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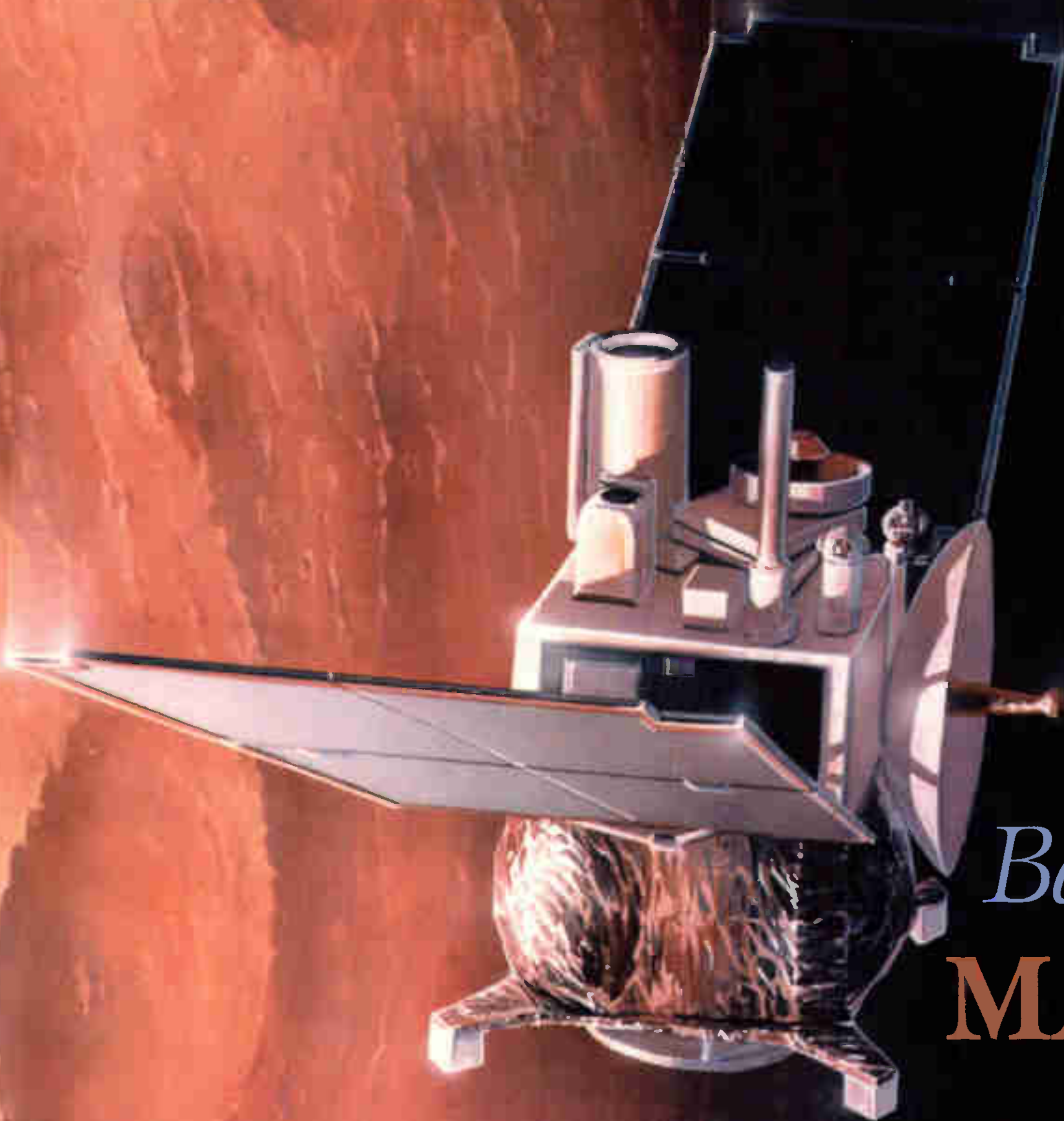


Back to MARS!

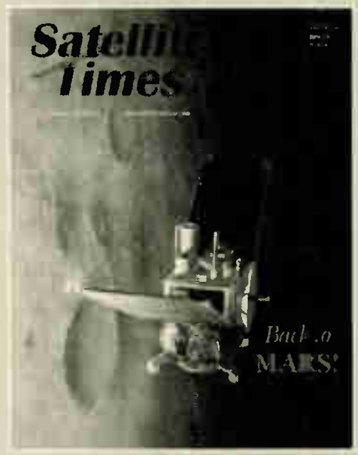
Satellite Times

Cover Story

Cover Photo: *An artist's rendition of the Mars Global Surveyor in orbit around the red planet of Mars. The spacecraft is expected to arrive in orbit in September 1997.*

The Journey Back to Mars

By Philip Chien, Earth News



With the possible discovery of ancient life on Mars, interest in the red planet has never been higher. On the heels of that major scientific discovery, NASA is launching two separate spacecraft towards Mars in the next two months. *ST* staffer Philip Chien takes an in-depth look at our new mission to Mars, starting on page 10. Complete details on the Mars relay flight test experiment—in which you can participate—are outlined on pages 15-16.

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November/December 1996

Universal Scores a Hit: The SCPC-200 Receiver

One of the most popular add-ons for the personal TVRO system is a single channel per carrier (SCPC) receiver. *ST* columnist, Ken Reitz conducts an *ST Tests* on the latest entry in the SCPC market place—Universal SCPC-200 receiver—on page 91.

DEPARTMENTS

ST

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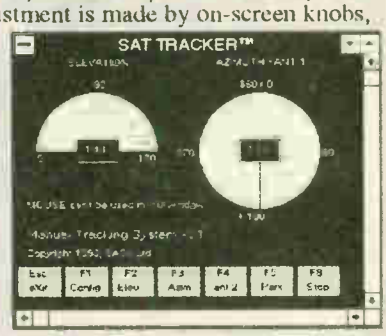

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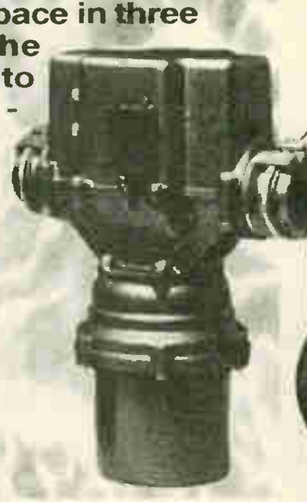

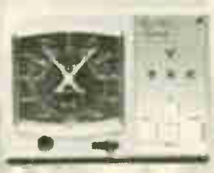

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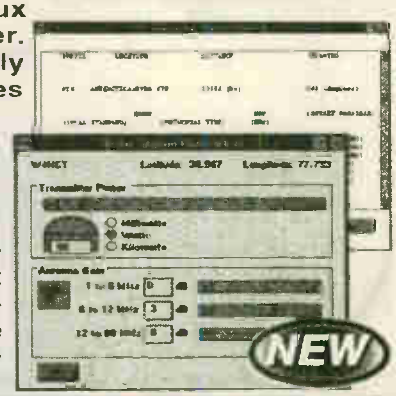

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DOWNLINK

By Larry Van Horn
Managing Editor

Trouble with the Satellite Home Viewers Act

I recently received a disturbing piece of correspondence from my satellite program provider PrimeTime 24-(PT24) indicating that I might be in jeopardy of losing my regular network programming (ABC, NBC, CBS, and FOX) via satellite. Now that might not seem bad to some of you, but it isn't making the Van Horn family a bunch of happy campers, and I'll tell you why.

Brasstown is nestled in the Appalachian Mountain chain in rural, southwestern North Carolina. We are a considerable distance from any major metropolitan center making reception via a local affiliate nearly impossible. We have to pay a satellite program provider for the privilege of watching network TV, commercials and all.

A law that was enacted by Congress called the Satellite Home Viewer Act of 1994 allows home owners to receive network broadcasts via satellite if you meet all of the following requirements: (1) the subscriber's TV set is used exclusively for private home viewing; (2) the subscriber has not received the same network programming by means of cable television within the 90-day period before the satellite network service began; and (3) the subscriber is unable to receive with a properly installed, properly working, and properly oriented, conventional outdoor rooftop antenna an adequate signal from a local affiliate of the same network. In order to meet the third requirement, the signal strength of the broadcast signal you receive from a conventional rooftop antenna must be less than Grade B intensity.

Needless to say, when I received a letter from PrimeTime 24 telling me that we could possibly lose our network service because of an Act of Congress, I immediately sent e-mail to my elected officials in Washington to let them know my point of view.

Today, I received a reply to one of my e-mail letters from 11th District Congressman, Rep. Charles H. Taylor. Here is a portion of that letter:

"Grade B is a technically defined intensity. In order to determine the broadcaster's signal strength at your home, just call the station, ask for the engineer, tell him/her where you live and ask if your house falls within the Grade B contour. There are instances where homes fall into the Grade B contour, but still do not receive the signal. In this situation, a survey, which requires contracting with an engineer, can determine the signal strength. If the signal strength is less than a Grade B intensity, you would be entitled to receive satellite network broadcasts. If the signal strength is Grade B intensity or stronger, then you would not be entitled to receive these broadcasts. If you are interested in pursuing this route, contact your satellite carrier, who should be able to provide a list of engineers able to conduct a survey."

Now that is an interesting concept: Not only do I have to pay to receive acceptable network programming via satellite, but if in the Grade B contour of a local affiliate and even if my signal is unacceptable, I have to pay for an engineer to prove that to a local affiliate. Something is wrong with this logic and the law has to be changed.

The law should be based on picture quality of the user, not on some technical standard of what a local affiliate says it should be. Many of you are no doubt aware of summer E-skip on channels two through six. Ever try to get a local even inside the Grade B contour during strong E-skip openings? The same applies to tropospheric bending skip. These phenomenon can render local television useless, especially within the Grade B contour.

If you are currently receiving PT 24 or Netlink's Denver 5, then this scenario can affect you and your family. Call or write your elected officials right away. Do it today before your network signal goes black. The Satellite Home Viewers Act of 1994 needs to be changed, and only the consumer will get it done during the 105th Congress that convenes in January.

By Wayne Mishler, KG5BI
E-mail: mishler@aol.com

Severe solar storm predicted

A massive solar storm that could send the Aurora Borealis as far south as Florida and wreak havoc with satellite communications and electrical power distribution on Earth is expected to strike within the decade. No one knows exactly when the storm will hit or how strong it will be, but scientists are expecting a billion-ton wave of super-hot ionic gas from the Sun to hit the Earth's outer atmosphere sometime around the turn of the century. "We're in a trough of activity now and we know we're coming up on a more active solar phase," says Ernest Hildner of the National Oceanic and Atmospheric Administration (NOAA). The coming phase is expected to be more active than normal. When it comes, a U.S. satellite will be in orbit to measure the solar wind gusts and give meteorologists advance notice so they can issue warnings.

The early-warning NASA spacecraft, which scientists call the *WIND* satellite, is scheduled to be launched November 1 from Cape Canaveral.

"Because the satellite will intercept solar wind streaming toward Earth, NOAA space weather forecasters will have about one hour advance notice to prepare warnings of geomagnetic storms (which cause) sharp fluctuations in the Earth's magnetic field that can have disastrous results," says Ronald Zwickl, chief of NOAA Research and Development.

These fluctuations can interfere with geosynchronous satellites, disrupt radio communications, and induce powerful electrical currents in power lines, pipelines, and train tracks. A severe solar storm in March 1989 caused millions of dollars in damage to power transmission equipment from eastern Canada to southern California, leaving six million people without electrical power for nine hours in Quebec.

The *WIND* satellite is just one of a series of missions planned under NASA's International Solar Terrestrial Physics Program. And the U.S. is not alone in its study of solar activity. The international space community is working together to unlock the secrets of the star that gives us life. A thousand images a day stream earthward from the sun-gazing *SOHO* spacecraft orbiting 1,500,000 kilometers out in space. Since its launch on December 2, 1995, the *Solar and Heliospheric Observatory* has improved the ability of scientists to probe the Sun's interior by detecting sound waves at its surface.

Using this technology, the international science community has found clues to the forces that accelerate the solar wind that blows continuously in the solar system. By relating huge outbursts from the Sun, called coronal mass ejections, to previous magnetic changes in the Sun, scientists hope to predict such events which endanger electrical power equipment on Earth and satellites in orbit.

"What is breathtaking is *SOHO*'s ability to explore the Sun all the way from its nuclear core to the Earth's vicinity and beyond. We can expect a completely new picture of how agitation inside the Sun, transmitted through the solar atmosphere, directly affects us on the Earth," says Roger Bonnet of the European Space Agency.

SOHO is a project of international cooperation between ESA and NASA. The spacecraft was built in Europe and instrumented by scientists on both sides of the Atlantic. NASA launched *SOHO* and provides the ground stations along with an operations center at the Goddard Space Flight Center.

Ultraviolet spectrometers aboard *SOHO*, called SUMER and CDS, were designed to analyze events in the solar atmosphere and measure temperatures, densities, and speeds of motion in the gas.

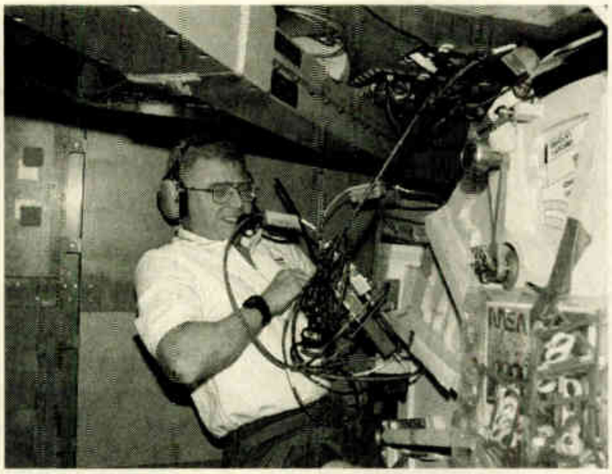
"By taking the Sun's atmosphere to pieces we begin to understand how it influences our lives," says Richard Harrison of the UK's Rutherford Appleton Laboratory. "Surprises here on Earth don't come from the steady light and heat, which we take for granted, but from atmospheric storms that send shock waves through the solar system. By making temperature and density maps of the Sun's atmosphere (using instruments aboard *SOHO*) we expect to find out how these storms develop."

There is a puzzle about how atoms of different weights are accelerated to the same speed in solar wind. If the speed of atomic particles was due only to the Sun's heat, heavy atoms would travel more slowly than lighter ones, such as hydrogen. This is not the case. Instead, a natural electromagnetic accelerator, akin to man-made particle accelerators, operates in the Sun's atmosphere and treats all elements alike. One of *SOHO*'s main tasks is to explain the solar wind, and further investigations by UVCS may settle arguments about how the natural accelerator works.

Instruments aboard *SOHO* divide the Sun's surface into a million points and measure vertical motions once a minute, by comparing changes in wavelength of light. Movement below the visible surface of the Sun is calculated by a supercomputer. *SOHO* actually charts magnetic fields at the Sun's surface. The pattern of these charts will change dramatically in coming years, when the Sun is due to swap its north and south magnetic poles and sunspots become more numerous.

Daily observations tell of remarkable activity in many parts of the Sun's atmosphere, even at a time when the surface observed by visible light looks calm. In one case a huge and complex magnetic disturbance in the Sun's equatorial atmosphere loomed almost half as wide as the Sun itself. The extent and violence of such events can only increase as the Sun becomes more active.

SOHO is due to operate for at least another six years, into the next maximum of sunspot activity, revealing more precisely than ever before the changes in solar weather with magnetic seasons that affect life on Earth.



Among the Inflight Maintenance (IFM) chores that were handled by the crew members during their almost 17 days in space aboard the space shuttle Columbia was one that involved going into the bay beneath the floor of the Life and Microgravity Spacelab (LMS-1) Science Module. Astronaut Terence T. (Tom) Henricks, mission commander, shines a tiny flashlight onto some cables related to LMS-1 supported computer systems. As in the case of the other IFM chores, Henricks efforts were successful. He was joined by four other NASA astronauts and two international payload specialists for the space shuttle duration record-setting mission. (NASA)

Spacelab reveals effects of weightlessness

The European-built Life and Microgravity Spacelab, riding in the belly of space shuttle *Columbia* this summer, allowed scientists to study the effects that near-weightlessness or microgravity of space has on astronauts' health, and on physical processes such as crystallization, solidification, evaporation, and condensation.

Extended periods in a weightless environment can cause physical deterioration in humans, even if they are sheltered in a space ship or in protective clothing. This is one of the major hurdles that scientists must overcome before sending astronauts on a flight to Mars or lengthy stays aboard the international space station.

In-orbit assembly of the space station is only about 400 days away. The first element, the Russian-built Functional Payload Block is to be launched into low Earth orbit in November 1997. The station is to remain in orbit for over a decade, providing scientists with a long-term opportunity for scientific research in space, similar to the studies conducted in the Spacelab.

Gravity is one of the physical forces being studied. The effects of gravity influence nearly all physical, chemical and biological processes. Gravity interferes with the study of other forces. This is particularly true of processes in unstable and sensitive areas between different states of matter, such as liquid, solid, or vapor. The study of these processes in action in a weightless environment brings new insights to the behavior of physical forces on Earth.

Research facilities in the Spacelab included a special furnace, a crystallization facility, a bubble analysis facility, and a muscle tester.

The Advanced Gradient Heating Facility, a furnace which generates 1115 degrees Celcius, was used for metallurgical experiments and to grow semiconductor crystals.

The Advanced Protein Crystallization Facility provided astronauts with three different ways to grow protein crystals, and the means to measure their concentrations.

The Bubble, Drop and Particle Unit was used to study how bubbles, drops and particles react and interact during melting and solidification. It was also used to investigate convection, evaporation, and condensation phenomena.

The Torque Velocity Dynamometer, which resembles exercise equipment, was used to study the effects of spaceflight on astronauts' muscles.

In addition, a set of very sensitive sensors called the Microgravity Measurement Assembly were placed at various locations in the Spacelab to measure the levels of

Aboard the middeck of the Earth-orbiting space shuttle Columbia, astronaut Charles J. Brady, mission specialist and a licensed amateur radio operator or ham, talks to students on Earth. Some of the crew members devoted some of their off-duty time to continue a long-standing shuttle tradition of communicating with students and other hams between their shifts of assigned duty. Brady joined four other NASA astronauts and two international payload specialists for almost 17-days of research in support of the Life and Microgravity Spacelab (LMS-1) mission. (NASA)

microgravity. They measured the effects of disturbances caused by atmospheric drag and by movement of the astronauts. The measurements were relayed in real time to scientists working on the ground.

Using "telescience" technology, such as will be used aboard the International Space Station, scientists were able to monitor and control on-board experiments from ground laboratories.

Interactive TV will dwarf Internet

The information superhighway will be a wagon trail compared to the coming revolution of interactive television, according to the University of Edinburgh in Scotland.

The real information technology of the future won't come from home computers and the Internet, say university industrial specialists. Rather, it will come through interactive television, using the family TV set in homes around the world. This coming revolution, they say, will change much more than our choice of programming. It will alter the way we socialize, learn, shop, play games, and spend our leisure time.

The possibilities are mind boggling. While relatively few homes have personal computers, nearly every home in the western world has a television set. So this will be a revolution that everyone can join in.

This concept was the focus of an international conference at Edinburgh University this past September which for the first time brought together more than 80 of the world's interactive television experts from Britain, Europe, Asia, and America.

Well-known computer experts such as Dr. Bob Glass, the man who invented the space walk system for astronauts, Chris Crawford, controversial video games guru, and Greg Roach, leading interactive film maker, mingled and mixed with behind-the-scenes figures from advertising, media, industry and academia. But they weren't making small talk. Their objective was to assess where interactive television technology stands at the moment, map out a vision for the future, and ask the key questions that concern everyone interested in electromedia. Those questions:

- What is the commercial potential of interactive television?
- Who are the main players? When will it come into common usage?
- What lessons can we learn from other media, such as the Internet?

The conference in the heart of the city's Old Town was intended to attract businesses considering investing in new media, organizations looking for new media for advertising and marketing, technologists working in electronic media, media researchers, social scientists, and others who need or want to understand the cultural and social impact of this new coming phenomenon.

Topics discussed included electronic shopping, gambling, community meetings, and voting.

"There is an urgent need for the public to have a say in the way in which these new technologies are developed and deployed. It cannot be simply left up to the governments who regulate and the companies who produce them. Producers, clients, and customers alike need to come together to discuss where the digital revolution is heading," says Dr. Alfonso Molina of the university.

Satellite brings school to students

In a new breakthrough in education technology, California State University (CSU) this year will bring education to students via a new satellite distance learning network, CSUSAT.

"Distance learning is one way we can meet the challenge of the coming enrollment boom," says Molly Corbett Broad of CSU. "We don't have enough physical facilities here or throughout the system to cope with the anticipated increases, but with distance learning we can still expand access to the University. It is all part of our strategic plan to bring CSU to the students, while enhancing academic quality and improving productivity."

CSU and Hughes Communications Inc. (HCI) joined forces last spring to expand distance learning programs. They signed a five-year contract for satellite capacity aboard HCI's Ku-band *SBS 5* satellite, which orbits about 22,300 miles above the Earth. The satellite allows CSU's

22 campuses to offer distance learning programs through the CSUSAT transponder.

The CSUSAT network uses digital compression. It offers two channels of video programming, increasing the availability of classes and reaching students who might never be able to visit a campus.

Seven campuses are using the network this fall to offer a full range of classes, including foreign language, political science, business, and others to more than 30 receive sites throughout California. CSU Chico, which pioneered the use of satellite technology in the CSU system, offers 25 upper division courses via satellite, and has served more than 12,000 remote students since 1980. CSU says its Dominguez Hills campus is the only one west of the Mississippi to offer a master's degree in behavioral science and negotiation. Other campuses offering courses by satellite this fall through the HCI agreement are Long Beach, Los Angeles, Fresno, Sacramento, and San Jose.

Sea Launch moves forward with ground breaking for home port

The idea of launching spacecraft from platforms at sea rather than dry ground moved forward this fall with an August 8 ground breaking by the Sea Launch Company for a 15.66-acre home port facility at Long Beach.

Officials representing Long Beach, the Port of Long Beach, Sea Launch Company, and Hughes Electronics Corporation joined in celebrating the ground breaking for the new facility on a site previously occupied by the U. S. Navy.

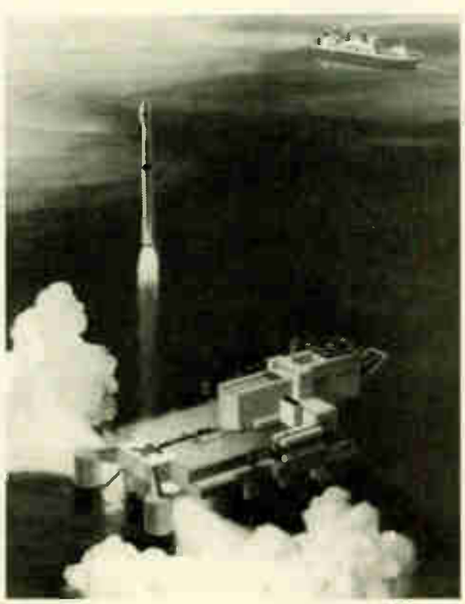
The site is located on a man-made peninsula known as the Navy Mole. It includes about 202,000 square feet of warehouse, office, and storage space comprising 14 structures built by the Navy between 1945 and 1989. Sea Launch will upgrade those facilities and construct two new buildings for processing spacecraft, and will make improvements to an 1,100-foot long by 60-foot wide pier for docking its launch vessels.

This home-port facility, which will be about a year in construction, will serve as headquarters for Sea Launch, a unique commercial space company that will use two Long Beach-based vessels to launch satellites from remote sites on the Pacific Ocean. A 430-foot semi-submersible launch platform and a 620-foot assembly and command ship are now under construction. The platform is being built in Norway; the command ship in Scotland.

Sea Launch sees several benefits to launching from sea. Land-based launch sites require huge amounts of real estate. Ariane's "space city" in French Guiana cost more than $4.5 billion, according to the *London Sunday Telegraph*. But an ocean-going launch platform can simply move to an empty stretch of sea. And the shortest and most efficient route to geostationary orbit is more easily reached by launching from the equator, which is mostly covered by water.

A spokesman for Sea Launch says launching from sea will transform the economics of putting satellites into orbit.

Construction and checkout of Sea Launch facilities in Long Beach is expected to be complete by October of 1997, with arrival of the two vessels expected in early the next year. The first launch will be conducted for Hughes in June 1998.



And finally...

Be careful what you do in the privacy of your back yard. Those satellites zooming around up there have eyes, or rather cameras. The pictures they take are highly detailed. And they are for sale to the highest bidder.

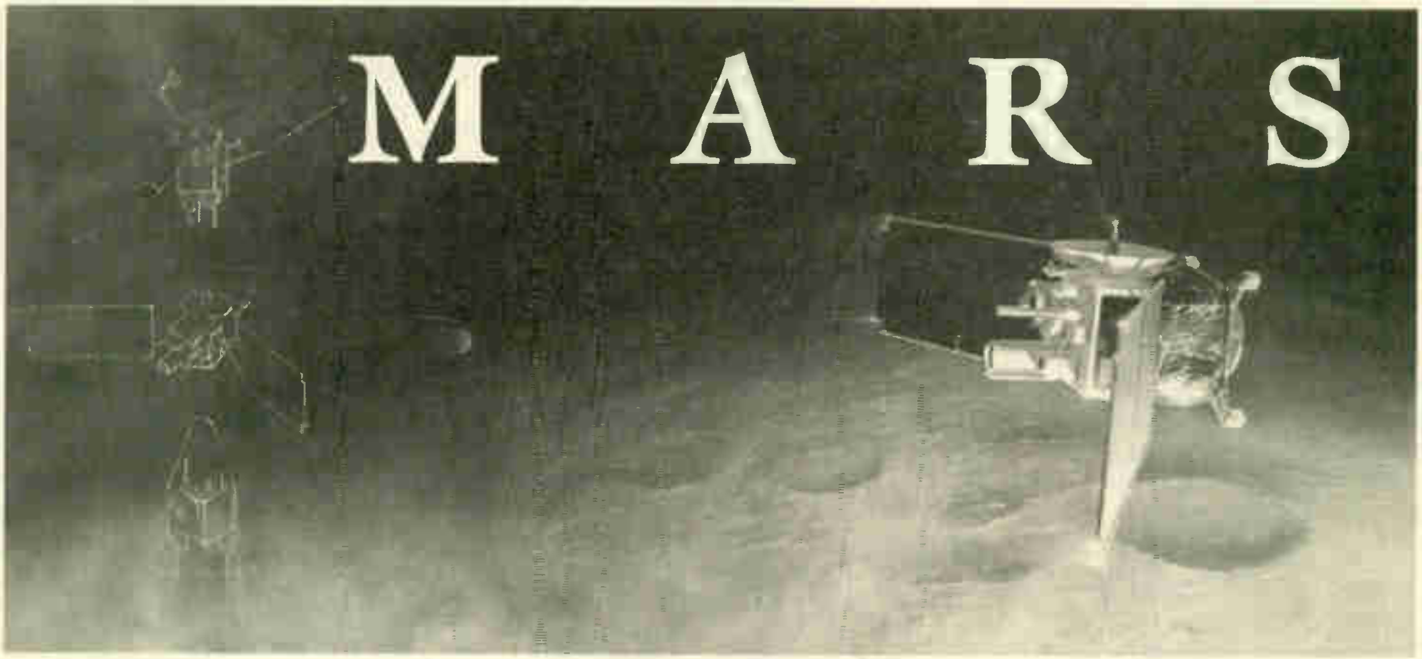
It's getting to be a real problem for nations worried about their national security, according to a recent report in *Washington Times*. Israel reportedly views them as a threat. China is worried about what they might reveal about operations in Tibet. Turkey is afraid the world might be getting an eye-full of its border skirmishes with the Kurds.

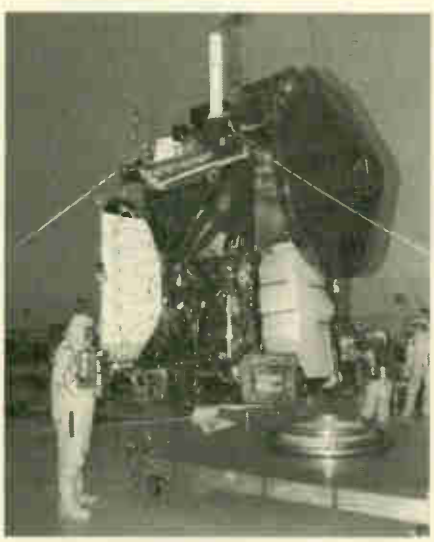
The reason for all the concern is the power of cameras and sensors aboard satellites these days. These instruments are reportedly capable of taking photographs with 100 times more detail than recent predecessors. They can show objects three feet in diameter from 22,000 miles away.

You sunbathers beware.

Sources: *Cleveland Plain Dealer* (courtesy of Harvey Graves), European Space Agency, National Oceanic and Atmospheric Administration, University of Edinburg Scotland, Hughes Communications, CSU California State University, Sea Launch, *Washington Times* (courtesy of Art Audley)

The Journey Back to





The Mars Global Surveyor spacecraft in KSC's Payload Hazardous Servicing Facility-2 being serviced by JPL personnel. (NASA)

By Philip Chien, Earth News

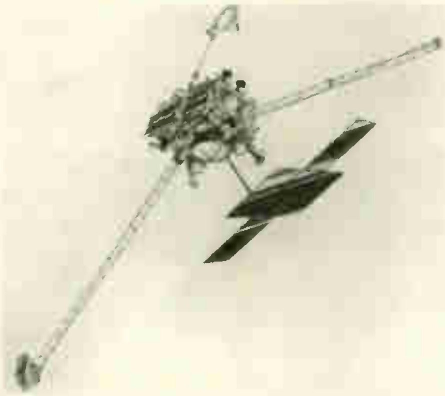
Our interest has been recently stirred by possible evidence of life on Mars, found petrified within meteors which originated from that planet (*Satellite Times* September/October 1996, page 88). Now on the heels of that discovery, NASA is launching two separate spacecraft towards Mars. The timing is lucky, considering the public interest, but the true determinant of the launch dates for the *Mars Global Surveyor* (*MGS*) and *Mars Pathfinder* missions is orbital dynamics: every 26 months Mars and the Earth are in the correct locations for a minimum energy flight from the Earth to Mars.

What's especially challenging about the launches is the incredibly short launch window mandated by the launch vehicle—just one second long. The Delta launch vehicle was originally developed from the Thor intermediate range ballistic missile (IRBM) as a temporary launch vehicle for medium size communications satellites and scientific probes, not for planetary missions.

Planetary launches involve moving targets, for while it's desirable to have a launch vehicle capable of aiming different directions within a couple of hours. Since the Delta was never intended for such use, it can only launch one specific preprogrammed direction, limiting the launch window to a single point in time.

To increase the system's flexibility the Delta engineers have developed a way of loading a second set of firing instructions into the second stage guidance, to permit a second instantaneous launch window, about a half hour after the first. It's believed that if a problem prevents everything from being ready for first window, the team can reconfigure the launch vehicle for the second window. If necessary, the launch window can be stretched to a minute or so, at the expense of using spacecraft propellant to compensate for the slightly incorrect launch direction.

Another factor is the relative motion of Earth and Mars around the Sun. Eventually the Earth moves too far away for any practical launch vehicle to send a spacecraft to Mars. The launch period of November 6 to 25, 1996, for the *Mars Global Surveyor*, and December 2 to 31, 1996, for *Mars Pathfinder*.



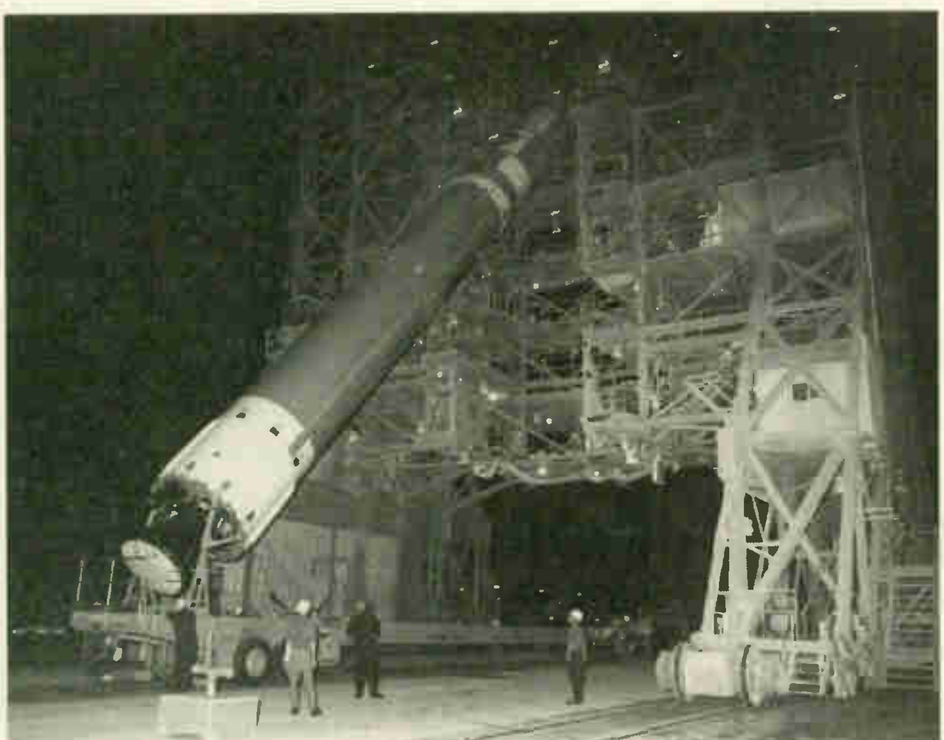
The failed Mars Observer spacecraft. (NASA)

Better Late Than Never

The Martian twins will pick up the exploration of Mars where *Viking* left off and *Mars Observer* failed. *Mars Observer* was originally supposed to be the first of a series of low-cost planetary spacecraft. Due to changing priorities and politics, the Observer program ended up being a single, incredibly expensive spacecraft—the $900 million *Mars Observer*. *Mars Observer* was originally scheduled for launch in 1990. The mission was delayed for two years to spread out the program costs and the launch vehicle was changed from the space shuttle to a commercial Titan III rocket.

Mars Observer was launched in September 1992, with a planned arrival at Mars a year later. On August 21, 1993, controllers at the Jet Propulsion Laboratory sent a series of commands to prepare the spacecraft for entry into orbit around Mars. The spacecraft shut off its radio transmitter to protect its delicate circuits, and pressurized its propellant tanks. A series of pyrotechnic valves opened to allow compressed helium to pressurize the monomethyl hydrazine fuel and nitrogen tetroxide oxidizer tanks. After pressurization was complete the spacecraft was supposed to turn its transmitter back on, and call Earth to confirm its status. That call never came. JPL sent desperate commands to try to get the spacecraft to use its backup transmitter, but never successfully recontacted Mars Observer.

Mars Observer was the first completely unsuccessful U.S. planetary spacecraft since Surveyor 4 in 1967. Had the original plan been kept to fund a backup spacecraft it's likely that instead of a total failure the backup would still be capable of fulfilling the program's objectives.



Launch Complex 17, Pad A at Kennedy Space Center. Build-up begines on the Delta II expendable that will carry the Mars Global Surveyor spacecraft. (NASA)

Learning from the Past

NASA examined the possibility of a replacement mission which could accomplish *Mars Observer*'s objectives, but within a more reasonable budget. There was no practical way to build a replacement spacecraft in time to make the 1994 launch window, so studies were aimed at 1996. Instead of a single-shot spacecraft without any follow-up plans, NASA got approval to start the planetary Surveyor program—an on-going series of low-cost planetary spacecraft, with a pair of spacecraft for each planetary window.

Mars Global Surveyor's funding cap was set at $155 million—less than the cost of *Mars Observer*'s launch vehicle. The requirements specified a launch in the 1996 planetary window, with a Delta-class launch vehicle.

MGS's launch mass is 1050 kilograms—40 percent of the mass of *Mars Observer*. *MGS*'s propellant only accounts for 35 percent of its mass, as opposed to *Mars Observer*, which consisted of over 57 precent propellant.

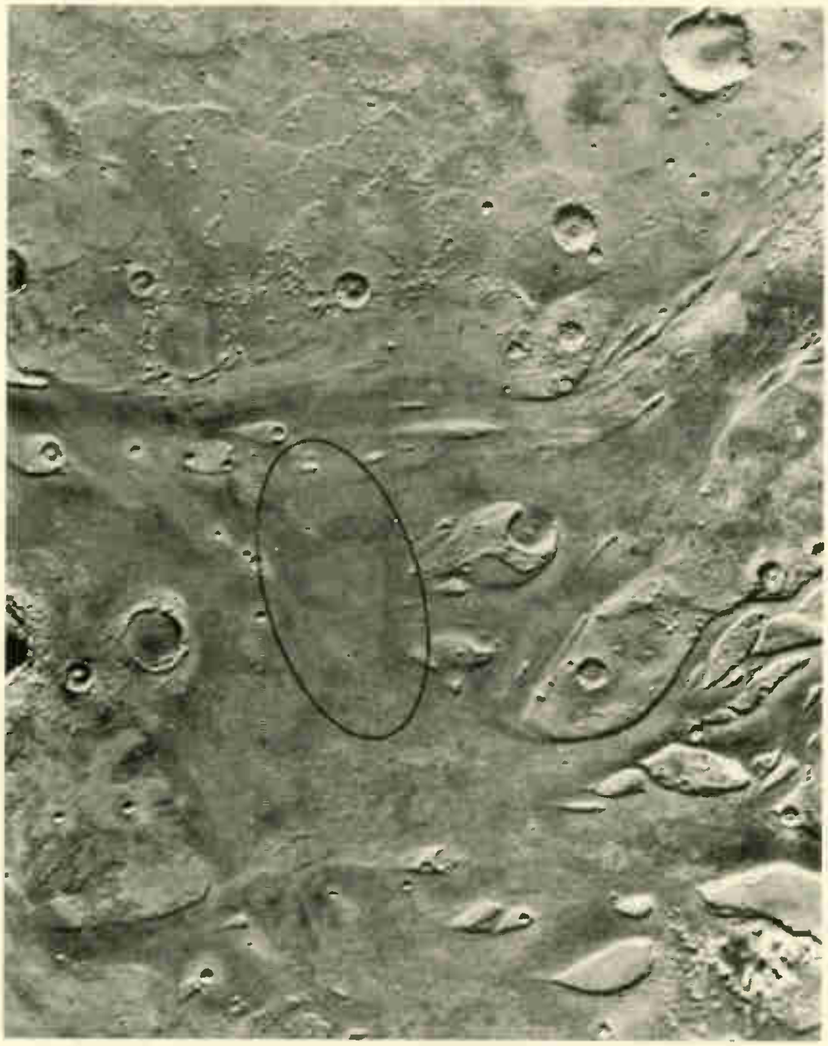
Mars Observer was supposed to use a large rocket engine to slow down the spacecraft in to the proper orbit around Mars and additional firings would change the orbit to the proper mapping orbit. *MGS* also uses a rocket engine to enter orbit around Mars, but will use aerobraking, instead of propellant, to reduce its orbit to the proper altitude for the science operations. Mars's middle atmosphere will be used to slow the spacecraft down, similar to the way a parachute or spoilers slows down an aircraft.

MGS's solar arrays have been designed based on aerobraking data obtained from the Magellan spacecraft, which performed a series of aerobraking maneuvers to change its orbit around the planet Venus.

MGS's adjustable arrays have been optimized to act like sails in the very thin Martian atmosphere.

When *MGS* arrives at Mars in September 1997 its rocket will fire to put it into a relatively easy-to-reach (low propellant requirement), elliptical orbit around Mars with an altitude ranging from about 450 to 56,400 kilometers. Dropping the spacecraft into Mars's middle atmosphere to an altitude of about 110 kilometers will gradually lower *MGS* into an almost circular orbit. It will take about four months to lower *MGS* to its final mapping orbit.

Altogether, the spacecraft will be slowed 4500 kilometers per hour (2800 miles per hour)—the equivalent of braking a plane traveling at Mach 4 to a complete stop. The aerobraking technique is more tricky for spacecraft dynamics planners, but uses much less propellant than conventional engines. Planners predict that friction with the Martian atmosphere won't raise the spacecraft temperature any higher than 160 degrees Celsius (320 degrees F). The lower fuel requirement results in a smaller spacecraft with more space for scientific instruments and a less expensive mission.



The Mars Pathfinder landing site, Ares Vallis, is in the Chryse Planitia region in the northern hemisphere of Mars. (NASA)

The Mission

By January 1998 *MGS* will be in its 378 kilometers (204 nautical miles) polar mapping orbit and scientific measurements of the planet's surface can begin. *MGS* will travel at 3 kilometers per second (2 miles per second), taking two hours to travel around Mars.

MGS's instruments are duplicates of *Mars Observer*'s—including the most sophisticated camera ever flown on a civilian spacecraft. The *Mars Observer* Camera was originally considered a low priority instrument, but had enough outside pressure to ensure its inclusion. Over the planned 687 day *MGS* mission the camera will return 30 billion bits of information. The camera has over 12 megabytes of memory and uses high quality microprocessors which had only been used previously in secret military spacecraft. While the amount of memory is fairly impressive, it was no less than astounding when the camera was first designed. The maximum resolution of the camera is 1.4 meters (4.7 feet)—enough to distinguish a car from a truck.

The two *Mars Observer* instruments which couldn't be carried on *MGS* are the gamma ray spectrometer and PMIR, due to their weight.

As with *Mars Observer* all of the instruments will be on the side of the spacecraft which will stare continuously at Mars. Other spacecraft components are also derived from existing designs. But there will be one very significant difference—the *MGS* radio will always remain powered on.

MGS's 1.5 meter (5 foot) high gain antenna receives commands on X-band at rates up to 500 bits per second. It returns its scientific results to Earth via a 25 watt transmitter on X-band and Ka-band. When Mars and Earth are at the closest points in their orbits the maximum throughput is 85,300 bits per second. In addition, the spacecraft has four low gain, omnidirectional antennas. Onboard storage consists of redundant solid state data recorders, with a capacity of 1.38 billion bits.

Besides the normal communications system, the *MGS* spacecraft also features a 70 centimeter antenna to relay data from other Martian spacecraft. When the Mars relay (MR) experiment was first approved, the Soviet Union was still considered an adversary, and high technology hardware could not be transferred. So an intermediary was used—the French space agency, CNES.

Working in cooperation with both space agencies, CNES built the Mars Relay antenna—a quadrifilar, helix, 70 centimeter antenna in a fiberglass mast. MR's objective is to collect data from Russian spacecraft within Mars atmosphere (either balloons or landers), and transmit it back to Earth. To minimize cost and weight, the data from MR is funneled through the *Mars Observer* Camera's memory and comes back to Earth looking like MOC data.

After *MGS* completes its one-year mapping of Mars, its primary application will be relaying data from the Russian Mars 96 lander and future Martian spacecraft.

The MR transmits on 437.1 MHz with an output power of 1.3 watts. It receives data from the Russian landers on 401.5 and 405.6 MHz. The electronics weigh 5.8 kilograms, plus 2.1 kilograms for the antenna. The antenna pattern (-3 dB) is a 65 degree cone from the nadir axis, providing coverage to the horizon (slant range about 1650 kilometers). The effective range of the link is about 1100 kilometers.

The MR downlink signal would indicate its proximity to the station and trigger an uplink response of telemetry.

Amateur Participation

About three weeks after *MGS*'s launch the Mars Relay experiment will be turned on for a diagnostic test. The 437.1 MHz frequency is close to the 70 centimeter amateur radio band, and hams are being encouraged to monitor the test to help out the *MGS* team. The MR signal strength should be adequate for amateurs with weak signal systems to receive the signal to a distance of up to 10 million kilometers—truly the longest distance for a DX reception!

Hams with OSCAR setups, or Earth-Moon-Earth bounce stations are especially encouraged to participate. As the Earth rotates the signal strength will change. In addition *MGS* will be rotating once every 100 minutes. The data from multiple locations will help JPL map the antenna's pattern and performance. If you want to participate in the test, JPL has a mailserver set up with updates on the experiment's status.

Another radio-related experiment on *MGS* is the radio science, ultra stable oscillator. Its downlink frequencies are 8417.716 MHz (closed loop) and 8416.368 MHz (in-use mode). The ultra-precise frequency will permit small variations in Mars gravitational field and atmospheric density to be measured by closely examining the signal received by NASA's Deep Space Network.

TABLE 1:
Mars spacecraft on the Worldwide Web

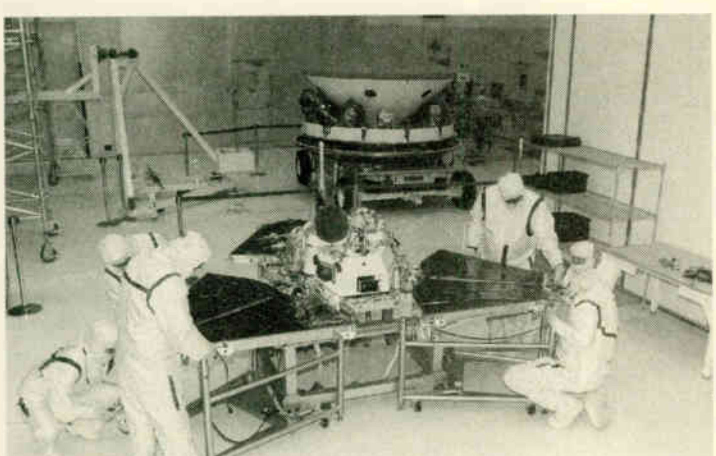
Mars Global Surveyor:	http://mgs-www.jpl.nasa.gov/
70 cm relay:	http://mgs-www.jpl.nasa.gov/Mars_Relay/mgs-mrtest.html
Mars Pathfinder:	http://mpfwww.jpl.nasa.gov/

The other scientific experiments include a laser altimeter, magnetometer, and the thermal emission spectrometer. Over its 687 days in orbit around Mars, *MGS* will return more data than all previous Mars spacecraft put together. After the primary mission has been completed *MGS* will be used to relay data from other spacecraft exploring Mars. Eventually *MGS*'s orbit will be raised to 405 kilometers (219 nautical miles) to ensure that *MGS* will not crash in to the Martian surface for at least 20 years. The U.S. has agreed not to let any unsterilized spacecraft land on Mars for at least that period of time, as part of the planetary protection program.

Mars Pathfinder

Mars Pathfinder was started in October 1993 as part of the Discovery program, NASA's new series of low-cost planetary spacecraft. A Discovery spacecraft is limited to under $150 million, must be finished within three years of project approval, and can only use small or medium class launch vehicles.

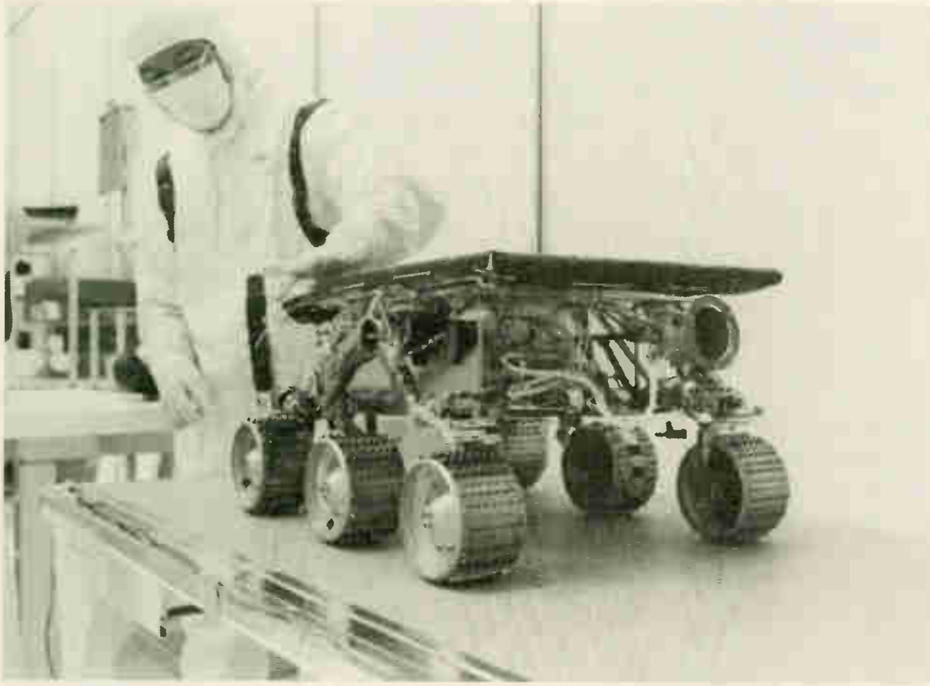
The key feature of *Pathfinder* is a microrover, named *Sojourner Truth* after the 19th century abolitionist. The six-wheel robotic machine weighs 11.5 kilograms (25 pounds) and has the point of view of a baby crawling on all fours. The baby analogy is pretty good. *Sojourner*'s 80C85 microprocessor is about as intelligent as a baby, the micro-rover has no 'teeth' to chip off rocks and determine their hardness, and its senses aren't fully developed. Like a baby, the microrover can still test the hardness of something—*Sojourner* can roll up its wheel against a rock to try to scrape its surface. And the microrover can "smell" through its Alpha/Proton/X-ray Spectrometer (APXS—pronounced "A-pics"). APXS places its sensor up against any interesting rocks, and "smells" by using a radioactive alpha particle source to illuminate the sample, and using a mass counter to calculate the element's atomic number.



Checkout of the lander portion of the Mars Pathfinder spacecraft. (NASA)

The six to seven month cruise to Mars is accomplished using a cruise stage designed to provide required guidance, navigation, attitude control, telemetry, and power generation functions. At Mars arrival, the cruise stage is jettisoned from the lander which is encapsulated within a protective aeroshell. Unlike previous planetary landers, *Pathfinder* goes directly to the Martian surface without first going in to orbit around Mars. Any spacecraft which enters Mars atmosphere is carefully scrubbed of any microbes or spores. It's feared that Earth bacteria could accidentally be introduced into the Martian environment and possibly grow on Mars. If any future spacecraft discovers signs of life on Mars there would always be a question as to whether or not that life form was actually carried from Earth. Surfaces were wiped with alcohol, and many pieces were baked in a dry oven to destroy spores and microorganisms. An inspection team took samples off the surface of the spacecraft to measure how many spores got by the cleaning procedures. The maximum number of spores permitted was 300 per square meter, and it turned out the team was able to keep the spacecraft at least ten times cleaner than the requirements.

Hitting Mars thin upper atmosphere at more than 27,000 kilometers per hour (17,000 miles per hour), the heat shield, based on *Viking*'s design, will slow *Pathfinder* to 1,450 kilometers per hour (900 miles per hour) in about two minutes. An onboard computer will sense the slowdown in speed and then deploy a large parachute. The parachute will slow the lander down to about 250 kilometers per hour (155 miles per hour) in the thin Martian atmosphere. At about 100 meters (330 feet) above the surface, the computer will inflate the air bags. Seconds


The small rover of the Mars Pathfinder mission shortly after it was unpacked at the Kennedy Space Center. (NASA)

later, three solid rocket motors placed inside the top half of the entry vehicle above the lander will be fired.

The rockets will halt the lander's decent about 12 meters (40 feet) above the Martian surface. The parachute will be released, and the lander, nestled inside its protective air bag cocoon, will fall to the ground, bouncing and rolling until it stops.

Pathfinder's landing will occur on July 4, 1997, at approximately 0144 UTC, 21 years after *Viking I*'s landing. The landing site in the Ares Vallis is a combination of engineering requirements for a benign daylight landing site and scientific requirements for an interesting location. Eons ago, when water flowed on Mars, great floods inundated the site. The site is 850 kilometers (527 miles) southeast of the location of *Viking Lander 1*.

The landing will occur at about 3 a.m. Martian Standard Time. About an hour after landing the air bags will deflate. *Pathfinder* will open its three metallic petals, which will force the instruments right side up. The camera will make a panoramic view of the surrounding area. On the afternoon of landing day the rover will be sent out for its extended range exploration.

Both the *Pathfinder* lander and rover have stereo imaging systems. The imaging system will reveal the mineralogy of surface materials as well as the geologic processes and surface-atmosphere interactions that created and modified the surface. The instrument package will also enable scientists to determine dust particle size and water vapor abundance in the atmosphere.

The nominal mission duration is 30 days for the *Pathfinder* and three days for the rover. Project managers are hoping to extend the mission to a year if the spacecraft continues to operate and funds are available.

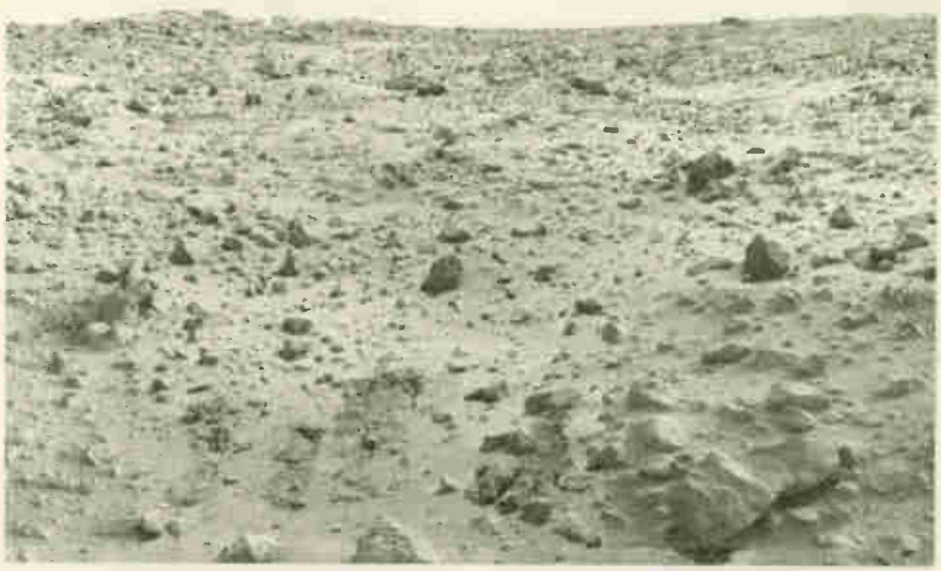
These missions were well underway when this summer's announcement of the potential discovery of primitive forms of Martian life in meteoroids were discovered; while they don't have any specific goals to discover life on Mars, they will pave the path for future missions.

Planning is already well underway for the two Mars 98 missions, the second *Mars Global Surveyor*, and the Mars Surveyor Lander. They will be half the weight of the 1996 Mars missions and launched on Delta-lite launch vehicles.

