Satellite Times®

A publication of Grove Enterprises

$3.50 US
$5.75 CAN

Volume 2, Number 5 May/June 1996

Monitoring The Big Ride

Swagur
ENTERPRISES

Swagur-Horn-C
A feed horn for circularly polarized signals. It can be ordered for 1691,1535 or 1425 MHz. Has an excellent 26 db return loss. Use with a 3 foot or larger dish.

Swagur-T-A
Bias T's with and without amplification to feed voltages to your LNA out at the antenna.

Swagur-AMP-L
Minimum of 35 db gain from 1 to 2 GHz. Has a noise figure of less than 1 db. Male N connector on input with a female N connector on the output. Case measures 2.5 x 2.5 x 1.6 inches high.

PRODUCT PRICE LIST:

Swagursat	$220.00
SuperSwagursat	$295.00
Swagur-Amp-L	$225.00
Bias T	$80.00
Bias T with amplifier	$125.00
Swagur-Amp-V	$195.00
Swagur-Horn-C	$120.00
Swagur-LA	$130.00
Swagur-T-V (bias T for 137 MHz)	$75.00
OFS Weather-FAX	$445.00

S&H $8.75 ($25.00 foreign)

Swagursat
Designed for owners of ICOM R7000 & R7100 receivers. It produces superb weather pictures.

SuperSwagurSat
Identical to the Swagursat except it also receives 30 KHz audio like that found on the Inmarsat satellite.

Swagur-LA
Our 1 to 2 GHz line amplifier can be placed in the coaxial line to provide further amplification.

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

Satellite Times

Cover Story

Cover: *The cover photo for this issue of Satellite Times is the launch of STS-76 during the early morning hours of March 21, 1996 from pad 39B at the Kennedy Space Center in Florida. (NASA Photo)*

Monitoring the Big Ride

By Bob Grove

It has been 14 years since Bob Grove published the first comprehensive list of active NASA frequencies in the inaugural issue of *Monitoring Times* magazine. That list became the backbone of listeners' lists around the globe. Now it's time for an update. Bob's story and his exclusive space shuttle mission frequency guide starts on page 10.

Vol. 2, No. 5

CONTENTS

May/June 1996

Mission Control II

By Haskell Moore

NASA has a new Mission Control Center at the Johnson Space Center in Houston. Author Haskell Moore takes an inside look at this new facility and some of JSC's scanner frequencies starting on page 16.

Changes and Challenges

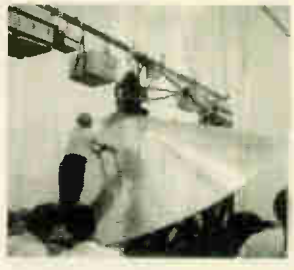
By Philip Chien

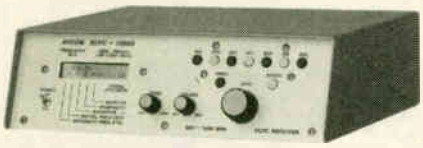
The International Space Station program promises a new era of space exploration and space-based scientific research. Phil Chien looks at some of the changes and challenges on the horizon for the proposed multinational space station. Story starts on page 19.

Dropping in on the Planets

By Jeanne E. Prevett

The effort to drop the Galileo probe into the atmosphere of Jupiter really began many years ago. It started with experiments in which payloads were released from high soaring balloons. The complete story on this historic program starts on page 22.





Test driving the SCPC-1000D receiver

Long time commercial satellite receiver manufacturer, AVCOM of Virginia has now joined the battle of consumer grade SCPC receivers with its new entry — the SCPC-1000D. In the *Satellite Times Tests* column this issue, *ST* staffer Ken Reitz reviews this new entrant in the competitive SCPC audio market

DEPARTMENTS

ST

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

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

Subscription Rates: $19.95 in US and $28.50 in Canada. Call for air mail rates for other countries.

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

DOWNLINK

By Larry Van Horn
Managing Editor

A Bad Start to a New Year

I was really hoping that 1996 would be a better year for the satellite industry, but it looks as if we are off to a rocky start if the first three months are any indication.

On February 14, the Intelsat 708 satellite was lost in a launch accident in China. Within seconds of the launch the first stage inertial platform failed, the vehicle veered off-course and crashed close to the launch pad. The launch vehicle was basically the Chinese CZ-3A which had flown successfully twice in 1994.

The Russians lost the Raduga 33 military communications satellite on February 19. After launch by the Proton launch vehicle, the fourth stage ignited to place the satellite into a geosynchronous transfer orbit. At about the time that the fourth stage should have re-ignited to raise the orbit to geosynchronous orbit, it exploded into about 200 fragments. The onboard sequencer separated the Raduga satellite after the explosion.

STS-75 had its problems in February with the now infamous Tethered Satellite. During deployment, the tether broke and the satellite was unintentionally launched into orbit as a separate object. This was the second failure in four years for this $400 million program.

March hasn't been much better. *Space News* reported in their March 11 issue partial failures aboard four large commercial satellites launched in recent months. The insurance claims to the owners could total over $100 million. The failures involved three HS-601 satellites built by Hughes Space and Communications, and a series 7000 satellite built by Lockheed Martin Astro Space. The satellites with problems included: Japan's JCSAT 3, the AMSC-1 satellite, Indonesia's Palapa C-1, and Asiasat 3.

After the final main-engine maneuver on March 14, the Galileo spacecraft performed a series of engineering activities, including checkout of the camera and the scan platform, followed by a final repetition of the of the "hammering" procedure — an attempt to free the stuck high-gain antenna. The camera and scan platform are operating nominally, but, as expected, the antenna remains stuck.

The Galileo project team also analyzed an unexpected tank pressure situation in spacecraft's propulsion system that was observed after the March 14 maneuver. The problem of possible internal leakage is located in the helium pressurization system and is somewhat similar to a problem observed last July. Tank pressures can be controlled by maintaining appropriate temperatures with electric heaters in the system — a procedure which requires careful management of all spacecraft electric power loads. This strategy has been applied since July. Telemetry now suggests that at least one check valve is closed. All tank pressures are within acceptable limits.

Finally, Telesat Canada's Anik E1 satellite lost more than 50 percent of its capacity when one of two solar panels became disconnected from the spacecraft. Telesat officials told *Satellite Times* that the failure occurred on March 26 at 3:47 p.m. EST. While the company indicated that this is both an extremely unique and unusual occurrence, particularly for a satellite that has been in operation for over four years, the initial prognosis is that a complete recovery from the failure and restoration of the satellite to full power is unlikely.

The impact of the power loss on the satellite has been to reduce its capacity from 24 C-band RF channels to 10. The 32 Ku-band channels have been reduced to 10 RF channels as well. The *Satellite Times* SSG sections have been updated to reflect the latest transponder changes made on both the Anik E1 and Anik E2 satellites.

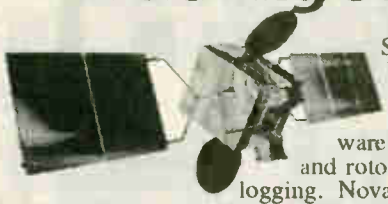
Telesat's remote telephony services, private network communications and high-priority data services were restored about six hours after the breakdown according to Telesat officials. The failure temporarily cut off a broad range of services utilizing the Anik E1 and has several customers worried about the use of only two satellites in Canada.

Anik E1 experienced a loss of attitude control January 20, 1994, after an electromagnetic storm sent it spinning out of control. It was determined that the primary momentum wheel of the spacecraft was the source of the problem. It took eight hours to restore pointing control of the spacecraft. The same day, Anik E2 suffered a similar failure, but it took almost six months to restore service on that satellite. There was also a minor service disruption on the Anik E1 last November.

The *Satellite Times* staff will continue to monitor these and other major developments for future issues of the magazine or inclusion on our worldwide web home page. Late breaking news can now be found on our home page at URL address: **http://www.grove.net/hmpgst.html**. If you have any late breaking news for the magazine or home pages you can send it to the *Satellite Times* web editor — Gayle Van Horn at: **swbcsked@grove.net**.

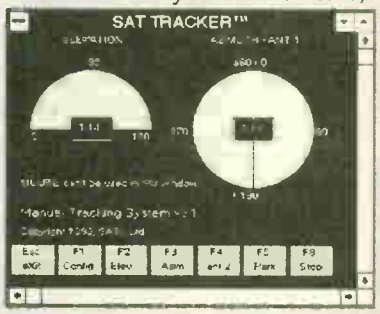
Now it's time to turn the page and launch into this edition of satellite news and information from your space magazine of record — *Satellite Times*.

SAT TRACKER™ & Nova the best Satellite Tracking solution!!



SAT TRACKER™, Nova and Frequency Manager have been combined to offer a complete hardware and software combination for your station and rotor control systems as well as logging. Nova provides full position information (azimuth, elevation, range, height, frequency, mode, etc.) in real time. Data is automatically updated approximately 5 times per second on a 33 MHz '486. All functions are accessed via the mouse: you may operate Nova and SAT TRACKER™ almost entirely without touching the keyboard.

Nova includes 16 maps in 2 sizes, for a total of 32 maps. Mercator projection (rectangular) with zoom view of any continent, whole-Earth central longitude may be set for Europe, North America, or the Pacific; country name labels on/off; up-to-date political boundaries; easy-to-see satellite footprints; up to 6 satellites plotted simultaneously. Orthographic (view from space) projection with full Earth positioning and manipulation, ground tracks, foot prints, and real-time orbit shapes; up to 6 satellites visible. Sky temperature (3 bands: 50, 136, and 400 MHz) with current satellite and antenna positions. Radar map showing all visible satellites and antenna position. Grid square maps centered anywhere in the world, with point-and-click bearing/distance display. AutoTracking via the popular SASI Sat Tracker, Kansas City Tracker, and AEA ST-1 hardware interfaces. Nova also includes full control of frequency (with or without real-time Doppler compensation) and mode of all modern satellite transceivers: ICOM twins, '970, '820, and others. Yaesu FT-736, Kenwood TS-790. Frequency adjustment is made by on-screen knobs, buttons, sliders, or the keyboard. TX and RX may be adjusted separately or linked (normal or inverted). Frequency control is through a user-selectable serial port via Frequency Manager or the radio manufactures interface (not required with Frequency Manager). 370 memories are available for your local repeaters, etc., plus 8 individual memories for each satellite.



Additional features of Nova:

- Built-in logging (separate logs for each satellite if desired)
- Super-easy Keplerian element updating (AMSAT or NASA 2-line)
- Real horizon modeling for user-defined footprint display
- Satellite editor with drag-and-drop arrangement of satellites and groups (20 groups of up to 30 satellites/group)
- Up to 2,000 satellites in database
- Fast rise-set AOS/LOS calculations
- Multiple-satellites/one observer
- One satellite/two observers with mutual window information
- Multiple Satellites/Multiple observers in real time
- Satellite-to-satellite (+/- one or two observers) co-visibility
- Full eclipse predictions (orbit-by-orbit and full day summaries)
- Satellite Script, a time-ordered sequence of multiple passes of multiple satellites; printed listing or real-time antenna control
- Daily and Monthly Moon conditions
- Customized grid square maps for any location, with point-and-click bearing/distance calculations (maps may be laser-printed)
- 2,000-city + DXCC country + EME directory databases + Buckmaster & QRZ! CD-ROM lookup
- Includes three TSR programs for background tracking/tuning (ICOM, Yaesu, Kenwood)

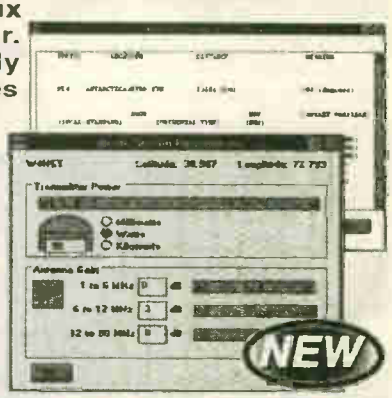
System requirements:

The combination of SAT TRACKER™ and Nova require only 420KB of conventional memory. Requires a math coprocessor, VGA graphics, mouse, and about 2 MB of hard disk space. SAT TRACKER™ and Nova run as DOS or Windows 95. **Call your Dealer for $$$$.**

SKYCOM 2.0

Skywave Propagation Prediction Software for Windows 3.1/Windows 95

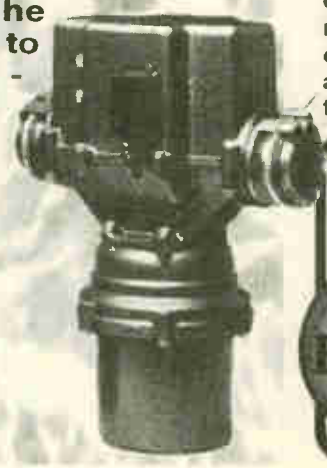
Pick a location from SKYCOM 2.0's database of over 400 call sign prefixes. Tell SKYCOM 2.0 where you are, your transmitter power, your antenna gain. Input the current solar flux or sunspot number. SKYCOM 2.0 instantly predicts and evaluates the MUFs expected for each hour of the day, calculates total path loss, and tells you the proper beam headings. SKYCOM is simple enough for the newest novice yet sophisticated enough to enable advanced users to fine tune parameters.

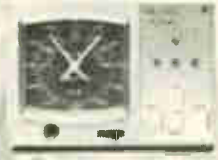


EMOTO

EV700D5X

Satellites pass through space in three dimensions and the EV700D5X is designed to track satellites. This AZ - EL Rotator is fully computer compatible using Sat Tracker Software or other user programs. EV700D5X is the strongest AZ-EL system available for todays amateur market.





CONTACT YOUR FAVORITE DEALER

Electronic Distributors Inc.
325 Mill Street
Vienna, VA. 22180
Ph: (703) 938 8105
FAX: (703) 938 6911

Exclusive North and South American Distributors

SATELLITE MONITOR

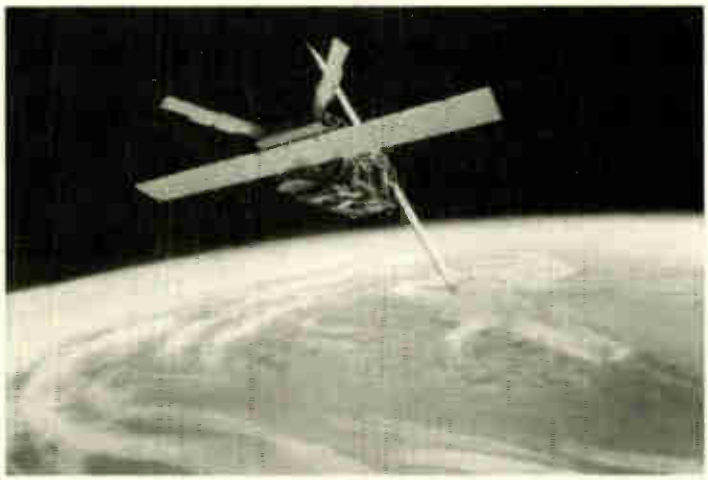
By Wayne Mishler, KG5BI

Have scientists found the 'holy grail' of ozone research?

There you are, staring with red eyes at Saturday morning cartoons on satellite TV when you know you should be out mowing the lawn. A hypnotized grin droops from your ears like a heavy clothes line. You sink lower into your easy chair and reach for last night's popcorn. Then it happens.

The TV starts beeping. You drop the popcorn, but it doesn't help. The beeping drills into your head. With imaginary laundry on your chin, you push the popcorn bowl away. No relief. Then a message scrolls across your screen and suddenly it all becomes clear. Whew! It wasn't a junk food alarm. The National Weather Service just issued a sunburn warning. A stretch of the imagination? Maybe not, says the European Space Agency.

There's a satellite zooming around up there sending to Earth images of the ozone layer which of course screens out harmful rays of the Sun. The satellite is called ERS-2 and its data helps scientists map global ozone and nitrogen dioxide. It keeps an electronic eye on the ozone hole over the Antarctic. And yes, weather forecasters are studying the feasibility of issuing sunburn warnings on the basis of the satellite's data.



Artist rendition of the ERS-1 satellites above the earth. (Photo courtesy of Matra Marconi Space)

Safeguarding the atmosphere

ERS-2 has been in orbit for about a year. It succeeds ERS-1 which observed the Earth's oceans and terrain for nearly half a decade, using radar and infrared radiation. The ozone monitoring experiment aboard ERS-2 is called GOME (Global Ozone Monitoring Experiment). It is a relatively new addition to the satellite's mission. It can chart the world's ozone every three days. And it has an important role in safeguarding the Earth's atmosphere.

GOME does its work by identifying trace gases in the atmosphere that affect ozone. This work has just begun, according to John Burrows, a British atmospheric chemist who leads the team of scientists deciphering GOME data. "We believe we have (identified) bromine monoxide, a notorious destroyer of ozone," says Burrows. "And we now have high hopes of attaining the holy grail of spaceborne ozone research."

This 'holy grail' is the scientific ability to distinguish harmful ozone in the lower atmosphere from beneficial ozone in the stratosphere, Burrows adds.

Searching for answers

The search for and vigil against substances that destroy beneficial ozone is of course not new. As far back as 1970 scientists were saying that certain oxides could interact with sunlight and degrade ozone. We all remember the warnings about manmade chlorofluorocarbons (CFCs). There was a worldwide drive to reduce the production and use of CFCs. High-altitude polar clouds and products of volcanic eruptions were known to damage the ozone layer. But these theories did not fully explain ozone depletion over Antarctica and more recently over northern Europe.

