001B JCSAT 2 (Japan)	154.0E	Dom FSS (Ku)
23227	1994-055A Optus B3 (Australia)	155.9E	DTH/Mob (L/Ku)
22253	1992-084A Superbird A1 (Japan)	157.9E	Dom FSS (Ku/K)
22087	1992-054A Optus B1 (Aussat B1)	160.9E	DTH/Mob (L/Ku)
21893	1992-010A Superbird B1 (Japan)	162.0E	Dom FSS (Ku/K)
16275	1985-109C Optus A2 (Aussat 2)	164.0E#	DTH (Ku)
23175	1994-040A PanAmSat 2 (PAS-2)	169.0E	Int FSS (C/Ku)
12046	1980-087A OPS 6394 (FltSatCom F4)(USA)	172.9E/i	Mil-POR reserve (P-Bravo/S/X)
22871	1993-066A Intelsat 701	174.0E	Int FSS (C/Ku)
20202	1989-069A DSCS III B9 (USA)	175.0E/i	Mil-WPAC primary (P/S/X)
23305	1994-064A Intelsat 703	177.0E	Int FSS (C/Ku)
21814	1991-084B Inmarsat 2 F3	177.9E#	Int Mar-POR (L/C)
15873	1985-055A Intelsat 511	179.9E/i	Int FSS (C/Ku)
16117	1985-092C DSCS III B5 (USA)	180.0E/i	Mil-WPAC reserve (P/S/X)
09478	1976-101A Marisat 3	177.5W/i	Int Mar-POR (P/L/C)
23467	1995-003A USA 108 (UFO-4) (USA)	177.2W/i	Mil-POR (P/S/K)
19121	1988-040A Intelsat 513	177.0W#	Int FSS (C/Ku)
15236	1984-093C Leasat 2 (USA)	177.0W/i	Mil-POR primary (P/S/X)
21639	1991-054B TDRS F5 (USA)	174.2W	Int FSS/Gov (C/S/Ku)
20499	1990-016A Raduga 25 (Russia)	170.7W/i	Dom FSS/Gov-Mil (X/C)
18631	1987-100A Raduga 21 (Russia)	170.1W/i	Dom FSS/Gov-Mil (X/C)
23613	1995-035B TDRS F7 (USA)	150.1W	Int FSS/Gov (C/S/Ku)
21392	1991-037A Satcom C5 (Aurora II)(USA)	139.0W	Dom FSS (C)
13969	1983-026B TDRS F1 (USA)	138.9E/i	Gov (Ku)
20945	1990-100A Satcom C1 (USA)	137.1W	Dom FSS (C)
17561	1987-022A GOES 7 (USA)	135.4W/i	Met (P/L/S)
22096	1992-057A Satcom C4 (USA)	135.3W	Dom FSS (C)
22915	1993-074A DSCS III B14 (USA)	135.0W/i	Mil-EPAC primary (P/S/X)
23016	1994-013A Galaxy 1R (USA)	133.1W	Dom FSS (C)
22117	1992-060B Satcom C3 (USA)	131.0W	Dom FSS (C)
13637	1982-106B DSCS III A1 (USA)	129.9W/i	Mil-EPAC reserve (P/S/X)
21906	1992-013A Galaxy 5 (USA)	125.1W	Dom FSS (C)
16649	1986-026A Gstar 2 (USA)	125.0W#	Dom FSS (Ku)
15826	1985-048D Telestar 3D (USA)	123.1W#	Dom FSS (C)
19484	1988-081B SBS 5 (USA)	123.0W	Dom FSS (Ku)
22988	1994-009A USA 99 (DFS-1/Milstar 1)	120.0W	Mil-Comm (P/S/K)
16274	1985-109B Morelos B (Mexico)	116.9W	Dom FSS (C/Ku)
13652	1982-110C Anik C3 (Canada)	114.9W/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)
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	106.7W/i	Int Mar-AOR (P/L/C)
15643	1985-028C Leasat 3 (USA)	106.0W/i	Mil-CONUS reserve (P/S/X)
03029	1967-111A ATS 3 (USA)	105.8W/i	Exp comm (VHF/C)
20946	1990-100B Gstar 4 (USA)	105.0W	Dom FSS (Ku)
08747	1976-023B LES 9 (USA)	105.0W/i	Mil-Exp comm (P/Ka)
15677	1985-035A Gstar 1 (USA)	103.0W	Dom FSS (Ku)
22930	1993-078A DBS 1 (USA)	101.3W	DTH (Ku)
23598	1995-029A DBS 3 (USA)	101.3W	DTH (Ku)
21227	1991-028A Spacenet 4 (USA)	101.1W	Dom FSS (C)
23553	1995-019A MSAT-2 (USA)	101.0W	Mobile (L/X)
23192	1994-047A DBS 2 (USA)	100.9W	DTH (Ku)
22796	1993-058B ACTS (USA)	100.1W	Exp Comm (C/K/Ka)
23696	1995-057A USA 114 (UFO-6)	100.0W	Mil-CONUS (P/S/K)
08746	1976-023A LES 8 (USA)	99.8W/i	Mil-Exp comm (P/Ka)
17181	1986-096A USA 20 (FltSatCom F7)(USA)	99.8W/i	Mil-CONUS primary (P/S/X/K)
22694	1993-039A Galaxy 4 (USA)	99.0W	Dom FSS (C/Ku)
22927	1993-077A Telstar 401 (USA)	97.0W	Dom FSS (C/Ku)
19483	1988-081A Gstar 3 (USA)	93.2W/i	Dom FSS/Mob (L/Ku)

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
16650	1986-026B SBTS 2 (Brazil)	92.1W/d	Dom FSS (C)
22205	1992-072A Galaxy 7 (USA)	91.0W	Dom FSS (C/Ku)
23581	1995-025A GOES 9 (USA)	90.0W	Met (P/L/S)
23670	1995-049A Telstar 402R (USA)	89.2W	Dom FSS (C/Ku)
18951	1988-018A Spacenet 3R (USA)	87.1W	Dom FSS (L/C/Ku)
15237	1984-093D Telestar 3C (302) (USA)	85.1W#	Dom FSS (C)
16482	1986-003B Satcom K-1 (USA)	85.0W	Dom FSS (Ku)
16276	1985-109D Satcom K-2 (USA)	81.0W	Dom FSS (Ku)
15235	1984-093B SBS 4 (USA)	77.1W/i	Dom FSS (Ku)
12309	1981-018A Comstar D4 (USA)	76.4W/i	Dom FSS (C)
14133	1983-059B Anik C2 (Argentina)	75.9W/i	Dom FSS (Ku)
23051	1994-022A GOES 8 (USA)	74.3W#	Met (P/L/S)
20873	1990-091B Galaxy 6 (USA)	74.1W	Dom FSS (C)
20872	1990-091A SBS 6 (USA)	74.0W	Dom FSS (Ku)
15642	1985-028B Anik C1 (Argentina)	71.9W	Dom FSS (Ku)
12855	1981-096A SBS 2 (USA)	71.1W/i	Dom FSS (Ku)
23199	1994-049A Brazilsat B1 (Brazil)	70.0W	Dom FSS (C)
19215	1988-051A Meteosat P2 (ESA)	69.4W/i	Met (L)
15385	1984-114A Spacenet 2 (USA)	69.4W	Dom FSS (C/Ku)
23536	1995-016A Brasilsat B2 (Brazil)	65.1W	Dom FSS (C/X)
15561	1985-015B SBTS 1 (Brazil)	63.1W#	Dom FSS (C)
21940	1992-021B Inmarsat 2 F4	53.9W/i	Int Mar-AOR-W (L/C)
23571	1995-023A Intelsat 706	53.0W	Int FSS (C/Ku)
20203	1989-069B DSCS III B10 (USA)	52.5W/i	Mil-WLANT primary (P/S/X)
23528	1995-013A Intelsat 705	50.0W	Int FSS (C/Ku)
22314	1993-003B TDRS F6 (USA)	45.7W/i	Gov (C/S/Ku)
19217	1988-051C PanAmSat 1 (PAS 1)	45.0W	Int FSS (C/Ku)
16116	1985-092B DSCS III B4 (USA)	42.5W/i	Mil-ATL reserve (P/S/X)
19883	1989-021B TDRS F4 (USA)	41.0W	Int FSS/Gov (C/S/Ku)
12089	1980-098A Intelsat 502	40.3W/i	Int FSS (C/Ku)
23413	1994-079A Orion 1 (USA)	37.8W	Int FSS (Ku)
20523	1990-021A Intelsat 603	34.6W	Int FSS (C/Ku)
20401	1990-001A Skynet 4A	34.0W/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)	30.2W	Dom BSS/FSS (Ku)
22116	1992-060A Hispasat 1A (Spain)	30.0W	Dom BSS/FSS (Ku)
13083	1982-017A Intelsat 504	29.3W/i	Int FSS (C/Ku)
21765	1991-075A Intelsat 601	27.6W	Int FSS (C/Ku)
21653	1991-055A Intelsat 605	24.5W	Int FSS (C/Ku)
23168	1994-038A Cosmos 2282 (Russia)	24.3W#	Mil-Early Warning (X)
22112	1002-059A Cosmos 2209 (Russia)	23.9W#	Mil-Early Warning (X)
20253	1989-077A USA 46 (FltSatCom 8)	22.6W/i	Mil-AOR primary (P-Charlie/S/X/K)
21989	1992-032A Intelsat K	21.5W	Int FSS (Ku)
16101	1985-087A Intelsat 512	21.3W#	Int FSS (C/Ku)
15391	1984-115A NATO III D	21.0W/i	Mil-Comm (P/S/X)
20705	1990-063A TDF 2 (France)	18.9W	DTH (Ku)
19621	1988-098A TDF 1 (France)	18.8W	DTH (Ku)
19772	1989-006A Intelsat 515	18.1W	Int FSS (C/Ku)
21047	1991-001A NATO IV A	17.8W/i	Mil-Comm (P/S/X)
20391	1989-101A Cosmos 2054 (Russia)	15.8W/i	Tracking & Relay WSDRN (Ku)
21149	1991-018A Inmarsat 2 F2	15.6W/i	Int Mar-AOR-E (L/C)
15386	1984-114B Marecs B2	15.0W/i	Int Mar-AOR (L)
23132	1994-035A USA-104 (UFO-3)(USA)	14.7W/i	Mil-AOR primary (P/S)
10669	1978-016A Ops 6391 (FltSatCom 1) (USA)	14.3W/i	Mil-AOR reserve (P-Alpha/S/X)
23319	1994-067A Express 1 (Russia)	14.3W	Int FSS (C/Ku)
23267	1994-060A Cosmos 2291 (Russia)	13.5W#	Data Relay (C)
21789	1991-079A Cosmos 2172 (Russia)	13.4W#	Data Relay (C)
22009	1992-037A DSCS III B12 (USA)	12.0W	Mil-ELANT primary (P/S/X)
22041	1992-043A Gorizont 26 (Russia)	10.9W#	Dom/Gov FSS (C/Ku)
22912	1993-073B Meteosat 6 (ESA)	10.3W#	Met (L)
21813	1991-084A Telecom 2A (France)	8.0W	Dom FSS/Gov-Mil (X/C/Ku)
21939	1992-021A Telecom 2B (France)	5.1W	Dom FSS/Gov-Mil (X/C/Ku)
23124	1994-034A Intelsat 702	1.0W	Int FSS (C/Ku)
20776	1990-079A Skynet 4C (UK)	0.9W#	Mil (P/S/X/Ka)
20762	1990-074A Thor/Marcopolo 2 (BSB R-2)	0.8W	Reg BSS (Ku)
21140	1991-015B Meteosat 5 (MOP 2)	0.5W	Met (L)
20168	1989-062A TV Sat 2 (Germany)	0.3W	Dom BSS (Ku)

Amateur Satellite Frequency Guide

The Radio Amateur Satellite Corp.

Satellite	Mode	Frequencies
OSCAR 13 (AO-13) (Notes 1 & 13)	B (u/V)	Dn 145.828 838 848 858 868 878 888 898 908 918 928 938 948 958 968 145.978 Up 435.570 560 550 540 530 520 510 500 490 480 470 460 450 440 430 435.420
	Bcns	145.812 (RTTY, CW, PSK) 145.965
	S (u/S)	Dn 2400.711 720 730 740 2400.747 Up 435.601 610 620 630 435.637
	Bcn	2400.650 (RTTY, CW, PSK)
OSCAR 10 (AO-10) (Notes 2 & 13)	B (u/V)	Dn 145.825 835 845 855 865 875 885 895 905 915 925 935 945 955 965 145.975 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) 145.987
RS 10/11 (Notes 3, 4, 5 and 13)	A (v/A)	Dn 29.360 370 380 390 29.400 Up 145.860 870 880 890 145.900 Robot (CW) 29.403 / 145.820
	Bcn	29.357 (CW)
RS-12/13 (Notes 3, 6 & 7)	K (h/A)	Dn 29.410 420 430 440 29.450 Up 21.210 220 230 240 21.250 Robot (CW) 29.454 / 21.129
	Bcn	29.408
RS-15 (Note 13)	A (v/a)	Dn 29.354 29.364 29.374 28.384 29.394 Up 145.858 145.868 145.878 145.888 145.898
UoSat 11 (UO-11) (Note 14)	Bcns	Dn 145.826 435.025 2401.500 Up None
PACSAT (AO-16) (Notes 8, 9 & 11)	[a]	Dn 437.025 (Sec) 437.050 Up 145.900 145.920 145.940 145.960
DOVE (DO-17) (Notes 10 & 11)	[b,c]	Dn 145.825 2401.220 Up None
WEBERSAT (WO-18) (Note 11)	[a]	Dn 437.075 437.100 (Sec) Up None
LUSAT (LO-19) (Notes 8 & 11)	[a]	Dn 437.125 437.150 (Sec) Up 145.840 145.860 145.880 145.900

NOTES

1. AO-13 carries a 70 cm trammitter for Modes J and L. However, this transmitter failed in mid-1993 and has been inoperative since.
2. 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.
3. RS-10/11 and RS-12/13 are each mounted on common spaceframes, along with comunication and navagation packages.
4. 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.
5. 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.
6. 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.
7. 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.
8. Transmitters on both AO-16 & LU-19 are currently using Raised Cosine Mode.
9. 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.
10. 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.
11. 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)
12. PO-28 is available to amateurs on an intermittent, unscheduled basis.
13. Modes of operation used include: CW,/USB/FAX/Packet/RTTY
14. Modes of operation used include: FM (AFSK) & PSK Data.
15. 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 11 & 13)	JA Linear	Dn 435.800 810 820 830 840 850 860 870 880 890 435.900
		Up 146.000 990 980 970 960 950 940 930 920 910 145.900
	Bcn	435.795 (CW)
	JD [a] Dgtl	Dn 435.910
		Up 145.850 145.890 145.910
OSCAR 22 (UO-22) (Note 11)	[c]	Dn 435.120
		Up 145.900 145.975
KITSAT A (KO-23) (Note 11)	[c]	Dn 435.173
		Up 145.850 145.900
KITSAT B (KO-25) (Note 11)	[c]	Dn 435.175 436.500
		Up 145.870 145.980
IT-AMSAT (IO-26) (Note 11)	[a,c]	Dn 435.820 (Sec.) 435.867
		Up 145.875 145.900 145.925 145.950
EYESAT /AMRAD (AO-27) (Note 11)	[b,a]	Dn 436.800
		Up 145.850
POSAT (PO-28) (Notes 11 & 13)	[c]	Dn 435.250 435.280
		Up 145.925 145.975
MIR (Note 15)	[b]	Up & Dn & FM voice 145.550
SHUTTLE (SAREX) (Note 15)	[b]	Dn 145.840
		Up 144.450 144.470

Compiled by
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The Radio Amateur Satellite Corp.
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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-72	January 1995/ Endeavour*	28.4/250	10 days	SFU-RETR
STS-75	February 1995/ Columbia**	28.4/160	13 days	TSS-1R
STS-76	March 1995/ Atlantis***	51.6/160	10 days	S/MM-03

*Crew Assignment: CDR-Brian Duffy, PLT-Brent W. Jett Jr, MS-Daniel T. Barry, MS-Leroy Chiao, MS-Winton E. Scott, MS-Koichi Wakata (Japan).

**Crew Assignment: CDR-Andrew M. Allen, PLT-Scott J. Horowitz, MS (PLC)-Franklin Chang-Diaz, MS-Maurizio Cheli (Italy), MS-Jeffrey A. Hoffman, MS-Claude Nicollier (Switzerland), PS-Umerto Guidoni (Italy).

***Crew Assignment: CDR-Kevin P. Chilton, PLT-Richard A. Searfoss, MS-Shannon W. Lucid, MS-Linda A. Godwin, MS-Michael R. Clifford, MS-Ronald M. Sega.

STS Downlink Frequency Assignment:

VHF/UHF Voice	145.550 145.840 259.7 and 296.8 MHz;
S-band TRK	2041.9 MHz; S-band TLM 2106.4 MHz;
TTC&V (TDRSS)	2217.5 and 2287.5 MHz;
K-band TLM (TDRSS)	15003.4 GHz.

SFU downlink frequency assignment: S-band TLM2263.6018 MHz

TSS-1R downlink frequency assignment: S-band TLM 2260.0 MHz

MIR downlink frequency assignment:

VHF band	121.125 121.750 130.167 139.208 143.625 and 145.550 MHz
UHF band	231.0 233.0 247.0 249.0 417.0 and 463.0 MHz
S-band	2025-2100 and 2200-2290 MHz
Ku-band	13 and 15 GHz

Russian Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
February	Cosmos	Plesetsk	COSMOS (NAV) FAISAT 2V
February	Soyuz	Baikonur	Soyuz TM-23
March	Proton	Baikonur	Priroda
March	Proton	Baikonur	Astra 1F

COSMOS (NAV) downlink frequency assignment: 149.910-150.030 MHz and 388-400.1 MHz

FAISAT 2V downlink frequency assignment: 400-401 MHz

Soyuz TM-23 downlink frequency assignment: 121.750 MHz (WBFM)

Japanese Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
February	J-1	Tangeshima	HYFLEX

U.S. Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
January	Pegasus XL	VAFB	REX-II
	Delta II	VAFB	Polar
	Pegasus XL	VAFB	SEASTAR
	Starfire 1	WSTF	CONQUEST
February	Atlas 2AS	CCAS	PALAPA C-1
	Delta II	CCAS	NEAR
March	Atlas 2A	CCAS	INMARSAT 3 F1
	Titan 4	CCAS	DSP 18
	Pegasus XL	WFF	SAC-B / HETE
	Pegasus XL	WFF	ORBCOMM 1
	Delta II	VAFB	MSX
	DC-X	WSTF	None

Pegasus XL downlink frequency assignments: 2288.5 MHz and tracking transponder (transmit/downlink) 5765.0 MHz

Delta II downlink frequency assignments:

S-band TLM	2244.5 2241.5 and 2252.5 MHz
C-band TRK	5765.0 MHz

Polar downlink frequency assignment:

S-band TLM/TRK	2265.0 MHz

Seastar/Seawifs downlink frequency assignment:

L-band TLM	1702.5 MHz
S-band TLM	2272.5 MHz

NEAR downlink frequency assignment:

X-band TLM	8.40-8.44 GHz

SAC-B downlink frequency assignment: 2255.5 MHz

HETE downlink frequency assignment: 137.96 MHz and 2272.0 MHz

ORBCOMM 1 downlink frequency assignment: 137.050 137.225 137.575 137.985

MSX downlink frequency assignment:

S-band	2282.5 MHz
X-band	8475.0 MHz

Indian Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
February 1996	PSLV	Shar	IRS P3

European Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
January	Ariane 4	Guiana	TELECOM 2D
	Ariane 4	Guiana	MEASAT-1 & PAS-3R
February	Ariane 44LP	Guiana	INTELSAT 707
March	Ariane 4	Guiana	AMOS 1A

Satellite Launch Schedules

Ariane 4 downlink frequency assignment:
S-band TLM 2203.0 2206.0 and 2218.0 MHz

Telecom 2D downlink frequency assignment:
S-band TLM/TRK 2207.130 MHz

List of Abbreviations and Acronyms

AMOS	Israel telecommunications satellite.
Astra 1F	These satellites will establish a medium-power system for TV distribution from geostationary orbit.
CCAS	Cape Canaveral Air Station.
CDR	Commander.
CONQUEST	???????
COSMOS	A Russian launcher & type of military/civilian navigation satellite.
DC-X	Delta Clipper-X experimental single-stage-to-orbit vehicle.
DSP-18	These Department of Defense early warning satellites sense targets at two IR wavelengths to avoid laser jamming and improve discrimination. The satellites also carry nuclear explosion detectors for the Dept. of Energy.
FAISAT	The system will provide data acquisition services, remote monitoring, tracking, personal and business non-voice messaging, and emergency communications/distress calls.
GHz	Gigahertz.
HETE	High Energy Transient Experiment spacecraft to study gamma ray burst sources and source locations, and x-ray burst sources and source locations.
HYFLEX	A Japanese hypersonic flight experiment spaceplane model.
INMARSAT	International Maritime Satellite, a commercial satellite series providing global maritime and aviation communications.
INTELSAT	Satellite for the International Telecommunications Satellite Organization.
IRS P3	Indian Remote Sensing satellite.
K-band	10.90 to 17.15 Ghz
MEASAT	Malaysia's first telecommunications satellite built by the U.S. based aerospace company Hughes.
MHz	Megahertz.
MS	Mission Specialist.
MSX	Midcourse Space Experiment is designed to detect, acquire, and track targets and to discriminate lethal from nonlethal objects.
NEAR	Near Earth Asteroid Rendezvous, a mission to rendezvous with an asteroid in near-Earth trajectory. First in planned Mission To Planet Earth "Discovery" series.
ORBCOMM	Orbcomm will provide low-cost alpha numeric data communications and position determination for emergency assistance, data acquisition and messaging services using pocket portable and mobile subscriber terminals.
PALAPA	Geosynchronous satellite communication system for the Republic of Indonesia.
PAS-3R	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.
Polar	Polar auroral plasma physics spacecraft.
Priroda	A new module for the Russian space station Mir, planned for remote sensing of land, oceans and atmosphere.
REX-II	Radiation Experiment satellite, researches effects of electron density irregularities on transionsphere radio signals.
RNG	Ranging.
SAC-B	Satelite de Aplicaciones Cientificas-B, a Argentine spacecraft carrying hard x-ray spectrometer to investigate solar flares and cosmic transient x-ray emissions.
S-band	2000 to 2300 Mhz
Seastar	To estimate ocean color, and derive from these measurements, various biological indicators and other useful scientific products.
SFU-RETR	Space Flyer Unit Retrieval is a reusable, retrievable unmanned free flyer launched on a Japanese H-II rocket and retrieved by Shuttle.
S/MM-03	Shuttle MIR Mission-03 is a flight to the Russian Space Station MIR, to support design and assembly of the international space station.
Soyuz TM	Manned mission to carry replacement crews to the Russian space station Mir.
TDRSS	Tracking & Data Relay Satellite System.
TELECOM	European telecommunications satellite.
TLM	Telemetry.
TRK	Tracking.
TSS-1R	Tethered Satellite System, a cooperative system developed by the Italian Space Agency (ASI) and NASA which is capable of deploying and retrieving a satellite which is attached by a wire tether from distances up to 100 km from the Orbiter.
TT&C	Tracking, Telemetry and Command.
TTC&V	Tracking, Telemetry, Commanding and Voice.
VAFB	Vandenberg Air Force Base, Calif.
VHF	Very High Frequency (30 to 300 MHz)
WFF	Wallops Flight Facility.
WTSF	White Sands Test Facility, New Mexico.