Mars Surveyor Orbiter 98 is scheduled for launch in December 10 to 29, 1998, on a Delta 7325. At launch it will weigh 565 kilograms (1246 pounds). It will arrive at Mars sometime between September 24 and October 11, 1999. 140 days of aerobraking will be used to put it in its mapping orbit. The three instruments will include the Mars surveyor color imager (MARCI), a duplicate of the pressure modulator infrared radiometer (PMIRR) which flew on *Mars Observer*, and another UHF relay.

Mars Surveyor Lander will be launched between January 1 and 27, 1999, with an arrival at Mars between December 5 and 28, 1999. The planned landing site is 71 degrees South, 210 degrees West, at the edge of polar ice cap. The instruments will include the Mars surveyor descent imager (MARDI), surface stereo imager, meteorology package, robotic arm/camera, thermal and evolved gas analyzer, and two new millennium mini-probes.

The exact capabilities and goals for missions beyond 1998 have not been defined. The results of the *MGS* and *Pathfinder* missions will help chart the course for future Martian exploration. ST

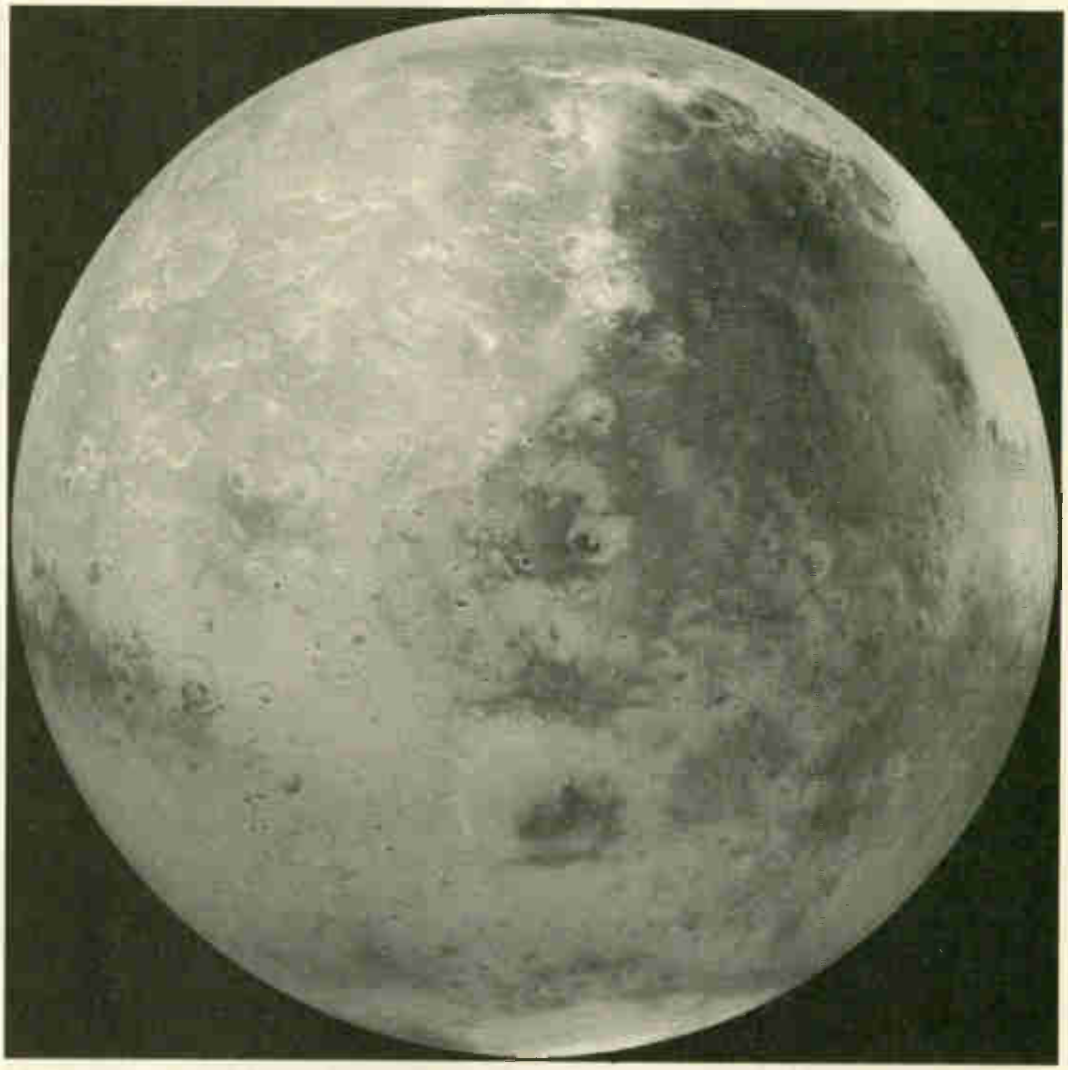

One of the still famous shots of the Martian landscape, taken by the Viking 1 lander.

Mars Relay Flight Test Information

What is the Mars relay flight test?

The Mars relay flight test will be a test of the UHF relay on board the *Mars Global Surveyor* (*MGS*) spacecraft. The test will occur approximately 18 to 30 days after launch of *MGS* (around 1996 December) while the spacecraft is still in proximity of the Earth. The Mars relay will be used at Mars for communications between *MGS* and small stations placed on the surface of Mars by other missions.

The Mars relay uses frequencies of 437.1 MHz for transmission, and 401.5 and 405.6 MHz for reception. Because these frequencies are in and near the radio amateur bands, hams will have the opportunity to help out NASA and listen for the Mars relay beacon transmission at 437.1 MHz. JPL is currently working with various large antenna operators to develop the uplink (or transmission) portion of the test at frequencies of 401.5 and 405.6 MHz.



Mosaic of the Valles Marineris hemisphere of Mars composed of 102 Viking Orbiter images of the planet. The mosaic was processed using a specialized imaging system developed by the U.S. Geological Survey in Flagstaff, Arizona (NASA).

How can amateur radio operators participate?

The broadcast beacon frequency for the Mars Relay is 437.1 MHz (the signal will be Doppler shifted). Signal strength should be such that amateurs with capable equipment should be able to detect the beacon signal even at distance of as much as 10 million kilometers.

Amateurs from around the globe will be asked to monitor the signal and measure its strength as a function of time (the spacecraft rotates every 100 minutes). This information will help JPL establish the functionality and performance of the Mars Relay prior to its use at Mars.

What we would like is a set of signal reports taken continuously or at least once every minute for any given period of time for which the spacecraft is in view. It would be best if these signal reports were measured against a standard reference value; however, that is not absolutely necessary for the information to be useful as long as the method of measurement is consistent over a given set of signal reports.

How do I calculate a Standard Reference Value?

A procedure for this is currently being written and will be posted on the web site mentioned above when it is completed.

What equipment do I need?

A description of this is currently being written and will be posted at the following URL when it is completed: 70 cm relay: http://mgs-www.jpl.nasa.gov/Mars_Relay/mgs-mrtest.html Mars

When is this experiment?

Between 18 to 30 days after launch (launch window opens November 6, 1996.

and closes-November 25, 1996. Each day there will be two launch opportunities, and each window is approximately 1 second), the beacon will be turned on for a period of at least 24 hours. The spacecraft will be between 5.6-8.4 million kilometers from earth (8 million kilometers is 20 times the distance to the moon). This 24 hour period is the time when the amateur radio experiment will be conducted. The exact time will be announced on the e-mail reflector mentioned below.

After an initial period in the CW mode, the beacon will be switched to FM with a pure FM signal on one sub-carrier. The signal level will drop by approximately 14 dB. This will drop the signal level below the noise level for most amateur radio sites.

What information would we like from the amateur radio operators?

- Provide the latitude, longitude, and elevation of your antenna location.
- Provide a measurement of the signal relative to time. Prefer samples to be taken once every minute or two.
- Please record time of each signal measurement in UTC.
- If possible give the reading relative to a standard reading. However, if a standard reference is not available, an S-meter reading will be helpful.
- Any information about your antenna and receiver system would also be helpful. (For example, gain, noise figure, search bandwidth, etc.)

Why would we like this information?

This information will be used to check the Mars Relay's antenna radiation pattern and transmitter output level.

How do I find out more information?

MGS WWW Page:
http://mgs-www.jpl.nasa.gov

See *QST*, January 1996 for an article on the Mars Relay flight test.

E-Mail reflector: "MARS-NET" which will discuss current issues relating to *MGS*. Update notices will be sent through the e-mail reflector. To Subscribe: Send message to: **Listserv@VM.StLawU.EDU**. Message: Subscribe MARS-NET Your-Name Your-Call-sign

For Example: Subscribe MARS-NET Robert R. Smith N6JKQ

To submit messages to the MARS-NET reflector, address your e-mail message to: **MARS-NET@VM.StLawU.EDU**

What to expect during the amateur radio experiment

The downlink frequency will be 437.100 MHz. This frequency will shift with respect to Doppler effects. The downlink from the *Mars Global Surveyor* spacecraft will be transmitted from the Mars relay's transmitter with a power of 1.3 watts through an antenna with better than zero dBi of gain.

The spacecraft will be rotating with the axis of rotation about 30 degrees off earth point. This means that the downlink signal will increase and decrease with respect to the period of rotation. The rotation period will be approximately 100 minutes. It is estimated that the Mars relay antenna gain, as seen from the Earth, will be above 0 dBi in gain for at least 30 minutes out of every 100 minute rotation of the spacecraft.

Russian Mars 96 Mars Relay Test

There is a possibility of performing a UHF flight test of the Russian Mars 96 spacecraft relay in a similar fashion to the *MGS* Mars relay flight test. The relay on the Russian spacecraft is very similar to the Mars relay on *MGS*. The Russian spacecraft launches around the same time as *MGS*, so the test would be about the same time as the *MGS* Mars relay flight test. The Russian antenna has a peak gain of 12 dBi making the flight test possible for amateurs with smaller antennas. ST

Information in this article was provided by: John L. Callas (John.L.Callas@jpl.nasa.gov) and written by: Robert R. Smith, N6JKQ(Robert.R.Smith@jpl.nasa.gov LAST)

TABLE 2: Mars Relay Radio System Overview

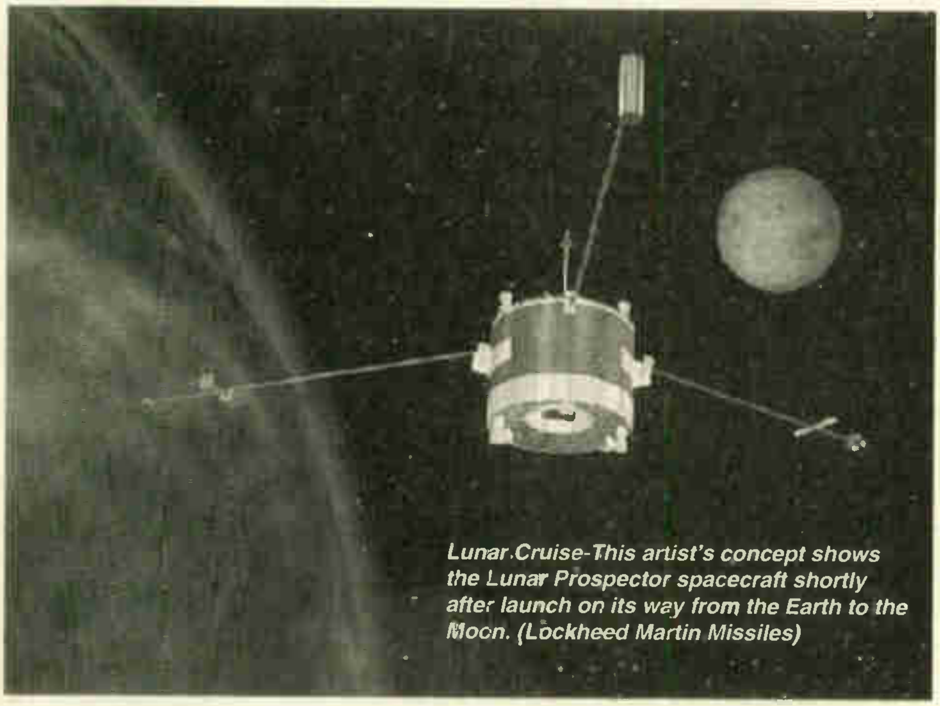
When the probe has arrived at Mars, the Mars relay aboard *MGS* receives telemetry from balloons or landed Instrument packages (including cameras, atmospheric and meteorology instruments)

Receive Frequency:	401.5275 and 405.625 MHz.
Beacon Transmit Frequency:	437.100 MHz.
Beacon Wavelength:	0.686m
MR Antenna Gain:	0.0 dBi
Beacon Transmitter Power (Effective Isotropic Rad Power):	1.30 watts 31.1 dBm
Beacon Modes:	FM or CW
Receive Data Rate:	8 to 128 kilobits per second
Downlink Signal Polarization:	RCP
Earth-Probe Distance:	5.6E+6 km
Total Received Carrier Flux:	3.3E-21 W/m2

Signal Modulation:

FM Subcarriers	Units
RC1	1484.06 Hz
RC2	1137.78 Hz
RC3	1028.11 Hz
TC1	1376.34 Hz
Peak Frequency Deviation	4300 Hz.

Bringing Space Down to Earth



Lunar Cruise-This artist's concept shows the Lunar Prospector spacecraft shortly after launch on its way from the Earth to the Moon. (Lockheed Martin Missiles)

By Len Losik

A Look at NASA's Lunar Prospector

Seven years ago scientists at Lockheed Martin in Sunnyvale, California, started an initiative to show that an inexpensive satellite could go to the moon and send back useful scientific data to Earth. The last time the United States had gone to the moon was when the military launched the *Clementine* satellite, built by the Naval Research Laboratory. *Clementine* was sent to the moon to map the back side, using newly developed sensors and missile defense technology.

The *Clementine* spacecraft used proven, low cost, commercial equipment and software, and demonstrated that space travel to the moon could be both successful and cost-effective. To keep the costs down, it did not have redundant equipment.

Clementine 2, somewhat of a follow-on to *Clementine 1*, has been funded. However, *Clementine 2* is designed to be an asteroid destroyer rather than a science data collection platform. It is set up to demonstrate a fully autonomous microsat for an asteroid defense system.

From scientists around the world Lockheed solicited instruments to ride on the *Lunar Prospector* that would help to understand the moon . Many instruments were proposed, but only six were chosen from among them.

The *Lunar Prospector* is an extremely simple spacecraft, designed with equipment and software that has been successfully used on many other satellites. The *Lunar Prospector* is a low power, spin-stabilized spacecraft with a minimum of equipment. It uses only 200 watts to operate and uses a single, small, 13-pound, 5 amp-hour battery to provide power when the sun is eclipsed from the spacecraft by the moon.

The *Lunar Prospector* is a NASA Discovery mission—low cost programs with small satellites that have a high science return. The program budgets are fixed at $100 million with no additional funding available from NASA. The program was conceived to make space accessible to an increased number of scientists.

The large, complex, $300 to $500 million spacecraft that require 5 to 15 years to build, test, and launch are undesirable under today's NASA management. On long satellite projects, the people that work on the project when it is launched are often not the ones that conceived and designed it. To eliminate this problem, the Discovery satellites are managed by the satellite builder and the instruments. In this way, the Discovery projects are of very short duration and costs are controlled by the satellite builder.

On *Lunar Prospector*, NASA is providing the funding and Lockheed Martin Missiles and Space is providing the technical resources to make the Lunar Prospector a reality. Lockheed Martin has also created the manufacturing capability to provide small, low cost, highly reliable commercial satellites for a variety of other missions.

In making space more accessible, NASA has revolutionized the way it is doing business. NASA maintains large satellite design, test, and on-orbit control complexes at Goddard Space Flight Center, Greenbelt, Maryland; Jet Propulsion Laboratory, Pasadena, California; and Ames Research Center, Mountain View, California. Prior to Discovery projects, NASA retained all the responsibility for satellite program management.

NASA used its large, internal resources for the design, test, launch, and on orbit control of space science missions. NASA managers designed space science missions so that the scientists received instrument data only after launch. The scientists were unable to participate in any of the other activities related to their satellite.

Clearly, the Discovery program management is a revolutionary management style for NASA. Spacecraft and instrument design, manufacture, test, and launch are all in the hands of experienced satellite builders and instrument scientists. Lockheed Martin has joined NASA to build the Discovery satellites because of the potential it sees for future, low cost, space travel.

TABLE 1: Lunar Prospector RF Characteristics

S-Band Link	Frequency	Modulation Type	Data Rate
Downlink	2273.0 MHz		
Subcarrier	1024 kHz	PM (BPSK)	300/3,600 bps
Ranging			
Sequential Tones	2273.0 MHz	PM	1,000 kbps
Uplink	2093.0542 MHz		
Subcarrier	16 kHz	PM (BPSK)	250 bps
Ranging			
Sequential	2093.0542 MHz	PM	1,000 kbps

PRN: Pseudo Random Noise
BPSK: Bi-Phase Shift Keying
kbps: Kilo bits per second
mbps: Mega bits per second
MHz: Megahertz
kHz: Kilohertz
bps: bits per second

Discovery Enables Asteroid Research

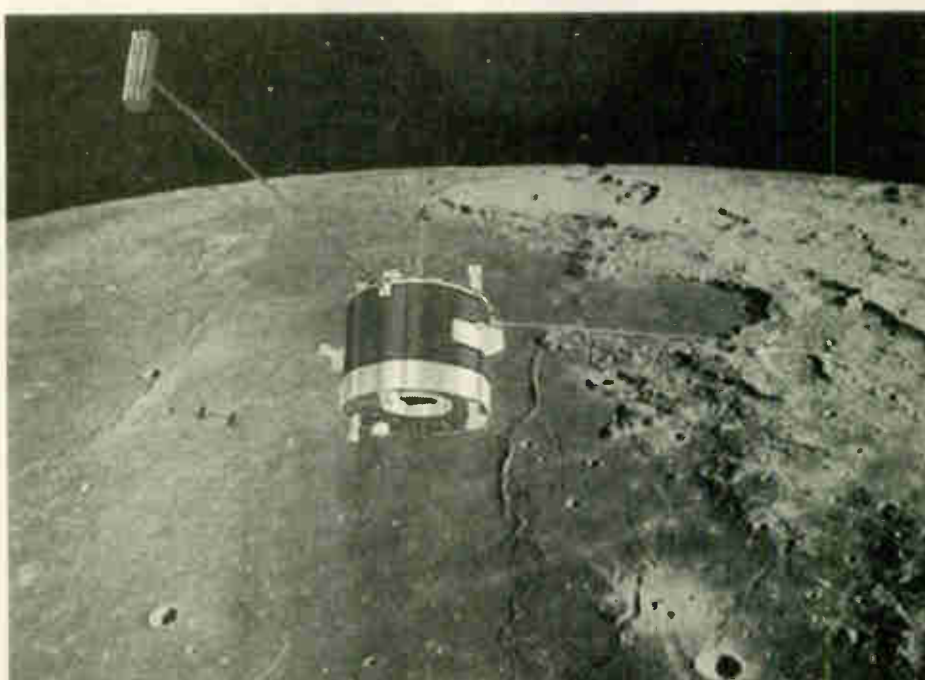
Another Discovery spacecraft called *NEAR*—for Near Earth Asteroid Rendezvous (see the July/August 1996 issue of *Satellite Times*)—was launched this year to map nearby asteroids. *NEAR* is also seeking answers to questions about asteroid make-up and why their surfaces are so different even though their spectral analysis shows them to be made of similar materials.

When *NEAR* reaches its intended asteroid, it will go into orbit for a long period and collect continuous information similar to the *Lunar Prospector*. This information will provide commercial mining companies the information they need in order to decide if it is economically feasible to mine asteroids.

NEAR was built at John Hopkins University's Applied Physics Laboratory for only $112 million. Both *NEAR* and *Clementine 2* missions are asteroid-related and are meant to expand our information about their composition and structure. *Clementine 2* is designed to fly by an asteroid at 10 to 12 kilometers per second and take flash spectroscopy. The data from the *NEAR*, *Clementine 1*, and *Clementine 2* missions will contribute precious scientific data to that collected by the *Lunar Prospector* about the moon.

The Mission

After lift-off from the Eastern Test Range on October 9, 1997, the *Lunar*



This artist's concept shows the Lunar Prospector spacecraft in its 100 km altitude polar mapping orbit over the eastern edge of Mare Serenatatis (Sea of Tranquility), immediately to the west of the Apollo 17 landing site. (Lockheed Martin Missiles)

Prospector will be injected into a lunar trajectory. The trip to the moon will take about 100 hours. When the *Lunar Prospector* arrives at the moon, it will be injected into a circular, low lunar orbit (LLO) at 100 kilometers, and it will have a 118 minute period.

There are two midcourse thruster maneuvers needed to adjust the spacecraft's path to the moon. Once the *Lunar Prospector* arrives at the moon, three more thruster maneuvers will be used to lower the altitude to 118 km into a circular orbit. The mission is planned for one year.

The *Lunar Prospector*'s final orbital path will be a polar mapping orbit. Regular orbit maneuvers will be required, using the propulsion thrusters, to keep the orbit shape and period. When the fuel is depleted, the orbit will change from circular into an elliptical orbit. The eccentricity of the elliptical orbit will increase and the height of perigee from the moon's surface will grow less. The mapping mission can continue with perigee as low as 10 kilometers. Finally, with no remaining propellant, the *Lunar Prospector* will impact the moon.

The Payload

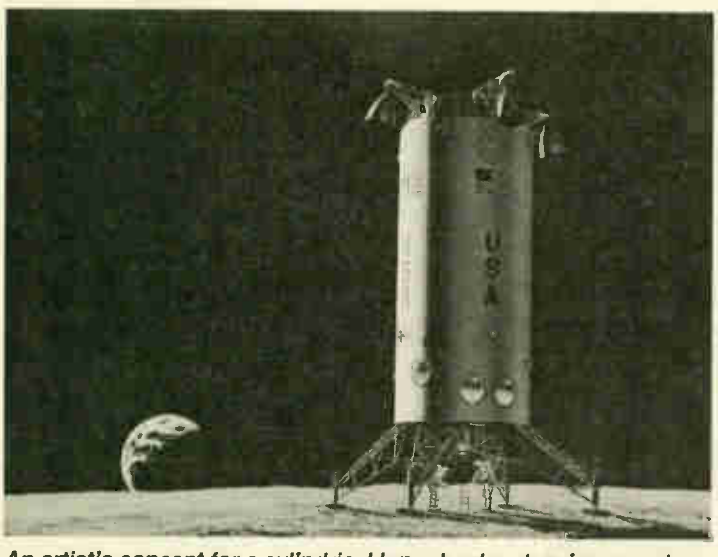
The science instruments that will be used to map, measure, and explore the moon include a gamma ray spectrometer, a neutron spectrometer, an alpha particle spectrometer, a magnetometer, an electron reflectometer, and the doppler gravity experiment.

The gamma ray spectrometer will look on the surface of the moon for trace elements such uranium, thorium, potassium, and more concentrated elements such as iron, titanium, oxygen, silicon, aluminum, magnesium, and calcium. These elements give scientists insight into the moon's evolution and composition of the lunar crust.

Water has not been detected on the moon, but some may exist, trapped at the bottom of craters in the polar regions from interstellar meteorites and comets. Many craters at the poles never see sunlight, and ice there would be stable enough to remain over the life of the moon. The neutron spectrometer instrument can detect water at 0.01 percent. This means that 200 grams (1 cup) in a cubic meter would be detected from the mapping altitude of the spacecraft.

The alpha particle spectrometer instrument is used to detect alpha particles from radioactive radon gas and its decay product, polonium. This information is used to study the tectonic motion of the crust and volcanic out-gassing. The moon is thought to be tectonically active today, despite the results obtained from the Apollo 15 and 16 missions. The results from an orbiting alpha particle experiment and mass spectrometer and surface seismometers are expected to show that the moon is active, but much less so than the Earth or Mars.

The magnetometer and electron reflectometer will be used to map the lunar magnetic fields. The lunar magnetic fields are believed to be only weak, local ones; mapping the strength and distribution of them will help to understand their origin. They may have been caused by meteoroid, asteroid, and comet impacts or may be remnants from a stronger global one. The size and composition of the lunar core, and the interaction of the local magnetic fields with the solar wind from the sun and earth will be studied, too. Magnetic mapping will help to locate economically important ores to better determine any potential economic importance the moon might have.



An artist's concept for a cylindrical lunar lander showing round windows, main thrusters at the top of the vehicle and maneuvering thrusters around the circumference of the vehicle. (Lockheed Martin Missiles)

The doppler gravity experiment will map the gravity at low lunar orbit. This information is essential for future travel to the moon: No other satellite has been in a low lunar polar orbit to create a lunar gravity model. Because mass-to-orbit costs remain extremely expensive, fuel allocation and fuel use budgets force precise prediction ability. A lunar gravity model is essential to calculate the fuel used to reach, establish, and maintain a satellite orbit about the moon.

The doppler gravity instrument will also be able to provide data on the density differences in the lunar crust, the internal density of the moon, and the nature of its core.

The Spacecraft

The *Lunar Prospector* spacecraft is a small, reliable, inexpensive one that uses technology developed decades ago. Thus, cost is low and reliability is high. This reliance on proven, off-the-shelf technology and equipment, maximizes reliability and reduces the special, labor-intensive analysis and systems engineering that drive most program costs.

The spacecraft itself is drum-shaped. It is 1.4 meters in diameter and 1.2 meters in height. On the top of the cylinder is a 1.6 meter antenna tower for holding an omnidirectional and medium gain antenna for communications with NASA Space Tracking and Data Network (STDN) and Deep Space Network (DSN) ground antennas.

When the instruments on the appendages are deployed, the entire spacecraft will be much larger. Each instrument mast extends another 2.5 meters from the side of the drum and the magnetometer booms extend an additional 1 meter beyond that. After launch, the stowed booms will deploy after release by centrifugal force and strain energy. The masts will deploy in about one minute and they will slow the spinning spacecraft from 48 rpm to 12 rpm, much like an ice skater slows down by extending his arms.

The structure is made from light-weight but strong graphite-epoxy. The spacecraft structure must be able to support the full weight of 600 pounds of fuel and survive the high launch and deployment loads.

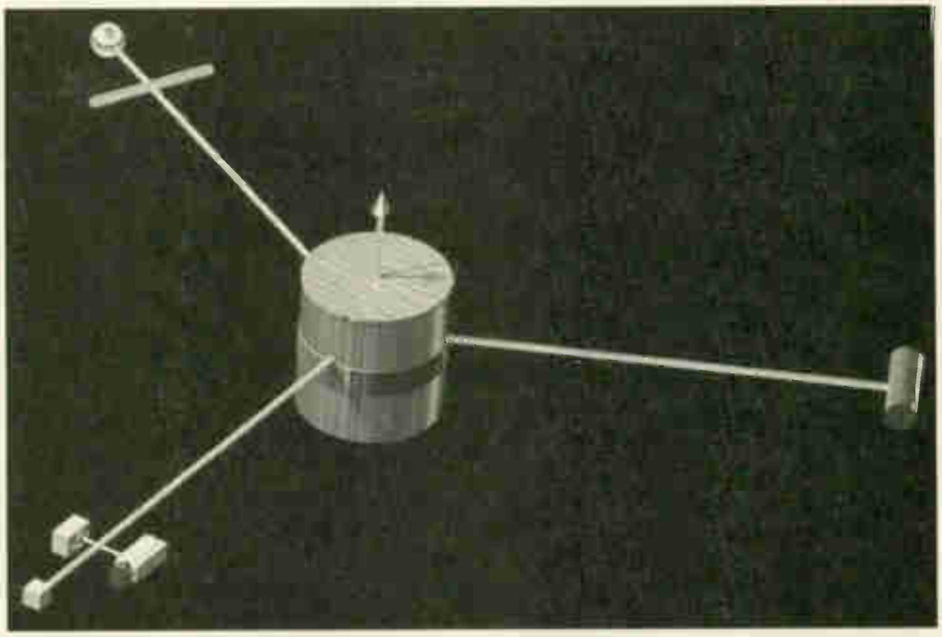
Electrical power is generated by strings of silicon solar cells bonded around the drum. Silicon solar cells have been used in space for decades. The solar cells—each about 1 inch by 2 inches—convert sunlight to electrical current to power all the electrical equipment as well as maintaining a battery fully charged. The cells are connected by silver-molybdium foil strips, micro welded from cell-to-cell.

The battery is a 13 pound, nickel-cadmium rated at 5 amp-hours. The battery is composed of 22 individual cells wired to produce the needed power when the *Lunar Prospector* goes into the moon's brief shadow. After every eclipse of the sun, the battery is recharged and made ready for the next shadow period.

The energy to complete the mid-course corrections and circularize *Lunar Prospector* when it arrives at the moon is provided by a mono-propellent hydrazine and six 22-newton (5 lbf) thrusters. Carrying 649 pounds of propellant, 4690 feet per second of velocity change will be available. The spin-stabilized satellite is expected to consume only 304 pounds of propellant to reach the moon, leaving 345 pounds of propellant for final orbit circularization and final orbit stationkeeping. Propulsion systems using these components are on hundreds of satellites. The thruster and fuel performance and repeatability are extremely high.

Spacecraft control and telemetry functions will be performed by a single piece of equipment. It accepts commands from the STDN compatible transponder, decodes the command message, and executes the command by relay switching and serial command message to the instruments. It also conditions and controls electrical power from the solar arrays, battery charge and discharge, and electrical power distribution to the *Lunar Prospector* equipment. The unit accepts science data from the science instruments, earth/sun, moon sensors, and actuators, and formats the data onto the downlink telemetry stream along with other housekeeping information for transmission back to Earth by the RF transponder. It also provides central timing for synchronization, clocks, and strobes throughout the spacecraft and science instruments.

Information on the telemetry is used by ground-based software to identify and calculate proper spacecraft attitude. This knowledge is crucial when the mid-course maneuvers and final orbit thruster burns are done. If the spacecraft is pointing a little off the desired course at the time the thrusters are fired, more fuel will be required to acheive the desired outcome. This, in turn, shortens the life of the *Lunar Prospector* and its mapping mission once it reaches the moon.



The Lunar Prospector probe is scheduled for launch in 1997. It will perform low altitude mapping to study surface compostition, magnetic fields, gravity fields, and gas-release events in an effort to improve scientists' understanding of the origin, evolution, current state and resources on the Moon. (Photo by Russ Underwood, LMSC)

Turn-around range tones are sent from the ground station to the satellite and are retransmitted back to Earth by the STDN transponder. The change in phase of the returned tones is used to decide the distance from the Earth to the spacecraft. This information is used to decide when and where to complete the mid-course adjustments.

Conclusion

NASA has many new exciting space projects in the works. NASA's Discovery missions are leading new short term space projects that could only be dreamed about in the past. NASA has also changed its way of doing business in space. By passing the responsibility for implementation on to the people responsible for mission conception, NASA is making space far more accessible.

The *Lunar Prospector* is bringing the United States back to the moon for a long duration mapping mission. The *Lunar Prospector* will be used to identify commercial applications for traveling to the moon. It will collect spectroscopic information that will yield detail data on the presence of precious metals and other information needed for long term exploration of its surface. It will demonstrate that low cost, small, simple spacecraft can be used effectively to minimize the cost of lunar exploration for commercial enterprises. The sharing of information between scientists on other recent deep space and lunar missions provides a large data base for scientists and commercial mining companies to study.

NASA's *NEAR* spacecraft was designed and launched to investigate commercial mining opportunities on near-Earth asteroids. The *Lunar Prospector* is meant to do the same, only on the moon surface. Using Lockheed Martin experience developed during 35 years of designing and building space-related equipment, the Discovery missions and *Lunar Prospector* are bringing space down to earth. ST

More information on the Lunar prospector mission can be found at the following Internet web site: http://www.lmsc.com/lunar/Mission.html

SOHO

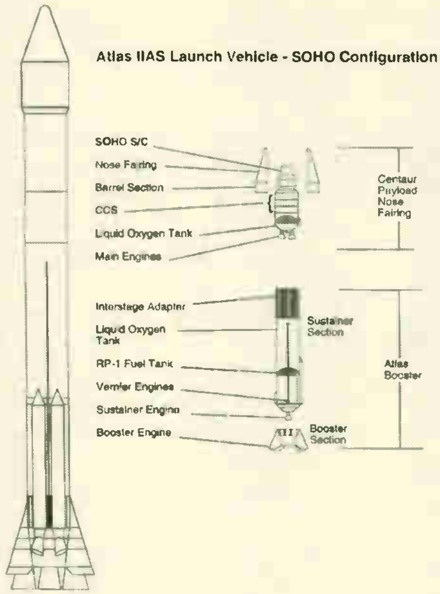
SOHO — the Solar and Heliospheric Observatory — is the most sophisticated solar observatory on or off the Earth.

By Philip Chien, Earth News

A joint ESA-NASA project, *SOHO* was launched last November on an Atlas IIAS launch vehicle. ESA was responsible for the spacecraft, data archive and distribution, and program management. NASA obtained the launch vehicle commercially, provided the Deep Space Network (DSN) for communications and tracking, performed mission and science operations and data processing. Both parties provided scientific instruments and everybody shares the scientific data. The total cost to the European Space Agency and NASA was about $1 billion for the spacecraft, instruments, launch vehicle, ground systems, and two years of operations.

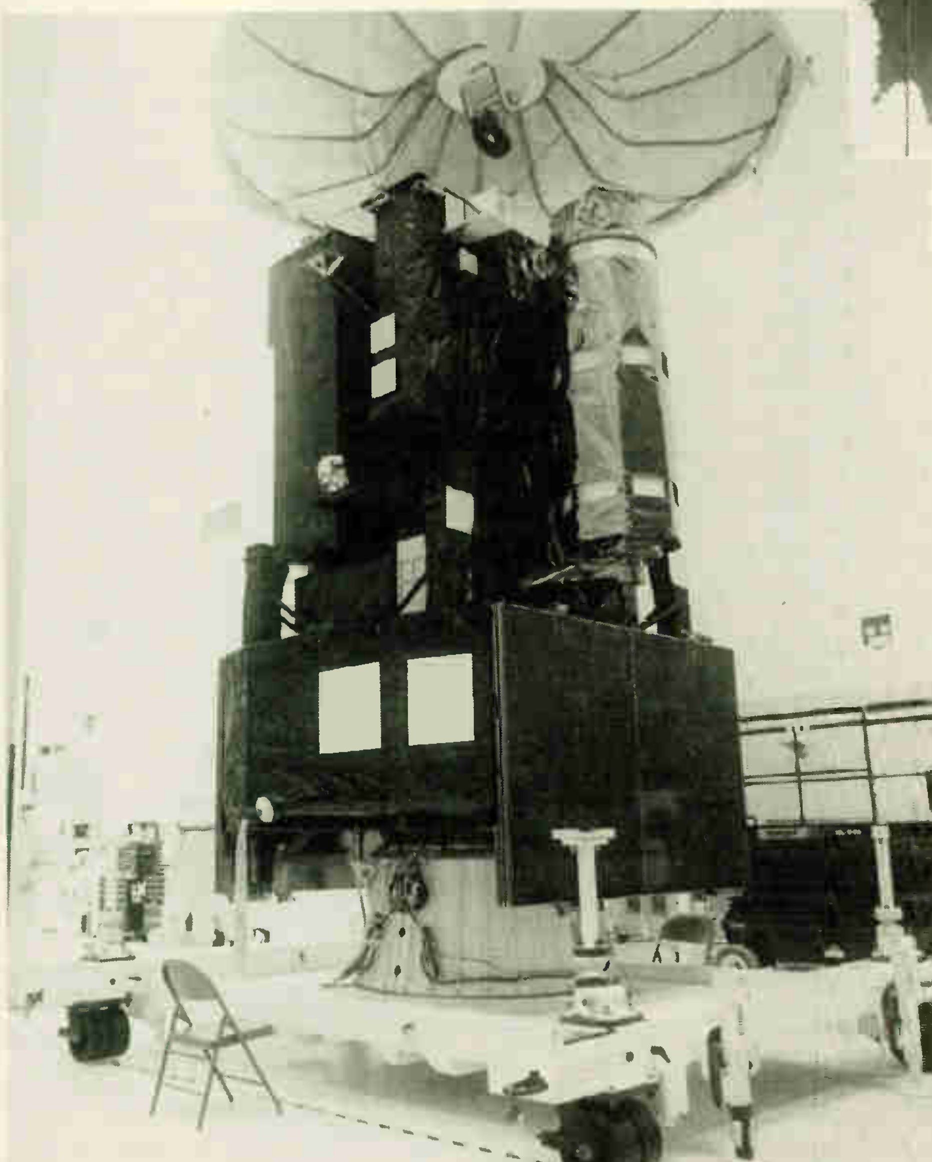
The normal planned spacecraft lifetime is two years, but *SOHO* carries enough propellant for six years. Considering the incredibly high cost of building *SOHO* and the relatively low cost to keep it in operation, it's likely that the mission life will be extended.

SOHO has been called "Europe's Hubble" and the comparison is apt. Both are incredibly expensive spacecraft, with grand promises for expanding our knowledge about the universe. Both go well beyond the capabilities of their predecessors and offer much more sophisticated instruments.



RIGHT: SOHO lifts off from complex 36B at Cape Canaveral, Florida on December 2, 1995.

LEFT: A diagram of the Atlas II rocket showing payload.



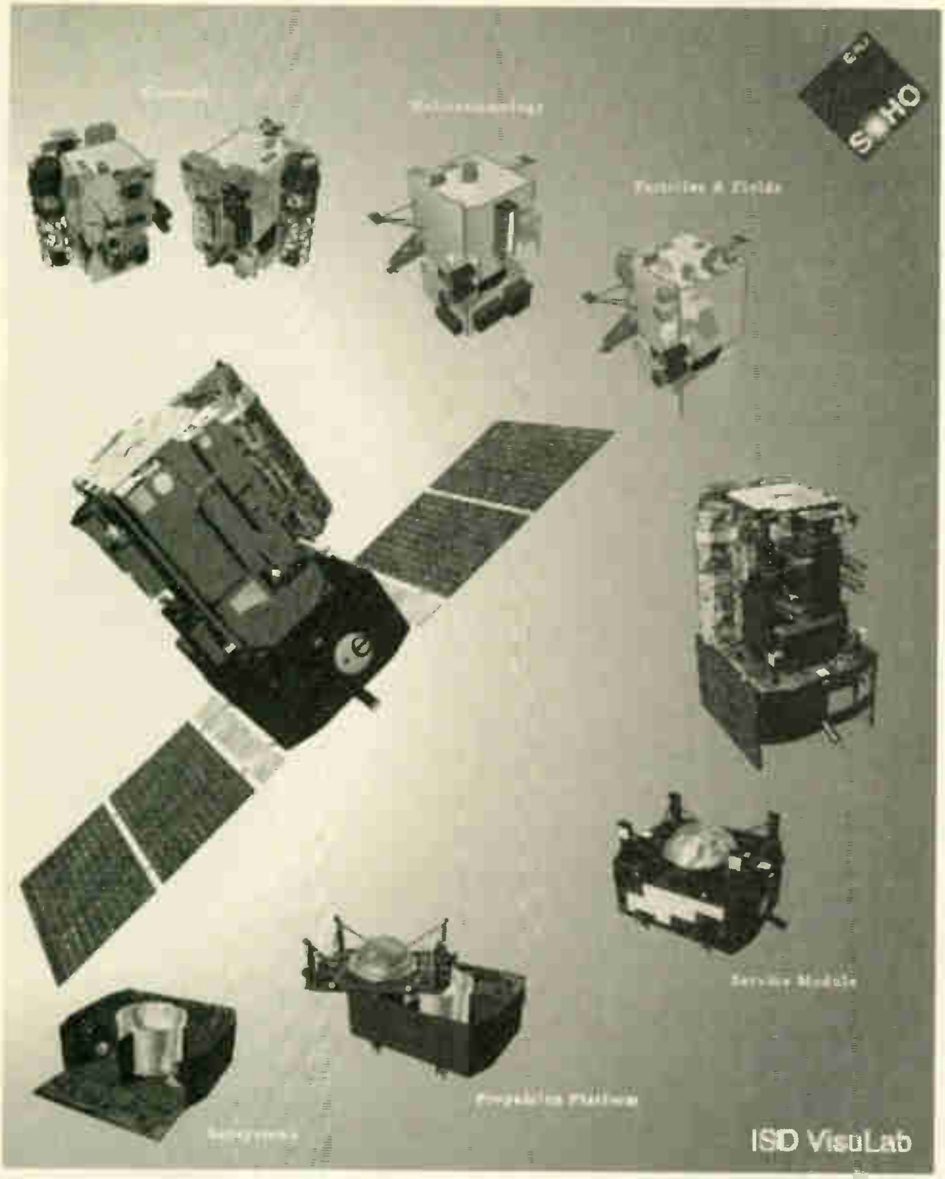
Technicians complete final checkout of the SOHO. (ESA)

SOHO's key objectives are the study of the solar corona and the study of the solar structure and interior dynamics. *SOHO*'s instruments will take photos, measure magnetic fields, measure the solar constant and how it changes over time, and how the solar wind leaves the sun on its way to the Earth. The solar wind can be measured directly, and other solar measurements can be made in far greater detail.

The spacecraft measures 3.7 meters (12.1 feet) in diameter and 3.8 meters (12.5 feet) in height. At launch it weighed approximately 1,850 kilograms (4,080 pounds). The solar arrays produce 750 watts of power. *SOHO* was one of the first spacecraft to use silicon carbide mirrors. Silicon carbide is an incredibly hard material, and computer-controlled diamond drills were used to grind and polish the mirrors.

The spacecraft has one gigabyte of onboard storage, and can downlink its data at 220 kbits per second to S-band antennas located at the three DSN stations in Canberra, Australia, Goldstone, California, and Madrid, Spain. *SOHO*'s downlink frequencies range from 2.200 to 2.290 GHz. Uplinks range from 2.025 to 2.110 GHz. The engineering telemetry channel operates at 1-kbps and the science downlink is at 45 kbps.

SOHO builds on the experience gained from the early Orbiting Solar Observatory

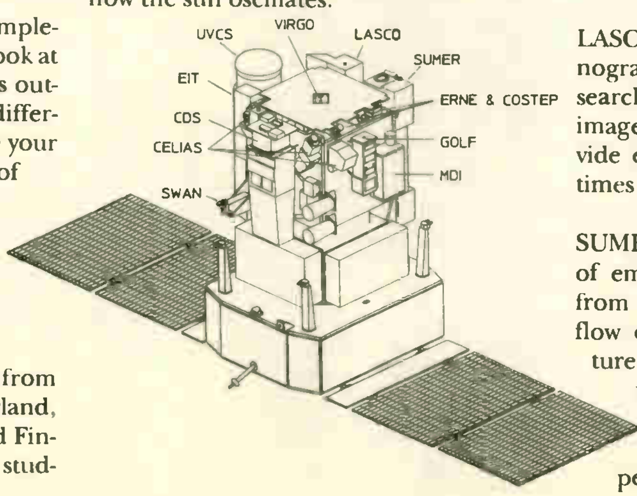


(OSO) spacecraft, Skylab's solar telescopes, the Solar Maximum Mission, and the *Spacelab 2* mission. Increases in technology have resulted in much more sophisticated capabilities; one camera is already 30 times faster than similar cameras used on Skylab.

Together, *SOHO*'s different complementary instruments offer a broad look at how the sun works, and at the sun's output. In the same way a doctor uses different types of instruments to measure your body, *SOHO* uses different types of instruments to measure the sun. And, like a doctor's medical instruments, some of *SOHO*'s instruments monitor the sun directly while others measure it from a distance.

SOHO's twelve instruments come from the United States, France, Switzerland, Germany, the United Kingdom, and Finland. The three key areas of *SOHO*'s studies are the structure and dynamics of the sun's interior, the sun's corona, and the solar wind.

The three helioseis-mology experiments are GOLF, VIRGO, and SOI/MDI. They will actually look for "sun-quakes"—how the sun oscillates.



GOLF: Global oscillations at low frequencies experiment was provided by France. GOLF will probe the deepest internal core structure of the sun by measuring the spectrum of free global oscillations.

SOI/MDI: Solar oscillations investigation/Michelson doppler imager was provided by Stanford University in the U.S. SOI/MDI will measure the internal stratification and dynamics of the sun by means of precise line-of-sight velocity measurements with mapping of the surface waves.

VIRGO: Variability of solar irradiance and gravity oscillations was provided by Switzerland. VIRGO studies the irradiance and radiance of the sun with high precision, stability, and accuracy.

The solar atmosphere, including the corona and chromosphere, is monitored by SUMER, CDS, EIT, UVCS, LASCO, and SWAN. Normally the sun's corona is only visible during an eclipse. In space, without the blurring effects of the Earth's atmosphere, a blocking disk can be used to create an artificial eclipse for a coronograph.

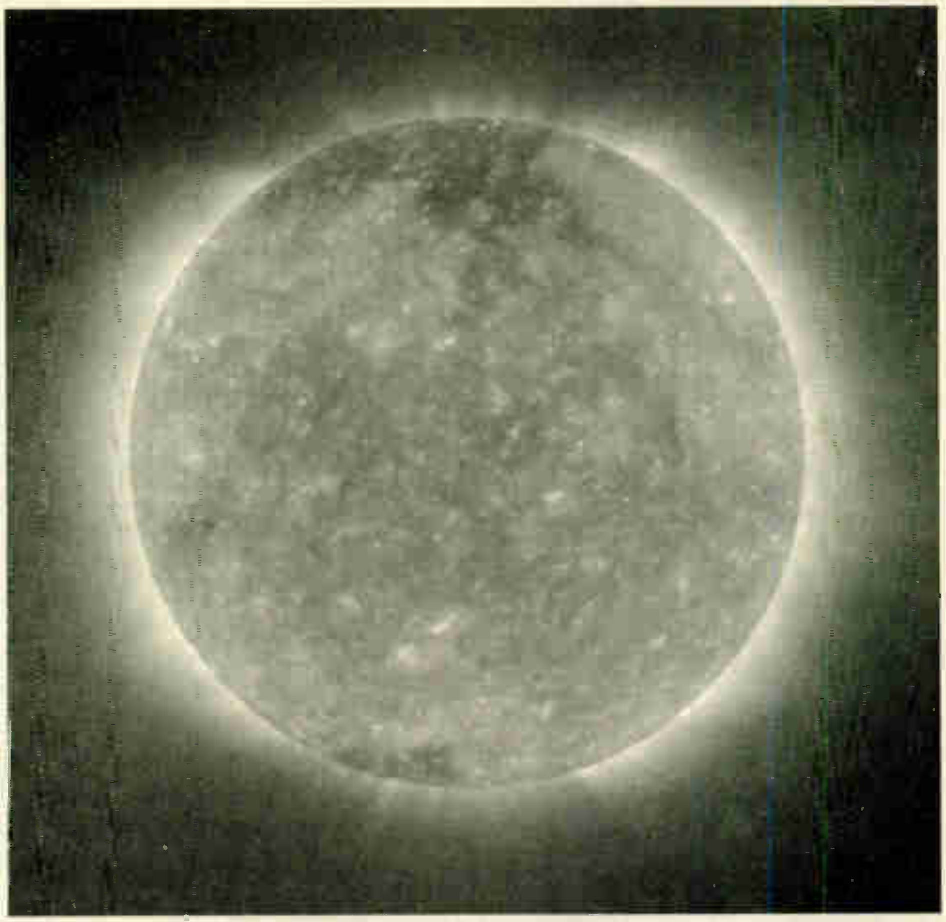
CDS: Coronal diagnostic spectrometer came from the United Kingdom. CDS obtains intensity ratios of selected extreme ultraviolet spectral line pairs simultaneously across a large portion of the solar atmosphere for studies of mass balance and energy flow.

EIT: Extreme ultraviolet imaging telescope came from France. EIT provides high resolution images of the entire sun at several temperatures, providing context for the spectral observations.

LASCO: Large angle spectroscopic coronograph came from the U.S. Naval Research Laboratory. LASCO's panoramic images show coronal structure and provide electron count densities out to 15 times the sun's diameter.

SUMER: Solar ultraviolet measurements of emitted radiation experiment came from Germany. SUMER studies plasma flow characteristics including temperature, density, and velocity in the sun's upper atmosphere.

SWAN: Solar wind anisotropies experiment came from France. SWAN



Daily images of the sun (top) are one highlight of SOHO's extensive web site (home page shown below, left).

measures the latitude distribution of the solar wind mass flux and variations in the distribution.

UVCS: Ultraviolet corono-graphic spectrometer came from the Smithsonian Astronomical Observatories in the U.S. UVCS provides electron and ion temperatures, densities, and velocities from ultraviolet spectroscopic observations of the solar corona out to several radii from the sun's center.

The solar wind is monitored by CELIAS, COSTEP, and ERNE. Outside of the Earth's protective magnetic field, *SOHO* is in an excellent position to measure the solar wind with instruments sensing the particles and electrical fields directly.

CELIAS: Charge, element, and isotope analysis system came from the Max Planck Institute in Germany. CELIAS measures the mass, ionic charge, and energy of the low and high speed solar wind, superthermal ions, and low energy flare particles.

COSTEP: Comprehensive suprathermal and energetic particle analyzer came from Germany. COSTEP uses particle emissions from the sun over a wide range of chemicals and energies as tools to analyze the composition of the solar superthermal and energetic particles.

ERNE: Energetic and relativistic nuclei and electron experiment came from Finland. ERNE operates with COSTEP to monitor the solar atmosphere and outer heliosphere by detecting particles produced by various solar energy release processes.

Since the sun is *SOHO*'s objective, the best orbit would be one where the Earth never gets in the way. Scientists chose to put *SOHO* at the L1 Lagrange point. The L1 point lies directly between the Earth and the sun, at the point where the sun and Earth's gravitational forces balance.

Since the sun is much more massive than the Earth, the point is 1.5 million km (930,000 miles) from the Earth—one hundredth of the distance from the Earth to the sun. *SOHO* isn't placed exactly at that point, though; it travels in a halo-shaped oval around L1, which is more stable and better for communications. L1 is well outside the Earth's protective magnetosphere, permitting *SOHO* to make direct, on-site measurements of the solar wind. Since the Earth is always on the opposite side of the sun, *SOHO* is in constant sunlight—the only time its batteries were required were for about 20 minutes during its launch phase. *SOHO* scientists can operate the spacecraft directly for twelve hours each day. The rest of the time the data is stored on the spacecraft, and then relayed to the science center.

While *SOHO* is designed as a research spacecraft, it can also function as a "solar weather satellite." Potentially, *SOHO* can give one hour's advance notice that a solar storm is on the way, or coronal measurements may indicate an upcoming solar flare. *SOHO*'s data is piped directly to the Space Environment Laboratory in Boulder, Colorado, which is responsible for space weather monitoring. If it receives the warning in time, the SEL can send out warnings that *SOHO* detects major upcoming solar activity.

One of *SOHO*'s unique features is a daily view of the sun for the public. *SOHO*'s worldwide web site is automatically updated each day with a new image of the entire Sun's surface. Sample data from other scientific investigations is also available. That URL is:

http://sohowww.nascom.nasa.gov/

ST

Phase 3-D Slated to Launch in April 1997

In a published report released Thursday, September 26, by the European Space Agency (ESA), Mr. Jean-Marie Luton, director general of ESA, and Mr. Alain Bensoussan, chairman of CNES (the French Space Agency) announced that the launch of Ariane 502 has now been tentatively set for mid-April, 1997. It was also confirmed that the Phase 3-D international amateur radio satellite will be on this flight. The other payloads are to be a pair of technological measurement packages for validation of the launch vehicle's ability to place two satellites into a geostationary transfer orbit (GTO).

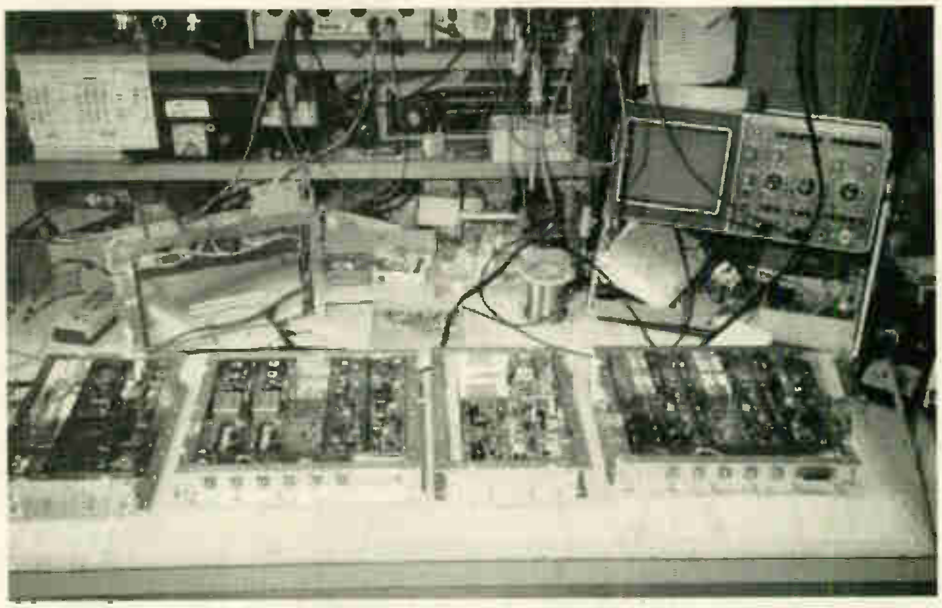
ABOVE: A close-up view of the "business end" of Phase 3-D's 400 Newton kick motor in the Marburg Lab. The motor will burn a hypergolic mixture of hydrazine and nitrogen tetroxide to propel Phase 3-D toward its final orbit. The motor's "high tech" shipping container (a well padded oil drum!) is also visible in the background.

LEFT: Dr. Andras (Bandl) Gschwindt, HA5WH, proudly displays Phase 3-D's Battery Charge Regulator (BCR) at the Marburg P3-D Lab. The BCR is a critical piece of Phase 3-D flight hardware that will control all the spacecraft's onboard power activity such as regulating battery charging from the solar panels. The BCR was expertly built by Bandl and his team at the Technical University of Budapest, Hungary.

These announcements came during a joint ESA-CNES press conference at ESA Headquarters in Paris called to outline the respective plans of the two agencies to correct identified deficiencies in the Ariane 5 launch vehicle. The actions are in direct response to a comprehensive report submitted in July by the Ariane 501 inquiry board that was chartered to investigate the loss on launch of the first Ariane 5 booster in early June.