The man accredited as the godfather of GOME, Paul Crutzen, who recently received the Nobel Prize for alerting the world to practices and conditions threatening the ozone layer, proclaims the role of GOME in quantifying ozone destruction. "The sooner we replace chemical conjecture by precise measurements from space, the better our chances of minimizing manmade damage," says Crutzen.

Chemistry is not an easy subject. GOME's job of doing chemistry from space is even tougher. For example, when GOME looks down from orbit through the Earth's atmosphere, only about one in every million molecules in its line of sight is ozone. Agents that attack ozone are even scarcer – less than one part per billion. But that doesn't keep them from doing damage. They are effective in attacking ozone because they act like catalysts in the ozone-destruction process.

A scientific eye

GOME does not see as we do. It sees small traces through a process that scientists call "differential absorption spectroscopy." The name is more complex than the idea.

As seen from space, the Earth's surface shines like that of the moon, by reflecting sunlight. Through "spectroscopy", GOME sends Earth's reflected light through a prism and breaks it down into a rainbow spectrum. Each segment of the rainbow's colors is then subdivided further. Silicon light detectors break down each segment into 1024 smaller wavelengths.

Some of the reflected light is absorbed by trace gases, including ozone. GOME compares Earthshine with direct Sun rays, and the difference tells scientists which gases were present to cause the "differential." This is how GOME "sees" and measures trace gases in the atmosphere.

Scientists use many instruments to detect ozone and other ingredients of the atmosphere. Measurements taken from

ground stations, aircraft, and balloons are more accurate than those taken from space. But they are limited to places and times. Long-term global observations like those from GOME help to reveal how the atmosphere works as a chemical system, and to distinguish natural changes from manmade.

Tethered-satellite experiment not a total loss

Had it worked, it might have answered several important questions of space exploration. Actually, up until the time at which the tether connecting the shuttle Columbia to a satellite snapped, it was working. The system was generating an electric voltage under the influence of the Earth's magnetic field as it was supposed to do in that February 26 experiment.

Even though the satellite weighed a half-ton on earth and the tether was just a tenth of an inch in diameter, engineers had calculated that there would be no more than a dozen pounds of stress on the tether at any given moment.

The tether was constructed in several layers. A Nomex core was surrounded by a layer of copper. The copper was surrounded by a layer of Kevlar for strength. And a Nomex braid formed the outer layer. So it should not have broken easily.

The concept of the tethered satellite experiment is fascinating. There were seven mission objectives.

1. Determine how much electrical power could be produced by the tether as it interacts with the Earth's ionosphere and magnetic and electrical fields.
2. Explain how an tethered satellite makes contact with the ionospheric plasma and how an electrical current can be extracted from it.
3. Demonstrate electrical power generation as a space-based power source.
4. Verify tether control and dynamics at various deployment ranges (1.2 miles/2 kilometers to 12.8 miles/20.7 kilometers.)
5. Demonstrate how neutral gas affects the satellite's plasma sheath, including its affect on electrical current production.
6. Demonstrate how neutral electrical current is conducted through near-Earth plasma.
7. Learn to control tether motion by collecting data about how current flow (through the tether) produces force that can move a spacecraft.

Artist rendition of the Tethered Satellite System deployed from the space shuttle. (Photo courtesy of NASA)

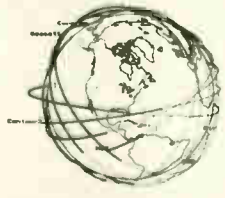
As you can see from the agenda above, electrical power generation was central to the overall tethered satellite experiment. The shuttle, the tether (containing a copper electrical conductor), and the satellite worked together like a dynamo in a power station.

You learned in high school physics that movement of a conductor (wire) in a magnetic field induces an electrical voltage in the wire. The tether was in essence a 12-mile-long wire suspended in the Earth's spinning magnetic field.

In a February 22 interview, Dr. Steven Mende of Lockheed Martin explained it this way. "Since the tether will be cutting the Earth's magnetic field, a potential will be developed across the tether, from one end to the other, and it will act somewhat like a generator. The positive pole will be at the satellite and the negative pole at the shuttle. Because of the length of the tether and the velocity at which it travels through space, it should produce about 5,000 volts."

This suggests some interesting possibilities for the future exploration of space. Power generation is a prerequisite for functioning on the high frontier. Solar arrays are bulky and fragile, and fuel cells need constant replenishment to continue operation. But tethers might provide an alternative means of tapping the kinetic energy of orbital motion.

A bigger question is this: Can that energy by captured and used? In part, this depends on how well a return circuit can be established from one end of the tether to the other. A battery produces voltage, but there can be no current flow and therefore no work done until a return



circuit is provided between the negative and positive poles of the battery.

"The return circuit in the case of the shuttle will be the amount of current the space environment can pass (between) the satellite and the shuttle. That is a function of the resistivity of space," says Mende. "What we're really doing is measuring the extent to which the shuttle or the satellite make contact with the space environment."

NASA reported "a powerful electric current" being generated at the time the tether snapped.

Scientists discover unexplained phenomena above thunderstorms

The next time you see lightning in a distant thunderstorm, watch the sky above the thunderhead. You may see a recently discovered phenomenon that scientists call "sprites" – mystic lights that shoot skyward when lightning flashes below.

NASA has funded a team of scientists to determine what sprites are, how they work, what effect they have on the Earth and its atmosphere, and whether or not they are a threat to spacecraft or aircraft.

"We may discover they are an important part of the global electrical circuit," says meteorologist Walter Lyons, who is working with 18 other scientists in the study. With their NASA grant money, they set up a high-tech outpost on Yucca Ridge near Fort Collins, Colorado, and have been video-taping the light shows going on over thunderstorms in the Rocky Mountains. There seem to be several varieties of sprites distinguished by color and behavior. They apparently are triggered by lightning, and flash upward 60 miles or so into the ionosphere.

"Just as static on your radio is produced by lightning, these are optically produced by lightning," says Lyons.

The discovery of sprites in 1989 has raised many questions but few answers. What affect do they have on communications and computers aboard aircraft and spacecraft? How do they affect the chemistry of the atmosphere? They were discovered by a University of Minnesota professor who filmed a distant thunderstorm and captured a strange image resembling a shimmering jellyfish or flowerpot trailing tendrils of light. He showed the video to Lyons who initiated the study.

NASA is curently studying the origin and effects of "sprites"—those recently discovered mystic lights that shoot skyward when lightning flashes below, shown here in very low resolution photos.

"If they do have a significant affect on the chemical processes in the stratosphere, we must understand them or we won't understand the impact they will have on global change or the next generation of aircraft which will operate in the stratosphere," says Lyons.

PanAmSat launches fourth satellite

PanAmSat's fourth satellite went into operation in February. It offers a wide range of broadcast and telecommunications services for customers in the Americas, Europe and Africa. And it will bring direct-to-home television services to Latin America later this year.

Initially broadcasters using the satellite include Discovery, ESPN, Televisa, Turner International, and Viacom International. At least 18 other broadcasters were expected to sign on this Spring. They will include Artear, Paraguay, Caracol, China Central Television, Cinemax, Country Music Television, HBO Ole, ImpSat, Liberty, NBC, SiTV, the Sony Channel, 20th Century Fox, TVN, TV-5, Universidad Catolica, and Warner Brothers Television. The Latin American DTH services will be offered jointly by Globo Organization, Grupo Televisa S.A., The News Corporation Ltd., and Tele-Communications International Inc.

The new satellite, PAS-3, is a Hughes HS 601 spacecraft with 16 Ku-band and 16 C-band transponders and is located at 43 degrees West.

Lockheed preparing to test military satellites prior to launch

Lockheed Martin Missiles & Space, based at Sunnyvale, Calif., is gearing up to test military satellites on the ground by simulating conditions in space. The company has received its first shipment of high-tech ground test equipment for the Defense Satellite Communications System (DSCS). This system was used in Desert Storm and is currently the primary communications link for U.S. forces in Bosnia. Installation of the test equipment precedes the June arrival in Sunnyvale of DSCS satellite (B-13).

A "radio frequency hat" has already arrived. A box-like structure with one side open, it sits over the DSCS satellite. The hat's interior is lined with a material that absorbs radio frequencies. It allows the spacecraft's antennas to radiate normally as they would in a free space environment. The hat can simulate a 22,000-mile link with Earth stations, and enable engineers to analyze antenna operation on both uplink and downlink modes.

"Most tests done outside the thermal vacuum chamber will take place in the RF hat," says Lockheed DSCS program manager Wilson Kinkead.

Arrival and installation of the hat is an important part of the overall process of transforming Lockheed's Sunnyvale Milstar building into the new home for both Milstar and DSCS. The two programs will exist as complementary systems under Lockheed's MILSATCOM contract with the Air Force. B-13 will undergo thermal chamber and acoustic testing at Sunnyvale prior to its launch later this year aboard a Lockheed Atlas II booster. It will join nine other DSCS satellites in geosynchronous orbit.

PanAmSat preparing for summer Olympics

With the Olympics just months away, PanAmSat has signed more than $2 million in contracts for satellite-based broadcast services during the summer Olympic Games. Broadcasters from Brazil, Chile, Indonesia, Mexico, The Philippines and other nations will cover the three-week-long competition in Atlanta, Ga., via PanAmSat's satellite and teleport services.

PanAmSat will operate a 24-hour facility in Atlanta to provide rooftop transmission, playback and editing services, and dedicated fiber optic links to the company's teleport facility in Ellenwood, Ga. This facility provides direct transmissions to the PAS-1 and PAS-3 satellites. In addition, Ellenwood is linked to PanAmSat's teleport in Sylmar, Calif., which accesses the PAS-2 satellite.

And finally ...

DIRECTV says there will be no shortage of Major League Baseball games for subscribers who sign up for its new professional sports package entitled "MLB Extra Innings."

The package includes up to 1,000 Major League Baseball out-of-market regular-season games beginning March 31. It is being offered at a discounted price of $119 to fans who subscribe by April 15, according to a company report. Subscribers must purchase a DSS system which includes an 18-inch satellite dish which receives 175 channels.

The service is being marketed in conjunction with ESPN, which controls out-of-market rights in a special arrangement with Major League Baseball.

This is the most recent sports package offered by DIRECTV. Other packages include NBA League Pass, which features more than 800 professional basketball games each season, ESPN Full Court, an out-of-market college basketball package covering 425 games nationwide, NHL Center Ice, a collection of more than 500 professional hockey games, and NFL Sunday Ticket with 13 professional football games each Sunday during the regular season.

DIRECTV also offers services for college football fans, in their ESPN/ABC Sports College Football package of 3 to 5 games each Saturday during regular season play. More than 18 regional sports networks are available through Sports Choice, which features every Prime Sports and Sportschannel network. Subscribers also receive the Madison Square Garden Network, Newsport, The Golf Channel, Classic Sports Network, Speedvision Network, and Outdoor Life.

Better stock up on popcorn.

Monitoring the Big Ride

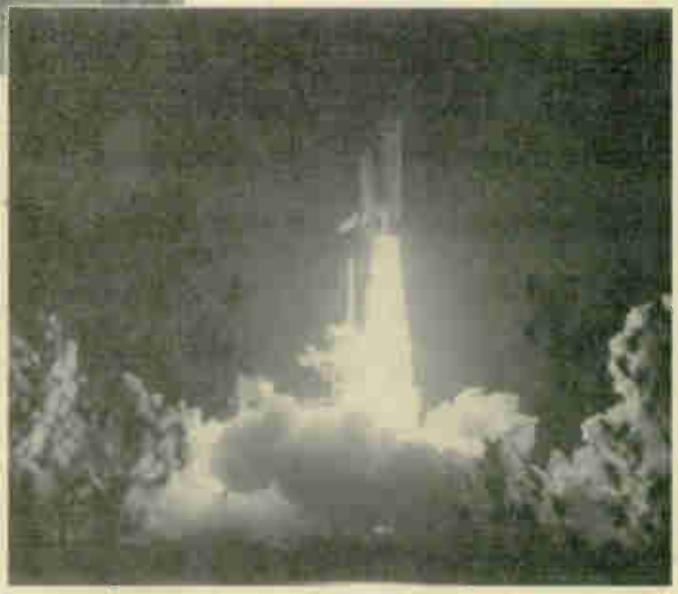
By Bob Grove
Publisher of
Satellite Times *magazine*

March 21, 1996, was a crisp spring day on Florida's Gold Coast. The sun shone brilliantly from a blue sky, a beacon illuminating the sleek spacecraft waiting impatiently within an ungainly hardware assembly on historical Launch Complex 39, site of the historical Apollo lunar program, now home to the space shuttle.

It had been some 14 years since I published the first comprehensive list of active NASA frequencies in the inaugural issue of *Monitoring Times*, a list which is still the backbone of listeners' lists around the globe. It was definitely time for an update!

My monitoring position in a Cocoa Beach motel, a few miles downrange, was

Early in the morning, as the nation slept, a stalwart conclave of scientists, technicians, space buffs, and journalists watched with awe as thunder erupted once again from Launch Pad 39B. A sleek spire of space-age technology rose majestically on a brilliant tongue of flame which turned night into daylight, saluting Man's dream of adventure, and honoring the heroes who went before.



fully outfitted. Signals would be captured by two experimental, portable antennas; the first was a frequency-agile ground plane, and the second a four-element, 30-2000 MHz, log periodic V antenna (LPVA), targeted on Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS).

Ready to receive the signals were an ICOM R7100 receiver upgraded with a Grove SDU-100 spectrum display unit, and a Radio Shack PRO-2006 fully loaded with 400 previously-reported discrete frequencies. I wasn't disappointed; upon connecting the antennas, the receivers came alive and, within minutes, I had verified dozens of active frequencies throughout the space complex. The antennas definitely worked!

After several hours of monitoring and logging, I headed for the Cape, a Radio Shack PRO-43 handheld scanner on my belt, to begin my tour of the space complex with fellow journalists of the press corps.

"Space Center communications come in loud and clear when you're standing next to the Shuttle," quips Grove at right. Below, he is shown targeting the launch complex with the ultra-wideband LPVA antenna mounted on a down-range motel balcony. In the foggy distance can be seen various ramps and buildings in the complex.

Things are different now

The halcyon years of America's Man in Space Program are past. As I arrived in the Public Affairs Office (PAO), a press conference was being conducted by NASA Administrator Daniel Golden; his outlook wasn't encouraging.

Funds have been cut dramatically from the space program; much of the once-glistening facility is in need of repair; a takeover of the launch operations by commercial interests seems certain. Even the PAO is augmented by a legion of some 100 volunteers, retirees of the legend called NASA. The vision may be blurred, but the deep feelings shared by these proud veterans are still very much alive.

As I climbed into the van, my mind drifted back nearly three decades to my first visit to the Cape. I was invited to a special VIP tour of Launch Complex 39 and the Vertical (now "Vehicle") Assembly Building (VAB), then occupied by a giant Apollo spacecraft which was being readied for its history-making moon mission. Armstrong, Aldrin and Collins would be suited up nearby, adrenalin rushing, as they anticipated the epoch adventure awaiting them.

The image then harshly changed to that of the Challenger disaster, a shattered dream, where seven of our finest lost their lives. It was a setback from which the U.S. space program would never fully recover.

My daydreaming was interrupted by the scanner on my belt alerting me to activity on the launch pad. As my van approached the fixed service structure (FSS), the giant assembly shone in the morning sun. Soon the rotating service structure (RSS) which cradles the shuttle began its laborious, plodding rollaway, revealing within the gleaming white spaceship — Atlantis.

Listening In

Mornings were favored times for monitoring; radio maintenance checks kept the airwaves busy, revealing active frequencies and nets. Most communications are in the simplex modes; repeaters are rare at the Cape. The majority of communications are short range, most often between a base station and associated mobiles and handie-talkies throughout the complex. There is some administrative scrambling (Motorola DVP), but most contacts are in the clear.

The vast majority of communications are high band (142-174 MHz, narrowband FM mode), with some UHF (406-420 MHz), but virtually no low band (30-50 MHz) or 800 MHz activity was noted. Air-to-ground communications were busy in the usual 118-137 MHz civilian and 225-400 MHz military aeronautical bands (AM mode).

The ICOM/Grove SDU installation discovered a wireless mike on 71.9 MHz, dutifully broadcasting a conversation from a nearby hotel room; I wondered if the occupants knew it was there.

Communications at the Cape are somewhat informal, casual but brief. Protocol is observed, but it isn't stuffy. Status reports are frequent, such as updates of "phase 1" and "phase 2" lightning alerts during a passing thunderstorm prior to final launch preparations.

According to one retired Spectrum Manager, the vast majority of communications, and this would presumably include nearly all data transmissions, are now conducted by fiber optics. Still, data and telemetry bursts were readily detected on a wide variety of frequencies from 72-2000 MHz by the Icom/Grove SDU package connected to the experimental rapid-deployment antennas.

Radio at the Kennedy Space Center continues to play a vital role in routine daily communications, as well as launch preparation and support operations. A scanner doesn't remain quiet for very long. During the mission itself, many local listeners lock in on 146.940 MHz, an amateur radio repeater maintained at Cape Canaveral which rebroadcasts NASA Select audio. NASA Select audio can be heard nationwide over WA3NAN, the amateur radio club station at the Goddard Space Flight Center in Maryland, on or near 3860, 7185, 14295, 21395, or 28650 kHz single sideband.

Space Shuttle Mission Frequency Guide

NOTE: The following list of NASA and associated frequencies is the most accurate and up to date in publication. Frequencies marked with an asterisk were heard in use preparatory to, or during the STS-76 Shuttle mission on March 21, 1996. Reader comments are welcomed. All frequencies are in megahertz and FM mode unless otherwise indicated.