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/publications/casr/home.html.

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 September and October 1995. 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.

Launch Date/Time	Int Des	Satellite	Mass
Epoch	Incl	Period	Perigee	Apogee
1995 Sep 3/0900	1995-047A	Soyuz-TM 22	7,150 kg ?
1995 Sep 3.36	51.63 deg	88.65 min	197 km	218 km
1995 Sep 5.80	51.65 deg	92.46 min	393 km	398 km

Piloted spacecraft launched to the Mir Complex for the EUROMIR-95 mission: crew comprised Yuri P Gidzenko (commander), Sergei V Avdeyev (flight engineer) and Thomas Reiter (ESA astronaut from Germany). Docked with Mir Complex at the front longitudinal port (+X) Sep 5 at 1030 UTC. Crew are scheduled to remain in orbit for about 179 days (originally planned as 135 days, but the mission duration has been extended), giving Reiter the record for the longest flight by a non-Russian (non-former-Soviet). Launched by a Soyuz-U2 from Tyuratam: third stage (Block I) discarded in an orbit similar to the first one quoted for the satellite.

1995 Sep 7/1509	1995-048A	Endeavour (STS-69)	99,663 kg
1995 Sep 7.77	28.47 deg	92.00 min	368 km	377 km
1995 Sep 10.81	28.47 deg	92.57 min	397 km	404 km
1995 Sep 13.28	28.47 deg	92.61 min	396 km	409 km

Launch Date/Time	Int Des	Satellite	Mass
Epoch	Incl	Period	Perigee	Apogee
1995 Sep 7/1509	1995-048B	SPARTAN 201-03	1,289 kg
1995 Sep 8.65	28.47 deg	92.00 min	368 km	377 km
1995 Sep 7/1509	1995-048C	Wake Shield Facility 2	1,979 kg
1995 Sep 11.57	28.33 deg	91.45 min	290 km	402 km
1995 Sep 11.66	28.48 deg	92.60 min	396 km	408 km

Piloted spacecraft carrying five astronauts: David M Walker (commander), Kenneth D Cockrell (pilot), James S Voss (payload commander, EVA crewman, mission specialist MS-1), James H Newman (MS-2) and Michael L Gernhardt (EVA crewman, MS-3). Mass quoted above is that projected for the time of landing. Launched from and landed at Kennedy Space Center: main gear touchdown was Sep 18 at 1138 UTC. SPARTAN 201 ("Shuttle Point Autonomous Research Tool for Astronomy") on its third flight: previous flights were as part of the STS-56 (1993-023B) and STS-64 (1994-059B) missions. Satellite carried Ultraviolet Coronal Spectrometer and White Light Coronagraph for solar studies. Deployed from the orbiter's cargo bay Sep 8 at 1542 UTC and was re-captured Sep 10 at 1502 UTC. Second flight of Wake Shield Facility (WSF): first flight aboard STS-60 (1994-006A), but not deployed on that flight because of communications problems. Designed to provided experiments with an "ultra-vacuum" created in the wake of the disk as it circles the Earth, WSF is intended for microgravity experiments and material processing. WSF was deployed from orbiter cargo bay Sep 11 at 1125 UTC and was captured Sep 14 at 1359 UTC. After deployment WSF used its own propulsion system to manoeuvre away from the orbiter — the first time that this had happened: normally the orbiter retreats from the deployed payloads before the payloads manoeuvre.

1995 Sep 24/0006	1995-049A	Telstar 402R	3,410 kg
1995 Sep 23.80	7.10 deg	647.03 min	259 km	36,546 km
1995 Oct 3.09	0.20 deg	1,436.12 min	35,747 km	35,827 km

Telstar 402R is a replacement for Telstar 402 launched September 9, 1994 which apparently disintegrated shortly after orbital injection. Lockheed Martin Astro Space series 7000 satellite bus launched for communications services operated by AT&T, New Jersey USA. Mass of satellite quoted above includes propellant: on station it is projected to be 2,097 kg at the beginning of the satellite's life, with a dry mass of 1,578 kg. Satellite is reported to have use of one gyro soon after launch but this did not prevent it reaching its planned orbital slot of 271 deg E at the beginning of October. Launched from Kourou using an Ariane 42L: Ariane third stage (H-10-3) discarded in an orbit similar to the first one quoted for the satellite.

1995 Sep 26/1120	1995-050A	Resurs-F 20	6,300 kg ?
1995 Sep 26.52	82.31 deg	88.79 min	181 km	248 km
1995 Sep 27.57	82.32 deg	89.16 min	231 km	235 km
1995 Oct 22.09	82.32 deg	89.85 min	256 km	278 km

Recoverable "Resurs-F2" remote sensing satellite, based upon the design of the "Zenit" photoreconnaissance satellite which in turn was derived from the Vostok manned spacecraft: the launch announcement indicated that this would be the final flight of a Resurs-F2 satellite. The final orbital manoeuvre marked a return to the orbital altitude slot which most of the original Resurs-F missions had used, both within the Cosmos programme and when Resurs-F launches started under their own name. Satellite was de- orbited Oct 26 with the descent module landing 90 km south-west of Troitsk (Chelyabinsk region) at 0537 UTC. Launched from Plesetsk using a Soyuz-U vehicle which left a third stage (Block I) in an orbit similar to the first one listed for the satellite.

Launch Date/Time		Int Des	Satellite		Mass
Epoch	Incl	Period	Perigee		Apogee
1995 Sep 29/0425		1995-051A	Cosmos 2320		7,000 kg ?
1995 Sep 29.24	64.92 deg	89.15 min	180 km		285 km
1995 Sep 29.98	64.92 deg	89.95 min	242 km		302 km

Fifth generation photoreconnaissance satellite, expected to remain operating for about a year. Data can be returned to Earth either by direct down-link communications or via geosynchronous communications satellites in the Potok system. Launched from Tyuratam using a Soyuz-U launch vehicle: third stage (Block I) left in an orbit similar to the first one shown for the satellite.

1995 Oct 6/0323		1995-052A	Cosmos 2321	825 kg ?
1995 Oct 6.52	82.94 deg	95.14 min	258 km	793 km

Russian statements issued shortly after the launch of Cosmos 2321 indicated that the second stage of the Cosmos-3M launch vehicle had malfunctioned, putting the satellite into an unplanned orbit. The orbital plane at launch was the same as that of Cosmos 2266, a military "Parus" navigation satellite launched in 1993, thus suggesting that Cosmos 2321 was also a "Parus" satellite. Launched from Plesetsk: second stage of Cosmos-3M left in an orbit similar to that of the satellite.

1995 Oct 8/1851		1995-053A	Progress-M 29	7.250 kg ?
1995 Oct 8.83	51.67 deg	88.60 min	188 km	223 km
1995 Oct 11.03	51.65 deg	92.45 min	393 km	396 km

Unmanned cargo freighter, carrying supplies to the Mir Complex cosmonauts. Docked with the Mir Complex at the rear (-X) port of Kvant 1 Oct 10 at 2033 UTC. Carries 1,611 kg of equipment plus fresh supplies of water and food. Launched from Tyuratam using a Soyuz-U: third stage (Block I) in an orbit similar to the first one listed for the satellite.

1995 Oct 11/1626		1995-054A	Luch-1 1	2,400 kg
1995 Oct 11.46	3.03 deg	1,442.60 min	35,864 km	35,963 km
1995 Oct 26.76	3.07 deg	1,436.17 min	35,767 km	35,810 km

First flight of improved "Altair" data relay satellite with three times the capacity of the original "Altair" satellites (similar data relay system to the United States TDRS). Launch announcement stated that the satellite would be located over 77 deg E (actual location based upon the Two-Line Orbital Elements is close to 76 deg E), indicating that this is the first satellite to be launched in the SSRD-2 data relay system: other locations registered for SSRD-2 are 167 deg E and 344 deg E. Launched from Tyuratam using a Proton-K (4): Proton third stage discarded in low Earth orbit, fourth stage (Block DM-2M on its maiden flight) in an orbit similar to the first one listed for the satellite.

Launch Date/Time		Int Des	Satellite		Mass
Epoch	Incl	Period	Perigee		Apogee
1995 Oct 19/0038		1995-055A	Astra 1E		3,010 kg
1995 Oct 18.82	4.14 deg	638.06 min	02 km		35,844 km
1995 Nov 2.98	0.10 deg	1,436.38 min	35,705 km		35,879 km

Astra 1E is a direct broadcast (to home users) digital television broadcast satellite operated by Societe Europeenne des Satellites (Luxembourg) and based upon the Hughes HS-601 satellite bus. Mass quoted above is at launch: on station the mass was 1,803 kg and the dry mass is 1,343 kg. Planned location is 19.2 deg E. Launched from Kourou using an Ariane 42L: third stage (H-10-3) discarded in an orbit similar to the first one listed for the satellite.

1995 Oct 20/1353		1995-056A	Columbia (STS-73)	104,399 kg
1995 Oct 20.70	39.01 deg	89.97 min	267 km	278 km

Second USML ("United States Microgravity Laboratory": USML-1 was flown aboard Columbia/STS-50 in 1992) flight with seven astronauts: Kenneth D Bowersox (commander), Kent Rominger (pilot), Kathryn C Thornton (payload commander, mission specialist MS-3), Catherine G Coleman (MS-1), Michael E Lopez-Alegria (MS-2), Fred W Leslie (payload specialist, PS-1) and Albert Sacco (PS-2). Spacelab module (mass 10,308 kg) carried in the shuttle orbiter's payload bay and experiments investigated fluid physics research, materials science research, biotechnology research and combustion science. Mass quoted above is that projected for the time of landing. Launched from and landed at the Kennedy Space Center, the latter being at 11.45 21 seconds UTC (time of main gear touchdown).

1995 Oct 22/0800		1995-057A	UFO 6 (USA 114)	3,000 kg ?
1995 Oct 22.31	27.00 deg	479.84 min	276 km	27,573 km
1995 Oct 29.26	5.28 deg	1,430.25 min	34,761 km	36,583 km

"UHF Follow-On" satellite is based upon the Hughes HS-601 satellite bus. Mass of the satellite on-station is 1,360 kg. To be located over 260 deg E. Launched by an Atlas-2: second stage (Centaur) in an orbit similar to the first one listed for the satellite.

1995 Oct 23/2203			METEOR-1	839 kg
Failed to reach orbit				

Maiden launch of the Conestoga 1620 commercial launch vehicle. Payload was the recoverable METEOR-1 ("Multiple Experiment Transporter to Earth Orbit and Return"), a two-module satellite . Service module (mass 447 kg) carried non-recoverable microgravity experiments. Recovery module (mass 392 kg) carried microgravity experiments planned for recovery. It was planned that the service module would operate in orbit for about a year, while the recovery module would return to Earth approximately 30 days after launch (landing in the North Atlantic Ocean). Some 45 seconds after launch from Wallops Island the launch vehicle was destroyed at an altitude of 11 km during the first stage burn. Planned orbit had an inclination of 40 deg and a near-circular altitude of 465 km.

Launch Date/Time		Int Des	Satellite		Mass
Epoch	Incl	Period	Perigee		Apogee
1995 Oct 31/2019		1995-058A	Cosmos 2322		3,250 kg ?
1995 Oct 31.98	71.02 deg	101.94 min	849 km		852 km

"Tselina-2" ELINT satellite manufactured by NPO Yuzhnoye. Launched from Tyuratam using a Zenit-2: second stage is in an orbit similar to the satellite.

Updates for Previous Launches

1981-119A	Approximately 1995 Aug 25 INTELSAT 503 was manoeuvred off-station over 182-183 deg E and started to drift to the west.
1984-101A	Galaxy 3 was manoeuvred off-station over 266 deg E approximately 1995 Oct 3.
1987-078A	Optus-A 3 had its orbital longitude restabilised over 151-152 deg E during the first week of September 1995.
1989-030A	Raduga 23 had its orbital longitude restabilised over 44-45 deg E during 1995 Sep 14-18, thus replacing the apparently-failed Raduga 31.
1994-060A	Cosmos 2291 was manoeuvred off-station over 79-80 deg E approximately 1995 Sep 27, shortly after the arrival of the newly-launched Cosmos 2319 at this longitude (see 1995-045A below).
1995-004D	ODERACS 2B decayed from orbit 1995 Sep 29.
1995-010A	Soyuz-TM 21 containing cosmonauts Solovyov and Budarin (who had flown to the Mir Complex aboard the Atlantis STS-71 mission: see 1995-030A) undocked from the Mir Complex 1995 Sep 11 AT 0331 UTC and landed 108 km NE of Arkelyk Sep 11 at 0653 UTC.
1995-030A	Cosmonauts Solovyov and Budarin who remained on board the Mir Complex after being launched on the Atlantis STS-71 mission returned to Earth aboard Soyuz-TM 21 1995 Sep 11 at 0653 UTC: see 1995-010A entry above for more details.
1995-031A	Cosmos 2314 was de-orbited 1995 Sep 6. If the satellite came down during a nominal landing opportunity then landing would be approximately Sep 6.8.
1995-036A	Progress-M 28 undocked from the Mir Complex 1995 Sep 4 at 0510 UTC and was de-orbited later the same day.
1995-040A	Add the following orbital data for PAS 4:- 1995 Sep 22.75, 0.06 deg, 1,436.06 min, 35,776 km, 35,795 km The satellite is located over 68 deg E.
1995-041A	Add the following orbital data for Mugunghwa 1:- 1995 Sep 4.48, 0.06 deg, 1,436.03 min, 35,778 km, 35,793 km The satellite is located over 115-116 deg E.
1995-043A	Add the following orbital data for JCSat 3:-1995 Sep 19.57 0.07 deg 1,436.54 min, 35,744 km, 35,846 km The satellite is located over 127-128 deg E.
1995-044A	Add the following orbital data for N-STAR a:- 1995 Sep 16.80 0.04 deg, 1,436.04 min, 35,773 km, 35,798 km, The satellite is located over 131-132 deg E.
1995-045A	Add the following orbital data for Cosmos 2319:- 1995 Sep 10.68, 1.56 deg, 1,436.20 min, 35,742 km, 35,836 km The satellite is located over 79-80 deg E.

MIR Complex Docking Ports

There has been some confusion over the identification of the longitudinal docking ports of the Mir Complex. Originally the front port on the multiple docking adapter was designated +X and the rear port of the Mir base module -X: since Kvant 1 is docked at the rear port of the Mir base module, its rear port became the -X port of the Complex. More recently, Russian literature has reversed these conventions. It has been decided to continue with the original designations since they have been used in the volumes of the "RAE Table of Earth Satellites" and other satellite listings.

Former-Soviet Union Launch Vehicle Designators

Starting with this listing of new launches a system of designators will be used for FSU launch vehicles which is derived from the names used by the FSU itself. The launch vehicles currently in use are as follows:-

Western Designators	"FSU" Designators	Comments
SL-4 A-2	Soyuz-U	Most photoreconnaissance-class missions, some Progress-M
	Soyuz-U2	Soyuz-TM, some Progress-M, sixth generation photoreconnaissance missions
SL-6 A-2-e	Molniya-M	
SL-8 C-1	Cosmos-3M	Previously called "Intermediate Cosmos": Russians sometimes call it the Cosmos launch vehicle.
SL-11 F-1-m	Tsyklon-M	Sometimes called "Tsyklon-2" in FSU literature
SL-12 D-1-e	Proton-K (4))	FSU calls both three- and four-stage Proton
SL-13 D-1	Proton-K (3))	vehicles "Proton-K"
SL-14 F-2	Tsyklon	Sometimes called "Tsyklon-3" in FSU literature
SL-16 J-1	Zenit-2	Sometimes simply called "Zenit" in FSU literature
SL-18	Start-1	Four-stage variant
SL-19	Rokot	
SL-20 ?	Start	Five-stage variant

The Russian designator system does not differentiate between the three- and four-stage versions of the Proton-K vehicle and therefore a modification of their designation system is used for launches of these vehicles. The Start (five stage variant) will not be assigned an "SL-" designator until it has completed its first orbital flight. Based upon this classification, the previous FSU launch vehicles in 1995 have been (only the primary payloads are listed: some launch vehicle designators have been shown using these names already):-

1995-002	Tsikada 1	Cosmos-3M
1995-005	Progress-M 26	Soyuz-U
1995-006	Foton 7 (F 10)	Soyuz-U
1995-008	Cosmos 2306	Cosmos-3M
1995-009	Cosmos 2307-9	Proton-K (4)
1995-010	Soyuz-TM 21	Soyuz-U2
1995-012	Cosmos 2310	Cosmos-3M
1995-014	Cosmos 2311	Soyuz-U
Failure	Gurwin 1	Start
1995-020	Progress-M 27	Soyuz-U
1995-024	Spektr	P roton-K (3)
1995-026	Cosmos 2312	Molniya-M
1995-028	Cosmos 2313	Tsyklon-M
1995-031	Cosmos 2314	Soyuz-U
1995-032	Cosmos 2315	Cosmos-3M
1995-036	Progress-M 28	Soyuz-U
1995-037	Cosmos 2316-8	Proton-K (4)
1995-039	Interball 1	Molniya-M
1995-042	Molniya-3 47	Molniya-M
1995-045	Cosmos 2319	Proton-K (4)
1995-046	Sich 1/FASat	Tsyklon

At present the only confusion arises between the launches of Soyuz-U and Soyuz-U2 vehicles within the Progress-M program.

ST SPACE NET

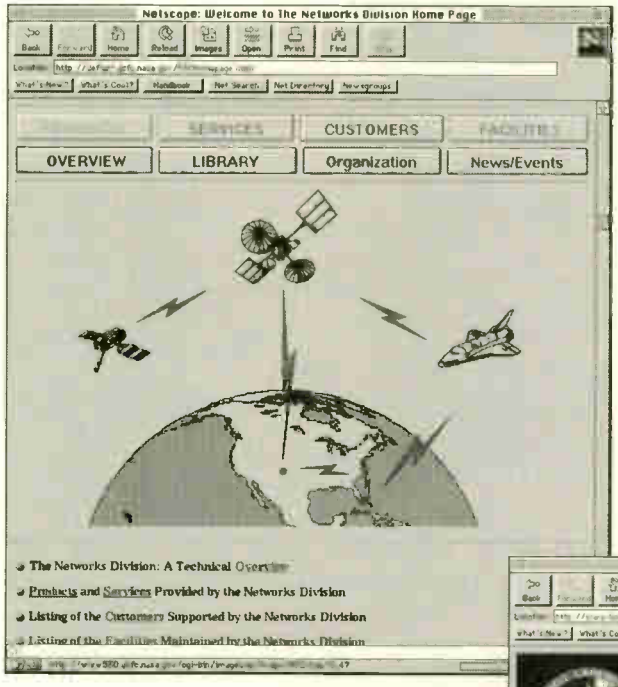
By Bill Grove

Where Do We Go from Here?

Space, the final frontier. These are the internet articles of the magazine *Satellite Times* and its continuing mission — to explore strange new topics, to seek out new worlds on web sites; to boldly show what no one else has shown before!

This space stuff all started with man's first glimpse at the sky. Amazement and hope filled the minds of people all over the planet. But space was a vast unknown.

In recent years, one source of information has brought the imaginations of millions together. This one place has given people everywhere a glimpse at the future, a sight into what can be. This world — known as the Internet — has brought space into our homes. It is allowing us to share our thoughts and knowledge and to bring closer that great, wide open known as space.



Many places on the Internet focus their attention on space and astronomy. NASA has a major presence on the net by launching an immense Internet initiative. A journey of a thousands links (or pretty darn close) begins at: *http://www.jsc.nasa.gov/~mccoy/nasa/Internet.html*. Linking through NASA sites at Kennedy, Ames, Goddard, Langley, JPL and many more, the information that a good space junkie wants and needs has been gathered by NASA for placement on the net. And as time goes along, more information is constantly being added. As with any site on the World Wide Web, your first visit can never be your last. Let's explore a few more of these sites.

Launching into the Jet Propulsion Laboratory's Deep Space Network, you quickly realize just how much work has been put into this whole project. Not just the Internet initiative, but all the work that NASA has done. With the recent decline of interest in the space program, sites like this are what is needed to pipe life and dreams back where they used to live, in the minds of the young. Pictures like "How large is large" show just what can be accomplished.

Leaving JPL, a quick tour of the Goddard Space Flight Center let me explore how satellite and relay communications really work at: *http://defiant.gsfc.nasa.gov/530homepage.html*. See screen capture above.

In document 530, the Networks Division through diagrams and technical information show what satellite links are being used and by who. An example, how about the Shuttle. When you ask for more information about the shuttle itself, it links to *http://shuttle.nasa.gov/sts-73/*. At that link you will learn more about the space shuttle and its missions and objectives. The NASA web page describing the countdown for shuttle mission STS-74 is shown below.

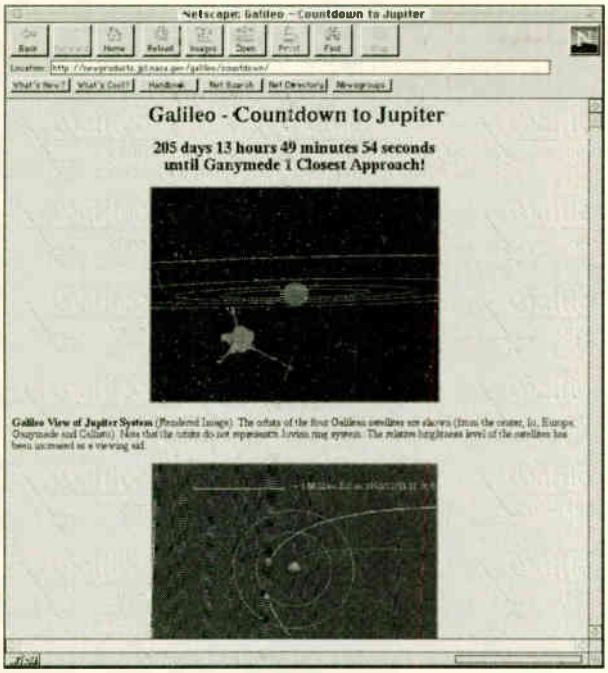
Shuttle Launch Countdown Home Page

At this point, a few important things should be mentioned about space and the Internet. Both are vast, ever-growing entities. We constantly find the need to explore and learn more about both of them. Only one, however, is cheap!