During the press conference, it was also reported that ESA's atmospheric reentry demonstrator (ARD), a technology demonstration capsule for a future European manned space transport vehicle, along with an as yet unspecified commercial payload, is to be flown on a subsequent Ariane 5 vehicle, Ariane 503, which has been made a part of the Ariane-5 qualification process. This flight could take place in September 1997. The ARD had earlier been slated to fly on Ariane 502 along with the *AMSAT Phase 3-D satellite*.

Mr. Luton and Mr. Bensoussan outlined several specific actions that are now being taken by ESA and CNES to assure the correction of software contained in the Ariane 5 inertial reference system. Errors in this software were previously reported by ESA as being one of the primary causes of the Ariane 501 failure. Corrective actions include making changes to the Ariane 5 Functional Simulation Facility to make the qualification tests more representative of the flight



Some flight electronic modules for the Phase 3-D International Satellite undergo final bench testing at the AMSAT-DL Laboratory in Marburg, Germany prior to their shipment to Orlando, Florida for integration into the satellite.

environment, as well as performing a comprehensive review of all the embedded software contained in the launch vehicle.

ESA and CNES also announced that the industrial architect on the Ariane project will henceforth assume the role of "software architect". This change will allow not only for verification of all software incorporated in equipment but also will help insure the overall functional integrity of the launcher. Mr. Luton and Mr. Bensoussan went on to note that this means that all of the launch vehicle's software will now become subject to qualification reviews in which outside experts will take part.

In addition, the joint ESA and CNES announcement reported that working methods used in the launcher qualification review have now been modified to introduce specialized audits on the most complex launcher systems in order to provide closer analysis wherever this is deemed necessary. A comprehensive review of the launcher's qualification is now also reported to be underway along with systematic efforts to identify "degraded" modes of operation that could affect launcher elements.

At the AMSAT-DL Phase 3-D Laboratory in Marburg, Germany, AMSAT-NA Vice President for Engineering Dick Jansson, WD4FAB (Right), holds a prototype L Band antenna feed that was constructed by Freddy de Guchteneire, ON6UG (Left).

AMSAT is a not-for-profit, 501 (c) (3) educational and scientific organization that was first chartered in Washington, D.C. Its objectives include promoting space research and communication by building, launching and controlling amateur radio spacecraft. Since its founding, over 25 years ago, many other like-minded organizations have been formed around the world to pursue the same goals and who now also share the AMSAT name. Often acting together, these groups have used predominantly volunteer labor and donated resources to design, construct and, with the added assistance of government and commercial space agencies, successfully launch, over two dozen amateur radio communications satellites into Earth orbit.

The Phase 3-D satellite, now under construction with the help of over a dozen AMSAT groups on five continents, will be the largest, most complex, and most expensive amateur radio satellite ever built.

Photos of the some of the various units appear in this issue of *Satellite Times*. These photos are courtesy of Keith Baker, KB1SF and AMSAT. In depth coverage of the launch of this important amateur satellite is planned for a future issue of *ST*. ST

AMSAT-NA Vice President, Engineering Dick Jansson, WD4FAB (Right), and AMSAT-DL's Konrad Mueller, DG7FDQ (Left), perform a final inspection of Phase 3-D's 400 Newton kick motor in Konrad's well-equipped machine shop at AMSAT-DL prior to its shipment to Orlando for integration. The motor is of the same design that successfully powered both AO-10 and AO-13 to their final orbits.

Phase 3-D Frequencies

With Phase 3-D being launched next Spring now is the time to start putting together your Phase 3-D station. These are the final AMSAT Phase 3-D frequencies (crystals have been ordered) and have been coordinated with IARU bandplans. These frequencies are courtesy of the AMSAT News Service.

UPLINKS

BAND (MHz)	DIGITAL (MHz)	ANALOG (MHz)	CENTER (MHz)
15m	none	21.210-21.250	21.230
2m	145.800-145.840	145.840-145.990	145.915
70cm	435.300-435.550	435.550-435.800	435.675
23cm(1)	1269.000-1269.250	1269.250-1269.500	1269.375
23cm(2)	1268.075-1268.325	1268.325-1268.575	1268.450
13cm(1)	2400.100-2400.350	2400.350-2400.600	2400.475
13cm(2)	2446.200-2446.450	2446.450-2446.700	2446.575
6cm	5668.350-5668.550	5668.550-5668.800	5668.675

DOWNLINKS

BAND (MHz)	DIGITAL (MHz)	ANALOG (MHz)	CENTER (MHz)
10m	29.330+/-5 kHz	(To be used for digitized voice bulletins)	
2m	145.955-145.990	145.805-145.955	145.880
70cm	435.900-436.200	435.475-435.725	435.600
13cm	2400.650-2400.950	2400.225-2400.475	2400.350
3cm	10451.450-10451.750	10451.025-10451.275	10451.150
1.5cm	24048.450-24048.750	24048.025-24048.275	24048.150

All downlink passbands are inverted from the uplink passbands.

BEACONS

Band	*Beacon-1*	*Beacon-2*
2m	none	none
70cm	435.450	435.850
13cm	2400.200	2400.600
3cm	10451.000	10451.400
1.5cm	24048.000	24048.400

ST THE VIEW FROM ABOVE

By Hank Brandli

Nighttime Visual Photos Spot Re-Entry Vehicles (or UFO's)

In 1975, an article was published in *Weatherwise* magazine, entitled: *Satellite Picture of Meteor over Central Pacific Ocean* (Kim, J.S.S. Vol. 28 no. 6, pp 258-259). This photo shown in figure 1, stated that a meteor could be seen on the DMSP nighttime visual imagery. At the time, researchers indicated it was not a man-made space object re-entering the atmosphere.

Figure 2 is a DMSP nighttime visual on November 13, 1994, at approximately 0028 UTC. North of Chicago, a curved line, separating slightly, can be seen from northwest to southeast. NASA Goddard Space Flight Center indicated that no objects were listed as having decayed on that date.

Several years ago, I was called by a well-known astronomer who stated that he felt the meteor trail published in 1975 was not a meteor at all. Due to its high speed, a meteor re-entry would be expected to show a path length of only a second or two. These photos (Figures 1 and 2) indicate that the time for these bright curved lines is approximately 30 seconds or so.

The DMSP scanning radiometer goes completely around the Earth in 101 minutes—or approximately 3.6 degrees per minute. These DMSP night visual photos show a latitude traverse of at least a degree of more (not consistent with a meteor re-entry).

What could this be? If it's not a meteor, and it's not a re-entry vehicle of the U.S., Russia, or some other country, it must be a UFO!

Ironically, I had had a dozen or more so-called meteor trail night visual images in my files for years, but disposed of them before I made the UFO connection.

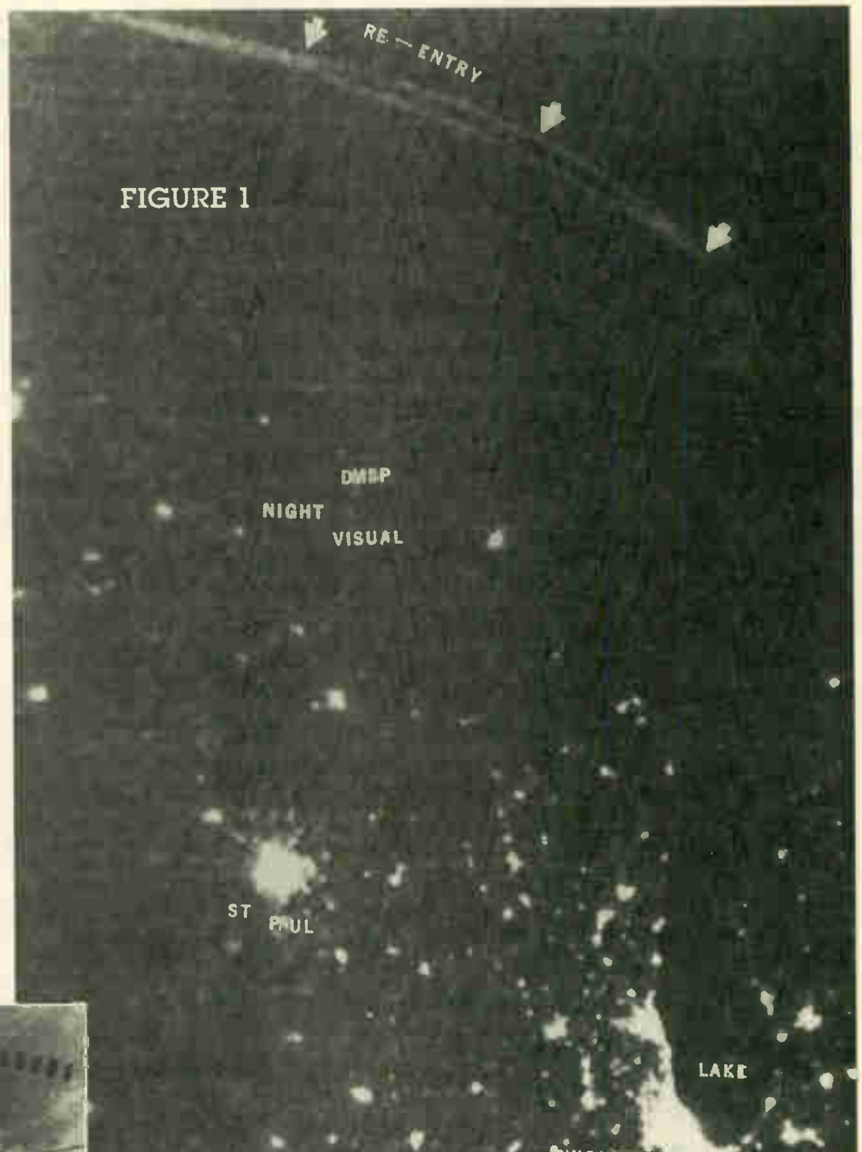


Figure 1: The above nighttime DMSP imagery was taken over the Pacific Ocean on a decending nodal pass on November 20, 1974. The lights of Oahu are clearly seen as well as moonlit clouds. The resolution of this DMSP sensor is 2 nautical miles. The spectral interval is .4 to 1.1 microns. In the lower left hand corner passing over Johnston Island is what appears to be a meteor trail. Research indicated that there was no man-made space object re-entering the atmosphere at this time and location. The DMSP radiometer scanned the path at 0554 UTC +/- 30 seconds.

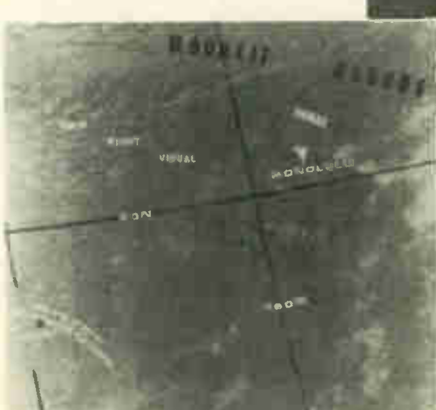


Figure 2: Nighttime DMSP visual, no moonlight, of the north central United States and southern Canada.

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

New OSCARs Are Born

The amateur radio service gained two new communication satellites during the summer of 1996. They include *Fuji-OSCAR 29* (*FO-29*)—a successor to the *Fuji-OSCAR 12* and *Fuji-OSCAR 20* satellites, and *Mexico-OSCAR 30* (*MO-30*)—a microsatellite containing a Pacsat store-and-forward communications package in addition to a commercial meteor ranging experiment.

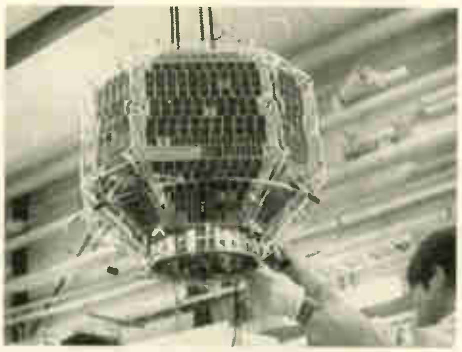
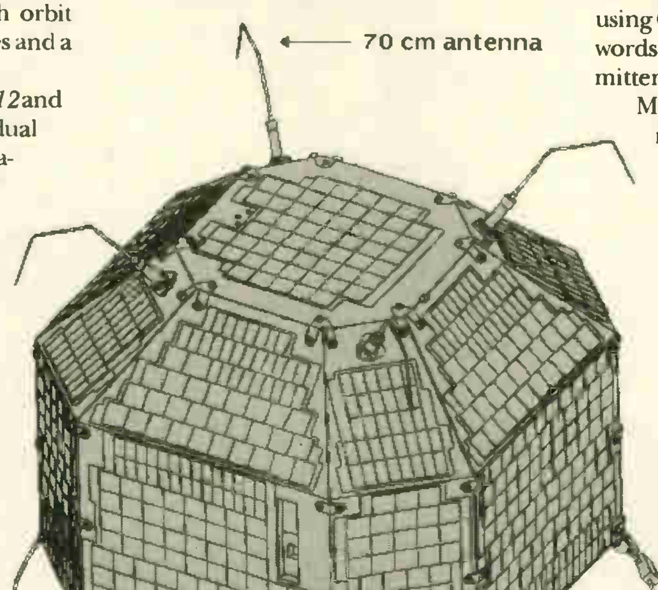


FIGURE 1: ***Fuji-OSCAR 29 undergoing construction in Japan. (JARL Photo)***

FIGURE 2: ***Drawing of Fuji-OSCAR 29 showing polyhedron shape, solar cells, and placement of antennas around the spacecraft. (JARL Photo)***



Fuji-OSCAR-29

Fuji-OSCAR-29 is the third in a family of amateur satellites brought to us by the Japanese Space Agency NASDA and Japan's Amateur Radio League (JARL). *Fuji-OSCAR 29*, known as *Fuji-2* prior to launch, was launched on July 17, 1996, at 0154 UTC from the Tanegashima Space Center in southern Japan along with NASDA's Advanced Earth Observing Satellite (*ADEOS*) into a nominally circular low-earth orbit having an inclination of 98.5 degrees and a nodal period of 106.5 minutes.

Like its older sisters *Fuji-OSCAR 12* and *Fuji-OSCAR 20*, *Fuji-OSCAR 29* has a dual personality. *FO-29* carries both analog and digital store-and-forward communication transponders that accept uplinks in the 2-meter band, and produce downlinks in the 70-cm band. It also carries some new features including a voice synthesizer based around National Semiconductor's "Digitalker" chip, and a high-speed (9600 baud) packet radio mailbox, as well a new and improved attitude control system.

Fuji-OSCAR 29 carries an inverting analog transponder that accepts uplinks between 145.900 MHz and 146.000 MHz, and relays them back to Earth within a downlink passband between 435.800 MHz and 435.900 MHz.

Since the transponder is analog, it will faithfully reproduce any communications mode, although modes containing a constant carrier such as amplitude modulation (AM) and frequency modulation (FM) are discouraged due to the heavy power consumption they impose on the transponder and the continuous current drain this places on the storage battery. Low duty cycle modes such as single sideband (SSB) voice and continuous wave (CW) telegraphy, on the other hand, are perfectly acceptable.

Since the transponder is inverting, a lower sideband (LSB) voice uplink produces an upper sideband (USB) downlink through the transponder. A lower sideband voice uplink should be used when communicating via *Fuji-OSCAR 29*, since it is by gentleman's agreement that all single sideband voice communications through OSCAR transponders are to be made in such a way as to produce an upper sideband downlink.

When in analog mode, *Fuji-OSCAR 29* transmits spacecraft telemetry information using CW Morse telegraphy at a speed of 12 words per minute through a beacon transmitter operating on a frequency of 435.795 MHz. 435.910 MHz is used as a packet radio downlink, as well as an output for the spacecraft's Digitalker.

Flying Mailbox In Space

Fuji-OSCAR 29's digital communications transponder functions similarly to that of a packet radio mailbox or bulletin board system. While the majority of the Pacsat satellite constellation uses an FTL0 communications protocol and compatible client software that must be run at groundstations for communications with these satellites, the Fuji-series of amateur satellites uses a simple mailbox system that requires no special communications software at groundstations. A dumb terminal or a PC running a simple telecommunications program is all that is required, in addition to a terminal node decoder (TNC), Pacsat mo-

While the majority of the Pacsat satellite constellation uses an FTL0 communications protocol and compatible client software ... the Fuji-series of amateur satellites uses a simple mailbox system that requires no special communications software.

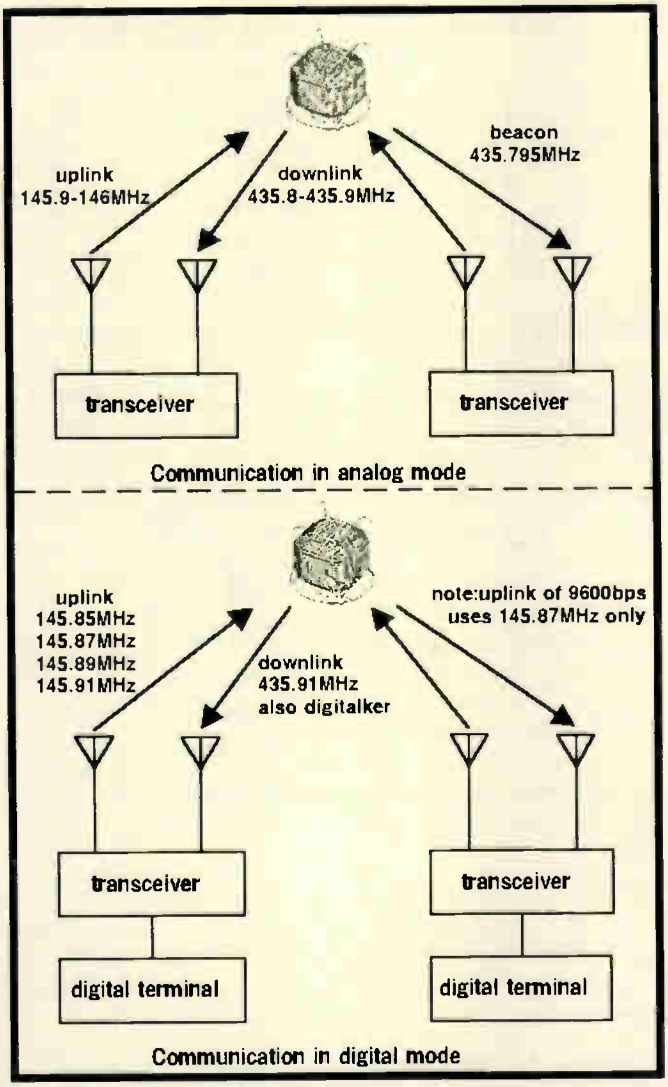


FIGURE 3: *Fuji-OSCAR 29 communication modes (JARL Photo)*

dem, and groundstation radio equipment. Table 2 lists the keyboard commands understood by the *Fuji-OSCAR 29* packet radio mailbox.

Fuji-OSCAR 29 operates at speeds of 1200 bits per second and 9600 bits per second. The commands understood by the mailbox are the same regardless of the speed of the satellite. At 1200 bps, the satellite accepts Manchester encoded frerquency shift keying (FSK) signals on an uplink of either 145.850, 145.870, 145.890, or 145.910 MHz. A single downlink on 435.910 MHz uses binary phase shift keying (BPSK) modulation, and is consistent with previous Fuji-OSCAR satellites, as well as *AMSAT-OSCAR 16*, *WEBERSAT-OSCAR 18*, *LUSAT-OSCAR 19*, *ITAMSAT-OSCAR 26*, and the *Mexico-OSCAR 30* satellite which will be discussed later. At 9600 bps, the satellite accepts FSK signals on a frequency of 145.870 MHz, and produces a single downlink on 435.910 MHz also using FSK modulation. This is consistent with the capabilities of the popular G3RUH modem that is used for both terrestrial as well as UoSAT and KITSAT-based satellite communications at 9600 baud.

As stated earlier, no special groundstation software is needed to access the *FO-29* mailbox; however, groundstations must remember to set their TNCs for full duplex communications (FULLDUP ON) prior to connecting to the satellite. The callsign used to connect with *Fuji-OSCAR 29* is 8J1JCS, and users are allowed ten minutes of access time per connection.

Mexico-OSCAR-30

Mexico-OSCAR 30 is a microsatellite similar in appearance, weight, and construction to earlier "microsats" such as *AMSAT-OSCAR 16*, *DOVE-OSCAR 17*, *WEBERSAT-OSCAR 18*, *LUSAT-OSCAR 19*, and *ITAMSAT-OSCAR 26*. By definition, any satellite weighing less than 50 kilograms is considered a microsatellite. *Mexico-OSCAR 30*, weighing in at only 10 kilograms, is well within this criteria.

Mexico-OSCAR 30, known as *UNAMSAT-B* prior to launch, is a product of the University Program of Space Research and Devel-

MO-30's primary mission is that of a meteor sounder. The satellite contains a 60-watt pulsed transmitter that operates on a frequency of 40.997 MHz ... The meteor sounder's purpose is to obtain research data on the ... distribution of meteors, with the focus on a search for high-velocity meteors originating outside our solar system.

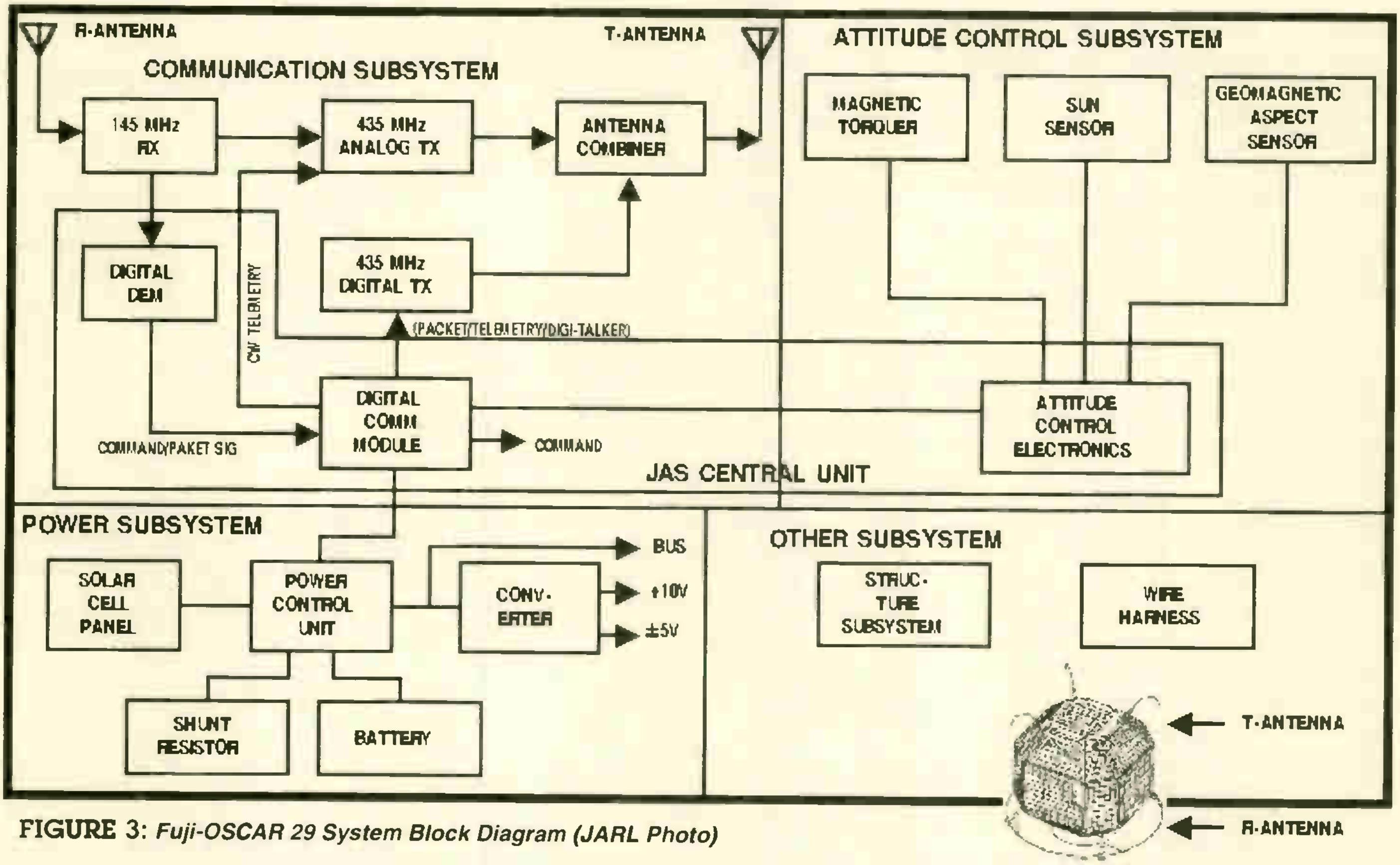


FIGURE 3: *Fuji-OSCAR 29 System Block Diagram (JARL Photo)*

opment (PUIDE) in Mexico. It was launched on September 5, 1996, at 1347 UTC, along with a Russian *Cosmos 2334* satellite from Plesetsk, Russia. While other microsatellites exist that carry amateur radio "Pacsat" transponders, *MO-30* is the first to also carry an astronomical experiment.

MO-30's design goals included the elimination of wire harnesses within the satellite's sub-assembly wherever possible, since such harnesses are frequently points of failure within a spacecraft and are very time-consuming to construct. *MO-30* also incorporated the use of a mechanical structure that can be assembled and disassembled in less than 30 minutes; the use of a solar panel array that can be rapidly installed on the spacecraft with minimum damage; the use of power management techniques that dynamically adjust the satellite's transmitter power output to balance the power budget of the satellite; the incorporation of a computer with multichannel serial communication capabilities; having a minimum storage capacity of 4 megabytes using static RAM that consumes less than 1.0 watt of maximum power; while keeping the total satellite package under 12 kilograms for easy launch.

These goals, as rigid as they seem, were met not once, but twice. *Mexico-OSCAR 30* is actually the twin of an earlier UNAMSAT satellite that was destroyed during an unsuccessful launch from Plesetsk, Russia, on March 28, 1995. Had it not been for these design goals, it would have taken much longer and been much more costly to duplicate and launch the spacecraft within such a short period of time.

MO-30's primary mission is that of a meteor sounder.

TABLE 1: *Several messages were posted on FO-29 in late August shortly after its launch while spacecraft testing was taking place.*

No.	Date	UTC	To	From	Size	Subject
0020	01/01	10:19	ALL	ZS6BMN	21	Great new satellite!
0018	01/01	09:14	ALL	AL7OB	272	GREETINGS FROM ALASKA!
0017	01/01	08:55	G6SVJ	ON4DY	203	First JAS2 try
0016	01/01	07:20	W9ODI	EI6EH	0	
0015	01/01	07:17	W9ODI	EI6EH	61	
0014	01/01	07:04	SV8RV	SV3KH	139	KALHSPERA DENIS
0013	01/01	05:46	ALL	KO6RD	139	?
0012	01/01	05:38	JF1AJE	EI6EH	86	Hi from Tom, EI6EH UTC: 18:22:30 on 0
0011	01/01	05:35		EI6EH	0	
0010	01/01	04:04	EI6EH	W9ODI	90	GREETINGS
0009	01/01	03:53	JF1ATE	EI6EH	1	
0008	01/01	03:50	JF1AJE	EI6EH	92	QSL..
0007	01/01	02:18	JF1AJE	W4IMT	122	Hello from Music City
0006	01/01	02:16	JF1ATE	EI6EH	0	
0005	01/01	01:52	ALL	JF1AJE	42	CQ
0004	01/01	01:47		JF1AJE	0	
0003	01/01	00:29	F3ZD	DL1TV	0	
0002	01/01	00:25	DL6KG	DL1TV	16	Freude
0001	01/01	00:22		DL1TV	0	

As OSCAR satellites get smaller, lighter, less expensive, and easier to build, the number of microsatellites serving in the amateur radio service will continue to increase.

The satellite contains a 60-watt pulsed transmitter that operates on a frequency of 40.997 MHz. The RF pulses from the transmitter can have a duration of between 1 and 10 milliseconds, and a repetition rate of between 1 and 10 seconds, all controlled by a 68HC05 CPU. The echoes received from passing meteors are detected on a receiver designed to measure their Doppler shift. The meteor sounder's purpose is to obtain research data on the full-sky spatial and velocity distribution of meteors, with the focus on a search for high-velocity meteors originating outside our solar system.

The 41 MHz frequency for this transmitter is in accordance with ITU frequency allocations for scientific research. The transmitter consists of a crystal controlled exciter and a class "E" power amplifier. Designers state that it is theoretically possible to receive echos of the transmitter via the ionized trail of meteors while *Mexico-OSCAR 30* passes below one's horizon.

The meteor receiver is an SSB "zero-IF" design that was suggested by Dr. Tom Clark, W3IWI. The echoes received from passing meteors are digitized and stored in the normal V40 Microsat computer's RAM. After each pulse, the spectrum of the received signal is determined using the onboard V40, which functions as a DSP Fourier Transform spectrum analyzer. If a meteor echo is detected, it is saved for later transmission as a special telemetry frame.

The 1-10 second repetition rate for the meteor transmitter is adjusted depending on the state of charge of the batteries, other spacecraft power requirements, and on the time domain requirements of the echoes.

When *MO-30* is not involved in meteor research, it is available to amateur radio operators as a "Pacsat" satellite. *MO-30*'s digital transponder operates at a rate of 1200 bits per second and carries uplink receivers on 145.815, 145.835, 145.855, and 145.875 MHz. *OSCAR-30*'s primary downlink is on 437.206 MHz, while its secondary transmitter operates on 437.138 MHz. The RF modulation, file transfer protocols, and antenna polarizations associated with *OSCAR-30* are consistent with those of the remaining constellation of 1200 baud communication satellites employing the Pacsat file transfer protocol.

TABLE 2:
An early message carried on Fuji-OSCAR 29

No.	Date	UTC	To	From	Size	Subject
0018	01/01	09:14	ALL	AL7OB	272	GREETINGS FROM ALASKA!

Hello All from Anchorage Alaska!

It is overcast and 16C here today...great fishing weather. I am uplinking with 12 ele. vertical yagi and recvng with 4 stacked 12 ele yagis horiz polarized.

Very good sigs here in Anchorage.

73
Mike, AL7OB

Conclusion

Fuji-OSCAR 29 and *Mexico-OSCAR 30* are the latest in the long series of communication satellites that are part of the OSCAR program. As OSCAR satellites get smaller, lighter, less expensive, and easier to build, the number of microsatellites serving in the amateur radio service will continue to increase. Although the *AMSAT-OSCAR 13* satellite is expected to decay in the Earth's atmosphere in December, there are still many other OSCAR satellites available to serve all radio amateurs worldwide for many years to come. ST

TABLE 3:
Keyboard commands for navigating the Fuji-OSCAR 29 digital mailbox.

B:	List file headers addressed to ALL
F:	List file headers from latest
F<MM/DD>:	List file headers since posted day<MM/DD>
H:	Show help message
K<nnnn>:	Kill a file number<nnnn>
M:	List file headers addressed to current user
Q:	Disconnect(quit) JAS-2 mailbox
R<nnnn>+:	Read a file number<nnnn>+
U:	List current user(s)
Y:	More display
W:	Write a file
Y:	More display

By Donald E. Dickerson, N9CUE

VITASAT Provides Vital Communications Link

Starving babies in Africa is not the usual picture your mind conjures up when contemplating the most recent advances in satellite technology. Most of us are too busy wondering how our satellite-based skyfones and direct broadcast TV will work to even imagine how such technology could be applied to help people at the opposite end of the economic scale.

Such a contrast is appropriate, however, when we think of Volunteers in Technical Assistance (VITA). VITA has been instrumental in bringing the benefits of high tech satellite systems into several impoverished Third World countries. Seventy-five percent of the world's population live in developing countries where there is less than one telephone per 100 residents. VITA can provide a vital communications link to areas without telephones, much less electricity. VITA satellite data links provide information to various parties for disaster response, conservation and development programs, enterprise development, and communication services. They can even provide internet access from solar powered, laptop sized terminals.

VITA began using low earth orbit (LEO) satellites back in 1984. Its first venture was to lease access on a satellite built in the UK by AMSAT (Radio Amateur Satellite Corporation). This first experiment with packet radio proved a success. VITA later leased an entire spacecraft from AMSAT-UK (*UoSAT-OSCAR 14* and *UoSAT-OSCAR 22*).

By 1995 VITA had its own satellite built by CTA Incorporated. Unfortunately the Lockheed launch vehicle which carried their new satellite had to be destroyed by the range safety officer when problems developed during lift-off on August 15, 1995. Then in 1996 VITA entered an agreement with Final Analysis Inc., of Greenbelt, Maryland. VITA again plans to share the transponder space on yet another spacecraft (*FAISAT-2V*) which was scheduled for launch as this issue goes to press.

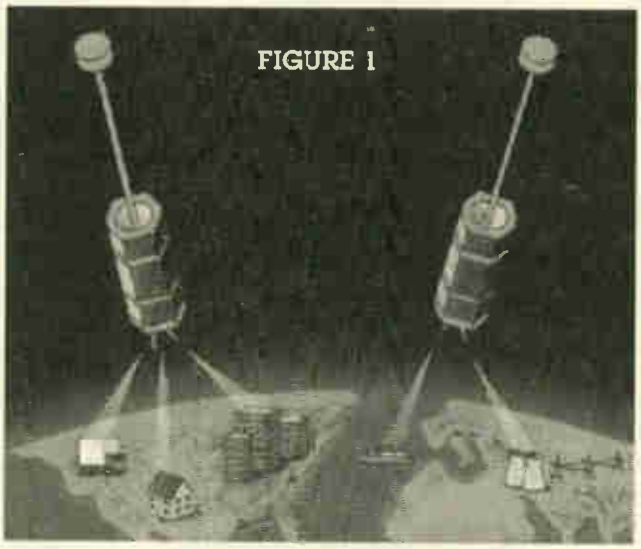


FIGURE 1

The *FAISAT-2V* (Final Analysis, Inc) spacecraft weights 198 pounds and measures 36-inches by 16-inches x 44-inches. It will orbit an altitude of 600 miles with an inclination of 83 degrees. The satellite will take 105 minutes to complete an orbit and move 26 degrees west per orbit. Once in orbit the communications footprint will stretch 2880 miles This means the satellite will be in view for approximately 10 minutes per orbit and will make a minimum of 4 orbits per day over each area of the world.

With the satellite-to-user station link operating at 9.6-kbps, a total of 40 minutes of operating time will allow for a large volume of traffic to flow to and from the field.

FAISAT-2V will carry two receivers that operate on two scanning overlapping channels in the 148.000 to 149.000 MHz band (uplink). The receivers can be switched between 2.4-, 9.6-, and 19.2-kbps The downlink frequency will be 400.505 and 400.595 MHz. The transmitters can operate at data rates between 9.6- and 38.4-kbps at 15 watts of RF. The antenna will be right-hand circularly polarized for both uplink and downlink. The satellite carries a GPS receiver and a Loral RS-6000 command and data handling processor with 16 megabytes memory. It also has deployable folding solar panels and is gravity gradient stabilized.

The *FAISAT-2V* will be launched from Plesetsk, Russia, on a Cosmos launch vehicle like the first satellite in the series *FAISAT-1*. Final Analysis, Inc. plans to launch 26 satellites from the Russian Cosmodrome at Plesetsk.

The major elements of the VITA system are shown in figure 1. The *FAISAT-2V* satellite operates in both the store-and-forward, and zero-delay repeater modes. The next element is the field station, consisting of a laptop size radio and packet modem known as a VITAPAC. These simple field stations will even be able to access the internet through a gateway station.

Each gateway station is equipped like the field station, with radio and packet modem, plus a Unix workstation. The Unix workstation is connected to the local area network (LAN) at the internet gateway facility which, in turn, is connected to the internet. There will be two primary internet gateway stations located outside the United States: one in Andenes, Norway, and the other in Capetown, South Africa.

Data terminals are industrial field stations used to communicate with the data service hubs which interface with leased lines, public switched networks (X.25 frame relay), or the internet. The satellite is accessed in the real-time repeater mode.

The network operations center (NOC) controls the operation of the satellite constellation and all internet gateways. In addition, the NOC performs billing and customer service functions, including technical support. Satellite control is performed at the network operations center through the VITA satellite telemetry, tracking, and control (TT&C) station that is located in Blacksburg. Virginia. This station is a fixed station and emergency backup control can be initiated through an internet gateway.

A remote user wanting to send an E-mail message to internet must have a DOS based PC using VITA software or their own internet RFC882 compliant software. The message is sent to a field station using the

FAISAT-2V will carry two receivers that operate on two scanning overlapping channels in the 148.000 to 149.000 MHz band (uplink). The receivers can be switched between 2.4-, 9.6-, and 19.2-kbps The downlink frequency will be 400.505 and 400.595 MHz.

RS-232 link. The field station then sends the message to the satellite on the next pass.

The VITA satellite scans the uplink band of 149.810 to 149.900 MHz at the start of every time division multiplex (TDM) frame. The sweep begins on the first 10 kHz channel of one receiver through 17 allowable 5 kHz segments. The specific frequency of two clear 10 kHz channels are determined. These two frequencies are sent to the field station to be used as uplinks. The field station will then request a time slot within the TDM frame. When the request is acknowledged, the field stations uplinks the messages in packets of up to 128 bytes in length. It should be noted that uplink request are allowed for a maximum of 10 percent of a TDM frame. All other uplinks are commanded by the VITA satellite through the downlink. These parameters apply to the United States only. Outside the U.S. 9.6-kbps on two 30 kHz wide channels are used with a maximum packet size of 512 bytes.

Under U.S. rules, software restrictions will enforce a packet transmission spacing of 15 seconds for any given frequency and a burst length of 450 milliseconds maximum. Finally, a burst counter limits the number of transmissions to 20 over a 15 minute interval; thus a one percent duty cycle limit is met. The result is that a field station operating at 2,400 bps can transmit a maximum of 2,560 bytes on a single assigned frequency in a single pass.

The packets are stored in the satellite communications processor until the spacecraft passes over an internet gateway. As the satellite appears over the horizon, the gateway will take control of the communications package and deny access to any field stations. The gateway will then command the communications processor to downlink the messages it has collected at either a 19.2- or 38.4-kbps data rate. Next it will uplink at 19.2-kbps any messages to remote users that have arrived at the gateway in time for the satellite pass. At the end of this sequence, the satellite will release control of the communications package. Downlink messages will then be processed by the Unix workstation and routed to their destination over the internet.

VITA also offers another service for commercial and industrial customers in the U.S. and elsewhere. VITA's data service provides a method for commercial interest to gather data from sparsely populated areas. This service allows users to send packet data from a data terminal to monitor environmental data or utility data, for example. This information can be downlinked directly to internet gateway stations when no other data service hubs exist in a particular area. While data service hubs will receive a large volume of data, they will transmit relatively little.

All data service hubs and data terminals in the U.S. operate under the same restrictions as the field stations. Like the internet gateways, these hubs are controlled by the network operations center. Unlike them, however, the data service hubs have direct links to the commercial and industrial customers for whom the data is being collected.

The data terminals can collect data from a single source or may act as concentrators for data collected from multiple sources through ground radio or power line transmission systems. In either case, as the VITA satellite comes into view of a population of data terminals, the VITA satellite will begin the data collection sequence by preforming a band scanning and frequency assignment sequence in the same manner as the E-mail service. The clear channel frequencies will be assigned to the data terminals which will then adjust themselves accordingly.

At this point, the satellite will transmit interrogation commands to the data terminals. Those that receive a command to transmit data will do so in their assigned time slot. The data from the terminals will then be received by the satellite for relay to a data service hub or internet gateway. Transmission of data by the data terminals and the data serviced hubs will be at 2,400 bps.

Compliance with U.S. telecommunications rules mandates a 15 second interval be maintained in the interrogation scheduling software at the data service hubs. The maximum the burst transmission can last is 450 milliseconds, the same as the E-mail service.

The hardware and the technology are only the mechanics of the VITA mission. What they deliver to developing countries is even more important than the method. Information can be downloaded to peasants anywhere in the world on methods of water purification, irrigation, crop development, medical procedures, and even how to build a crystal radio. This shared wealth of information changes lives....no, it *saves* lives, and the method is a marvel. Till next time around. ST

SATELLITE LISTENING POST

By Keith Stein
kstein@erols.com

Battle Plans From Orbit

Looks like our latest confrontation with Saddam Hussein is over for now. During any military conflict, radio hobbyists want to tune in to the action. So now is as good a time as any to discuss military space communications.

Here's a million dollar question that comes up everytime there is a major conflict in the world: "Anybody have a list of the frequencies being used for the cruise missile attacks on Iraq?"

No, we don't and I don't think anyone outside DoD is going to hear this type of sensitive communications in the clear. When a ship at sea is getting ready to launch a cruise missile attack, any covert interference from your enemy could halt the whole operations. These operations are very secure and are not capable of being monitored with your average receiving equipment. There may be an area where you might be able to listen for some action in Iraq, though. Tune in some of the local Baghdad fire and rescue channels.

Most communications in the clear over satellite downlinks are training exercises, very low priority phone calls, administrative chi-chat, etc... But, hey, it never hurts to monitor them; piecing together intercepts might develop into something. And if you're looking for a place to start, I have just the thing for you.

Fleet Satellite Communications

This system provides two-way UHF links for all of the military services. The Navy relies almost completely on satellite communications. Positioned at 14.5 deg West, 172 deg East, 100 deg West, and 23.1 West these satellites may begin to drop out of service next year after exceeding their design life of seven years. The aging fleet is being replaced by a new constellation called UFO's (UHF Follow-On). *FLTSATCOM 4* has already been replaced by *UFO-7*, but I'd still keep an ear on it just in case. Details on the UFO system coming up.

Communications between military commanders, nuclear forces, ships, submarines, aircraft, the National Command Authority, and even the President of the United States can be monitored.

The FLTSATCOM's have been a big favorite upon monitors across the globe. There are always some interesting voice transmissions active within this family (see chart below).

For more details on this satellite system, check out the May/June 95 issue of *Satellite Times*.

UHF Follow-On

Only three more launches remain before this new constellation will be complete, but not without some problems. The first UHF Follow-On (UFO) spacecraft launched on March 25, 1993, was left in an unusable orbit by its Atlas 1 launch vehicle.

The new UFOs are replacing the older leased satellite (LEASAT) and fleet satellite communications (FLTSATCOM) systems. These new switchboards in the sky bring enhanced anti-jamming technology, double communications capacity, and an interlink with the new, highly advanced Milstar constellation.

Placed at 15 degrees, 72 degrees, 105 degrees, 172 degrees, and 177 degrees, the UFO spacecraft provide voice, data, and video transmissions to military forces. See charts beginning on following page.

For more details on this system, check out the September/October 95 issue of *Satellite Times.*

IUE Mission Ends

In September, the European Space Agency (ESA) ended the mission of the International Ultraviolet Explorer (IUE). The 18-year old spacecraft has been in orbit since January 1978.

In May, the system was operating with only a single gyrometer after all other flight controls instruments failed.

Using its on board 45-cm telescope, IUE studied Jupiter and its moons, star wind, massive constellations, and mini-quasars of the Seyfert NGC 7469 galaxy.

The IUE mission has been one of the most accomplished programs in the field of astrophysics. ST

FLTSATCOM Frequency Plan Downlinks
(all frequencies in MHz)

	Alpha	Bravo	Charlie
Channel 1: Fleet Broadcast			
	250.450	250.550	250.650
Channel 2: 500 kHz wideband			
	260.350-260.850	262.450-261.950	262.050-262.550
Channel 3-11: Navy relay channels			
ch.3	251.950	252.050	252.150
ch.4	253.650	253.750	253.850
ch.5	255.350	255.450	255.550
ch.6	256.950	257.050	257.150
ch.7	258.450	258.550	258.650
ch.8	265.350	265.450	265.550
ch.9	266.850	266.950	267.050
ch.10	268.250	268.350	268.450
ch.11	269.750	269.850	269.950

	Alpha	Bravo	Charlie
Channels 12-23: AFSATCOM narrow band channels			
ch.12	243.945	244.045	244.145
ch.13	243.955	244.055	244.155
ch.14	243.960	244.060	244.160
ch.15	243.965	244.065	244.165
ch.16	243.970	244.070	244.170
ch.17	243.975	244.075	244.175
ch.18	243.980	244.080	244.180
ch.19	243.985	244.085	244.185
ch.20	243.990	244.090	244.190
ch.21	243.995	244.095	244.195
ch.22	244.000	244.100	244.200
ch.23	244.010	244.110	244.210

Most communications in the clear over satellite downlinks are training exercises, very low priority phone calls, administrative chi-chat, etc... But, hey, it never hurts to monitor them; piecing together intercepts might develop into something.

UHF FOLLOW-ON STATUS

Satellite	Position	Replacing
UFO-1	Wrong Orbit	
UFO-2	72.7 degrees East	
UFO-3	15.2 degrees West	
UFO-4	177.7 degrees West	LEASAT 2
UFO-5	71.5 degrees East	LEASAT 5
UFO-6	105.4 degrees West	LEASAT 3
UFO-7	172.0 degrees West	FLTSATCOM 4

243.915	UHF Follow-On ch.19 (5 kHz) November, AFSATCOM
243.925	UHF Follow-On ch.20 (5 kHz) November, AFSATCOM
243.935	UHF Follow-On ch.21 (5 kHz) November, AFSATCOM
243.945	UHF Follow-On ch.22 (5 kHz) November, AFSATCOM
243.955	UHF Follow-On ch.23 (5 kHz) November, AFSATCOM
243.965	UHF Follow-On ch.24 (5 kHz) November, AFSATCOM
243.975	UHF Follow-On ch.25 (5 kHz) November, AFSATCOM
243.985	UHF Follow-On ch.26 (5 kHz) November, AFSATCOM
243.995	UHF Follow-On ch.19 (5 kHz) Oscar, AFSATCOM
244.005	UHF Follow-On ch.20 (5 kHz) Oscar. AFSATCOM
244.015	UHF Follow-On ch.21 (5 kHz) Oscar, AFSATCOM
244.025	UHF Follow-On ch.22 (5 kHz) Oscar, AFSATCOM
244.035	UHF Follow-On ch.23 (5 kHz) Oscar, AFSATCOM
244.045	UHF Follow-On ch.24 (5 kHz) Oscar, AFSATCOM
244.055	UHF Follow-On ch.25 (5 kHz) Oscar, AFSATCOM
244.065	UHF Follow-On ch.26 (5 kHz) Oscar, AFSATCOM
244.075	UHF Follow-On ch.19 (5 kHz) Papa, AFSATCOM
	UHF Follow-On ch.26 (5 kHz) Papa, AFSATCOM
244.085	UHF Follow-On ch.20 (5 kHz) Papa, AFSATCOM
244.095	UHF Follow-On ch.21 (5 kHz) Papa, AFSATCOM
244.105	UHF Follow-On ch.22 (5 kHz) Papa, AFSATCOM
244.115	UHF Follow-On ch.23 (5 kHz) Papa, AFSATCOM
244.125	UHF Follow-On ch.24 (5 kHz) Papa, AFSATCOM
244.135	UHF Follow-On ch.25 (5 kHz) Papa, AFSATCOM
244.155	UHF Follow-On ch.19 (5 kHz) Quebec, AFSATCOM
244.165	UHF Follow-On ch.20 (5 kHz) Quebec, AFSATCOM
244.175	UHF Follow-On ch.21 (5 kHz) Quebec, AFSATCOM
244.185	UHF Follow-On ch.22 (5 kHz) Quebec, AFSATCOM
244.195	UHF Follow-On ch.23 (5 kHz) Quebec, AFSATCOM
244.205	UHF Follow-On ch.24 (5 kHz) Quebec, AFSATCOM
244.215	UHF Follow-On ch.25 (5 kHz) Quebec, AFSATCOM
244.225	UHF Follow-On ch.26 (5 kHz) Quebec, AFSATCOM
248.055	UHF Follow-On ch.35 (5 kHz) Oscar, AFSATCOM
248.065	UHF Follow-On ch.36 (5 kHz) Oscar, AFSATCOM
248.075	UHF Follow-On ch.37 (5 kHz) Oscar, AFSATCOM
248.085	UHF Follow-On ch.38 (5 kHz) Oscar, AFSATCOM
248.095	UHF Follow-On ch.39 (5 kHz) Oscar, AFSATCOM
248.105	UHF Follow-On ch.40 (5 kHz) Oscar, AFSATCOM
248.845	UHF Follow-On ch.27 (5 kHz) November, AFSATCOM
248.855	UHF Follow-On ch.28 (5 kHz) November, AFSATCOM
248.865	UHF Follow-On ch.29 (5 kHz) November, AFSATCOM
248.875	UHF Follow-On ch.30 (5 kHz) November, AFSATCOM
248.885	UHF Follow-On ch.31 (5 kHz) November, AFSATCOM
248.895	UHF Follow-On ch.32 (5 kHz) November, AFSATCOM
248.905	UHF Follow-On ch.33 (5 kHz) November, AFSATCOM
248.915	UHF Follow-On ch.34 (5 kHz) November, AFSATCOM
248.925	UHF Follow-On ch.35 (5 kHz) November, AFSATCOM
248.935	UHF Follow-On ch.36 (5 kHz) November, AFSATCOM
248.945	UHF Follow-On ch.37 (5 kHz) November, AFSATCOM
248.955	UHF Follow-On ch.38 (5 kHz) November, AFSATCOM
248.965	UHF Follow-On ch.39 (5 kHz) November, AFSATCOM
248.975	UHF Follow-On ch.40 (5 kHz) November, AFSATCOM
	UHF Follow-On ch.27 (5 kHz) Oscar, AFSATCOM
248.985	UHF Follow-On ch.28 (5 kHz) Oscar, AFSATCOM
248.995	UHF Follow-On ch.29 (5 kHz) Oscar, AFSATCOM
249.005	UHF Follow-On ch.30 (5 kHz) Oscar, AFSATCOM
249.015	UHF Follow-On ch.31 (5 kHz) Oscar, AFSATCOM
249.025	UHF Follow-On ch.32 (5 kHz) Oscar, AFSATCOM
249.035	UHF Follow-On ch.33 (5 kHz) Oscar, AFSATCOM
249.045	UHF Follow-On ch.34 (5 kHz) Oscar, AFSATCOM
249.105	UHF Follow-On ch.27 (5 kHz) Papa, AFSATCOM
249.115	UHF Follow-On ch.28 (5 kHz) Papa, AFSATCOM
249.125	UHF Follow-On ch.29 (5 kHz) Papa, AFSATCOM
249.135	UHF Follow-On ch.30 (5 kHz) Papa, AFSATCOM
249.145	UHF Follow-On ch.31 (5 kHz) Papa, AFSATCOM
249.155	UHF Follow-On ch.32 (5 kHz) Papa, AFSATCOM
249.165	UHF Follow-On ch.33 (5 kHz) Papa, AFSATCOM
249.175	UHF Follow-On ch.34 (5 kHz) Papa, AFSATCOM
249.185	UHF Follow-On ch.35 (5 kHz) Papa, AFSATCOM
249.195	UHF Follow-On ch.36 (5 kHz) Papa, AFSATCOM
249.205	UHF Follow-On ch.37 (5 kHz) Papa, AFSATCOM
249.215	UHF Follow-On ch.38 (5 kHz) Papa, AFSATCOM
249.225	UHF Follow-On ch.39 (5 kHz) Papa, AFSATCOM
249.235	UHF Follow-On ch.40 (5 kHz) Papa. AFSATCOM
	UHF Follow-On ch.27 (5 kHz) Quebec, AFSATCOM
249.245	UHF Follow-On ch.28 (5 kHz) Quebec, AFSATCOM
249.255	UHF Follow-On ch.29 (5 kHz) Quebec, AFSATCOM
249.265	UHF Follow-On ch.30 (5 kHz) Quebec. AFSATCOM
249.275	UHF Follow-On ch.31 (5 kHz) Quebec, AFSATCOM
249.285	UHF Follow-On ch.32 (5 kHz) Quebec, AFSATCOM
249.295	UHF Follow-On ch.33 (5 kHz) Quebec, AFSATCOM
249.305	UHF Follow-On ch.34 (5 kHz) Quebec, AFSATCOM
249.315	UHF Follow-On ch.35 (5 kHz) Quebec, AFSATCOM
249.325	UHF Follow-On ch.36 (5 kHz) Quebec, AFSATCOM
249.335	UHF Follow-On ch.37 (5 kHz) Quebec, AFSATCOM
249.345	UHF Follow-On ch.38 (5 kHz) Quebec, AFSATCOM
249.355	UHF Follow-On ch.39 (5 kHz) Quebec, AFSATCOM
249.365	UHF Follow-On ch.40 (5 kHz) Quebec, AFSATCOM
250.350	UHF Follow-On ch.1 (25 kHz) November broadcast
250.450	UHF Follow-On ch.1 (25 kHz) Oscar, broadcast
250.550	UHF Follow-On ch.1 (25 kHz) Papa, broadcast
250.650	UHF Follow-On ch.1 (25 kHz) Quebec, broadcast
251.850	UHF Follow-On ch.2 (25 kHz) November, relay
251.950	UHF Follow-On ch.2 (25 kHz) Oscar, relay
252.050	UHF Follow-On ch.2 (25 kHz) Papa, relay
252.150	UHF Follow-On ch.2 (25 kHz) Quebec, relay
253.550	UHF Follow-On ch.3 (25 kHz) November, relay
253.650	UHF Follow-On ch.3 (25 kHz) Oscar, relay
253.750	UHF Follow-On ch.3 (25 kHz) Papa, relay
253.850	UHF Follow-On ch.3 (25 kHz) Quebec, relay
255.250	UHF Follow-On ch.4 (25 kHz) November, relay

Continued on following page

The new UFOs are replacing the older leased satellite (LEASAT) and fleet satellite communications (FLTSATCOM) systems. These new switchboards in the sky bring enhanced anti-jamming technology, double communications capacity, and an interlink with the new, highly advanced Milstar constellation.