Antigua

5060 5436 6810 6919 7313 7332 7605 7765 7860 7919 9115 9138 9170 10310 10327 10475 10949 11407 11414 12160 13495 13943.5 14497 14585 14819 14891 14914 15528 15575 16216 17554 18237 18700 19143 19961 20272 22990 23413 23603 23940 24530 24760 26515 (All kHz, various modes are used)

Contingency — search and rescue: 11440 kHz (USB)
Fire/security police: 163.4875
Space shuttle range support: 264.8/284.1 (AM)

Ascension Island

2622 4500 4992 5775 5822 7313 7354 7605 7765 7804 7910 9043 10230 10780 10850 10880 10949 11407 11634 12107 13468 13878 14432 14497 14585 14615 14896 14914 14921.4 14967 16246 17554 18331 18434 18700 19126 19198 19371 20195 20390 20475 23035 23485 23603 23661 23840 24240 25245 25299 26356 23389 26684.5 27720 27870 27925 (All kHz, various modes are used)

Fire: 173.575
Space shuttle range support: 264.8/284.1/291.8 (AM)

Cape Canaveral Air Force Station, Florida

Air/ground control: *284.0
Air rescue: 138.450 (AM)
Base commanders net: 149.535/148.065 170.575
Cape communications: *165.1125
Cape tower: *118.625/393.0 *118.625 *120.950125.900 *126.650 128.150 *133.800 134.275 135.375 135.825 (AM)
Data links: *403.000 (Pulsed tones) *1030 (Pulse every 14 sec.) *1680 (Pulse every 4, 10 sec.) *1749.5 *1750.5 *1757.2 *1758.2 *1820 (Pulse every 1-4 sec.)
Disaster operations (weather alerts, etc): *163.5125 (ETR Net B)
Disaster preparedness net: *148.650 (Data bursts)
Department of Energy explosive ordinance disposal operations: 409.475/412.700

The crew of Space Shuttle Mission STS-76 included, left to right: (back row) Commander Keven P. Cilton, Mission Specialist Shannon Lucid, Mission Specialist Linda Godwin, Mission Specialist Ronald Sega, Mission Specialist Michael Clifford, and Pilot Richard Searfoss,

Eastern Test Range command destruct: 406.5 *416.5 (Voice) 421.0 425.0 428.0 (Data)
Eastern Test Range FTS command alert: *168.000 (tones)
Eastern Test Range instrumentation net: *148.485
Eastern Test Range launch operations support: *163.4375 165.0625 407.450
Eastern Test Range paging channel: *165.0125 (ETR Net S)
Eastern Test Range — test range safety: 46.65 141.300 *142.125
Eastern Test Range — test range support: 229.0 253.6 270.0 (AM)
FCA net: *163.5875
Federal Highway Administration construction net: *169.550
Fire: *163.5625 (ETR Net F)
Flight support: 138.150 139.050 139.250 140.400 141.300 149.250 (All AM)
Helicopter control: 284.000 (AM)
Maintenance: 149.500 *150.150 (ETR Net N) 165.0625
Operations: 413.200/407.250
Operations security: 419.650
Ordnance Control/Missile loading net: 419.150
Public service agencies mutual aid channels: 154.160 (Fire NASA Net 316) 155.370 (Police NASA Net 303)
Radiation monitoring: *164.500 (ETR Net Y)
Search and Rescue: 282.8 (AM)
Security: *163.000 (ETR Net Z) *163.4625 (ETR Net D) *164.200 (channel 2) *165.0875 (Repeater DVP/clear voice) *170.125 *171.975
Seek Skyhook (Aerostat uplink): 440.0 445.0
Solid rocket booster recovery beacons: 240.0 242.0 (Data)
Space shuttle range support: 264.8 291.8 *294.6 341.6 349.6 *350.6 (AM)
Special projects: 413.450
Support services: *165.0375
Titan III operations: *148.515 *149.150
Transportation/Admin: *407.225 413.075
TV audio: *1799.75 (Computer lesson; spurious emission from another service?)
TV operations net for Eastern Test Range launches: *148.035
U.S. Air Force miscellaneous frequencies: 74.75
U.S. Air Force Office of Special Investigation (OSI): *138.075/139.675 138.175 141.525
U.S. Army explosive ordinance disposal (EOD): 49.70 49.80 148.700/143.025
U.S. Army research and development support: 36.70 40.90
U.S. Coast Guard maritime frequencies: *156.600 *156.800 157.050 157.075 *157.100 157.175
U.S. Navy Aegis project support: 30.29

Space Shuttle Mission Frequency Guide

U.S. Navy FACSFAC Jacksonville warning area coordination net: *267.5 *284.5 *349.9 369.9 385.1 (AM)
Utilities: *150.195 (ETR Net C) *150.250 (ETR Net E)
Unknown use: *400.050
Weather Balloons (Rawinsonde): *403.0 (Data; pulse tones)

Kennedy Space Center, Florida
Administration (loan pool): *173.5375 (NASA Net 111)
Base communications net: *170.150 (NASA Net 107) *173.6375
Camera control: 407.575 412,850 *932.00625 941.00625
Civil Air Patrol: *148.150 (Repeater output and simplex)
Cape Canaveral National Seashore: *164.625 *163.150 (Department of the Interior)
Civil Defense: 158.940 (Transmit) 155.715 (Receive) (NASA Net 208)
Civil engineers/maintenance net: *171.000 (NASA Net 101)
Crane operations: *407.100 *409.525 409.775
Crane telecommand: 408.49375 408.96875
Crawler transport moves: *916.0 (Pulses every 3, 3, 8 sec.) 929.0 *932.0 (Pulse every 3.8 sec.) 939.0 *1030 (Pulse every 14 sec.) *1104 (Pulse every 14 sec.)
Data link: *409.925
Department of Energy communications: 167.850 *168.450 (Tone)
Fire/rescue: *173.5625 (NASA Net 116/channel 1) *173.7875 (NASA Net 216-tactical channel 2)
Ground Control: 121.750 (AM)
Flight Service Station: *123.600 (AM)
General maintenance net: *171.150 (NASA Net 201)
Industrial Area Cranes: 412.825 (UHF-1) 412.950 (UHF-2) 413.025 (UHF-3) 413.150 (UHF-4) *413.250 (UHF-5) 413.375 (UHF-6) 413.525 (UHF-7) 413.550 (UHF-8)
Launch support operations: *162.6125 (NASA Net 104)
Launch complex 39 convoy command: 407.325 (UHF-1)
Launch complex 39 VAB crane operations.: *407.475 (UHF-2) 408.175 (UHF-4) 409.050 (UHF-6)
Launch complex 39 convoy purge: 408.150 (UHF-3)
Launch complex 39 operations pool: 408.800 (UHF-5) 409.125 (UHF-7)
Launch complex 39 convoy cooling: 409.175 (UHF-8)
Local Control: 126.650 (AM)
Marine operations: 162.0125 (NASA Net 306)
Measurements/safety: *165.1875 (NASA Net 102)
Medical net: *173.4375 (NASA Net 117) also UHF MED 1-10 channel pairs (463.000/468.000-463.975/468.975)
MSBLS/telemetry: *165.6125 (NASA Net 202)
Orbiter operations: *165.4125 (NASA Net 110)
Paging (voice): *170.350 (NASA Net 308) *171.000
Public Affairs/Hurricane operations: *163.5375 (NASA Net 108)
Public Affairs TV coordination: *171.2625 (NASA Net 408)
Railroad operations: *170.175 (NASA Net 206) *413.125 413.325
Safety: *173.4625 (NASA Net 205) *173.6625 (NASA Net 105)
Security: *173.175 (NASA Net 203/Tactical 2) *173.6875 (NASA Net 103) 173.8625
Shuttle landing facility: 121.5 (Emergency-civilian) 243.0 (Emergency-military) 121.750 (Ground operations) 126.3 (Air to ground control) 259.7 (Orbiter to ground) 296.8 (Orbiter to ground) 284.0 (Air to ground control) *128.550/ 284.0 (AM)
Shuttle TV coordination net: *171.2625 (NASA Net 408)
Supply (digital paging): *150.325 (Repeater output/ 173.4875 repeater input) *170.400 (NASA Net 106)
TACAN: 1104.0 1146.0
Telemetry: *409.925 *410.8625 *413.050 *1250.0 (erratic pulses) *1441.5 (Pulses every 14 sec.) *1780.0 (Erratic pulses)
Traveler Information Service (TIS): 1320 kHz (AM)
Transportation: 162.0125 (NASA Net 306)
U.S. Customs Service: *165.2375 *166.4375 166.4875
Utilities: *171.000 (NASA Net 101)
VAB to crawler transport duplex channels: 407.600 408.025 412.975 413.825
VAB crane operation: 410.1375 *410.8625 (Data)
Weather telemetry: *409.925 *413.050
Wind telemetry: 418.075
Wireless mikes: 169.505 170.245 171.045 171.905

Malabar, Florida
FAA net: 172.850 (repeater output/169.250 repeater input) 166.175 172.175
Harbor common: 2716 kHz (USB)
Range clearance function: 2638 kHz (USB)
Space shuttle support: 5187 kHz (USB)
Solid rocket boosters recovery vessels: 2356 2622 2639 (Intership ops) 2716 2764 2800 2820 2837 3187 3365 5810 (All kHz) (plus various VHF marine channels)
Test range communications to Ascension/Antigua: 6937 7833 9043 9132 10310 11104 11407 11414 11548 11622 13878.0 13986.1 14559.5 14896 14937 15610 17490 17668 18196 18237 18355 18769 19304 20189 20195 23413 23581 24240 24760 27720 27870 (All kHz)
U.S. Air Force Eastern Test Range control: 2622 5810 7765 10780 11615.5 13878 20195 20390 (All kHz)
U.S. Air Force emergency hurricane net: 3365 4900 5350 7412 10305 (All kHz)
U.S. Navy to Atlantic aircraft: 3120 4704 5718 6693 6708 6723 9006 11205 11252 13227 13237 15021 15051 15057 15067 18009 (All kHz and USB)
U.S. Navy to Atlantic ships: 2357.5 2764 2800 3187 4521 4766 4856.5 5180 5190 5246 6897 7461 7676 (All kHz and USB)
U.S. Navy Atlantic ships/aircraft: 2836.5 kHz (USB)
U.S. Navy surface radar: *1250 MHz

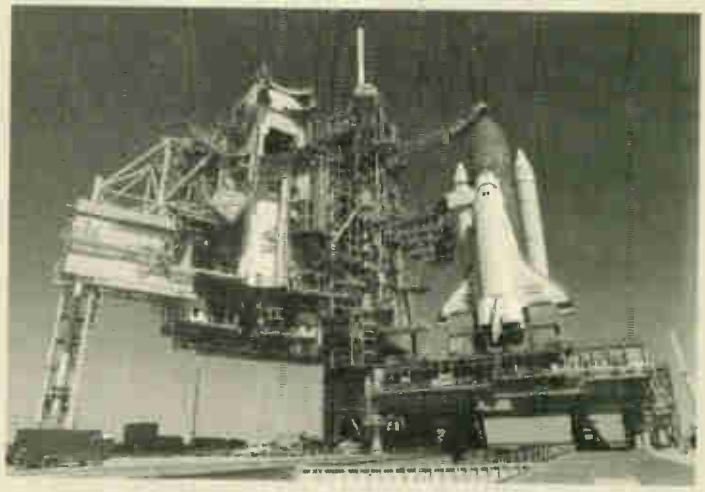
Melbourne, Florida (Miscellaneous)
Data: *908.000 (Pulse every 1, 3, 5 sec.)

Bob adjusts the Grove Spectrum Display Unit (SDU) which is connected to an ICOM R7100. On the left is a Sangean ATS 803A for casual HF monitoring, and on the right is a Radio Shack PRO-2006 loaded with 400 Cape frequencies.

Space Shuttle Mission Frequency Guide

FAA: *269.300 *348.700 *379.250 *998.000 (Pulse every 14 sec.)
FAA DME: 998.0
FBI: *167.7875 (Repeater output)
National Weather Service broadcasts: 162.550
U.S. Air Force: *141.850 (Unmodulated carrier)
Merritt Island, Florida
Solid rocket booster maintenance net: 407.225

Patrick AFB, Florida
Administrative (U.S. Navy): 138.375
Air defense: 148.125 (AM)
Air Force Reserve training: 138.275 138.475 (AM)
Air National Guard administration: 408.000 408.050
Air National Guard maintenance: 141.625
Approach control: 121.050 *125.450 *127.850 (AM)
Approach/departure control: *132.65/340.9 *134.95/358.3 (AM)
Approach radar: *1265.0 *1345.0
ARIA aircraft radar: 1441.5
Automatic Terminal Information Sservice: *119.175/273.5 (AM)
Civil engineers: *171.3875 173.4125 173.5125
Clearance delivery: *118.400/289.400 (AM)
Command channel: 407.525 413.225 413.400
Commanders net: *149.535 148.065
Command post: 311.0 321.0 (AM)
Communications/navaid repair: 413.000
Consolidated command post (call sign Mayaap): 138.3/383.0 (AM)
Contingency (Eastern Test Range): 141.725
Control tower: *133.750/348.400 (AM)
ETR test range control: 46.850 49.850 324.7 (AM) 340.8 (AM) 407.300 413.100
FAA flight check: 135.850 (AM)
FAA telemetry: *1265.0 *1345.0 (Wideband swept pulse)
Fire: 172.300 (Tactical 2-Simplex) *173.5875 (Tactical 1-Dispatch/Explosive Ordinance Disposal)
Fire alarm: 138.925 (data)
Fuel Farm: *165.1625
Geodetic survey detachment 4: 141.475/143.075 142.475
Ground control: *124.350/335.800 (AM)
ILS glide slope: 330.8 (Rwy 20) 331.4 (Rwy 2)
Instructional TV audio link: 1799.75
Launch operations (ETR): 266.2 308.95 320.050 (AM) 413.500
Local control: 126.650 128.150 133.800 (AM)
Marine channels: 156.300 156.575 156.800
Medical: 173.4375
Motor pool/taxi: *165.1375
Mutual Aid-Fire: 154.130
Mutual Aid-Medical: 154.160 155.160 155.340
Mutual Aid-Police: 155.370
Navaid maintenance: 407.375
Paging: 142.675 931.8375 (digital, leased)
Pilot to Dispatcher (PTD): *122.850/372.200 (AM)
Possible security channels: 407.400 407.425 413.350 413.475
Radar (IFF): 1030.0
Ramp control/Base operations: *173.125
Regional approach control: *290.8 297.2 369.2 372.8 378.8 (AM)
Search and rescue: 236.0 251.9 252.8 (AM)
Security: *163.4875 (Tactical channel 2) *173.025 (Tactical channel 1)
Security (AFTAC): *413.275



Seek Skyhook surveillance balloon telemetry: 1749.5 1750.5 1757.2 1758.2 1820.0
Special operations: 282.4 (AM)
Supply and transportation: *149.265
TACCS training: *412.875
Training: 138.400 139.650 139.700 141.600 142.300 143.800 148.050
Training Operations: 225.350 316.275 351.2 *363.9 383.2 385.7 395.1 (All AM)
U.S. Air Force Military Affiliate Radio System (MARS): 142.150 *143.450 (Repeater output)
U.S. Air Force Office of Special Investigations: 138.075 (Repeater output) 138.175 141.525 (Repeater input)
Weather (Metro): 344.6
Weather balloon telemetry: 1680.0
Wireless mike: 170.305
71st rescue squadron maintenance: 148.095 148.175
301st rescue squadron maintenance: 148.100 *149.300 163.5875 164.175
71st/301st rescue squadrons: 413.300
Unknown use: *142.400

NASA General Frequencies
NASA HF air-to-ground: 3089.5 6743.5 9003.5 11192.5 15062.5 (All kHz and USB)
NASA emergency net: 3385 3395 4604.5 6982.5 14455 (All kHz and USB)
NASA shuttle emergency landing site net: 408.150 408.800
NASA NCS HF net: 2360 3379 3388 5403.5 5821 5961 6106 6108 6809 9462 11801 12129 12219 13633 13744 13780 14836 14989 14908 15464 16201 16430 18744 20063 22983 23390 (All kHz and USB)
NASA nationwide assignments: 162.1125 162.9875 163.100 166.525 166.8375 167.0125 167.350 167.400 167.775 168.350 168.4125 168.9375 169.2125 171.5125 171.6375 172.0375 172.3375 172.9625 173.425 173.900
Search and rescue operations: 282.8 (AM)
Solid rocket booster recovery beacons: 240.0 242.0 (Data)
Shuttle to ground: 139.300 (FM voice to Mir) 143.600 (FM voice to Mir) 145.840 (Amateur SAREX downlink) 243.0 (emergency only) 259.7 (primary UHF) 279.0 (EVA channel) 296.8 (secondary UHF) (All AM) 410.0-420.0 (EVA) 2106.4 (S-band tracking) 2217.5 (Orbiter OI transmitter: PM TT&C) 2250.0 (Orbiter DFI transmitter: voice, data, video) 2287.5 (PM primary) 15003.4 GHz (Ku-band telemetry)

MISSION CONTROL II

Touring NASA's New Facility in Houston

By Haskell Moore

NASA's new Mission Control Center is located in a new wing adjacent to the old Mission Control in Building 30 at the Johnson Space Center. In this view, the new wing is the taller structure on the left. (Photo courtesy of NASA)

Beginning in 1965 with Gemini 4, every aspect of a manned space flight mission has been controlled from the Mission Control Center (MCC) at the Johnson Space Center in Houston, Texas. For thirty years, essentially the same technology was used to coordinate each flight from the time the rockets were lit until the spacecraft landed.