The Internet needs a few basic tools to function optimally. Although many of you already have an Internet account, those of you who don't, need one! It is the future of communications and education, and getting online now can only help you in the future. If you're not sure how to get online or who to get online with, contact your local college, university, or computer user's group. Now back to our journey.

If you like to keep up with the latest news and technology being put into space, then the Space Calendar at *http://newproducts.jpl.nasa.gov/calendar/* is the site for you. Updated daily, this calendar shows the events as they happen. For example: the entry for December 9, 1995 says,

"Observers along a diagonal band from the Southwest to the Northeast and the Maritime provinces can watch for the asteroid Io (no relation to Jupiter's moon) to occult an 8.5-magnitude star in Taurus in early evening. And yet another asteroid occultation! Large-telescope users in the



NASA's Galileo web site (above) and one frame of a downloadable movie from that site of the probe descending into the Jovian atmosphere (far right).

Northwest and western Canada can watch for Euphrosyne to occult an 11th-magnitude star in Ursa Major late tonight. All this month's asteroid occultations are charted in the December Sky & Telescope, page 70."

As I'm sure most of you know by now, the spacecraft Galileo will orbit Jupiter for the next two years. At *http://www.jpl.nasa.gov/galileo/*, you can get the latest information on just what is going on with that project. From current images to technical data gathered by the probe, this site is not one to miss.

One of my personal attractions to this page is the first-hand approach that they are taking with it. For example, in the description of the radiation that the probe will experience, one of the project workers stated,

"Roughly 60 percent of Galileo's radiation dose will be received within an hour of Jupiter closest approach. Unshielded, 15 minutes would be fatal to a human being. Your average PC probably wouldn't do a lot better. We've had to use some special computer chips and a lot of shielding to protect our computers."

This kind of approach allows me to feel closer to the project. It gives me the feeling that they are talking to me and not just sending out information to the masses. Again, this is the type of work that is going to bring the space program back into the fore front.

I started this column at NASA's Johnson Space Center, went to the Jet Propulsion Labratory, and eventually ended up watching movies about the landing of the Galileo probe. You've got to love the Internet!

If you are not using NetScape, do so. I'm not biased in any way to the company itself, but they do have one fantastic web browser program. It really allows you to do just about anything that the Net has to offer. If you're using any other browser, just give NetScape a try. It's available free from *http://home.netscape.com.*

The Internet will continue to provide endless amounts of information for people of all generations. Its resources come from near and far and bring our world closer together. Now with all the space resources available on the net, it brings the Universe just a little closer to home. See you next issue for our continuing adventures in the SpaceNet. ST

Bill Grove is the manager of computer services at Grove Enterprises. He can be reached via e-mail at: *bill@grove.net.*

By John A. Magliacane, KD2BD

Spotlight On Fuji-OSCAR-20

Fuji-OSCAR-20 is the second in a series of Japanese amateur communications satellites having both analog and digital Mode J transponders. The first spacecraft, Fuji-OSCAR-12 was launched on August 12, 1986, and was the first orbiting satellite carrying amateur radio (OSCAR) satellite to carry a digital transponder that utilized the AX.25 packet radio communications protocol. It was followed by the currently active Fuji-OSCAR-20 several months after FO-12 had to be removed from service due to a deteriorating power budget.

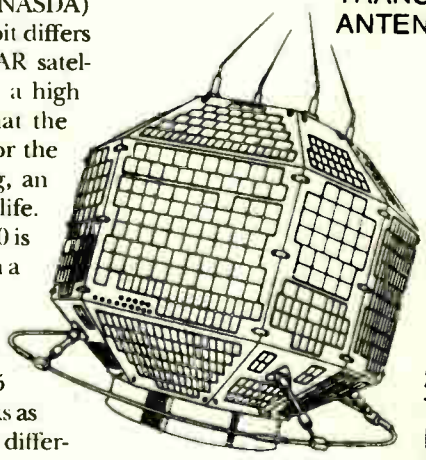
Fuji-OSCAR-20 was launched on February 7, 1990 at 0133 UTC from the Tanegashima Space Center, National Space Development Agency of Japan (NASDA) on an H-1 two-stage rocket. Its orbit differs slightly from most current OSCAR satellites, being slightly elliptical with a high inclination. This orbit assures that the satellite will remain in sunlight for the majority of its orbit all year long, an important aspect for long battery life.

The physical structure of FO-20 is that of a 26 sided polyhedron, with a weight of approximately 50 kg, so it is much larger than the Microsat satellites. Although Fuji-OSCAR-20 uses Mode J AX.25 packet radio communications links as the Microsat satellites do, one big difference between FO-20 and the Microsats is that FO-20's packet radio mailbox can be access without the need for special Microsat groundstation software. Any computer or terminal that can be used to access terrestrial packet radio bulletin board systems (BBSs) can be used to access the FO-20 mailbox.

The other big difference between FO-20 and the Microsat satellites is that in addition to the packet mailbox features of the satellite, FO-20 also supports a Mode J analog transponder for single sideband (SSB) and continuous wave-telegraphy (CW) or Morse code communications.

Fuji-OSCAR-20 System Specifications

FO-20 carries two beacon transmitters. The Mode JA beacon is active during periods of analog transponder operation. It operates on a frequency of 435.795 MHz with 100 mW of power and can carry CW or binary phase-shift keying (BPSK) information, or can be configured for continuous carrier transmissions for Doppler shift experiments.



The Mode JD beacon serves as the single AX.25 Mode JD downlink to groundstations, and also carries telemetry in either a ASCII (most often used), or binary formats. The Mode JD beacon operates on a frequency of 435.910 MHz with 1 watt of output power, and uses BPSK modulation.

The CW telemetry carries 12 analog status items and 33 status items, while the BPSK packet telemetry beacon carries 29 analog items, plus 33 status items.

The Mode JA analog transponder system consists of an inverting heterodyne transponder with a bandwidth of 100 KHz, with an uplink in the 145 MHz band, and a downlink in the 435 MHz band. An uplink power of about 100 watts effective isotropic radiated power (EIRP) is required for access to the transponder, but of course, the more sensitive your downlink receiver, the less power that is required on the uplink for an adequate downlink signal-to-noise ratio.

The Mode JD digital transponder system functions as a BBS "mailbox" using the AX.25 level 2 protocol, the same that is used for terrestrial packet radio communications. The satellite receives 1200 bit/second Manchester encoded frequency shift keying (FSK) on any one of four uplink frequencies, and transmits to all groundstations under its footprint using a single downlink frequency of 435.910 MHz with one watt of power using BPSK modulation at 1200 bits/second. An uplink of about 100 watts EIRP is the minimum required for Mode JD transponder access.

Fuji-OSCAR-20 uses circular antenna polarization on all uplink receivers and all downlink transmitters and beacons. The 145 MHz uplink antenna is a ring turnstile antenna mounted below the bottom side panels of the spacecraft, and exibits a maximum gain of about +0.5 dBi. The 435 MHz transmitting antenna is a turnstile array mounted on the top of the spacecraft, and exibits a maximum gain of about +4 dBi.

Mode JA Operation

Communication via Fuji-OSCAR-20's Mode JA analog transponder is similar to operating through any of the other analog OSCAR transponders. The only diffence is in the way in which Doppler effect is compensated. During normal communications through any non-geosynchronous satellite, Doppler shift is encountered between the uplink to the spacecraft, and the downlink to the groundstation. Different groundstations within the footprint of the satellite will experience different and varying degrees of Doppler shift. In order to minimize the effects of Doppler shift on frequency sensitive communication modes such as SSB, CW, and BPSK, two things are done.

First, spacecraft designers use "inverting transponders", so as the spacecraft sees an uplink signal that is drifting lower in frequency, it is translated to a downlink that

TABLE 1: FUJI-OSCAR-20 Satellite Profile

Launch and Orbit	
Launch Date	February 7, 1990, 0133 UTC
Launch Vehicle	H-I (2-stage) rocket
Launch Site	Tanegashima Space Center, National Space Development Agency of Japan (NASDA)
International Designator	1990-013C
NORAD Catalog Number	20480
Orbit:	Slightly elliptical polar orbit, with 912 km perigee, Period:112 minutes,
Inclination	99 degrees
Transponders	
Mode JA - Inversely heterodyned linear translator.	
Uplink Passband	145.900 MHz to 146.000 MHz (Uplink EIRP required: About 100 W)
Downlink Passband	435.900 MHz to 435.800 MHz (approximately 1 watt)
Beacon Frequency	435.795 MHz CW or BPSK [also capable of A0 transmission] ca. 100 mW power Frequency and modes are similar to those of FO-12. The analog system (Mode JA) consists of the inverted heterodyne transponder with a bandwidth of 100 kHz (3 bd bandwidth) operating with a mode J of uplink 145 MHz and a downlink of 435 MHz.
Mode JD - Digital, 1200 bps, Store-and-forward packet communication using AX.25 link level protocol, version 2	
Uplinks	145.850 MHz Uplinks are Manchester 145.870 MHz encoded FSK using a maximum 145.890 MHz frequency shift of 3.5 KHz 145.910 MHz
Uplink EIRP required	About 100 W
Downlink	435.910 MHz 1200 bps, AX.25, NRZI, BPSK ca. 1 W power The digital system (JD) functions as a mailbox using the AX.25 link level protocol. Stations currently using FO-12 will be able to use JAS-1b without any modifications to equipment.
Telemetry	
CW telemetry	12 analog data items/33 status items
PSK telemetry	29 analog data items/33 status items
Commands	Equipped with real-time program command function
Satellite Specifications	
Satellite Dimensions	
Size/Weight	26-face polyhedron measuring 440mm across and 470mm in height and weights approx 50 kg.
System Configuration	Analog and digital transponder in Mode J: uplink 144 MHz, downlink: 430 MHz
Attitude Control	Satellite attitude will be maintained by using the torque generated by interaction of two permanent magnets with the earth's magnetic field.
Thermal Control	Passive control using thermal insulation
Planned service life	5 years
Antennas	144 MHz receiving antenna (R-ANT): Ring turnstile antenna mounted at bottom of side panels. 435 MHz transmitting antenna (T-ANT): turnstile antenna mounted at the top of satellite (shared by analog and digital modes)
Antenna polarization gain	R-ANT: circular +0.5 dBi max/T-ANT: circular +4 dBi max.
Power Supply	
Solar cells	Gallium arsenide, Size and Quantity: 2x2 sq-cm and 1x2 sq-cm, over 1300 cells, Power Output: More than 10 W (BOL)
Battery	11 series-connected NiCad cells (rectangular) with a capacityof 6 Ah
Voltage Converter	
Bus voltage:	+11 to 18 V (14 V average)
Regulated voltages:	+10 V, +5 V, -5 V
Efficiency:	Better than 70%
Power control functions	Bus voltage limit control (full-short),and UVC function to disconnect load when battery terminal voltage drops.

drifts higher in frequency within the transponder passband. Second, users of the transponder adjust their transmitter and receiver tuning frequencies during a contact to prevent excessive frequency drift throughout the transponder passband.

The general "rule of thumb" in amateur satellite work is to vary the transmitter or receiver operating on the highest frequency band to minimize frequency drift observed by the downlink receiver. In the case of Mode J, the transmitter frequency should remain fixed during a contact, while each groundstation adjusts their downlink receiver in compensation for Doppler shift. This is done because Doppler shift is proportional to the RF operating frequency, and since the Mode J downlink is on the higher of the two bands used by the transponder, adjusting the downlink receiver will have the greatest effect in compensating for Doppler effect, while providing the smallest chance of two groundstations drifting into one another and causing interference.

Fuji-OSCAR-20's Mode JA transponder is primarily used for SSB and CW communications. It is interesting to point out that FO-20 has also been used by some amateurs in England and Europe to relay analog facsimile (FAX) images in full color. JVFAX software was used along with standard personal computers to send and receive the FAX images through Fuji-OSCAR-20.

Mode JD Operation

Communications via Fuji-OSCAR-20's Mode JD digital store-and-forward communications transponder requires the use of a packet radio terminal node controller (TNC), a 1200 bps "Pacsat Modem" along with a 2-meter FM uplink transmitter, and a 70-cm SSB receiver or combination of high frequency (HF) receiver and downconverter. Some means of routing automatic frequency control (AFC) signals from the modem to the downlink receiver is required so the modem can tune the downlink receiver in compensation for Doppler shift. The uplink transmitter does not require Doppler compensation, however.

Since Fuji-OSCAR-20's packet transponder operates in a full-duplex mode, groundstations have good results setting the MAXFRAME parameter of their TNCs to 7. FRACK should be set to 7 or higher to allow FO-20 time to respond to all the packets it receives from groundstations.

Users of the AMSAT-OSCAR-16 and

TABLE 2:
FO-20's BPSK beacon transmits telemetry and status information as an unnumbered information <UI> packet frames once every minute.

8J1JBS>BEACON <UI C>:
JAS1b RA 92/11/18 16:15:00
000 656 654 652 705 831 841 826 000 566
613 000 457 497 493 480 482 495 650 000
671 699 679 720 999 641 873 290 8FD 000
010 101 000 001 111 100 001 100 000 000

8J1JBS>BEACON <UI C>:
JAS1b M0 92/11/18 16:15:00
Mailbox is at your service from 92/11/05 00:45:00 The JD Transmitter is available in all orbits during JD mode.

TABLE 3:
A sample listing of messages carried on FO-20's pack

NO.	DATE	UTC	FROM	TO	SUBJECT
0315	11/18	16:17	W9ODI	AB4KN	timing
0314	11/18	16:16	AB4KN	KB2MVN	Your picture
0313	11/18	15:50	JR7ZSZ	JA7QHM	HELLO
0312	11/17	10:15	DL6KG	N0NBH	finally..
0311	11/17	10:13	DL6KG	W8BKO	success
0309	11/17	04:15	N5AVK	JH1AOY	HELLO
0306	11/17	01:05	JH1AOY	JA1VSB	Hello Fufui san.
0305	11/17	01:03	JH1AOY	ALL	Hello
0304	11/17	00:58	JH1AOY	KB2MVN	OKAY, I wish so.
0302	11/16	22:43	F3ZD	F6HLG	73 de TETEGHEM
0300	11/16	22:29	DL6KG	N0NBH	tnx
0298	11/16	20:50	F3ZD	F6HLG	
0297	11/16	18:52	OH2GV	OHSTNS	Onko kukaan qrv?
0295	11/16	17:26	W9ODI	W1WXZ	HELLO
0291	11/16	09:54	ON1AIG	ALL	ESDX Satellite DX News 16Nov92
0287	11/16	05:48	AB4KN	ALL	KITSAT Keps wrong
0286	11/16	05:48	W9ODI	ALL	KO23 EL. STILL BAD
0285	11/16	05:42	AB4KN	ALL	SPACENEWS, Nov. 16.
0284	11/16	03:49	AB4KN	ALL	ORBS$319.2L
0283	11/16	02:28	JA7MJ	N8NYU	N8NYU DE JA7MJ
0280	11/16	00:47	JH1AOY	KB2MVN	Hello Frank.
0279	11/15	22:18	G2BFO	N8NYU	HI
0271	11/15	11:32	IT9FUR	IK8OZV	prg. webersat

JAS>

TABLE 4:
A short message addressed to "ALL" and sent via FO-20's mailbox.

NO.	DATE	UTC	FROM	TO	SUBJECT
0305	11/17	01:03	JH1AOY	ALL	Hello

Hello !
Nice to meet you.
My name is Masaji Tamagawa.
And address is 16 TSUKAHARA KIM
ITSU-CITY CHIBA 29211 JAPAN,
located about 50km south east of capital TOKYO, grid locator PM95XH.
I wish all the best.

73s...
Masaji...JH1AOY...

JAS>

LUSAT-OSCAR-19 Pacsat satellites have observed receiving faster packet acknowlegments (ACK frames) from FO-20 than they do from the other digital satellites. This sometimes creates a problem if the uplink transmitter generates "clicks" in the downlink receiver as the transmitter is keyed on and off, and the "click" corrupts the acknowledgement packet received from the satellite as the transmitter is unkeyed.

Connection to the FO-20 mailbox is made by issuing the TNC connect command to FO-20's callsign, "8J1JBS":

cmd:CONNECT 8J1JBS

Upon successful connection to FO-20, the ground station TNC will announce the connection with the message:

***** CONNECTED TO 8J1JBS**

Then FO-20 will provide a greeting and mailbox prompt:

FO-20/JAS1b Mailbox ver. 2.00
commands [B/F/H/M/R/U/W]
Use H command for Help

JAS>

FO-20 mailbox commands differ somewhat from what most packet users are used to from terrestrial packet bulletin board systems. FO-20 mailbox commands are as follows:

B:	List file headers addressed to ALL
F:	List latest 15 file headers
F *:	List latest 50 file headers
F <d>:	List file headers posted on day <d>
H:	Show help message (list of available commands)
K <d>:	Kill a file number <n>
M:	List file headers addressed to current user
R <n>:	Read a file numbered <n>
U:	List callsigns of those currently connected
W:	Write a file

Files are ended by entering a period on a line by itself, after which the mailbox responds:

END
JAS>

This signals that the satellite is ready for the next groundstation command.

Note that FO-20 does not have a "bye" command to log off of the mailbox. Users must manually issue the DISCONNECT command to their TNC to log off of the mailbox and disconnect from the satellite.

In recent months, Fuji-OSCAR-20 has been spending most of its time in Mode JA. Operating schedules, when made available by spacecraft controllers, are often published in *SpaceNews* (current issue is available at ftp://pilot.njin.netpub/SpaceNews) and are made available through AMSAT News Service bulletins.

LOS

Mode JA is "one step above Mode A" in complexity, and the use of a UHF downlink insures a clean, interference-free passband. FO-20's elliptical orbit provides for some interesting DX opportunities on Mode JA, and its Mode JD mailbox is simple to use and requires no special groundstation terminal software. Fuji-OSCAR-20 spacecraft designers promise a new Mode JA/JD satellite in the near future, so stay tuned to *Satellite Times* for the latest news and developments. ST

ST THE VIEW FROM ABOVE

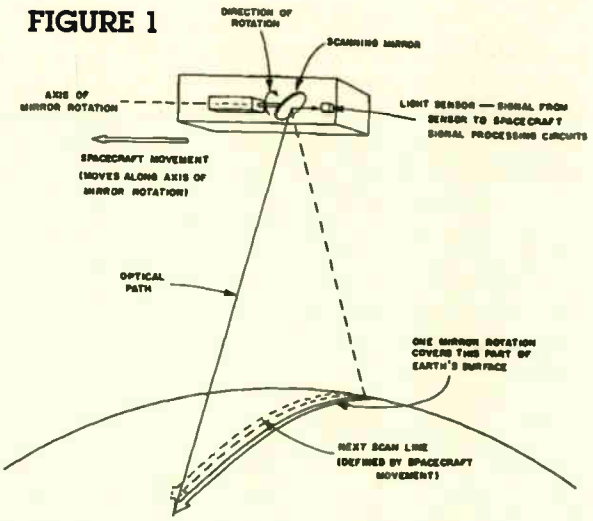
By Jeff Wallach, Ph.D.
Dallas Remote Imaging Group

High-Resolution Image Systems (HRPT) Part 1

Previous installments of *View from Above* have reviewed the 'lower resolution' (4-7 km per pixel) products of the NOAA polar-orbiter automatic picture transmission (APT) and GOES weather facsimile (WEFAX) imagery. We have talked about the satellite systems, the image data streams, and some groundstation equipment requirements to display the APT and WEFAX imagery on your home PC. The question now arises as to what do you need to receive those fantastic high resolution picture transmission (HRPT) and GOES VAS images that we have 'teased' you with in past issues of *ST*? This month's column will be the first of a multi-part series dealing with *HRPT and GOES VAS/GVAR for Beginners*. We will start with the polar-orbiting high resolution systems and then cover the new GOES GVAR receiving stations.

In order to provide a solid framework of understanding, we will need to review the NOAA polar-orbiter data products. Comparisons will be made of the APT (4 km per pixel) imagery to the higher resolution (1.1 km per pixel) HRPT pictures.

FIGURE 1



Satellite Systems and Sensors

The National Oceanic Atmospheric Administration (NOAA) is responsible for operating the Advanced TIROS satellites. These satellites carry the Advanced Very High Resolution Radiometer (AVHRR) instrument that generates both the High Resolution Picture Transmission (HRPT) and Automatic Picture Transmission (APT) imagery. The AVHRR instrument utilizes a 45 degree rotating mirror that captures the light energy as the satellite orbits the Earth 870 km. below. The mirror rotates at 360 rpm while collecting up to five channels of visible and infrared energy. The scanning track across the Earth measures both the reflected visible light and infrared energy and builds up an image in the process.

The instrument's relative motion across the orbital track of the Earth causes successive scan lines to form a continuous, two-dimensional image. Each image scan line (6 lines per second, or 360 lines per minute) has 2048 individual picture elements (pixels), with each pixel covering an area of 1.08 square kilometers at the nadir point.

One interesting note about the HRPT imagery compared to APT: as the image moves farther away from the downward nadir point, the pixels gets progressively elongated, or distorted. Thus, the outer edges of the HRPT image often appear stretched out. (The APT image, derived from the HRPT data, is averaged and does not exhibit this geometric distortion).

These scan lines are sent directly to the groundstation, in a continuous fashion, as long as the satellite is within view of the groundstation receiving equipment. (Thus you will not see any of the geopolitical gridding such as is placed on the GOES WEFAX, which is first processed on the ground, sent back up to the satellite, and back down again to the user terminal). Figure 1 shows the process of AVHRR scanning the Earth along its ground track.

The mirror on the AVHRR instrument sends the spectral energy through an optical magnifying and filtering system, which splits the incoming light into discrete spectral bands focused on electronic detectors. The detectors are sensitive to visible, infrared, and near-infrared wavelengths. There are either four or five spectral bands, depending on the NOAA satellite doing the processing (the older AVHRR instruments only processed 4 spectral bands). The detectors generate a proportional electrical current, which is amplified and converted to digital information for radio transmission direct to the groundstation.