255.350	UHF Follow-On ch.4 (25 kHz) Oscar, relay
255.450	UHF Follow-On ch.4 (25 kHz) Papa, relay
255.550	UHF Follow-On ch.4 (25 kHz) Quebec, relay
256.850	UHF Follow-On ch.5 (25 kHz) November, relay
256.950	UHF Follow-On ch.5 (25 kHz) Oscar, relay
257.050	UHF Follow-On ch.5 (25 kHz) Papa, relay
257.150	UHF Follow-On ch.5 (25 kHz) Quebec, relay
258.350	UHF Follow-On ch.6 (25 kHz) November, relay
258.450	UHF Follow-On ch.6 (25 kHz) Oscar, relay
258.550	UHF Follow-On ch.6 (25 kHz) Papa, relay
258.650	UHF Follow-On ch.6 (25 kHz) Quebec, relay
260.375	UHF Follow-On ch.11 (25 kHz) November, relay
260.425	UHF Follow-On ch.11 (25 kHz) Papa, relay
260.475	UHF Follow-On ch.12 (25 kHz) November, relay
260.525	UHF Follow-On ch.12 (25 kHz) Papa, relay
260.575	UHF Follow-On ch.11 (25 kHz) Oscar, relay
260.625	UHF Follow-On ch.11 (25 kHz) Quebec, relay
260.675	UHF Follow-On ch.12 (25 kHz) Oscar, relay
260.725	UHF Follow-On ch.12 (25 kHz) Quebec, relay
261.575	UHF Follow-On ch.13 (25 kHz) November, relay
261.625	UHF Follow-On ch.13 (25 kHz) Papa, relay
261.675	UHF Follow-On ch.14 (25 kHz) November, relay
261.725	UHF Follow-On ch.14 (25 kHz) Papa, relay
261.775	UHF Follow-On ch.15 (25 kHz) November, relay
261.825	UHF Follow-On ch.15 (25 kHz) Papa, relay
261.875	UHF Follow-On ch.16 (25 kHz) November, relay
261.925	UHF Follow-On ch.16 (25 kHz) Papa, relay
262.075	UHF Follow-On ch.13 (25 kHz) Oscar, relay
262.125	UHF Follow-On ch.13 (25 kHz) Quebec, relay
262.175	UHF Follow-On ch.14 (25 kHz) Oscar, relay
262.225	UHF Follow-On ch.14 (25 kHz) Quebec, relay
262.275	UHF Follow-On ch.15 (25 kHz) Oscar, relay
262.325	UHF Follow-On ch.15 (25 kHz) Quebec, relay
262.375	UHF Follow-On ch.16 (25 kHz) Oscar, relay
262.425	UHF Follow-On ch.16 (25 kHz) Quebec, relay
263.575	UHF Follow-On ch.17 (25 kHz) November, relay
263.625	UHF Follow-On ch.17 (25 kHz) Papa, relay
263.675	UHF Follow-On ch.18 (25 kHz) November, relay
263.725	UHF Follow-On ch.18 (25 kHz) Papa, relay
263.775	UHF Follow-On ch.17 (25 kHz) Oscar, relay
263.825	UHF Follow-On ch.17 (25 kHz) Quebec, relay
263.875	UHF Follow-On ch.18 (25 kHz) Oscar, relay
263.925	UHF Follow-On ch.18 (25 kHz) Quebec, relay
265.250	UHF Follow-On ch.7 (25 kHz) November, relay
265.350	UHF Follow-On ch.7 (25 kHz) Oscar, relay
265.450	UHF Follow-On ch.7 (25 kHz) Papa, relay
265.550	UHF Follow-On ch.7 (25 kHz) Quebec, relay
266.750	UHF Follow-On ch.8 (25 kHz) November, relay
266.850	UHF Follow-On ch.8 (25 kHz) Oscar, relay
266.950	UHF Follow-On ch.8 (25 kHz) Papa, relay
267.050	UHF Follow-On ch.8 (25 kHz) Quebec, relay
268.150	UHF Follow-On ch.9 (25 kHz) November, relay
268.250	UHF Follow-On ch.9 (25 kHz) Oscar, relay
268.350	UHF Follow-On ch.9 (25 kHz) Papa, relay
268.450	UHF Follow-On ch.9 (25 kHz) Quebec, relay
269.650	UHF Follow-On ch.10 (25 kHz) November, relay
269.750	UHF Follow-On ch.10 (25 kHz) Oscar, relay
269.850	UHF Follow-On ch.10 (25 kHz) Papa, relay
269.950	UHF Follow-On ch.10 (25 kHz) Quebec, relay

Downlink Frequency Assignments:

VHF-band TLM and RNG	136.900 MHz
S-band TLM	2249.800 MHz

All times in UTC. All voice transmissions in English unless otherwise noted.

a/c	aircraft
ARIA	Advanced Range Instrumentation Aircraft
FAST	Fast Auroral Snapshot Explorer
GHFS	Global High Frequency System
K	kHz
LSB	Lower Sideband
M	MHz
NOAA	National Oceanic & Atmospheric Administration
NASA	National Aeronautics and Space Administration
USB	Upper Sideband
K3840	AMSAT North America East Coast Net heard at 0142, LSB, with W8GUS, Ron, as net control in Columbus, OH (Keith Stein-Woodbridge, VA).
K4486	ARIA Control working ARIA1 and ARIA2 during Pegasus/FAST launch countdown at 0745, USB. Launch was scrubbed due to a ground UHF uplink problem. Also heard on K6889 (K. Stein-VA).
K6820	ARIA 1 heard between 0723-1015 working with Abnormal 10 and ARIA Control during second Pegasus/FAST launch attempt, USB. Launch occurred at 0947 (K. Stein-VA).
K15016	NOAA 43 (P-3 Hurricane Hunter a/c) heard at 2135 working Albrook GHFS with phone patch to National Hurricane Center, Coral Gables, FL, passing current weather conditions from dropsondes and other instruments in Hurricane Edouard. NHC advises that USAF recon a/c should be in the area by 2300. (Mike Jacobs-Allentown, PA).
M119.100	NASA 8 (Beech 200 aircraft) cleared for take-off from Washington National Airport at 1140, AM mode (K. Stein-Washington, DC).
M121.750	WBFM voice in Russian heard from Soyuz TM-24 (Sven Grahn-Stockholm, Sweden).
M121.950	NASA 432 (Fokker-27 aircraft) heard tracking ship movements off the coast of Wallops Island, VA, during launch of NASA Nike-Orion sounding rocket at 1750, AM mode. A few weeks later, NASA 432 was heard again supporting launch of a classified Phillips Lab. experiment aboard a NASA Black Brant 5 rocket. Callsigns heard; Wallops Control, Echo Control, Pathfinder, 540R (aircraft), and 370P (aircraft) (K. Stein-VA).
M143.625	Voice downlink heard in Russian from Mir space station. Also visually observed in the sky during pass from 1951-1955, NFM (Grahn-Sweden)
M145.550	Signals from Mir complex picked up at 0525, NFM (Grahn-Sweden)
M150.000	Russian navigation satellite Tsikada was heard around 0236, NFM (Dale Lamm-Canton, OH)
M150.030	Russian navigation satellite Cosmos 2142 was heard at 0236, NFM. Also logged Cosmos 2334 at 1725, NFM (Dale Lamm-Canton, OH)
M166.000	FM telemetry heard from Soyuz TM-24 from 1748-1752. Signals from Mir complex picked up at 0525, WBFM (Grahn Sweden).
M259.700	Crew aboard space shuttle Atlantis (STS-79) heard during launch at 0902, AM mode (K. Stein-VA).
M435.820	ITAMSAT-Oscar-26 has returned to the air. The satellite was transmitting telemetry, WOD, LSTAT, BCRXMT, TIME, and STATUS frames. In addition, at 1455Z the satellite was sending the following text message: (John Magliacane, KD2BD-NJ) IY2SAT-1AMSAT <UI: ** 5th June 1996 ** IHT 3.1 is running. Digipeater is ON. WOD is underway. 73 de ITAMSAT Command team.
M922.750	CW and telemetry signal heard from Soyuz TM-24 from 1748-1753 (Grahn, Sweden).
M926.050	CW signal heard from Soyuz TM-24 from 1748-1753 (Grahn, Sweden).

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INTRODUCTION

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

How to Use the Satellite Service Guide

The various sections of the SSG include:

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

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

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

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

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

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

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

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

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

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

Satellite Radio Guide

By Robert Smathers and Larry Van Horn

AUDIO SUBCARRIERS

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

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

Classical Music

KUCV-FM (90.9) Lincoln, NE (NE Public Radio)	S3, 4	5.76/5.94 (DS)
SuperAudio—Classical Collections	G5, 21	6.30/6.48 (DS)
WFMT-FM (98.7) Chicago, IL.	G5, 7	6.30/6.48 (DS)
WQXR-FM (96.3) New York, NY, ID-*96.3 FM*	C4, 15	6.30/6.48 (DS)

Satellite Computer Services

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

Contemporary Music

Radio Romance (from Philippines)	G4, 24 (Ku-band)	6.20
SuperAudio—*Light and Lively Rock*	G5, 21	5.96, 6.12 (DS)
Unidentified station	C4,5	5.58

Country Music

CINC-FM (96.3) Thompson, MB	E2, 2	6.40
SuperAudio—*American Country Favorites*	G5, 21	5.04/7.74 (DS)
Transtar III radio network	S3, 9	5.76/5.94 (DS)
WOKI-FM (100.3) Oak Ridge-Knoxville, TN., ID-*The Hit Kicker*	E2, 18	6.20
WSM-AM (650) Nashville, TN	C4, 24	7.38

Easy Listening Music

Easy listening music, unidentified station	G4, 6	7.69
SuperAudio—*Soft Sounds*	G5, 21	5.58/5.76 (DS)
United Video—easy listening	C4, 8	5.895 (N)

Foreign Language Programming

Antenna TV (Greece)	T402R, 18	7.78
Arab Network of America radio network	G6, 10	5.80
CBC Radio-East (French)	E2, 1	5.38/5.58 (DS)
	E2, 1	7.36
CHIN-AM/FM (1540/100.7) Toronto, ON Canada, ID-*CHIN*—multilingual	E2, 2	7.89
DZMM-Radyo Patrol (from Philippines)	G4, 24 (Ku-band)	6.80
French language audio service	E2, 11	6.12
French language audio service	E2, 20	6.40
India ethnic radio	E2, 2	7.61
Indian Sangeet Sager	E2, 16 (Ku-band)	6.12
Irish music (Sat 1430-0000 UTC)	S3, 3	6.20
KAZN-AM (1300) Pasadena, CA—Asian Radio	K2, 8 (Ku-band)	6.20
Northern Native Radio (Ethnic)	E2, 26 (Ku-band)	6.43/6.53 (DS)
RAI Satelradio (Italian)	G7, 14	7.38
Radio Canada (French)	E2, 11	5.40/5.58 (DS), 5.76
Radio Dubai (Arabic)	G7, 10	7.48
Radio Maria (Italian-Religious programming)	G7, 10	5.80
Radio Maria	G7, 10	8.03
Radio Sedeye Iran (Farsi)	S3, 15	6.20 (N)
Radio Tropical (Haitian Creole)	S2, 11	7.60
Reotto Network (Italian)	T402R, 18	5.80
Russian-American radio network	SBS5, 14 (Ku-band)	6.20
The Clanny Channel (Anti-Castro Cuban clandestine station programming)	S2, 4	7.56
Trinity Broadcasting radio service (Spanish) SAP—religious	G5, 3	5.96
WCMQ-FM (92.3) Hialeah, FL (Spanish), ID-*Mega 92*—contemporary hit radio	S2, 4	7.74, 7.92
WLIR-AM (1300) Spring Valley, NY (Ethnic)	S2, 1	7.60
XEW-AM (900) Mexico City, Mexico (Spanish), ID-*LV de la America Latina*	M2, 14	7.38
XEW-FM (96.9) Mexico City, Mexico (Spanish), ID-*W-FM 96.9*	SD1, 7	7.38
XEWA-AM (540) Monterrey, Mexico (Spanish), ID-*Super Estelar*—contemporary music	M2, 8	7.38

Jazz Music

KLON-FM (88.1) Long Beach, CA., ID-*Jazz-88*	G5, 2	5.58/5.76 (DS)
Superaudio—*New Age of Jazz*	G5, 21	7.38/7.56 (DS)

News and Information Programming

Business Radio Network	C4, 10	8.06 (N)
	E2, 2	7.43 (N)
Cable Radio Network	C3, 23	7.24 (N)
CNN Headline News	G5, 22	7.58
CNN Radio News	S3, 9	5.62
	G5, 5	7.58
Standard News	S3, 17	5.20
USA Radio Network—news, talk and information	S3, 13	5.01 (Ch 1), 5.20 (Ch 2)
WCBS-AM (880) New York, NY—news	G7, 19	7.38
WCCO-AM (830) Minneapolis, MN	G6, 15	6.20
WGN-AM (720) Chicago, IL/Interstate Radio Network (overnight)—talk	E2, 2	5.22

Religious Programming

Ambassasor Inspirational Radio	S3, 15	5.96, 6.48 (DS)
Brother Staire Radio	G5, 6	6.48
CBN Radio Network/Standard News	G5, 11	6.12
	C3, 1	6.20
Christian Music Network Lakeland, FL	S2, 21	6.20, 7.60
Heaven Radio Network	G1, 17	7.92
Inspirational/Gospel music (no ID)	G4, 6	7.38
KHCB-FM (105.7) Houston, TX	C1, 10	7.28
Salem Radio Network	S3, 17	5.01
Trinity Broadcasting radio service	G5, 3	5.58/5.78 (DS)
WHME-FM (103.1) South Bend, IN, ID-*Harvest FM*	G4, 15	5.58/5.78
WROL-AM (950) Boston, MA (occasional Spanish)	S3, 3	6.20
Z-musis—Christian rock	G1, 6	7.38/7.56

Rock Music

Seltech Radio syndicated service—classic rock	E2, 2	5.40/5.58 (DS)
SuperAudio—*Classic Hits*-oldies	G5, 21	8.10/8.30 (DS)

Satellite Radio Guide

SuperAudio—*Prime Demo*-mellow rock	G5, 21	5.22/5.40 (DS)
WCNJ-FM (89.3) Hazlet, NJ/Skylark Radio network—Oldies	G4,22	5.80

Speciality Formats

Aries In Touch Reading Service	C4,10	7.87
C-SPAN I ASAP (program schedule)	C3, 7	5.58
C-SPAN II ASAP (program schedule)	C4, 19	5.58
In-Store Networks	S3, 18	5.04, 5.21, 5.58, 6.48
	S3, 24	5.04, 5.21, 5.40, 5.58
Nebraska Talking Book Network	S3, 4	6.48
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
Voice Print Reading Service	E2, 6	7.44 (N)
Yesterday USA—nostalgia radio	G5, 7	6.80
	T402R, 11	5.80

Talk Programming

American Freedom Radio network	G6, 14	5.80
Amerinet Broadcasting	G6, 23	8.10
For the People radio network (Chuck Harder)—talk and information	C1, 2	7.50
FOX Sports Radio—sports talk and information	S3, 24	5.80
Media Bypass Radio network	G7, 14	7.70
One on One Sports radio network—sports talk	E2, 2	7.51
Orbit 7 Radio Network	C1, 14	7.48
Talk America—talk programs	S3, 9	6.80
Talk Radio Network—talk programs	C1, 5	5.80
WOKIE Network (tech talk)	SBS6, 13B (Ku)	6.20 (occasional network on when Megabingo is present)
Worldwide Freedom Radio network	G6, 14	7.56
WWTN-FM (99.7) Manchester, TN—news and talk	G5, 18	7.38, 7.56

Variety Programming

American Urban Radio—news/features/sports	S3, 9	6.30/6.48 (DS)
CBC Radio (English)	E2, 6	5.40/7.58, 5.58
CBC Radio (occasional audio)	E2, 1	5.78
CBC-FM Atlantic (English)	E2, 6	6.12/6.30 (DS)
CBC-FM Eastern (English)	E2, 6	5.76/5.94 (DS)
CBM-AM (940) Montreal, PQ Canada—variety/fine arts	E2, 1	6.12
CFR-FM	E2, 19 (Ku-band)	6.12/6.30
CJRT-FM (91.1) Toronto, ON Canada—fine arts/jazz-nights	E2, 26 (Ku-band)	5.76/5.94 (DS)
KBVA-FM (106.5) Bella Vista, AR., ID-*Variety 106.5*	G4, 6	5.58/5.76 (DS)
KSL-AM (1160) Salt Lake City, UT—news/talk/country-overnight	C1, 6	5.58
WAXY-AM (790) Miami, FL—variety	S2, 4	7.38
WUSF-FM (89.7) Tampa-St. Petersburg, FL (Public Radio), ID-*Concert 90*	C4, 10	8.26 (N)

FM SQUARED (FM²) AUDIO SERVICES

Another type of satellite audio is known as FM Squared. FM Squared signals require a video carrier to exist. These signals are similar to audio subcarriers as we know it except for the fact that they are located below the 5.00 MHz audio subcarrier frequency that a normal satellite receiver can tune to.

Spacenet 3 Transponder 13

Ambassador Inspirational Radio: 1.420, 4.470, and 4.650 MHz
Blank audio carriers: 1.050, 2.130, 2.310, 2.500, 2.670, 2.860, 3.030, 3.390, 3.570, 3.750, 3.390, and 4.110 MHz
International Broadcasting Network: 4.830 MHz
Religious Backhauls (various): 1.235 MHz
USA Radio Network: .330 MHz
VCY America: .540 and .780 MHz
WJSO-FM (90.1) Pikeville, KY (Moody Broadcasting Network): 1.770 and 4.290 MHz

Spacenet 3 Transponder 17

Blank audio carriers: 3.570 and 3.750 MHz
Childrens Sunshine Network: 1.275 MHz
Data Transmission: .800, .840, and 1.225 MHz
Focus on the Family: 1.050 and 1.400 MHz
In-Touch—religious: 4.470 MHz
Salem Satellite Network: 4.650 and 5.010 Mhz
Skylight—religious: 1.770 and 4.260 MHz
UPI Radio Network: .330 MHz
WGNR-FM (88.9) Monee, IL—Good News Radio: 2.500 and 2.650 MHz

Spacenet 3 Transponder 18

Data Transmissions: 4.800 MHz

Galaxy 4 Transponder 3 (Ku-band)

Blank Audio Carriers: 1.065, 1.155, 1.245, 2.070, 2.430, 2.550, 2.670, 2.790, 2.950, 3.040, 3.160, 3.960, and 4.080 MHz
Data Transmissions: 3.090 MHz
Generic News: 3.510 MHz (occasional audio)
In-Store audio network ads: .710, .795, .880, 3.420, 3.600, 3.690, 3.780, and 3.860 MHz
MuZAK ‡ Services: .275, .390, .510, .975, 1.355, 1.470, 1.590, 1.710, 1.830, 1.945, 2.190, 2.310, and 3.330 MHz

Galaxy 4 Transponder 4 (Ku-band)

Blank Audio Carriers: .180, .350, and 1.250 MHz
Data Transmissions: .110, .255, .300, .350, .470, .575, .675, .710, .740, .765, .845, .890, .930, 1.180, and 1.225 MHz

Galaxy 4 Transponder 16 (Ku-band)

Blank Audio Carriers: 1.230, 1.470, 1.965, 2.070, 2.280, 2.730, and 3.280 MHz
Data Transmissions: .645, 2.140, 2.350, 2.470, 2.820, 2.870, 2.970, 3.000, 3.060, 3.115, 3.205, 3.245, 3.265, 3.345, 3.620, 3.735, 4.145, and 4.150 MHz
In-Store audio networks: .150, .270, .390, .755, .870, .990, 1.110, 1.350, 1.590, 1.710, and 1.800 MHz

Anik E1 Transponder 7 (Ku-band)

Nova Network FM Squared Services

FM CUBED (FM³) AUDIO SERVICES

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

Single Channel Per Carrier (SCPC) Services Guide

By Robert Smathers

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

Spacenet 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, WA—news, talk, and sports talk radio/Seattle Seahawks NFL radio network
1405.40 (54.6) Sports Byline USA/Sports Byline Weekend
1404.60 (55.4) Talk America Radio Network
1403.80 (56.2) Occasional audio/Free Enterprise Radio Network/Green Bay Packers NFL radio network/University of Wisconsin sports
1403.20 (56.8) Motor Racing Network (MRN)
1400.80 (59.2) WBAL-AM (1090) Baltimore, MD—news/talk
1397.20 (62.8) WTMJ-AM (620) Milwaukee, WI—talk radio/Green Bay Packers NFL radio network/University of Wisconsin sports
1394.10 (65.9) WLAC-AM (1510) Nashville, TN—news/talk/Tennessee Volunteers sports
1393.40 (66.6) WGN-AM (720) Chicago, IL—talk radio/Interstate Radio Network (IRN)/Chicago Bears NFL radio network/Northwestern University sports
1393.20 (66.8) Wisconsin Radio Network/Illinois Radio Network/Tribune Radio Networks
1393.00 (67.0) USA Radio Network
1392.70 (67.3) WGN-AM (720) Chicago, IL—talk radio/Interstate Radio Network (IRN)/Chicago Bears NFL radio network/Northwestern University sports
1391.60 (68.4) XEPRS-AM (1090) Tijuana, Mexico—Spanish language programming, ID - *Radio Express*
1390.60 (69.4) Occasional audio
1390.40 (69.6) Occasional audio
1389.70 (70.3) Occasional audio/data transmissions (burst)
1389.50 (70.5) Data transmissions (burst)
1387.10 (72.9) Michigan News Network (MNN)
1386.70 (73.3) Michigan News Network (MNN)
1386.50 (73.5) WJR-AM (760) Detroit, MI—talk radio
1386.30 (73.7) Illinois News Network
1385.10 (74.9) For the People Radio Network
1384.20 (75.8) Occasional audio
1384.00 (76.0) Illinois News Network
1383.80 (76.2) KJR-AM (950) Seattle, WA—sports talk radio/Washington State sports
1383.40 (76.6) KFRC-AM (610) Oakland, CA—oldies
1383.20 (76.8) Occasional audio
1375.40 (84.6) USA Radio Network/Grow-wise Gardner Network/Agrinet/James Madison University Sports

Satcom K2 Transponder 2-Vertical (Ku-band)

1010.60 Unidentified foreign audio service

Spacenet 3 Transponder-Horizontal 13 (C-band)

1207.90 (52.1) Wisconsin Voice of Christian Youth (VCY) America Radio Network—religious
1207.20 (52.8) Good News Radio Network—christian radio
1207.00 (53.0) Good News Radio Network—christian radio
1206.70 (53.3) Data Transmission
1204.45 (55.55) KJAV-FM (104.9) Alamo, TX—spanish language religious, Nuevo Radio Christiana Network
1204.25 (55.75) Wisconsin Voice of Christian Youth (VCY) America Radio Network—religious
1201.70 (58.1) Occasional audio
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-Horizontal (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)

1444.45 (55.55) Data transmissions
1443.80 (56.2) Voice of Free China (ISWBC) Taipei, Taiwan
1443.60 (56.4) KBLA-AM (1580) Santa Monica, CA—*Radio Korea*
1443.40 (56.6) Voice of Free China (ISWBC) Taipei, Taiwan
1438.30 (61.7) WWRV-AM (1330) New York, NY—Spanish religious programming and music, ID - *Radio Vision Christiana de Internacional*
1436.50 (63.5) West Virginia Metro News
1436.30 (63.7) KOJY-AM (540) Costa Mesa, CA/KJQI-AM (1260) Beverly Hills, CA—all news

Galaxy 4 Transponder 3-Horizontal (C-band)

1405.00 (55.0) Illinois News network
1404.80 (55.2) KOA-AM (850)/KTLK-AM (760) Denver, CO— news and talk/Denver Broncos NFL radio network/University of Colorado sports
1404.60 (55.4) WGN-AM (720) Chicago, IL—news/talk/Bears NFL radio network/Northwestern University sports
1404.20 (55.8) Tribune Radio Networks
1403.00 (57.0) KSJN-FM (99.5) Minneapolis/St. Paul, MN—Minnesota Public Radio
1402.70 (57.3) WLAC-AM (1510) Nashville, TN—news/talk/Tennessee Volunteers sports
1402.40 (57.6) Beethoven Satellite Network
1402.10 (57.9) KNOW-FM (95.3) St. Paul, MN—fine arts, Minnesota Public Radio
1401.80 (58.1) Michigan News Network
1398.80 (61.2) People's Radio network—talk
1398.50 (61.5) KKFN-AM (950) Denver, CO—sports talk
1398.30 (61.7) WSB-AM (750) Atlanta, GA—news/talk/University of Georgia sports
1398.00 (62.0) Occasional audio
1397.80 (62.2) Occasional audio
1397.50 (62.5) Minnesota Talking Book network
1397.30 (62.7) Clemson University sports
1396.90 (63.1) Occasional audio
1396.40 (63.4) Georgia Network News (GNN)
1396.20 (63.8) WCNN-AM (680) Atlanta, GA—all sports talk radio/Georgia Tech sports
1396.00 (64.0) WHO-AM (1040) Des Moines, IA—talk/Iowa News Network/University of Iowa sports
1395.60 (64.4) WGST-AM/FM (640/105.7) Atlanta, GA—news/talk/Atlanta Falcons NFL radio network
1395.20 (64.8) Michigan News Network
1395.00 (65.0) Occasional audio
1394.70 (65.3) WJR-AM (760) Detroit, MI—news/talk
1394.40 (65.6) Beethoven Satellite Network
1394.00 (66.0) KSJN-FM (99.5) Minneapolis/St. Paul, MN—Minnesota Public Radio
1391.00 (69.0) Occasional audio
1388.90 (71.1) Data transmissions (burst)
1387.80 (72.2) Data transmissions (constant)
1385.40 (74.6) University of Kentucky sports
1384.40 (75.6) KOA-AM (850)/KTLK-AM (760) Denver, CO—news/talk/Denver Broncos NFL radio network/University of Colorado sports
1384.20 (75.8) WSB-AM (750) Atlanta, GA—news and talk/University of Georgia sports
1383.20 (76.8) United Broadcasting Network—talk
1382.60 (77.4) Soldiers Radio Satellite (SRS) network—U.S. Army information and entertainment
1382.30 (77.7) Motor Racing Network (occasional audio)
1382.00 (78.0) University of Tennessee sports/University of Kentucky sports
1381.60 (78.4) KEX-AM (1190) Portland, OR—news/talk
1381.40 (78.6) Occasional audio
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)

1376.00 (64.0) Data transmissions

Single Channel Per Carrier (SCPC) Services Guide

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

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

Anik E2 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 E2 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
1036.70 (63.3) In-store music
1037.00 (63.0) In-store music
1037.50 (62.5) In-store music

SBS5 Transponder 2-Horizontal (Ku-band)

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/University of Wyoming sports
1400.60 (59.4) Learfield Communications/Indiana University sports
1400.40 (59.6) Learfield Communications/Missouri Net/ Los Angeles Rams NFL radio network
1400.20 (59.8) Occasional audio/Data transmissions
1400.00 (60.0) Learfield Communications/University of Purdue sports
1396.60 (63.4) Kansas Information Network/Kansas Agnet/Kansas State sports/SW Missouri State sports
1396.40 (63.6) Nebraska Agriculture Network/University of Nebraska sports
1396.20 (63.8) Missouri Network
1396.00 (64.0) Occasional audio
1395.90 (64.1) Wyoming News Network/University of Wyoming sports
1395.70 (64.3) Missouri Net/WIBW-AM (580) Topeka, KS—news and talk
1387.30 (72.7) WPTF-AM (680) Raleigh, NC/North Carolina News Network
1386.40 (73.6) Learfield Communications/Kansas City Chiefs NFL radio network
1386.20 (73.8) Radio Iowa/University of Iowa sports
1385.00 (74.0) People's Radio Network
1384.60 (75.4) North Carolina News Network/Capitol Sports Network/Washington Redskins NFL radio network/North Carolina State sports
1384.00 (76.0) Occasional audio/ABC Direction Network
1383.80 (76.2) Occasional audio/Oklahoma State sports
1383.60 (76.4) Occasional audio
1383.40 (76.6) Capitol Sports Network/Carolina Panthers NFL radio network/North Carolina University sports
1382.90 (77.1) Missouri Net/University of Missouri sports
1382.60 (77.4) North Carolina News Network
1382.30 (77.7) Virginia News Network
1382.10 (77.9) Learfield Communications/Missouri Net/ University of Illinois sports
1378.10 (81.9) Occasional audio

RCA C5 Transponder 21-Vertical (C-band)

1045.00 (55.0) Occasional audio
1043.60 (56.4) Unistar Music Radio — *Today's Hits, Yesterday's Favorites*
1043.40 (56.6) CNN Radio Network
1043.20 (56.8) Unistar Music Radio — *Today's Hits, Yesterday's Favorites*
1042.80 (57.2) Unistar Music Radio — *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) CNN Radio Network
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.

CHINA RADIO INTERNATIONAL

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

DEUTSCHE WELLE (DW)

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

ISLAMIC REPUBLIC OF IRAN BROADCASTING (IRIB)

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

ISRAEL RADIO

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

LA VOIX DU ZAIRE

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

RADIO ALGIERS INTERNATIONAL

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

RADIO AUSTRALIA

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

RADIO BELGRADE

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

RADIO BUDAPEST

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

RADIO CANADA INTERNATIONAL

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

RADIO EXTERIOR DE ESPANA (REE)

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

RADIO FRANCE INTERNATIONAL (RFI)

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

RADIO MEDITERRANEE INTERNATIONALE

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

RADIO NETHERLANDS

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

RADIOSTANTSIYA MAYAK

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

RADIO SWEDEN

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

RADIOTELEVISIONE ITALIANA (RAI)

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

RADIO VLAANDEREN INTERNATIONAL

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

RDP INTERNATIONAL

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

SWISS RADIO INTERNATIONAL

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

International Shortwave Broadcasters via Satellite

TRANS WORLD RADIO (TWR)

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

TUNIS INTERNATIONAL RADIO

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

VATICAN RADIO

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

VOICE OF 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 704	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 707 at 1.0 west. No other details are available at this time.

VOICE OF THE IRAQI PEOPLE (CLANDESTINE)

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

WORLD HARVEST INTERNATIONAL RADIO, WHRI-South Bend, Indiana

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

WORLD RADIO NETWORK

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

WRN 1 North American English Program Schedule

Galaxy 5 (125 deg West) tr 6-3.820 GHz V (TBS) 6.8 MHz audio. WRN is also available on cable and local radio stations. WRN program details can be heard at 0525, 1425 and 1955 Eastern Time, and are also available on TBS text page 204. All times below are Eastern (UTC +5 hours)

0000	RTE Dublin, Ireland-*Irish Collection*
0100	SABC Channel Africa, Johannesburg (Mon-Sat)
0130	*BBC Europe Today* (Mon-Fri)
0130	Glenn Hauser's *World of Radio* (Sat)
0130	UN Radio from New York (Sun)
0200	Polish Radio-Warsaw
0230	Radio Canada International
0300	ABC Radio Australia
0400	KBS Radio Korea International
0500	Voice of Russia
0530	Radio Netherlands
0630	SABC Channel Africa, Johannesburg (Mon-Sat)
0630	Radio Romania International (Sun)
0700	ABC Radio Australia
0800	RTE from Dublin, Ireland
0900	Radio Prague
0930	RTHK-News from Hong Kong (Mon-Fri)
0930	Radio Romania International (Sat)
0930	UN Radio from New York (Sun)
1000	YLE Radio Finland
1030	Radio Vlaanderen-Brussels Calling
1100	Radio France International
1200	Voice of Russia
1230	ORF Radio Austria International
1300	RTE from Dublin, Ireland
1330	Radio Netherlands
1430	YLE Radio Finland
1500	Blue Danube Radio, Vienna (Mon-Fri)
1500	Glenn Hauser's World of Radio (Sat)
1500	SABC Network Africa (Sun)
1530	Radio Vlaanderen-Brussels Calling
1600	*BBC Europe Today* (Sun-Fri)
1600	UN Radio from New York (Sat)
1630	Polish Radio
1700	RTE Dublin, Ireland-*Ireland Tonight* at 1800
1900	Radio Netherlands
2000	ABC Radio Australia
2100	YLE Radio Finland
2130	Radio Sweden
2200	Radio Prague
2230	Radio Austria International
2300	Polish Radio
2330	Radio Budapest

WRN 2 North American Multilingual Program Schedule

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

WRN European Service

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

WRN Asia-Pacific Service

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

WRN Middle East and Africa Service

Intelsat 707 (1 deg West) 3.9115 GHz, RHCP, Symbol Rate 8.022 Mbaud, FEC 3/4, MPEG2 Audio Stream.

WORLDWIDE CATHOLIC RADIO - WEWN

P.O. Box 176, Vandiver, AL 35176 USA. Telephone: (205) 672-7200 (voice), (205) 672-9988 (fax). WWW URL: http://www.ewtn.com. WEWN broadcasts are available on: Galaxy 1R (133 west) Tr 11 (3920 MHz H) 5.40 MHz (English) and 5.58 MHz (Spanish). WEWN is also available internationally on Intelsat 601 (27.5 west) Tr 22.7, 5.59 MHz (English) and 5.68 MHz (Spanish).

YLE RADIO FINLAND

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

Direct Broadcast Satellite (DBS) Systems

By Larry Van Horn

Alphastar (United States)

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

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

Programming: A&E Network, ABC (WJLA Washington DC), Alpha Preview Channel, C-Span 1 (US House), C-Span 2 (US Senate), Cartoon Network, CBS (WRAL Raleigh, NC), Cinemax, Cinemax 2, Cinemax West, Classic Sports Network, CNBC, CNN, CNN International/CNN fn, Comedy Central, Country Music Television, Court TV, Discovery Channel, Disney Channel (E), Disney Channel (W), E! Entertainment Television, Encore, Encore Plus, ESPN, ESPN2, Family Channel, FOX Network (Foxnet), Golf Channel, HBO, HBO 2, HBO 2 West, HBO 3, HBO West, Headline News, History Channel, Learning Channel, Lifetime, Local Regional Sports Networks (tba), MTV, Nashville Network, NBC (WNBC New York), NewsTalk Television, Nickelodeon / Nick at Nite, PBS Network (National), Playboy TV, 10 PPV Channels, Sci-Fi Channel, Showtime, Showtime 2, Showtime West, Starz!, Sundance Film Channel, TBS Atlanta, The Movie Channel, The Movie Channel West, Three Sports Channels (tba), Turner Classic Movies, Turner Network Television (TNT), TV Land, Two Liberty Sports Channels (tba), USA Network, VH-1, Weather Channel, 30 DMX Channels

DirecTV and USSB (United States)

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

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

100	Direct Ticket Previews (DTV)	Previews
101-199	Direct Ticket Pay Per View (DTV)	PPV
120/121	Letterbox (LTBX)	
140-142	Unknown service (LC)	
200	Direct Ticket Previews (DTV)	Previews
201	DirecTV Information Updates (DTV)	Promo
202	Cable Network News (CNN)	News
203	Court TV (CRT)	Speciality
204	CNN Headline News (HLN)	News
205	DirecTV Special Events Calendar (DTV)	Promo
206	ESPN 1 (ESPN)	Sports
207	ESPN Alternate (ESNA)	Sports
208	ESPN 2 (ESN2)	Sports
210	DirecTV Sports Schedule (DTV)	Promo
212	Turner Network Television (TNT)	TV programming
213	Home Shopping Network (HSN)	Home Shopping
214	Home and Garden TV (HGTV)	Home Improvement
215	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	MSNBC (MSNBC)	News
248	The Weather Channel (TWC)	Weather
250	Newsworld International (NWI)	News
252	CNN International (CNNI)/CNN fN	News/Financial
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 Stories (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
282	WRAL Raleigh, NC (CBS)	Network TV
283	KPIX San Francisco, CA (CBSW)	Network TV
284	WNBC New York, NY (NBC)	Network TV
285	KNBC Los Angeles, CA (NBCW)	Network TV
286	PBS National Feed (PBS)	Network TV
287	WJLA Washington, DC (ABC)	Network TV
288	KOMO Seattle, WA (ABCW)	Network TV
289	FoxNet. (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 Calendat (DTV)	Promo
302	MLB Extra Innings Daily Program Lineup (DTV)	Sports
303	Newsport (NWSP)	Sports
304	The Golf Channel (GOLF)	Sports
305	Classic Sports Network (CSN)	Sports
306	Speedvision (SV)	Sports
307	Outdoor Life Channel (OL)	Sports
309	SportsChannel New England (SCNE)	Sports
310	Madison Square Garden (MSG)	Sports
311	New England Sports Network (NESN)	Sports
312	SportsChannel New York (SCNY)	Sports
313	Empire Network (EMP)	Sports
314	SportsChannel Philadelphia (SCPH)	Sports
315	Prime Sports KBL (PKBL)	Sports
316	Home Team Sports (HTS)	Sports
317	SportsSouth (SPTS)	Sports
318	Sunshine (SUN)	Sports
320	Pro AM Sports (PASS)	Sports
321	SportsChannel Ohio (SCOH)	Sports
322	SportsChannel Cincinnati (SCCN)	Sports
323	SportsChannel Chicago (SCCH)	Sports
324	Midwest SportsChannel (MSC)	Sports
325	Prime Sports Southwest (PSSW)	Sports
326	Prime Sports Midwest/Rocky Mountain/ Intermountain West (PS)	Sports
330	Prime Sports Northwest (PSNW)	Sports
331	Prime Sports West (PSW)	Sports
332	SportsChannel Pacific (SCP)	Sports
333-348	NFL Sunday Ticket	Sports
350	NFL Sunday Ticket/NBA League Pass	Sports
356	NFL Sunday Ticket/NBA League Pass	Sports
380	DirecTV Sports Schedule (DTV)	Promo
401	Spice (SPCE)	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

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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 Christi. (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
530	Music Choice — Bluegrass (MC30)	Audio
531	Music Choice — Rock New Release Show (MC31)	Audio
599	NRTC Radio Service (NRTC) For private use only	
790	RealNet — Real Estate Channel (REAL)	

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

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

EchoStar (United States)

The new Echostar 1 high power DBS (Ku-band 12.2-12.7 GHz) satellite is now operational at 119º West. Echostar 2 was launched September 10, 1996. It should be operational by November 1, 1996. Echostar's service is called "TheDISH (Digital Satellite Network) Television Network.

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

100	DISH Network Channel	Promo
102	USA Network	TV
104	Comedy Central	Comedy
106	TVLand	Variety
108	Lifetime	TV
110	TV Food Network	Food
112	Home and Garden Network	Speciality
114	E! Entertainment TV	TV
118	Arts and Entertainment	TV
120	History Channel	History
122	Sci-Fi Channel	Science Fiction
132	Turner Classic Movies	Movies
138	Turner Network Television	TV
140	ESPN	Sports
141	ESPN Alternate	Sports
142	ESPN2	Sports
143	ESPN2 Alternate	Sports
160	MusicTV (MTV)	Music Videos
162	VH-1	Music Videos
166	Country Music Television	Music Videos
168	The Nashville Network	Country
170	Nickelodeon	Kids
172	The Disney Channel	Movies/Kids
176	The Cartoon Network	Cartoons
178	The Learning Channel	Science/TV Documentary
180	The Family Channel	TV
182	The Discovery Channel	Science/TV Documentary
200	Cable News Network	News
202	CNN Headline News	News
204	Court TV	Speciality
206	CNN International/CNNfn	News/Financial
208	CNBC	Financial/Talk
210	C-SPAN	Government
214	The Weather Channel	Weather
220	The Travel Channel	Travel Shows
226	QVC Shopping Network	Home Shopping
230	WTBS Atlanta, GA	Superstation
232	KTLA Los Angeles, CA	Superstation
234	WPIX New York, NY	Superstation
240	WGN Chicago, IL.	Superstation
241	WNBC-NBC New York, NY	Network TV
242	KNBC-NBC Los Angeles, CA	Network TV
243	WRAL-CBS Raleigh, NC	Network TV
244	KPIX-CBS San Francisco, CA	Network TV
245	WJAL-ABC Washington, DC	Network TV
246	KOMO-ABC Seattle, WA	Network TV
247	FOXNet	Network TV
249	PBS	Network TV
260	Trinity Broadcasting Network	Religious
261	Eternal Word TV Network	Religious
300	HBO East	Movies
301	HBO2 East	Movies
302	HBO3 East	Movies
303	HBO West	Movies
304	HBO2 West	Movies
310	Showtime East	Movies
311	Showtime West	Movies
312	Showtime East 2	Movies
320	Cinemax East	Movies
321	Cinemax East 2	Movies
322	Cinemax West	Movies
330	The Movie Channel East	Movies
331	The Movie Channel West	Movies
401	The Golf Channel	Sports
500	PPV 1 DISH-on-Demand (events)	Pay per view
501	PPV 2 DISH-on-Demand	Pay per view
502	PPV 3 DISH-on-Demand	Pay per view
503	PPV 4 DISH-on-Demand	Pay per view
504	PPV 5 DISH-on-Demand	Pay per view
505	PPV 6 DISH-on-Demand	Pay per view
600	RAI (Italy)	International
602	ART (Arab Radio and Television)	International
604	Antenna TV Greece	International
620	MTV Latino	International
626	Prime Deportiva	International
628	Telemundo	International
700	DISH 2 (Showroom Promo Channel)	Promo
900	Business TV	Financial
901	Business TV	Financial
DISH CD ™		
950	Young Country	Audio
951	Country Classics	Audio
952	Country Currents	Audio
953	Jukebox Gold	Audio
954	70's Song Book	Audio
955	Adult Favorites	Audio
956	Adult Contemporary	Audio
957	Album Adult Alternative	Audio
958	HitLine	Audio
959	Classic Rock	Audio
960	The Edge	Audio
961	Power Rock	Audio
962	Non-Stop Hip Hop	Audio
963	Urban Beat	Audio
964	Latin Styles	Audio
965	Fiesta Mexicana	Audio
966	Eurostyle	Audio
967	Jazz Traditions	Audio
968	Contemporary Jazz Flavors	Audio
969	Expressions	Audio
970	Contemporary Instrumentals	Audio
971	Concert Classics	Audio

Direct Broadcast Satellite (DBS) Systems

By Larry Van Horn

972	Light Classical	Audio
973	Easy Instrumentals	Audio
974	Big Band Era	Audio
975	Contemporary Christian	Audio
976	KidZone	Audio
977	LDS Radio Network	Audio

ExpressVu (Canada)

This is Canada's first digital medium power Direct-to-Home satellite TV service. The service will provide Canadian, American, and international video and audio programs. 110 channels will be offered using Canada's Anik E1 (Ku-band 11-.7-12.2 GHz) satellite at 111º West. Channel assignments and programming were not available at presstime.

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

Galaxy Latin America (Mexico, Central and South America)

Ft. Lauderdale, FL
Web site: **http://www.sattv.com**
New Latin American DBS service carried on Galaxy 3R at 95º West (Ku-band, 11.7-12.2GHz). Medium power Direct-to-Home service for Mexico, Central and South America. Galaxy Latin America will have 144 channels of video (72 channels in Spanish/72 channels in Portuguese). Pay-per-view movies and events will also be provided. A .6-1.1 meter dish will be needed to utilize the service. Channel assignments were not available at presstime.

Programming: AS, BBC, Bloomberg Business TV in Espanol, Bloomberg Business TV in Portuguese, Bravo Brasil, Canal de Noticias NBC, Cartoon Network, CBS TeleNoticias, Cinelatino, Cinemax Brasil, Cl@se (Latin America Channel for Educational Services), CNA (Brasil all news channel), CNN en Espanol, CNN International, Discovery Latin America, ESPN Brasil, GEMS, HBO Brasil, HBO Cinemax Multiplex, HBO Ole Multiplex, KID, MTV Brasil, MultiCinema, RBN News (Brasil), RTP (Portugal), Sony Entertainment TV (SET), Televen International, The Warner Channel (WBTV), TNT Latin America, Univision, Venevision International, ZAZ, Zeta, 60 CD-Quality Audio Channels

Primestar (United States)

Primestar is a medium power Direct-to-Home satellites service carried on Satcom K1 at 85º West (Ku-band 11.7-12.2 GHz). Primestar uses K1 transponders 2-13 and 15-16 19 transponders).

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

1	HBO (East)	Movies
2	HBO 2 (East)	Movies
3	HBO 3	Movies
7	Cinemax (East)	Movies
8	Cinemax 2	Movies
13	TV Japan (English)	Not included in $50 a month package
14	TV Japan (Japanese)	Not included in $50 a month package
15	Future service	
17	Future service	
19	Future service	
27	Starz!	Movies
31	Encore 3 — Westerns	Movies
32	Encore 4 — Mystery	Movies
33	Encore	Movies
34	The Disney Channel (East)	Movies/Kids
35	The Disney Channel (West)	Movies/Kids
40	The Golf Channel	Sports
47	C-SPAN	Congress
48	CNBC—occasional service	Financial/Talk
49	The Weather Channel (TWC)	Weather
50	CNN International (CNNI)/CNN fN	News/Financial
51	Cable Network News (CNN)	News
52	CNN Headline News	News
	Ingenius News Service	Data Wire Services
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	Nickelodeon/Nick at Nite	Kids
75	E! Entertainment Network	Speciality
76	Lifetime	TV
77	The Nashville Network (TNN)	Country/Outdoors
78	Country Music TV (CMT)	Country music videos
80	MTV	Music Videos
83	Faith and Values Network	Religious
84	QVC—occasional service	Home Shopping
111	WHDH-NBC Boston, MA	Network TV
112	WSB-ABC Atlanta, GA	Network TV
117	WUSA-CBS Washington, DC	Network TV
120	KTVU-FOX Oakland/San Francisco, CA	Network TV
124	WHYY-PBS Philadelphia, PA	Network TV
131	ESPN	Sports
133	ESPN2	Sports
137	Classic Sports Network (occ)	Sports
138	Mega+1	Sports
141	New England Sports Network (NESN)	Sports
142	Madison Square Garden Network (MSG)	Sports
143	Empire Sports Network	Sports
144	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	
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
181	HBO en Espanol	Movies
182	HBO2 en Espanol	Movies
183	HBO3 en Espanol	Movies
187	Cinemax Selecciones	Movies
188	Cinemax2 Selecciones	Movies
190	Univision	Spanish language
201	Viewer's Choice	PPV
202	Request 1	PPV
203	Request 5	PPV
204	Hot Choice	PPV
205	Continuous Hits 1	PPV
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
311	DMX Audio—Lite Jazz	Audio
312	DMX Audio—Classic Rock	Audio
313	DMX Audio—70's Oldies	Audio
314	DMX Audio—Adult Contemporary	Audio
315	DMX Audio—Hottest Hits	Audio
316	DMX Audio—Modern Country	Audio
317	DMX Audio—Traditional Blues	Audio
318	DMX Audio—Salsa	Audio
527	Testing Channel	Tests

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
21	11900-H	TV ASAHI [Leitch]
22	11980-H	Empire Sports Network [video compression]
23	12060-H	Kentucky Educational TV (occ) - uses half transponders
24	12140-H	Occ video

SBS-2 (SBS2) 71º West

3	11872-H	NBC contract channel

SBS 6 (SBS6) 74º West

1	11717-H	Data transmissions
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 (half transponders)
12	11994.5-V	CONUS Communications (half-transponders)
13	12019-H	CONUS Communications (half transponders)
14	12043.5-V	Occ video
15	12075-H	Occ video
16	12092.5-V	Occ video
17	12110-H	Occ video
18	12141.5-V	Occ video
19	12174-H	CNN Newsbeam (occ)

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

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

GE 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
5	11847-H	NBC contract channel
6	11876.5-V	NBC contract channel/Occ video
7	11906-H	NBC contract channel
8	11935.5-V	Chinese Communications Channel [Dak]
9	11965-H	NBC-Mountain
10	11994.5-V	NBC contract channel/Occ video
11	12024-H	NBC contract channel
12	12053.5-V	NBC contract channel/Occ video
13	12083-H	NBC NewsChannel
14	12112.5-V	NBC contract channel/Occ video
15	12142-H	NBC contract channel
16	12171.5-V	NBC contract channel/Occ video

GE 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
22	11980-H	NYNET (SUNY) Ed Net/NY Lottery feeds (East spot beam)
23	12060-H	Oregon Educational Network (West spot beam)
24	12140-H	Occ video

Telstar 402R (T402) 89ºWest

Alphastar DBS uses many T402 Ku-band transponders

1	11730-V	AT&T Tridom [digital]
2	11743-H	AT&T Tridom [digital]
3	11790-V	AT&T Tridom [digital]
4	11803-H	AT&T Tridom [digital]
5	11850-V	Occ video
9	11971-V	Occ video (half transponder)
15	12157-V	DMX for Business [digital data]

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
6	11810-V	TCI Headend in the Sky?
7	11840-V	TCI Headend in the Sky?
8	11870-H	Data transmissions
9	11870-V	TCI Headend in the Sky?
10	11900-V	Occ video
11U	11945-H	[Compressed video]
12	11930-V	TCI Headend in the Sky?
13	11960-V	Occ video
14	11990-H	Occ video
15	11990-V	Occ video
16	12020-V	Occ video/The People's Network (TPN)
17	12050-H	Westcott Communications ASTN [B-MAC]/National Weather Networks (occasional)
18	12050-V	TCI Headend in the Sky?
19	12080-V	The Asia Network/Real Estate TV Network/Occ video
20	12110-H	Data transmissions
21	12110-V	TCI TV [B-MAC]
22	12140-V	TCI Headend in the Sky?
23	12170-H	Data transmissions
24	12170-V	TCI Headend in the Sky?

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

1	11730-H	Data transmissions
2	11791-H	Data transmissions
3	11852-H	Occ video
4	11913-H	Occ video
5	11974-H	Occ video
6	12035-H	Occ video
7	12096-H	Occ video
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

Galaxy 3R (G3R) 95º West

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

Telstar 401 (T401) 97º West

1	11730-V	Data 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	Occ video
7	11902-V	PBS educational services (half-transponders)
8	11915-H	PBS stations/regionals and backhauls
9L	11958-V	Egyptian TV
9U	11986-V	PBS digital video [Digicipher]/VSAT traffic
10	11962.5-H	Louisiana Public TV State Network [Digicipher]
11	12040-V	Occ video
12	12046-H	Occ video
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	Chinese Television Network *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)/ Microsoft TV (occ)
13	11960-H	Occ video
14	11990-V	Occ video (half-transponders common)
16	12020-H	FM² services/Data transmissions
17	12050-V	CBS Newsnet and affiliate feeds (half-transponders)
18	12050-H	Honk Kong TVB Jade Channel (Chinese) [videocrypt]
19	12080-H	Data transmissions
20	12110-V	Occ video (half-transponders common)
21	12110-H	Asian-American TV Network (occ)
22	12140-H	Family Net [Digicipher]
23	12170-V	CBS Newsnet and affiliate feeds (half-transponders)
24	12170-H	The Filipino Channel [Dak]

Spacenet 4 (S4) 101º West

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	Occ video
4	11913-H	Data transmissions
5	11974-H	Occ video
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	Data transmissions
14	12049-V	Data transmissions
15	12110-V	Data transmissions
16	12171-V	Fed-Ex TV [B-MAC]

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	Occ video
7	12096-H	CNN Newsbeam/Occ video
8	12157-H	CNN Newsource International/ Occ video
9	11744-V	Data transmissions
11	11866-V	Occ video
12	11927-V	Occ video
13	11988-V	CNN Newsbeam/occ video
15	12110-V	CNN Newsource/occ video
16	12171-V	Occ video

Anik E2 (A1) 107.3º West

1	11717-V	Telesat Canada DVC: MovieMax!, Family Channel E&W, SuperChannel [digital video compression]
2	11743-V	DirectPC [digital]
3	11778-V	Data transmissions
4	11804-V	Much Music
5	11839-V	Canadian Parliamentary Access Channel, Youth TV E&W, Vision TV, CHSC Shopping [digital video compression]
6	11865-V	Moviepix!; The Movie Network [digital video compression]
7	11900-V	Rogers Network [digital video compression]
8	11926-V	Rogers Network [digital video compression]
9	11961-V	Data transmissions
10	11987-V	Data transmissions
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	Knowledge Network
18	11756-H	Showcase E&W/Discovery Channel Canada/Life Network [digital]
19	11791-H	Bravo! Canada
21	11852-H	Data transmissions
22	11878-H	Data transmissions
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
28	12061-H	Data transmissions
29	12096-H	Atlantic Satellite Network (ASN)
30	12122-H	Telesat Canada stationkeeping (GLACS)
31	12157-H	CBC Newsworld feeds
32	12183-H	RDI feeds

Solidaridad 1 SO1 109.2º West

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

Anik E1 (A2) 111º West

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

1	11717-V	Data transmissions
2	11743-V	Data transmissions
3	11778-V	Data transmissions
4	11804-V	Data transmissions
5	11839-V	Business TV [digital]
6	11865-V	NovaNet FM² Services
17	11730-H	Woman's Television Network E&W [digital video compression]
18	11756-H	Data transmissions
19	11791-H	Data transmissions
20	11817-H	SCPC/Data transmissions/New Country Network, Access Network of Alberta [Shaw digital video compression]

Solidaridad 2 (SO2) 112.9º West

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

Anik C3 (C3) 114.9º W(Inclined Orbit)

(This satellite rarely has video transmissions)

7	11900-V	Occ video

Morelos 2 (M2) 116.8º West

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

EchoStar 1/2 119ºWest

A complete channel guide for TheDISH Television Network is presented in the DBS section of *Satellites Times* Satellite Service Guide. This satellite (and in the near future Echostar 2) operate in the 12.2-12.7 GHz range.