The original MCC has served NASA well over the years. Such historic events as the first man on the moon and the first shuttle launch were orchestrated from there. However, the original MCC was based on mainframe computer technology and proprietary hardware and software systems developed specifically for NASA. The hardware systems alone requires a staff of approximately 80 technicians to maintain a 24 hour-a-day vigil when a mission is in progress. And when something does go wrong, repairs are sometimes required at the component level.

However, beginning with shuttle mission STS-70 in July, 1995, control is being gradually passed to the new, state of the art Mission Control Center. Built at a cost of approximately US$250,000,000, the new Mission Control Center was designed to take NASA into the 21st century. Using the latest in client-server technology, NASA has tried to steer away from the proprietary hardware systems that eventually became a maintenance nightmare at the old facility. NASA has attempted to use commercially available software packages whenever possible, and reverts to writing custom software only when necessary.

For those of you who have watched NASA missions over the years, the Flight Control Room (FCR, pronounced "ficker") is a familiar sight. From the FCR's seventeen control stations, NASA astronauts, scientists and controllers not only guided the flights, but served as the focal point for television audiences around the world. However, this icon of America's space program will soon be retired and preserved for future generations as a federally protected national monument.

The new MCC has not one, but two functionally identical Flight Control Rooms. Either room can be used for an actual mission, or configured

TABLE 1

Monitoring Guide to JSC, Houston, Texas
All frequencies are in megahertz (MHz) and mode is frequency modulation (FM) unless otherwise indicated).

123.125	NASA aircraft operations (Ellington AFB) (AM)
154.280	Mutual Aid (emergency/disasters only)
155.265	Civil Defense (emergency/disasters only)
155.370	Texas Intercity (emergency/disasters only)
164.200	JSC security net
164.9875	NASA administrative net
169.000	Engineering/maintenance net (repeater input 168.000) - Bldg. 1
170.100	Public affairs net (repeater input 171.000) - Building 45
170.350	Construction/maintenance (Alpha net) - Building 49 (164.700 repeater input)
170.375	Medical net (repeater input 168.450) - Building 45
170.750	Aircraft operations
171.150	NASA Select (Audio of NASA Select TV broadcasts)
173.6625	Paint net - Building 49
173.6875	Procedures net
173.8125	NASA transportation Net (repeater input 172.300) - Bldg. 420
235.400	NASA air-to-ground (AM)
409.175	NASA medical network (repeater input 407.175)
409.025	NASA JSC paging
429.6725	Bridge crane operations - Building 48

NASA also shares a 10 channel trunking network with other government agencies in the Houston area. The trunking system consists of the following frequency pairs (first frequency repeater output/second frequency repeater input):

406.350/415.150 407.150/415.950 407.950/416.750 408.550/416.550
408.750/417.550 408.950/417.750 409.150/417.150 409.550/418.350
409.750/418.550 409.950/417.950

for simulation to serve as a training tool. The new FCR is comprised of nineteen primary consoles (see figure 1), a display/control system on the front wall, and a viewing gallery in the back.

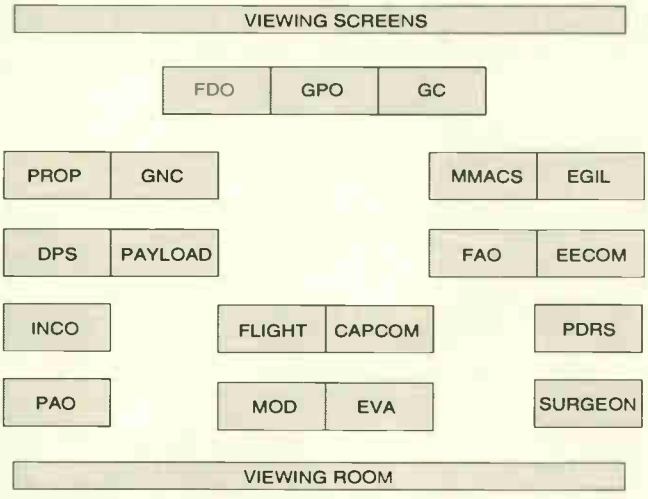
The three large displays at the front of the FCR can be configured to display a variety of information. The spacecraft tracking map (which was a projector image that was manually moved on a track at the old FCR), various telemetry and timers, as well as video downlinks can be displayed on any one of the three displays.

Although the FCR is the most visible component of the MCC, there's a whole world of activity going on behind the

An overall view from the rear (above) and wide angle view (left) shows activity in the new Mission Control Center (MCC), opened for operation and dedicated during the STS-70 mission. (Photo courtesy of NASA)

TABLE 2

Role of each console in JSC MCC



Flight Director (FD): Call sign *Flight*, serves as leader of the flight control team, and is responsible for overall Shuttle mission and payload operations and all decisions regarding safe, successful flight conduct.

Spacecraft Communicator (CAPCOM): Call sign *Capcom*, serves as primary communicator between flight control and astronauts. The initials are a holdover from earlier manned flight, when Mercury was called a capsule rather than a spacecraft.

Flight Dynamics Officer (FDO): Call sign *Fido*, plans maneuvers and monitors trajectory in conjunction with Guidance officer.

Guidance Procedures Officer (GPO): Call sign *Guidance*, monitors onboard navigation and onboard guidance computer software.

Data Processing System Engineer (DPS): Determines status of data processing system including the five onboard general purpose computers, flight-critical and launch data lines, the malfunction display system, mass memories, and systems-level software.

Surgeon (Surgeon): Monitors crew activities, coordinates medical operations flight control team, provides crew consultations, and advises flight director of the crew's health status.

Booster Engineer (Booster): Monitors and evaluates main engine, solid rocket booster and external tank performance during pre launch and ascent phases of missions.

Payload Deploy Retrieval (PORS): Monitors operation of the remote manipulator system.

Propulsion Engineer (PROP): Monitors and evaluates reaction control and orbital maneuvering propellants and other consumables available for maneuvers.

Guidance, Navigation, and Controls Systems Engineer (GNC): Monitors all vehicle guidance, navigation and control systems, notifies flight director and crew of impending abort situations, and advises crew regarding guidance hardware malfunctions.

Electrical, Environmental, Consumables Manager (EECOM): Responsible for: passive and active thermal control of the vehicle, cabin atmosphere control, avionics cooling, supply/waste water system management, and fire detection/suppression.

Electrical Generation and Illumination Engineer (EGIL): Monitors electrical systems, fuel cells and associated cryogenics, ac and dc power buses, vehicle pyrotechnics, and lighting and hardware caution and warning systems.

Integrated Communications Officer (INCO): Plans and monitors in-flight communications and instrumentation systems configuration.

Russian Interface Operator (RIO): The Russian Interface Officer serves as the primary interface between the U.S. and Russian control teams. The RIO updates the Russian team on shuttle related activities and issues, and relays messages from the Russian team to the U.S. team.

Ground Controller (GC): Directs maintenance and operation activities affecting Mission Control hardware, software and support facilities, coordinates the Ground Space Flight Tracking and Data Network (GSTDN) and the Tracking and Data Relay Satellite System (TDRSS) with Goddard Space Flight Center.

Flight Activities Officer (FAO): Plans and supports crew activities, checklists, procedures and schedules, and plans/manages the attitude (orientation in space) of the vehicle.

Payloads Officer (Payload): Coordinates onboard and ground system interfaces between the flight control team and payload user, and monitors Spacelab and upper stage systems and their interfaces with the payload.

Maintenance, Mechanical, Arm, and Crew Systems (MMACS): Call sign *Max*, monitors operation of the orbiter's structural and mechanical system, and follows use of onboard crew hardware and in-flight equipment maintenance.

Public Affairs Officer (PAO): Provides mission commentary to supplement and explain air-to-ground transmissions and flight control operations to the news media and the public on the NASA Select Network.

Mission Operations Directorate Manager (MOD): Provides a link from the Flight Control Room to top NASA and JSC Missions Operations Directorate management.

Extravehicular Activity Officer (EVA): Monitors and provides support for Extravehicular Activities.

Note: During missions on which a Spacelab module is carried in the orbiter's payload bay, an additional flight control position is Command and Data Management Systems officer (CDMS), responsible for data processing systems involving Spacelab's two major computers.

scenes. In the Multipurpose Support Room (MPSR), specialist in the various systems monitor and analyze incoming data. This necessary information is then passed on to the flight controllers as required.

There are two Payload Operations Control Centers (POCCs), which are used to monitor and control the payload or experiments conducted in the shuttle's cargo bay. One is located at Huntsville, Alabama, and the other is at Greenbelt, Maryland.

The Spacelab POCC operates from Marshall Space Flight Center in Huntsville, Alabama. The Spacelab is a reusable scientific research laboratory that fits in the bay of the shuttle. From the Spacelab POCC, data can be relayed to and from the shuttle to track the status of the various experiments and systems.

From the Goddard Space Flight Center, located in Greenbelt, Maryland, control of all "free-flying" systems is performed. This includes deployment, retrieval or servicing of satellites, and the deployment of deep space probes. Finally, a new 102,000 square-foot facility has been built to house the Space Station Control Center (SSCC).

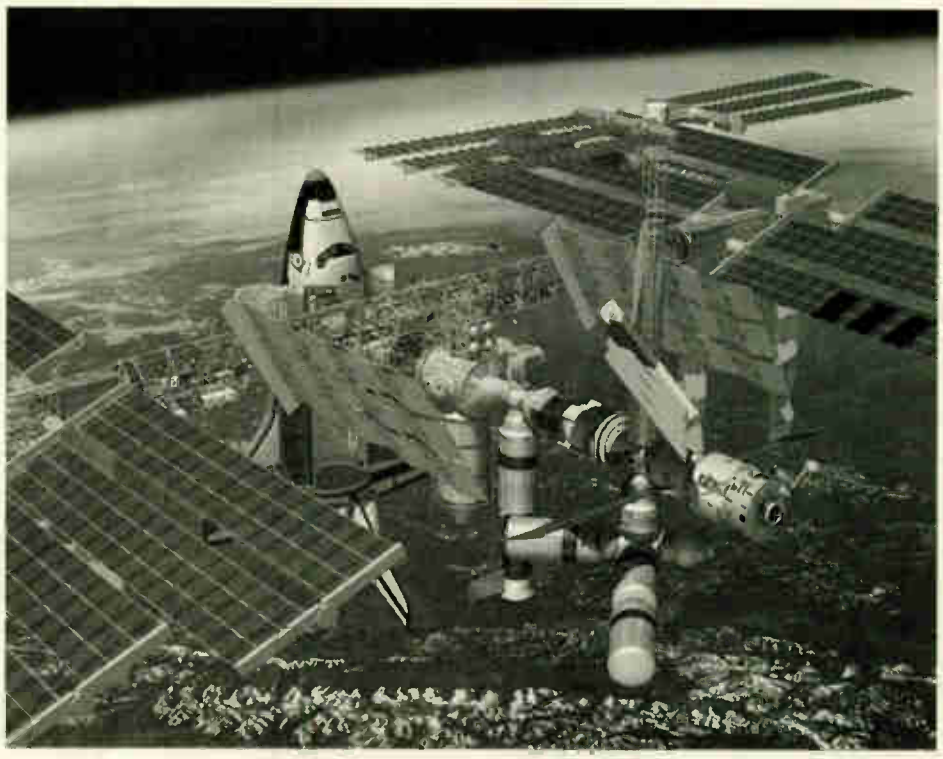
Since the MCC is crucial to the safety and success of any space flight, all mission-critical systems have a redundant backup to be used in the event of emergency. For example, there are both backup generators and air conditioners to ensure the MCC never misses a beat in the event of a failure of either of these crucial components. And in a worst-case scenario, space flight control can be passed to an emergency facility at the Kennedy Space Center (KSC) in Florida. At the KSC Launch Control Center, the mission can supported to a safe completion.

Touring The Johnson Space Center

If you ever make it to the Houston, Texas area, you can visit the Johnson Space Center (located 25 miles south of downtown Houston) and tour many of the facilities mentioned here. Space Center Houston is adjacent to the Johnson Space Center, and contains a wealth of information and exhibits of everything from lunar rovers to a shuttle mock-up. Space Center Houston can be contacted at (713) 244-2100. ST

Changes & Challenges

Both are Looming on the Horizon for the Proposed Multinational Space Station



By Philip Chien, Earth News

NASA, the Russian Space Agency, and the other space station partners have recently agreed to the assignment of NASA astronaut William Shepherd and Russian cosmonaut Sergei Krikalev to become the first crew to man the International Space Station. The two will be joined by a Russian pilot-cosmonaut to be named later.

Bill Shepherd is a veteran of three shuttle missions, STS-27, STS-41, and STS-52. He had been serving as the deputy manager for space station activities at the Johnson Space Center. Bill Shepherd was a Navy SEAL before he became an astronaut. He was the first member of the 1984 class to fly in space, aboard the classified STS-27 mission in December 1988. The crew deployed the classified 'Lacrosse' radar imaging spacecraft (International ID 1988 106B, NORAD 19671). Lacrosse is an extremely distinctive red-colored bright spacecraft and one of the most popular satellites to observe with the naked eye.

Shepherd second flight was the STS-41 mission in October 1990 which launched the international Ulysses spacecraft towards Jupiter. His most recent shuttle mission was STS-52 in October 1992 which launched the Italian LAGEOS spacecraft, and marked the first flight of the United States Microgravity Payload (USMP-1). Ironically that flight flew in the month Space Station Freedom was originally scheduled for launch — eight years after its go-ahead.

Sergei Krikalev is the veteran of two long duration flights aboard Mir, and a one-week flight aboard the STS-60 shuttle mission. His first flight in space was aboard Soyuz TM-7, the fourth long duration flight aboard the Mir space station. The commander was Alexandr Volkov and they were joined by cosmonaut researcher Valeri Polyakov who was already aboard Mir. The crew used the call sign *Donbass*. Its mission lasted from November 26, 1988 to April 27, 1989.

His second mission got the world's attention. He was launched on Soyuz TM-12 on May 18 1991, with commander Anatoly Arsebarski for a planned five month stay. The crew used the call sign *Ozon* and was the ninth long duration mission. By this time the Soviet Union was entering an economy crunch, along with internal pressures. An agreement was made with Austria to fly a passenger to Mir for $7 million. Russian-controlled spacecraft are launched from the Soviet republic of Kazakhstan and the Kazakh's were loudly complaining that they had received very little benefits from the Soviet space program. Russia agreed to fly a Kazakh as a passenger for a short duration Mir flight.

Originally these two 'guest passengers' were planned for separate missions, but the budget crunch resulted in the cancellation of one Soyuz crew exchange mission. Both VIP passengers were important so the decision was made to fly them on the Soyuz TM-13 spacecraft. Since a Soyuz can only carry three people the original flight engineer Alexandr Kaleri had to

Russian cosmonaut Sergei Krikalev (left) and NASA astronaut William Shepherd have been chosen to become the first two crewmen of the International Space Station.

give up his seat. Consequently the TM-13 launch on October 2, 1991 consisted of Russian commander Alexandr Volkov, with Austrian Franz Viehboeck and Kazakh Toktar Aubakirov.

The passengers were only qualified for short duration missions, so flight engineer Sergei Krikalev was asked to serve a double-shift in space. The Russian commanders swapped places, with Arsebarski returning to Earth with the two VIP passengers. Alexandr Volkov and Sergei Krikalev—who had flown together on the 7th long duration crew — became the 10th long duration crew, with the call sign *Donbass*.

Somehow this musical seat swapping was interpreted by the non-technical press as Sergei Krikalev being stranded in space — alone, without any means of getting home and not enough food. The press completely ignored simple facts like a Soyuz ferrycraft was always available in case the crew had to abandon Mir if there was an emergency; there were always at least two people aboard Mir at any given moment; they received regular Progress supply spacecraft carrying food, mail, and other supplies; they always had work to keep them busy; and they knew exactly when they would return to Earth — on April 27, 1992.

However the crew did have their share of excitement. Their lifeline to worldwide news was Mir's ham shack. Mir has a standard ICOM 2-meter radio with a packet modem (145.550 MHz). The cosmonauts can communicate with hams around the world either by voice or computer messages.

During Sergei's eleven months in space he heard rumors that the Soviet Union wanted to sell off the Mir space station for highly needed hard currency—complete with its cosmonauts onboard, hams at the Goddard Spaceflight Center told him about the upcoming STS-44 shuttle launch and the crew stayed up to watch from their orbital vantage point, and — most excitingly — the cosmonauts got to watch the fall of the Soviet Union from the ultimate detached perspective. Sergei later commented "There wasn't anything we could do about it, so we just concentrated on our work."

Sergei's excellent English made him one of the prime candidates for the astronaut-cosmonaut exchange program and in 1993 it was announced that he and cosmonaut Vladimir Titov would train to fly aboard the shuttle. Sergei flew on the week-long STS-60 mission and Vladimir flew aboard STS-63.

Since returning to Russia Sergei has been a member of the joint team of Russian flight controllers who assist NASA's mission control during the joint U.S.-Russian Phase I flights.

Surprising many people NASA space station manager Wil Trafton verified that Shepherd will be the commander for the three person crew while they are aboard space station. He acknowledged that future space station crews may have a Russian commander, or even a European, Japanese, or Canadian commander, but that the first commander had to be an American.