The AVHRR instrument contains several other electronic packages, including:

- S-Band Transmitter (1698 MHz) for real-time transmission (direct readout) of the AVHRR image and satellite housekeeping telemetry
- Two more S-Band transmitters for later playback from onboard digital tape recorders (1707, 1702.5 MHz)
- A 137 MHz VHF transmitter for the transmission of the low resolution APT images at 137.5 or 137.62 MHz, and digital telemetry at 137.77 MHz

The HRPT imagery is transmitted as digital data (665.4 kilobits per second, split-phase encoded, phase modulated signal) from a 5 watt onboard transmitter. Frequencies employed by the NOAA satellites include the 1698 MHz, 1707 MHz, and 1702.5 MHz downlinks. Table 1 summarizes the characteristics of the AVHRR downlink:

TABLE 1

Orbit	Polar, Sun-synchronous, 450 miles (870 km)
Frequency	1698, 1707, 1702.5 MHz
Transmitter Power	5 watts
EIRP	39 dBm
Antenna Polarization	1698, 1707 MHz RHCP, 1702.5 MHz LHCP
Spectrum Bandwidth	< 3 MHz
Modulation Type	PCM/PSK +/- 67 degrees
Modulation Code	HRPT — Split-phase digital

Other high resolution instruments are carried onboard the NOAA Advanced TIROS satellites (including Space Environment Monitor, Microwave Sounding Unit, Data Collection System, TIROS Operational Vertical Sounder), but these instruments will not be covered in this series.

By the way, don't expect to turn on your HRPT receiver and hear all of this great high resolution data coming over your speaker. At 665 kilobits per second, with a PSK modulation format, the data rate is about 42 time higher than the highest frequency the ear can detect, and the bandwidth is about 100 times greater than most normal radio receivers!

Digital Image Format

O.K., so much for the satellite sensor systems. What about the format of the digital data. Is it just like the APT image frame format we covered in the September/October 1995 issue of *ST*? The answer lies in genealogy. As you may recall, the APT image frame is derived from the HRPT data. Two of the five channels of the AVHRR instrument are selected for the APT picture. Every third line of the AVHRR scan (one-third of 360 lines per minute is 120 lines per minute, or 2 scan lines per second) is transmitted as an analog signal to produce the APT image. And every few HRPT pixels are averaged in APT to negate the geometric distortion problem experienced by the HRPT data.

The HRPT digital data is more complex than the 'offspring' APT analog frame. This places some more stringent requirements on the HRPT ground-station receiving and display systems (for you satellite monitoring enthusiasts, read that as "More Bucks!").

TABLE 2

HRPT	APT
Digital Data	Analog Data
(665.4 kbps, PSK modulation)	(2400 hz AM modulation)
1698, 1707, 1702.5 MHz	137.5, 137.62, 137.77 MHz
1.1 km pixel resolution	4 km (visible), 7 km (IR) pixel resolution
10 bit data (1024 levels)	8 bit data ((256 levels)
Geometric Distortion of image	Geometrically corrected
5 Spectral Bands	2 Spectral Bands
(1 visible, 4 IR)	(1 visible, 1 IR daytime, 2 IR nighttime)

The basic HRPT data frame format is as follows:

Six scan lines are produced every second. Each scan line of the HRPT image data contains 11,090 words of information (each of the words is 10 bits long- providing 1024 levels of grayscale on the screen). A sync pulse, space data calibration, back scan data, telemetry data, time code, and spacecraft identifier number are transmitted prior to the AVHRR video data. Data is transmitted continuously, and the scan lines build up a high resolution of the Earth below.

See Table 2 to review what we have learned about HRPT versus APT image formats.

Thus the HRPT digital images offers higher resolution and more spectral bands contrasted with the APT analog format.

We have included a series of HRPT images with this column captured by Dallas Remote Imaging Group (DRIG) members Ed Murashie and Tracy Lenocker on a home-brew HRPT receiving station. Figure 3 on page 68 is a spectacular view of the northeast US taken in visible light from NOAA 11. Notice the detail of the Appalachian mountains. Figure 4 is another great visible shot of the St. Lawrence seaway. Do you know what the circular structure is in the upper left part of the image? Remember the SL-9 comet impacts on Jupiter? This is Manicougan Lake, and ice-filled remnant of an ancient meteorite impact. The crater is about 35 miles in diameter. Figure 5 is a close-up of one of my favorite cities — San Francisco and the Bay area.

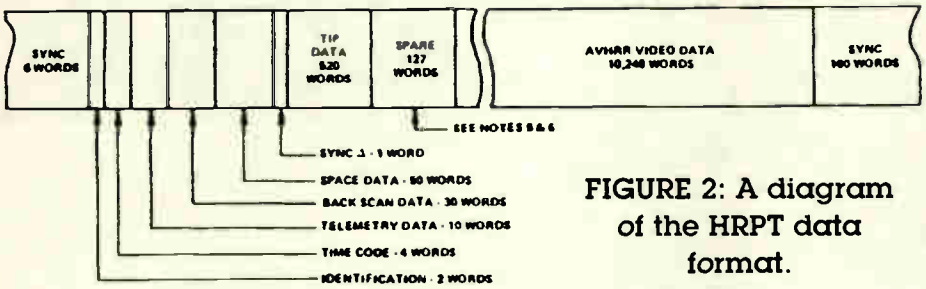


FIGURE 2: A diagram of the HRPT data format.

NOTES:

(1) MINOR FRAME LENGTH - 11,090 WORDS
(2) THREE MINOR FRAMES PER MAJOR FRAME
(3) MINOR FRAME RATE - 6 FRAMES/SECOND
(4) WORD LENGTH - 10 BITS/WORD

(5) HRPT OUTPUT - ALL SPARES ARE 10TH DEGREE P-N CODE (BAR).
(6) IF A FOURTH SOUNDING INSTRUMENT IS ADDED, THESE SPARE WORD SLOTS WILL MOST LIKELY BE USED FOR DATA FROM THIS INSTRUMENT.

TLM WORD ALLOCATIONS		10 WORD BIT ALLOCATIONS			
		1ST 10 WORD		2ND 10 WORD	
1-5	RAMP CALIBRATION			(SPARE)	
6	CHANNEL 3 TARGET TEMP (6 PT SUBCOM)	1	SYNC ID	1-10	ALL DATA UNDEFINED
7	CHANNEL 4 TARGET TEMP (6 PT SUBCOM)	2-3	FRAME ID		
8	CHANNEL 5 TARGET TEMP (6 PT SUBCOM)	4-7	SPACECRAFT ADDRESS		
9	CHANNEL 3 PATCH TEMP	8	RESYNC MARKER		
10	SPARE (UNDEFINED)	9	DATA 0		
		10	DATA 1		

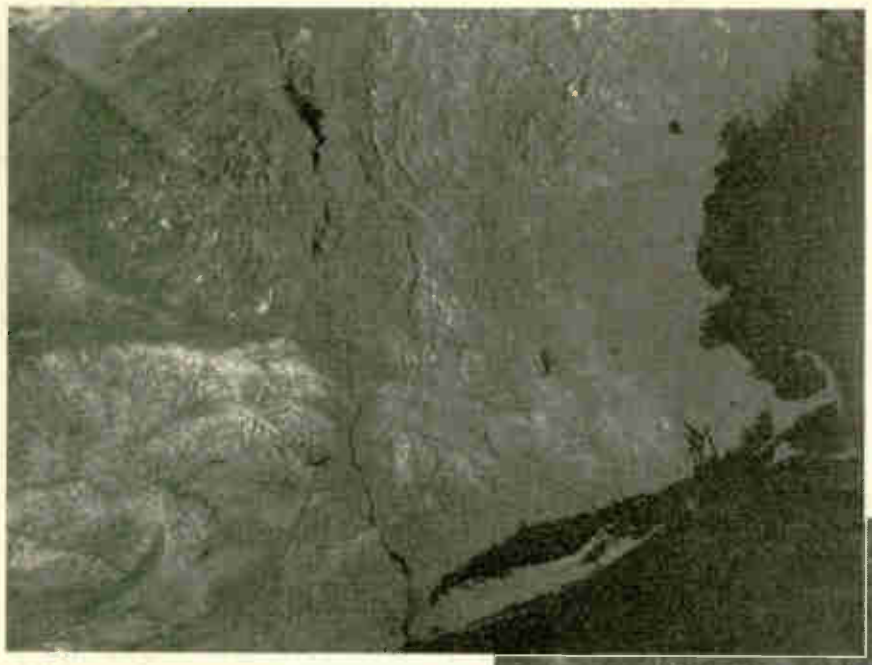
HRPT Groundstation Equipment

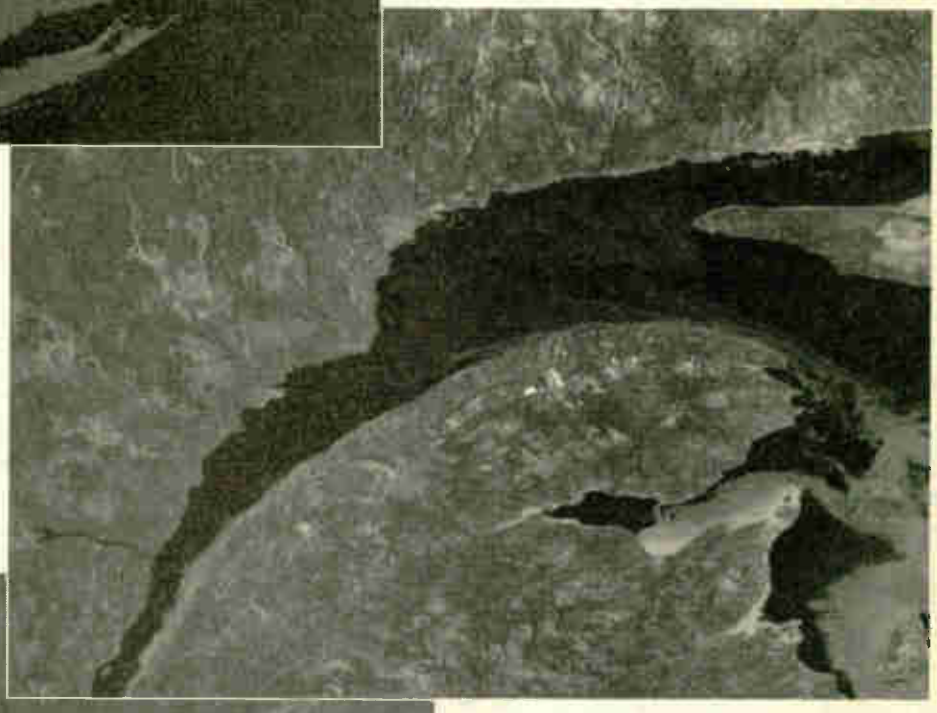
HRPT groundstation equipment is a bit more complex than just assembling an APT station. While it is not impossible to build one yourself, there are many commercial systems and semi 'kits' available on the marketplace today. To get rolling, one would need the following basic system:

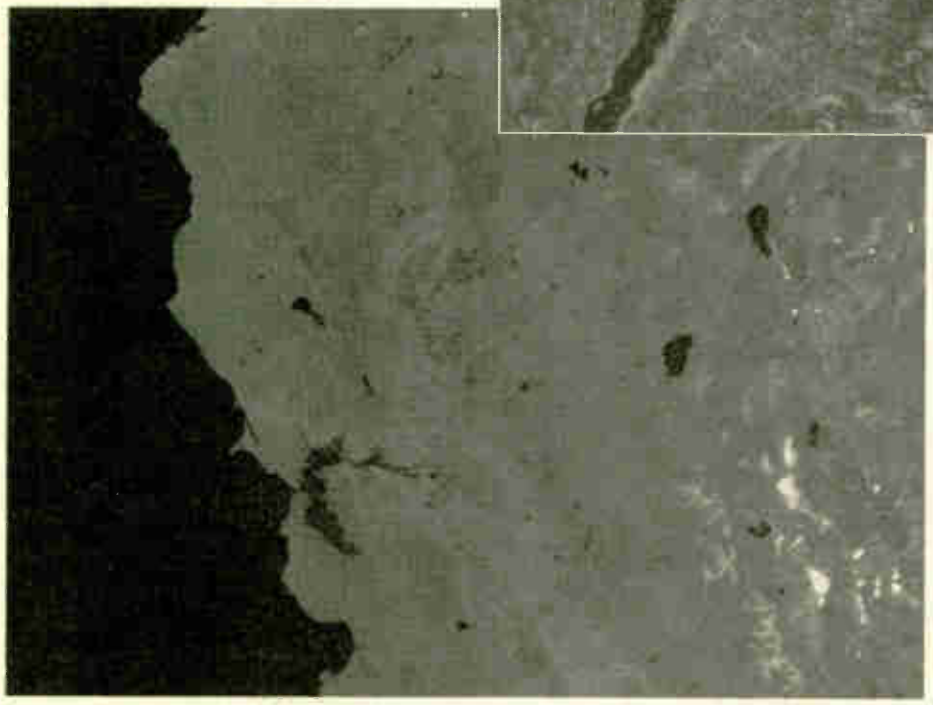
The basic HRPT groundstation would consist of the following:

- Four foot parabolic dish
- Antenna Positioner
- Feed horn and quadrature combiner
- Low Noise Amplifier
- Downconverter
- Phase Locked Loop Demodulator section
- Bit Synchronization section
- Personal Computer
- Image Ingestion/Digital Image Processing Software
- Satellite Tracking software

In 1990, Dr. John DuBois pioneered one of the first amateur HRPT systems, which later went on to be commercialized and used by industry, education, Department of Defense, NOAA, and yes, amateurs!







stretched shape of the Hurricane. This is a good visual indication of some of the geometric distortion that can occur in HRPT imagery as the satellite moves away from nadir relative to the observing groundstation.

A partial listing of HRPT vendors, along with the images shown in this article, may be found on the Dallas Remote Imaging Group BBS at (214) 492-7057 (telnet bbs.drig.com). A HRPT vendor list is also available and is called HRPTVEND.ZIP. This list may also be obtained on the DRIG FTP site at: *ftp.drig.com* or accessed through the Drig World Wide Web site at *http://www.drig.com.* ST

In the next issue of *View from Above*, we will cover the basic building blocks of the classic DuBois HRPT design, how the above system elements are integrated, and provide a listing of HRPT vendors. But before we take leave in this issue, lets show you another great HRPT image. The image in Figure 6 was captured by Tracy Lenocker of Southern California. Tracy imaged this Feng Yun 1B HRPT shot of Hurricane Fefa in August, 1991, when it was 1135 miles west southwest of Baja, California. Notice the

Latest Weather Satellite Constellation Information

NOAA 9	137.62 MHz	Off
NOAA10	137.500 MHz	Off
NOAA11	137.620 MHz	Of
NOAA12	137.500 MHz	On
NOAA14	137.620 MHz	On
METEOR 2-21	137.850 MHz	Off
METEOR 3-5	137.850 MHz	On
METEOR 3-6	137.850 MHz	Off
OKEAN 1-7	137.400 MHz	On
SICH-1	137.400 MHz	On over Europe
GOES 8	1691 MHz	WEFAX (Active at 75 degrees W
GOES 9	1691 MHZ	WEFAX (In test at 90 degrees W)

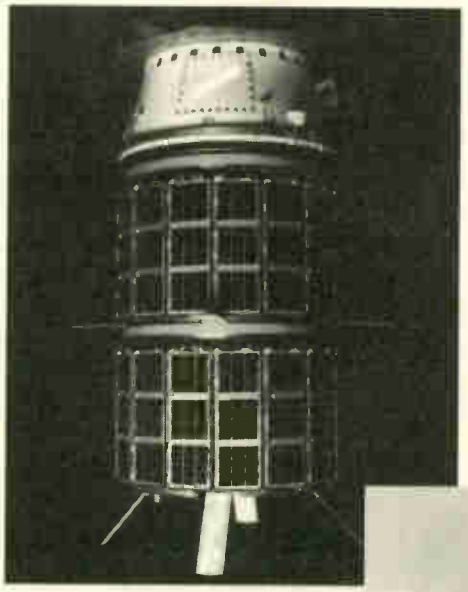
Donald E. Dickerson, N9CUE

The Mobile Satellite Communications Handbook

Did you know that the space age began in 1945 when Arthur C. Clark wrote an article for *Wireless World* entitled *Extraterrestrial Relay?* In it he described the concept of a worldwide communications system using three geostationary satellites. The altitude that these satellites would need to be in to provide worldwide coverage was 35,680 km (22,300 miles) high. This altitude above the Earth at the equator would match the speed of the Earth's rotation and the spacecraft would then appear to hover overhead.

Everyone knows that Sputnik was the first artificial earth orbiting satellite, launched in October 1957 by the Soviets. However, did you know in 1958 the U.S. Army had launched an operational communications satellite into an elliptical orbit of 1440 km by 160 km in altitude? It was called SCORE (Signal Communications by Orbiting Relay Equipment). The payload consisted of several VHF radio transmitters (transmitting on 107.940. 107.970, 132.405, 132.435, and 150 MHz), and a tape recorder. Due to SCORE and the success of a second satellite called Courier 1B — which operated for 17 days with an output power of 3 watts on 2 GHz — the Department of Defense set up the Advanced Research Projects Agency (DARPA) to develop new satellite technology.

These events and other early historical events from the early days of space exploration can be found in a newly published book from Quantum Publishing. Even if you are just a space historian, the first chapter of Roger Cochetti's new *Mobile Satellite Communications Handbook* entitled *A Brief History of Satellites Communications*, is replete with fascinating details of the early days of the space race, along with the successes and failures of both the U.S. and Soviet Space Programs. This chapter also includes sections on domestic and international law relating to space communications and describes the different approach that civilian and military satellite research took in the early days.



DoD's first two MACSATs (above) were stacked and launched together on a Scout launch vehicle. They were placed into a circular, polar orbit at 720 km. (Photo courtesy of the Department of Defense). At right, Leasat, also known as Syncom, are leased military satellites that use the 240 to 270 Mhz band for military tactical communications. (Photo courtesy of NASA)

The history briefing sets the stage for the next step in this logical and orderly presentation of 50 years of space research and technology. That next step is the technology itself. Roger Cochetti includes sections on frequencies, orbits used by communications satellites, space and ground segments as well as an over view of current commercial, civilian, and military satellite systems both domestic and international.

Before we move on and leave one of my favorite subjects — space history — here is one more trivia question for you space junkies. Did you now that early studies revealed the devastating impact on shortwave radio that nuclear explosions produce? It was theorized that a nuclear explosion would vaporize the ionosphere, so the military experimented with needles. Over 500 million needles were launched into a low earth orbit to form a reflective surface from which it was hoped shortwave radio signals would reflect. Chapter two gives a detailed account of this and other early military space systems.

Chapter three covers the first commercial marine mobile satellites services — Marisat and Marecs. Another marine satellite system in current use is the Inmarsat — managed by the International Maritime Satellite Organization. Created in 1979, this satellite system became operational in 1981. Inmarsat maritime mobile systems are outlined along with technical and operational details in chapter four of the Cochetti book. Inmarsat offers five different terminals/services for various mobile configurations and these are all covered in that chapter.

Radio location or radio determination as many of you know is the process of determining the longitude, latitude and altitude of an object through the use of satellite radio transmissions. Commercial and government applications for this technology appear to be endless. In fact a company called GEOSTAR had made great inroads into the commercial and federal

government markets before going bankrupt in 1991. Two other companies have since taken up the slack, OmniTRACs and Euteltracs.

I'll bet some of you weather satellite buffs don't know what the Argos system is. Argos is a meteorological data collection system using space-based assets from unmanned sensor platforms scattered around the world. This French system operates uplinks in the VHF/UHF and S-band radio spectrum and it is covered in chapter five of this new book. Chapter five also reveals details about the Russian Volna and U.S. UFO military satellite systems.

The second half of the *Mobile Satellite Communications Handbook* is where "the-rubber-meets-the-road." It deals with three separate areas of research and development: planned geostationary mobile satellite systems, low earth orbit (LEO) mobile phone systems and LEO mobile satellite data services.

It is accepted wisdom that the Russians have launched and deployed more satellites than anyone else. Their participation in the Inmarsat system has been limited for two reasons: the hard currency crunch due to the unstable Russian economy, and the below standard ground station equipment produced in Russia. So as not to be out done, the Russians have started their own Inmarsat type service. This handbook tells you all about it and other marine satellite systems being proposed by ESA, Japan and Mexico.

Nothing has revolutionized space communications more than electronics miniaturization. Microelectronics have enabled some very complex electronic gear to be carried into space on very small satellites. Added to this is the rediscovery of the low earth orbit and you have the beginnings of a revolutionary change in satellite communications. The use of low earth orbits for various proposed mobile phone systems is what will allow the use of low power handheld transceivers that will use simple omnidirectional antennas.

Chapter 7, which covers the LEO phones goes into great detail about some of the systems like Iridium and Odyssey that you have seen profiled in this column. The author even explains the systems and hardware specifications of the ground stations. Proposed systems by Globstar, Ellipso and Aries are also presented.

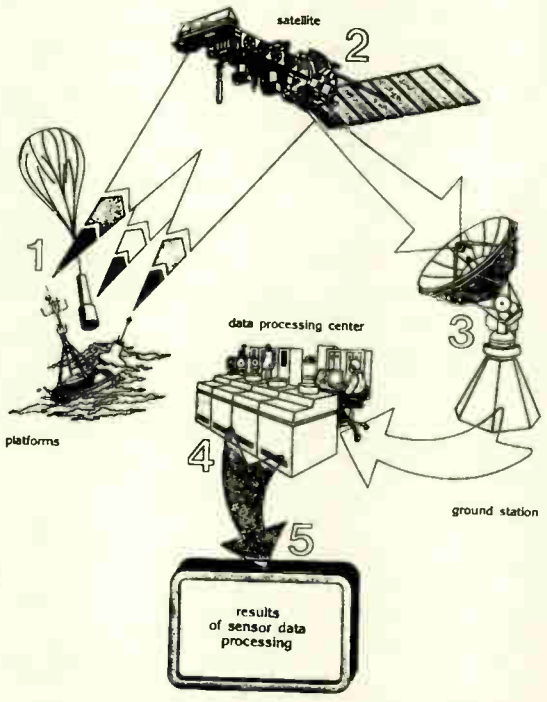
MACSATs are the military version of the microsat. These were being developed by DoD's Advanced Research Projects Agency about the same time U.S. amateurs radio operators were again discovering the advantage of small LEO satellites. MACSAT is a acronym for Multiple Access Communication Satellites. They are three foot long, two foot across and weigh in at 150 lbs. They orbit at an altitude near 720 km (450 miles). The frequencies used by the microsats are between 275 and 400 MHz. They use store and forward techniques using voice, data, and image modes. Other systems such as Starnet and Gonets (built by a Russian company) are also discussed in this book.

I haven't even had the opportunity to tell you about the upcoming military projects that are covered from countries like the U.S., Russia and France to mention a few. The last portion of the handbook covers radio spectrum issues followed by a detailed chapter on Inmarsat operation — both the space and ground segments.

The book also includes an exhaustive list of equipment suppliers for Inmarsat systems complete with phone and fax telephone numbers, addresses, and equipment specifications.

Aeronautical mobile services provided by Inmarsat are also discussed. This includes ARINC and other international service providers. Two sections contain the Inmarsat Convention articles and operating agreements. Roger Cochetti closes his book with system profiles of new L- and Ku-band systems.