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	Occ video
10	12166-H	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
13	11988-V	Occ video
14	12049-V	Occ video
15	12110-V	Occ video
16	12171-V	Occ video

Satellite Transponder Guide

By Robert Smathers

	Spacenet 2 (S2) 69°	Galaxy 6 (G6) 74°	Telstar 302 (T2) 85°	Spacenet 3 (S3) 87°	Telstar 402R (T4) 89°	Galaxy 7 (G7) 91°	Galaxy 3R (G3R) 95°	Telstar 401 (T1) 97°	Galaxy 4 (G4) 99°	Spacenet 4 (S4) 101°
1	SC New York [V2+]	Tokyo BS New York feeds	(none)	(none)	The Babe Channel/o/v	Sega Channel Interactive [digital]	TVN Theatre 1 [V2+]	Exxxtasy (adult) Promo/VTC	SCPC services	Data Transmissions
2	(none)	Global Access/Canadian Horse Racing/o/v	(none)	American Independent Network (AIN) [CLI Spectrumsaver]	(none)	CBS West [VC1]	TVN Theatre 2 [V2+]	Data Transmissions	Data Transmissions	STARZ! 2 [V2+]
3	USIA Worldnet TV	SCPC services	(none)	WSBK-Ind Boston [V2+]	The Babe Channel/o/v	Action PPV [V2+]	TVN Theatre 3 [V2+]	Keystone/Parmount feeds/o/v	SCPC services	Data Transmissions
4	H.TV (Spanish) [V2+]	Canadian Horse Racing/o/v	(none)	Nebraska Educational TV (NETV)	Shop at Home	fX East	TVN Theatre 4 [V2+]	Group W Videoservices/o/v	Data Transmissions	Encore-Westerns [V2+]
5	NASA Contract Channel-o/v [Leitch]	o/v	(none)	Univision [V2+]	FOX feeds East	fX West	TVN Theatre 5 [V2+]	Keystone o/v	4 Media Company feeds	Data Transmissions
6	Data Transmissions	NHK (TV Japan) feeds	(none)	(none)	o/v	Game Show Network [V2+]	TVN Theatre 6 [V2+]/TVN Promos (occ)	Buena Vista TV feeds	Shepherd's Chapel Network (Rel)	KNBC-NBC Los Angeles (PT24W) [V2+]
7	(none)	National Empowerment TV	(none)	Data Transmissions	Cable Video Store/Adam & Eve/Spice (adult) [digital]	The Golf Channel [V2+]	TVN Theatre 7 [V2+]/GRTV infomercials	o/v	Warner Brothers Dom TV/WB Network	Basil Bassett Bingo
8	Data Transmissions	Horse Racing [digital]	(none)	Data Transmissions	o/v	o/v	TVN Theatre 8 [V2+]	PBS X	Telemundo [SA MPEG]	KOMO-ABC Seattle (PT24W) [V2+]
9	NASA TV	MuchMusic U.S. [V2+]	(none)	WPIX-Ind New York [V2+]	Horse Racing [digital]	Eye on People Network [digital]	TVN Theatre 9 [V2+]	FOX feeds East	o/v	Data Transmissions
10	Data Transmissions	Arab Network of America (ANA)	ABC West [Leitch]	Data Transmissions	XXXplore/XXXpose (adult) [V2+]	United Arab Emirates TV Dubai	TVN Theatre 10 - adulTVision (adult) [V2+]	FOX feeds East	WJLA-ABC Washington (PT24E) [V2+]	FOXNet (PT24E) [V2+]
11	SC Philadelphia [V2+]	Keystone o/v	(none)	CNN feeds/o/v	Outdoor Channel	(none)	o/v	ABC feeds	o/v	STARZ! East [V2+]
12	Data Transmissions	TV Asia [digicipher]	(none)	Data Transmissions	Horse Racing [digital]	(none)	MCI Andover o/v/RAI TV	ABC NewsOne channel	Keystone o/v	Keystone o/v
13	Data Transmissions	RTPi	(none)	SCPC/FM2 services	FOX feeds West	CSN/Kaleidoscope/P-SS/The Box [digicipher]	o/v	FOX feeds East	Informercials/o/v/NC Open Net	Data Transmissions
14	Data Transmissions	Cornerstone TV WPCB-TV (Rel)	(none)	(none)	o/v	Independent Film Channel [V2+]	o/v	FOX News Service	WRAL-CBS Raleigh (PT24E) [V2+]	o/v
15	HERO Teleport [digicipher]	Midwest Sports Channel [V2+]	(none)	KTLA-Ind Los Angeles [V2+]	o/v	Intro Television [V2+]	Gospel Music TV [V2+]	True Blue (adult) [V2+]	World Harvest TV (Rel)	Data Transmissions
16	Data Transmissions	o/v	(none)	CNN International/CNN fM [V2+]	Eurotica (adult) [V2+]	(none)	HBO 2 East [V2+]	o/v	CBS West [VC1]	NPS Promo Channel
17	Data Transmissions	Keystone o/v	(none)	FM2/SCPC services	FOX feeds	ESPN Intl Pacific Rim [B-MAC]	Cinemax 2 East [V2+]	o/v	CBS East/o/v [VC1]	Data Transmissions
18	(none)	o/v	(none)	US Sat.Corp (infomercials)	Kelly Broadcast Systems contract channel/o/v	Teleport Minnesota/CBS feeds/o/v	Univision Contract [occ analog/mostly digital]	Keystone o/v	CBS feeds/o/v	STARZ! West [V2+]
19	Data Transmissions	University Network/Dr. Gene Scott (Rel)	(none)	SSN Sportsouth [V2+]	o/v	CBS East [VC1]	HBO 3 [V2+]	Keystone o/v/UPN	CBS East/o/v [VC1]	Data Transmissions
20	Armed Forces Radio & Television Service [B-MAC]	CNN Headline News Clean Feed [V2+]	ABC East [Leitch]	(none)	GOP TV/o/v	FOX News Channel	HBO 2 West [V2+]	ABC East [Leitch]	CBS East [VC1]	Data Transmissions
21	SC New England [V2+]	o/v	(none)	SSN Pro Am Sports (Pass) [V2+]	o/v	BET on Jazz	o/v	ABC East [Leitch]	CBS feeds/o/v	Data Transmissions
22	o/v	Horse Racing (digital)	(none)	Data Transmissions	ABC feeds - L.A. Bureau	NewsTalk Television	Horse Racing [digital]	ABC West [Leitch]	WNBC-NBC New York (PT24E) [V2+]	Data Transmissions
23	NHK TV Japan secondary feeds	Worship TV (Rel)	(none)	SSN Home Teams Sports (HTS) [V2+]	La Cadena de Milagro (Spanish Rel)	fX Movies [V2+]	3 Angels Broadcasting	ABC East [Leitch]	SCOLA [Wegener]/Blue & White Network	Data Transmissions
24	o/v	Horse Racing [digital]/o/v	(none)	America One	PandaAmerica (Home Shopping)	International Channel [V2+]	o/v	Exxxtasy (adult) [V2+]	CBS Newspath feeds	KPIX-CBS San Francisco (PT24W) [V2+]

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

Satellite Transponder Guide

By Robert Smathers

Anik E2 (A1) 107.3º	Solidaridad 1 (SD1) 109.2º	Telesat E1 (A2) 111º	Morelos 2 (M2) 116.8º	Galaxy 9 (G9) 123º	Galaxy 5 (G5) 125º	Satcom C3 (F3) 131º	Galaxy 1R (G1) 133º	Satcom C4 (F4) 135º	Satcom C1 (F1) 137º	
CBC-H English Eastern	(none)	Data Transmissions	Data Transmissions	Global Access o/v/BBC Breakfast News	Disney East [V2+]	Family Channel West [V2+]	Comedy Central West [V2+]	American Movie Classics (AMC) [V2+]	FOX Sports Network [V2+]	1
The Sports Network [Oak]	(none)	(Inactive)	Data Transmissions	Global Access o/v	Playboy (adult) [V2+]	The Learning Channel	Spanish language networks [SA MPEG]	Request TV PPV [digicipher]	KMGH-ABC Denver [V2+]	2
Telesat [digital video compression]	SCPC services	Data Transmissions	Data Transmissions	NHK TV Japan	Trinity Broadcasting (Rel)	Viewer's Choice PPV [V2+]	Encore [V2+]	Nickelodeon East [V2+]	KRMA-PBS Denver [V2+]	3
Cancom Video Compression [SA-MPEG]	(none)	Data Transmissions	Data Transmissions	General Communication [digital]	Sci-Fi [V2+]	Lifetime West [V2+]	TV Food Network [digicipher]	Lifetime East [V2+]	SC Pacific [V2+]	4
Telesat [digital video compression]	o/v	Data Transmissions	Data Transmissions	Global Access o/v	CNN [V2+]	Odyssey (Rel)	Classic Arts Showcase	Deutsche Welle TV (German)	KDVR-Fox Denver [V2+]	5
CBC Newsworld [Oak]	(none)	(Inactive)	Data Transmissions	General Communication [digital]	WTBS-Ind Atlanta [V2+]	Court TV [digicipher]	Z-Music	Madison Square Garden [V2+]	KCNC-CBS Denver [V2+]	6
CBC-M English	XEQ-TV canal 9	Data Transmissions	Data Transmissions	TVN Video Compression [digital]	WGN-Ind Chicago [V2+]	C-SPAN 1	Disney West [V2+]	Bravo [V2+]	SSN FOX Sports West [V2+]	7
Global TV [Leitch]/Global feeds	(none)	(Inactive)	XHGC canal 5	General Communication [digital]	HBO West [V2+]	QVC-2 Fashion Channel	Cartoon Network [V2+]	Prevue Guide	NBC-East	8
CBC-B English Atlantic	o/v	(Inactive)	(none)	TVN Video Compression [digital]	ESPN [V2+]	Music Choice [digital]	ESPN2 Blackout [V2+]/SAH	QVC Network	FOX Sports Showcase	9
Cancom Video Compression [SA-MPEG]	Mexican Parliament	(Inactive)	o/v	TVN Video Compression [digital]	MOR Music	Home Shopping Club Spree	MSNBC [V2+]	Home Shopping Network (HSN)	SSN FOX Sports SW [V2+]	10
CBC-A French	(none)	(Inactive)	XEIPN canal 11	TVN Video Compression [digital]	Family Channel East [V2+]	Newsport [V2+]	Eternal Word TV Network (Rel)	(none)	Network One N1	11
Cancom Video Compression [SA-MPEG]	Data Transmissions	(Inactive)	Data Transmissions	General Communication [digital]	Discovery West [V2+]	History Channel [V2+]	Valuevision	Starnet	Data Transmissions	12
CBC-C English Pacific	(none)	(Inactive)	(none)	GRTV infomercials	CNBC [V2+]	The Weather Channel [V2+]	Encore [digicipher]	Travel Channel [V2+]	SC Chicago [V2+]	13
Cancom Video Compression [SA-MPEG]	Data Transmissions	o/v	XEW canal 2	Sundance Channel [V2+]	ESPN2 [V2+]	New England Sports Network [V2+]	ESPN Blackout [V2+]/SAH	Fit TV	KUSA-NBC Denver [V2+]	14
o/v	Multivision [digicipher]	(Inactive)	Data Transmissions	Showtime West [V2+]	HBO East [V2+]	Showtime East [V2+]	(none)	WWOR Ind New York [V2+]	SC Cincinnati/Ohio/Florida [V2+]	15
Cancom Video Compression/NTV [SA-MPEG]	Data Transmission	CTV Network [digital]	Canal 22	General Communication [digital]	Cinemax West [V2+]	M2: Music Television [V2+]	Turner Classic Movies [V2+]	Request TV 1 [V2+]	FOX Sports West/FOX Sports Deportiva [digicipher]	16
CBC-D Feeds	o/v	(Inactive)	o/v	Nickelodeon West [V2+]	TNT [V2+]	Movie Channel East [V2+]	The New Inspirational Network (Rel)	MTV East [V2+]	SSN FOX Sports (various) [V2+]	17
Video Catalog Channel	(none)	(Inactive)	Clara Vision (Rel)	The Movie Channel West [V2+]	TNN [V2+]	TVLand	HBO Multiplex [digicipher]	Viewer's Choice [digicipher]	FOX Sports/Sunshine Alt Cal-Span	18
o/v	Multivision [digicipher]	TV Northern Canada [digital]	(none)	MTV West [V2+]	USA East [V2+]	Showtime/MTV [digicipher]	Cinemax East [V2+]	C-SPAN 2	FOXNet [V2+]	19
Exxtreme/Climaxxx (adult) [V2+]	(none)	Canadian Horse Racing/o/v	Data Transmissions	General Communication [digital]	BET [V2+]	Jones Intercable [digicipher]	Home and Garden Network [V2+]	Showtime 2 [V2+]	o/v	20
Telesat [digital video compression]	(none)	SCPC services/ Data Transmissions	(none)	Global Access o/v	MEU	Comedy Central East [V2+]	USA West [V2+]	Discovery East [V2+]	Sportchannel alt/SportsChannel Fla.	21
XXXotica (adult) [V2+]	(none)	(Inactive)	XHIMT canal 7/TeleCasa	Global Access o/v	CNN/HN [V2+]	Your Choice TV [digicipher]	Nostalgia Channel	FLIX [V2+]	SSN FOX Sports NW [V2+]	22
CBC-E English	(none)	(Inactive)	(none)	The Computer Network	A&E [V2+]	E! Entertainment TV [V2+]	(none)	VH 1 [V2+]	KWGN-Ind Denver [V2+]	23
Inactive (Failed Transponder)	(none)	(Inactive)	XHDF canal 13	General Communication [digital]	Showtime/Movie Channel [SA MPEG]	Digital Music Express Radio (DMX) [digital]	Global Shopping Network	CMT [V2+]	SSN Sunshine [V2+]	24

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

Geostationary Satellite Locator Guide

By Larry Van Horn

This guide shows the orbital locations of 254 active geostationary/synchronous satellites at publication deadline. Synchronous satellite location information is supplied to *Satellite Times* by NASA's Goddard Space Flight Center-Orbital Information Group (Mr. Adam Johnson). We are particularly grateful to the following individuals for providing payload information and analysis: Earth News: Philip Chien; Molniya Space Consultancy: Mr. Phillip Clark; JSC NASA: Dr. Nicholas Johnson; University of New Brunswick: Mr. Richard B. Langley; Havard-Smithsonian Center for Astrophysics: Jonathan McDowell; U.S. Space Command/ Public Affairs; Naval Space Command/Public Affairs; NASA NSSDC/WDC-A, Goddard Space Flight Center; and the *Satellite Times* staff.

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

Radio Frequency Band Key

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

Satellite Service Key

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

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
21140	1991-015B Meteosat 5 (MOP 2)	0.4E	Met (L)
24209	1996-044B Telecom 2D (France)	2.7E	Dom-FSS/Gov-Mil (C/X/Ku)
23730	1995-067A Telecom 2C (France)	2.9E	Dom FSS/Gov-Mil (X/C/Ku)
23712	1995-060A USA 115 (DFS-2/Milstar-2)	4.0E/i	Mil-Comm (P/S/K)
19919	1989-027A Tele X (Sweden)	4.9E	Reg DTH/FSS (Ku)
20193	1989-067A Sirius/Marcopolo 1(BSB R-1)	5.1E	Reg DTH (Ku)
22921	1993-076A USA 98 (NATO 4B)	5.9E/i	Mil-Comm (P/S/X)
20929	1990-095A DSP F-15 (USA)	6.6E#	Mil-Early Warning (S/X)
22028	1992-041B Eutelsat II F4	7.0E	Reg FSS (Ku)
21056	1991-003B Eutelsat II F2	9.9E	Reg FSS (Ku)
19596	1988-095A Raduga 22 (Russia)	11.3E/i	Dom FSS/Gov-Mil (X/C)
22557	1993-013A Raduga 29 (Russia)	11.6E#	Dom FSS/Gov-Mil (X/C)
22269	1992-088A Cosmos 2224 (Russia)	11.7E#	Mil-Earl Warning (X)
20777	1990-079B Eutelsat II F1	13.0E	Reg FSS (Ku)
21055	1991-003A Italsat F1 (Italy)	13.1E	Dom-Telephone (S/K/Ka)
23537	1995-016B Hot Bird 1 (Eutelsat II F6)	13.2E	DTH (Ku)
24208	1996-044A Italsat F2 (Italy)	13.2E	Dom-Telephone-Mob (S/K/Ka)
24307	1996-053A Inmarsat 3 F2	15.8E/i	Int Mar (L/C)
21803	1991-083A Eutelsat II F3	16.0E	Reg FSS (Ku)
19688	1988-109B Astra 1A	19.1E	Reg DTH (Ku)
23686	1995-055A Astra 1E	19.1E	Reg DTH (Ku)
21139	1991-015A Astra 1B	19.2E	Reg DTH (Ku)
22653	1993-031A Astra 1C	19.2E	Reg DTH (Ku)
23331	1994-070A Astra 1D	19.2E	Reg DTH (Ku)
23842	1996-021A Astra 1F	19.2E	Reg DTH (Ku)
14234	1983-077A Telstar 3A (301) (USA)	20.0E/i	Dom FSS-Saudi Arabia (C)
19331	1988-063B Eutelsat 1 F5 (ECS 5)	21.4E#	Reg FSS (VHF/Ku)
22175	1992-066A DFS 3 (Germany)	23.5E	Dom BSS (S/Ku/K)
18351	1987-078B Eutelsat 1 F4 (ECS 4)	25.5E/i	Reg FSS (VHF/Ku)
23948	1996-040A Arabsat 2A (Arabsat)	26.0E	Reg FSS/BSS (C/Ku)
20659	1990-054A Gorizont 20 (Russia)	26.3E/i	Dom/Gov FSS (C/Ku)
20706	1990-063B DFS 2/Kopernikus (Germany)	28.5E	Dom BSS (S/Ku/K)
21894	1992-010B Arabsat 1C (Arabsat)	31.0E	Reg FSS/BSS (S/C)
13595	1982-097A Intelsat 505	33.1E/i	Int FSS/Mar (L/C/Ku)
19765	1989-004A Gorizont 17 (Russia)	33.7E/i	Dom/Gov FSS (C/Ku)
21821	1991-087A Raduga 28 (Russia)	34.5E/i	Dom FSS/Gov-Mil (X/C)
22963	1993-002A Gals 1 (Russia)	35.9E	Dom BSS (Ku)
14128	1983-058A Eutelsat 1 F1 (ECS 1)	36.1/i	Reg FSS (Ku)
23717	1995-063A Gals 2 (Russia)	36.3E	Dom BSS (Ku)
23775	1996-005A Gorizont 31 (Russia)	39.6E#	Dom/Gov FSS (C/Ku)
23200	1994-049B Turksat 1B (Turkey)	42.0E	Reg FSS (Ku)
23949	1996-040B Turksat 1C (Turkey)	42.1E	Reg FSS (Ku)
22981	1994-008A Raduga 1-3 (Russia)	48.9E#	Dom FSS/Gov-Mil (X/C)
23880	1996-034A Gorizont 32 (Russia)	52.8E	Dom/Gov FSS (C/Ku)
19687	1988-109A Skynet 4B (UK)	53.0E/i	Mil-Comm (P/S/X/Ka)
23305	1994-064A Intelsat 703	57.0E	Int FSS (C/Ku)
13040	1982-006A DSCS II E15 (USA)	57.0E/i	Mil-IOR reserve operational (S/X)
20203	1989-069B DSCS III A2 (USA 44)	57.0E/i	Mil-IOR primary operational (P/S/X)
20667	1990-056A Intelsat 604	59.9E	Int FSS (C/Ku)
22913	1993-074A DSCS III B10 (USA 97)	60.0E/i	Mil-IOR primary operational (P/S/X)
20315	1989-087A Intelsat 602	62.9E	Int FSS (C/Ku)
23839	1996-020A Inmarsat 3 F1	64.0E/i	Int Mar (L/C)
13636	1982-106A DSCS II F16 (USA 43)	64.9E/i	Mil-IOR reserve operational (S/X)
20918	1990-093A Inmarsat 2 F1	65.1E#	Int Mar-IOR (L/C)
23461	1995-001A Intelsat 704	66.0E	Int FSS (C/Ku)
23636	1995-040A PanAmSat 4 (PAS 4)	68.5E	Int FSS (C/Ku)
20083	1989-048A Raduga 1-1 (Russia)	70.2E/i	Dom FSS/Gov-Mil (X/C)
23448	1994-087A Raduga 32 (Russia)	70.7E#	Dom FSS/Gov-Mil (X/C)
22787	1993-056A USA 95 (UFO-2)	71.2E/i	Mil-IOR primary (P/S)
20410	1990-002B Leasat 5 (USA)	71.5E/i	Mil-IOR reserve (P/S/X)
12474	1981-050A Intelsat 501	72.1E/i	Int FSS (C/Ku)
23589	1995-027A USA 111 (UFO-5)	72.1E/i	Mil-IOR reserve (P/S/K)
13129	1982-031A Insat 1A (India)	72.6E/i	DOM FSS?Met (S/C)
22027	1992-041A Insat 2A (India)	73.9E	Dom FSS/BSS/Met (S/C)
23327	1994-069A Elektro 1 (Russia)	76.0E#	Met (L)
23680	1995-054A Luch 1-1 (Russia)	77.3E/i	Tracking & Relay SDRN-2 (Ku)
23314	1994-065B Thaicom 2 (Thailand)	78.4E	Reg FSS (C/Ku)
22931	1993-078B Thaicom 1 (Thailand)	78.5E	Reg FSS (C/Ku)
21759	1991-074A Gorizont 24 (Russia)	79.4E/i	Dom/Gov FSS (C/Ku)
23653	1995-045A Cosmos 2319 (Russia)	80.0E#	Data Relay (C)
20643	1990-051A Insat 1D (India)	82.9E	Dom FSS/BSS/Met (S/C)
19548	1988-091B TDRS F3 (USA)	85.3E/i	Gov (C/S/Ku)
22836	1993-062A Raduga 30 (Russia)	85.5E#	Dom FSS/Gov-Mil (X/C)
24435	1996-058A Express 2 (Russia)	87.1E	Int FSS (C/Ku)
18922	1988-014A PRC 22 DFH2-1(China)	87.9E/i	Dom FSS (C)
22880	1993-069A Gorizont 28 (Russia)	90.0E#	Dom/Gov FSS (C/Ku)
23765	1995-003A Measat 1 (Malaysia)	91.4E	Dom FSS/DTH (C/Ku)
22724	1993-048B Insat 2B (India)	93.5E	Dom FSS/BSS/Met (S/C)
23731	1995-067B Insat 2C (India)	93.5E	Dom FSS/BSS/Met (S/C)
23426	1994-082A Luch 1 (Russia)	95.4E#	Tracking & Relay CSDRN (Ku)
22245	1992-082A Gorizont 27 (Russia)	96.7E#	Dom/Gov FSS (C/Ku)
20263	1989-081A Gorizont 19 (Russia)	96.9E/i	Dom/Gov FSS (C/Ku)
20473	1990-011A PRC 26 DFH2A-1 (China)	98.1E#	Dom FSS (C)
22210	1992-074A Ekran 20 (Russia)	98.9E#	Dom BSS (P)
19683	1988-108A Ekran 19 (Russia)	99.1E/i	Dom BSS (P)
23723	1995-064A AsiaSat 2	100.5E	DTH (C/Ku)
21922	1992-017A Gorizont 25 (Russia)	102.7E/i	Dom/Gov FSS (C/Ku)
20558	1990-030A Asiasat 1	105.4E	DTH (C/Ku)
20570	1990-034A Palapa B2R	108.0E	Reg FSS (C)
23176	1994-040B BS-3N (Japan)	109.8E	Dom BSS (Ku)
21668	1991-060A BS-3B (Yuri 3B)(Japan)	109.9E	Dom BSS (Ku)
20771	1990-077A BS-3A (Yuri 3A)(Japan)	109.9E	Dom BSS (Ku)
19710	1988-111A PRC 25 DFH2-2 (China)	110.3E#	Dom FSS (C)
23864	1996-030A Palapa C2	113.0E	Reg FSS (C/Ku)
14985	1984-049A Chinasat 5 (Spacenet 1)	115.6E	Dom FSS (C/Ku)
23639	1995-041A Koreasat 1 (Mugunghwa 1)	115.8E	Dom FSS (Ku)
23768	1996-003A Koreasat 2 (Mugunghwa 2)	115.8E	Dom FSS (Ku)
21964	1992-027A Palapa B4	118.1E	Reg FSS (C)
20217	1989-070A GMS-4 (Himawari 4)	120.3E#	Met (P/L)
21132	1991-014A Raduga 27 (Russia)	127.2E/i	Dom FSS/Gov-Mil (X/C)
23649	1995-043A JCSAT 3 (Japan)	128.0E	Dom FSS (Ku)
22907	1993-072A Gorizont 29 (Rimsat 1)	130.1E#	Reg FSS (C/Ku)
18877	1988-012A CS 3A (Sakura 3A)(Japan)	132.0E	Dom FSS (C/K)
23943	1996-039A Apstar 1A (China)	133.9E	Reg FSS (C)
23781	1996-007A N-Star B (Japan)	135.6E	Dom/Mob FSS (S/C/Ku/Ka)
19508	1988-086A CS 3B (Sakura 3B) (Japan)	136.0E	Dom FSS (C/K)
23185	1994-043A APStar I (China)	138.0E	DTH (C)
23522	1995-011B GMS-5 (Himawari 5)	139.6E#	Met (P/L)
20107	1989-052A Gorizont 18 (Russia)	140.1E/i	Dom/Gov FSS (C/Ku)
20953	1990-102A Gorizont 22 (Russia)	140.1E/i	Dom/Gov FSS (C/Ku)
23108	1994-030A Gorizont 30 (Rimsat 2)	142.1E#	Reg FSS (C/Ku)
17706	1987-029A Palapa B-2P	143.9E	Reg FSS (C)

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OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
20923	1990-094A Gorizont 21 (Russia)	144.4E/i	Dom/Gov FSS (C/Ku)
20066	1989-046A DSP F-14 (USA)	145.4E/i	Mil-Early Warning (S/X)
19874	1989-020A JCSAT 1 (Japan)	150.0E	Dom FSS (Ku)
18316	1987-070A ETS V/Kiku 5 (Japan)	150.2E/i	Experimental (L/C)
23779	1996-006A Palapa C1	150.5E	Reg FSS (C/Ku)
18350	1987-078A Optus A3 (Aussat K3)	152.0E#	DTH (Ku)
20402	1990-001B JCSAT 2 (Japan)	154.0E	Dom FSS (Ku)
23227	1994-055A Optus B3 (Australia)	156.0E	DTH/Mob (L/Ku)
12994	1981-119A Intelsat 503	156.9E/i	Int FSS (C/Ku)
22253	1992-084A Superbird A1 (Japan)	158.0E	Dom FSS (Ku/K)
22087	1992-054A Optus B1 (Aussat B1)	160.0E	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/i	DTH (Ku)
23175	1994-040A PanAmSat 2 (PAS-2)	169.0E	Int FSS (C/Ku)
12046	1980-087A OPS 6394 (FltSatCom F4)(USA)	172.0E/i	Mil-POR reserve (P-Bravo/S/X)
22871	1993-066A Intelsat 701	174.0E	Int FSS (C/Ku)
22719	1993-046A DSCS III B9 (USA 93)	175.0E/i	Mil-WPAC primary operational (P/S/X)
23124	1994-034A Intelsat 702	177.0E	Int FSS (C/Ku)
21814	1991-084B Inmarsat 2 F3	178.0E#	Int Mar-POR (L/C)
16117	1985-092C DSCS III B5 (USA 12)	180.0E/i	Mil-WPAC reserve operational (P/S/X)
15873	1985-055A Intelsat 511	179.9W/i	Int FSS (C/Ku)
08882	1976-053A Marisat 2	178.2W/i	Int Mar-IOR (P/L/C)
23467	1995-003A USA 108 (UFO-4) (USA)	177.6W/i	Mil-POR (P/S/K)
15236	1984-093C Leasat 2 (USA)	177.3W/i	Mil-POR primary (P/S/X)
19121	1988-040A Intelsat 513	177.0W#	Int FSS (C/Ku)
21639	1991-054B TDRS F5 (USA)	174.2W	Int FSS/Gov (C/S/Ku)
23613	1995-035B TDRS F7 (USA)	171.3W#	Int FSS/Gov (C/S/Ku)
09478	1976-101A Marisat 3	170.9W/i	Int Mar-POR (P/L/C)
23967	1996-042A USA 127 (UFO-7)	170.5W/i	Mil-EPAC (P/S/K)
18631	1987-100A Raduga 21 (Russia)	170.4W/i	Dom FSS/Gov-Mil (X/C)
20499	1990-016A Raduga 25 (Russia)	170.1W/i	Dom FSS/Gov-Mil (X/C)
21392	1991-037A Satcom C5 (Aurora II)(USA)	139.0W	Dom FSS (C)
20945	1990-100A Satcom C1 (USA)	137.0W	Dom FSS (C)
22096	1992-057A Satcom C4 (USA)	135.0W	Dom FSS (C)
23581	1995-025A GOES 9 (USA)	135.3W#	Met (P/L/S)
21873	1992-006A DSCS III B14 (USA 78)	135.0W/i	Mil-EPAC primary operational (P/S/X)
23016	1994-013A Galaxy 1R (USA)	133.0W	Dom FSS (C)
22117	1992-060B Satcom C3 (USA)	130.9W	Dom FSS (C)
13637	1982-106B DSCS III A1 (USA)	129.8W/i	Mil-EPAC reserve operational (P/S/X)
21906	1992-013A Galaxy 5 (USA)	125.0W	Dom FSS (C)
16649	1986-026A Gstar 2 (USA)	124.9W#	Dom FSS (Ku)
23877	1996-033A Galaxy 9 (USA)	123.0W	Dom FSS (C)
19484	1988-081B SBS 5 (USA)	122.9W	Dom FSS (Ku)
22988	1994-009A USA 99 (DFS-1/Milstar 1)	120.0W	Mil-Comm (P/S/K)
15826	1985-048D Telestar 3D (USA)	119.9W#	Dom FSS (C)
24313	1996-055A Echostar 2 (USA)	119.1W	DTH (Ku)
23754	1995-073A EchoStar 1 (USA)	118.9W	DTH (Ku)
16274	1985-109B Morelos 2 (Mexico)	117.2W	Dom FSS (C/Ku)
13652	1982-110C Anik C3 (Canada)	114.8W/i	Dom FSS (Ku)
23313	1994-065A Solidardad 2 (Mexico)	112.9W	Dom FSS (L/C/Ku)
21726	1991-067A Anik E1 (Canada)	111.0W	Dom FSS (C/Ku)
22911	1993-073A Solidaridad 1 (Mexico)	109.1W	Dom FSS (L/C/Ku)
21222	1991-026A Anik E2 (Canada)	107.2W	Dom FSS (C/Ku)
23846	1996-022A MSAT M1 (Canada)	106.5W	Mobile (L/X)
23696	1995-057A USA 114 (UFO-6)	105.8W/i	Mil-CONUS (P/S/K)
03029	1967-111A ATS 3 (USA)	105.6W/i	Exp comm (VHF/C)
15643	1985-028C Leasat 3 (USA)	105.0W/i	Mil-CONUS reserve (P/S/X)
20946	1990-100B Gstar 4 (USA)	105.0W	Dom FSS (Ku)
08697	1976-017A Marisat 1	104.7W/i	Int Mar-AOR (P/L/C)
08747	1976-023B LES 9 (USA)	103.8W/i	Mil-Exp comm (P/Ka)
08746	1976-023A LES 8 (USA)	103.1W/i	Mil-Exp comm (P/Ka)
24315	1996-054A GE-1 (USA)	103.0W	DOM FSS (C/Ku)
15677	1985-035A Gstar 1 (USA)	102.9W	Dom FSS (Ku)
23435	1994-084A DSP F-17 (USA)	102.6W#	Mil-Early Warning (S/X)
22930	1993-078A DBS 1 (USA)	101.2W	DTH (Ku)
21227	1991-028A Spacenet 4 (USA)	101.0W	Dom FSS (C/Ku)
23553	1995-019A AMSC 1 (USA)	100.9W	Mobile (L/X)
23598	1995-029A DBS 3 (USA)	100.9W	DTH (Ku)
23192	1994-047A DBS 2 (USA)	100.9W	DTH (Ku)
22796	1993-058B ACTS (USA)	100.0W	Exp Comm (C/K/Ka)
17181	1986-096A USA 20 (FltSatCom F7)(USA)	99.9W/i	Mil-CONUS primary (P/S/X/K)

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
22694	1993-039A Galaxy 4 (USA)	98.9W	Dom FSS (C/Ku)
22927	1993-077A Telstar 401 (USA)	97.0W	Dom FSS (C/Ku)
23741	1995-069A Galaxy 3R (USA)	94.9W	Dom/DTH (C/Ku)
19483	1988-081A Gstar 3 (USA)	93.5W/i	Dom FSS/Mob (L/Ku)
16650	1986-026B SBTS 2 (Brazil)	92.0W	Dom FSS (C)
22205	1992-072A Galaxy 7 (USA)	91.0W	Dom FSS (C/Ku)
23670	1995-049A Telstar 402R (USA)	89.0W	Dom FSS (C/Ku)
18951	1988-018A Spacenet 3R (USA)	87.0W	Dom FSS (L/C/Ku)
15237	1984-093D Telestar 3C (302) (USA)	84.9W#	Dom FSS (C)
16482	1986-003B Satcom K-1 (USA)	84.9W	Dom FSS (Ku)
16276	1985-109D Satcom K-2 (USA)	80.9W	Dom FSS (Ku)
15561	1985-015B SBTS 1 (Brazil)	79.0W#	Dom FSS (C)
15235	1984-093B SBS 4 (USA)	77.0W/i	Dom FSS (Ku)
12309	1981-018A Comstar D4 (USA)	76.0W/i	Dom FSS (C)
14133	1983-059B Anik C2 (Argentina)	75.9W/i	Dom FSS (Ku)
23051	1994-022A GOES 8 (USA)	74.4W#	Met (P/L/S)
20873	1990-091B Galaxy 6 (USA)	74.0W	Dom FSS (C)
20872	1990-091A SBS 6 (USA)	73.9W	Dom FSS (Ku)
15642	1985-028B Anik C1 (Argentina)	71.8W	Dom FSS (Ku)
23199	1994-049A Brazilsat B1 (Brazil)	70.0W	Dom FSS (C)
15385	1984-114A Spacenet 2 (USA)	68.9W	Dom FSS (C/Ku)
23536	1995-016A Brasilsat B2 (Brazil)	65.0W	Dom FSS (C/X)
21940	1992-021B Inmarsat 2 F4	54.2W/i	Int Mar-AOR-W (L/C)
23571	1995-023A Intelsat 706	53.0W	Int FSS (C/Ku)
23628	1995-038A DSCS III B7 (USA)	52.5W/i	Mil-WLANT primary operational (P/S/X)
23915	1996-035A Intelsat 709	49.9W	Intl FSS (C/Ku)
13969	1983-026B TDRS F1 (USA)	49.1W/i	Gov (C/S/Ku)
22314	1993-003B TDRS F6 (USA)	47.0W/i	Gov (C/S/Ku)
19217	1988-051C PanAmSat 1 (PAS 1)	44.9W	Int FSS (C/Ku)
23764	1996-002A PanAmSat 3R (PAS 3R)	43.0W	Int FSS (C/Ku)
16116	1985-092B DSCS III B4 (USA 11)	42.5W/i	Mil-ATL reserve operational (P/S/X)
19883	1989-021B TDRS F4 (USA)	40.9W	Int FSS/Gov (C/S/Ku)
12089	1980-098A Intelsat 502	40.4W/i	Int FSS (C/Ku)
23413	1994-079A Orion 1 (USA)	37.5W	Int FSS (Ku)
20523	1990-021A Intelsat 603	34.5W	Int FSS (C/Ku)
20401	1990-001A Skynet 4A	34.0W/i	Mil-comm (P/S/X/Ka)
14077	1983-047A Intelsat 506	31.3W/i	Int FSS/Mar (L/C/Ku)
22116	1992-060A Hispasat 1A (Spain)	30.1W	Dom BSS/FSS (Ku)
22723	1993-048A Hispasat 1B (Spain)	29.9W	Dom BSS/FSS (Ku)
21765	1991-075A Intelsat 601	27.4W	Int FSS (C/Ku)
21653	1991-055A Intelsat 605	24.5W	Int FSS (C/Ku)
22112	1002-059A Cosmos 2209 (Russia)	23.8W#	Mil-Early Warning (X)
16101	1985-087A Intelsat 512	23.5W#/d	Int FSS (C/Ku)
20253	1989-077A USA 46 (FltSatCom 8)	22.7W/#	Mil-AOR primary (P-Charlie/S/X/K)
21989	1992-032A Intelsat K	21.4W	Int FSS (Ku)
19772	1989-006A Intelsat 515	21.2W	Int FSS (C/Ku)
19621	1988-098A TDF 1 (France)	21.2W	DTH (Ku)
15391	1984-115A NATO III D	20.9W/i	Mil-Comm (P/S/X)
20705	1990-063A TDF 2 (France)	18.8W	DTH (Ku)
23528	1995-013A Intelsat 705	18.0W	Int FSS (C/Ku)
21047	1991-001A NATO IV A	17.6W/i	Mil-Comm (P/S/X)
20391	1989-101A Cosmos 2054 (Russia)	16.0W/i	Tracking & Relay WSDRN (Ku)
21149	1991-018A Inmarsat 2 F2	15.5W/i	Int Mar-AOR-E (L/C)
15386	1984-114B Marecs B2	15.0W/i	Int Mar-AOR (L)
10669	1978-016A Ops 6391 (FltSatCom 1) (USA)	14.5W/i	Mil-AOR reserve (P-Alpha/S/X)
23132	1994-035A USA-104 (UFO-3)(USA)	14.3W/i	Mil-AOR primary (P/S)
23319	1994-067A Express 1 (Russia)	14.0W	Int FSS (C/Ku)
23267	1994-060A Cosmos 2291 (Russia)	13.3 W#	Data Relay (C)
22009	1992-037A DSCS III B12 (USA 82)	12.0W	Mil-ELANT primary operational (P/S/X)
22041	1992-043A Gorizont 26 (Russia)	11.2W#	Dom/Gov FSS (C/Ku)
22912	1993-073B Meteosat 6 (ESA)	9.7W#	Met (L)
21813	1991-084A Telecom 2A (France)	8.0W	Dom FSS/Gov-Mil (X/C/Ku)
21805	1991-080B DSP F-16 (USA)	6.9W#	Mil-Early Warning (S/X)
21939	1992-021A Telecom 2B (France)	5.0W	Dom FSS/Gov-Mil (X/C/Ku)
23865	1996-030B Amos 1 (Israel)	4.0W	Dom FSS (
23816	1996-015A Intelsat 707	1.0W	Int FSS (C/Ku)
20776	1990-079A Skynet 4C (UK)	0.9W#	Mil (P/S/X/Ka)
20762	1990-074A Thor 1/Marcopolo 2 (BSB R-2)	0.7W	Reg BSS (Ku)
20168	1989-062A TV Sat 2 (Germany)	0.4W	Dom BSS (Ku)

Amateur Satellite Frequency Guide

The Radio Amateur Satellite Corp.

Satellite	Mode		Frequencies															
OSCAR 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)															145.985
	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				Robot	29.403						
		Up	145.860	870	880	890	145.900				(CW)	145.820						
	Bcn		29.357 (CW)															
RS-12/13 (Notes 3, 6 & 7)	K (h/A)	Dn	29.410	420	430	440	29.450				Robot	29.454						
		Up	21.210	220	230	240	21.250				(CW)	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-II) (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

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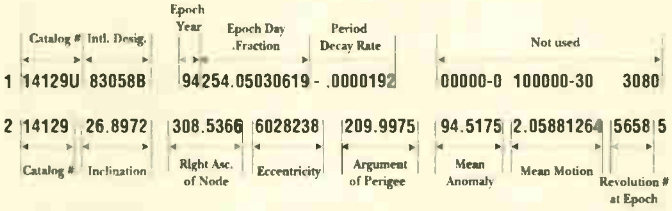
Satellite	Mode	Frequencies											
JAS-Ib (FO-20) (Notes 11 & 13)	JA Linear	Dn	435.800	810	820	830	840	850	860	870	880	890	435.900
		Up	146.000	990	980	970	960	950	940	930	920	910	145.900
	Bcn	435.795 (CW)											
	JD [a] Dgtl	Dn											435.910
		Up	145.850		145.890		145.910						
OSCAR 22 (UO-22) (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									
FUJI/ OSCAR 29 (FO-29) (Notes11&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
	JD Digtl (b,c)	Dn					453.910						
		Up	145.850	145.870	145.890	145.910							
MEXICO/ OSCAR 30 (MO-30) (Note 11)	(b)	Dn	437.138 (sec)				437.206 (pμ)		BCN:				
		Up	145.815	145.835	145.855	145.875			40.997 MHz				
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
AMSAT
The Radio Amateur Satellite Corp.
PO Box 27 Washington, DC 20044

Amateur and Weather Satellite Two-Line Orbital Element Sets

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

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



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

AMATEUR RADIO SATELLITES

OSCAR 10 (AMSAT OSCAR 10, AO-10)
1 14129U 83058B 96274.83271966 +.00000061 +00000-0 +10000-3 0 04571
2 14129 025.9142 186.7455 6045033 053.3722 348.1805 02.05880649072045
UOSAT 2 (UoSAT 2, UoSAT 11, UO-11)
1 14781U 84021B 96277.53672070 .00000032 00000-0 13218-4 0 9171
2 14781 97.8083 263.4904 0012600 100.1769 260.0834 14.69484128673566
RS-10/11 (Radio Sputnik 10/11, Cosmos 1861)
1 18129U 87054A 96274.98559751 +.00000032 +00000-0 +18706-4 0 02659
2 18129 082.9222 070.3306 0010381 218.5932 141.4482 13.72369809464680
OSCAR 13 (AMSAT OSCAR 13, AO-13)
1 19216U 88051B 96276.65856910 .00069483 69670-6 51037-3 0 2896
2 19216 57.0992 87.7737 7426102 52.2483 354.2194 2.15213892 32116
OSCAR 16 (PACSAT, AMSAT-OSCAR 16, AO-16)
1 20439U 90005D 96274.80377024 -.00000038 +00000-0 +22913-5 0 00121
2 20439 098.5551 358.2282 0010639 253.5541 106.4429 14.29984866349163
OSCAR 17 (DOVE, DO-17)
1 20440U 90005E 96275.79502820 .00000007 00000-0 19594-4 0 132
2 20440 98.5571 359.8962 0010680 248.2271 111.7781 14.30127224349334
OSCAR 18 (WEBERSAT, WO-18)
1 20441U 90005F 96274.73767577 -.00000007 +00000-0 +14039-4 0 00194
2 20441 098.5573 358.7866 0011286 253.8538 106.1400 14.30096384349180
OSCAR 19 (LUSAT, LO-19)
1 20442U 90005G 96278.22341375 -.00000010 00000-0 12900-4 0 130
2 20442 98.5585 2.7530 0011479 242.1666 117.8359 14.30206902349704
OSCAR 20 (JAS 1B, FUJI 2, FUJI OSCAR 20, FO-20)
1 20480U 90013C 96278.06808887 -.00000004 00000-0 69620-4 0 9109
2 20480 99.0223 282.2103 0540035 237.7069 117.0626 12.83234795311855
RS-12/13 (Radio Sputnik 12/13, Cosmos 2123)
1 21089U 91007A 96277.10150194 .00000030 00000-0 15894-4 0 9229
2 21089 82.9222 109.3249 0028492 295.9734 63.8473 13.74073814283854
OSCAR 22 (UoSAT-F, UoSAT 5, UO-22)
1 21575U 91050B 96277.18286566 .00000043 00000-0 28881-4 0 7196
2 21575 98.3412 340.2992 0007257 308.1870 51.8665 14.37038253273577
OSCAR 23 (KITSAT-A, KITSAT 1, KO-23)
1 22077U 92052B 96276.23610663 -.00000037 00000-0 10000-3 0 6096
2 22077 66.0787 325.3241 0015240 271.0304 88.8967 12.86298047194572
OSCAR 25 (KITSAT-B, AMSAT OSCAR 25, KO-25)
1 22828U 93061F 96275.26589015 .00000019 00000-0 25269-4 0 4821
2 22828 98.5708 349.1164 0009741 268.2641 91.7424 14.28153202125259
OSCAR 26 (ITAMSAT-1, ITALY OSCAR 26, IO-26)
1 22826U 93061D 96275.73035184 .00000043 00000-0 34809-4 0 5035
2 22826 98.5728 349.5029 0008901 285.2790 74.7405 14.27814060157209
OSCAR 27 (EYESAT-A, EYESAT-1, AMSAT OSCAR 27, AO-27)
1 22825U 93061C 96276.23272947 .00000007 00000-0 20290-4 0 5051
2 22825 98.5721 349.8099 0008238 283.5558 76.4699 14.27704885157260
OSCAR 28 (POSAT-1, PO-28)
1 22829U 93061G 96276.26477352 .00000026 00000-0 27968-4 0 4975
2 22829 98.5717 350.1632 0009469 265.7502 94.2596 14.28135055157313
RS-15 (Radio Sputnik 15)
1 23439U 94085A 96274.28937141 -.00000039 00000-0 10000-3 0 1652
2 23439 64.8130 213.1110 0158567 180.6394 179.4345 11.27528867 72635
OSCAR 29 (Fuji-OSCAR 29, Fuji 3, FO-29)
1 24278U 96046B 96276.20991262 -.00000038 00000-0 -53073-5 0 200
2 24278 98.5770 346.1552 0351829 134.1658 228.8969 13.52626033 6240
OSCAR 30 (Mexico-Oscar 30, MO-30)
1 24305U 96052B 96277.20985965 .00000204 00000-0 20364-3 0 299
2 24305 82.9371 184.4816 0029363 197.9058 162.1052 13.73083605 3792

WEATHER SATELLITES

Geostationary Spacecraft

GOES 8 (Operational East-USA)
1 23051U 94022A 96278.12166082 -.00000273 00000-0 10000-3 0 5887
2 23051 0.2409 89.3294 0004511 107.6239 145.5415 1.00274283 16450
GOES 9 (Operational West-USA)
1 23581U 95025A 96276.59670139 .00000066 00000-0 10000-3 0 2595
2 23581 0.1940 266.4820 0002211 310.4551 234.0520 1.00272905 5005
ELEKTRO (Russia)
1 23327U 94069A 96269.91073354 -.00000128 00000-0 00000+0 0 2016
2 23327 0.2334 115.5239 0003713 36.2238 257.2135 1.00273474 7016
METEOSAT 5 (MOP-2 Operational-ESA)
1 21140U 91015B 96276.15738773 -.00000030 00000-0 00000+0 0 2766
2 21140 0.7467 78.0728 0003648 101.8342 247.5550 1.00274376 22682
METEOSAT 6 (Operational-ESA)
1 22912U 93073B 96277.82453822 -.00000101 00000-0 00000+0 0 5586
2 22912 0.1926 52.0349 0002691 155.9396 91.9376 1.00274664 8941
HIMAWARI 4 (GMS 4 Standby-Japan)
1 20217U 89070A 96277.23807292 -.00000385 00000-0 10000-3 0 4547
2 20217 2.0057 74.2658 0001004 209.2578 294.5458 1.00265971 26509
HIMAWARI 5 (GMS 5 Operational-Japan)
1 23522U 95011B 96273.79398731 -.00000308 00000-0 10000-3 0 1598
2 23522 0.4341 11.2812 0000605 174.2498 249.0091 1.00276557 5507

Near Polar/Polar Orbiting Spacecraft

NOAA 12 (Operational morning spacecraft-USA 137.50 MHz)
1 21263U 91032A 96278.01185407 .00000065 00000-0 48217-4 0 1042
2 21263 98.5526 293.9807 0012572 323.7331 36.2993 14.22659779279932
NOAA 14 (Operational afternoon spacecraft-USA 137.620 MHz)
1 23455U 94089A 96277.87373944 .00000103 00000-0 81547-4 0 7693
2 23455 98.9547 223.0707 0008951 301.6053 58.4240 14.11614861 90785
Meteor 2-21 (Operational-Russia/off at last report)
1 22782U 93055A 96278.08061991 -.00000030 00000-0 -41237-4 0 5160
2 22782 82.5451 260.8303 0023616 35.7178 324.5549 13.83060012156186
Meteor 3-5 (Operational-Russia 137.850 MHz)
1 21655U 91056A 96274.89432976 .00000051 00000-0 10000-3 0 9211
2 21655 82.5480 245.7891 0012276 271.1181 88.8537 13.16848422246586
Meteor 3-6 (Operational-Russia/off at last report)
1 22969U 94003A 96274.53671588 .00000051 00000-0 10000-3 0 2875
2 22969 82.5636 186.1678 0015736 340.4466 19.6052 13.16738836128916
DMSP B5D2-7 (DoD meteorological polar orbiter: downlink encrypted)
1 23233U 94057A 96278.07941096 .00000069 00000-0 60647-4 0 9459
2 23233 98.8178 335.2044 0011592 229.9300 130.0868 14.12739530108202
DMSP B5D2-8 (DoD meteorological polar orbiter: downlink encrypted)
1 23533U 95015A 96278.00868355 -.00000017 00000-0 14458-4 0 6940
2 23533 98.8449 279.0905 0008178 102.0371 258.1718 14.12755247 78993
OKEAN 1-7 (Okean 4 Earth Resources-Russia/Off at last report-137.400 MHz)
1 23233U 94057A 96278.07941096 .00000069 00000-0 60647-4 0 9459
2 23233 98.8178 335.2044 0011592 229.9300 130.0868 14.12739530108202
SICH-1 (Earth Resources-Russia 137.400 MHz)
1 23657U 95046A 96275.61079978 .00000104 00000-0 12477-4 0 1120
2 23657 82.5309 102.6107 0029649 64.0362 296.3896 14.73496995 58508

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-80	Nov. 1996/ Columbia*	28.5/190	16 days	WSF-03 & ORFEUS
STS-81	Jan. 1997/ Atlantis**	51.6/213	9 days	S/MM-05

*Crew Assignment: CDR: Kenneth D. Cockrell, PLT: Kent V. Rominger, MS: Tamara E. Jernigan, MS: Thomas D. Jones, MS: F. Story Musgrave.

**Crew Assignment: CDR: Michael A. Baker, PLT: Brent W. Jett, MS: John E. Blaha (D), MS: John M. Grunsfeld, MS: Marsha S. Ivins, MS: Jerry M. Linenger (U), MS: Peter J. K. Wisoff.

STS	Downlink Frequency Assignment
VHF/UHF Voice	139.208 (STS-81 only), 145.550, 145.840 (STS-81 only), 259.7 (AM), 279.0 (AM), and 296.8 MHz (AM)
S-band TLM	2217.5, 2250.0, and 2287.5 MHz
C-band TRK	5400.0 - 5900.0 MHz

MIR	Downlink Frequency Assignment:
VHF	143.625, 145.550, and 145.800 MHz
UHF	437.925, 437.95, and 437.975 MHz

Russian Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
Nov. 1996	Proton	Baikonur	MARS96
Nov. 1996	Cosmos	Plesetsk	COSMOS & FAISAT 2
Dec. 1996	Proton	Baikonur	Tempo

MARS96	Downlink Frequency Assignment:
X-band	8417.68 MHz

COSMOS	Downlink Frequency Assignment:
VHF-band	149.910-150.030 MHz
UHF-band	399.760-400.080 MHz

FAISAT 2	Downlink Frequency Assignment:
UHF-band	400.000-401.000 MHz

Japanese Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
Jan. 1997	M-5	Tanegashima	MUSES-B
Jan. 1997	H-II	Tanegashima	COMETS

MUSES-B	Downlink Frequency Assignment:
Ku-band	14.2 GHz

U.S. Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
Nov. 1996	LMLV-1	VAFB	LEWIS
Nov. 1996	Delta II	CCAS	Mars Global Surveyor
Nov. 1996	Atlas	CCAS	HOT BIRD-2
Nov. 1996	Delta II	VAFB	Iridium #1
Nov. 1996	Pegasus XL	Spain	MINISAT 1
Dec. 1996	Delta II	CCAS	Mars Pathfinder
Dec. 1996	LMLV-1	VAFB	CLARK
Dec. 1996	Atlas	CCAS	INMARSAT-3
Jan. 1997	Pegasus XL	VAFB	SWAS
Jan. 1997	Delta II	CCAS	GPS II R1
Jan. 1997	Titan	???????	???????
Jan. 1997	Atlas	CCAS	JCSAT-4
Jan. 1997	Delta II	VAFB	Iridium #2

LEWIS	Downlink Frequency Assignment:
S-band	2275.3 MHz

Delta II	Downlink Frequency Assignment:
S-band	2244.5, 2241.5 and 2252.5 MHz
C-band	5765.0 MHz.

Mars Global	Downlink Frequency Assignment:
UHF-band	437.100 MHz
S-band	2252.500 MHz
X-band	8417.716 MHz, 8417.71605 MHz, & 8423.148147 MHz

Atlas	Downlink Frequency Assignment:
S-band	2202.5, 2206.5, 2210.5, 2211.0, 2215.5 MHz
C-band	5765.0 MHz

HOT BIRD-2	Downlink Frequency Assignment:
S-band	2264.818 MHz

L-1011 A/C	Downlink Frequency Assignment:
L-band	1480.5, 1727.5 MHz
S-band	2250.5 MHz
C-band	4583.5, & 5765.0 MHz

Pegasus XL	Downlink Frequency Assignments:
S-band	2288.5 MHz
C-band	5765.0 MHz.

Mars Pathfinde	Downlink Frequency Assignments:
X-band	8427.222, 8429.938 MHz

SWAS	Downlink Frequency Assignments:
S-band	2215.0 MHz

INMARSAT-3	Downlink Frequency Assignment:
L-band	

Satellite Launch Schedules

European Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
Nov. 1996	Ariane 44LP	Kourou	ARABSAT 2B & MEASAT 2
Dec. 1996	Ariane 4	Kourou	PAS 6
Jan. 1997	Ariane 4	Kourou	NAHUEL 1A, GE-2

Ariane 4 — **Downlink Frequency Assignment:**
S-band — 2203.0, 2206.0 and 2218.0 MHz.