It's expected that the third crew member for the crew will be a Russian pilot astronaut who will be in charge while the team flies the Russian Soyuz spacecraft to and from space station. Unlike the current Phase I flights where Russian cosmonauts travel to and from Mir primarily via Soyuz while Americans travel to Mir via the shuttle space, station crews will train and fly together.

Shepherd, Krikalev, and the Russian pilot will be launched aboard a Soyuz spacecraft in May 1998. At that point the space station will consist of the Russian-built and U.S. financed FGB tug, a U.S. pressurized node, and the Russian Service Module. The Service Module includes living quarters and will serve as the primary occupied area until the U.S. laboratory and habitation modules are launched a couple of years later. During their stay several Russian and American launch vehicles will deliver several space station components, including the Russian universal docking module, U.S. solar arrays and part of the truss. The three person crew is expected to spend 120 days aboard space station before returning to Earth in their Soyuz spacecraft.

For the early space station assembly period all of the astronauts and cosmonauts will travel via Soyuz spacecraft. Eventually crews may be launched on Soyuz and returned by the shuttle or vice versa. When the U.S. hab module is in place, and the modified Soyuz emergency spacecraft are in place there will be enough flexibility for crews to arrive and depart via the shuttle. In all cases there will be a Soyuz available either as a rescue craft or planned return spacecraft for each long duration crewmember.

The Russian Space Agency plans to continue to operate the Mir complex during space station's early assembly period. While the Mir core module was launched in February 1996, over ten years ago, it is still in usable condition and the Russians hope to operate it through the year 2000. NASA is expected to continue to use Mir for joint operations, including additional long duration stays of U.S. astronauts. So it's quite possible that U.S. astronauts may be in space aboard three different spacecraft at the same time - International Space Station, Mir, and unrelated shuttle missions. ST

The International Space Station

ST Sat Facts

The International Space Station program promises a new era of space exploration and space-based scientific research, and will come to fruition through an unprecedented level of international cooperation. When complete, the Space Station will be permanently occupied by a crew of six, and it is anticipated that it will remain fully operational for ten years following its planned completion in June, 2002.

The International Space Station program is divided into three phases, each defined by the inception of new capabilities:

PHASE I (1994-1997)

Phase I is currently underway, and utilizes existing resources, primarily the Space Shuttle and Russian Mir space station to build experience in the technical aspects of space station construction and occupation, and to usher in a new area of international cooperation in space. Phase I began with the launch of Discovery for Shuttle mission STS-60, when Russian cosmonaut Sergei Krikalev became the first Russian to fly aboard a U.S. spacecraft.

Phase I will be completed following the ninth Shuttle/Mir docking mission, currently envisioned to be STS-91, in May, 1998, which will carry the Alpha Magnetic Spectrometer (AMS) and other scientific experiments specially selected to maximize the utilization of the space station environment.

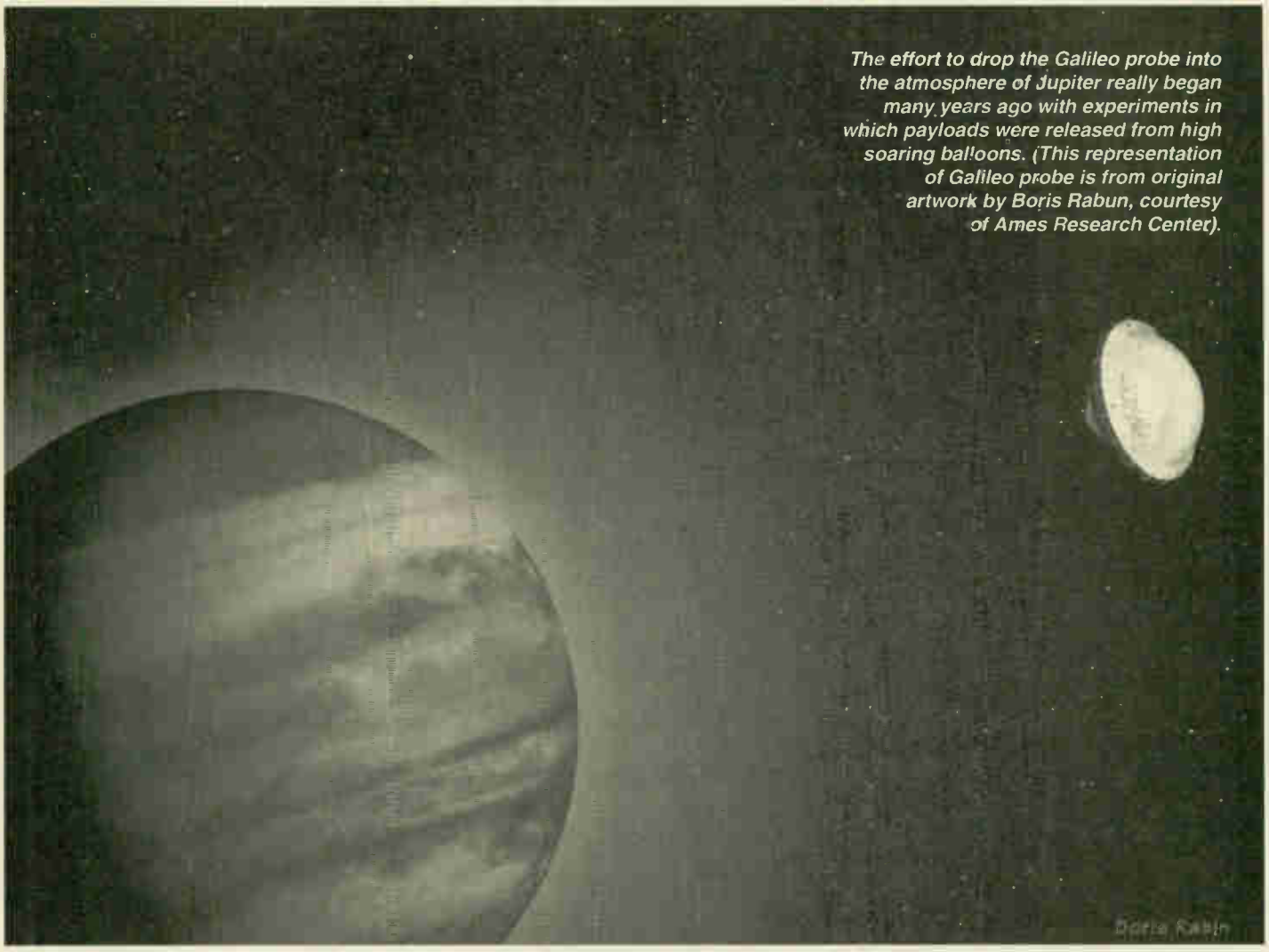
PHASE II (November 1997 - February 1999)

Phase II will mark the beginning of the assembly phase of the International Space Station, and will see the first "production" experiments conducted aboard the Station. Phase II will commence upon launch, aboard a Russian Proton launch vehicle, of the Russian-built "FGB" module, a propulsion and attitude control module of a design proven years ago aboard Russian military flights.

In May, 1998, permanent occupation of the station will commence with a crew of three, and the Canadian Mobile Servicing System will be launched in late 1998. The end of Phase II will be marked by the delivery of the U.S. Laboratory Module aboard Shuttle flight STS-94.

PHASE III (February 1999 - June 2002)

Phase III will see permanent occupation of the partially completed International Space Station by a crew of six in November, 1999. Construction will continue along with flights tailored to Station utilization. The first Phase III flight will be Shuttle mission STS-96, which will also be the first Space Station Utilization flight. After the permanent docking of a second Soyuz craft to serve as an escape "lifeboat" (and which will permit a permanent, 6-person crew), Phase III will include the addition of the Japanese Experiment Module (JEM) in 2000 and the European Columbus Orbiting Facility (COF) in September, 2001. Phase III will draw to a close with the flight of Shuttle mission STS-121 and the addition of the Station's largest module, the U.S. Habitation Module. With assembly now complete, full operational use of the International Space Station will begin. ST



The effort to drop the Galileo probe into the atmosphere of Jupiter really began many years ago with experiments in which payloads were released from high soaring balloons. (This representation of Galileo probe is from original artwork by Boris Rabun, courtesy of Ames Research Center).

Dropping in on the Planets

(Attention: This is only a Test)

By Jeanne E. Prevett

Imagine you've been entrusted to drop off a package — a 746-pound capsule containing highly precision instruments capable of extracting clues to the very birth of our solar system. The package is late. It has traveled 2.3 billion miles on the longest detour in history, taking six years to reach its destination. Now you must drop it a distance of over 200 miles, and not a soul stands within 500 million miles to catch it.

The team of scientists at NASA's Jet Propulsion Lab in Pasadena, California, accomplished such a feat with the landing of the Galileo probe last December. Moments after its release, the capsule was streaking Jupiter-ward at 106,000 miles per hour, its heat shield rapidly disintegrating in the searing heat of its own friction. Then suddenly, like Superman's cape, a parachute unfurled, slowing the precious payload to a cool clip of 100 miles

per hour — and buying the critical hour in which the probe would analyze the Jovian atmosphere into which it would soon sacrifice itself.

Of course, a full dress rehearsal for this stunning performance had not been feasible. Yet so much could have gone wrong. And NASA sure had crammed a pricey half dozen eggs into that one speeding basket. How had they ascertained that a safe landing would indeed be possible? The answer goes back nearly 30 years to the early phase of what was termed "PEPP", NASA's Planetary Entry Parachute Program, and a series of test launches from what was then the world's largest balloon.

Why Balloons?

The U.S. government had employed high altitude balloon technology primarily for obtaining weather data since the late 1940's. In the 1950's, manned gondolas were launched to high altitudes by balloon in order to test the effects of space on humans. Then in 1966, NASA proposed an ambitious new space-related application for the technology to Air Force Cambridge Research Laboratories (AFCRL) of Bedford, Massachusetts, now the Phillips Laboratory.

"NASA explained that their desire was to land a sounding device on a parachute to Mars, Jupiter, and any other planet they had in mind. . . It was the preliminary stage of planetary exploration . . . so it was an exciting concept for us," recalled Harold L. Prevett, AFCRL's now retired assistant engineer on the project.

The Lab had the capability of lifting payloads weighing more than two tons to altitudes in excess of 20 miles. They could position a balloon over a designated area, and by radio command control over a dozen functions, including dropping a rocket from the payload, separating the payload from the balloon, dropping ballast, and arming and disarming destruct circuits. They could also operate cameras and read numerous parameters including temperature, altitude, and orientation of the payload.

Balloons have several advantages over airplanes for launching payloads because they can attain higher altitudes, sustain flight for days at a time if necessary, and are able to obtain more accurate information because they do not generate shock waves or emissions which can interfere with the chemical composition of the atmosphere being studied. They are also more cost effective, according to officials at the Balloon Operations Center at Holloman Air Force Base in Alamagordo, New Mexico, the operating location for the Lab.

PEPP Photos by Cambridge Research Labs, courtesy of Harold L. Prevett

Planning the Launch

The series of high altitude launches of a balloon-borne rocket containing the prototype for a planetary probe would be the first of their kind for several reasons. The AFCRL balloon operations crew knew before the capsule was even designed that it would take a mighty big balloon to lift NASA's hefty payload, plus the Lab's usual battery of flight control instrumentation, rigging, and parachute — to the desired altitude of 130,000 feet, where the atmosphere was believed to most closely approximate that of Mars.

"It is clear that it will be the largest balloon ever constructed with a volume ranging from 20 to 30 million cubic feet — costing about US$100,000 per copy. And one final point, the launching will likely be made shortly after midnight. This factor in combination with the fact that the balloon system will stand a hundred or more feet higher than the Prudential Center immediately prior to

PEPP Photos by Cambridge Research Labs, courtesy of Harold L. Prevett

PEPP Photos by Cambridge Research Labs, courtesy of Harold L. Prevett

launching makes for numerous interesting possibilities," noted AFCRL Balloon Design branch chief, the late Thomas W. Kelly, in an early memo concerning the project.

After months of joint meetings between NASA and AFCRL, extensive design work, planning and preparation, the first test was conducted on August 30, 1966, then again the following summer. On the night of July 27, 1967, a swarm of workers spread out over the runway at the former Walker Air Base, south of Roswell, New Mexico. Most had been up since early morning, preparing for the launch. Now, at 10 p.m., they would embark upon a long night of testing, adjusting, and inspecting. "Everyone's so busy, you don't get excited. It's a busy time because you're trying to make an early morning launch," recalled Jim Payne, AFCRL's retired launch chief for the project.

A Big Mother Bear

Kelly's projections proved fairly accurate. The balloon was a whopper. Constructed of acres of thin polyethylene, mylar, and nylon film, it was among the earliest of the large, synthetic zero pressure balloons commonly used today. Uninflated, the main balloon stretched a length of 570 feet, holding an awesome capacity of 26 million cubic feet. Atop its crown sat a much smaller balloon which, when inflated to 84 feet across, would hold up the uninflated main balloon prior to launching. Attached to the empty main balloon was a 145-foot parachute train for landing the A.F.C.R.L's control equipment, and below that, their horizontal load bar with several packages of balloon instrumentation and ballast dangling like an array of luggage from an oversized roof rack. Finally, grasped by a huge 30-ton crane was NASA's attached rocket with its cone-shaped aeroshell poised at an angle. Tucked neatly inside the capsule was NASA's parachute which would, if all went well, brake the free-fall of the simulated planetary probe as it plummeted back to Earth.

The sheer enormity of the apparatus presented some unique challenges. "On the ground, it was a monster," recalled Prevett, remembering how the chief engineer of the rocket design group first surveyed the trail of uninflated balloon and remarked, 'That's a big mother bear, Mr. Prevett!'. " Stretching 815 feet, it would take up a substantial segment of runway long before the project literally even got off the ground. Then, due to its heft, the equipment would have to trail the moving balloon for some distance before liftoff could be attained. Also, AFCRL's load bar with instrument packages had to be suspended above NASA's equipment, far higher than the Lab was accustomed to positioning its balloon control equipment.

Previously, the engineers had relied upon a rather low-tech method of monitoring the functioning of their timers inside the instrument packages: They'd simply placed an ear up to the box, and listened for the ticking sound. With the packages now beyond earshot, they had to devise a new way of checking on the timers. So they built in a transducer to pick up the sound and relay it through a long wire to a set of earphones on the ground. After listening to ensure that the timers were working properly, the workers could pull a plug to disconnect the headphones. "We knew it wasn't very sophisticated to put your ear against the box, but it always worked before," commented Prevett.

In addition, the crew had to take care not to accidently set off the eight live rockets attached to NASA's package. Two inflation tubes, like giant drinking straws, facilitated inflating the smaller tow balloon with helium. Later, in the thin upper atmosphere, the gas would swell to 220 times its original volume, flowing into and expanding the main balloon. "It was a painstaking, ticklish task to inflate the balloon. Surface winds of only five or six knots maximum could be tolerated," said Prevett. If winds at the surface happened to blow opposite those affecting the upper portions of the mammoth system, all hell could break loose. "It's such a big sail that it's a real problem," explained Payne.

But nature cooperated that night, and by 4 a.m. the next morning, a portable scale built into the launch arms at last indicated enough free lift available for launching. Stretched to its full height by the tow balloon, the immense system stood taller than the Washington Monument against the pre-dawn sky. In the distance, a tethered blimp bobbed lazily, monitoring wind direction and speed at 900 feet in the air. "We had to make sure the winds were right for deploying all the instrumentation — the rocket, the aeroshell, and balloon equipment — over a sparsely populated area," explained Prevett, stressing safety and security concerns.

Up, up and Away

Finally at 6:28 a.m., Payne issued the command and the launch arm freed the gigantic balloon. A crewman held tightly to a cable to prevent entanglement, then the connection was severed by radio command. The smaller orb floated aloft, trailing the mammoth empty balloon in its wake like a long, silvery ribbon. Simultaneously, the giant crane carrying NASA's attached rocket and capsule chased the wind driven balloon down the runway until the payload was positioned directly under it; then the whole system was released.

"It was quite a sight to see — a small bubble of helium at the top of a length of uninflated plastic, followed by 100 feet of parachute, and dangling 40 feet below the 'chute, a payload of ballast, control equipment, suspension bar, and the rocket with its landing capsule!" said Prevett.

When the contraption was confirmed headed westerly as planned over the Army's White Sands Missile Range, Payne and Prevett boarded a plane and headed 85 miles to the main control center at Alamagordo to assume control of the flight. The spectacle of the record-breaking balloon floating across the sky is one that will remain etched in their minds. "It glistened in the morning sun like Venus might on a clear night," recalls Prevett.

PEPP Photos by Cambridge Research Labs, courtesy of Harold L. Prevett

Blast Off

In about three hours, the balloon had reached its ceiling altitude of 130,000 feet, its girth expanded to a paunchy 456 feet in diameter. It was now time to manipulate the valve and ballast system into a favorable position for the release of the payload and the firing of NASA's rocket. The radio commands were issued, and the rocket jettisoned. Then its eight jets ignited to propel the craft at 850 m.p.h. on an arching trajectory farther into space. When it peaked at 140,000 feet, the capsule ejected to begin its 1,100 m.p.h. free-fall back to Earth. Right on cue, its parachute unfurled, the capsule decelerated, and the equipment package floated safely down. Recovery crews were dispatched to two separate locations, and the experiment declared a complete success. Two subsequent tests confirmed repeatability of the system and concept.