The Mobile Satellite Communications Handbook by Roger Cochetti is an easy to read and entertaining report on the history, current state and future of worldwide personal satellite communications. It is available from Quantum Publishing, Inc, P.O. Box 1738, Mill Valley, CA 94942. While the cost of the book is a little steep — US$95.00 — if you are interested in PCS and other satellite communications systems, you need this book in your reference library. ST



Schematic diagram of the Argos meteorological data processing and dissemination network.

By Jeffery M. Lichtman

Automatic Noise Cancellation

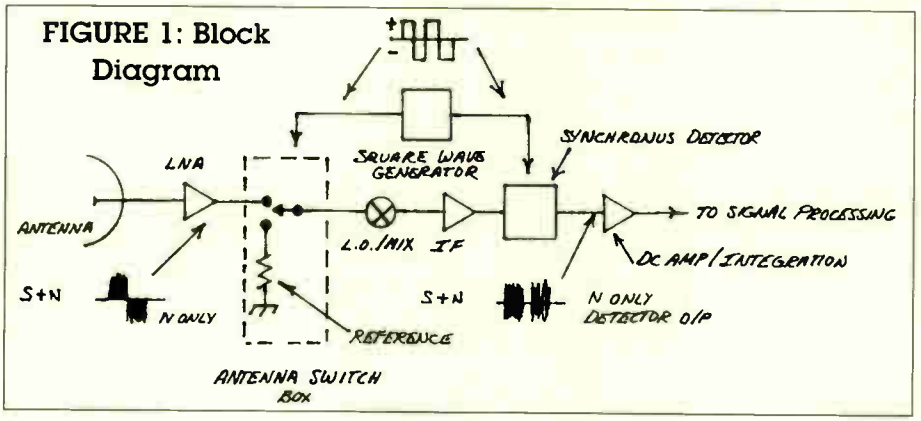
One of the major deterients to successful radio astronomy observations is Noise. In this edition of the *Radio Astronomy* column we will take a look at automatic noise cancellation receivers.

A total power receiver can be converted to an automatic noise cancellation receiver by the introduction of a few additional components. It is recommended that the total power receiver be truly stable and dependable before the noise cancellation modification is added. Then and only then should the building and installation of all the necessary modules be considered.

This type of receiver configuration is often referred to a "comparison radiometer". A comparison radiometer is described as:

- The comparison radiometer works by rapidly comparing two chopped signal conditions. This is accomplished by installing a diode switch box at the antenna headend which in turn is driven by a bi-phase square wave generator.

- The effect therefore is that for one quick instant, the signal plus all of the receiver noise is present at the detector output. In the next instant, the switch box disconnects the antenna from the receiver, and switches the receiver input over to a comparison circuit, which may be a terminating load resistor or some other reference source. In this second condition, we only have the receiver noise represented at the detector output.

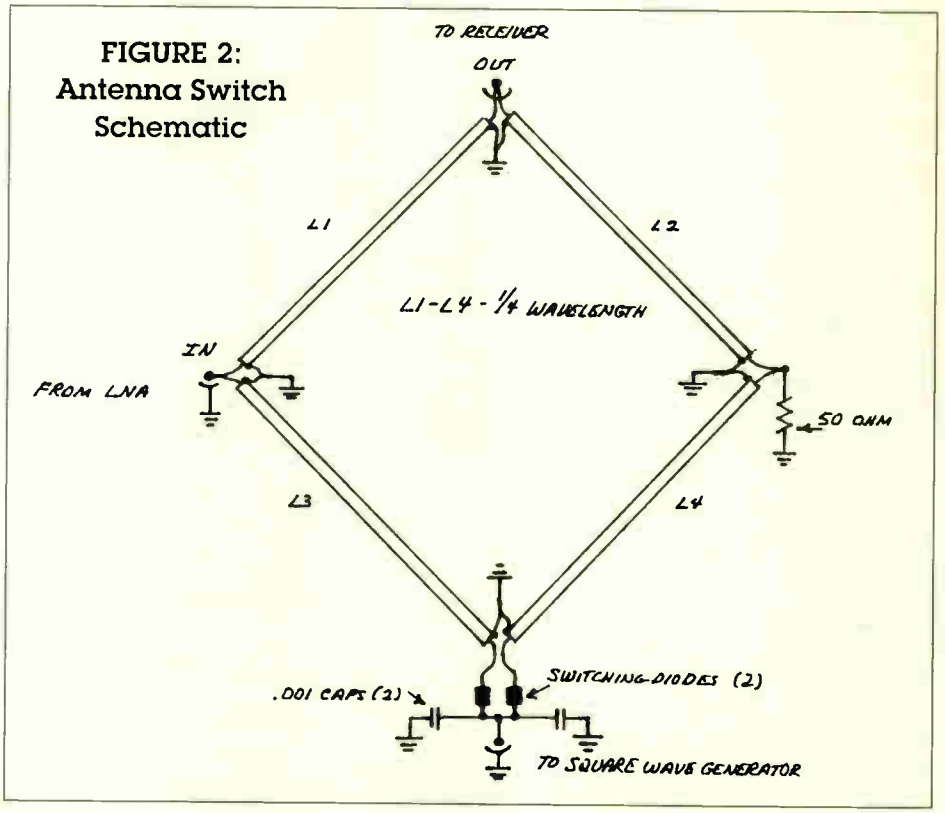


- In practice, the above two conditions are subtracted one from the other by a phase detector, with the result that only the desired signal exits at the D.C. amplifier.

(Signal + Noise) - Noise = Signal Only

When this circuitry operates correctly, it matters very little whether the gain of the receiver varies, since its noise is always being subtracted from the S + N relationship at many times a second. Referring to the block diagram in figure 1, should make the above clear.

Again, as stated above, the three modules to be described should only be added to the receiver if it has been found to work well in the total power mode. The first module for noise we will talk about is the antenna switch box, which is powered only by an input signal from the square wave generator. It consists of four 1/4 wave sections of coax interconnected as shown, two diodes wired in reverse polarity with respect to each other, a 50 ohm terminating resistor, and two .001 filtering capacitors. One very



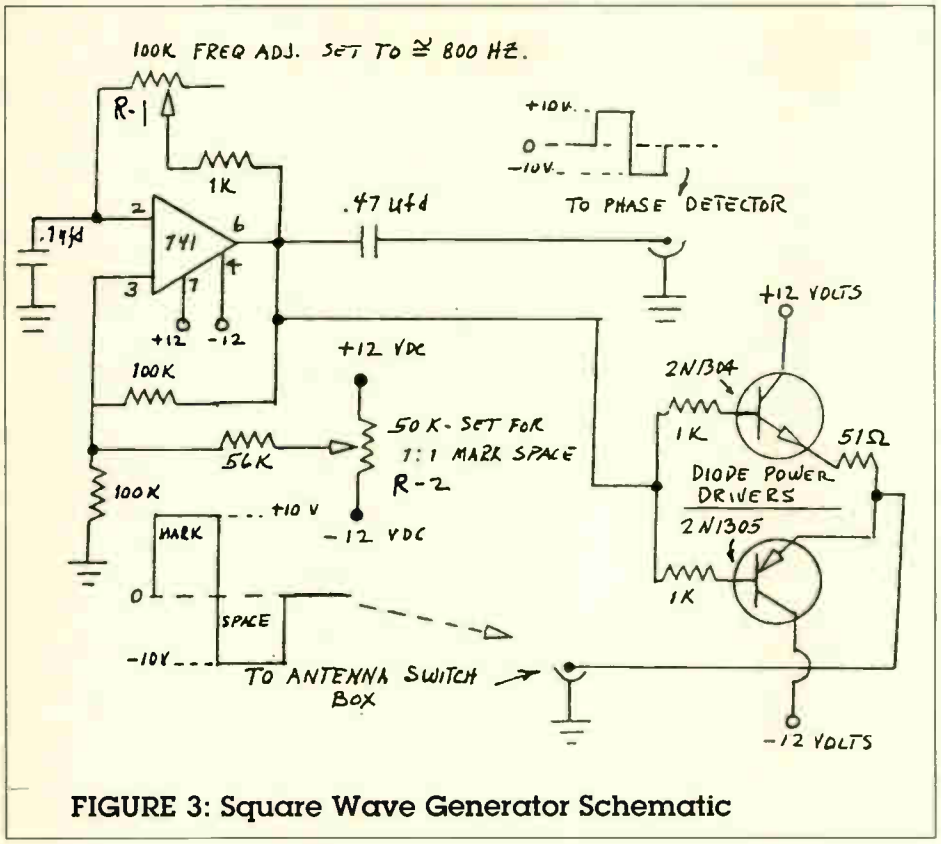


FIGURE 3: Square Wave Generator Schematic

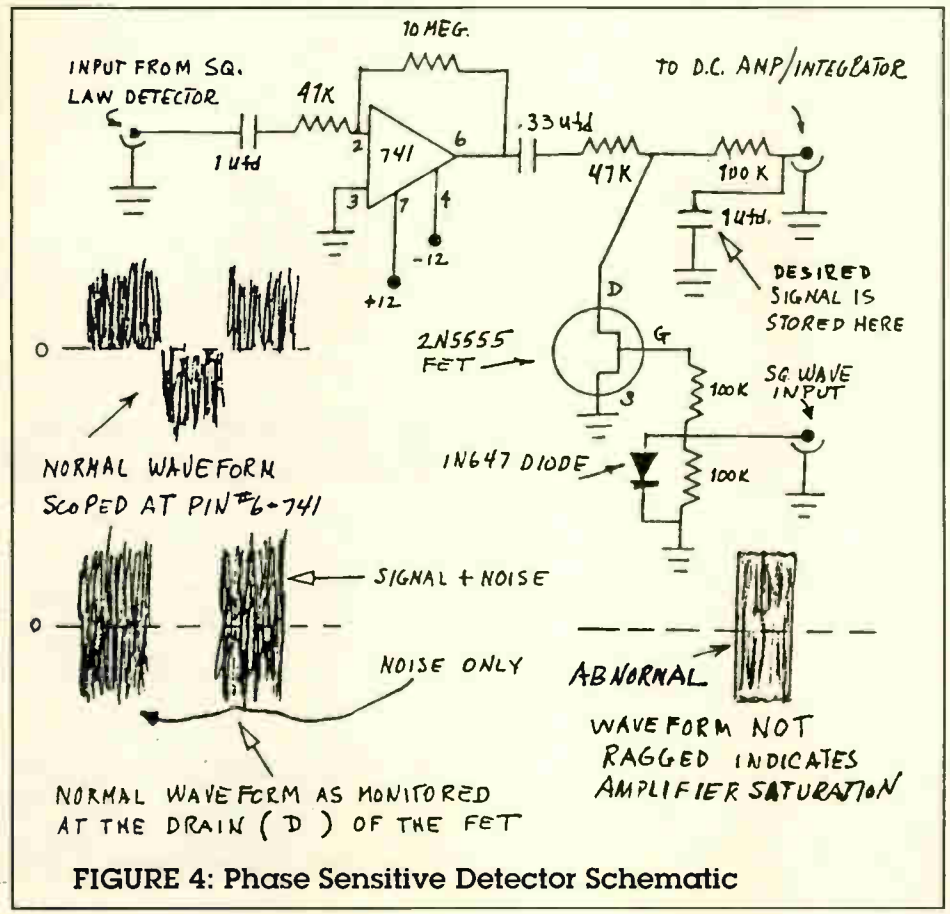


FIGURE 4: Phase Sensitive Detector Schematic

important of this circuit is the isolation choke wired in series with the square wave input line. This is to keep the signal from exiting back down the line. Housing of this module should be a watertight, and shielded enclosure.

The next module is the square wave generator. This module permits the two signal comparisons, S+N and N only. It accomplishes this the same way a single pole double throw switch operates. The generator puts out a positive going square wave with respect to ground, then another which is negative with respect to ground.

This generator is very inexpensive to construct and is built around a standard 741 op amp. The 741 is used as an oscillator. In addition, two medium power 2N1304 transistors and a few other inexpensive parts are also used. The square wave is adjusted by the use of the trim pots, this is a one time setting. R2 sets the output for the mark/space. R1 sets the frequency (this should not be multiple or harmonic of the 60 Hz line current). 57 to 58 Hz would assure that this will not happen. As seen in figure 3, the generator has two outputs. One for the phase detector and the other for the antenna switch box.

The phase sensitive detector operates as follows; The two switched conditions originating at the antenna switch are present throughout the entire receiver amplifying system and exit from a square law detector diode. The signal is then fed to the phase detector. The phase sensitive detector module performs the subtraction requirement: S + N - N = S.S, is the desired signal which rests as a charge on the 1 MFd capacitor. This desired signal will be at a low millivolt level. The small DC signal is then fed to the DC amplifier/integrator for the necessary boost up to the 5 - 10 Vdc level to drive a strip chart recorder or an A/D (analog to digital) converter.

The last module to be used is one that would always be present in any radio telescope, the DC amplifier. The circuit shown is a x10 version. This version uses the stan-

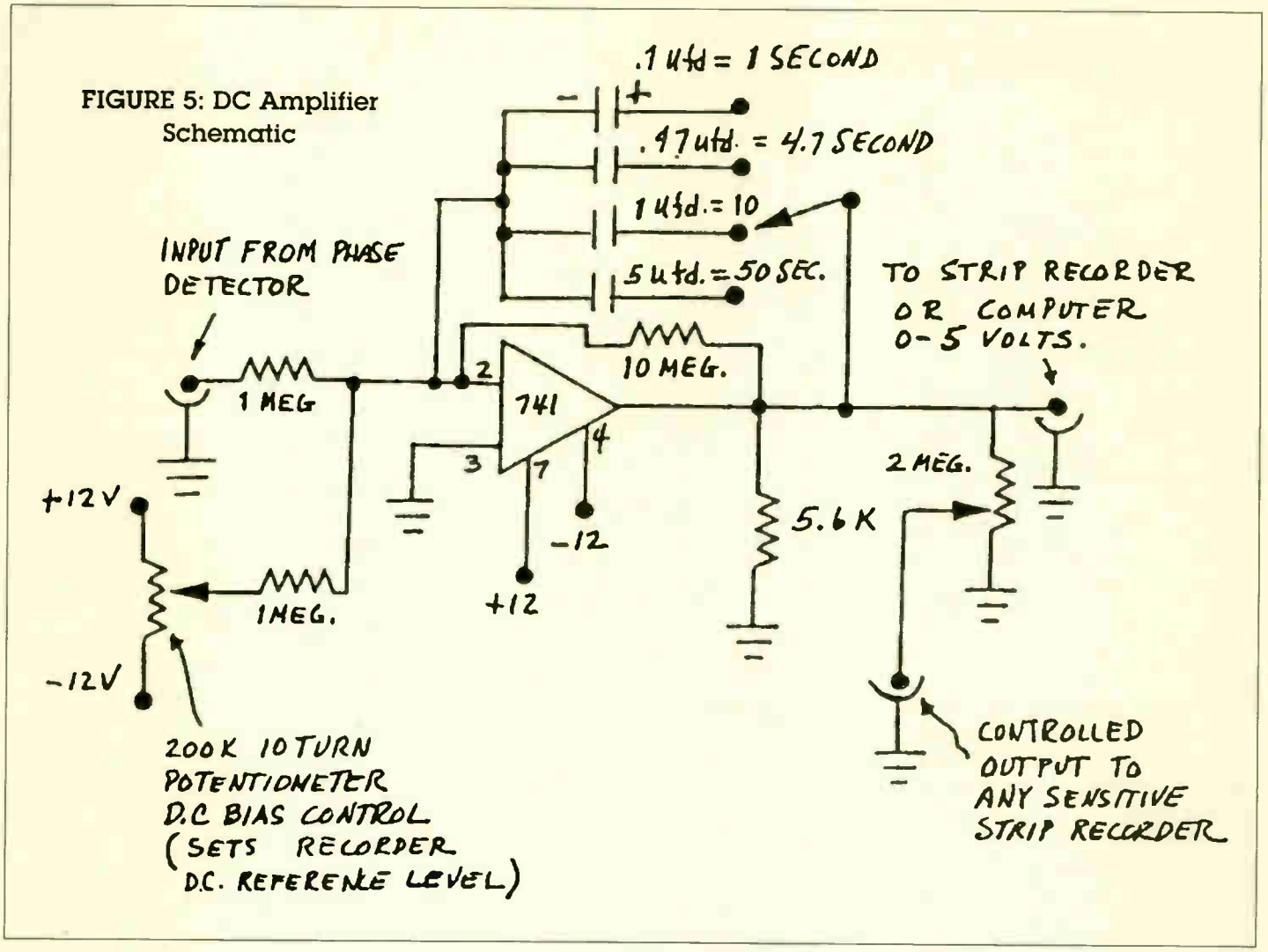


FIGURE 5: DC Amplifier Schematic

dard 741 operational amplifier. I have found the RCA CA3140 operational amplifier works better due to it being a FET type device.

The above circuit information is from the Robert M. Sickels archives and the *Radio Astronomy Handbook*.

A Challenge to Satellite Times RA Readers

Over the past year, I have reported on and illustrated some of the basics of amateur radio astronomy. Now it is time to find out if "*there is anyone out there*". I would like to hear from those of you who read this column and hear about your radio astronomy projects. All submissions received will be entered into a contest. I will judge them for originality and for the observations made on the equipment. The first place winner will receive a copy of *Radio Astronomy* by Dr. John Kraus. Second place will get a copy of *Big Ear II* by Dr. John Kraus, and the third place winner will receive a copy of *The Radio Astronomy Handbook* by Robert M. Sickels. Names of winners will be announced and featured in an upcoming ST Radio Astronomy column.

Those of you who wish to participate need to submit a description of your system, a block diagram (including charts or photos), and any observations you have made with your equipment.

Speaking of equipment, Radio Astronomy Supplies will be unveiling a new radio telescope system right after the first of the year. For the first time ever, RA enthusiasts will be able to purchase a turnkey radio astronomy system. This affordable system will featured in future columns. And yes, it is a secret! Don't tell anybody.

In other news, the Society of Amateur Astronomers will be holding their 1996 conference at NRAO Green Bank, in July of 1996. We have invited Dr. Paul Goldsmith as guest speaker. Dr. Goldsmith is director of the National Astronomy and Ionosphere Center. Paul heads up the Arecibo Observatory in Puerto Rico. ST

GPS at a Glance

The Global Positioning System (GPS) is a highly precise, satellite-based radionavigation system providing three-dimensional positioning, velocity, and time information. GPS is an all-weather system whose coverage is continuous and worldwide. The system was developed and operated by the U.S. department of Defense.

GPS consists of three segments: space, control, and user.

The space segment consist of 24 operational satellites in six circular orbits 20,200 km (10,900 nm) above the earth at an inclination angle of 55 degrees with a twelve hour period. The satellites are spaced in orbit so that at any time a minimum of six satellites are in view to users anywhere in the world. These satellites continuously broadcast position and time data to users throughout the world.

The control segment consists of a master control station at Falcon AFB in Colorado Springs, Colorado, with five monitor stations and three ground antennas located around the world. The monitor stations track all GPS satellites in view and collect ranging information from the satellite broadcasts. The monitor stations send the information they collect from each of the satellites back to the master control station, which computes extremely precise satellite orbits. The information is then formatted into updated navigation messages for each satellite. The updated information is transmitted to each satellite via the ground antennas, which also transmit and receive satellite control and monitoring signals.

The user segment consists of GPS receivers that collect signals from satellites in view. They display the user's position, velocity, and time, as needed for their marine, terrestrial, or aeronautical applications. Some display additional data, such as distance and bearing to selected waypoints or digital charts.

The GPS concept of operation is based upon satellite ranging. Users figure their position on the earth by measuring their distance from the group of satellites in space. These satellites act as precise reference points.

Each GPS satellite transmits an accurate position and time signal. The user's receiver measures the time delay for the signal to reach the receiver, which is the direct measure of the apparent range to the satellites.

Measurements collected simultaneously from four satellites are processed to solve for the three dimensions of position, velocity, and time.

GPS signals are provided at two levels of service — a Standard Positioning Service (SPS) for general public use and an encoded Precise Positioning Service (PPS) primarily intended for use by the Department of Defense.

SPS signal accuracy is intentionally degraded to protect U.S. national security interests. This process called Selective Availability (SA), controls the availability of the system's full capabilities. The SPS accuracy specifications, given below, include the effects of SA. SPS provides accuracies of (for position, the accuracy with respect to geographic, or geodetic coordinates of the Earth) within:

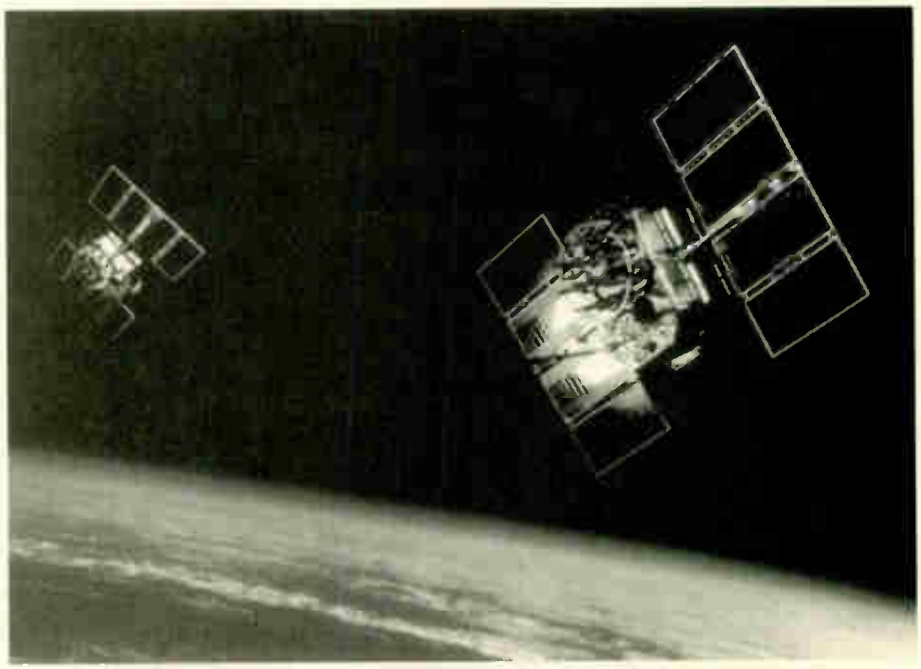
100 meters (2 drms) horizontal
156 meters (2 Sigma) vertical
300 meters (99.99% probability) horizontal
340 nanoseconds time (95% probability)

SPS coverage is continuous and worldwide, with a position dilution of precision (PDOP) of 6 or less.

GPS is used to support land, sea, and airborne navigation, surveying, Geophysical exploration, mapping and geodesy, vehicle location systems, and a wide variety of additional applications.

The GPS system became fully operational in 1995. Satellite Times would like to thank the United States Coast Guard (USCG) for the material that has appeared in this column. It came from the USCG's GPS Facts and Figures publication.