List of Abbreviations and Acronyms

ARABSAT	Communications satellite for the Arab Satellite Communications Organization (ASCO) for providing regional TV, telephony, data and fax relay.
C-band	3700 to 6500 MHz
CCAS	Cape Canaveral Air Station.
CDR	Commander.
CLARK	This high resolution satellite will locate utility pipelines & cables, and help town planners at construction sites.
COMETS	Japanese Communications & Broadcast Engineering Test Satellite designed to demonstrate new high quality mobile, inter-satellite & broadcasting.
COSMOS	A Russian launcher & type of military/civilian navigation satellite.
(D)	Downlink from Mir.
FAISAT	The system will provide data acquisition services, remote monitoring, tracking, personal and business non-voice messaging, and emergency communications/distress calls.
GE-2	General Electric telecommunications satellite that will cover the continental United States including Alaska and Hawaii.
GHz	Gigahertz.
GPS II R1	U.S Air Force global positioning satellite for military and civilian navigation services.
HOT BIRD2	Will provide direct TV programming to 45 cm dishes across Europe.
INMARSAT	International Maritime Satellite, a commercial satellite series providing global maritime and aviation communications.
INTELSAT	Satellite for the International Telecommunications Satellite Organization.
Iridium	The Iridium system is a planned commercial communications network comprised of 66 low earth orbiting satellites. The system will use L-band to provide global communications services through portable handsets.
JCSAT-4	A communications satellite for Japan Satellite Systems Inc., Tokyo and planned to enter geosynchronous orbit.
Ku-band	10.90 to 17.15 GHz
L-band	1,400 to 1,800 MHz
LEWIS	Small earth imaging payload under NASA's Small Spacecraft Technology Initiative (SSTI) program.
Mars96	This mission to Mars will release two small landers before entering a highly elliptical polar orbit to undertake extensive surface mapping and other investigations.
Mars Glob	Mars Surveyor Program consists of a series of orbiter's and/or landers to be launched at every Mars opportunity roughly 25 months apart.
Mars Path	Initial mission concept validation precursor for follow-on MARS Lander series.
MEASAT	Malaysia's first telecommunications satellite built by the U.S. based aerospace company Hughes.
MHz	Megahertz.
Minisat	Program under the Interministerial Commission for Science & Technology (INTA). The spacecraft will carry a Extreme Ultraviolet Radiation Detector and Low Energy Gamma Ray Imager.
MS	Mission Specialist.
MUSES-B	A deep space mission managed by the Institute of Space and Astronautical Science (ISAS) in Japan.
Nahuel	Argentine telecommunications satellite designed to provide TV distribution, telephony, VSAT data and business services.
ORFEUS	Orbiting, Retrievable Far and Extreme Ultraviolet Spectrometer-Shuttle Pallet Satellite. A German developed payload to explore the distribution and character of radiation absorbing material in the solar system and to perform direct ultraviolet observations of the direct interstellar component.
PAS 6	U.S. telecommunications satellite for Pan American Satellite of Connecticut.
PLT	Pilot.
Progress	Unmanned cargo ship launched to the Russian Mir space station bringing food, water, fuel and equipment to the present crew aboard the complex.
RNG	Ranging.
S-band	2000 to 2300 MHz
S/MM-05	Shuttle MIR Mission-05 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.
SWAS	Submillimeter Wave Astronomy Satellite will study how molecular clouds collapse to form stars and planetary systems.
Tempo	A high power DTH satellite owned by Tempo, a subsidiary of Tele-Communications Inc.
THAICOM	A Thailand telecommunications satellite designed to provide domestic phone, TV, cable TV, voice, video, data, VSAT services.
TLM	Telemetry.
TRK	Tracking.
(U)	Up to Mir.
UHF	Ultra High Frequency (390 to 499 MHz).
VAFB	Vandenberg Air Force Base, Calif.
VHF	Very High Frequency (30 to 300 MHz).
WBFM	Wide Band Frequency Modulation
WSF-03	Wake Shield Facility-03 is a satellite for molecular and chemical beam epitaxy growth of compound semiconductors, high temperature superconductors, and other materials using techniques requiring ultra-high vacuum, high pumping speeds, and relatively large working volumes.
X-band	8000 to 10,999 MHz

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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 July and August 1996. 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**
1996 Jul 2/0748	1996-037A		TOMS-EP	295 kg
1996 Jul 2.50	97.37 deg	97.56 min	342 km	942 km
1996 Jul 31.30	97.44 deg	94.67 min	494 km	511 km

TOMS-EP ("Total Ozone Mapping Spectrometer - Earth Probe") is the first satellite dedicated to the mapping of the Earth's ozone layer. TOMS-EP will also monitor the sulphur dioxide emitted by volcanic eruptions. The L-1011 aircraft carrying the Pegasus took off from Vandenberg AFB and Pegasus was released at 0748 UTC.

1996 Jul 3/0031	1996-038A		USA 125	?
1996 Jul 8.00	54.99 deg	90.64 min	292 km	319 km

Classified payload, no details of which were released. Satellite might be a communications satellite which has entered a Molniya-type orbit (63 deg, 710 minutes, 500-39,500 km). The orbital data shown above are derived from unofficial visual observations. Launched by a Titan-4 from Cape Canaveral.

1996 Jul 3/1047	1996-039A		APStar 1A	1,400 kg?
1996 Jul 4.78	26.86 deg	756.06 min	211 km	42,016 km
1996 Jul 13.97	0.07 deg	1,436.13 min	35,770 km	35,804 km

Communications satellite built for Asia-Pacific Telecommunications Satellite Co Ltd in Hong Kong and uses a Hughes Space and Communications Company HS-376 satellite bus. Mass quoted above is at launch. Satellite flown to cover for APStar 2, lost at launch in January 1995. Located over 133-134 degrees. Launched from Xi Chang using Chinese CZ-3 vehicle.

1996 Jul 9/2224	1996-040A		ARABSAT 2A	2,617 kg
1996 Jul 10.17	6.97 deg	630.74 min	214 km	35,755 km
1996 Jul 23.44	0.08 deg	1,436.18 min	35,782 km	35,794 km
1996 Jul 9/2224	1996-040B		TURKSAT 1C	1,743 kg

Launch Date/Time	Int Des		Satellite	Mass
Epoch	**Incl**	**Period**	**Perigee**	**Apogee**
1996 Jul 10.17	6.99 deg	630.63 min	211 km	35,753 km
1996 Jul 25.61	0.02 deg	1,436.06 min	35,781 km	35,791 km

ARABSAT 2A is a telecommunications and direct broadcast satellite, launched for the Arab League countries. Mass of the satellite quoted at launch: on-station at the beginning of its life the mass is 1,570 kg and the dry mass is 1,108 kg. Satellite located over 25-26 deg E.

TURKSAT 1C is a telecommunications and television satellite, launched for Turkish Telekom. Mass quoted is at launch: on-station at the beginning of its life the mass is 1,078 kg and the dry mass is 789 kg. Satellite initially located over 31-32 deg E and then to be relocated to 42 deg E. Both spacecraft launched by an Ariane-44L from Kourou.

1996 Jul 16/0050	1996-041A		Navstar 26 (USA 126)	1,881 kg
1996 Jul 17.13	35.01 deg	356.38 min	193 km	20,352 km
1996 Jul 31.18	55.04 deg	717.93 min	20,138 km	20,224 km

Navigation satellite to be operated in plane E slot 3 of the Global Positioning System (GPS). Mass quoted includes propellant and the dry mass is 930 kg.

1996 Jul 25/1242	1996-042A		UFO 7 (USA 127)	3,020 kg
1996 Jul 25.40	26.97 deg	473.89 min	297 km	27,216 km
1996 Aug 12.31	5.06 deg	1,435.83 min	34,919 km	36,643 km

UFO 7 ("UHF follow-On") is a communications satellite. Mass of the satellite on-station is 1,360 kg. To be operational over 337 deg E but initially located over 189-190 deg E. Launched from Cape Canaveral using an Atlas-2 vehicle.

1996 Jul 31/2000	1996-043A		Progress-M 32	7,250 kg ?
1996 Jul 31.88	51.63 deg	88.65 min	186 km	229 km
1996 Aug 3.09	51.65 deg	92.21 min	375 km	391 km

Unmanned cargo freighter, carrying supplies to the cosmonauts and astronaut aboard the Mir Complex. Docked with Mir Complex at the +X port (front longitudinal port) 1996 Aug 1 at 2204 UTC. It undocked from the station Aug 18 at 0934 UTC to free the docking port for the arrival of Soyuz-TM 24 which docked the following day. Progress-M 32 was due to re-dock with the Mir Complex at the rear longitudinal port (-X) on Kvant 1 1996 Sep 3 after Soyuz-TM 23 undocked from the port and returned to Earth. Launched from Tyuratam using a Soyuz-U vehicle. Launch originally scheduled for July 24, but the launch was scrubbed at T-45 seconds due to pressure problems in one of the propellant tanks.

1996 Aug 8/2249	1996-044A		ITALSAT 2	1,990 kg
1996 Aug 9.64	5.46 deg	630.47 min	228 km	35,728 km
1996 Aug 16.84	0.17 deg	1,413.90 min	34,911 km	35,791 km
1996 Aug 8/2249	1996-044B		Telecom 2D	2,260 kg
1996 Aug 9.35	5.45 deg	631.63 min	215 km	35,800 km
1996 Aug 27.84	0.44 deg	1,435.82 min	35,768 km	35,795 km

ITALSAT 2 is a telecommunications satellite, to be used for data transmission and digital television. Carries ESA's EMS package for mobile communications. Satellite operated by Telecom Italia in Rome. Mass quoted is at launch: on station the mass is 1,200 kg and the dry mass is 1,025 kg. To be located over 10.2 deg E.

Telecom 2D is a telecommunications satellite, to be used for telephone and television communications, plus French Government communications. Operated by France Telecom and the Ministere Francais de la Defense in Paris. Mass of the satellite which is quoted is at launch: on station the mass is 1,400 kg and the dry mass is 1,085 kg. Satellite located over 3 deg E. Both spacecraft launched by an Ariane-44L from Kourou.

1996 Aug 14/2221	1996-045A		Molniya-1 89	1,600 kg ?
1996 Aug 15.49	62.80 deg	736.11 min	455 km	40,800 km
1996 Aug 25.58	62.84 deg	717.70 min	464 km	39,887 km

Telecommunications satellite: the series is also called Molniya-1T. Satellite is replacing Molniya-1 85. Launched from Plesetsk using a Molniya-M vehicle.

Launch Date/Time Epoch	Incl	Int Des	Period	Satellite	Perigee	Mass Apogee
1996 Aug 17/0153		1996-046A		ADEOS 1		3,560 kg ?
1996 Aug 18.10	98.59 deg		101.08 min		800 km	820 km
1996 Sep 2.13	98.62 deg		100.83 min		797 km	799 km
1996 Aug 17/0153		1996-046B		Fuji 3 (JAS 2)		50 kg
1996 Aug 17.49	98.58 deg		106.46 min		802 km	1,323 km

Advanced Earth Observing Satellite (ADEOS) is an Earth observation platform, intended to monitor the Earth's surface, atmosphere and oceans to observe the global environmental changes. Fuji 3 (JAS 2 before launch, Japan Amateur Satellite) is an amateur radio satellite. Both satellites launched from Tanegashima aboard a Japanese H-2 vehicle.

1996 Aug 17/1318		1996-047A		Soyuz-TM 24		7,150 kg ?
1996 Aug 18.10	51.65 deg		89.76 min		233 km	292 km
1996 Aug 21.96	51.65 deg		92.20 min		375 km	390 km

Piloted spacecraft carrying V G Korzun (commander), A Y Kaleri (flight engineer) and Claudi Andre-Deshays (CNES spationaut) to the Mir Complex: French part of the mission designated Cassiopeia. Spacecraft docked with the Mir Complex at the front longitudinal port (+X) Aug 19 at 1450:21 seconds UTC. Korzun and Kaleri are planned to remain in orbit until approximately 1997 Feb 22: Andre-Deshays returned to Earth aboard Soyuz-TM 23 with cosmonauts Onufriyenko and Usachov Sep 2. Launched from Tyuratam using a Soyuz-U vehicle.

1996 Aug 18/1027		1996-048A		Zhongxing 7		1,200 kg ?
1996 Aug 18.98	27.25 deg		307.53 min		200 km	17,229 km

Telecommunications satellite (name means "China Star"), intended to domestic Chinese use. Mass quoted is at launch: on station it would have been about 700 kg. After launch the second burn of the CZ-3 third stage motor terminated 48 seconds earlier than planned, leaving the satellite stranded in a useless orbit. Launched from Xi Chang using a CZ-3 vehicle.

1996 Aug 21/0947		1996-049A		FAST		180 kg
1996 Aug 21.55	82.98 deg		133.12 min		351 km	4,165 km

Fast Auroral Snapshot Explorer (FAST) is a small science satellite, launched to investigate the plasma phenomena in the auroral processes. The L-1011 carrier plane took off from Vandenberg at 0850 UTC and the Pegasus separated to begin the ascent to orbit at 0947 UTC.

1996 Aug 29/0522		1996-050A		MUSAT 30 kg		
1996 Aug 29.34	62.79 deg		98.84 min		236 km	1,171 km
1996 Aug 29/0522		1996-050B		MAGION 5 (C-2A)		62 kg
1996 Aug 30.24	62.80 deg		347.46 min		791 km	19,196 km
1996 Aug 29/0522		1996-050C		Interball 2		1,250 kg ?
1996 Aug 29.76	62.77 deg		347.34 min		769 km	19,211 km

MUSAT is a small experimental payload to demonstrate low-cost technologies from the Instituto Universitario Aeronautico de Cordoba, Argentina. It was separated before the Molniya-M fourth stage ignited to take the two main satellites into their planned more elliptical orbits.

Also called the Auroral Probe, Interball 2 is the second flight of the Prognoz-M2 science bus. Major international scientific research programme investigating the magnetosphere and plasmasphere. Science payload has a mass of 210 kg and includes seven plasma instruments, ion emitter, three-axis magnetometer, wave analysers, auroral radio detector, particle detectors, paired auroral oval imagers.

MAGION 5 (MAGnetosphere - IONosphere) is built by the Czech Republic to work in conjunction with MAGION 4 (1995-039F) and parent Interball satellites and studies the mechanisms for transporting the energy from the solar wind into the magnetosphere.

Updates for Previous Launches

International Designation	Comment
1981-122A	Marecs A was manoeuvred off-station over 22-23 deg E approximately 1996 Aug 20 and appears to have been retired. Add the following retirement orbit:- 1996 Aug 22.87 8.05 deg 1,515.15 min 36,791 km 37,850 km
1982-097A	INTELSAT 505 was manoeuvred off-station over 63-64 deg E approximately 1996 Jun 26: it was relocated over 32-33 deg E approximately Jul 12.
1983-105A	INTELSAT 507 was manoeuvred off-station over 46-47 deg E on 1996 Jul 23.
1985-015B	BRASILSAT A1 was relocated over 280-281 deg E on 1996 Jul 16.
1985-025A	INTELSAT 510 was manoeuvred off-station over 56 deg E approximately 1996 Jul 1.
1987-022A	GOES 7 was relocated over 265-266 deg E on 1996 Jul 10.
1987-029A	Palapa-B 2P had its longitude stabilized over 144 deg E approxi mately 1996 Aug 2.
1988-018B	Telecom 1C has been retired from operations.
1988-098A	TDF 1 was manoeuvred off-station over 341 deg E approximately 1996 Aug 17-18 and was still drifting to the west at the end of the month.
1988-099A	Visual observers have reported that USA 33 has not been seen in orbit since mid-May 1996 and it is probable that it has been de-orbited. No decay notices have been issued for this payload.
1989-006A	INTELSAT 515 was manoeuvred off-station over 341-342 deg E approximately 1996 Aug 22 and was still drifting to the west at the end of the month.
1989-030A	The last station-keeping manoeuvre to be performed by Raduga 23 was 1996 Apr 19-20 and by the end of August the satellite had drifted to 49 deg E from approximately 44 deg E. It seems probable that the satellite is no longer operational.
1991-060A	Yuri 3B was manoeuvred off-station over 109 deg E approximately 1996 Jul 10 and was still drifting to the west at the end of August.
1992-082A	Gorizont 27 was manoeuvred off-station over 53 deg E on 1996 Jul 8: it was relocated over 95-96 deg E on Aug 15.
1995-013A	INTELSAT 705 was manoeuvred off-station over 309 deg E on 1996 Jul 29.
1995-063A	Gals 2 was re-located over 35 deg E on 1996 Jul 9.
1996-006A	Palapa-C 1 was manoeuvred off-station over 112 deg E approxi mately 1996 Aug 15. The satellite was still drifting to the east at the end of the month.
1996-028A	Progress-M 31 undocked from the front longitudinal port (+X) of the Mir Complex 1996 Aug 1 at 16.45 UTC and was de-orbited later the same day.
1996-029A	The following orbital data for USA 119 are derived from unofficial visual observations:- 1996 Jun 12.95 63.41 deg 107.44 minutes 1,051 km 1,165 km
1996-029B	The following orbital data for USA 120 are derived from unofficial visual observations:- 1996 Jun 14.97 63.41 deg 107.44 minutes 1,050 km 1,166 km
1996-029C	The following orbital data for USA 121 are derived from unofficial visual observations:- 1996 Jun 13.92 63.41 deg 107.44 minutes 1,053 km 1,163 km
1996-029D	The following orbital data for USA 122 are derived from unofficial visual observations:- 1996 Jun 20.50 63.42 deg 109.20 minutes 1,186 km 1,194 km
1996-029E	Name of this object is USA 123. No orbital data are available for the object.
1996-029F	Name of this object is USA 124. No orbital data are available for this object.
1996-035A	INTELSAT 709 was manoeuvred off-station over 303 deg E on 1996 Jul 19.
1996-036A	Columbia (STS-78) landed at the Kennedy Space Center 1996 Jul 7.53 (1236.45 UTC). This is the longest shuttle flight to date with a duration of 16d 21h 47m 45s.

Collision Between Cerise and Ariane-1 Debris

The first accidental collision between two orbiting objects (excluding some impacts which have taken place during the deployment phase) took place on 1996 July 21 at 0948 UTC when a piece of debris from the Ariane-1 third stage which launched SPOT 1 in 1986 collided with CERISE, launched in July 1995. During the impact the upper portion of the CERISE gravity gradient boom was broken off and was catalogued as 21995-033E (23994), this being noted in the August 8th issue of Worldwide Satellite Launches (page 60). The orbital data for the piece of Ariane-1 debris and CERISE before and after the impact suggest that the orbits of the objects were not disturbed:-

Ariane-1 third stage debris (1986-019RF/18208):

1996 Jul 20.34	98.45 deg	98.14 min	660 km	680 km
1996 Jul 21.29	98.45 deg	98.14 min	660 km	680 km
1996 Jul 22.32	98.45 deg	98.14 min	660 km	680 km

CERISE (1995-033B/23606):

1996 Jul 20.80	98.10 deg	98.14 min	663 km	676 km
1996 Jul 21.75	98.10 deg	98.14 min	663 km	676 km
1996 Jul 22.16	98.10 deg	98.14 min	663 km	676 km

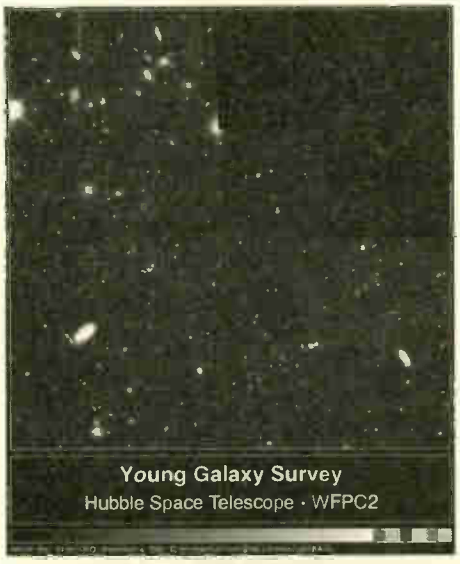
Hubble Sees Early Building Blocks of Today's Galaxies

New Hubble Space Telescope (HST) images reveal what may be galaxies under construction in the early universe, out of a long sought ancient population of "galactic building blocks."

Hubble's detailed images, taken with the Wide Field Planetary Camera 2, reveal a grouping of 18 gigantic star clusters that appear to be the same distance from Earth, and close enough to each other that they will eventually merge into a few galaxy-sized objects. They are so far away, 11 billion light-years, that they existed during the epoch when it is commonly believed galaxies started to form.

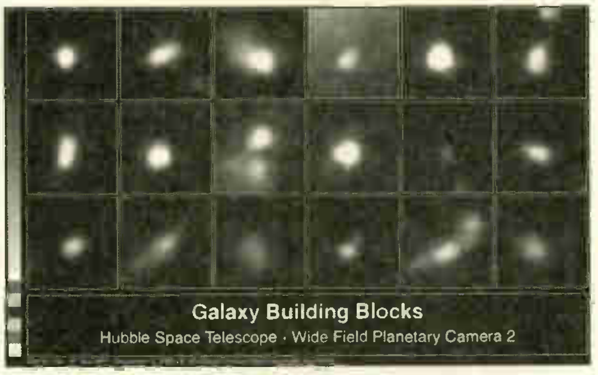
These results add weight to a leading theory that galaxies grew by starting out as clumps of stars, which, through a complex series of encounters, consolidated into larger assemblages that we see as fully-formed galaxies today.

The finding is another step back into the dim past, where astronomers ultimately hope to uncover the earliest seeds of galaxy formation which arose shortly after the birth of the universe, or the Big Bang.



Embedded in this Hubble Space Telescope image of nearby and distant galaxies are 18 young galaxies or galactic building blocks, each containing dust, gas, and a few billion stars. Each of these objects is 11 billion light-years from Earth and much smaller than today's galaxies. (Roger Windhorst and Sam Pascarelle, Arizona State University and NASA)

Astronomers at Arizona State University, Tempe, Arizona, (ASU) and the University of Alabama at Tuscaloosa found 18 of these cosmic building blocks packed into an area about two-million light-years across. "It's the first time anyone has seen that many star-forming objects in such a small space. There are not nearly as many such luminous objects in the two-million light-years separating Earth's galaxy, the Milky Way, from the Andromeda Nebula, the nearest major galaxy", says Rogier Windhorst of Arizona State University.



These 18 small blue objects—each 11 billion light-years from Earth—could be the seeds of some of today's galaxies. Each clump contains several billion stars. Astronomers believe that many of these objects have collided and merged with each other over time to grow into the giant and luminous galaxies seen around us today. (Roger Windhorst and Sam Pascarelle, Arizona State University and NASA)

The astronomers published their findings in an article, authored by ASU graduate student Sam Pascarelle, in the September 5 issue of the journal Nature. The coauthors are ASU's Rogier Windhorst and Stephen Odewahn, and William Keel of the University of Alabama at Tuscaloosa.

The building blocks seen by Hubble consist of only about a billion young stars each, and Hubble shows star formation is underway through the presence of many blue stars and glowing gases. The objects typically measure only 2,000 light-years across. "That's not very big. Our own galaxy is 100,000 light-years across," Odewahn says. The objects are much smaller than even the central bulge of the Milky Way, which measures about 8,000 light-years in diameter. "We think that by repeated merging, they will grow big enough to become the bulges of nearby galaxies," says Keel, citing other HST studies that have shown that the galaxy merger or collision rate was higher in the past. "In fact, at least four of the objects in this field show double structure in their centers only a few thousand light-years apart, as if we've caught them in the act of falling together."

Hubble shows a new level of detail for determining the true nature of these "pre-galactic blobs." Hubble resolved clumps as small as 2,000 light-years across (1/10th of an arc second). These were seen in a two-day (67-orbit) exposure by Hubble of a small region of sky in the northern part of the Hercules constellation near the border with Draco.

"We've never seen so many of these objects in a single exposure and so small," says Pascarelle. "We are convinced that these objects are not peculiar, but part of the general formation process of galaxies in the early universe."

Astronomers see stars form, because star formation is an ongoing process. However, astronomers have never directly seen galaxies form, because their formation may have happened a long time ago, or because galaxy formation is not as spectacular as once believed, and is therefore much harder to observe.

The idea that galaxies grew from small pieces coming together, rather than through the collapse of a gigantic gas cloud, has been predicted from previous theoretical work and ground-based observations. The Hubble observations offer some of the best direct visual evidence to date, says Pascarelle.

Though many of the objects are isolated in the image, they are close enough together in space that most of them should eventually merge, according to Windhorst. He sketches a scenario where two or more objects will pass through each other, drawing out hydrogen gas to form more stars later. (Although the term "collision" is used, their individual stars don't collide.) They may then evolve to form the numerous faint blue galaxies, a distant population of galaxies seen by Hubble and other telescopes. Later, surrounding hydrogen gas then settles into a disk to form a spiral galaxy.

If this construction plan is correct, our Milky Way galaxy contains all the pieces of the assembly process. The older, redder stars in the Milky Way's central bulge came from the merged clusters, or "sub-galactic units," seen by Pascarelle and collaborators. The spiral arm that our Sun inhabits was made later after hydrogen settled into a disk. Some of the 140 globular star clusters which orbit the Milky Way may be "left over" smaller building blocks which formed before the larger units seen by Pascarelle and collaborators, but were never pulled directly into larger assemblages.

In some of the deepest exposures of the universe (apart from the Hubble Deep Field) yet obtained by the telescope, the astronomers found 18 objects in one image, in the vicinity of a faint radio galaxy they were studying. The researchers used an optical filter precisely tuned to detect the ultraviolet emission from glowing hydrogen gas heated by newborn stars that formed early in the universe, but shifted to longer visual wavelengths by the universal expansion. "This is a case where Hubble is uniquely suited to study sub-galactic objects at these great distances," says Windhorst, "because these objects are so compact that it would be very hard to recognize them from the ground."

Follow-up spectroscopic observations with the Multi-Mirror Telescope at Mt. Hopkins, Arizona (MMT) showed at least five of the clumps are all at the same distance from Earth. The team confirmed that another five objects were at the same distance by imaging another redshifted hydrogen line in the near infrared with NASA's Infrared Telescope Facility, and through spectroscopic follow-up at the 10 meter W.M. Keck Telescope, both on Mauna Kea, Hawaii (the latter by Drs. Nicholas Scoville and Lee Armus of Caltech). The amount of redshift corresponds to a distance of 11 billion light-years—far enough to probe the early universe during the period where many of the giant galaxies were being assembled.

In a companion paper in press for the Astrophysical Journal Letters, Stephen Odewahn, Windhorst, Keel, and Simon Driver (from the University of New South Wales in Sydney, Australia) show that the counts of faint blue objects in this field are no different from that in other deep HST fields. Astronomers interpret this to mean that in almost every direction an observer should see similar activity going on at these distances—the gradual construction of galaxies from faint blue sub-galactic building blocks.

Hubble Achieves Milestone: 100,000th Exposure


HST's 100,000th Observation
Hubble Space Telescope · WFPC2

The Hubble Space Telescope reached a milestone several years sooner than scientists expected when it snapped its 100,000th exposure June 22. The six-year-old orbiting observatory has averaged 1,389 exposures a month, an amount that would make any photographer envious.

Space Telescope Science Institute officials largely attribute the achievement to better management of telescope observing time. In fact, Hubble has been using its time so wisely that it has posted a 55 percent observing efficiency over the past eight weeks, beating pre-launch expectations by 20 percent.

Without the improved scheduling efficiency, "it would have taken us at least 10 years to reach 100,000 exposures," says Institute Director Robert Williams. "This means that we're putting out more interesting scientific results to more astronomers and to the public.

Pat Fraher, Head of the Data Systems Division says, "the data resulting from this extremely efficient observation rate are nominally processed by STScI within 48 hours of receipt." Data processing involves data calibration, evaluation and subsequent archiving. The data are then sent to specific astronomers who were awarded observing time, and eventually are made available to researchers worldwide in a data archive. This archive presently contains over 2.5 trillion bytes of Hubble science data stored on 375 optical disks. About 2 Gbytes of data are processed and archived daily.

More than 25 percent of the exposures were spent probing galaxies and galaxy clusters, and another 25 percent on stars and star clusters. The 24-hour observatory has taken images of about 10,000 objects. Hubble's images of galaxies and planets represent a travelogue of exotic celestial places. Jupiter and Saturn top Hubble's favorite target list.

Rare Hubble Portrait of Io and Jupiter

This image, shows Jupiter's volcanic moon Io passing above the turbulent clouds of the giant planet, on July 24, 1996. The conspicuous black spot on Jupiter is Io's shadow. The shadow is about the size of Io (3,640 kilometers or 2,262 miles across) and sweeps across the face of Jupiter at 17 kilometers per second (38,000 miles per hour).

The smallest details visible on Io and Jupiter are about 100 miles across. Bright patches visible on Io are regions of sulfur dioxide frost. Io is roughly the size of Earth's moon, but 2,000 times farther away.

This is one of a series of images of Io taken by Hubble to complement the close-up images currently being taken by the Galileo spacecraft now orbiting Jupiter. Though the Galileo images show much finer detail, Hubble provides complementary information because it can observe Io at ultraviolet wavelengths not seen by Galileo, can observe Io at different times than Galileo, and can view Io under more consistent viewing conditions.

The image was taken at violet wavelengths, with the Wide Field Planetary Camera 2, in PC mode. (J. Spencer Lowell Observatory and NASA) ST


Jupiter and Io
Hubble Space Telescope · WFPC2

By Doug Jessop

New Kids on the Block

Warner Brothers is trying to expand its television distribution base with the introduction of a new cable service called WeB. Syndicated kids' shows will air in the morning and afternoon, talk and game shows in the daytime, sitcoms in the early evening and action hours in prime time and late night. But don't be warming up your LNB's anytime soon... the WB network plans to launch the new WeB channel in September of 1997.

Discovery Communications will be launching new kids' programming by the end of first quarter 1997. On October 22, 1996, Discovery will introduce Discovery Kids, a 24-hour digital (sorry about using the "D" word) cable service. Let's hope they have a free intro period to check them out. On November 4, 1996, Discovery will begin a Discovery Kids service in Latin America.

WebTV Networks Inc. (not to be confused with Warner Brother's WeB service mentioned above) expects to launch an online service that will deliver Internet services through digital terminals that are hooked to televisions. The service, which will reportedly cost users $19.95 a month, will serve as a replacement for accessing the Internet with a personal computer. Supposedly users

will have unlimited Internet access to services such as electronic mail, the World Wide Web, home shopping, and on-line banking.

According to Steve Perlman, WebTV's co-founder and chief executive officer, the device will use a technology that makes it easier to read text on a TV screen. The service is meant for people who don't want to pay for PCs.

By the time you read this, direct broadcast satellite (DBS) newcomer, EchoStar Communications, should be testing their new satellite called *EchoStar II*. The Lockheed Martin Series 7000 satellite carries 16 transponders capable of transmitting over 100 channels for the fledgling DISH network. The satellite was launched aboard a Ariane 42P rocket from the Guiana Space Center in Kourou, French Guiana, on September 11, 1996.

On August 8, 1996, Arianespace launched Flight 90 with a payload of two telecommunications satellites: *ITALSAT F2* for Telecom Italia and *TELECOM 2D* for France Telecom and the French Ministry of Defense's DGA arms-procurement agency.

General Instrument Corporation announced that TCI's "Head End In the Sky" (HITS) has agreed in principle to support distribution and digital programming to the consumer C-band market when HITS begins transmitting at the end of this year. HITS is a national television distribution system providing program transmission utilizing GI's MPEG-2 digital video compression technology.

Consumers with new digital C-band receivers will be able to access HITS programming primarily off *Galaxy* 7. By utilizing 12 Ku-band transponders of G7, HITS anticipates providing over 80 video and 40 audio channels, including new networks, expanded pay-per-view data services and premium movie services.

"We are encouraged by GI's demonstration of commitment to deploy new digital boxes in the consumer C-band market, and believe this is a market programmers on HITS will be interested in. The HITS offering could provide consumers with a vast amount of digital content that will continue to grow," stated Rich Fickle, VP of Marketing for HITS.

¿Se Habla Espanol?

In other news from EchoStar, they recently announced that they are getting into the Spanish language programming game for the DISH Network. For $4.99 per month viewers will get Telemundo, Prime Deportiva, and MTV Latino. With the launch of *EchoStar II*, the DISH network plans to provide alternate Spanish audio feeds for its MultiChannel premium services at no extra charge.

Carl Vogel, president of EchoStar Satellite Corporation, commented, "The addition of a Spanish language tier of services provides us with a unique opportunity to serve Hispanic and Latino viewers who are currently unable to receive such a broad assortment of Spanish language programming from any other source."

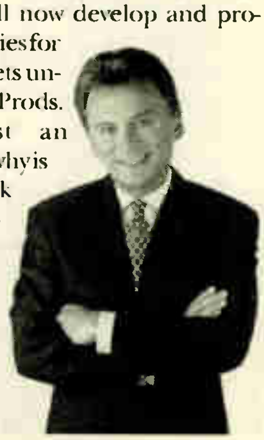
ESPN will launch its fourth Latino network, ESPN 2, in association with Mexican programming broker Productora y Comercializadora de TV. The network, to be dubbed ESPN "Dos," will be available in Mexico and Central America and will mix sports from that region with sports like major league soccer and baseball. "ESPN's philosophy is that localization is the key to success," said International Senior VP Jacques Kremer. "Because Mexican viewers are more interested in American programming than viewers in the more southern regions of Latin America, we feel it is crucial to provide them with sport presentation suited to their tastes."

According to a report in the *Wall Street Journal,* Television Espanola of Spain and Grupo Televisa of Mexico, two of the world's largest producers of Spanish-language programming, were said to be in "advanced negotiations" this week over the joint operation of digital television in Spain and Latin America. Additionally, Sogecable, the Spanish company allied with Canal Plus of France, is expected to announce an agreement to enter the digital-television market in Spain and Latin America with DirecTV Inc., a unit of General Motors. Both developments followed an announcement by the Kirch Group of Germany and Telefonica de Espana SA, to explore a similar digital-TV venture in Spain.

Programming Notes

Montel Williams will keep on talking through 2001. The talk show host has agreed to an exclusive development deal with Paramount Television Group that will run his show through the 2000-2001 season. The first-look development deal was announced by Frank Kelly, president of creative affairs at Paramount Domestic Television.

The syndicated talk show, produced by Paramount Domestic Television in association with Chris-Craft/United Television, began its fifth season this fall. Williams, who is host and executive producer of *The Montel Williams Show,* will now develop and produce television series for all broadcast outlets under his Letnom Prods. company. (Just an observation...but why is it that daytime talk show folks like to use their name backwards to create the name of their production companies? Case in point, Harpo Productions for Oprah.)



According to Columbia TriStar Television, top-rated game shows *Wheel of Fortune* and *Jeopardy!* are being revamped to make them more appealing to younger viewers. In addition to a new puzzle board, *Wheel* will feature a new set each week that reflects a certain theme such as "Broadway" or "California Adventure," new prizes with more trips, and a progressive jackpot. As far as production, the show will feature new graphics and additional cameras.

Similarly, *Jeopardy!* will also get a new set and will add categories with more contemporary questions. The show will also seek out younger contestants. "It's not going to turn into *Jeopardy!*'s version of *Singled Out,*" said Sony TV Entertainment Executive Vice President Andy Kaplan. "But we're also not going to do ridiculous, arcane historical questions."

Fox Broadcasting Company will spin off its Fox Children's Network and merge it into a new company along with the assets of television-programmer Saban Entertainment Group. Fox and Saban will each own half of the new company that is positioned to be a major producer in the children's television arena.

Fox broadcasts 19 hours of children's programming each week that is scheduled during weekday afternoon and Saturday morning time periods on Fox affiliates. Saban Entertainment is a major producer and distributor of children's shows such as *Mighty Morphin Power Rangers* and *The X Men.* The transaction brings Fox and Saban closer in a bid to aggressively challenge other leaders in children's programming that have been formed by the mergers of the Walt Disney Co. and CapCities/ABC, Time Warner and Turner Broadcasting System, as well as the growth of Viacom's Nickelodeon.

Fox entertainment chief Peter Roth quickly axed two of the network's low-rated freshman comedies; *Lush Life* and *Party Girl.* "Hell of a first day," said Roth, who replaced the shows with episodes of the canceled series *America's Most Wanted.* Fox had received an "enormous outpouring" of mail from viewers, government officials, and law enforcement agencies-each requesting that the show be put back on the air. (I even got e-mail from *ST* readers upset about the cancellation).

"The audience spoke to us loudly," he said. Fox has ordered "multiple episodes" of *Most Wanted* and intends to use it as a "backup show." The network added that its new comedy game show, *Big Deal* (which finished its run on Sunday), will remain in production as a backup series.

A new public-access show that *ST* readers should be able to relate to, *Wild Feed TV,* has some network executives wondering about copyright laws. The show will use portions of a *Nightly News* telecast from the August Republican National Convention—including clips of NBC anchor Tom Brokaw and other network staffers. The footage, say representatives of the show, was taped from an intercepted video feed from the convention to NBC's New York headquarters.

The show is covered under the Fair Use provision (which provides for the use of some information without credit or permission) of the copyright law, says Jed Rosenzweig, who compiles clips for *Wild Feed TV.* "I'm not making any money and it hardly diminishes their product," he said. In the next several months, *Wild Feed TV* viewers will see Fox News anchor Mike Schneider throwing a tantrum off-air, portions of a commercial starring model Christy Turlington, and the uncut version of Madonna's appearance on CBS' "Late Show with David Letterman." A network spokesman said that NBC execs are considering their options.

BET Holdings Inc. and Liberty Media Corp. announced that they will launch a pay-TV movie network next February. The network will be aimed at urban audiences, featuring African American artists in every movie. Actor Denzel Washington will be an investor in the new pay-TV network called BET Movies.

Time Warner and FOX Take the Gloves Off

News Corp. all but declared war on Time Warner recently after the No.2 cable company decided not to carry the Fox News Channel. Time Warner reneged on a solid deal to carry Fox News, says Fox CEO Chase Carey.

Now his company will "evaluate all our options"—including taking Time Warner to court. Carey alleges that Time Warner led Fox on to show the Federal Trade Commission that it would consider carrying competition to CNN. That became a condition for FTC approval of Time Warner's acquisition of Turner Broadcasting System. Time Warner said it didn't want to sign a deal with Fox before the FTC vote because "that would be giving up a chip" to the FCC, Carey said. Time Warner executives said they did not have a deal with Fox.

Time Warner further slammed News Corp. when it agreed to carry the all-news cable network MSNBC on half of its systems, equal to nearly six million homes. The agreement, according to sources, was part of a requirement to appease antitrust regulators. The agreement meets Federal Trade Commission requirements the company made in return for the agency's approval of Time Warner's acquisition of Turner Broadcasting System Inc. for $6.7 billion.

Fox may be launching its all-news cable channel, but New York City cable subscribers won't be seeing it. This is the second time Murdoch has launched a channel that couldn't get clearance in NYC. The other wait-listed Murdoch channel: f/X.

The new Fox News Channel will offer something other all-news cable networks don't: round-the-clock news breaks. Fox News chairman Roger Ailes says that FNC will break for news on the half-hour, 24 hours a day. In addition to news programs, FNC will include daily shows devoted to topics such as psychology, family, entertainment, and sports with issues-oriented shows in the evenings. Weekends, said Ailes, will be a mix of original and repeat shows.

Our Good Neighbors to the North

Attempting to further break its ties with American television, the Canadian Broadcasting Corp. has decided to drop US soap operas and other regular US programming from its daytime lineup by Sept. 1998. "(We are) finally taking on the job of making CBC television a service that every Canadian will recognize as a distinctly Canadian service," the government-owned broadcaster said.

In a recent survey of Canadians, 78% said they favored an "all-Canadian" CBC. Perrin Beatty, the CBC's president, told the *Wall Street Journal* that the network also decided that "commercials will no longer drive" its program schedules. Instead, he said, we will decide what programs to show based on our mandate as a public broadcaster and on those things we do better than anyone else."

Daily Variety reports that the Canadian Broadcasting Corp. will chop C$127 million from its operating budget and cut 2,500 jobs over the next 18 months as it copes with reduced federal funding. Much of the hacking and pruning will be done by April, CBC president Perrin Beatty said. CBC brass are figuring out which jobs will go. "We must move within six months," he said, "or our checks will bounce. The latest cuts are the final stage in a three-year program to cut $302 million from the CBC budget. It cost Canadian taxpayers more than $730 million a year to finance the CBC. Beatty said the CBC will complete its transition to an all-Canadian schedule on English-language television, eliminating what little remains of its U.S. programming, including daytime soap operas. "We will live or die on our Canadian programming."

If I may, here's a little editorial comment. When you are subsidized by the government you can afford to not care as much about advertisers footing the bill, but now, with even the subsidies being cut, doesn't it seem a bit odd to ignore advertising revenues? Most advertisers are not idiots: if a show is not popular with viewers you just put your money somewhere else.

Do you think their survey happened to include Canadian satellite dish owners? From the BUD people I have spoken to in Canada, a fair amount of U.S. programming cruises via satellite over the border without a lot of complaints from viewers.

Closing Notes

The National Association of Broadcasters has announced that it will raise over $1 million to file a lawsuit against a satellite program distributor. The NAB claims the distributor is violating the Satellite Home Viewer Act (SHVA) which gives satellite carriers the right to provide program feeds only to viewers incapable of receiving over-the-air local affiliates. Network affiliates have challenged thousands of DBS customers they claim receive out-of-market signals.

A group of Washington lobbyists, currently writing the rules for a television content code, recently discussed the need for an independent board that ensures ratings are consistent across the industry. (Gosh, doesn't that sound like something you read in this column recently...) According to sources, particular concern about resolving differences between shows that compete directly have risen in recent months. The new content code, on which no final decision has been reached, will be used in conjunction with the V-chip and will allow parents to program their TV sets to block reception of shows with questionable content.

The V-chip implementation group set a tentative goal of completing the ratings rules by December. Rules are, of course, one thing, implementation is an entirely different matter.

In case you haven't noticed or possibly just don't care (?)... according to a report in *USA Today*, Dan Rather has gone back to natural! The *CBS Evening News* anchor recently ditched the bottle and went from dark brown to gray-brown and the buzz around CBS News is: it looks good and it's about time.

Rather, who in the past has been a tad defensive about subject of "dye," celebrated his 65th birthday on October 31 and now admits freely that his hair will remain *au naturel.*

"Clint Eastwood is my role model," Rather said. "Hey, it's not as if I work in an industry obsessed by image and youth." Yeah, right... ST

Doug Jessop has been in the broadcasting industry since 1979. He can be reached through the Internet at: http://www.searcher.com/STcomments.html

By George Wood
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Broadcasting and Cyberspace

Many companies around the world are developing low cost machines to access the internet, often at high speeds, using digital TV satellites or cable TV networks. In the States, Oracle and other companies are promoting their "NCs," network computers, as cheap hardware for World Wide Web access. At Home is developing systems to deliver fast Web access over cable TV networks. DirecTV already has its satellite-based DirecPC system.

European countries are slowly working in this direction, but until the mandated deregulation of European Union telecommunications policies in 1998, the giant national public telephone monopolies are dragging their feet. Only in Scandinavia and Britain, where deregulation has already been implemented, is much happening.

However, the telecom dinosaurs got shaken up on August 23, 1996, when the news broke that both British Sky Broadcasting (BSkyB) and Germany's Bertelsmann plan to offer access to the Internet over their planned digital satellite television systems. According to the *Financial Times*, the BSkyB digital offerings will include home banking, home shopping, and other interactive services, via a conventional TV set fitted with a decoder. The services will be offered when BSkyB introduces its digital satellite television service in 1997.

Even before the *Financial Times* story, BSkyB chief executive Sam Chisholm had said the company was considering a link-up with British Telecommunications (the former monopoly phone company) to supply interactive services (any satellite-based Internet access service needs to use phone links for the input from home users, plus high-speed lines connecting the Internet to the satellite uplink).

There was less revealed about Bertelsmann's plans—just that it will allow access to the Internet on TV sets through its "Mediabox" digital TV decoder.

Meanwhile, in Scandinavia, digital television has brought the small town of Motala in southern Sweden is having a bit of a revival at its venerable Luxor TV factory, which was bought by the Finnish company Nokia in 1984. Today the factory concentrates on satellite TV receivers, and Nokia has had to double the workforce to deal with an order from Germany's Kirch Group for one million digital satellite receivers—what Nokia likes to call multimedia terminals.

These are for Kirch's new digital satellite TV service. Other terminals are being produced for the digital packages from the Scandinavian/Benelux FilmNet Multichoice, and Italy's Telepiu. A cable TV version of the Nokia Media Master terminal will be out in the next few months, and a model to receive terrestrial digital televison should be ready at the end of 1997 or the beginning of 1998. Besides digital TV, the terminals can also be used for Internet access and playing CD-ROMs.

Even as digital services were starting to much of Europe outside Britain, a whole new series of analog channels have gone on the air to Britain and Ireland, as part of Rupert Murdoch's British Sky Broadcasting package on Astra.

SKY sports

First to appear was Sky Sports 3, which launched on Astra transponder 31 on August 15th. The earlier-launched "Sky Sports 2" operates more-or-less on weekends only, as one of seven channels that share transponder 47. Sky Sports 3, on the other hand, broadcasts for around 12 hours a day.

SKY 1

More channels appeared on August 31 and September 1. The general entertainment Sky 2 launched on transponder 7 with a night of *X-Files* favorites. It carries programs that don't fit into the Sky 1 primetime schedule, mostly from BSkyB owner Rupert Murdoch's Fox Network in the U.S. Murdoch's plans to take over The Children's Channel have fallen through, and TCI's subsidiary Flextech will continue to operate TCC, along with the Family Channel. So, Murdoch launched his own Fox Kids Network channel on October 19, sharing time on Sky 2, in order to provide an outlet for children's programming produced by Fox.

Country Music Television has moved from sharing the weak transponder 24 with Japan Satellite TV to round-the-clock service on transponder 51. JSTV also moved—to transponder 53, which it now shares with a horse racing channel during the morning and afternoons, and with China Entertainment Europe, which takes over four hours in the middle of the night.

Granada's so-called seven channels launched on three Astra transponders on October 1st. Transponder 3 carries the general entertainment Granada Plus (0500-2100), along with the curiously named Granada Men and Motors (2100-0030).

Transponder 58 is the home of the Granada Good Life package, with four separate programs (or channels): TV High Street (0500-0730), Health and Beauty (0800-1030), Food and Wine (1100-1335), and Home and Garden (1400-1630). Transponder 59 carries Granada Talk (0500-1900).

The Weather Channel, which had been scheduled to take over mornings on transponder 60 (with Sky Movies Gold) on September 1, was delayed until October. Sky Movies Gold is starting an hour earlier, and is on the air from 1100 hrs British time, with the Weather Channel running 0600-1100 British time.

The final new English-language channels under the British Sky Broadcasting umbrella launch on November 1. BSkyB itself has announced a two hour a night Computer Channel, between 1800 and 2000 British Time. Presumably it will share an existing BSkyB transponder (possibly Sky 2).

Warner Brothers Television is coming to Astra transponder 57 (former home of the Dutch channel SBS-6) on November 1. It will include series like *China Beach, Murphy Brown*, and *The New Adventures of Superman*, as well as children's programming such as *Looney Tunes* cartoons.

Like SBS-6, the other Dutch-language channels on Astra have closed their analog transponders and moved to digital packages. RTL 5 left transponder 64 and moved to the digital transponder 80 on *Astra 1E.* Its former spot was taken over by the German women's channel TM3 on September 1. The following day the channel closed down on *Hot Bird* 11.345 GHz. Veronica 6 has left transponder 51. RTL 4 has done likewise, and was replaced on transponder 52 by the new German-language QVC Deutschland.

Following the launch of MSNBC in the U.S., programming from the new channel has been appearing on NBC's two European transponders. CNBC on Astra transponder 50 began relaying *Internight, Time and Again*, and (sporadically) *The Site* on weekends. Beginning September 9, two MSNBC programs began to appear daily on the NBC Super Channel transponder on *Eutelsat II-F1*, with *The Site* late afternoons and *Internight* carried live at 0200 Centeral European Time.

NBC says MSNBC is expected to launch in Europe in late 1997 as a digital channel.

NBC and Eutelsat have signed a contract that gives NBC Super Channel (which is changing its name to NBC Europe) a 12 year home on the upcoming *Hot Bird 5* satellite. This is scheduled to join *Eutelsat II-F1* (current home of NBC Super Channel) and the other Hot Birds at 13 degrees East, when it is launched in 1999.

BBC World and DMX radio channels have ceased on *Hot Bird* and are now available only on *Eutelsat II-F1* at the same position, on 12.542 GHz, within the Italian Telepiu MPEG package.

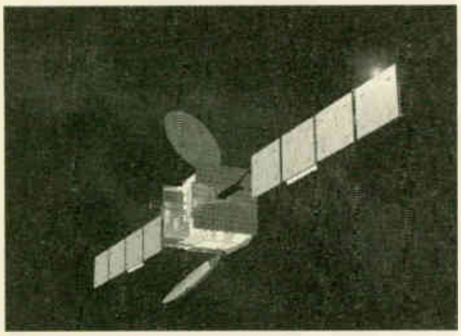
Italian satellite viewers and dealers are waiting with bated breath for the launch of Eutelsat's new *Hot Bird 2* satellite, scheduled for launch in November. Out of the 20 transponders on the new satellite, 10 have been leased by Italian media companies.

Each of the 20 transponders can transmit between four and eight digital TV channels depending on the type of compression used. The 10 reservations are: Telepiu (4), RAI (2), Silvio Berlusconi's Mediaset (1), Cecchi Gori—owner of TMC and Videomusic channels (1), and the state-run telecommunications company Stet (2).

Telepiu will use its transponders to transmit its three existing terrestrial channels as well as a package of foreign satellite channels and PPV football. Mediaset is planning to offer several pay TV channels. RAI, which has leased transponder space for eight channels, will probably transmit only two or three, but will use a different decoder than Telepiu.

Along with its digital transponders, *Hot Bird 2* will carry four analog transponders on 11.728, 11.747, 11.766, and 11.785 GHz. Portugal's RTP is expected to use one, and Dubai's EDTV will be moving from *Hot Bird 1.* The Hungarian Broadcasting Corporation has announced that it has signed a contract with NetHold to distribute the existing A3 TV terrestrial channels via *Hot Bird 2.*

Turner Broadcasting has begun transmitting a digital package in MPEG-2 on *Astra 1F*, 12.285 GHz. This includes CNN, CNN Radio, Cartoon Network, and TNT.



Radio

Super Gold, on 7.38 MHz on transponder 47 has changed its name to Classic Gold, with an improved signal quality, a slightly shifted emphasis in which decades are being played, and no news during the day.

Country Music Radio appeared on the audio 7.38/7.56 MHz subcarriers on transponder 50 on September 1, but with a terrible signal. It announced that because of the poor quality it would be going off the air, returning a few days later with much improved audio.

Bloomberg Business Radio is launching on transponder 31 (Sky Sports 3) on 7.38 MHz.

July 4 marked the launch of Voice of America programming on the World Radio Network (WRN). The VOA can be heard at 0500-0600 and 2100-2200 UTC on WRN1 in Europe, on Astra transponder 22, audio 7.38 MHz. Kim Elliot's *Communications World* program is heard during the Sunday evening slot. The VOA replaces programming from National Public Radio, which can still be heard on America One, on the same transponder, audio 7.74 MHz.

Radio Sweden is also to get a new home on Eutelsat, on the NBC Super Channel transponder, also used by the WRN2 service to Europe. This will replace the Astra and Tele-X services, which will run in parallel for a few months. The Eutelsat relay will allow Radio Sweden to once again reach Swedes in the Canary Islands, which Astra has been unable to provide, as well as Greece.

New Satellites

Contrary to previous information and Intelsat own's WWW pages (**http://www.intelsat.int**), the new *Intelsat 709* satellite is being deployed at 50 degrees West (rather than the previously reported 18 degrees), while *Intelsat 705* replaces *Intelsat 515* at 18 degrees West.

On August 8, an Ariane 4 rocket placed into orbit Italy's *Italsat-F2* and France's *Telecom-2D*. Italsat will provide voice data, and digital television broadcasting throughout Italy. It carries nine Ka-band transponders, and complements Italy's existing *Italsat-F1* satellite.

Telecom will be used for civilian telephone, data, and television links within France and between France and its overseas territories. The satellite will also be used by the French military for its Syracuse-2 military communications program. It is equipped with 10 C-band transponders, five X-band transponders, and 11 Ku-band transponders.

Scandinavia

New public service TV channels launched in Denmark and Norway on August 31. In Denmark, the public service Danmarks Radio has started DR2 (and the existing channel is now known as DR1). The new channel will primarily concentrate on young viewers. It is on Intelsat 707 on 11.667 GHz D2-MAC.

On August 30, both DR1 and DR2 also launched on Intelsat 707 on 11,592 in MPEG-2.

Denmark's commercial channel TV2 is planning to respond by launching its own second channel. This is expected to start in the new year, and will also be relayed via satellite.

Norway's NRK has started NRK 2, which is also aimed at younger viewers. It is also on Intelsat 707, on 11.485 GHz in D2-MAC.

As the new channels were starting, TV Pluss Norway went off the air on September 1. According to the screen text on Intelsat 707 11.679 GHz, the station's new owners—rival TV Norge (owned by ABC's Scandinavian Broadcasting System), the Norwegian Labor Party newspaper chain A-pressen, and the giant publishers Schibsted—are developing a new format. The station is to return to air on a new transponder.

The new FTV MPEG service from Finland to Europe reported last time is expected to start on *Hot Bird* this Fall. It will also carry two audio services from Radio Finland, one a simulcast of the existing audio now on *Eutelsat II-F1*; the other will carry some of the Radio Finland programming currently heard on shortwave.

The Swedish government has approved a plan by Swedish Television to offer its two SVT channels on satellite. The goal is to reach several thousand Swedish households that pay annual license fees, but are outside the reach of Swedish Television's transmitters, as well as Swedes living in other parts of Europe: 60,000 households altogether.

Until now, the only SVT satellite channels were encoded as a feed to Norwegian cable systems. The new SVT package is to be co-ordinated with the FTV package from Finland, and will be broadcast from one of the "Nordic" satellites at 5 degrees East or 1 degree West.

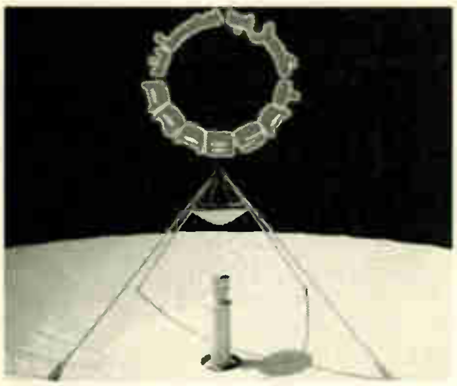
Middle East

Israel's new *Amos* satellite is carrying MPEG-2 test transmissions for Antenna Hungarian's four channel digital package.

After pressure from the Turkish government led to the Kurdish channel MED-TV losing its Eutelsat uplink from Poland on July 1, the station returned via *Intelsat 705* at 18 degrees West, on 11.075 GHz. It is illegal under Turkish law to espouse Kurdish separatism, and even use of the Kurdish langage has been supressed. As Intelsat is based in Washington, DC, Turkey has asked the United States to stop the relays of MED-TV. According to a statement from the American

Embassy in Ankara, a private Belgian company has signed a contract with Intelsat, for the relay. The statement adds that the U.S. government has "no authority to approve or disapprove contracts by Intelsat with entitites operating outside the United States."

Iraq has been turned down in a bid for access to the Arabsat system, frustrating its goal of broadcasting TV programs to the Arab world. The director of Baghdad Television was in Cairo in mid-July, seeking permission from the Arab nations that control the system. Arab diplomats say no one supported the Iraqi request. The satellite is controlled by the Saudi-based Arab Telecommunications Organization.



Arabsat 2A has been putting out strong signals from 26 degrees East, seen as far away as Norway! On August 27 Libya's Peoples' Revolution TV started regular broadcasts on *Arabsat 2A* on 12.700 GHz. Before this, Libya was testing on this satellite at 12.518 GHz.

Asia

China has suffered another space setback, as the domestic *Chinasat-7* satellite, launched on a Long March rocket on August 18, failed to enter orbit. A rocket engine reportedly shut down 48 seconds too soon, causing a failure at the key moment when the satellite separated from the rocket. China has suffered a series of Long March failures, including the explosion of the rocket carrying an Intelsat satellite in February, which killed at least 13 people. After that calamity, Intelsat and other operators shifted planned launches to rival commercial operators.

Rupert Murdoch's British Sky Broadcasting is expanding overseas. Sources tell *Tele-satellit* that Sky Sports is set to expand to India and some areas of Asia. Apparently, advertisements for the channel are already being seen in India.