Mature Fruit

But the experiment would not come to fruition until the next decade, with the Viking and Pioneer landers to Mars and Venus. And not until 1982-83, was the technology adapted to a simulated descent of the Galileo probe to Jupiter. Using the same parachute that recently entered the Jovian atmosphere, those tests were conducted in similar manner over the White Sands by the Lab, whose name by then had been changed to Air Force Geophysics Lab. This time, an elaborate heat shield added substantially to the weight of the payload. Also, a control line was run halfway down the side of the lander's parachute to restrict it from fully opening in the dense atmosphere scientists had expected to encounter, but didn't.

The Galileo prototype was launched to only 97,000 feet by a mere five million cubic foot balloon — one-fifth the size of its 1966-67 predecessor. The smaller balloon and lower altitude ensured that the dangerously heavy payload would remain over the test area's restricted 50-mile impact area, in case its parachute failed to deploy. The probe was released and allowed to free-fall to an altitude of 57,000 feet, where a drogue chute was deployed. Then, after dropping another 400 feet, the heat shield and descent module separated and the descent module floated to the ground.

Those tests would take another dozen years to come to fruition with the long awaited landing of the real McCoy, the Galileo probe, last December 7. For some scientists who'd reportedly been working on the project for nearly 20 years, the landing was said to be a closure of sorts. No doubt they'd relate to Jim Payne's sentiment about successfully helping launch the project with the early testing for PEPP three decades ago: "It was very satisfying to have the darn thing work," he said. ST

DOMESTIC

TVRO

By Doug Jessop

What is DBS (and Why Should I Care)?

The stir that DBS (Direct Broadcast Satellite) has caused in the last year reminds me of the advent of radio and all the so called experts that said that it would replace the newspaper. TV then comes along and those same eagle eye experts declare the certain death of radio. Now comes digital television and according to some experts the sky is falling for "regular" television as we know it.

The other night I even saw a local TV station run an ad featuring their General Manager telling people to call Washington and let them know that they are concerned about the demise of free TV. Give me a break... the facts are that competition is good for technological advances (okay, so high definition television has thus far laid an egg) and for consumer prices.

So what are the facts with digital television. The FCC has been auctioning digital bandwidth as if it where the gold rush for the 90's. Why all the sabre rattling? As we reported in the last issue, it all comes down to major bucks.

You can catch DirecTV on the Internet at http://www.directv.com.

Direct Broadcast Satellite was born with the joint effort launch of DBS-1 by Hughes' DirecTV and USSB. Hubbard Broadcasting's USSB owns 4 of the transponders on the high powered bird, 120 watts compared to the average of 10-20 watts for a C-Band sateelite. DirecTV owns the remaining transponders as well as the entire capacity of DBS-2 and DBS-3.

EchoStar Communications Corporation is looking at a private offering of senior secured to notes to raise $250 million in new capital. The dough would be used to finance EchoStar's $52.3 million FCC bid last month for the 148 deg West longitude orbital slot along with the marketing and distribution expense for launching their new *DISH* DBS network.

According to News Corp. Chairman Rupert Murdoch, plans by MCI and News Corp. to deliver television and other services directly to homes via satellite could include Tele-Communications Inc., the nation's biggest cable company. Murdoch told the National Press Club that "discussions are under way" with TCI and EchoStar Satellite Corp. about becoming possible partners in the direct broadcast satellite business. Can you say "media mogul?"

The basic premise for DBS was that people would be willing to pay about $800 for an 18-inch dish and a decoder and then about $30 a month for the programming. The major pro-side argument was for people that didn't want to fork over the $3000-$4000 for a BUD (Big Ugly Dish) system and either lived in an area that did not have good primary television signals and/or cable in their area.

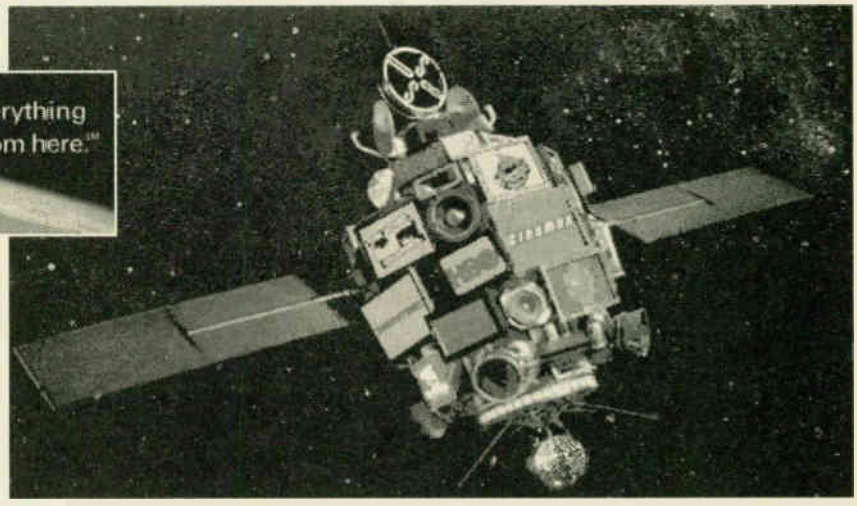
One major drawback is that you can only watch their satellites with their equipment on their terms (sound a touch like a monopoly, eh?) .The multi-million dollar gamble has paid off. The DBS folks are strutting around like peacocks saying that DBS is the fastest growing electronic item ever, even surpassing the initial introduction of VCR's. Just like any kind of new technology the price has now fallen for the hardware...in my neck of the woods dealers are advertising in the $500-$600 range.

On the other side of the coin, "Full View Satellite" viewers (aka BUD owners) have kind of poo-pooed the whole ruckus as something that they have been able to do for years. Want to watch sports, news, movies, etc.? Just going surfing with the satellite dish and you'll find it. The beauty of regular satellite dish owners is the fact that it is the ultimate channel surfing experience. Another major point is the fact that there is a HUGE amount of absolutely free programming to see in the clear. Of course, there is the larger cash outlay for a regular dish not to mention the fact that the dishes are so big that they refer to them in meters rather than centimeters.

Somewhere in the middle is Primestar that actually has a pretty good compromise. You don't buy the equipment you rent it....it being a dish that is about 3 feet. The wide variety of movies, sports, etc. is there without parking a humungous dish, but again you can only see Primestar's medium powered Ku-band satellite. Another wrinkle in the Primestar deal is that the satellite that they are using will be reaching end-of-life in a little while and they haven't quite figured out where their new home will be. A third party had reserved an orbital slot with the FCC in hopes of then selling the rights to Primestar. Apparently some of Primestar's competitors put a bug in the ear of the FCC and got the deal squashed.

As you can see there are a lot of things to be said on both sides. My personal opinion is that there is plenty of room for both systems. The DBS dish isn't an alien invitation beacon and is extremely portable. ST Managing Editor Larry Van Horn's parents have one

The basic premise for DBS was that people would be willing to pay about $800 for an 18-inch dish and a decoder and then about $30 a month for the programming. The major pro-side argument was for people that didn't want to fork over the $3000-$4000 for a BUD (Big Ugly Dish) system.



USSB information is on the Web at http://www.ussbtv.com

in their RV, but you pay for that portability. While I'm not exactly sure what kind of Pandora's box I'm opening here I want to know what you think. I have set up a comments form on the Internet at: http://www.xmission.com/~insearch/STcomments.html. Your comments are invited and may even show up in a future article. We'll soon see how closely you really read this column!

Rupert Wants Brokaw

Rupert's best buddy, Ted Turner has made no secret that he hopes to entice Tom Brokaw away from NBC and a bidding war just may break out for other top TV talent as the networks wake up and smell the coffee in response to Turner's 24-hour-news channel CNN. Among the top names whose services could be bid upon are Peter Jennings, Ted Koppel and Christiane Amanpour. "Personality pulls audiences," said CNN President Tom Johnson. "This is clearly an area of vulnerability."

Both ABC and Fox have already announced plans for their own cable news networks and NBC and Microsoft should be launching MSNBC, their joint venture cable news network, on or around July 15 MSNBC will replace America's Talking on most cable systems around the country.

Established TV news reporters and anchors are cheering in the aisles. Network news officials "can recite the names of free agents whose contracts will expire or can be reopened in the next year or so," said The New Yorker's Ken Auletta, who spoke with many network executives for a recent article.

CNN/SI to Debut Soon

Ted Turner is a busy boy, he's apparently joining forces with Time Warner (*Sports Illustrated*), to launch a 24-hour sports-news service to be called CNN/SI. The channel will combine the news-gathering resources of CNN with Sports Illustrated magazine and is expected to be launched in December. The service will report on sports events only, not broadcast them. "Anytime of the day when a sports fan will want to know what's going on, they can turn to CNN/SI," said Steven Robinson, senior editor of *Sports Illustrated*. The new service will "not only be sports and highlights, but depth and perspective and analysis."

Satellite Networks News

In a move to try and woo fans back from the annual baseball strikes, Fox Sports announced that former New York Yankee Dave Winfield is joining their team as a pregame analyst on Fox's studio-based show. The network begins coverage of professional baseball as part of a new five-year pact, with regional coverage of regular-season games on June 1. Fox seems to pretty serious about the whole deal, they have over 50 promotional spots already produced.

It's only a matter of time before ABC News has to select a production center location for its upcoming 24-hour all-news cable channel. Network officials said they hope to launch the channel by the end of the year, possibly as early as September. The Washington Business Journal reported last week that the network needs as much as 150,000 square feet of space, including up to 15,000 square feet for offices. ABC News president Roone Arledge is believed to prefer northern New Jersey, close to the network's Manhattan headquarters, for the site of the new center.

Word on the street is that Comcast Corp. is about to announce a programming arrangement that is sure to have daytime channel surfers jumping up and down. They plan to air soap operas from Walt Disney Co.'s ABC on its Q2 home shopping cable channel and, in return, will carry the proposed ABC cable-news channel as early as this year on some of its cable systems. Both ABC and Comcast have declined to comment on the deal.

For you news junkies out there, point your dishes (try to do that with a DBS dish) to CBS Newspath and ABC NewsOne/ABSAT. As of mid-March, CBS Newspath has produced more than 300 live reports for its affiliates and clients since beginning its *Campaign '96* coverage.

"The CBS News Political Unit provides an enormous amount of support that translates into a real competitive edge for our sta-

According to a report in the Wall Street Journal, Microsoft Corp, DirecTV and Intel announced plans recently that will allow personal computers to receive satellite-television broadcasts and conduct two-way audio and video communication over the Internet.

tions," said John Frazee, Vice President, News Services, CBS News.

ABC NewsOne and affiliates plan to get aggresive with Vote '96 to provide complete wrap packages, custom live shots and group live shots. ABC NewsOne/ABSAT is starting its coverage by assisting stations satellite feeds with a dual-threaded KU uplink from Gulflink. In addition, ABC affiliates from KMBC/Kansas City, KAKE/Wichita and WISN/Milwaukee sent their KU trucks to Des Moines to link up with NewsOne/ABSAT in the concerted effort to cover the first big political event of the 96 Presidential campaign year. At just the Iowa Caucus, ABC NewsOne/ABSAT coordinated satellite feeds for more than 150 live reports and tape playbacks.

The Fox network announced its mid-season schedule this week, introducing four new series. Two new comedies, *The Show*, about a white man working as head writer for a black comedy series, and *Local Heroes*, about four male friends in their twenties. Aaron Spelling's *Kindred: The Embraced*, a vampire drama that will air Wednesday nights. With a name like "kindred" I wonder if Aaron will have any of his relatives show up in the credits? The last new show, *Profit*, is about the corporate moves of a rising star in the business world.

CBS is rearranging its Sunday and Monday night schedules to premiere a new comedy, *Good Company*. The sitcom, about a New York ad agency, will air in the Monday night 9:30 p.m. time slot. That same night, *Almost Perfect* will move from its Sunday time period to Mondays at 8:30 p.m. *The Bonnie Hunt Show* will return to the network on Sundays at 8:30 p.m. The Monday night comedies *Can't Hurry Love* and *High Society* will be taken off the air, but remain contenders for fall renewal.

The Movie Channel changed its format in March with a new "nonstop movie experience" programming slate. The new Movie Channel will feature a high-profile film each night at 9, a daily "movie marathon" with three or more thematically related back-to-back films and less than one minute of commercial time between movies. The new format will feature more than 100 movies a month.

A new game show broadcast on the TV Food Network, matches professional chefs against one another in creative cook-offs. Each contestant is given an assortment of random ingredients and 20 minutes in which to make up a recipe and cook the dish. In a recent show, rosemary lamb chops by Michel Richard of Los Angeles beat turkey with mozzarella by Jean-Louis Palladin in Washington, DC. "The clock ticks, the food flies, and the two sous chefs recruited from the audience duck for cover," said *Food and Wine* magazine. The audience gets to eat what's prepared. How do I get tickets?

Libby Weaver has been made weekend anchor at Warner Bros.' syndicated magazine, *Extra*. Weaver replaces Maureen O'Boyle, who is leaving the show to host a new talkshow for Warner Bros. (debuting in September). Weaver will co-host the weekend edition with David Rose. After seeing Libby do a news stint in Salt Lake City, she should do great on the show modeled after *Entertainment Tonight*.

Net Broadcast News, a TV production and new media company, will launch an ongoing news series, *The Computer Guy*, in Los Angeles in April to roll out nationally in May. "Our goal is to make *The Computer Guy* accessible to new or non-computer users yet at the same time keep the high tech whiz interested," said Knutsson. "We want people to rush home to get on the net or work through their lunch hour just to do some surfing." Sounds like something that my wife would be jumping cartwheels to see me do (not).

According to a report in the *Wall Street Journal*, Microsoft Corp, DirecTV and Intel announced plans recently that will allow personal computers to receive satellite-television broadcasts and conduct two-way audio and video communication over the Internet. The deal assumes that PC users could receive images soon by relying on an existing satellite network. Unlike modems, the new system will deliver data in one direction — to the receiver.

Jones Health Network (Mind Extension University, The Jones Computer Network, Great American Country Network and the Personal Information Network (which is an information network) has just launched an on-line service, The Jones Internet channel, which is offering broadband, high speed access to the Internet and the World Wide Web.

In the "gosh however will I survive" department the *George and Alana* show was canceled recently due to "lack of public interest"...read: low ratings. The show officially ceased production at the end of March, leaving behind only enough original episodes to make it through May sweeps.

I really don't mean to sound like I'm picking on the poor lady, but guess what. Tammy Faye Messner, ex-wife of televangelist Jim Bakker, resigned from *The Jim J. and Tammy Faye Show* after just over a month of shows claiming that the taping schedule was too much for her to handle.

"The rigorous taping schedule and the stress that comes with a national television show is more that I can handle at this personally difficult time in my life," she said. Her current husband, Roe Messner, is free on bond pending sentencing on federal bankruptcy fraud charges. "God helped me make (the) decision (to quit)...My heart is and will always be in the ministry and I feel that's where I belong."

I realize this isn't quite "domestic" news but as a FYI, NBC's business and financial news channel, CNBC, launched a 24-hour European service recently via the Astra satellite, reaching 7 million homes across the pond. NBC Cable and Business Development president Tom Rogers called the launch "the completion of the CNBC ring around the world," including US and Asian services.

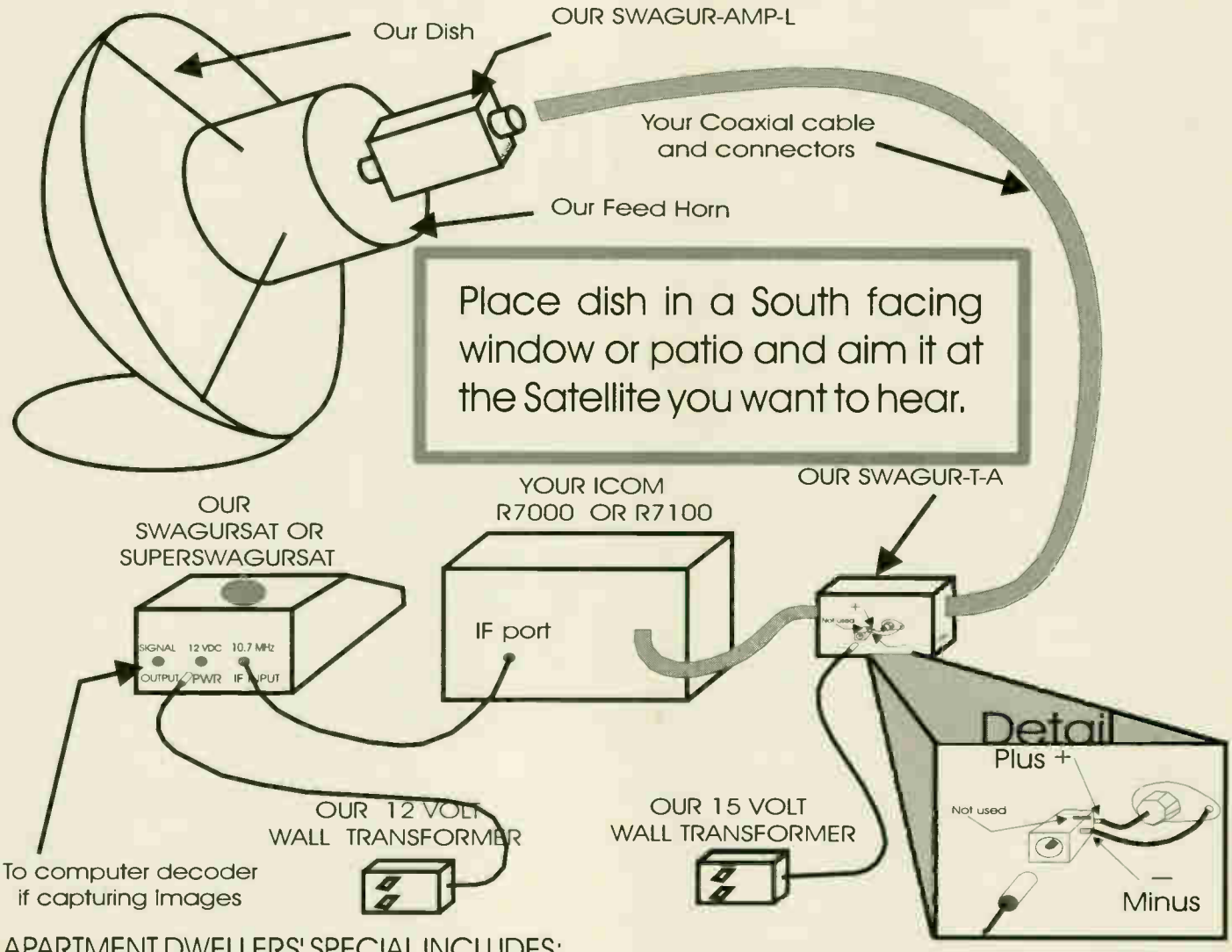
Viacom-owned MTV announced in late March that it is custom-tailoring its international expansion. The network will use digital compression technology it bought last year on its new channels and added local programming. MTV already claims to be the largest television network in the world, reaching 264 million subscribers in 70 countries. "Musical tastes are different from region to region," said Tom Freston, chairman and chief executive of MTV Networks. The expansion will also help MTV attract new advertisers who currently lack distribution throughout Europe.