In the next issue of *ST* we will be featuring extensive coverage on navigation satellites. If you have an interest in the GPS or GLONASS satellite systems you don't want to miss the March/April issue of *Satellite Times*, your space magazine of record. ST



ST WHAT'S NEW

by Wayne Mishler, KG5BI

What's New?

New Hamtronics Weather Satellite Receiver

If you are looking for an inexpensive but effective wideband fm receiver module for 137 MHz weather fax reception, then consider the new R139 Receiver from Hamtronics. Because a wide intermediate frequency bandwidth is necessary for good reception of weather fax signals, most conventional receivers and scanners are not suitable for this purpose, without extensive modification that would degrade their use for receiving other types of signals. The R139 is designed for quality weather fax reception.

Over the years, Hamtronics has made special versions of their receivers available with wide IF filters and detector optimized for NOAA APT and Russian Meteor weather satellites. The R139 is a new and improved 3rd generation receiver designed specifically for weather satellite reception. It combines the circuitry of all previous R138/AS138 modules in one unit, with cabinet and power supply, and it incorporates all of the suggestions customers have made.

The R139 is crystal controlled with five channel oscillators to cover all five of the popular U.S. and Russian satellite frequencies. All crystals are supplied with the unit. This approach, says Hamtronics, reduces cost and simplifies construction and maintenance. An extensive instruction manual is provided.

With the R139, you can either select channels manually, or use a built-in scan capability to search out an active satellite overhead. The scan feature allows you to monitor the various weather satellites even when away from home. When the R139 in scan mode detects a satellite, the scanner stops on that channel and turns on a tape recorder output. This can be used to activate a tape recorder (not included) allowing you to play back the tape into your demodulator unit when ready to send the data to your computer.

LEDs on the front panel of the R139 indicate which satellite is being received. The receiver has a sensitivity of 0.2 microvolts, capable of sniffing out faint signals, and an adjustable audio output for driving a speaker or demodulator. A squelch circuit mutes the audio when no satellite is in range. The R139 is compatible with any popular tone demodulator and software.

The kit is priced at $159. Hamtronics says assembly is simple for people with kit-building experience. A signal generator is required for alignment. You can get an aluminum cabinet and 12-volt DC power adapter for another $30.

A factory-wired version with cabinet and adapter is available for $239.

For additional information, you can write to Hamtronics, Inc.; 65-F Moul Rd; Hilton NY 14468-9535. You can fax your request to 1-716-392-9420, or call 1-716-392-9430 (voice). While you are at it, you might as well ask for their catalog which includes preamps, helical resonator filters for the 137 MHz band, and VHF/UHF transmitters, receivers, repeaters, converters, preamps, and accessories.

Hamtronics Offers Inexpensive WWV Receiver

Ever wish you had an HF receiver that you could click on to pick up WWV time and solar predictions, etc. Hamtronics offers one—a new, inexpensive, dedicated receiver for the continuous 10 MHz WWV broadcast. It is small, super sensitive, and selective. It features an AM superhet receiver that is crystal controlled for simple construction and rock-solid performance. The kit price is $59. Pre-wired and tested is $99.

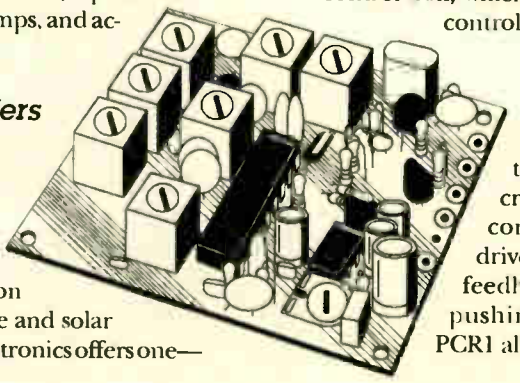
AVCOM products simplify satellite system alignment

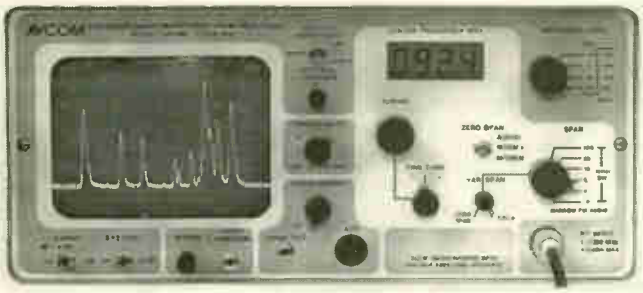
The AVCOM Corporation has announced a new portable microwave spectrum analyzer, model PSA-65B which is great for aligning satellite systems along with dozens of other uses. Its main attraction is light weight and battery or AC operation. It covers frequencies from less than 1 MHz and has greater than -95 dBm sensitivity. U.S. price is $2,930. Accessories include BNG-1000A tracking (noise) generator for doing sweep measurements, 1250 MHz wide frequency extenders, RFP-24 preamplifier for increasing sensitivity to less than 1 microvolt, and LPA-1000 log periodic antenna. Internal options available include a 10 KHz resolution bandwidth, FM demodulator and AM detector.

The AVCOM SPA-20A unit is a portable box that turns any TV into a powerful 950-2050 MHz spectrum analyzer. It enables the satellite system owner to find and identify satellite downlink signals, achieve optimum antenna performance, and trouble-shoot system failures. Connect it to your TV like you would a VCR. It retails in the U.S. for $389.

AVCOM also produces an adapter kit that allows low cost DBS LNBs to be modified for use with larger prime focus dishes to receive DBS signals in Alaska, Hawaii, and other remote areas where such reception may be legal. Installation is a snap – literally. Just snap off the DBS LNB cover and insert the adapter. The price of the kit is $39. An optional mounting plate is $19.

There is another AVCOM product, a control box, which provides remote control over polar-otors. The PCR1 Polorator Control Box is a self-contained, battery-powered, microprocessor based controller that can drive servo actuated feedhorns. By simply pushing buttons, the PCR1 allows you drive the





polarotor to preset positions. You can make continuous adjustments to the polarotor by turning a knob. Vertical and horizontal settings can be quickly stored and recalled. This is a handy device for TVRO installers and can be used with other AVCOM devices. It measures just 6.5 inches long by 1.5 inches high and 13.3 inches deep. Price is $149.

You can get more information about AVCOM products by calling 1-804-794-2500, faxing 1-804-794-8284, or writing AVCOM of Virginia Inc., 500 Southlake Blvd, Richmond VA 23236.

Omni-Link bracket lets you attach omnidirectional antenna to DBS base

Kaul-Tronics, Inc., has released a new product that enables you to combine your UHF/VHF/FM and DBS antennas on the same base. It is a bracket which attaches to either side of a DBS antenna mount and holds the company's omnidirectional antenna, allowing you to receive local signals along with DBS.

The bracket fits all brands of DBS antennas. It comes complete with antenna mast and hardware to complete the installation. It retails for $24.95. For more information call a KTI representative at (608) 647-8902.

Global Broadcasting Systems book covers broadcasting worldwide

Focal Press has released a new book entitled "Global Broadcasting Systems" providing a comprehensive look at broadcasting throughout the world. It covers every continent, region, and almost every country in North America, South America, Europe, Africa, Asia and Oceania.

In each geographic area, the book presents the history, key issues, trends and status of five important factors of the broadcast industry, including satellite reception.

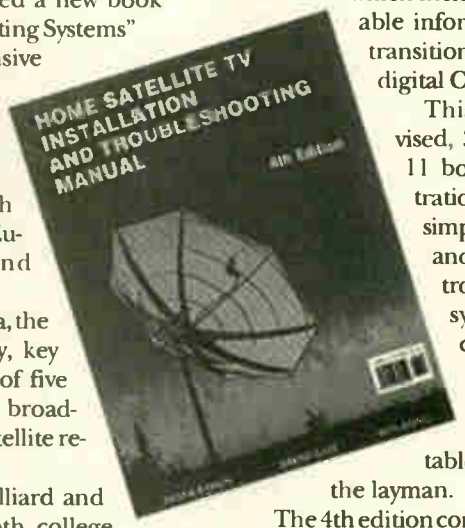
Authors Robert L. Hilliard and Michael C. Keith are both college professors. Hilliard is a professor at Emerson College and lectures on broadcast systems. He previously was chief of the educational (public) broadcasting branch of the FCC, and chair of the Federal Interagency Media Committee. He has written numerous books including "TV Station Operations and Management", "The Federal Communications Commission," and "Writing for Television and Radio." Keith is a professor at Boston College and previously was director of education at the Museum of Broadcast Communications, in Chicago. A former radio programmer, he has written several books on that field, including "The Radio Station," "Radio Production," and "Selling Radio Direct."

They combined their knowledge and skills in producing this new book with chapters on the world telecommunications revolution, world systems overview, control and regulation of world systems, financing global electronic media, broadcast programming worldwide, freedom and world broadcasting,
and external services and organizations.

The book is available for $29.95 from Focal Press, 313 Washington Street, Newton MA 02158-1626, 1-800-366-2665 (voice) or 1-800-446-6520 (fax.)

Baylin revises installation and troubleshooting manual

Baylin Publications recently published the 4th edition of "The Home Satellite TV Installation and Troubleshooting Manual," which includes new and valuable information about the transition from analog to digital C-band technology.



This thoroughly revised, 326-page, 8 1/2 x 11 book contains illustrations and tables to simplify the installation and maintenance of trouble-free satellite systems. The text contains over 300 up-to-date illustrations, photographs and tables. It is written for the layman.

The 4th edition contains background theory and details on how satellites and TVROs operate, methods to select and judge satellite TV components, a detailed step-by-step installation and dish-aiming guide with necessary charts and tables, thorough diagrams and text explaining multiple receiver and multiple-television hookups, methods to install unusually large dishes, and a complete strategy and details on troubleshooting any satellite TV systems.

Also covered is the MPEG-2 digital television standard, video compression methods, the IF distribution of satellite signals, and an overview of digital link analysis.

In the Appendix there are useful equations, a glossary, and a complete list of manufacturers of satellite equipment, as well as reference books and magazines.

The book is available for $30 plus $4 shipping and handling, directly from Baylin Publications, 1905 Mariposa, Boulder CO 80302. For a free catalog of other publications, software and videos, call 1-800-483-2423. ST

By Dr. T.S. Kelso

Orbital Coordinate Systems, Part III

Last time, we worked through the process of calculating the ECI (Earth-Centered Inertial) coordinates of an observer's position on the Earth's surface, starting with the observer's latitude and longitude. Then, we used those coordinates to calculate look angles (azimuth and elevation) from the observer's position to an orbiting satellite. The most difficult part of that process was in calculating the sidereal time, a quantity necessary to determines the Earth's orientation in inertial space.

In the process of performing those calculations, however, we made one simplifying assumption: that the Earth is a sphere. Unfortunately, this assumption is not a good one. Ignoring the fact that the Earth's shape can more accurately be described as an oblate spheroid (a flattened sphere) can have a significant effect in certain types of satellite tracking applications. In this column, we will examine the implications of our initial assumption by modifying our calculations to allow for the Earth's flattening at the poles and then tackle the related problem of determining the sub-point of an orbiting satellite. Let's start by looking at a cross-section of the Earth and defining some terms.

Figure 1 is an exaggerated view of the cross-section of the Earth. For an observer on the Earth's surface, we can define a couple of terms fairly easily. The first is the local zenith.

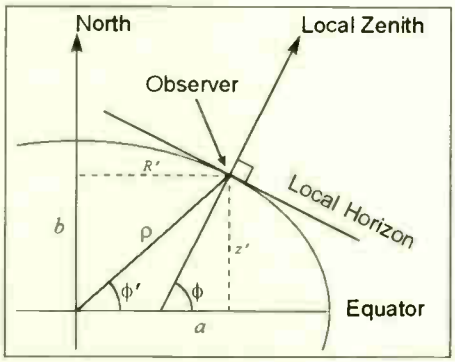


Figure 1: Cross-Section of Oblate Earth

The local zenith direction is just a fancy way of saying "straight up." It is the direction away from a point on the Earth's surface perpendicular (at a right angle to) the local horizon. On a sphere, this direction is always directly away from the Earth's center. However, on an oblate spheroid, this is not the case since a line from the center of the Earth to the observer's position would not point to the local zenith (except on the equator and at the poles).

Since the local zenith direction depends upon the local horizon, let's take some time to better define it, as well. The local horizon is a plane which is tangent (touching at a point) to the Earth's surface at the observer's position. For our purposes, we will consider the local horizon to be the plane tangent to the reference spheroid. The term reference spheroid is used to define the oblate spheroid which 'best' defines the shape of the Earth. How 'best' is defined is a complicated process and depends upon whether the fit of the reference spheroid is regional or global. We will use the reference spheroid defined in WGS-72 (World Geodetic System, 1972) for our standard.

In WGS-72, the Earth's equatorial radius, a, is defined to be 6,378.135 km. The Earth's polar radius, b, is related to the equatorial radius by something called the flattening, f, where

$$b = a(1 - f)$$

The flattening term, as defined in WGS-72, is only 1/298.26 – a very small deviation from a perfect sphere. Using this value, the Earth's polar radius would be 6,356.751 km – only 22 kilometers difference from the equatorial radius.

The first real significance of using an oblate spheroid instead of a sphere to define the Earth's shape comes in determining the observer's latitude. On a sphere, latitude is defined as the angle between the line going from the center of the Earth to the observer and the Earth's equatorial plane. However, on an oblate spheroid, geodetic latitude is the angle between the local zenith direction and the Earth's equatorial plane. This angle, ϕ, is the latitude used on maps; the angle formed by the observer's position, the Earth's center, and the equatorial plane is more properly referred to as the geocentric latitude, ϕ'.

The impact of this change is that in order to calculate the observer's ECI position, we must determine the geocentric latitude from the geodetic latitude. Knowing the geocentric latitude, ϕ', we can then calculate the geocentric radius, ρ, and from that calculate the z coordinate ($\rho \sin \phi'$) and the projection in the equatorial plane ($\rho \cos \phi'$). Let's start by developing the relationship between ϕ and ϕ' since we'll usually be given ϕ.

From the basic definition of an ellipse,

$$\frac{(R')^2}{a^2} + \frac{(z')^2}{b^2} = 1$$

where

$$R' = \rho \cos(\phi')$$

and

$$z' = \rho \sin(\phi').$$

Now,

$$\tan(\phi') = \frac{z'}{R'}$$

and

$$\tan(\phi) = -\frac{dR'}{dz'}$$

(that is, the normal to the tangent of the spheroid). Differentiating the equation of the ellipse,

$$\frac{2R'dR'}{a^2} + \frac{2z'dz'}{b^2} = 0$$

and rearranging terms,

$$\frac{z'}{R'} = -\frac{b^2}{a^2} \cdot \frac{dR'}{dz'}$$

which can be written as,

$$\tan(\phi') = \frac{b^2}{a^2} \tan(\phi) = (1-f)^2 \tan(\phi).$$

So, knowing the geodetic latitude and the flattening, we can now determine the geocentric latitude. Now, let's see how much of a difference results from using an oblate spheroid. Figure 2 plots the difference between geodetic and geocentric latitude as a function of geodetic latitude.

That's it? All that work and the maximum error is less than two-tenths of a degree? It would hardly seem worth the effort to perform the calculation. But let's explore a little further.

Although the development is too complicated to present here, it can be shown that

$$\rho \sin(\phi') = z' = S \sin(\phi)$$

and

$$\rho \cos(\phi') = R' = C \cos(\phi)$$

where

$$C = \frac{1}{\sqrt{1 + f \cdot (f-2) \cdot \sin^2(\phi)}}$$

$$S = (1-f)^2 \cdot C.$$

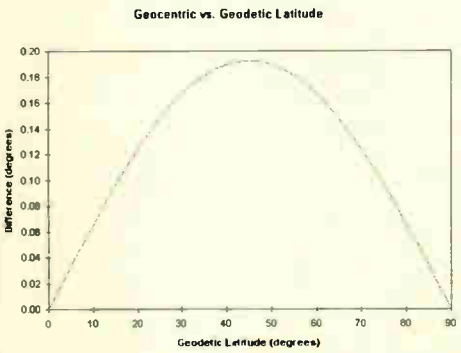


Figure 2. Geocentric vs. Geodetic Latitude

Our ECI coordinates, are now

$$x' = C \cos(\phi) \cos(\theta)$$
$$y' = C \cos(\phi) \sin(\theta)$$
$$z' = S \sin(\phi).$$

Using the example of calculating the ECI coordinates of 40° N (geodetic) latitude, 75° W longitude on 1995 October 01 at 9^h UTC,

$x' = 1703.295$ km, $y' = 4586.650$ km, $z' = 4077.984$ km.

Although close to our calculations assuming a spherical Earth, we find this simplification resulted in a position error of 22.8 km.

What we really want to know, however, is just how big an error will result when generating look angles to a satellite from an observer's position on the Earth's surface if we assume a spherical Earth. From Figure 2, we would expect to have the largest errors for observers around 45° N latitude, so let's use a location near Minneapolis at 45° N latitude and 93° W longitude for our example. On a pass of the Mir space station over Minneapolis on 1995 November 18, Mir passed almost directly overhead. At 12^h 46^m UTC, its ECI position was calculated to be: x = -4400.594 km, y = 1932.870 km, z = 4760.712 km. Calculating the look angles for both a spherical and oblate Earth yields the results shown in Table 1.

The pointing error produced by assuming a spherical Earth is 3.17 degrees. For most applications, this error might not be significant. However, in applications involving tracking with high-gain, typically narrow-

TABLE 1: Look Angles for Spherical vs. Oblate Earth

	Spherical Earth	Oblate Earth
Azimuth	118.80∞	100.36∞
Elevation	80.24∞	81.52∞

beamwidth, antennas, an error of 3 degrees can result in a loss of communications.

So, now that we've completed the calculation of a satellite look angle for an oblate Earth, let's look at how to calculate the sub-point of a satellite in Earth orbit. We'll begin by examining the calculations for a spherical Earth first before looking at the case for an oblate Earth.

First, let's be sure we understand what we're looking for. The satellite sub-point is that point on the Earth's surface directly below the satellite. For the case of a spherical Earth, this point is the intersection of the line from the center of the Earth to the satellite and the Earth's surface, as shown in Figure 3.

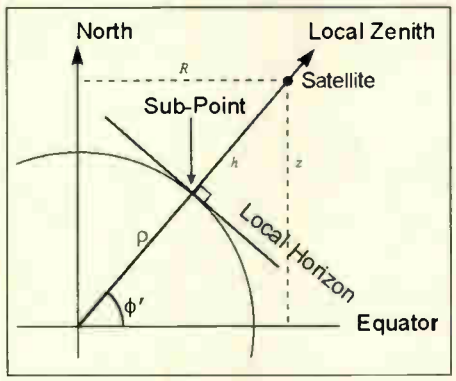


Figure 3: Calculating Satellite Sub-Point – Spherical Earth

Given the ECI position of the satellite to be [x, y, z], the latitude is

$$\phi' = \tan^{-1}\left[\frac{z}{\sqrt{x^2 + y^2}}\right]$$

and the (East) longitude is

$$\lambda_E = \tan^{-1}\left[\frac{y}{x}\right] - \theta_g$$

where θ_g is the Greenwich Mean Sidereal Time (GMST). The altitude of the satellite would be

$$h = \sqrt{x^2 + y^2 + z^2} - R_e$$

where R_e is the Earth's circular radius.

As seen in Figure 4, the calculation for an oblate Earth is somewhat more complicated. The first thing we notice is that our definition of satellite sub-point requires some refinement. The point on the Earth's surface directly below the satellite is not on a line joining the satellite and the center of the Earth. Instead, it is that point on the Earth's

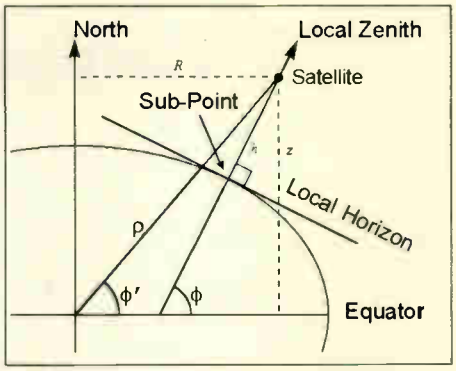


Figure 4: Calculating Satellite Sub-Point – Oblate Earth

surface where the satellite would appear at the zenith.

Calculating the longitude of the satellite's sub-point doesn't change. However, to calculate the geodetic latitude of the satellite sub-point, we'll want to begin by approximating ϕ with ϕ' (as calculated above) and letting (for computational efficiency). Then, we'll want to loop through the following calculations

$$\phi_i = \phi$$

$$C = \frac{1}{\sqrt{1 + e^2 \cdot \sin^2(\phi_i)}}$$

$$\phi = \tan^{-1}\left[\frac{z + aCe^2 \cdot \sin(\phi_i)}{R}\right]$$

until is within the desired tolerance. To compute the altitude of the satellite above the sub-point,

$$h = \frac{R}{\cos(\phi)} - aC.$$

Using our example of Mir passing over Minneapolis on 1995 November 18 at 12^h 46^m UTC yields a sub-point at 44.91° N (geodetic) latitude, 92.31° W longitude, and 397.507 km altitude. And while we cannot solve for the sub-point directly, the number of iterations required is typically quite small. For this example, the value of after the first iteration is 0.180537 degrees, after the second iteration it's 0.000574 degrees, and after the third iteration it's 0.000002 degrees.

Admittedly, some of the differences we've found may seem small, but that will depend upon your tracking requirements. And, since they are not that much more difficult to calculate, there is little reason not to use them. As always, if you have questions or comments on this column, feel free to send me e-mail at tkelso@afit.af.mil or write care of *Satellite Times*. Until next time, keep looking up! ST

ST THE BEGINNER'S COLUMN

By Ken Reitz, KC4GQA

Satellite Monitoring: What You Should Know To Start

If you thought that monitoring satellites was the exclusive domain of the pocket protector set or a luxury pastime for the financially endowed, you will be happy to learn that it's not!

The fact is, rudimentary monitoring can be done with some of the radio gear you've probably got lying about the house. Additional forays into more sophisticated frequency regions can be done for a modest investment. And you'll be surprised to learn that you can become quite an expert in your own right just by reading a little, listening to the right folks and paying attention. I said, *Paying attention!* Just checking.

Scanners Pictured: ICOM R7100-2 (Top), ICOM R100 (Bottom).

A Good Place To Start

Let's pretend that you don't know anything about satellites and just happened to pick up *Satellite Times* on a whim or a dare by a friend who questioned your literacy.

Perhaps you've glanced at the articles in the front of *ST* and found yourself saying, "Huh?". Maybe you looked in the center pages and saw all this fine print and columns of numbers and frequencies you didn't even know existed. Yet you persisted. Some primeval urge toward the elevation of the species led you to think that maybe you needed to know what this was all about, but couldn't figure out where to start. Well, then, this is where to start. Here are Kousin Ken's four most important things to know about getting started in the satellite monitoring hobby.