On September 6, the Indian government announced approval for a 11 million dollar direct foreign investment for Murdoch's News Television India Private Ltrd (NTVI). This gives NTVI clearance to operate as an Indian company, breaking the barrier that has kept foreign broadcasters out of India. Murdoch's Star-TV owns 40 percent of NTVI, with the rest owned by a Mauritius-based offshore company headed by a non-resident Indian. If NTVI applies to become a broadcaster, and if Indian law is changed to allow satellite uplinks directly from the country, Star will be better placed than any rivals in the direct-to-home TVRO market, with programming originating in India, rather than beaming in from abroad. Four Star-TV channels already reach India via cable networks in the major cities.

JSkyB, Rupert Murdoch's planned Japanese digital TV venture, has contacted rival PerfecTV with hopes of the two companies using a compatible digital TV system, according to a report on the Kyodo news service. PerfecTV launched Japan's first digital TV package on October 1st with a package of channels from the *JCSAT-3* satellite. Full service is due from early next year when 70 TV channels and 100 radio channels are due to be part of the package.

Murdoch's JSkyB, which will also use the same satellite, is anxious to use a compatible system so homes with *JCSAT-3* dishes and receivers can easily subscribe to both services.

New channels will join existing cable and satellite TV channels in the PerfecTV service and many viewers of existing services can expect better programming from October as the stations relaunch their schedules for the digital package.

Sports channel Sports-i will be extending hours and changing name to "Sports-i ESPN" to reflect the greater role that ESPN will take in the service. The Golf Channel is also advertising its new service. Other new channels include a Japanese version of the Hong Kong-based Chinese Television Network. Two other companies, including Hughes' DirecTV, are planning to launch digital packages in Japan.

JCSAT

Shandong TV has begun broadcasts on *Apstar 1A* (134 degrees East) on 4.100 GHz. Other Chinese stations on this satellite include: ZTV on 4.020 GHz, CCTV 1 on 3.860 GHz, CCTV 2 on 4.180 GHz, SCTV on 4.080 GHz, and XZTV on 4.040 GHz.

Indonesia's *Palapa B2P* satellite, withdrawn from service on March 1 after the launch of the new *Palapa C1* satellite, has been acquired by the Philippines. Renamed Mabuhay, it's been moved from its former home at 113 degrees East to 144 degrees East. It carries 14 C-band transponders, capable of providing coverage to Southeast Asia. It will be used by its new owner, the Mabuhay Philippines Satellite Corporation, until the MPSC's own spacecraft goes into orbit, scheduled for early 1997.

Finally, if I can stray into North America....not everyone can tune into the World Radio Network relay on *Galaxy 5*, as it is on the WTBS transponder 6, which is a scrambled signal. Older receivers are unable to tune in subcarriers on scrambled VC II+ channels. Ray Robinson writes that there is an alternative. During the night, WRN programming, including Radio Sweden, is relayed on medium wave across Canada on the *CBC Newsworld* service. But *CBC Newsworld* can also be heard on an unscrambled satellite channel, via *Anik E2* at 107.3 degrees West, transponder 6, audio 5.58 MHz. Radio Sweden in English can be heard at 0503-0530 UTC, and again one hour later on the subcarrier 5.41 MHz.

Thanks as well to Curt Swinehart, James Robinson, Richard Karlsson, Mark Mahabir, Goro Amihari, and *Tele-satellit News* for their contributions. ST

By Steven J. Handler

MSNBC VS. CNN

General Electric, the corporate giant that owns NBC, has teamed up with Microsoft, the colossus of the computer software industry. News of their upcoming marriage had echoed in the halls of TVRO viewers' homes. All eyes and ears awaited the fateful delivery of their offspring, MSNBC. This summer MSNBC hit the C-band airwaves using *Galaxy 1*, Channel 10.

It came, I viewed, and in simple language, I'm disappointed. I prefer CNN. MSNBC comes to your screen armed with the resources of NBC-owned and affiliated TV stations around the country and their vast army of reporters and "on air" personalities. Catchy slogans such as "It's time to get Connected" and "MSNBC the news you need from the people you know" abounded on their broadcasts. But slogans aren't enough.

Those who clicked off the networks to watch CNN's coverage of the Gulf War know the depth of CNN's news coverage. Day in and day out CNN provides thorough coverage of both the major and routine events that affect our lives. For me, CNN is the gold standard of news coverage. MSNBC's coverage isn't bad, but side by side against CNN, I find MSNBC doesn't cut the mustard. Perhaps in time MSNBC will evolve and I'll change my mind. But for now, it's click off MSNBC and back to CNN.

I almost forgot to mention the Microsoft ("MS") part of MSNBC. Blended with MSNBC's television broadcasts is their Internet news connection, located at **http://www.msnbc.com** on the world wide web. I took a peek, and thanks, Microsoft, but no thanks. I've seen your world and I don't like it. Call me old fashioned, but I enjoy sitting down in the morning slugging down my fresh cup of caffeine soup while flipping the pages of the morning paper. That's right, *paper*. You know the stuff: you can touch it, smell it, and feel it.

News via the web just doesn't excite me. You can't send the dog to go fetch a web page. Nor when I'm done with my early morning read am I left with newsprint-covered fingers that I wear as a badge of honor. And heck, it took me years to learn the proper way to fold a tabloid. This fossil is sticking with print for my news read of the day.

Galaxy 9 launched earlier this year into its 123 deg West orbital slot until replaced there by Galaxy 10 (Hughes Communications, Inc)

Make your own comparison. CNN uses *Galaxy 5*, Channel 5. For those whose attention span is short, try CNN Headline News on *Galaxy 5*, Channel 22. Their stories are more bite-sized and they repeat the news often, they repeat the news often, they repeat the news often. CNN International and CNNfn (financial network) share Channel 16 on *SpaceNet 3*. I think the quality of CNN's financial reporting is good, but prefer the original CNN to CNN International.

By the time this issue is in your mailbox, News Corporation, the international news conglomerate, should be on the air with the Fox News Channel. Rupert Murdoch appears to be a shrewd judge of the public's wants and desires. His endeavors in print, satellite and broadcast media appear to be successful. Perhaps News Corp's entry into the fray will get me to consider switching off CNN.

How vast is the cable and satellite TV news market? Will MSNBC, Fox, and the throngs of new want-to-be news channels draw additional viewers to their news channels? Or will they simply cannibalize the existing viewers of the CNN and network news programs? New entries will find that CNN has built up one of the best news organizations in the world. The question is whether the newcomers will be able to wrestle audience and market share.

Britannia Doesn't Rule the U.S. TV Waves

For those that love listening to British accents, BBC Television provides a look at world news from a different, more continental perspective. Unfortunately, catching them is not easy. *BBC Breakfast News* can often be seen on domestic C-band transponders. However, their feeds move around faster than a chicken at a fast food convention.

Past reports of their early morning airing from 2:55 to 3:25 a.m EST Sundays through Thursdays, include using *Telstar 401*, Channel 17; *Galaxy 4*, Channels 5 and 11; and *Galaxy 9*, Channel 1. Where their feeds will be in the future is anybody's guess. In your search, I suggest trying the above three birds as well as *Telstar 402R*.

BBC Radio Via Satellite

The BBC World Service has long had the reputation of providing objective and unbiased news reporting. This tradition of news excellence dates back to World War II. Their English language broadcasts can be heard throughout the U.S. on satellite. They broadcast on *Satcom C-3*, Channel 7, using a 5.40 MHz audio subcarrier. When you tune in, use your receiver's controls to switch from C-Span's audio on 6.8 MHz to the BBC. Unlike listening to their broadcasts over the crackle and pop of the shortwave band, the satellite channel audio is crystal clear. If you are looking for quality news coverage, you can't go wrong tuning in.

Franc Talk

News from France is available here in the United States. I checked out the feed of the French network, France 2's *Le Journal* program observed at 6 p.m. EST using

Galaxy 9 is home to the Computer Television Network. (Hughes Communications, Inc.)

Telstar T401, Channel 4. Broadcast are in French with English subtitles. Their newscasts are slightly less that a half hour in length. If you can't find the feed, Mind Extension University airs France 2's news programs at 7 p.m. EST, weeknights. They use *Galaxy 5*, Channel 21.

Take a Byte out of this Channel

If you use a computer at work or home, you may find the Computer Television Network (CTVN) offers programs that both entertain and help improve your productivity. CTVN launched this summer using the new *Galaxy 9* on Channel 23. Programs are typically a half hour in length and cover topics ranging from the Internet to setting up a home office. CTVN's World Wide Web site located at **http://www.ctvnet.com** can provide more information.

There's a Whole Galaxy out There

Galaxy 9 is not only the home of CTVN but has other major tenants including Viacom's Showtime, Nickelodeon, The Movie Channel and MTV networks. Launched in May of this year, current plans call for *Galaxy 9* to be replaced in its 123 degree orbital slot by *Galaxy 10*, scheduled for launch in early 1998. Plans call for *Galaxy 9* to then be moved to a new location and used for general video distribution.

Galaxy 9 is a spin-stabilized HS-376 satellite built by Hughes Space and Communications Company. It carries 24 sixteen-watt C-band transponders.

Galaxy 10 will be an HS-601 body stabilized spacecraft also built by Hughes. Plans call for it to carry a dual payload of 24 sixteen-watt C-band transponders as well as 24 sixty-three-watt Ku-band transponders. Hughes Communications has a very interesting site on the World Wide Web. Visit them at **http://www.hcisat.com** for more information.

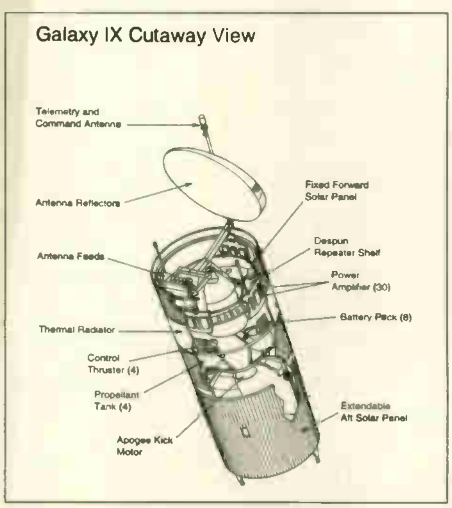
Moo've Over QVC and Home Shopping Network

Just when I thought that I'd seen every type of product hawked on one of the dazzling array of home shopping TV networks, I found something new. Shipping their products by UPS or Fed Ex is out for this merchandise, as the local delivery man has a tough time toting 1,000 pound heifers.

Superior Livestock Auction has brought cattle auctions into the 21st century. These folks now claim to be the largest livestock auction in the U.S. through the use of satellite technology. No bull, this high tech cattle beauty pageant allows geographically dispersed potential buyers to view the cattle before they buy, and it's sure easier than roving the country attending cattle auctions each week.

Begun in January 1987, this on-the-air parade of prime beef has grown. They now market over one million head of cattle each year from cattlemen in 42 states, Canada, and Mexico.

Superior maintains a regular schedule



Galaxy 9 satellite carries some of the leading names in cable television programming. (Hughes Communications Inc.)

of auction sales using *Telstar T-402R*, Channel 20. Each Wednesday at 1 p.m. EST feeder pigs go to auction, and at 1:30 p.m. EST stockers and feeder cattle go under the gavel. Every other Saturday at 9 a.m. EST an auction preview airs, with videos of the cattle for auction. Their sale day preview show even has commercials with special appeal to those in the cattle business. At 10 a.m. EST the bidding starts.

Cattle have been shown in their natural surroundings with their location subtitled on the TV screen. I find these broadcasts fascinating: when time permits I sit back and, in the serene comfort of my easy chair, watch future members of the food chain strut their stuff.

Dueling Dishes, Prices Falling

Price wars have broken out. Rebates, coupons, and other incentives have hit the DBS satellite TV industry. Competition is heating up between DirecTV and Echostar's Dish Network. Viewers can now purchase a system for under $200 after incentives. The consumers will be the prime beneficiaries of the DBS price wars. How low a price is rock bottom? Who knows, but take a look at the cellular phone industry where they give away the phone to get you to buy the service. Is this what the future holds for the DBS industry?

I believe John and Jane consumer don't care whether the program reaches them over the air, by cable, satellite, or telephone line. They just want a vast selection of programming appearing on their screen, in near perfect audio and video quality. To the viewer, it's what's on the air that counts.

More News Channels In Our Future?

From unreliable, unnamed, and potentially imaginary sources, word has leaked that several other news channels may be in the works. An unnamed British tabloid may put out an all Royals news channel, with complete coverage of the British Royal Family, 24 hours a day. After all, we just can't get enough of their Royal frivolity and family antics. Not to be outdone, several American supermarket tabloids may join forces and launch their own news channel. Unnamed as yet, they will concentrate on UFO and Elvis sightings, with indepth reporting on the lives of the people who are lucky enough to experience these phenomena. You never know what you'll see, *On The Air*. ST

By Steve Dye, sdeye99@aol.com

GLONASS—The Russian GPS

In this issue of *Satellite Times* we will look at an alternative satellite navigation system, the Russian Ministry of Defense version of GPS—GLONASS. GLONASS is an acronym derived from Global Navigation Satellite System. Like GPS, it provides users the ability to determine three dimensional position, velocity, and accurate time referencing.

Also similar to GPS, the GLONASS system is comprised of 24 satellites and a ground monitoring network which providies telemetry to the satellites for status and control purposes. Each satellite is in a 19,100 kilometer (11,937 mile) orbit with an inclination of 64.8 degrees. The orbital period is slightly shorter than GPS, at 11.25 hours. The antennas on each satellite have a wide beamwidth in excess of 30 degrees. This means the navigation service is also available to users at altitudes of 2000 kilometers (1,250 miles), ideal for navigating to space stations and other space vehicles.

In 1988, the then-Soviet Union offered the world free, unrestricted use of the GLONASS system even though it consisted of less than 10 satellites. The GLONASS system operates two services just as GPS system does. These are known as the standard position service (SPS) allocated for civilian use, and the high precision service (HP) available exclusively to military users.

In the GLONASS system, a receiver determines its position by processing the inbound signal from each satellite and quantifying the time of arrival (TOA) just as GPS does. The difference is that while GPS uses the same frequency with a different pseudorandom code used for each satellite, GLONASS uses the same code for each satellite, but a different frequency (in most cases). Some GLONASS system satellites actually share the same frequency, but their signals are sent only when in the appropriate orbital position. The principle of using the same code with different frequencies is known as frequency division multiple access (FDMA). The codes used are pseudorandom noise (PRN) in nature, but with different chip rates to those in GPS. Table 1 shows these values .

As can be seen, the course acquisition (C/A) code has the same 1 millisecond cycle time as GPS. The GLONASS satellites carry three on-board cesium clocks, providing a timing standard similar to that offered by GPS. The clocks, also subject to offset and bias from system time, induce errors in the ranging measurements as GPS would. The frequencies used in the GLONASS system depend on the individual satellite in question since they typically have their own L-band frequency. The L1 frequency is calculated according to the following formula.

fMHz = 1602 + (n x 0.5625 MHz)
(Where n is the channel or satellite number)

The L2 frequency for each satellite is calculated using a similar formulae :

fMHz = 1246 + (n x 0.4375 MHz)

As an example, channel 3 in the GLONASS system is 1603.6875 MHz for L1 and 1247.3125 MHz for the L2 frequency.

To say each satellite has its own frequency is not exactly correct. The same frequencies can be reused by satellites placed in an antipodal orbital slot (i.e., provided they are on opposite side of the earth), thus not causing interference which would degrade the accuracy.

The civilian service specification quotes an accuracy within 100 meters (110 yards) and a

TABLE 1: Current GLONASS Constellation Information

All GLONASS spacecraft are part of the general Cosmos series of satellites. The Cosmos numbers (nnnn) invoked by USSPACECOM have often differed from the numbers (NNNN) associated in Russia; when different, the USSPACECOM Cosmos numbers are shown in parentheses. The corresponding GLONASS numbers are Russian numbers.

The operating frequencies in MHz are computed from the channel number K. Frequencies (MHz) are L1 = 1602.0 + 0.5625K and L2 = 1246.0 + 0.4375K.

Cosmos NNNN (nnnn)	ID (Catalog #)	Channel number	Inc (deg)	GLONASS number
COSMOS 2111	90-110C (21008)	23	65.1	GLONASS 249
COSMOS 2178	92-005B (21854)	2	65.1	GLONASS 769
COSMOS 2179	92-005C (21855)	23	65.1	GLONASS 771
COSMOS 2204 (2205)	92-047B (22057)	24	64.8	GLONASS 756
COSMOS 2206 (2204)	92-047A (22056)	1	64.8	GLONASS 774
COSMOS 2235 (2336)	93-010C (22514)	21	65.1	GLONASS 759
COSMOS 2236 (2235)	93-010B (22513)	5	65.1	GLONASS 757
COSMOS 2275 (2277)	94-021C (23045)	10	64.7	GLONASS 758
COSMOS 2276 (2275)	94-021A (23043)	24	64.7	GLONASS 760
COSMOS 2277 (2276)	94-021B (23044)	3	64.7	GLONASS 761
COSMOS 2287	94-050A (23203)	22	64.8	GLONASS 767
COSMOS 2288 (2289)	94-050C (23205)	9	64.8	GLONASS 770
COSMOS 2289 (2288)	94-050B (23204)	22	64.8	GLONASS 775
COSMOS 2294 (2296)	94-076C (23398)	12	65.0	GLONASS 762
COSMOS 2295 (2294)	94-076A (23396)	21	65.0	GLONASS 763
COSMOS 2296 (2295)	94-076B (23397)	13	65.0	GLONASS 764
COSMOS 2307	95-009A (23511)	1	64.7	GLONASS 765
COSMOS 2308	95-009B (23512)	10	64.7	GLONASS 766
COSMOS 2309	95-009C (23513)	3	64.7	GLONASS 777
COSMOS 2316	95-037A (23620)	4	64.9	GLONASS 780
COSMOS 2317	95-037B (23621)	9	64.8	GLONASS 781
COSMOS 2318	95-037C (23622)	4	64.8	GLONASS 785
COSMOS 2323	95-068C (23736)	6	64.8	GLONASS 776
COSMOS 2324	95-068B (23735)	11	64.8	GLONASS 778 (Spare)
COSMOS 2325	95-068A (23734)	6	64.8	GLONASS 782

The GLONASS NNN series orbits in three distinct planes that are 120 degress apart. Each plane has eight "slots." Following are the members of the planes/slots.

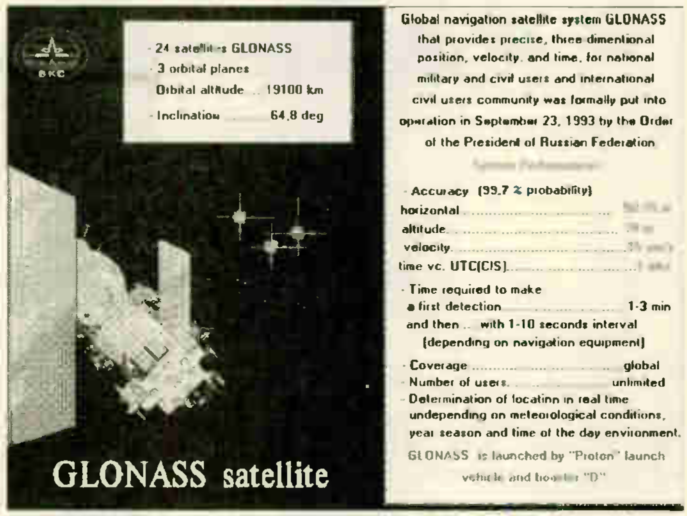
Plane 1	Plane 2	Plane 3
slot-1 771	slot-9 776/778	slot-17 760
slot-2 757	slot-10 781	slot-18 758
slot-3 763	slot-11 785	slot-19 777
slot-4 762	slot-12 767	slot-20 765
slot-5 249	slot-13 782	slot-21 756
slot-6 764	slot-14 770	slot-22 766
slot-7 759	slot-15 780	slot-23 761
slot-8 769	slot-16 775	slot-24 774

For more information on the GLONASS system contact: Coordinational Scientific Information Center (CSIC) Russian Space Forces.
E-Mail: **sfcsic@iki3.bitnet; sfcsic@iki3.iki.rssi.ru; sfcsic@mx.iki.rssi.ru**

velocity accuracy of 0.15 meters per second (m/s) (6 inches per second). It appears that so far that the Russians have not introduced selective availability; measurements performed reveal an accuracy in the order of 26 meters (28.4 yards) with velocity measurements down to 0.04 m/s. (1.6 inches per second). The performance of GLONASS exceeds GPS in one aspect—it provides a better visibility to satellites in Northern latitudes greater than 50 degrees.

Differential GLONASS

Currently, no differential GLONASS service exists on the scale that GPS users can enjoy. Discussions are underway regarding a variety of solutions to this, including equipping the Russian military space force's command and control sites with differential equipment. Since these sites have already been precisely surveyed, most of the ground work has been completed. A second proposal utilizes the existing maritime radio beacons to transmit the differential corrections, offering a solution on par with the U.S. Coast Guard DGPS system. Additionally, the Russians are planning to apply DGPS and differential GLONASS techniques at airports for use in all categories of landing and approach. This system is comparable to the Federal Aviation Administration's plans for using local area differential GPS (LADGPS) systems.



GLONASS and GPS together would provide a formidable satellite navigation system with one system augmenting the other. GPS equipment manufacturers are now marketing dual system receivers, taking advantage of GLONASS and *Glasnost*. One problem that had to be overcome in designing the dual system receivers was standards. The Russian system uses its own coordinate and time referencing system-a system not widely used outside Russia. However, by applying on-board firmware that converts between the two standards, the problem was solved and dual system integrity is now available. ST

TABLE 2: Current Keplerian Element Sets for the GLONASS constellation

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Glonass 49 (249)
1 21008U 90110C   96274.96121677  .00000007  00000-0  00000+0 0  2864
2 21008  65.2362  81.1499 0008835 270.1076  89.8066  2.13098558 45249
Glonass 54 (769)
1 21854U 92005B   96277.91743529  .00000032  00000-0  00000+0 0  3478
2 21854  65.1883  80.6748 0015649  23.0851 337.0067  2.13104619 36428
Glonass 55 (771)
1 21855U 92005C   96276.10889737  .00000015  00000-0  00000+0 0  3359
2 21855  65.1853  80.7411 0007655 192.1487 167.8498  2.13102005 36373
Glonass 56 (774)
1 22056U 92047A   96275.06798326 -.00000049  00000-0  00000+0 0  2656
2 22056  64.7251 319.8592 0006131 263.2964  96.6981  2.13103165 32446
Glonass 57 (756)
1 22057U 92047B   96275.83396556 -.00000049  00000-0  00000+0 0  2325
2 22057  64.7327 319.8620 0008122 307.3704  52.6183  2.13102551 32430
Glonass 60 (757)
1 22513U 93010B   96276.16413745  .00000016  00000-0  00000+0 0  9768
2 22513  65.1945  80.6096 0007646 183.3498 176.6618  2.13102623 28165
Glonass 61 (759)
1 22514U 93010C   96276.45815286  .00000018  00000-0  00000+0 0  9714
2 22514  65.2136  80.5993 0011263 181.2192 178.7955  2.13101879 28172
Glonass 62 (760)
1 23043U 94021A   96277.00460577 -.00000047  00000-0  00000+0 0  4073
2 23043  64.6088 320.1368 0007455 201.3490 158.6818  2.13102791 19305
Glonass 63 (761)
1 23044U 94021B   96276.41779664 -.00000049  00000-0  00000+0 0  3776
2 23044  64.6062 320.1560 0031881 205.6685 154.2358  2.13102858 19298
Glonass 64 (758)
1 23045U 94021C   96276.12613648 -.00000050  00000-0  00000+0 0  3844
2 23045  64.5915 320.1675 0010129  28.7209 331.3988  2.13101851 19288
Glonass 65 (767)
1 23203U 94050A   96276.26347110 -.00000003  00000-0  00000+0 0  3450
2 23203  64.7630 200.5242 0006672 151.7215 208.3370  2.13101997 16683
Glonass 66 (775)
1 23204U 94050B   96276.02778652 -.00000001  00000-0  00000+0 0  3610
2 23204  64.7445 200.5651 0015003 344.5011  15.4750  2.13102166 16673
Glonass 67 (770)
1 23205U 94050C   96275.44100841  .00000004  00000-0  00000+0 0  3471
2 23205  64.7567 200.5658 0002058 284.0615  75.9352  2.13102666 16663
Glonass 68 (763)
1 23396U 94076A   96275.28490536  .00000009  00000-0  00000+0 0  3256
2 23396  65.1294  80.6813 0029909 188.0338 171.9336  2.13102382 14500
Glonass 69 (764)
1 23397U 94076B   96277.80746025  .00000031  00000-0  00000+0 0  3091
2 23397  65.1181  80.6031 0011025 321.8567  38.0856  2.13101822 14552
Glonass 70 (762)
1 23398U 94076C   96275.34486519  .00000009  00000-0  00000+0 0  3307
2 23398  65.1076  80.6628 0001595 269.9908  90.0071  2.13101703 14511
Glonass 71 (765)
1 23511U 95009A   96276.24174577 -.00000050  00000-0  00000+0 0  2406
2 23511  64.6238 320.4361 0008232 221.4772 138.5238  2.13103592 12258
Glonass 72 (766)
1 23512U 95009B   96277.30010203 -.00000046  00000-0  00000+0 0  2517
2 23512  64.6136 320.4030 0006566 301.8673  58.1309  2.13101528 12275
Glonass 73 (777)
1 23513U 95009C   96277.12247695 -.00000047  00000-0  00000+0 0  2639
2 23513  64.6223 320.4243 0015053 205.1938 154.7942  2.13102875 12272
Glonass 74 (780)
1 23620U 95037A   96275.49849180  .00000003  00000-0  00000+0 0  1870
2 23620  64.8156 200.4138 0018575 170.1963 189.8620  2.13102826  9273
Glonass 75 (781)
1 23621U 95037B   96276.14531926 -.00000002  00000-0  00000+0 0  1971
2 23621  64.8263 200.4000 0018265 181.2354 178.7807  2.13102034  9280
Glonass 76 (785)
1 23622U 95037C   96277.61122407 -.00000016  00000-0  00000+0 0  2005
2 23622  64.8199 200.3502 0036677 166.3317 193.7904  2.13102409  9310
Glonass 79 (782)
1 23734U 95068A   96275.38280590  .00000004  00000-0  00000+0 0  1705
2 23734  64.8255 200.3358 0018398 321.7452  38.1532  2.13102005  6232
Glonass 78 (778)
1 23735U 95068B   96277.93015137 -.00000019  00000-0  00000+0 0  1664
2 23735  64.8160 200.2404 0007429 217.0035 142.9682  2.13125149  6285
Glonass 77 (776)
1 23736U 95068C   96276.08652814 -.00000001  00000-0  00000+0 0  1457
2 23736  64.8086 200.3228 0007866 203.2237 156.7633  2.13102033  6246
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Jeff Lichtman

A Rare Find

In the quest for active amateur radio astronomers, I must say that one of the most enthusiastic amateurs around is SARA (Society of Amateur Radio Astronomers) member, Dr. David Moore.

Dave and I met through a phone call back in 1991. Dave had seen a feature article I had written for *Science Probe* magazine, entitled "Signals from the Cosmos." It wasn't long before Dave was building and experimenting with a simple system. In the following paragraphs, you will see how far he has progressed!

As a physics teacher at Brookwood High School in Snellville, Georgia, Dave is a driving force in teaching his students the theories of physics and, of course, radio astronomy. To his credit, many of his students have gone on to careers in engineering and science. One student went on to win a major science fair for her work in cold fusion, and later was asked to work at the Fermi Lab during her college term. Dave is also an active ham radio operator (KC4YFD) and is associated with the Alford Radio Club of Stone Mountain, Gwinnett County, Georgia.

Dr. Dave Moore with military surplus antenna, redesigned for radio astronomy use.

A few months ago, Dave found out about a surplus radar antenna and mount. It was a 1968 vintage Scientific Atlanta system used by the military (shipboard) during the Gulf war and then put to use by a research company in the local area. This fast slew type system was used to track aircraft. When Dave heard about this find, he promptly put in a bid for $160.00, never thinking he would get anywhere close to what it was worth. You guessed it: he's now the proud owner of this Scientific Atlanta antenna and pedestal!

Originally refurbished in 1985, the eight foot antenna and front end are fully operational as received. Dave had to do some rewiring of the servo system for control purposes and a lot of cleaning. The focal length is 36 inches with a F/D of .37, HPBW is 6.4 degrees, and it exhibits 29 dB of gain. The total weight is 1600 pounds. The mounting pad took 1830 pounds of Sakrete cement.

Moving the antenna from Marietta, Georgia, took a bit of doing. With the help of a fellow ham radio operator (who just happened to have a wrecker truck), the antenna was brought to Oakwood, Georgia, until the pad was cured. At that point, the antenna was moved to Dave's rural home in Carl, Georgia, and placed on the pad. The antenna will be used for L-band work at 1.4 GHz.

Not surprisedly, the wife of one of Dave's neighbors was so horrified by the sight of the antenna, she put their home on the market before she had even informed her husband; obviously, they had no love for radio or hard science! Dave informed me that his new neighbor's father is a ham radio operator and they are quite used to seeing all types of antennas.

The front end portion had to be slightly modified. Originally there was a five dipole configuration installed. All of the front end electronics were removed to determine which modules would stay and which would go. Some of the modules were originally used for the purpose of slewing the antenna to different locations when aircraft were being tracked. These modules will not be needed for the work Dave will be doing.

The electronics portion of the radio telescope has been engineered by Carl Lyster (RF engineer for Radio Astronomy Supplies). The front end will be set up for thermoelectric liquid cooling. The electronics for the front end will be housed in the pedestal of the antenna and the signal processing equipment will be housed in the home observatory. Dave had to construct power supplies for the voltages needed for the specific front end modules and a 200 volt supply for the field coils. In addition, special bandpass filtering had to be made for this front end. As pointed out earlier, the antenna had modules from 1968 and 1985, all some what noisier than today's receiving equipment.

With the help of Stan McDonald (a friend who works for Scientific Atlanta), an antenna control unit was built to interface the antenna to the home computer. This control unit will operate the DC servos during movement executions via computer commands. The movements will be in altitude and azimuth to the position of the object being observed. All observations will be done in the drift scan mode initially. Tracking will be added later on.

Lichtman (left) and Grote Reber at Green Bank Observatory.

Referring to the block diagram, Dave's system is known as a simple radiometer. As shown, the first stage is the antenna RF preamplifier which has 28 dB of gain at .52 dB NF. The following stage is the converter which takes the primary frequency of 1.4 GHz and converts down to 70 MHz. In addition, the converter has a phase lock loop and an IF preamp. Following the converter is the back end, or signal processing, with an IF amplifier. This amplifies the 70 MHz signal and detects it via a square law detector, then routes it to the DC amplifier and integration circuitry. The DC output is then sent to a 12-bit analog to digital (A/D) converter.

Receiver Block Diagram

The antenna movement computer is a standard 286 type system with software (Quickbasic) written by Stan McDonald (WA4AZI) at Scientific Atlanta. A bank of relays and DC servo motors will generate timing and location voltage, which, in turn, will tell the computer the location of the antenna. Additional help was received from Jeff Smith and Marvin Hughes, also from Scientific Atlanta, and Jim Plofchan (KD4OTB), employed at Dixie Bearing.

Dave has also done VLF (40 kHz) and VHF solar radio astronomy (220 and 430 MHz). Prior to his position at Brookwood High School, Dave held a teaching position at Gainesville High School, Gainesville, Georgia. Stan McDonald was responsible for getting a 16-foot antenna for the school, which helped Dave do further work on radio and satellite projects.

Dave will be choosing a student who exhibits an interest in radio astronomy and submitting his or her name for the SARA mentoring program. This program was originally conceived by Robert M. Sickels (now deceased). Bob would find a student who showed interest in radio astronomy and he would fund the student's science fair project. After his passing, his wife asked me if SARA would like to carry on this worthy program. Indeed we did!

If you know any junior or senior high student that has an interest in radio astronomy, please submit the name to me. We will contact the student and review his or her project. We will offer some funding toward the project and invite the student to report on the project's progress at the next SARA conference.

SARA Conference a Success

The annual SARA conference held at the National Radio Astronomy Observatory in Green Bank, West Virginia, took place in July and was a great success, as usual. Those in attendance were treated to a wonderful surprise when, upon arrival, we noticed the name *Reber* on the room log. We all looked at each other in awe. As you may remember from my earlier columns on the history of radio astronomy, Grote Reber is the father of radio astronomy! We were honored to have him speak to our group about his history and his current work. At the end of the conference, I was able to get a priceless pose with Reber.

For those of you interested in radio astronomy, you should treat yourself by visiting the SARA conference next year. ST

WHAT'S NEW

by Wayne Mishler, KG5BI
email: mishler@aol.com

Jobs in the Space Industry

Here's your chance to land the job of your dreams in the space industry. All you need is a computer, modem, access to the Internet, and the right credentials. The URL **http://www.spacejobs.com** is the online gateway to a new service linking job seekers with industry openings via cyberspace.

Job seekers can sign up for a free subscription to receive space-related job announcements by email, or you can simply browse through listings online.

"A new job in the space field could be just a few keystrokes away," says John R. Criswick, president of Internet Conveyor, which offers the service. "We have combined the power of the World Wide Web and email to make the job search easier."

The service features a digital database of job openings throughout the world. Subscribers accessing the Space Jobs World Wide Web site can use a sophisticated search engine to review new openings, which are organized by company and geographical region.

Space Jobs delivers straight to the job seeker. That is, the site employs an "intelligent delivery system" to deliver relevant listings to potential job applicants via the Internet. Subscribers can refine their job search to specify the types of jobs they are interested in and to zero in on specific locations. When a posting meets one of the criteria specified, a copy of the job announcement is emailed to the subscriber free of charge.

"The intelligent delivery system sets Space Jobs apart from other systems," says Criswick. "Job seekers do not have to visit a Web site regularly or wade through dozens of extraneous email or hundreds of newsgroup postings."

Employers can target their job announcements directly to likely candidates. Job advertisers will receive statistical summaries of email postings, including crucial geographic and demographic data to help them target each announcement.

This enables employers to "reach an enormous subscriber base of highly-trained, motivated, and mobile professionals eager to meet specific needs anywhere in the world," Criswick says. "With electronic delivery, responses will be rapid."

Space jobs is free for job applicants. Criswick says all names and personnel information are kept confidential to protect subscribers. You can become a subscriber by filling out a simple online form at the web site.

"During these difficult times of government spending cutbacks and strong competition, job applicants need every advantage they can get to compete. This service will give them the edge they need by providing up-to-date, comprehensive information on new job openings," says Criswick

For more information on this service visit the web site or send an email to **spacejobs@spacejobs.com**. Their voice telephone number is (613) 562-2816.

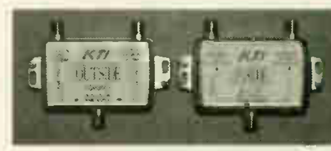
And speaking of web sites

The new worldwide web site of Analytical Graphics Inc. has something for aerospace users at every level. There is a tutorial for orbital mechanics. You can access eye-opening orbital information. You can find cloud cover data and spacecraft databases. There are even animated movie clips of three-dimensional satellite scenarios. And that's just for starters.

You'll also find information about Analytical Graphics product line, featuring the Satellite Tool Kit, an off-the-shelf (COTS) numerical and graphical analysis tool for the space industry. This software runs on Windows 95 and Windows NT platforms, and is used by commercial, government, and academic organizations worldwide. It allows users to analyze and view satellites and more.

To find out more about the companies products, log in on **http://www.stk.com** and view their web site.

New devices simplify TV connections



Using KTI's new Diplexer splitter and combiner adapters, you can receive signals from your satellite dish and off-air antenna on a single cable. This means you only have to run one cable through your wall, saving money and time in installation. Plus if your home has been wired for cable TV, you may be able to use this same cable for satellite and off-air TV reception.

Diplexers provide the ultimate solution for the absence of off-air channels in today's growing DBS market. For more information, contact a KTI representative at (608) 647-8902.

New line of antennas offered for 10 and 11 GHz

The Andrew Corporation, of Orland Park, Il., has introduced a new line of unshielded, category A, parabolic microwave antennas for use in the 10.5 to 10.7, and 10.7 to 11.7 GHz frequency bands. Category A antennas are required where interference is due to heavy frequency congestion or adjacent paths.

These new antennas are suitable for applications involving 2 GHz relocation, cell site backhaul, personal communications systems (PCS) site backhaul, and private networks. They provide a cost-effective alternative to shielded, high performance antennas because they also feature high front to back ratios, which are critical in eliminating interference paths in microwave systems.

For the 10 and 11 GHz bands, the antennas are available in 6 feet (1.8 meters), 8 feet (2.4 meters), and 12 feet (3.7 meters) diameters. They can be outfitted with optional molded radomes which help reduce tower wind loading.

In April the company added to its product line an antenna for the lower 6 GHz band (5.925 to 6.425 GHz).

For complete information on the Andrew Corporation line of antenna products, visit their web page at **http://www.andrew.com**.

J & B Electronics offers QHA antennas for Weather and Ham bands

If you're looking for a source for Quadrifilar Helix antennas for the weather and ham bands, consider the product line offered by J & B Electronics, of West Alexander, Pa.

"We make and sell Quadrifilar Helix antennas, and we've had a positive response to our products. The QHA produces fade free pictures," says company owner Buck Ruperto.

All of their antennas are tested on actual satellite passes. They are available with VHF connectors as standard, and optional F, BNC, or N connectors on request. They sell for $129.95 plus shipping.

For more information send an email to Buck at **w3kh@dns.pulsenet.com**, or write B & J Electronics, 1035 McGuffey Rd., West Alexander, Pa. 15376.

Tile roofs no problem for this antenna mounting system

There's a new antenna mounting system on the market that simplifies mounting satellite equipment and passing the signal through tile roofs. It is essentially the same type of system used to mount solar equipment on tile roofs. Called Tile Trac, this system, says Professional Solar Products, is safe, fast, and economical to use. There's more information at **http://www.prosolar.com/tiletrac.htm**

Drake hits the information superhighway

Need to get in touch with the R. L. Drake Company? You can now find them online. They have a web site at **http://www.rldrake.com** The site includes information on all Drake's consumer and commercial electronic products.

For example, you can get the latest on the enhanced Drake ESR 1255 commercial satellite receiver, which the company has improved by extending its frequency range to 2050 MHz. The ESR 1255 is designed for use in commercial cable headends. But the 1255 is only one of many Drake products you can check out on the Internet.

Drake's web site will include information on all its domestic and international products, including information on shortwave radio equipment.

Drake says it intends to expand its web site over time to include general company information, service, and technical information. Drake will also use the site to post news releases on new product announcements and other company news.

KVH announces satellite phone system for boats

Its manufacturer, KVH Industries, bills it as the smallest marine satellite phone system available in North America. They call it Tracphone. Its complete antenna with radome measures only 19.25 inches in diameter. The whole system weighs only 30 pounds. And it works with American Mobile Satellite Corporation's newest satellite communications service, SKYCELL.

The price is just under $5,000; and Tracphone enables boaters to send and receive phone and fax, and has numerous other telecommunications features and options. The total package includes the telephone handset, precision sensor-controlled robotic antenna, and fiberglass radome. The hardware and service package is available from authorized SKYCELL dealers.

KVH says the phone rates are lower with SKYCELL marine phone service. Callers, they say, pay half the per-minute rate of that charged by other marine satellite phone services.

Using the system couldn't be simpler. To place a call, you dial the area code and phone number, and press the "send" button. The call goes directly to the SKYCELL satellite, then down through the downlink gateway, and from there is delivered through the public telephone network.

KVH's unique tracking system keeps the Tracphone antenna pointed in precisely the correct direction needed to receive and send satellite signals regardless of movement of the vessel. This is true whether the boat is under way or anchored.

When only exact time will do

It's not for everyone, but if you happen to run a calibration lab, an electrical power company, a 911 emergency communications system, a military operation, or one of several other highly specialized operations requiring precise time synchronization, you might want to get in touch with the Absolute Time Corporation. The company produces several products that provide exact time measurements for a variety of specialized purposes.

For example, their Model 520 NetSync distribution system, priced at $995, offers absolute time and frequency with up to 16 outputs.

The Absolute Time Corporation is well known for its high performance Global Positioning System (GPS) time and frequency systems.

The Model 520 NetSync is a 1-3/4 inch rack mountable distribution system which accepts up to four plug-in modules for custom distribution of time and frequency to customer systems. It has an external 115/230 volt power supply and optional +24 or -48 volt DC power supplies. Flexible mounting options include stackable systems, front panel 19 inch rack mounting, rear panel forward rack mounting, and 4 inch forward extended rack mounting.

You can get more information from the company's Marketing & Sales Department at (408) 383-1518. ST

By Dr. T.S. Kelso
tkelso@grove.net

Real-World Benchmarking

In a previous column on benchmarking (*Satellite Times*, March/April 1996, pages 80–81), we discussed three issues of particular significance to benchmarking: relevancy, speed, and accuracy. While most users are well aware of the need for benchmarks to report both speed and accuracy, it is also extremely important that the benchmark used be relevant to the type(s) of applications the system supports.

For satellite tracking applications, we showed that fairly simple system benchmarks, such as the Savage benchmark, can give a pretty good idea of the relative performance—both in speed and accuracy—of the system hardware, operating system, and application software (most notably the compiler). A more thorough demonstration of application performance was shown using an SGP4-based benchmark (that is, a benchmark based upon the NORAD SGP4 orbital model) which calculates the positions of a set of ten satellites at one-minute intervals throughout an entire day. The satellites were chosen to be representative of a wide range of orbit types.

The time taken to calculate the 14,400 predictions is used to determine the average throughput of the particular system (hardware, OS, and compiler) together with the specific implementation of the orbital model. An even better implementation would not only calculate the throughput, but also calculate the average error relative to an expected result.

While this previous discussion of benchmarking served to give us a good idea of system and application performance, it is all a bit antiseptic. That is, we really haven't done anything to show how well a particular application tracks a satellite in the real world. Just as it is important to understand the relative performance factors of various systems, it is often critical to show that the system and application software work together to produce the desired result.

Real-World Data

Before we can set up any real-world benchmarks, there are several things that must be done. First, we must understand what type(s) of data are representative of our application under normal operating conditions. For example, if we need to point an antenna at a satellite for communication, to collect telemetry, or for radar tracking, then we will want to use look angles (azimuth and elevation) to test our application's performance. If we need to point a telescope at a satellite to perform optical tracking, then we would probably want to use right ascension and declination so that the satellite's position could be measured directly against a star background.

The second step in the process is to obtain a good quality data set to test the application against. The better the quality of the data set, the more useful it will be for this type of benchmarking. Because any data set is merely a set of observations—and any such set comes complete with its own errors—it is important that not only the raw data be available, but that there also be some discussion of the observation parameters and the error characteristics.

Good quality data sets can be difficult to come by, but if you know where to look, they can be found. For example, several satellite programs provide high-precision ephemerides (or more simply, tables of position and velocity over time). Satellite navigation programs such as the Global Positioning System (GPS), or geodetic satellite programs such as the *LAGEOS* or *TOPEX/Poseidon* missions, provide very-high-precision ephemerides which can be used to test a wide range of applications and can even be used to test performance between competing high-precision orbital models. Testing high-precision models, of course, requires complete understanding (and modeling) of the specifics of the coordinate systems involved. About the only real drawback to these types of data sets is that they are available for only a limited set of orbit types.

The final requirement to be able to conduct real-world benchmarking of an application is to be able to output data from the application in a format suitable for comparison with the real-world data sets. Many satellite tracking applications have the ability to output ephemerides for use in analysis, but many do not describe the particulars of the coordinate system being used. For those applications that are entirely graphically based, testing anything more than a few data points can be extremely frustrating and time consuming.

A Real-World Case Study

Let's examine an actual case study to see what kind of information is required and how such a benchmark might be applied. As an example, let's look at some visual observing data for two satellites—*Landsat 5* and *Cosmos 1766*—and see how it was used to perform part of the validation effort for the routines that went into my SGP4 Pascal libraries that are used in the TrakStar program.

In the early 1990s, I was approached by the U.S. Navy to help them test the operation of a new S-band antenna that was being built for them. Because of the narrow beamwidth of the antenna, it was important that the antenna be able to track within one-quarter degree of the intended target. Although the antenna was being built to support their *FLTSATCOM* satellites—which are geostationary and require little, if any, tracking—they wisely chose to test the system performance using a low-earth orbiting satellite (DMSP). The U.S. Navy needed a satellite tracking program which would provide look angles to get the new antenna within the required tolerance.

As the code was developed and *verified* (*verification* is the process of ensuring that the program does what it is expected to do), it was obvious that the US Navy would not accept the program unless it could be *validated* (*validation* is the process of ensuring that the program accurately models the real world). That meant I needed to show that the program would work to track representative low-earth orbiting satellites within the tolerances the U.S. Navy required. I turned to a set of data I had obtained while working on another project with Contraves Goerz Corporation back in 1987 (Contraves is best known for building the optics and mounts for US Space Command's GEODSS deep-space surveillance network, a system capable of resolving a basketball-sized target at a range of 20,000 miles).

The data was obtained during the process of satellite tracking using an optical instrument called a KINETO (KineTheodolite). The KINETO instruments are used by test ranges from the Far East to White Sands, New Mexico. This particular instrumentmounts a pair of lenses, a Zoom lens of instrumentation accuracy (180-1800 mm), and a 100-inch catadioptric lens of Contraves design, with better than 150 line pairs resolution for 75mm film. The instrument is remotely controlled by a set of 11/73 series DEC mini-computers (remember, this was built in the mid-1980s), and uses a hybrid, 8 MHz, real-time video tracking unit developed for a military anti-aircraft unit. The electronics are all mounted in an air-conditioned van, and the whole setup is mobile. With this instrument, you can drive down the road, park, set up in about an hour, and track a target. After the track, you can reduce the data, and obtain output on the target's look angles or position in ECI coordinates—again in less than an hour.

The data was collected in an auto-tracking mode with samples taken every 0.02 seconds. The azimuth and elevation data is accurate to within 5 arc seconds (approximately 0.001 degrees), after having been corrected by a star calibration run. The observation point is known to approximately 1 cm, having been surveyed by GPS, Phase II, and by a USGS benchmark some 1 mile from the site. The details are presented in table 1.

The latitude, longitude, and altitude of the observation site represents the origin of the XYZ coordinate system with the offset denoting the center of the observing system (center of axes of an El-over-Az mount).

An azimuth of zero degrees is true north and an elevation of zero degrees corresponds to the true earth tangent (WGS 72). The targets were tracked with a 0.258-degree field of view optic using a video camera and a digitizing TV tracker. The field of view is 412 pixels wide (x) by 312 pixels high (y)—that is, each pixel represents an angle of less than one millidegree (0.001 degree).

The observations were collected as a set of UTC times with corresponding (corrected) azimuth and elevation. To complete the data collection, it was necessary to obtain NORAD two-line element sets just prior to the observation periods. Both the original observation data and the NORAD two-line element sets are available on the Celestial WWW (http://www.grove.net/~tkelso/). The results of the observations are plotted against the predictions from TrakStar's look angle output in figures 1 and 2.

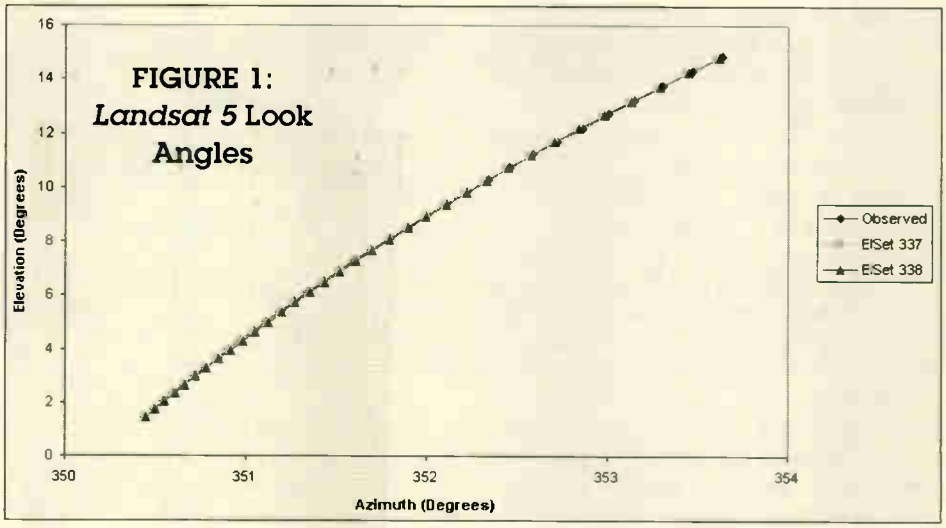


FIGURE 1: *Landsat 5* Look Angles

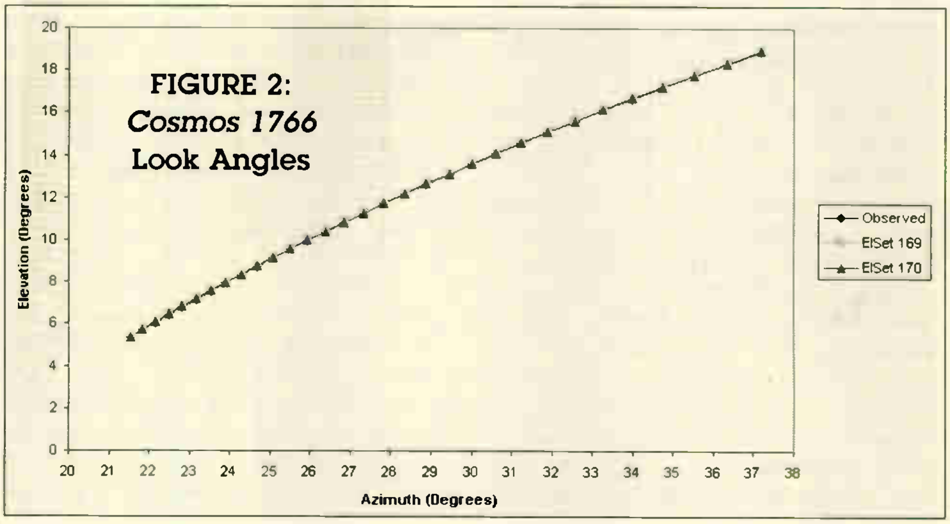


FIGURE 2: *Cosmos 1766* Look Angles

TABLE 1. Observation Site Coordinates

	Geodetic Coordinates		XYZ Offset
Latitude	40.5018 degrees	*X coordinate*	-7.8500 m
Longitude	280.1250 degrees	*Y coordinate*	-17.6940 m
Altitude	280.2710 meters	*Z coordinate*	2.2910 m

In figure 1, the observations for *Landsat 5* are plotted at five-second intervals along with the predictions from two successive NORAD two-line element sets—one with an epoch almost two days prior to the observations and the other with an epoch threehours afterwards. *Landsat 5* is moving toward the horizon during the period of observation.

In figure 2, the observations for *Cosmos 1766* are plotted at five-second intervals along with the predictions from two successive NORAD two-line element sets—one with an epoch almost two days prior to the observations and the other with an epoch about an hour and a half afterwards. *Cosmos 1766* is moving toward the horizon during the period of observation.

Examination of figures 1 and 2 shows very good agreement between the observations and the values predicted by TrakStar using either two-line element set. In fact, the agreement is so good that it is difficult to distinguish any difference on this scale. This is true even at the lower elevations where atmospheric refraction becomes significant because TrakStar calculates this effect (using standard atmosphere) when determining the look angles. In order to accentuate the differences between the observations and the predictions, the error (that is, the observed value minus the predicted value) is plotted for each element set in figures 3 and 4.

In figure 3, the error trend for *Landsat 5* moves from the upper right to the lower left (toward the origin) over the course of the observation period. While there does appear to be some systematic trend in the error, it is quite clear from this graph that the error remains well within the quarter-degree tolerance.

In figure 4, the error trend for *Cosmos 1766* moves from the lower left to the upper right (toward the origin) over the course of the observation period. Again, while there does appear to be some systematic trend(s) in the error, it is evident that the error remains well within the quarter-degree tolerance required by the US Navy. It was just this kind of analysis, using other test cases, that convinced the Navy that the NORAD SGP4 orbital model, together with the NORAD two-line element sets, was capable of generating look angles of sufficient accuracy to allow them to acquire low-earth orbiting satellites using their new S-band antenna.

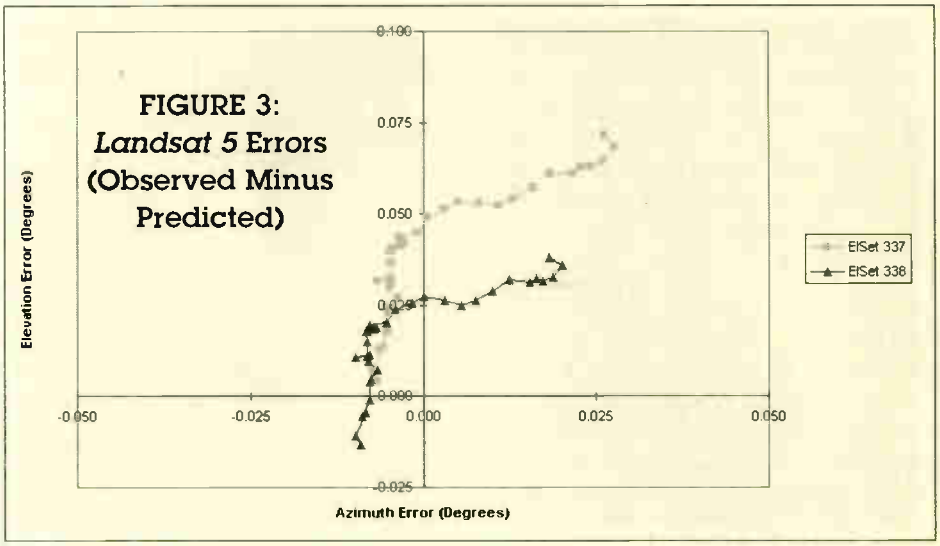


FIGURE 3: *Landsat 5* Errors (Observed Minus Predicted)

Other Test Cases

There are many ways to devise useful benchmarks. We have already discussed using state vectors from satellite navigation programs such as GPS or various geodetic satellites to test model accuracy and demonstrated how visual observations can be used in our case study. Other approaches could include auto-tracking using a radio signal (many S-band antenna systems can do this), using Doppler shifts, or even timing AOS and LOS (acquisition of signal and loss of signal). These methods may not be as accurate as the others discussed, but could provide adequate validation for certain types of applications.