In closing, according to a recent Harris Poll, six in 10 Americans enjoy television commercials and believe that they contain useful information, but nevertheless tune them out....you don't say! ST

SWAGUR ENTERPRISES ANNOUNCES

A BREAKTHROUGH IN GOES INMARSAT RECEPTION

THE APARTMENT DWELLERS' SPECIAL



APARTMENT DWELLERS' SPECIAL INCLUDES:

1. 3 Foot Dish with Patio Ring.....$ 75.00
2. Feed Horn $120.00
3. LNA (<1db noise, 38 db gain).....$225.00
4. Bias T with Amplifier $125.00
5. Wall Transformer for LNA .....$ 10.00
6. Super-Swagursat.....$295.00

Regular Price.....$850.00

Special System Price $775.00

Shipping charges:

Carton & cushioning for dish..$10.00

Estimated UPS charges.....$35.00

Return policy: Because we operate so close to our costs, and because we cannot sell returned items as new ones, we must charge a 20% restocking charge on each item returned to us.

SWAGUR Enterprises

P.O, Box 620035
Middleton, WI 53562-0035
Phone/Fax 608-592-7409
Email: swagur@execpc.com
Web Page: http://www.execpc.com/~swagur/

INTERNATIONAL

TVRO

By George Wood

Digital Decoder Wars

Digital satellite broadcasting is about to get underway in Europe, following last year's launch of the all-digital Astra 1E satellite with Ariane, and the recent launch of Astra 1F on a Russian Proton rocket. The transponders are waiting for the broadcasters, but the latter are busy fighting decoder wars. European digital television will be based on the MPEG-2 standard, but this can be implemented in different ways. Ideally there would be one standard decoder box for all of Europe, and all you would need is the right smart card to watch channels from different suppliers.

The problem is that some broadcasters don't want to use boxes that are compatible with transmissons from their competitors. Different alliances are forming. Nethold, one of the first to start digital broadcasting to Europe, wants to have its own system, and plans to subsidize decoders, hoping that viewers will choose one and only one box, the Nethold decoder, and won't be able to afford a second set-top device.

France's Canal Plus and Germany's Bertelsmann are trying to put together a European standard, but two major media barons, Germany's Leo Kirch and Rupert Murdoch, owner of British Sky Broadcasting, have been playing coy about their plans. Kirch said first "no", then "yes" to a joint standard, but when the standard was announced at a major press conference, the Bavarian satellite lord was nowhere to be seen. There's even speculation that Murdoch's News Corp may been developing a digital TV alliance with Luxembourg's media giant CLT, which has interests around Western Europe. This follows speculation, since denied, that Murdoch wanted to buy into CLT, which operates the RTL stations in several countries, and has radio interests in a number of others.

Murdoch is exercising his power in other ways. The Children's Channel has obtained a separate broadcasting licence for its Scandinavian service on the Thor satellite, anticipating a take-over by Murdoch's Twentieth Century Fox. Fox is apparently only interested in the British version of TCC, because its US produced kids shows are expected to find a more recepetive audience in the UK than in Scandinavia.

Back in March the schedules of TCC on Astra and Thor became totally different, apparently preparing the way for the Murdoch take-over.

The Russian state broadcaster RTR is ready to launch two pay-TV channels this Spring, one featuring movies, the other sports. An unnamed European broadcaster, almost certainly Sky, has signed a 15 million dollar joint venture deal for the service. Distributed in digital form via Intelsat 604, the channels will be redistributed via cable networks, and should be followed next year by children's and health channels.

In other European news, Saudi Arabian Channel 1 is reported to be broadcasting on "Gorizont 26", more generally known as Statsionar 11 at 11º West, on the transponder formerly used by Apna TV on 11.525 GHz. Sound is on 7.0 and 7.5 MHz.

Russia's Gals 2 is now broadcasting alongside Gals 1 at 71º East. TV 6 Moscow has been seen on 11.920 GHz, and there is a strong signal on 12.208 GHz. There are also digital transmissions on a number of frequencies.

On January 6, the German music video channel Onyx TV launched on Eutelsat II-F1, at 11.146 GHz. The new music channel, owned by the London-based Excalibur Communications Limited, operates for 18 hours a day, and according to a Eutelsat press release addresses "adult music enthusiasts who no longer find themselves represented in chart-dominiated music channels...There will be something for those who like pop songs and hit tunes, for jazz lovers, country music connoisseurs, fans of musicals or follows of rhythm and blues or rock."

Onyx is competing directly, not only with German versions of MTV and VH-1, but also the twin German music video channels Viva 1 and Viva 2, on the same satellite.

General Electric announced some time ago that it will be using half the transponders on Sweden's upcoming Sirius 2 satellite at 5º East, for Pan-European channels. Now GE Capital Satellite International has announced it is seeking 12 addiitonal satellite orbital slots to serve the European, African. and Asian-Pacific regions. Applications for these orbital locations have been made to the International Telecommunications Union by the government of Gibraltar, a British Dependent Territory. Satellites launched to these locations would be operated from a planned control facility on Gibraltar.

Planned orbital locations include 3º East, and 6.5, 10, 15, and 23º West to Europe; 27.5, 47 and 51º East to Africa; and 97, 100.7, 105.3, and 108.2º East to Asia and the Pacific. (It's gonna get crowded up there!)

The Russian state broadcaster RTR is ready to launch two pay-TV channels this Spring, one featuring movies, the other sports. An unnamed European broadcaster, almost certainly Sky, has signed a 15 million dollar joint venture deal for the service.

The proposed satellites as currently envisioned would be used mainly for video programming distribution, including direct-to-home, cable headend, and other broadcast applications The planned spacecraft design would accommodate both analog and digital video formats.

The long-announced split between CNBC on Astra and the more entertainment-oriented NBC Super Channel on Eutelsat II-F1 took place in mid-March. The choice of satellites goes completely against conventional wisdom, as Astra is regarded as an entertainment satellite, while the Eutelsat/Hot Bird position at 13° East carries several news and business news channels.

Polonia 1 has moved from Eutelat II-F1 to Hot Bird, both at 13° East. The new frequency is 11.492 GHz. Italy's RAI 3 has also joined the other two RAI channels on Hot Bird as well.

On the radio front, Radio Austria International is joining Astra Digital Radio on Germany's public broadcaster ADR's Astra transponder 45 on 8.10 MHz. Swiss Radio International has ceased analog transmissions on Astra transponder 55. It remains as part of Astra Digital Radio via ADR on 7.92 MHz, and analog on Kabel 1's transponder 9, with a mixture of languages on 7.38 MHz and English only on 7.56 MHz.

There will be no more analog radio stations on Astra. On ZDF's transponder 33 (still the home of Radio Sweden), the new digital version of Radio Ropa is on 6.12 MHz, and digital Star*Sat is on 6.30 (both replacing the analog transmissions on transponder 14. NRJ Munich joins the digital offerings, on 6.48 MHz.

There are some new analog radio stations on the Travel Channel's transponder on 11.175 GHz on Intelsat 601. During the day 7.38 MHz is the home of a Virgin Megastore channel. 2300-0800 hrs UTC this channel is used for The Network, a national British student station. BHS Radio is on 7.74 MHz, and Texas FM is on 8.10 MHz.

Scandinavia

Outside of the Murdoch sphere, most of the news from Scandinavia concerns the two arch-rivals Kinnevik and Nethold-FilmNet. Kinnevik is Scandinavia's answer to Rupert Murdoch, a media empire embracing satellite channels, radio networks, telephone companies, a GSM mobile telephone operator, an Internet provider and national data network, as well as publishing interests,

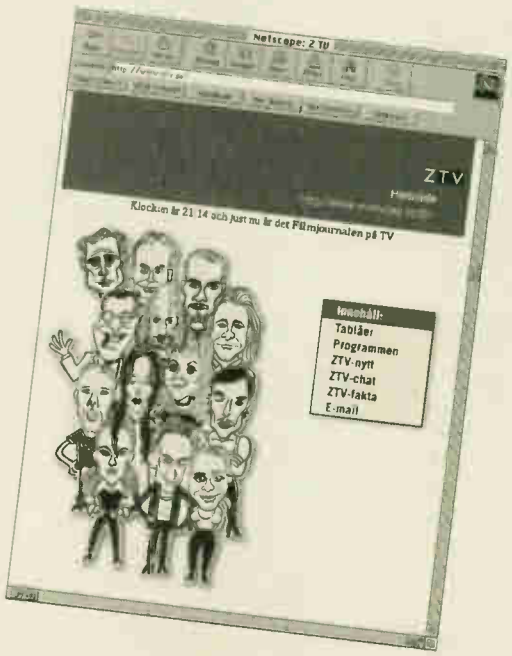
all owned by one man, Jan Stenbeck (who rules his empire from New York).

At the beginning of March Kinnevik moved its TV3 Sweden channel on the Sirius satellite to 12.092 GHz (and not 11.785 GHz as I reported last time), and switched from clear PAL to D2-MAC. This followed similar switches from PAL by sister channels TV6 and Z-TV. The line-up was completed, partly, three weeks later by Kinnevik's new Sports Channel (Sportkanalen).

Nethold's digital broadcasts are to be on Astra transponders 66 (11.730 GHz), 67 (11.750), and 80 (12.010).

It was only a few months ago that Radio Denmark resumed shortwave broadcasts in English, on the first Sunday of every month, using the transmitters of Radio Norway International. Radio Denmark is now also being relayed by the World Radio Network on satellite to both Europe and North America. The first broadcasts were monthly, but repeated two weeks later. Radio Denmark plans to produce extra programs, not heard on shortwave, so the satellite service can go weekly.

Look for Radio Denmark on Sundays in Europe at 1715 hrs UTC, and to North America at 2015 hours UTC, which is 1515 hours Eastern time. WRN can be heard in Europe on Astra transponder 22, sound 7.38 MHz, and in North America on Galaxy 5, transponder 6, audio 6.8 MHz.



On February 15th, a Chinese Long March rocket veered toward the ground and exploded 22 seconds after lift-off. China has admitted that six people died when the rocket crashed into a village, destroying 80 homes. 57 people were seriously injured as well. China's satellite launch record is not good.

The kick-off of the Norwegian public service broadcaster NRK 's second TV channel NRK 2, has been postponed from March until August. A satellite relay is planned eventually, which was apparently intended for the Intelsat 707 satellite at 1 degree West. However, since that satellite has been diverted, the future of the satellite relay and other Nordic expansion at 1 degree West is now in doubt.

On February 15th, a Chinese Long March rocket veered toward the ground and exploded 22 seconds after lift-off. China has admitted that six people died when the rocket crashed into a village, destroying 80 homes. 57 people were seriously injured as well. China's satellite launch record is not good. In January, 1995 a Long March rocket carrying the Apstar-2 satellite crashed in flames 50 seconds after blast-off, killing six people. Before that an Australian Optus satellite failed after launch from China.

The new rocket was carrying the Intelsat 708 satellite, which was to have been placed at 50º West, above the Atlantic. Rupert Murdoch's News Corporation and three partners were planning to use the satellite to provide signals for a 150 channel digital package of direct broadcasts to South and Central America. It would also have been used for voice, data, and video services across the Americas, Africa, and Europe.

However, Intelsat then diverted its 707 satellite, which launched from French Guiana some weeks later, to 50º West instead. Intelsat 707 was to have replaced the Nordic Intelsat 702 satellite at 1º West. It's redeployment will greatly delay the expansion of satellite broadcasting to the Nordic region, as the next scheduled Intelsat launch isn't until September.

Nethold Moves East

Nethold's Multichoice has secured exclusive direct to home satellite rights for progrmming from ART-TV, and will launch a DTH package to the Middle East via PAS-4 within the few weeks. The service will be based in Dubai, and will uplink at least 12 programs from a base in Italy. Programs will include Arabic and foreign programming aimed at the family, and covering music, sports, children's programs, movies, culture, and variety shows.

BBC World Service Television is investigating reports that news stories about the proposed expulsion by Britain of a Saudi dissident were blacked out on its service via the Saudi Arabian-based Orbit television package. The signals travel from London via satellite to Rome, where they are combined with other channels and sent up to the Arabsat satellite. The Rome Earth station is operated by a Saudi company with close ties to the Saudi royal family.

While Rupert Murduch may have axed the BBC World news channel from Asiasat, things have gone the other way in South Africa. The SABC says it's replaced Murdoch's Sky News with BBC World on its satellite service. The SABC says BBC World is far more international in scope than the highly British-oriented Sky.

When BBC World's remaining lease on Asiasat's southern beam expired on March 31, the British news channel immediately moved to the new PanAmSat-4 at 68.5º East. This satellite may become a rival to the Murdoch-dominated package on Asiasat. Besides BBC World, other PAS-4 broadcasters include Asia Business News, China Central TV, Disney, India's Doordarshan, ESPN, HBO, Liberty MultiChoice, NHK, Sony Entertainment Television, CNN and MTV Asia (another channel forced by Murdoch to leave Asiasat, making a return to the pan-Asian airwaves).

Nethold/Multichoice's African package on PAS-4 consists of: M-Net, Movie Magic, SuperSport, KTV, CNNI, BBC World, Sky News, ESPN, VH-1, TNT/Cartoon Network, Discovery, SeleTV, Sci-Fi Channel, The Travel Channel, and The Cable Jazz Channel.

PanAmSat Corp. has announced plans for the launch in late 1997 of its PAS-7 Indian Ocean Region satellite, which will vastly expand PanAmSat's ability to provide satellite services for South Africa and the African continent. It will be placed at 68.5º East, the same location as the current PAS-4 satellite, after launch on an Ariane 5 rocket. PAS-7 will extend Ku-band coverage, complementing the 16 C-band and 24 Ku-band transponders on PAS-4.

Murdoch in Asia

Rupert Murdoch's News Corp. is reportedly trying to forge an alliance with the Chinese leadership. According to reports, Murdoch's Star-TV is negotiating to create a joint-venture company with Chinese state-backed companies, including the country's sole national broadcaster, China Central Television.

The new company would probably beam CCTV programming though Star's network on the new Asiasat-2 satellite, and will supply Star programming to CCTV, which recently launched a satellite network of its own. The joint venture would allow CCTV to put four more pay channels on the satellite, raising the total to eight.

The deal would mark a fresh chapter in Murdoch's sometimes difficult relations with the Chinese government. China has banned indiviudal ownership of satellite dishes, severely restricting Murdoch's access to the massive Chinese market. Murdoch removed BBC World Television from Star's northern beam after protests from the Chinese authorities.

Asiasat-2 launched from China in November, and entered service early this year. While one of the major users will be Murdoch's Star-TV, the first broadcasts from the new satellite were from Portugal's RTP. Launching the venture, Portuguese Prime Minister Antonio Guterres pledged to support East Timor in its fight for self-rule. Lisbon is still regarded by the United Nations as the administering power in East Timor, despite Indonesia's 1975 invasion of the territory.

In response, Indonesian Foreign Minister Ali Alatas criticised Portugal's motive in launching the service.

RTP is one of the few analog broadcasters on Asiasat-2. A group of European television channels and international radio broadcasters have signed an agreement for sharing C-band transponder

The World Radio Network also launched a special service to Japan in mid-February. Unlike WRN's usual selection of non-commercial international broadcasters, the Japanese service includes commercial stations Virgin, and NRJ, as well as Radio France Internationale and the BBC Asia-Pacific service.

10B on Asiasat-2, using MPEG-2 digital compression. Listeners through-out the Asia-Pacific region will receive television from: Germany's Deutsche Welle, the French TV5, Spain's TVE Internacional, RAI International from Italy, and France's MCM International.

The package includes 20 radio channels as well, which are expected to be: Swiss Radio International, YLE Radio Finland, Radio Netherlands, Radio Canada International, RAI, Radio Nacional de Espana, Radio France Internationale, France Inter, France Culture, France Info, and the World Radio Network.