1. What Satellite Signals Will and Won't Do

Satellite signals can be found in many different places in the radio frequency spectrum high frequency (HF), very high frequency (VHF), ultra high frequency (UHF), super high frequency (SHF), and extremely high frequency (EHF) and wow, that's really HF (WTRHF). Most satellite signals, however, are in the UHF spectrum and go up in frequency from there. You can expect that these signals won't bend around corners or bounce and hop off the ionospheric layers the way HF signals do.

Virtually all satellite signals require two things of a receiving antenna: It needs to be in the *line of sight* of the satellite and it has to have enough gain to reproduce a readable signal.

Owing to the weak nature of their tiny transmitters, satellite signals cannot travel through building materials such as walls or roofs. Trees, mountains, and buildings are all the enemy of satellite signals.

Geostationary satellites (ones placed high enough in orbit that they appear to be stationary) do not require tracking devices and there is no need for orbital element sets (all those number columns in the keplerian section of the ST's Satellite Services Guide).

Low earth orbiting (LEO) satellites are different, however, and they are always on the move. They zip around our planet on a regular basis and require some form of tracking (a way to move the antenna to follow the satellite across the sky).

2. What Antennas Can and Cannot Do

In your experiments with the lower frequency band you've probably noticed that a random length of wire tossed behind the sofa or thrown out the window will give decent enough reception of shortwave signals.

UHF and higher signals will require considerable more effort. Here's a good example of how it works: To receive TV channels over the air on a pair of "rabbit ears" your location needs to be fairly close to the TV station's transmitter. If you're out in the country, you'll find they don't work too well. If you put the rabbit ears on a pole and turned them in the direction of the TV transmitter you'll notice an improvement. If you added a second set of rabbit ears, slightly longer, a little ways behind the original rabbit ears you'll notice even more improvement. If you had a way to amplify the signal at the rabbit ears before sending it down the feed line to the house you'll get even better reception.

But, don't try to use this antenna for AM or shortwave reception. It's specialized for the TV band (54-210 MHz) and would be of no use for lower band reception. Does this mean that you'll need separate antennas for each band you wish to monitor? Yes! If you want to watch VHF TV you use a VHF antenna, if you want to watch UHF TV you use a UHF antenna. If you want to listen to distant FM radio stations you use a VHF TV antenna because the FM broadcast band (88-108 MHz) sits between channels 6 and 7 on the VHF TV band.

3. What Receivers Can and Can't Do

Receivers are the core of your monitoring station. Even though antennas are the

most important component (a great receiver with a minimal antenna will not live up to expectations) antennas are the least expensive component of your monitoring station. Receivers, conversely, can be the most expensive component. Here is where you need to spend your money wisely.

Scanners can be used to monitor some satellite activity and it's a good place to start. But you'll find that most scanners don't have the flexibility to monitor CW (Morse Code) and SSB (single sideband) amateur transmissions. Shortwave radios are useful for monitoring some amateur radio satellites transmissions, but you'll need a CW/SSB capability (usually denoted as a BFO or beat frequency oscillator knob on the receiver). Digital packet amateur transmissions can be monitored with a scanner, but you'll need a packet computer program.

Fancy multi-mode VHF/UHF communications receivers (such as the ICOM R7100-2) are excellent. They feature coverage from 25-800 MHz and 900-2000 MHz. But the price tag (around $1,300) is staggering. You'll want to use your scanner and shortwave radios to start. If you find yourself bored or disinterested, then, you'll want to consider stamp collecting.

4. Informed Sources

In the fast paced world of satellite monitoring there's no substitute for current information. It happens that you've already taken the first step in becoming among the best informed in this hobby. Forget the expensive books and trade journals. A one year subscription to *Satellite Times* ($19.95) is the cheapest way to get the information you need to stay on top of this hobby. You may also benefit from articles in back issues of *ST*. They're available and when a print run for a given issue of ST runs out, reprints of *ST* articles are available for a reasonable charge. To find out what you've already missed in the previous year you should get an index of ST articles available for a SASE and $2.00 from Grove Enterprises.

The Amateur Satellite Corporation (AMSAT) is the authority on amateur satellite communications. They publish the *AMSAT Journal* which is devoted exclusively to amateur satellites and they also have a number of publications including the fifth edition of Keith Baker's *How To Use The Amateur Radio Satellites*. They also carry satellite tracking program for your computer. To join AMSAT and subscribe to *The AMSAT Journal* write them at 850 Sligo Avenue, Silver Spring, MD 20910-4703 or call them at 301-589-6062 FAX 301-608-3410.

Grove Enterprises, publisher of this magazine also has a catalog and buyer's guide which lists 12 satellite related titles as well as some related receiving equipment. You can order a free copy of the catalog by calling 800-438-8155 or visit their world wide web site at: *http://www.grove.net* and check out their online catalog .

Tiare Publications, (P.O. Box 493, Lake Geneva, WI 53147) has a catalog of several satellite related publications. They ask you to send $1 for a full catalog.

Universal Radio (6830 Americana Parkway, Reynoldsburg, OH 43068) has a catalog of satellite and radio related publications/products. It is yours for $1.

WeatherSat Ink is great source of up-to-date information on weather satellites. This magazine is published quarterly and a subscription is $18 per year from WeathSat Ink, c/o Bluebird Greenhouses, 4821 Jessie Drive, Apex, NC 27502.

In addition to the fore mentioned companies and organziations, there is a wealth of information available via various computer bulletin board services and the Internet. Of course, your first stop should be at the Grove Web site. This is a good starting point to sniffing out the dozens of other computer sources and internet chat groups.

Mailbag

Paula Dwek of Elberon, New Jersey, says that she is an avid shortwave listener and new to the satellite hobby. She would like to know what kind of equipment would be needed to receive the audio from *The Voice of the Arabs* which she notes is on Eutelsat II F3.

Well Paula, I'm sorry to report that Eutelsat is out of our reception range here in North America. Its location (16 degrees East) is so far to the East that there is no chance of picking up any signal. The only thing that might come close is the Arab Network which is found on 6.20 MHz audio on Galaxy 6 channel 10. A standard C-band satellite TV set-up will receive this programming with no difficulty. By using some of the cheap receiving techniques detailed in previous issues of this column, you could receive these transmissions for as little as a few hundred dollars. To determine if this programming is, indeed, what you may be looking for, you might ask a friend or neighbor who has a satellite TV system if you could monitor the channel (audio and TV) and see what it's like.

On a similar note, Arsenio Fornaro of Brooklyn, New York, is interested in receiving programming from Brazil. As far as I know there is no source of readily available programming from Brazil available to U.S. viewers. Brasilsat A2 is located, tantalizingly, at 70 degrees West, easily within our region of the Clarke Belt. The catch is, however, that all the programming on the bird are spot beamed to Brazil and not receivable outside of that country.

On a positive note, American satellite manufacturer Hughes Aircraft is said to be joining Multivision (from Mexico), Venevision (from Venezuela) and TV Abril (from Brazil) to launch a new satellite service to be called Galaxi LatinoAmerica which will feature 144 channels of video and 60 channels of stereo audio with 50 per cent of the programming in Spanish and 50 per cent in Portugese. The service is scheduled to begin in March of this year. Whether or not this service would be receivable in this country is not known at this time. Nor is it clear as to who would be eligible to subscribe to the service.

And, finally, Fabian Husley of Biloxi, Mississippi, would like to know if his Icom R-100 radio could be used to receive SCPC satellite signals. He would also like to know what antenna would be best.

Well, sure, the R-100 makes a great SCPC radio but you'll need a few other components in addition. First, you'll need a parabolic dish antenna to pick up the C-band signals. Check the various TVRO satellite catalogs (Skyvision 800-334-6455 and RMA Electronics Company 603-434-7445 for starters) for a nice 6 or 7 foot dish. You'll also need a C-band feed horn and Low Noise Block Down Converter (LNB). In addition, you'll need a power inserter which feeds the voltage to power the LNB along the RG-6 coax which is the final link to your radio. It's not as much trouble as it sounds, but you'll need some help. Most suppliers of TVRO equipment will be able to help give you tips on installation. ST

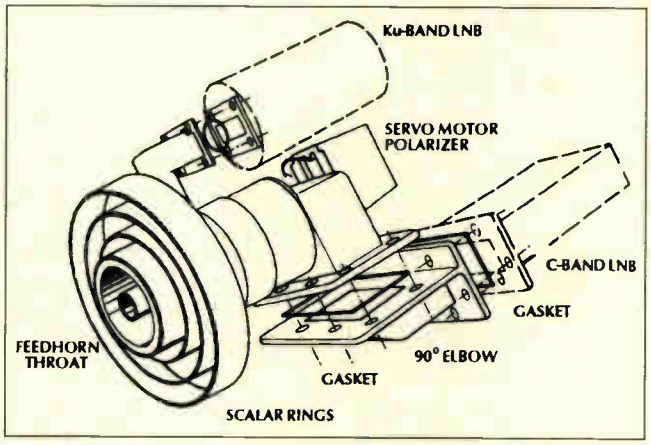
If you have a question for Kousin Ken, you can write him at ST Beginner's Column, P.O. Box 98, Brasstown, NC 28902 or e-mail your questions to st@grove.net. Be sure to mark those e-mail questions for the Beginners Column.

By by Tim Olin

Feedhorns and LNBs

Feedhorns and LNAs or LNBs have come a long way over the years. They have evolved from bulky, metal funnels and heavy metal wonders that together could be at least a foot-long, to sleek, palm-sized technological wonders. They have changed from separate, single components that were turned by ordinary TV antenna rotors to a small, mated units.

If you are not sure what exactly a feedhorn and an LNB is, then begin by looking at that piece of equipment that is suspended out in front of the center of the dish. The feed and LNB are probably hidden by some kind of protective cover, but trust me they are there. Any more it's hard to talk about one without talking about the other.



Schematic of a dual-band C/Ku feed. (Courtesy of Frank Baylin's Home Satellite TV Installation and Troubleshooting Manual, 3rd edition).

What purpose does a feedhorn have? A satellite dish is actually a reflector that bounces signals to a central focal point. The feed is placed at that focal point and it channels the signals to an LNB. The LNB then converts those signals to an electrical current, amplifies the signals and converts them to a lower block of frequencies that in turn is used by a receiver.

There's a variety of types of signals that feeds gather. All North American C-band satellites use a linear polarization scheme. This means half the signals come down in a vertical position and half come in a horizontal position. The signals from the new, little DBS-dish employ circular polarization, which can be either left-handed (DBS-1) or right-handed (DBS-2) or both. International satellites also transmit a circular pattern. That's one of the reasons you can't use one kind of feed or LNB for all kinds of signals.

Within a C-band feedhorn there is a probe or a waveguide. It's actually a little antenna that is moved back and forth horizontally and vertically by a servo motor. It receives the horizontal and vertical signals that satellites send down.

It's extremely important that the feedhorn be placed in the proper focal point of a particular dish. Remember that a dish is actual a parabolic reflector that bounces satellite signals to a central point (focal point) in front of the dish. The focal point is determined by the f/D ratio of the dish. Each dish has a certain f/D ratio and a true parabolic dish will have an exact focal point. When a feed is placed in the proper focal point it will gather the maximum amount of signal possible.

Feeds are made with fixed or adjustable scalars (concentric rings that surround the throat of the feed). The position of the scalars determines how the feed will use the signals it receives. Adjustable scalars can be positioned to match the f/D ratio of most any dish. Feeds with fixed scalars are best used with dishes that have an f/D ratio of .375. Each dishes' assembly instructions should list the f/D ratio.

There's all kinds of feeds for all kinds of applications.

- Sometimes they are used to help reduce the effects of terrestrial interference (TI), such as telephone microwave signals that can mess up a dish's reception. National ADL's RP 1 C/Ku-band feed is one example of a feed that is used to battle TI. California Amplifier also makes a feed that helps fight TI.

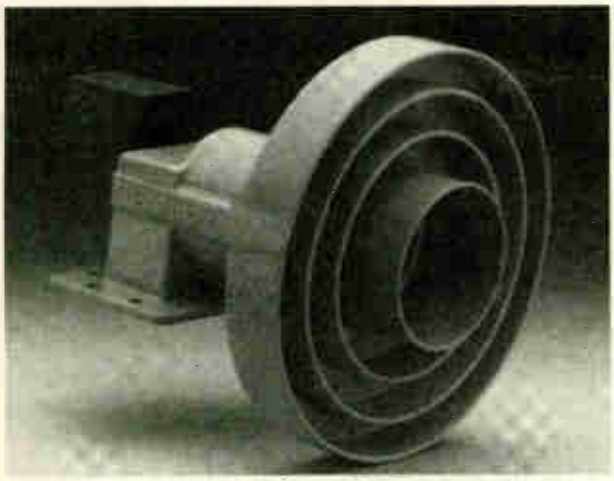
- Ku-band feeds. These feeds are used in receiving Ku-band signals.

- Dual-band feeds. Used in C/Ku-band applications. Astotel's Precision Pak and Chaparral's Co-rotor Pak are two examples of dual-band feeds.

- LNBFs. These feeds have the feedhorn and the LNB integrated into one unit. They have no moving parts or servo motor, but instead use two fixed probes and electronic switching of polarity. Both C-band and C/Ku-band applications are available. Pro Brand is one company that offers a C/Ku-band LNBF. LNBFs are ideally suited for fixed-dish installs as they don't provide any skew adjustment.

So, what is skew and why is it important to the subject of feedhorns? One way to understand skew is right at your finger tips. As you scan across the sky, the satellite belt begins at one horizon, arcs upward at a gradual slope until you hit due south and then slowly arcs down to the other horizon. Crook your index finger and point it at where you think a satellite is on the western horizon. Remember that the probe (your finger in this case) must rotate 90 degrees from horizontal to vertical and back to pick up those signals. The probe of a feedhorn is bent in the same shape as your bent finger. It rotates back and forth the way you have to rotate your finger from horizontal to vertical.

The probe must aim the same way as your finger does in order to accept the horizontal and vertical signals of each satellite. If you were only able to rotate that probe back and forth between one horizontal and one vertical angle as you go across the belt (such as with an LNBF), you would only be able to receive the signals of those satellites that lined up exactly with the probe. As you move to the next satellite the angle of horizontal and vertical changes ever so slightly. As you go across the entire belt you must slightly adjust the probe (or your finger) for the angle of each satellite. Skew is that slight adjustment.



Polarotor I is among the most popular mechanical feedhorns used in TVRO Installations today. (Courtesy of Frank Baylin's Install, Aim and Repair Your Satellite TV System, 2nd edition and Chaparral Communications).

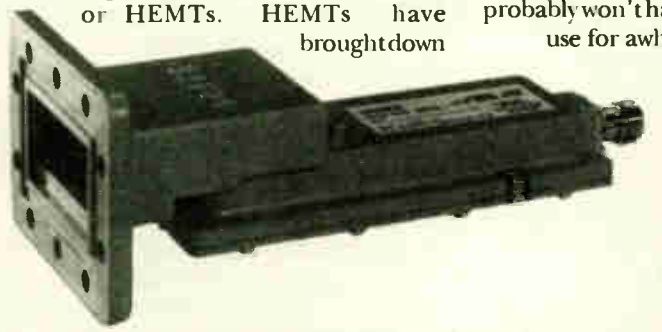
Dual-polarity

Dual-polarity feeds are used in multiple receiver applications and are employed in many commercial settings. Both the horizontal and vertical polarizations are picked up and made available. Without dual-polarity the second receiver would have to watch the same polarity as the main receiver. Dual-polarity allows the second receiver to watch either polarity.

Dual-band, dual-feed

Chaparral's Bullseye II offers the ability to receive C/Ku-band signals and both horizontal and vertical polarization from the same feed.

LNBs and LNBFs match up to the kinds of applications that feeds are used for. All LNBs generate some noise, but they must function without adding noise to the signal. An advancement in this area is the advent of High-Electron-Mobility-Transistors or HEMTs. HEMTs have brought down the noise temperatures of new LNBs and LNBFs a great deal.



This LNB has a typical configuration. It bolts onto the feedhorn output and signals are fed to coaxial cable via a screw-on F-connector. (Courtesy of Frank Baylin's Install, Aim and Repair Your Satellite TV System, 2nd edition and R.L. Drake Company).

LNBs and LNBFs for C-band are rated on a Kelvin scale that is based on absolute zero. These units have come a very long way over the years. Originally, there was the LNA (Low Noise Amplifier). Ten years ago or so a 100 degree LNA was considered a good LNA. Now LNBs in the 20 to 45 degree Kelvin range are a common place. They can be used for video, audio and data applications.

Ku-band LNBs are rated different than C-band LNBs. They use a noise figure instead of a noise temperature. They range from 1.5 dB to .6 dB. They can be used for strictly Ku-band applications or in conjunction with C/Ku-band installations.

LNBFs are the new kid on the block, although they have been around for a couple of years and were discussed earlier in the article.

DBS

The feed and LNB used for Direct Broadcast are in a category all their own. Astrotel offers a C-band/DBS feed, however, considering that you can buy a complete DBS system for $699.00, such an application may not see widespread use. A DBS receiver costs around $650.00 and you have to have one of those to make use of a DBS feed. Maybe in the future it will average out and we will see multiband (C/Ku/DBS) receivers built. But, don't start shopping for one yet. Other combination feeds/LNBs for Ku/DBS applications are emerging.

One of these emerging satellite bands that probably won't have widespread consumer use for awhile is Ka-band.

Who makes feeds, LNBs and LNBFs? Here is a list of manufacturers. In most cases you can't buy direct unless you are a dealer or wholesaler, but they can tell you where you can buy their products. It's not every company in the business, but our list will cover most of the common units sold today. ST

ST's Feedhorn and LNB List of Manufacturers

A.D.L., 2216 Agate Court, Unit B, Simi Valley, CA 93065
Telephone: (805) 526-5249, FAX: (805) 584-0634
Feedhorns

Astrotel, 17906 Crusader Avenue, Cerritos, CA 90701
Telephone: (310) 403-7036, FAX: (310) 403-7040
Feedhorns

California Amplifier, 460 Calle San Pablo, Camarillo, CA 93012
Telephone: (805) 987-9000, FAX: (805) 987-8359
LNAs, LNBs, LNBFs

Channel Master-Division of Avnet, Inc, 1315 Industrial Park Drive, P.O. Box 1416, Smithfield, NC 27577
Telephone: (919) 934-9711, FAX: (919) 989-2200
Manufacturer of satellite reception equipment

Chaparral Communications, 2450 North First Street, San jose, CA 95131
Telephone: (408) 435-1530, FAX: (408) 435-1429
Complete TVRO systems including feedhorns, polarizers and satellite receivers

Gardiner Communications, 3605 Security St., Garland, TX 75042
Telephone: (214) 348-4747, FAX: (214) 341-1933
LNBs

MTI, 130 Rose Orchard Way, San Jose, CA 95134
Telephone: (404) 954-1818, FAX: (404) 954-0908
LNBs and LNBFs

Norsat, 12 Pacific Highway, Blaine, WA 98231
Telephone (604) 597-6200, FAX: 597-6211
LNBs

Panarex, 11672 Tuxford St., Sun Valley, CA 91352
telephone: (818) 768-5161, FAX: (818) 768-5191
Panarex is pecialized in manufacturing complete Ku- and S-band TVRO systems under the brand name Pansat.

Pro Brand International (Aspen), 1900 West Oak Circle, Marietta, GA 30062
Telephone: (404) 423-7072, FAX (404) 423-7075

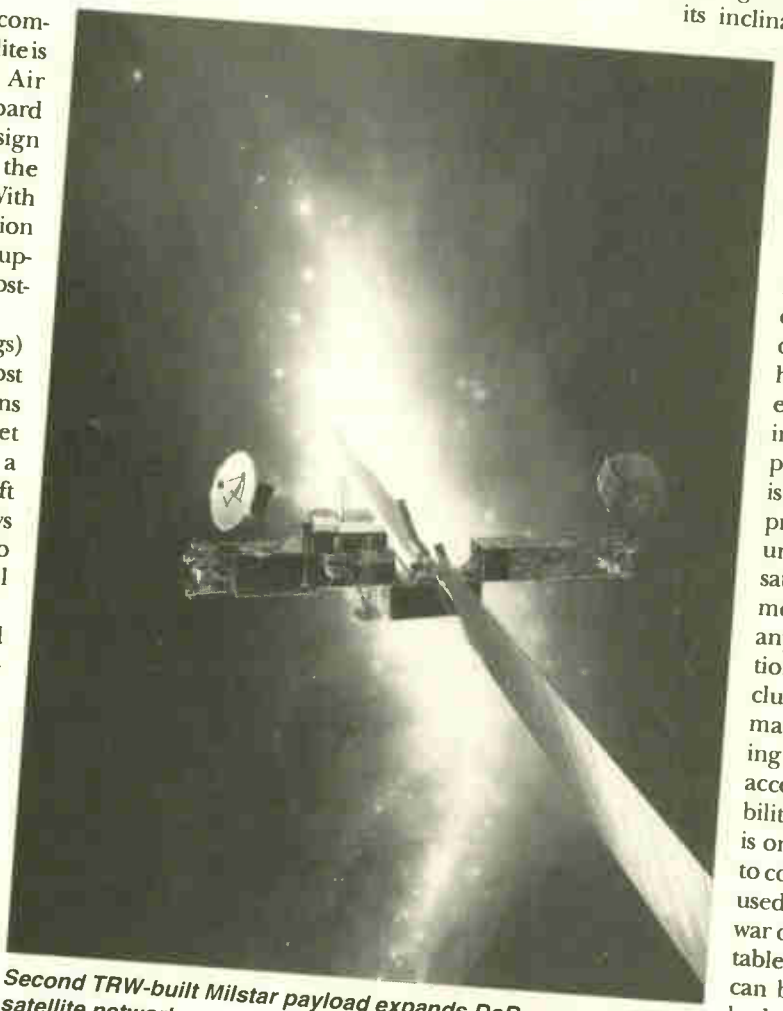
By Philip Chien, Earth News

ST Satellite Profile — Milstar

The world's largest communications satellite is Milstar — the Air Force's $1 Billion switchboard in the sky. Milstar's design started in 1983 — during the height of the Cold War. With the changing world situation Milstar is now evolving to support the military in the post-Cold War era.

At 10,000 lbs. (4,540 kgs) Milstar's the largest and most sophisticated communications satellite. It measures 51 feet (15.5 meters) in length, with a solar array "wingspan" of 116 ft (35.4 meters). The solar arrays generate almost 5,000 watts to power Milstar's many powerful transponders.