In a future column, we will show how visual imagery can be used for validation, using a case study analyzing APT (automatic picture transmission) data from the NOAA polar-orbiting weather satellites.

A Proposal

While it is important for any user to understand the limitations of the application they are using for satellite tracking, it can be difficult and time consuming to build an appropriate test suite and conduct the benchmarks for that application themselves. A much more reasonable approach would be for the producer of the application to provide—as part of the application's documentation—an analysis of the application's performance against its intended purpose.

To ensure that such an analysis fairly represents a particular application's performance and that the results are directly comparable to those from other similar applications, it is paramount that such an analysis be conducted against a standardized test suite. Such a test suite could be developed by a technical committee of one of the professional societies of the astrodynamics community, such as the American Institute of Aeronautics and Astronautics (AIAA) or the American Astronautical Society (AAS). Once a draft test suite was developed, it would be made available for community comments—with those comments being incorporated into the final version, as appropriate.

The test suite would consist of a number of dated data sets, together with relevant details on observation conditions, coordinate systems, and how the test should be applied. The test suite should be easily accessible via the Internet. This type of standard is long overdue in our community and would be a welcome addition not only in comparing satellite tracking packages but in improving their overall performance.

If you have any questions or comments regarding this column, please feel free to contact me at tkelso@grove.net. Until next time, keep looking up! ST

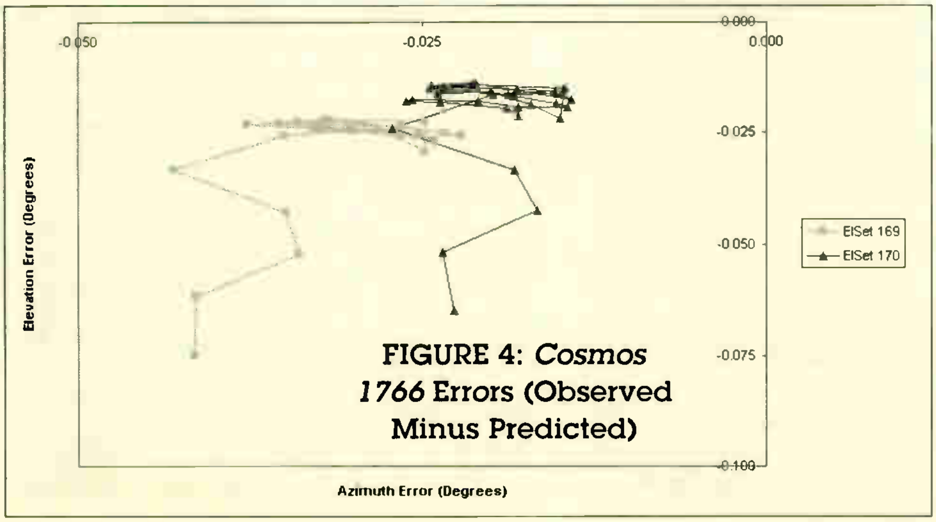


FIGURE 4: *Cosmos 1766* Errors (Observed Minus Predicted)

"You don't have to be Magellan to find your way around ...

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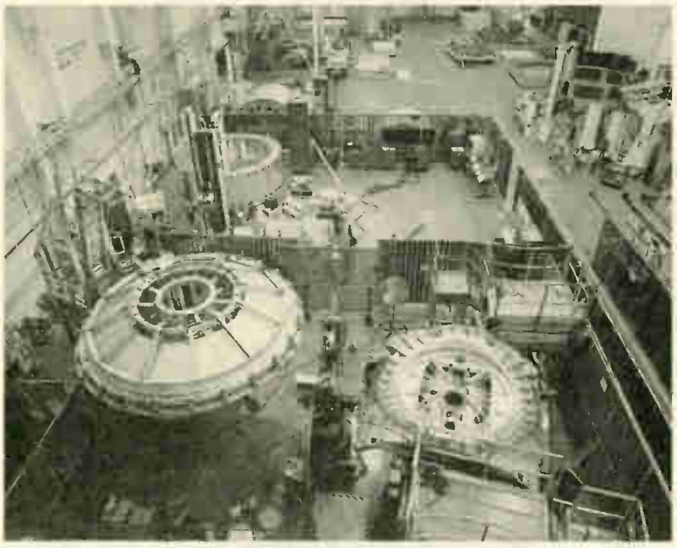
FINAL FRONTIER

By Philip Chien

Entering the Space Station Era

In the midst of concerns that the first U.S. space station components won't be completed in time, major changes to the shuttle program, and whether or not Russia will come up with enough funding for its service module, NASA and the space station partners have assigned the first astronauts who will help assemble space station.

As anticipated NASA signed the single prime contractor for space shuttle operations with United Space Alliance (USA) on September 30, 1996. USA was formed by Rockwell International and Lockheed Martin, the contractors which were responsible for most of the shuttle processing activities. The integrated contract covers shuttle processing at the Kennedy Space Center and flight operations at the Johnson Space Center. The incentive-based contract calls for USA to keep 35 cents of every dollar they save beyond the agreed contract value, provided that safety standards are upheld and the shuttle manifest remains on schedule.



The aft or rear bulkhead, which serves as an endcone on the Space Station's pressurized modules, nears completion. This bulkhead, fifteen feet In diameter, will be part of a Space Station connecting node test article which will become the Space Station s second flight node. In the center Is the hatch or door area through which the Space Station astronauts will float to other areas in the zero gravity of space. (Boeing Defense & Space Group)

The U.S.-funded, Russian-built functional cargo module (FGB) is on schedule for launch in November 1997. It will provide the initial building-block to which the rest of space station will be attached. Externally the FGB looks a lot like the *Mir* core module, with the multiple docking port on the forward end, an aft docking port, and solar arrays. The key difference is a grapple fixture which will permit the shuttle's robot arm to grab the FGB during the assembly process.

While FGB is on schedule, the service module—another Russian built component is falling behind. It's funded by the Russian Space Agency, which has not received its allocated funds from the Russian government. The Russian government has promised to come through with the funds to permit an on-schedule launch.

The next critical milestone is the mechanical assembly whicch should be completed by the time you read this article. If the service module is delayed by more than a couple of months the entire space station assembly could be delayed.

On the U.S. side, space station managers are confident that Node 1 remains on schedule. Recent changes to the program requirements have resulted in additional software and avionics requirements.

The FGB is still on schedule for launch a year from now in November 1997 aboard a Proton rocket. A couple of weeks later *Endeavour* will be launched on the STS-88 shuttle mission. Its cargo bay will carry the U.S. Node 1, with its two pressurized mating adapters (PMAs) which will permit access to the Russian portions of space station and shuttle dockings. The same docking rings will be used which have been used successfully for all shuttle-*Mir* missions.

Endeavour's crew for the STS-88 mission will consist of commander Bob Cabana (Colonel., U.S. Marine Corps), pilot Rick Sturckow (Major, U.S. Marine Corps), and mission specialists Nancy Currie (Major, U.S. Army), Jerry Ross (Colonel., U.S. Air Force), and Jim Newman, Ph.D. Mission specialist Nancy Currie will be the flight engineer, assisting the pilots during launch and landing. On orbit she will operate the shuttle's robot arm to attach the Node to the shuttle's docking port, and to grab the FGB.

Endeavour's launch is currently scheduled for December 4, 1997. During the crew's first days on orbit they will check out the shuttle's robot arm and spacesuits. The mating of the Node with the docking port will be virtually identical to the procedures used for the Russian docking module on the STS-74 shuttle mission.

On the fourth flight day the crew will complete their rendezvous with FGB. FGB will "feather" its solar arrays as the shuttle approaches. Nancy Currie will use the robot arm to grab the FGB, and immediately Russian ground controllers will command the FGB to shut off its thrusters. The Node will then be mated with the FGB, with the same procedures used to mate the Node to the docking port.

Flight day five will see astronauts Jerry Ross and Jim Newman putting on their spacesuits for the first of three scheduled spacewalks. They will mate electrical connectors between the Node and FGB and install handrails for future astronauts who work outside the space station's structure.

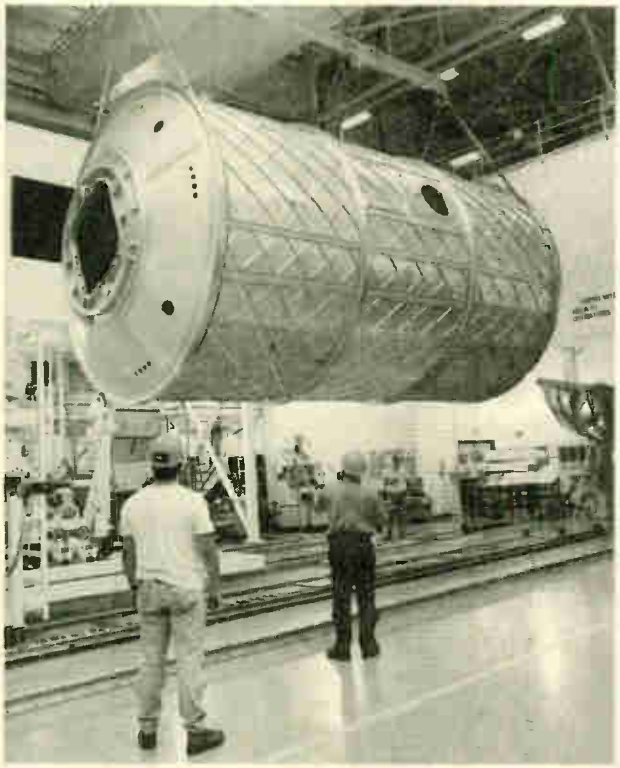
On day six the crew will enter the Node and possibly the FGB. NASA is considering leaving supplies aboard the space station since *Endeavour* has excess cargo-carrying capacity for that flight. An additional spacesuit, tools, and communications equipment may be transferred to the Node.

On the seventh and ninth flight days additional spacewalks will complete the mating tasks. The eighth flight day is being kept in reserve as a crew rest day, but could be used for contingencies if things don't go according to plan. On flight day 10 the shuttle will undock from the world's first international spacecraft—built on two different continents—and *Endeavour* will return to Earth on flight day 11.

The service module, with living space for up to three space travelers, is scheduled for launch in April 1998. It will automatically rendezvous and dock with the FGB's aft docking port. Once the service module is in place crews can remain aboard space station on a permanent basis.

The first three-person crew is scheduled for launch May 1998 aboard a Russian *Soyuz* spacecraft. Unlike the shuttle-*Mir* program, all of the long duration International Space Station crews will train together and fly together. The practice of U.S. astronaut/cosmonaut researchers training separately from their host *Mir* crews, with occasional crew changeouts, has not helped crews work with each other, especially for tasks which require interaction.

Until spare *Soyuz* "lifeboats" are installed aboard the space station all of the long term crews will travel to and from the station on *Soyuz* spacecraft.



The main structure of the U.S. laboratory module—centerpiece of the many modules and structures the U.S. is building for the International Space Station—has been successfully completed. This is the pressure hull for the laboratory, where astronauts will perform continuous scientific experiments. (Boeing Defense & Space Group)

As reported in the May/June issue of *Satellite Times* (page 19 *Changes and Challenges*), the first long term astronauts will be U.S. astronaut Bill Shephard and Russian cosmonaut Sergei Krikalev. The third astronaut will be Anatoly Solovyev, a veteran commander of several *Mir* missions, including the *Mir 19* crew, which traveled to *Mir* on the STS-71 *Atlantis* and returned on *Soyuz*.

In 1988, he was the commander of a Soviet-Bulgarian crew for an expedition that visited the *Mir* station. The flight lasted nine days. Then, from February 11 to August 9, 1990, Solovyev accomplished a 179-day flight on board the *Mir* orbital complex as commander for the sixth primary expedition. During the mission, the crew conducted a series of technological, geophysical, and biomedical investigations; performed two spacewalks; and placed the *Krystall* module into service.

Solovyev's third flight was a 189-day mission to *Mir* from July 27, 1992, to February 1, 1993. Mission activities included the completion of a Russian-French science program with microgravity, biology, medical, biotechnology, and other investigations. His most recent trip to *Mir* was from July to September 1995, traveling to *Mir* as part of the joint STS-71/*Mir 19* crew and returning via *Soyuz*.

The three-man crew will travel to and from *Mir* on a *Soyuz* spacecraft, Solovyev is the commander aboard *Soyuz*, but Shephard will be the commander responsible for the crew's activities aboard the space station. The space station at that point will consist of the Russian-built service module and FGB module, plus the U.S. Node. During the crew's four-month stay they will receive a visit from the shuttle carrying additional space station components. Before their return to Earth another *Soyuz* will deliver the replacement crew.

The on-going shuttle-*Mir* program is being used to evaluate many systems for the space station. Besides the key goal of learning how to deal with the Russian Space Agency as a partner, NASA is using extra space on shuttle-*Mir* flights for risk mitigation experiments (RME). RMEs are flown as "insurance" to evaluate hardware and concepts which will be required for space station's normal operations.

The active rack isolation system (ARIS), flew as an RME on the STS-79 mission. One of the space station's key applications is microgravity experiments. With such a large structure, people moving about, motors, and other mechanical mechanisms, it's only possible for a very small portion of the space station to have a benign microgravity environment. ARIS, and a similar, Canadian-designed experiment aboard the *Mir Priroda* module, are attempts to provide a higher quality microgravity environment.

Active isolation systems use sensitive accelerometers to detect any variations to the microgravity environment. Under computer control, a set of pushrods move the experiment with the same amount of force in the opposite direction, canceling out the disturbance. It's similar to the way an autopilot on a plane senses when the plane's going off course and adjusts it back to its proper path. The ARIS experiment occupied a double-rack within the double Spacehab module inside *Atlantis*'s cargo bay.

Going up to *Mir*, the ARIS's area, which would be occupied by the space microgravity experiments in an operational system, held Russian food containers with John Blaha's food supply for his four month stay aboard *Mir*. On the way back it carried the empty food canisters from Shannon Lucid and her crewmates stay aboard *Mir*.

ARIS used a dozen small actuators which moved back and forth to maintain the microgravity environment. There were problems with some of the actuators which the astronauts were able to solve by replacing components with spares. Commander Bill Readdy said, "We had glitches with some our payloads. So we fixed them, and moved on. And in some cases we fixed them again." Mission Specialist Jay Apt added, "It was just like being in a laboratory where you're trying to bring a piece of gear online for the first time. We had all of the help from the ground which we could ever wish for. We had the tools on board that we needed to work on it for every possible contingency—we used them all. In the time we had, we worked on it and made it work. It's tremendously gratifying to me that the risk mitigation experiment program has things which are meant for the space station flying on the shuttle. [RME] was proven out so successfully on this flight. Had we flown [ARIS on the space station] without testing it, it would have cost a lot of people a lot of work on space station. But we tested it and made it work." ST

THE BEGINNER'S COLUMN

By Ken Reitz, KS4ZR

Beginner's Guide to Satellite Guides

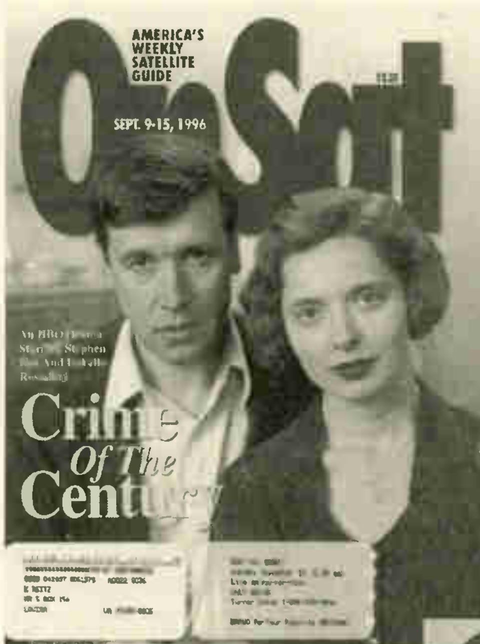
In sports, you can't tell the players without their names stitched neatly on the backs of their uniforms and a good pair of binoculars. Similarly, with hundreds of video channels available on all types of satellite services, finding a good guide is a necessity.

As consumers we have five satellite TV systems from which to choose: the C-band "full view" universe, Primestar, DSS (DirecTV and USSB), AlphaStar, and EchoStar. All the DBS services have their own on-screen guides and as you'll see, there are others being published you may want to consider as well.

The C-band side is a little different. Originally, in the very earliest days of the TVRO industry when almost all gear was homemade or outrageously expensive (typical installation: $35,000), viewers subscribed to the Texas edition of *TV Guide* which was among the first publications to list all cable channels then available.

Many satellite TV guides have come and gone since the beginning of the industry and at present there are five such guides. All are available on newsstands in most locations but a yearly subscription is much cheaper. In many cases these publications have special offers for first time subscribers. It's a very competitive business, and once you've subscribed, these guides usually continue to offer incentives to re-subscribe. Refer to the chart at the end of this column to contact the guides that most interest you. Ask them to send a sample copy. With annual subscription rates in the $50-60 range it makes good sense to see a sample to compare before you're ready to commit to a subscription.

While individual formats may vary, all guides have several things in common. All have a transponder chart or channel chart, appearing either in the centerfold or as a tear-out on card stock. This chart is similar to the one found in the center pages of *Satellite Times*. All the C-band satellites are listed by channel with pertinent information such as polarity and availability given. Usually adjacent to that chart are smaller ones listing the Ku-band satellites as well as all audio subcarriers by service or interest, with frequencies. All have complete sports listings, movie listings (with brief descriptions, times, and dates), wild feed listings, and prime time grids for each day. All have several pages of feature articles and industry related news. So, here's a review of what's available, listed in alphabetical order.



OnSat

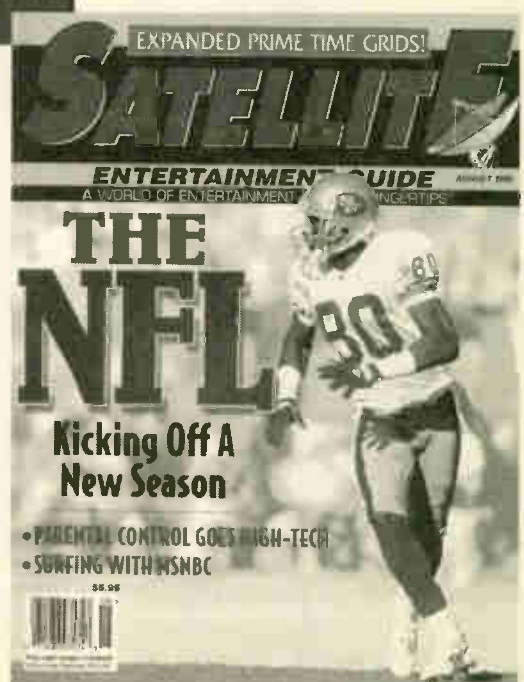
This weekly magazine-sized guide is in its twelfth year. Published by Triple D Publications of Shelby, North Carolina, it features around 160 pages, 120 of which are actual listings. The other 40 pages are feature articles, regular columns, and ads. It has a cover price of $2.25 and an annual subscription is $59.95. *OnSat* is available in different editions for each time zone. Notable features include the popular *Dr. Dish* column written by well-known TVRO technician Richard Maddox; special feeds listing; and a column of *Recent Satellite Changes You Should Know About.*

Satellite Entertainment Guide

Published by Vogel Satellite TV Publishing, *SEG* is in its fourteenth year. This magazine-sized monthly runs typically 300 pages including a sealed, fourteen page, adult programming guide which can be removed intact from each issue. There are 16 pages of feature articles and industry news. Of note is the card-stock transponder chart (which is perforated for easy removal), *Dear SEG* mailbag column, and Marc Etherington's *Wild Feeds.* Printed in one edition for all of North America, single copy price is $5.95 and regular annual subscriptions are listed at $52.00.

Satellite Orbit

In its fifteenth year, *Satellite Orbit* is the second oldest of the TVRO guides. A magazine-sized monthly, it is published



by CommTek Communications, Corp. and has over 350 pages, including more than seventy pages of feature articles and regular columns. Of note here are Jay Hylsky's *Satellite Secrets* column; a 16 page, sealed, removable adult movie listing; pull-out, card stock, transponder chart; and separate pages at the back for satellite radio and Ku-band channel listings. Published in one North American edition, *Satellite Orbit* costs $5.95 per single copy and annual subscriptions are listed at $57.00.

Satellite SuperGuide

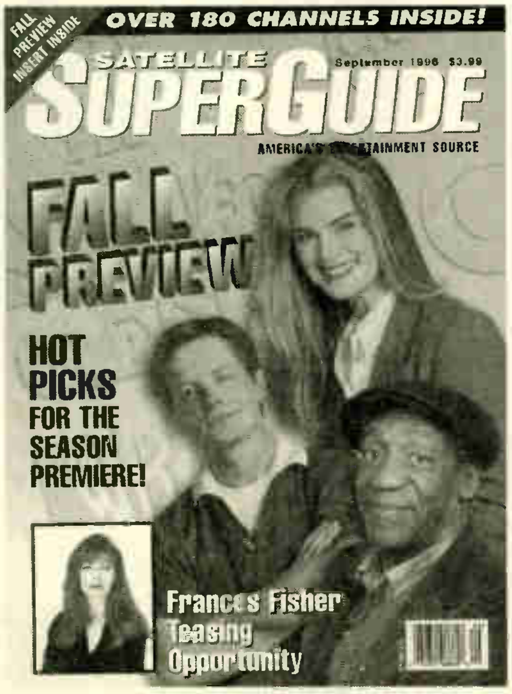
This monthly is published by the same company which produces *OnSat*. Still in its first year, *Satellite SuperGuide* is a magazine-sized format with 352 pages in one North American edition. It includes 32 pages of feature articles and regular columns (including *OnSat's Dr. Dish*); a perforated card stock transponder chart; and home electronics showcase of new products. Single issue price is $3.99 and regular annual subscriptions are listed at $45.00.

Satellite TV Week

This weekly is the oldest of the satellite TV guides and, in its fifteenth year, remains in its original tabloid size. With 92 pages of listings and 16 of feature articles and regular columns, *Satellite TV Week* is published by Fortuna Communications Corp. Notable features include *Ask the Tech Editor* by Karl Finke, long-time satellite TV answer man; and *Recurring Feeds* column by "Tracker" Bob, an original of the early TVRO days. Single issue price is $2.95 and annual subscription rate is $59.95. It is available in separate time zone editions.

The DSS Guides

What's newer than DSS services? DSS guides! With the DSS craze in its second year, one thing has become apparent: DSS viewers want more of a guide than what they're getting on-screen or in the mail from their programming provider. Entrepreneurs have stepped forward and filled the gap. As a result there are a number of guides produced specifically for the DSS market. Not surprisingly, they are produced by the same folks who publish the other guides. All are monthlies and feature daily program grids, feature articles and regular columns, a complete channel directory, and have in excess of 300 pages per issue.

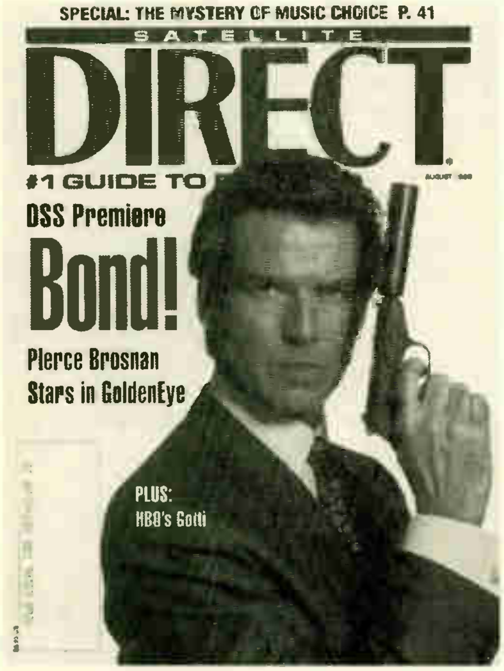


Direct Guide

Published by Vogel Satellite TV Publishing, Inc. which also produces *Satellite Entertainment Guide*. Cover price is $5.95 with annual subscriptions $52.

Satellite Channels Magazine

Published by Satellite Business News, Inc. Cover price is $3.95 with annual subscriptions $29.95.

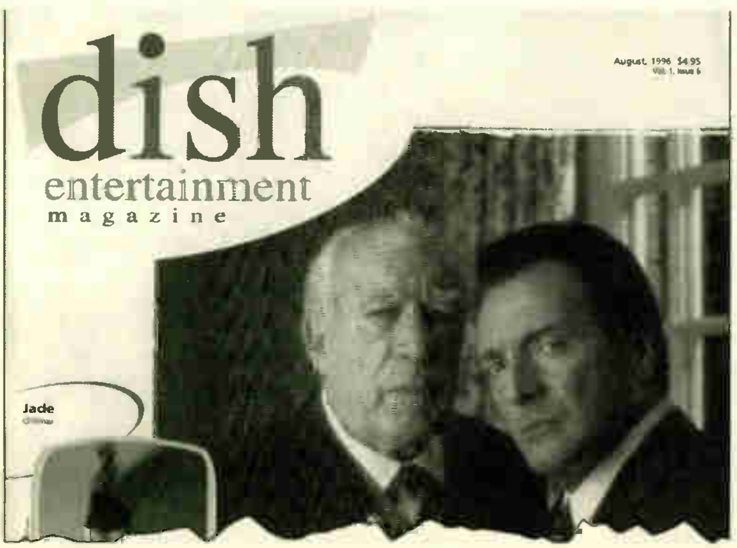


Satellite Direct

Published by Commtek Communications, Inc. which also produces *Satellite Orbit*. Cover price is $5.95 with annual subscriptions $52.00.

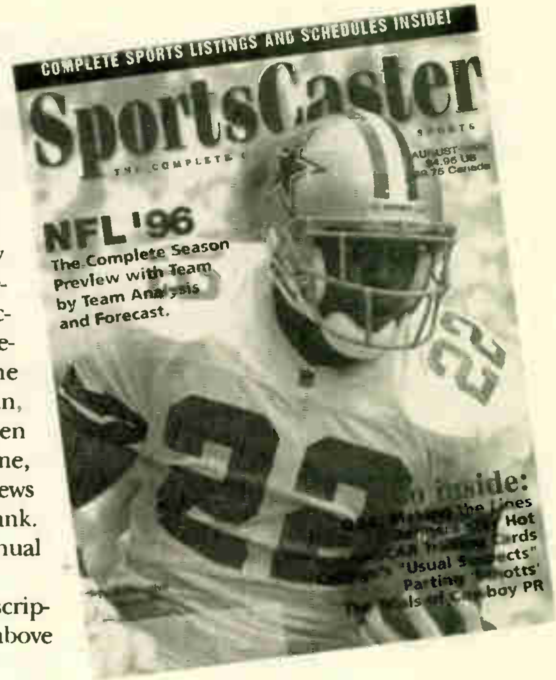
Other Niches

DISH Entertainment Guide is published by J. D. Publishing, Inc. for subscribers to EchoStar's DISH Network. A monthly, this odd-sized 11 by 12-1/2 inch guide has the usual feature articles and columns as well as several pages devoted to TV channel and audio channel line-up on the DISH Network system. The entire issue runs just under 200 pages. Single issue price is $4.95 with annual subscriptions at $59.40.



Sportscaster

In its fifth year and dubbed *The Complete Guide to Satellite Sports, Sportscaster* lives up to it name. Published monthly by the Liberty Publishing Group, this magazine-sized guide is like the sports sections of all other guides on steroids. At nearly 150 pages it has the usual feature stories and column, but they are all sports related. Even the transponder chart is the same, except all the messy movie and news channels are thoughtfully left blank. Single issue price is $4.95 with annual subscriptions $39.95.



For more information about subscriptions to all the guides mentioned above write or call:

CommTek Communications Corp. (*Satellite Orbit* and *Satellite Direct*), 8300 Boone Blvd. Suite 600, Vienna, VA 22182. U.S. toll free number for subscription inquiries or orders: 800-234-4220 others call 703-827-0511

DISH Entertainment Guide, J.D. Publishing, 1743 W. Green Tree Road, Glendale, WI 53209. Subscriptions: 800-333-DISH.

Fortuna Communications Corp. (*Satellite TV Week*), 140 South Fortuna Blvd., Fortuna, CA 95540-0308. Subscriptions 800-345-8876. Customer Service 707-725-1185.

Liberty Publishing Group (*SportsCaster Magazine*) 100 East Royal Lane, Suite 250, Irving, TX 75039. Phone: 214-868-1515.

Satellite Business News, which publishes *Satellite Channels Magazine*, retails the publication through National Programming Service (NPS) at 800-444-3474.

Triple D Publishing, Inc., *OnSat* subscriptions, P.O. Box 2347, Shelby, NC 28151-2347. U.S. toll free number for subscriptions: 800-234-0021. Customer service: 704-482-8900. *Satellite SuperGuide* subscriptions: 704-481-0784. Customer service 704-484-2804. ST

ST BOOK REVIEW

Repairing Satellite Equipment: The Insider's Notebook

Written and Compiled by Brian J. Hoopsick and Rich Ford. Published by Brich & Associates Publishing, P.O. Box 203, Dallas Center, IA 50063, or call 515-992-4142. Price: $79.95 and two updates are $29.95 each.

Satellite TV receivers, like all modern electronic equipment, seem a daunting package of tiny components packed into impossibly tight containers. When the LED display fails to light up or the power switch does little besides making a soft clicking sound, most consumers are at a loss. In fact, many dealers are, too. Often the solution is to replace the receiver with a newer model. And so, all across the land, in the back rooms of satellite dealer showrooms, are stacks of old satellite receivers just waiting to be brought back to life. Now, with *Repairing Satellite Equipment, The Insider's Notebook*, that may be an inexpensive and real alternative.

Calling on nearly 30 years of combined technical experience, Brian Hoopsick and Rich Ford have compiled what has turned out to be a notebook filled with short cuts to commonly found problems addressing virtually every major brand of satellite receiver. In fact, the top 13 brands have their own sections, with a final section devoted to 11 other less popular brands. Presented in a loose-leaf 8- by 11-inch format, Hoopsick and Ford have made it easy for technicians to get to the heart of the problem.

As pointed out in the introduction "...The book is formatted and written with the technician in mind. It is not a theoretical study of the receivers; rather a hands-on 'how to' collection that will enable anyone with basic troubleshooting skills to repair their own satellite receiver or those of their friends and customers. In addition...this book will attempt to give you pointers that will enable you to effectively troubleshoot and repair units not covered by this book, even if you do not have the schematics for the particular unit in question."

It's important to know that this is for the technically inclined; if you're not handy with a soldering iron or you're not confident in your electronic repair ability, this is not a good place to start. If, however, you are technically minded, this is like looking over the shoulder of a competent repair man while he works.

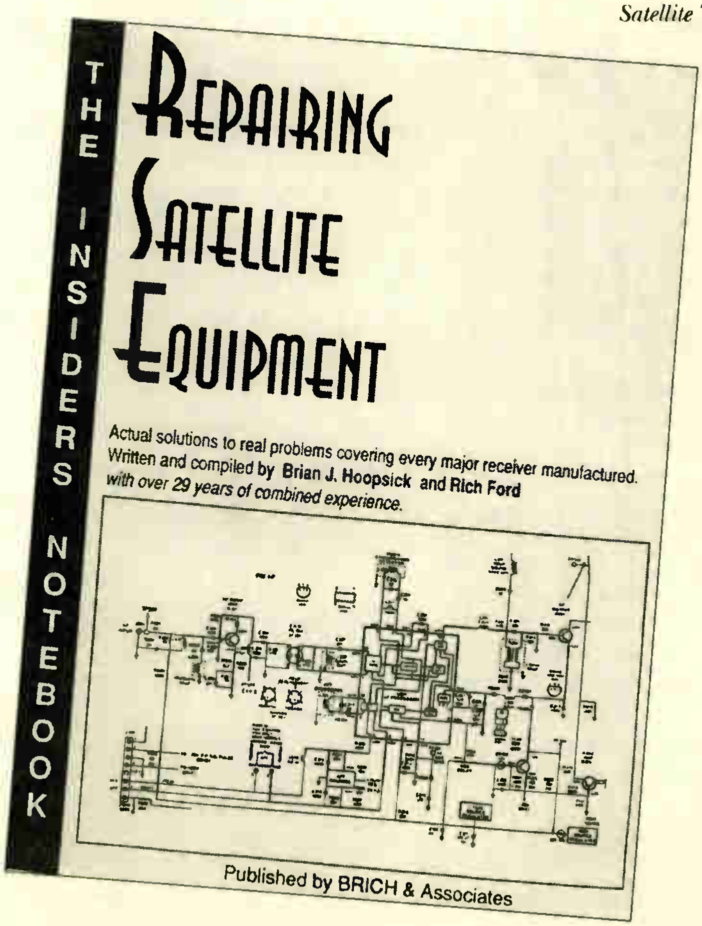
These folks know their stuff. Hoopsick says that he is so familiar with the Uniden products that their repair technicians actually call him if they get stumped! Do any of these problems sound familiar? No remote operation; no power up; blows fuses; dish drives in one direction; distorted video; no polarity control; hum bars; no LED display—the list goes on and on, from the Uniden 710 to the 9900.

Of course, it's not just Uniden. *Repairing Satellite Equipment* covers Channel Master, Chaparral, Drake, GI, Houston Tracker, Luxor, Norsat, STS, Tee-Com, and Toshiba models. The loose-leaf format makes for easy bench top viewing, or sheets can be taken out individually without having to find bench space for the whole book.

The authors don't waste your time with flowery prose. Do you have a pesky problem with your Norsat NRF 300R exhibiting "poor or no video?" Here's the solution: "...1) Check for video out of the RCA jacks. If it is present, then replace the RF modulator. Also make sure the video level control is set properly (RVC10). If all of this is OK then check IC 23 (MC1733 or NE592). You should have video at pins 7 and 8; if not, replace. If there is video present, then take a small metal screwdriver..." Heck, I think I could do this!

First published in 1994, Brich and Associates also sells updates for both '95 and '96 addressing gear and problems not covered in the original book. ST

—Ken Reitz
Satellite Times staff



ST SATELLITE TIMES TESTS

Universal Scores a Hit: The SCPC-200 Receiver

By Ken Reitz KS4ZR

It's never long after being introduced to satellite television, that most hobbyists become attracted to reception of single channel per carrier (SCPC) signals. If you've ever wondered where radio stations get their sports and news programs or how networks distribute their programming to affiliates, you'll be interested in this form of satellite communications.

Receiving SCPC signals has always been a challenge for the satellite enthusiast. The extreme narrowband nature of the signal has made cheap and easy reception methods marginal and professional reception methods expensive. Universal's SCPC-200 has successfully bridged the gap.

Universal has made the SCPC-200 an attractive and unobtrusive addition to your satellite gear. This well designed, low profile receiver does a terrific job with a minimum of front panel distractions. The layout is clean and easy to use. A set of six round buttons on the left of the front panel does all the tuning and memory save/recall. A clear, easily understood LCD panel in the front center shows at a glance the current signal status: bandwidth, transponder, 2nd IF frequency, 3-digit service ID (user designated), and memory channel. Next to the display panel are three LEDs lined up vertically and used as a tuning aid. The top and bottom LEDs are red and the center one green. When the signal is strongest, only the green one is lit. The last knob is a power/volume control.

The rear panel is equally spare but useful. No 950-1450 MHz splitter is necessary as the SCPC-200 has an "F" fitting to take the signal directly from the LNB and another "F" fitting to feed the signal directly to your satellite receiver. There's a jack for the power supply (which is included), and two RCA jacks: one's for a single line-out (remember, stereo reception of SCPC signals requires two separate SCPC receivers) which can connect directly to your home stereo, and the other jack is an 8 ohm speaker output, the volume of which is controlled by the knob on the front.

Tuning the Universal SCPC-200 couldn't be easier. First, find a satellite (Galaxy 4 is a good place to start), then tune to the polarity of the SCPC channel (the SCPC-200 has a built-in tuner which allows you to watch any channel while listening to channels of the same polarity which have SCPC signals). Now, tune through the frequencies starting at 50.00 on the LCD display.

The first thing you'll notice when you tune in a signal is the crisp, clean audio. Many SCPC signals are uplinked in a compressed audio format and expanded at the downlink receiver. This "companding" is handled internally by the SCPC-200. Wide and narrowband signals are switched via the front panel.

One important feature on the receiver is the calibration of the LNB to track any drift in the local oscillator, a problem which plagued some earlier receivers. To test the stability of this receiver I set it to Minnesota Public Radio in the evening; it was still right on frequency the next morning.

In addition to a thorough instruction manual, Universal includes a complete list of all satellites carrying SCPC services and their frequencies. To get an idea of what you're missing take a look at the center section on pages 42-43 of this issue of *Satellite Times* and consider adding the SCPC-200 to your satellite system. Suggested retail price for the SCPC-200 (RCV 28) is $399.95 plus $9.00 UPS shipping and handling from Grove Enterprises, P.O. Box 98, Brasstown, NC 28902 or call 800-438-8155 in the United States, 704-837-9200 elsewhere. You can fax your order to 704-837-2216 or send it via e-mail to: **order@grove.net**. ST

World Radio Network Schedules

WRN 2- N. American Multi-lingual Service

Galaxy Five (125 deg West) transponder 6-3.820 GHz (TBS) vertical polarization, audio subcarrier 6.2 MHz. Please note that programs listed below with an asterisk (*) are subject to pre-emption without notice. All times Eastern (UTC +5 hours)

0030 -	*WRN Announcements, until....
0255 -	*YLE, Church Service (Sunday only)
0400 -	*WRN Announcements, until....
0600 -	[YLE Radio Finland], News in Finnish
0625 -	YLE, News in Swedish
0630 -	YLE, News in English
0700 -	*WRN Announcements, until....
0800 -	RTE News in Irish
0900 -	Radio Prague in Czech
0927 -	*WRN Announcements, until....
1000 -	YLE, Radio Finland, News in Finnish
1005 -	YLE, Regional News
1030 -	YLE, News in Finnish
1100 -	YLE, News in Swedish
1130 -	YLE, Easy Listening Music and Chat in Finnish
1200 -	*Vatican Radio, news in French, English, Albanian, Slovene, Croatian, Hungarian, Czech, and Slovak
1400 -	*WRN Announcements, until....
1500 -	*Radio Vlaanderen International in Dutch
1530 -	*Radio Netherlands in Dutch
1625 -	*WRN Announcements, until....
1645 -	*YLE, News in French
1700 -	*Polish Radio Warsaw in Polish
1800 -	Radio Budapest in Hungarian
1830 -	YLE Radio Finland, Devotional Music
1855 -	YLE, News in Swedish
1900 -	YLE, News in Finnish
1930 -	YLE, Easy Listening Music and Chat in Finnish
2010 -	YLE, Current Affairs in Finnish
2030 -	YLE, Documentaries in Finnish
2030 -	YLE, New Classical releases in Finnish (Sun)
2130 -	YLE, Easy Listening Music in Finnish
2230 -	YLE, News in Finnish
2300 -	YLE, News in Finnish
2310 -	YLE, Devotional Programming in Finnish
2320 -	YLE, News in Swedish
2323 -	YLE, Programme Information in Finnish
2330 -	ORF Radio Austria International in German

WRN1- European English Service

Astra 1B (19 deg East) transponder 22-11.538 GHz (VH-1) vertical polarization, audio subcarrier 7.38 MHz. WRN is also available on cable and local radio stations. WRN program information can be heard daily at 0125 and 1025 BST. It is also available on VH-1 text pages 222, 223, 224. All times UTC (Central European Time +1 hour)

0000 -	Radio Budapest
0030 -	Radio Netherlands
0127 -	*Earth and Sky* (Daily Science Series)
0130 -	ORF Radio Austria International
0200 -	NPR *All Things Considered* (repeat)
0300 -	CBC *As It Happens* (Tue-Sat) RCI News, and Features (Sun and Mon)
0400 -	Polish Radio Warsaw
0430 -	*BBC Europe Today* (Mon-Fri) Glenn Hauser's *World of Radio* (Sat) UN Radio From New York (Sun)
0500 -	PRI *Market Place* (Tue-Sat) Radio Romania International (Sun) SABC Channel Africa-Johannesburg (Mon)
0530 -	YLE Radio Finland
0600 -	Voice of America World Wide (Mon-Fri) VoA Saturday (Sat) VoA Sunday (Sun)
0700 -	NPR *All Things Considered* (repeat)
0800 -	ABC Radio Australia
0900 -	Polish Radio Warsaw (Mon-Sat) *C-Span Weekly Radio Journal* (Sunday)
0930 -	Radio Canada International (Mon-Fri) UN Radio (Sat)
1000 -	Radio Prague
1030 -	Radio Netherlands
1127 -	*Earth and Sky* (Daily Science Series)
1130 -	SABC Channel Africa-Johannesburg (Mon-Sat) Glenn Hauser's *World of Radio* (Sun)
1200 -	NPR *Morning Edition* (Monday-Friday) NPR *Weekly Edition* (Sat) NPR *Weekly Edition* (rpt) (Sun)
1300 -	NPR *Morning Edition* (Monday-Friday) NPR *Weekend Edition* (Saturday and Sunday)
1400 -	Radio France International
1500 -	Voice of Russia (Mon-Fri) Radio Romania International (Sat) Voice of America-*Communications World* (Sun)
1530 -	KBS Radio Korea International
1600 -	ABC Radio Australia
1700 -	ORF Blue Danube Radio (Monday-Friday) Glenn Hauser's *World of Radio* (Sat) SABC Network Africa (Sun)
1730 -	Radio Austria International
1800 -	RTE *News at Six*
1830 -	Radio Netherlands
1925 -	News in Esperanto from Polish Radio Warsaw
1930 -	YLE Radio Finland
2000 -	RTHK-News from Hong Kong (Mon-Fri) UN Radio from New York or Radio Denmark (alternate Sat)
2015 -	Health Watch (Sat) Radio Romania International (Sun)
2030 -	Radio Vlaanderen International
2100 -	Radio Sweden
2130 -	Polish Radio Warsaw
2200 -	Voice of America *World Report* (Mon-Fri) VoA *Today* (Sat and Sun)
2300 -	PRI *The World* (Mon-Fri) NPR *All Things Considered* (Sat and Sun)

WRN2- European Multi-lingual Service

Eutelsat II-F1 (13 deg East) transponder 25-10.987 GHz (NBC) vertical polarization, audio subcarrier 7.38 MHz. Please note that programs listed below with an asterisk (*) are subject to pre-emption without notice. All times UTC (Central European Time +1 hour)

0309 -	Vatican Radio
0745 -	*WRN1 (NPR and ABC Radio Australia)
0830 -	Vatican Radio (Sun) until 1130
0930 -	Vatican Radio (Mon-Sat) until 1130, except Wed to 1200
1130 -	*WRN1 (SABC Channel Africa) except Wed
1200 -	Radio Studio Delta (Mon-Fri) until 1300
1200 -	*WRN1 (NPR Sat and Sun)
1300 -	Vatican Radio
1530 -	Radio Studio Delta (Mon-Fri)
1530 -	*WRN1 (Sat and Sun Radio Vlaanderen-Brussels and ABC Radio Australia)
1630 -	Vatican Radio
2230 -	Radio Studio Delta (Mon-Fri)
2230 -	*WRN1 (Sat and Sun)
2330 -	*WRN1 (Mon-Fri)

WRN- Asia-Pacific English Service

AsiaSat-2 (100.5 deg East) 4.000 GHz, vertical polarization, MPEG2 DVB, Symbol Rate 28.125 Mbaud, FEC 3/4, Select WRN1 from audio menu. AET-Australian Eastern Time (UTC +11 hours and for Hong Kong +8 hours to UTC).

UTC... AET	
0000...1100 -	YLE Radio Finland (Mon-Fri) UN Radio (Sat) Radio Romania (Sun)
0030...1130 -	ORF Radio Austria International (Mon-Fri) Radio Sweden (Sat) Polish Radio Warsaw (Sun)
0100...1200 -	PRI *The World* (Tue-Sat) NPR *Weekend All Things Considered* (Sun and Mon)
0200...1300 -	RTE Dublin
0300...1400 -	CBC *As It happens* (Tue-Sat)
0300...1400 -	Radio Canada International (Sun and Mon)
0400...1500 -	Polish Radio Warsaw
0430...1530 -	Radio Budapest
0500...1600 -	PRI *Market Place* (Tue-Sat) UN Radio from New York (Sun) UN Radio Romania (Mon)
0530...1630 -	ORF Radio Austria International
0600...1700 -	NPR *All Things Considered* (repeat)
0730...1830 -	Radio Canda International
0800...1900 -	RTE Dublin
1000...2100 -	Radio Prague
1030...2130 -	SABC Channel Africa (Mon-Fri) SABC Network Africa (Sat) Radio Romania International (Sun)
1100...2200 -	RTHK Hong Kong United Nations Radio (Sat) Glenn Hauser's *World of Radio* (Sun)
1130...2230 -	KBS Radio Korea International
1200...2300 -	NPR *Morning Edition* (Monday-Friday) NPR *Weekly Edition* (Sat) NPR *Weekly Edition* (repeat) (Sun)
1300...0000 -	Radio Canada International
1400...0100 -	RTE Dublin
1500...0200 -	Voice of Russia
1530...0230 -	ORF Radio Austria International
1600...0300 -	Radio France International
1700...0400 -	ORF Blue Danube Radio (Tue-Sat) Glenn Hauser's *World of Radio* (Sun) SABC Network Africa (Mon)
1730...0430 -	KBS Radio Korea International
1800...0500 -	RTE Dublin
1830...0530 -	Radio Netherlands
1927...0627 -	*Earth and Sky*
1930...0630 -	YLE Radio Finland
2000...0700 -	RTHK Hong Kong (Tue-Sat) Radio Romania International (Sun) UN Radio and *Health Watch* (Mon)
2030...0730 -	Radio Vlaanderen International
2100...0800 -	RTE Dublin
2230...0930 -	ORF Radio Austria International
2300...1000 -	Radio Netherlands
2357...1057 -	*Earth and Sky* (Daily Science Series)

WRN- Middle East and Africa English Service

Intelsat 707 (1 deg West) 3.9115 GHz, right-hand circular-polarization, Symbol Rate 8.022 Mbaud, FEC 3/4, MPEG2 Audio Stream. CAT-Central African Time (UTC +2 hours).

UTC... CAT

Next four hours can be heard in South Africa on SAfm 104-107

2300...0100 -	Radio Netherlands
2357...0157 -	*Earth and Sky* (Daily Science Series)
0000...0200 -	YLE Radio Finland (Mon-Fri) UN Radio (Sat) Radio Romania (Sun)
0030...0230 -	ORF Radio Austria International (Mon-Fri) Radio Sweden (Sat) Polish Radio Warsaw (Sun)
0100...0300 -	PRI The World (Tue-Sat) NPR *Weekend All Things Considered* (Sun and Mon)
0200...0400 -	RTE Dublin
0300...0500 -	CBC *As It Happens* (Tue-Sat) Radio Canada International (Sun and Mon)
0400...0600 -	Polish Radio Warsaw
0430...0630 -	Radio Budapest
0500...0700 -	PRI *Market Place* (Tue-Sat) UN Radio from New York (Sun) UN Radio Romania (Mon)
0530...0730 -	ORF Radio Austria International
0600...0800 -	NPR *All Things Considered* (repeat)
0730...0930 -	Radio Canada International
0800...1000 -	RTE Dublin
1000...1200 -	Radio Prague
1030...1230 -	SABC Channel Africa (Mon-Fri) SABC Network Africa (Sat) Radio Romania International (Sun)
1100...1300 -	RTHK Hong Kong (Mon-Fri) United Nations Radio (Sat) Glenn Hauser's *World of Radio* (Sun)
1130...1330 -	KBS Radio Korea International
1200...1400 -	NPR *Morning Edition* (Monday-Friday) NPR *Weekly Edition* (Sat) NPR *Weekly Edition* (repeat) (Sun)
1300...1500 -	Radio Canada International
1400...1600 -	RTE Dublin
1500...1700 -	Voice of Russia
1530...1730 -	ORF Radio Austria International
1600...1800 -	Radio France International
1700...1900 -	ORF Blue Danube Radio (Tue-Sat) Glenn Hauser's *World of Radio* (Sun) SABC Network Africa (Mon)
1730...1930 -	KBS Radio Korea International
1800...2000 -	RTE Dublin
1830...2030 -	Radio Netherlands
1927...2127 -	*Earth and Sky*
1930...2130 -	YLE Radio Finland
2000...2200 -	RTHK Hong Kong (Mon-Fri) Radio Romania International (Sat) UN Radio and *Health Watch* (Sun)
2030...2230 -	Radio Vlaanderen International
2100...2300 -	RTE Dublin
2230...0030 -	ORF Radio Austria International

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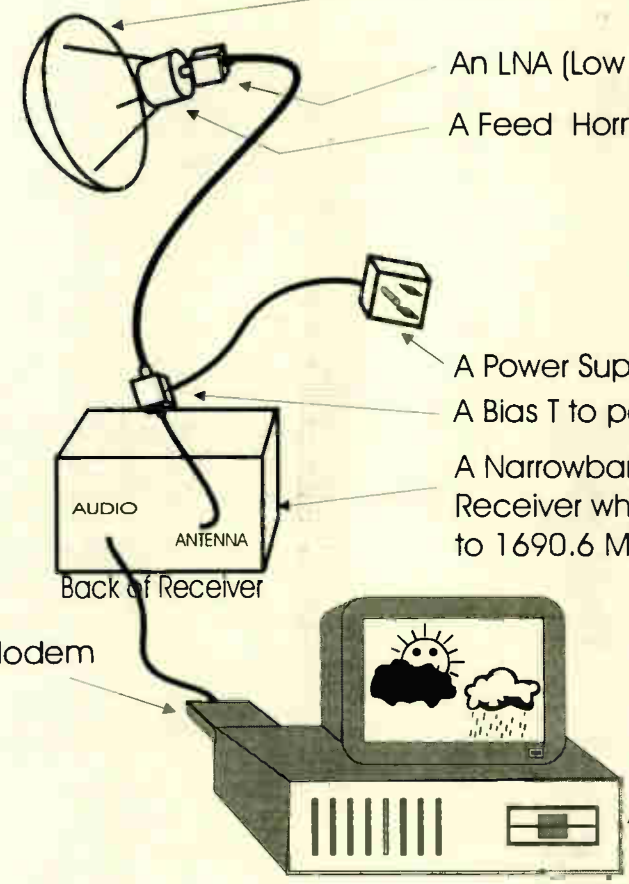

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SPACE GLOSSARY

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 DF 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.

UPLINK

By Bob Grove, Publisher
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Things Aren't Really All That Bad

The reports of my death have been greatly exaggerated.
—Mark Twain

A recent editorial I wrote for our sister magazine, *Monitoring Times*, seems to have hit a resonant nerve in our fragile economy. After its publication, we heard over and over from throughout the industry that we were going belly up! Nothing could be farther from the truth, but I really was appreciative of the concern. First, I'd like to reassure everyone we are just fine, thank you! And next I'd like to share some of those thoughts which appeared in *MT* with you this month.

It all started by my mentioning that we, like our colleagues is the hobby radio industry, were feeling a substanial decrease in sales over the last year. I guess my open admission was an error in judgement in a community of vendors where no one wants to admit publicly that his sales are down! My uninhibited honesty seemed to portend gloom and doom. The fact of the matter is, however, that the climate now seems to be getting better—slowly, but surely. And the holiday season is just ahead.

So what caused the original downturn? Some dealers steadfastly hang on to the mistaken belief that the low sunspot count has caused sagging ham sales, but the No-Code Technician class licensee—by far the most rapidly-growing ham class—doesn't use spectrum which is affected by sunspots, and even the No-Code applications are decreasing.

In-fighting among the ham oligarchy, increasingly high cost of equipment, tasteless and inane content of amateur communications, the perpetuation of obsolete Morse code requirements for ham upgrading, virtual abandonment of ham demonstrations at public events, ready availability of alternative communications, high-tech saturation of the consumer marketplace, and the spectacular growth of the worldwide, inexpensive, interference-free, highly-visual, no-test Internet are more likely reasons for the moribund state of amateur radio. It is no longer a "gee whiz" draw to today's youth.

Scanner sales, too, have been severely truncated by the loss of cellular frequency coverage, the elusiveness of trunked police radio systems, and the non-receivability of digitized communications.

But perhaps comparing this year's scanner sales with last year's is unfair. Over the previous two years we saw a buying frenzy as scanning enthusiasts scrambled to purchase those few remaining cellular-capable radios, now contraband; we may well be feeling the backlash of that scanner blitz—a scanner glut. But I suspect that we will see a resurgence in scanner sales very soon as a major manufacturer announces a new breed of scanner which overcomes one obstruction to listening.

A drop in subscriptions, which has been felt by all hobby publishers, has leveled as well—at least at *MT* and *ST*—indicating that folks still depend upon respected print media for information. Still, the subscription downturn has been accompanied by an increasing number of bankruptcies, the discontinuation of several of Wayne Green's and *CQ*'s publications, the demise of the oldest and largest scanner club (RCMA), and so on.

Perhaps we are unusual in that we pay our writers what we promise, and on time. This has created a tenaciously loyal stable of writers—the best in the business—and we're proud of that. As a result, the communications industry knows that *MT and ST* are the driving forces in the monitoring community. Good products succeed and bad products fail after a few words from our staff of experts.

While there has been an undeniable migration of active minds to the Internet, the rate has been more linear than logarithmic—they're joining fast, but not all *that* fast, and they're learning that while there is a lot of free information on the net, the freebies are frequently teasers, requiring the inquiree to spend money for the whole package.

Few publishers or dealers will review their actual business successes or failures. It's a matter of ego, not strategy. But what harm can come from an honest admission that business is down 16 percent from last year? Ours is. Or that subscriptions slumped 15 percent over the same time period? Ours did. After all, Fortune 500 companies post earnings and losses all the time.

Fortunately, the Grove staff is highly diversified; if one aspect of the business is on the downgrade, we reassign our people into other, more productive areas. The result is that we have a powerful, dedicated work force with cross-trained skills. When we decided to explore Internet marketing, we didn't need to hire anyone, we simply moved our dynamic team laterally into the new slot and they're having the time of their lives! It's challenging, gratifying, and profitable.

Many of our advertisers are experiencing the benefits of our Internet web page services; if you would like to learn how you can profit from this marvelous marketing medium, call Melody on our toll-free line, (800) 438-8155.

Diversity, the key to survival, is a hallmark of Grove Enterprises. We are experiencing an unprecedented growth in satellite-dependent communications, and *Satellite Times* will continue to grow as well.

World Radio History