The program was started over a decade ago as a follow-on to the Defense Satellite Communications System (DSCS). The Cold War-era program combined three requirements: strategic communications, tactical communications, and advanced technologies. The original plans called for a constellation of satellites in geosynchronous and high inclination orbits to cover the entire Earth continuously. The launches were planned from the shuttle, using high energy Centaur upper stages. In 1991 Congress instructed the Air Force to restructure Milstar for the post-Cold War era, and reduce the program's astronomical costs.



Second TRW-built Milstar payload expands DoD secure satellite network.

Unlike most other launch vehicles the Centaur upper stage, when used with the shuttle or Titan IV launch vehicles, goes all of the way to geostationary orbit with the payload. With other launch vehicles the final stage of the launch vehicle typically puts the spacecraft in to an elliptical geosynchronous transfer orbit, and the spacecraft's onboard propulsion system (either a liquid propellant engine or a solid apogee kick motor) is used to circularize the orbit at geosynchronous altitude and reduce its inclination to zero. With the Centaur two burns are used to accomplish the transfer to geostationary orbit. The launch vehicle leaves the Centaur-payload combination in a low earth orbit. Then the Centaur makes a burn to change the low earth orbit in to an elliptical geosynchronous transfer orbit — with a perigee the altitude of the parking orbit (typically around 185 km (100 nautical miles) and an apogee close to geostationary altitude 35,588 km (about 19,375 nautical miles).

The half-full Centaur and payload then make a six hour coast up to geosynchronous altitude and the Centaur's engines fire again to circularize the orbit, and zero its inclination. It makes launch vehicle manufacturers extremely nervous for six hours, wondering whether or not everything's going to work out perfectly, but has proven to be a reliable method of placing satellites in to geosynchronous orbit.

As a strategic satellite, Milstar would be critical for communications during an all-out nuclear war. It's radiation hardened to prevent damage, either from nuclear explosions in space or natural radiation, primarily solar storms. Milstar is intelligent enough to correct problems and recover from failures which would disable other satellites. It operates autonomously and does not require any tracking and control stations. Autonomous control includes the capability to automatically prioritize traffic, giving high priority users assured access to the spacecraft's capabilities. The command center is only used as a planning hub to configure how the satellite is used. In an emergency, either a war or a natural disaster, a portable control station in a trailer can be used. Since the trailer looks like a normal interstate truck it can easily be hidden from enemies by just putting it on the road.

An all-out nuclear war isn't likely to happen any more, but regional conflicts will continue around the world. As a tactical satellite Milstar can permit a commander to communicate with up to 1,000 field units with extreme high system security. The 2 GHz bandwidth would allow the equivalent of 50,000 faxes to be sent every hour.

Milstar's Low Data Rate (LDR) transponders transmit and receive voice and

SMART-T

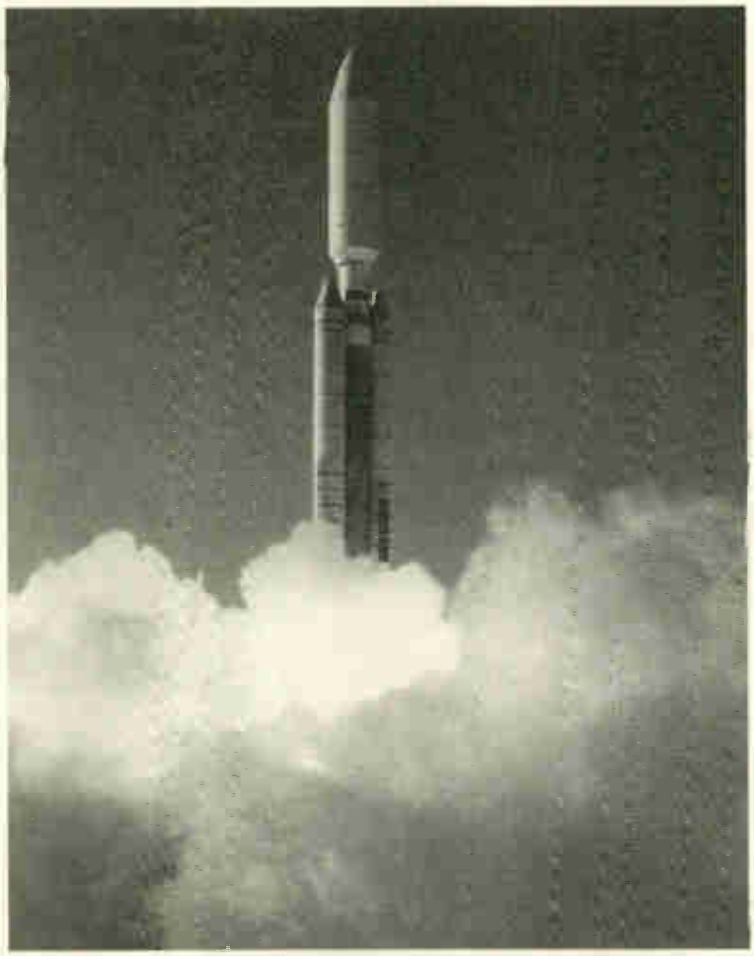
U.S. Army's Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T).

teletype signals on the 44.5 Ghz. EHF uplink (2 Ghz. bandwidth) and 20.7 Ghz. SHF downlink (1 Ghz bandwidth). The low data rate payload is designed to transmit voice, fax, and data information at 75 to 2400 bps. The payload can use its 192 channels to connect up to 212 independent circuits simultaneously to satellite managed networks. Currently about 200 Army, Navy, and Air Force terminals use Milstar on a regular basis.

Many different types of terminals are available, from built-in units onboard aircraft and ships to small portable terminals. SCAMP (Single Channel Anti-Jamb Manportable) weighs under 30 lbs. (13.6 kgs.), can be set up in less than 5 minutes, and operates for up to 24 hours on a single battery. It features a built-in GPS receiver (to determine its location and where to aim the unit for satellite recpetion) and a user-friendly menu screen.

The spacecraft has an extremely large antenna farm, with nine different uplink antennas — five EHF agile beam, one EHF Earth coverage, two narrow spots, and 1 wide spot, and four downlink antennas — 1 SHF agile beam, 1 Earth coverage, 2 narrow spots, and 1 wide spot. In addition Milstar also sports 4 AFSATCOM IIR UHF two-way channels and 1 fleet broadcastchannel.

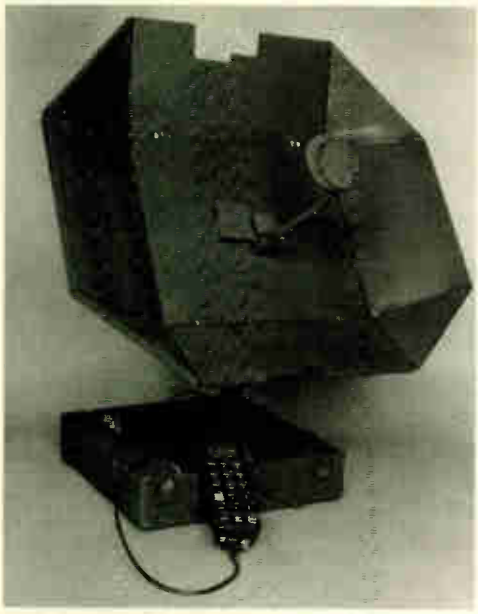
As an electronic switchboard in the sky Milstar can automatically process calls and requests for access from authorized users, without any outside scheduler. Its on-demand access capabilities permits any user to literally 'pick up the phone' to use the satellite. One of the key requirements for Milstar is its secure anti-jam, low-probability of intercept, and low probability of detection capabilities.



The first Titan IV Milstar launch on February 7, 1994.

Brigadier General Leonard Kwiatkowski, the program director for the MILSATCOM Joint Program Office, stated "Our unique digital processing and frequency provides unparalleled security which protects our communications from interception and jamming threats." One of its methods of protecting transmissions is frequency hopping. Thousands of times each second the frequency changes in random hops. Any potential eavesdropper would have to figure out the constantly changing frequencies to listen in on a conversation. Other technical advances include on-board signal processing, on-board signal routing, on-board resource control, crossband links, and satellite crosslinks.

The satellite crosslinks consist of 60 GHz. transponders which permit the spacecraft to 'talk' to each other directly without using a ground terminal. For example, if a user in Saudi Arabia had to



U.S. Army's Single Channel Anti-Jam Manportable Terminal (SCAMP).

contact a user in Los Angeles he would contact the DFS-2 spacecraft over the Atlantic Ocean. That spacecraft would use its crosslink to transmit the signal to the DFS-1 spacecraft over South America which would retransmit the message to the receiver.

Those capabilities aren't cheap though, and in today's economy, future satellites will have scaled back capabilities. The program will shrink from a US$40 billion program to a US$17 billion program. The satellite's weight will drop from 10,000 lbs. to about 5,000 to 7,000 lbs. Only two of the original Development Flight Satellites (DFS) were built.

Due to the end of the Cold War a classified payload will be eliminated from follow-up satellites and replaced with additional 32 medium data rate channels. The classified payload was rumored to be a set of transponders for the Keyhole spy satellites which was completed by the time Milstar DFS-1 was ready so it's in orbit with the first spacecraft. On the second satellite the classified payload was replaced with 800 lbs. of ballast.

Milstar is launched on a Titan IV-Centaur, the largest operational launch vehicle. The Titan IV was supposed to be the space shuttle's backup. After the Challenger accident it became the primary launch vehicle for military satellites, but it has had many delays and setbacks. Milstar DFS-1 was only the eighth Titan IV launch over a four year period — far less than what had been planned. With the end of the Cold War many Titan payloads have been canceled and others have been scaled back.

The Titan IV-Centaur uses the wide-body version of the Centaur upper stage which was originally intended for the shuttle. It can place up to 10,000 lbs. (4,540 kgs.) into geosynchronous orbit, more than any other launch vehicle.

DFS-1 was shipped to the Cape Canaveral Air Station in early 1993 for a June 1993 launch. Its launch was delayed eight months due to problems with Centaur failures on other launch vehicles and an Titan IV failure. It took a while, but Milstar DFS-1 finally made it in to orbit. DFS-1 was launched on February 7, 1994 — on the first Titan IV Centaur launch vehicle. It's located in the middle of the Western Hemisphere at 120 degrees West, south of Los Angeles, California.

Milstar DFS-2 was launched on November 6, 1995. The satellite will be tested for four months at 120 degrees West and its operational location is 4 degrees East, over the Atlantic Ocean near Laos, Nigeria.

The third Block I satellite is being modified in to a Block II satellite, with the Medium Data Rate (MDR) payload. The MDR transponders will permit rates up to 1.544 Megabits per second. DFS-3 isn't scheduled for launch until 1999. Ultimately four Block II spacecraft will be built. The specifications call for a ten year planned lifetime from each spacecraft.

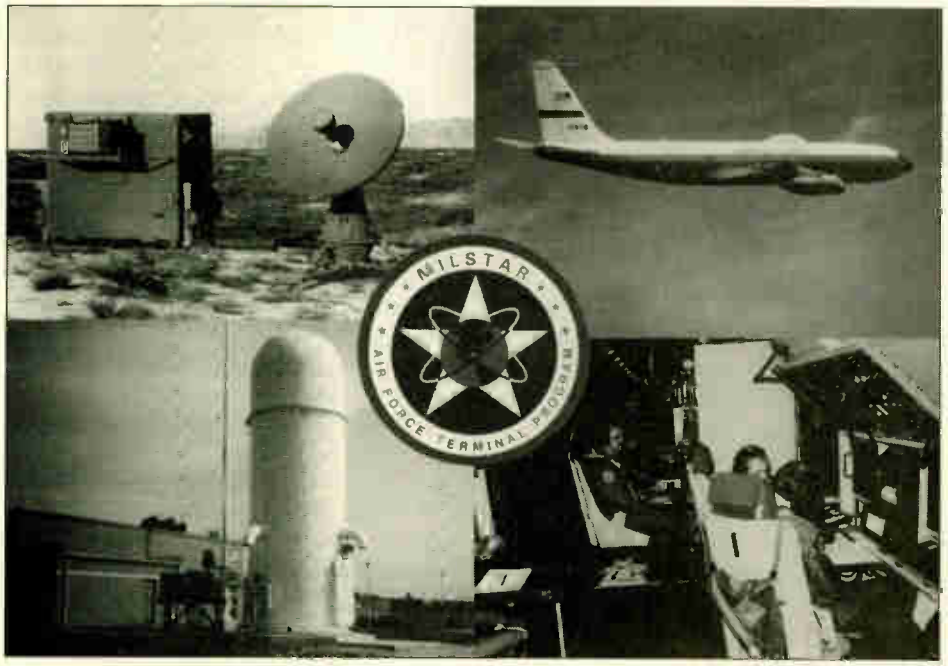
After the Block II spacecraft the future is still being evaluated. Five additional Milstar Block II spacecraft have been scrapped, and will be replaced with a new somewhat smaller EHF satellite incorporating advanced technologies. It will require a smaller, less expensive launch vehicle.

When it becomes fully operational the Milstar constellation will consist of four satellites around the world operating together. Each satellite has the capability to talk to the other satellites via secure crosslinks — without using an intermediate ground station to relay the data.

With the end of the Cold War many people have wondered why there even is a need for Milstar's capabilities. As the Milstar DFS-1 launch was taking place President Clinton was talking with Russian cosmonaut Sergei Krikalev flying aboard the space shuttle. Still, if the world situation does change drastically the President can rely on Milstar for secure military communications. ST

MILSTAR COMMUNICATIONS PAYLOADS

EHF Uplink	44 GHz
UHF Uplink	300 MHz
SHF Downlink	20 GHz
UHF Downlink	250 MHz
V-Band Satellite Crosslink	60 GHz



Various elements of the U.S. Air Force Milstar program.

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SPACE INTEREST GROUPS

ST's Space Interest Groups list those local, national and worldwide groups you can join that promote space, astronomy, and space activities. Groups are selected for inclusion in this column by the staff of *Satellite Times* and run as editorial space permits.

Space Group Profile: AMSAT Organizations Worldwide

Most North American hams are familiar with AMSAT-NA, our national amateur radio satellite organization. Other countries have national AMSAT organizations as well. In this issue of *ST's Space Interest Groups* we present a list of all the other known national AMSAT groups. Information included in this column is courtesy of Paul Williamson (KB5MU) webmaster at the AMSAT home page: *http://www.amsat.org/amsat/AmsatHome.html* and the AMSAT-UK home page at: *http://www.mcc.ac.uk/AMSAT/*. If we have missed a national AMSAT group in your country, we would like to hear from you. You can reach us at: Space Interest Groups, c/o Satellite Times magazine, P.O. Box 98, Brasstown, NC 28902-0098 USA or you can reach us via e-mail at: *steditor@grove.net*.

Radio Amateur Satellite Organisation of the United Kingdom (AMSAT-UK) — Affiliated with the Radio Society of Great Britain (RSGB) All communications for AMSAT-UK including orders for supplies etc., should be addressed to: The Secretary, 94 Herongate Road, Wanstead Park, London, E12 5EQ. VAT No: 432 4330 88, Office Hours: 9.30 - 18.30 daily (Local time UTC/BST) Telephone: (+44) 181 989 6741, Fax: (+44) 181 989 3430 (24 hours) COMPUSERVE ID: 100024, 614 Ron Broadbent.

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Birmingham. G4ULS, 7.00pm (UTC) Thursday 144.280MHz.

AMSAT-Australia
G.P.O. Box 2141, Adelaide 5001, Phone: (08) 297 5104

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Secretary Henry Bervenmark, SM5BVF.

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President: Bolon Lin, BV5AF
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Voice telephone: +886-4-7388746, Fax: +886-4-7385441.

University Space Programs

University of Surrey
The University of Surrey's Spacecraft Engineering Research Group has been responsible for many amateur radio satellite projects, including UO-9, UO-11, UO-14, UO-15, UO-22, KO-23, KO-25, and POSAT. You can reach them on the web at: *http://www.ee.surrey.ac.uk/EE/CSER/UOSAT/*

University of Arizona
The Students for the Exploration and Development of Space (SEDS) at the Lunar and Planetary Laboratory of the University of Arizona is working on the SEDSAT1 satellite project, among others. You can reach them on the web at: *seds.lpl.arizona.edu*

SAREX - Shuttle Amateur Radio Experiment
The Shuttle Amateur Radio Experiment (SAREX) is a long-running program to use amateur radio equipment on board the Space Shuttle to involve students in exchanging questions and answers with astronauts on orbit. More than 200 schools have participated to date. It is also used to conduct communications experiments with amateur radio operators on the ground. More information on this program can be found at the following world wide web sites: *http://www.acs.ncsu.edu/HamRadio/Sarex/index.html* or at: *http://www.nasa.gov/sarex/sarex_mainpage.html*

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1996 SATELLITE BROADCASTERS GUIDE. *By Bart Kuperus.* Learn how to set up your own home satellite system and receive hundreds of TV and radio stations that you probably didn't know existed! This book also reveals how dishes work and provides a guide to satellite broadcasters, maps of satellite locations, and a directory of reputable dealers. BOK 79-96 $24.95

WEATHER SATELLITE HANDBOOK, Fifth Edition. *By Ralph E. Taggart.* Concentrating on the 137 and 1691 MHz birds, Taggart's handbook includes construction details on antennas and rotators, tracking devices and programs, computer control, receivers, monitors and printers, converters and demodulators--both simple and sophisticated. BOK 56 $19.95

HIDDEN SIGNALS ON SATELLITE TV, Third Edition. *By Thomas P. Harrington.* The ultimate reference for information on how to hear and watch those mystery signals on TV satellites. Everything from teletype press news to stock market reports, business teleconferencing to long distance telephones, international broadcasting relays to music services. BOK 42 $19.95

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MINIATURE SATELLITE DISHES, THE NEW DIGITAL TELEVISION. *By Dr. Frank Baylin.* Covers all aspects of the DBS industry. Nine chapters delve into the DBS technology, corporations offering the service, programming, installation, and more. Essential reading for anyone considering purchasing a DBS system. BOK 96 $19.95

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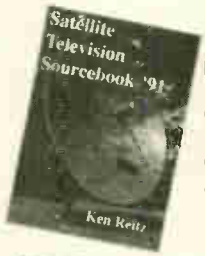

1991 SATELLITE TELEVISION SOURCEBOOK. *By Ken Reitz.* This ultimate reference to TV satellites provides more information than anything else on the market. Lists of dealers, manufacturers and publishers, including addresses and phone numbers, for magazines, books and equipment. Detailed chapters on how satellite TV works. C band, Ku band, weather, amateur and even international satellites are covered. *A free update sheet is included.* Target Audience: general. BOK 19 $5.95

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SATELLITE TIMES ADVERTISERS' INDEX

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 DECAY 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.

RETROGRADE 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
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The Growth Industries — Money Talks

No question about it, the two fastest-growing elements of consumer technology are satellites and computers, with common carriers and Internet the driving influences. The fast-paced Personal Communications Service (PCS) is also a beneficiary of this momentum, with instant consumer convenience and professional telecommuting rapidly becoming reality and, in some areas, commonplace.

With the World Administrative Radio Conference (WARC '95) now concluded, the current winners and losers of radio spectrum have been announced. A big winner is large-constellation, broadband satellite architecture — at the expense of future growth in low-earth orbiting (LEO) systems.

Early-entry LEO competitors like Orbcomm have little to fear from the decisions made at the WARC since they already have spectrum authorization, but other entrepreneurial "little LEO" efforts are stymied, at least for now. While they requested only a minimal 7-10 megahertz of additional spectrum, they received only 2, and it was for North and South American uplinks — no downlink spectrum as is desperately needed for simultaneous two-way telecommunications.

In marked contrast to the small systems, Teledesic came out well in their ambitious proposal to place 840 LEOs in orbit at a projected cost of $9 billion to assist global access to voice, video and data services. This technology was granted 400 megahertz of Ka-band spectrum for its broadband use of non-geostationary satellites, with yet another 100 megahertz held in reserve for WARC '97.

Big backer bucks bagged this bonanza: Microsoft's Bill Gates and cellular's Craig McCaw wanted Teledesic to have the capability for worldwide videoconferencing, interactive multimedia and digital data, and they got it. Company representatives lobbied heavily in developing countries before WARC convened, demonstrating the advantages of their system to national interests such as health care, human services and education.

This does not draw down the final curtain on little LEOs by any means; however these companies will have to continue their development without knowing with any certainty what future frequencies will be made available, and may have to contend with the prospect of sharing previously-allocated terrestrial frequencies on an interference-tolerant basis. ST

Editor's Note: If you would like to respond to this editorial you can send us e-mail at: steditor@grove.net or write us at Uplink, P.O. Box 98, Brasstown, NC 28902.

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◄ Section of multi-spectral false-colorized NOAA APT image of Hurricane Andrew. This image was created directly from a raw image file using the new MFCOLOR software from Weather Dynamics. The bright area south of Andrew is sun glint.

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The IC-820H isn't your typical base station transceiver. This all mode dual bander has compact and lightweight dimensions offering operating versatility other base stations just can't match. Mobile and field operations are ideal with this rig. But don't let its size fool you. This is a high performance transceiver with state-of-the-art construction, circuit design and cutting edge features.

ICOM's **Newly Designed I-loop DDS** (digital direct synthesizer) is employed in the PLL circuit of the IC-820H. Previous PLL circuits for 10 Hz resolution transceivers contained 2-loop circuits. The new I-loop has a single loop and **Generates a Signal with Superior 1 Hz Resolution**. ICOM's DDS PLL also contains a normal PLL as the main-loop and a DDS as the sub loop.

Satellite operation with the IC-820H's **Built-In Satellite Functions** has never been this easy. These include **Normal and Reverse Tracking** for different modes of satellite communications; **Independent Uplink/Downlink Control** for Doppler shift compensation; **Separate Satellite VFO** and **10 Dedicated Satellite Memories** provide quick switching from normal to satellite operation as well as easy recall of satellite and downlink frequencies.

With **Independent Controls and Indications for Both Bands**, this dual bander is as easy to operate as most single band transceivers – and exchanging the main and sub bands is just a switch away. **Separate S-Meters** simultaneously indicate each band's respective signal strengths.

The **Sub Tuning Function** can be assigned to the **RIT** or **SHIFT** control and allows you to tune automatically at variable tuning speeds. This is especially useful when searching for signals over a wide frequency range – eliminating the need for excessive rotations of the main dial.

The IC-820H's **Compact Size** enables easy installation in a shack as well as a vehicle. Overall dimensions may be small, but important points such as LCD size and space between switches are more than adequate.

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The IC-820H's **DATA Terminal** (in ACC socket) is connected to its modulator circuit directly. This **Data Jack supports Packet Operation** at up to **9600 bps**. A newly designed **Modulation Limiter Circuit** prevents you from exceeding the maximum deviation – even with large amounts of data.

For more information about the IC-820H, visit your local ICOM dealer, contact ICOM Technical Support in the HamNet forum on CompuServe® @ 75540,525 (Internet: 75540.525 @ compuserve.com) or

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