The World Radio Network also launched a special service to Japan in mid-February. Unlike WRN's usual selection of non-commercial international broadcasters, the Japanese service includes commercial stations Virgin, and NRJ, as well as Radio France Internationale and the BBC Asia-Pacific service. The signals are carried by optical fiber to Los Angeles, and then relayed by PanAmSat to Japan. The programming is part of the 440 channels on Usen Cable Radio, which reaches 1.8 million homes. The system is being upgraded to 880 channels. (Japanese radio offerings include such themed channels as the sound of locomotives, and what are called "lying channels", such as the background noise of a bar, reportedly so a businessman can call home from his mistress' apartment and pretend to somewhere else.)

On January 14th, Koreasat-2 was launched from Cape Canaveral. The identical Koreasat-1 was launched in August, but because of a booster separation problem, it's lifetime has been shortened.

Indonesia's Palapa C1 satellite was successfully launched on an Atlas rocket from Cape Canaveral on January 31. It carries 30 C-band and 4 Ku-band transponders. It will be placed at 113º East. Besides Indonesia, the coverage area includes parts of China, India, Japan, and Australia.

On February 5, Ariane successfully placed into orbit Japan's N-Star B satellite. To be located at 136º East, it complements N-Star A, launched by Ariane last September. The new satellite carries transponders in the Ku, Ka, S, and C-bands, and will provide fixed and mobile telephone and ISDN services through-out Japan.

From Asia to Latin America

On January 12th, an Ariane rocket successfully launched Malaysia's Measat-1 and PanAmSat-3R. Measat will be positioned at 91.5º East, and carries 4 high-powered Ku-band transponders, which can be received by 50 centimeter antennas. The 12 C-band transponders will be used for video, voice, and data services from Burma to Japan. With the launch of its own satellite service, Malaysia is ending its ban on private satellite dishes.

The new Atlantic relay satellite PAS-3R replaces PanAmSat-3, which crashed on launch at end of 1994, The satellite has begun operation at 43º West, and carries 16 Ku-band and 16 C-band transponders. It will cover the Americas, Europe, and Africa.

Among the broadcasters using PAS-3 are: Discovery, ESPN, Televisa, Turner International, CMT, HBO Ole, Liberty, NBC, Sony, Fox, TV-5, Warner Brothers, and Viacom International. They are part of the first DTH TV service to Latin America.

The PAS package has gained a huge advantage over Rupert Murdoch and his partners who planned to use Intelsat 708 for a rival DBS service to Latin America. Brazil's Organizacoes Globo says the February 14 failure of China to launch Intelsat 708 will "indefinately delay" the broadcaster's entry into the DTH market. Even with the Intelsat 707 launch replacing the 708 satellite, Globo officials said they don't think the company will maintain its deadlines.

Despite Globo's scepticism, partners News Corp and TCI say the launch failure won't hinder their plans to offer DTH services to Latin America. A News Corp spokesman says the company has a number of options open, and a TCI spokeswoman says there are back-up plans including leasing space on another satellite. Following the failure of Intelsat 708, News Corp terminated its five year lease with Comsat for satellite capacity on the Intelsat system.

Finally, now that Bill Grove is writing his columns about radio and the Internet, both here in *Satellite Times* as well as in our syster magazine *Monitoring Times*, there's less reason for me to mention interesting Worldwide Web sites in this column. But I can't pass up the opportunity to mention that Radio Sweden's Web pages have been rated as among the top 5% on the Web!

Pointcom is one of the many search sites on the WWW. Unlike most of the others, Pointcom (**http://www.pointcom.com**) reviews sites as well as lists them, and then only those sites that are consided to be among the top 5%. Not only have Radio Sweden's Web pages been accorded that honor, Radio Sweden is also the first international broadcaster, after the BBC and the Australian Broadcasting Corporation, to be included. So I hope my pride and pleasure at this honor will be tolerated.

Pointcom liked the inclusion of the texts of Radio Sweden's daily newscasts. The MediaScan section also includes MediaLinks to many other international broadcasters, as well as other sites relating to space and satellites. Texts and interviews from the twice- a-month MediaScan programs are also included.

Radio Sweden's Web pages begin at: **http://www.sr.se/rs/** As usual, contributions to this column can be sent to me directly at: **wood@rs.sr.se** Thanks to Curt Swinehart, James Robinson, Kauto Huopio, and Bert Dahlstroem for their contributions, along with *Tele-satellit* and *What Satellite TV.*

ST

ON THE AIR

By Steve Handler

Getting the News as it Happens!

Flash! A fiery rail collision has occurred between a Maryland commuter train and an Amtrak passenger train in Silver Springs, Maryland. TV reporters are dispatched to the scene shortly after the trains collide to provide the major television networks and their affiliates with continuous live coverage. How are stories like this covered by the networks and how can you get in on the action with that BUD in the front yard? In this edition of *On The Air* we will explore the world of network news feeds.

Each of the three major television networks operates a system to provide news stories to its affiliates. Whether it's the routine news story or a sensational news event, stories as diverse as a child's missing pet to the invasion of Haiti are covered live by Satellite News Gathering (SNG) teams.

These special trucks, usually outfitted with Ku-band equipment, beam the news stories up to satellites and this process is known as uplinking. From there the stories are edited, or sometimes rebroadcast live, and sent to the local network affiliates via another satellite. This process is known as downlinking. These downlinks takes place on C-band satellite transponders for ABC, CBS and FOX networks, and on Ku-band satellite transponders for NBC network.

Most SNG trucks use Ku-band to uplink, rather than C-band, because of the smaller size of the dish as well as the lower costs involved. In addition to SNG trucks, local affiliates often have a fixed site uplink at their station from which they can feed live in-station interviews and news events recorded on video tape that have a regional or national interest. Once uplinked, the stories can then be used either by the network on its national news or downlinked for use by affiliates in a particular region or affiliates nationally.

ABC NewsOne

ABC NewsOne is the news gathering service that provides news, sports and related material to ABC affiliate stations, as well as to foreign news agencies. Twelve hours each weekday, scheduled feeds covering news, sports and features are broadcast on Telstar T401 channel 12. In addition to 16 national news feeds daily, there are regional feeds, with content that is suited for a specific regional market. Live stories and advisories are broadcast 24 hours a day.

ABC's satellite news gathering system is known as ABSAT. It has 71 members using 61 SNG trucks and 25 fixed uplinks. ABSAT owns two full time Ku-band transponders on T401, transponders 15 and 16, and another full time Ku-band transponder (11) on GSTAR 4. If additional capacity is required, T401 transponder 11 (Ku-band) is available to support SNG efforts, as well as occasional use transponders on Telstar T402R and GSTAR 4. An ABC NewsOne staff member recalled one busy day in which he estimated 30 uplink paths were in operation at the same time.

NewsOne collects its stories from ABC affiliates, ABC News network bureaus and outside sources. Stories include regional, national and international news. Special events, and historical news footage are also broadcast. They provide feeds to support early, late, morning, overnight and weekend local newscasts in all domestic time zones.

ABC ABSAT SNG trucks. The one at left is used by WKBW-TV Buffalo, New York (ABC NewsOne and ABC News Photos).

Each of the three major television networks operates a system to provide news stories to its affiliates. Whether it's the routine news story or a sensational news event, stories as diverse as a child's missing pet to the invasion of Haiti are covered live by Satellite News Gathering (SNG) teams.

NewsOne has seven regional bureaus: New York City (Northeast), Atlanta (Southeast), Chicago (Midwest), Dallas (Southwest), Denver (Mountain), Los Angeles (Pacific), and a Washington D.C. bureau.

During the peak weekday hours of 4:00 to 6:25 p.m. Eastern, T401 channel 21 is used for national, sports and Northeast regional feeds. Also, weekdays from 5:15 p.m. to 6:00 p.m. T-401 channel 11 is used for Southwest and Midwest regional feeds and updates. Channel 11 is also used for live on scene news feeds of important breaking stories.

The ABC TV network also uses C-band for prime time and other programming distribution to its affiliates. These broadcasts are usually scrambled using the Leitch system. Some of the satellites used include Galaxy 6 channel 5; Telstar T401 channels 11, 20, 21, 22 and 23; and Telstar T302 channel 20.

CBS Newspath

With offices in New York City, CBS Newspath a unit of CBS News, provides services for over 200 domestic affiliates. CBS operates a continuous 24 hour newsfeed distribution service on C-band using the Galaxy 4 satellite channel 24. CBS Newspath claims to be the largest satellite news gathering network in the world. Newspath has 14 domestic offices in Charlotte, Chicago, Houston, Kansas City, Los Angeles, Miami, Minneapolis, New York, Sacramento, Salt Lake City, San Antonio, Seattle, Tallahassee, and Washington D.C. News is available to Newspath from 115 affiliates using Ku-band uplinks, and 15 additional affiliates using C-band uplinks. Recently, CBS announced plans to utilize transponders on GSTAR 4 for satellite news gathering.

News programming is distributed (downlinked) to the CBS affiliates using Galaxy 4 channel 24. At the top of each hour a news recap is broadcast featuring the top stories with the latest video. Each recap is consecutively numbered based on the hour of the day it is broadcast. For example, the 1:00 a.m. recap broadcast would be designated as the first recap, the 2:00 a.m. recap broadcast would be the second recap, and the 24th recap is broadcast at midnight.

A correspondent team dedicated to reporting exclusively for affiliates provides reports for CBS Newspath. Their reports can usually be found starting at 4:45 p.m. and these continue each hour following the recap broadcasts.

National and international newsfeeds to the affiliates occur four times a day. To provide news stories of specific interest to the local markets covered by the affiliates, regional news stories are also broadcast. Regional feeds are broadcast three times a day (early afternoon, late afternoon and evening) for each of the regional areas (East, Northeast, Southeast, Mideast U.S., Midwest, Northwest, and Southwest).

The early afternoon feed is timed to include late breaking news stores that can be used for dinner time news programs. The evening feeds are timed to provide material to use on late night newscasts.

Affiliates can uplink important stories originating in their local market to Newspath for use by other affiliates around the country. Newspath's Live News Center coordinates the satellite news gathering (SNG) resources of the local affiliates and assigns times to the local affiliates for use of the CBS Newspath transponders. Using four fulltime Ku-band transponders plus additional occasional use Ku-band transponders, the affiliates can uplink live news stories 24 hours a day. To use this service a local affiliate contacts the Live News Center to reserve a time slot and be assigned a specific Ku transponder. At the assigned time they uplink their broadcast to the Live News Center who then coordinates the actual live shots. An interruptable feed back (IFB) line is set up for the reporter at the scene. Through an earpiece connected to the IFB, the reporter receives audio cues and other information regarding the shots.

CBS Newspath officials would not confirm which Ku satellites and transponders, are currently used for SNG. However, *Satellite Times*' SSG Ku-band listings indicates that Galaxy 4 transponders 17 and 23 are being used by CBS Newsnet and affiliate feeds.

In addition to being able to obtain national news stories for use in their local markets, CBS Newspath affiliates are compensated for the material they originate that is used on National feeds. The affiliates receive no compensation for material used on the CBS regional feeds since those are being provided on a cooperative basis.

CBS Newspath operates a full time European distribution link on Panamsat 1 using digicipher compression. The link originates from New York and services 38 European Newspath subscribers as well as the CBS News European bureaus. Newspath receives international stories from the CBS News London Bureau via a 24 hour analog link on one of the Intelsat satellites.

The CBS TV network uses a number of other satellite transponders on C-band for prime time and other programming distribution to its affiliates. At various times Galaxy 4, channels 16 through 20; Galaxy 3 channel 1; and Galaxy 7 channels 2, 18 and 19 have been observed with CBS programming. Recently most of these network feeds are in the clear, but VC-1 scrambling has been observed on an irregular basis.

NBC News Channel

The NBC News Channel operates their news programming distribution on the Ku-band using GE Americom's K2 satellite transponder 13. The NBC News Channel operates around the clock providing news for network affiliate use in their local markets. The News Channel and network affiliates operate 62 SNG trucks. In addition, they have 54 fixed uplink sites called "Pups" which is an acronym for portable uplink sites. They also operate 15 lower powered fixed uplink sites known as "Son of Pups." The word portable is relative in the sense that it could take several days to assemble or disassemble a Pup according to one NBC network official.

Unlike ABC NewsOne and CBS Newspath, which are head-

Often live and unedited, the raw news coverage provided on these channels offers a glimpse of the events with a perspective not available to the terrestrial or cable TV viewer. It's news as it happens, On The Air.

NBC News Channel headquarters in Charlotte, North Carolina (NBC News Channel Photo).

quartered in New York City, NBC News Channel located their headquarters in Charlotte, North Carolina. Located in a building next to the NBC Charlotte affiliate, News Channel shares a studio at night with the local affiliate to produce the Nightside program. Charlotte is also well situated to receive the network feed from the NBC news bureau in London which is broadcast on Intelsat 601 (3920 MHz) at 27.5 deg West.

A daily schedule of planned broadcasts is sent via an audio subcarrier on K2 transponder 13. At the affiliates the subcarrier is received on a device known as the "black box" that is hooked into either a printer or computer. This provides the affiliate with a list of available programming and transponders to be used. The black box has a speaker and is capable of receiving urgent voice messages to alert the affiliate of news events.

This summer, GE Americom plans to launch the GE1 satellite. The NBC News Channel will own two Ku transponders on GE1 and will switch over the news programming distribution from the K2 bird. The NBC Network will use six additional Ku-band transponders on GE1 for network programming and one C-band channel.

The Hughes SBS4 satellite is the main NBC SNG satellite. NBC owns all of the transponders on this spacecraft. News Channel uses transponders 2, 4, 7, 8, and 10 for SNG feeds. They also use transponder 1 for digital news express communications. If demand requires, SBS2 which is in an inclined orbit is used for SNG broadcasts.

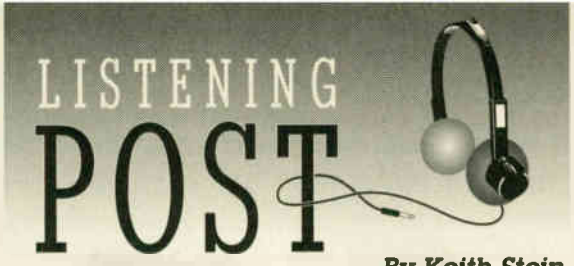
The NBC television network uses a number of other satellite transponders on both Ku- and C-band for prime time and programming distribution to the affiliates. The K2 satellite transponders 2, 4, 5, 9 and 11 are used by the network, as well as transponder 7, which typically is used for backhaul. Galaxy 6 channel 5 has also been observed with NBC programming.

FOX News

A relative newcomer to the network arena, FOX also apparently provides news feeds to its affiliates. They have been observed at 10:45 p.m. using Telstar T401 channel 7. Channel 10 on T401 has also been observed with live news shots from affiliates. The FOX network uses a number of satellite transponders on C-band for prime time and program distribution to the affiliates. These channels include 4, 7, 9, 10, 13 and 14 on the T401 satellite.

The affiliate news services run by the networks provide international, national, and regional news programming for use by their affiliates. The entire gambit of news events from sports to live disaster coverage can be viewed on these channels. Often live and unedited, the raw news coverage provided on these channels offers a glimpse of the events with a perspective not available to the terrestrial or cable TV viewer. It's news as it happens, *On The Air.*

Satellite Times and columnist Steve Handler would like to thank ABC NewsOne, CBS Newspath and the NBC News Channel for their cooperation in preparing this column. A complete schedule for ABC NewsOne and the NBC News Channel is on page 95 in this issue of *ST*. All times used in this column are Eastern Time. ST



By Keith Stein
us011192@pop3.interramp.com

The Old Russian and U.S. Navigation Satellites

You know, after looking over the last two columns in the Listening Post, did you notice something? I never did review what kind of equipment you would need to participate in the VHFsatellite area of listening. No, I just jumped right into throwing frequencies at you, with modes, orbits, etc. Well there is a reason for that. The next area we are going to explore is the best place to test a potential VHF satellite receiver before you buy it. If you don't hear anything in this band, don't buy that receiver your test driving. Lets see if we can navigate you toward a good receiver, hint hint.

The most common areas to find satellites in the VHF high band are: 135.555-144.000 MHz (Jan/Feb 96 issue), 145.800-146.000 MHz (Mar/Apr 96 issue), 149.900-150.100 MHz (this issue), and 150.100-225.000 MHz (next issue).

Receivers come in a variety of models. If you are in the mobile a lot you might consider installing a mobile unit. You may want a nice hand-held to clip on your belt. Or do you enjoy sitting back in your favorite easy chair and listening at home? A base unit would do the trick with an external antenna positioned on the roof.

Now to give you an idea of how simple your setup could be, let me tell you what I use in my satellite listening post. First off, you do not need a large satellite dish to hear satellite transmissions. I live in an apartment and use a Radio Shack PRO-2006, RG-8 coax cable with a Radio Shack Discone antenna.

Take a minute and look back at the past three issues of the *Listening Post* and note all the intercept reports with my name at the end. You can get an idea of the range of targets available with even the simplest of equipment.

Where is my antenna located? Sitting on the ground floor taped to my patio railing with only a direct visible shot from about 0 degrees North to 180 degrees South. I can't see anything in the West. Even with this simple setup, you can be a major player in the satellite monitoring hobby.

Any scanner that covers the frequencies ranges mentioned above will do for starters. As you progress more in the hobby, you should consider upgrading your receiving equipment and antennas.

Ok, now that you have your equipment all setup what should you start with? I've got just the thing.

Russian Navigation Satellites

The easiest VHF satellites for a new hobbyist to monitor are the Russian navigation satellites in the 149.91-150.03 MHz range. These spacecraft are launched from the Plesetsk cosmodrome in northern Russia (62.8 degrees north latitude, 40.1 degrees east longitude) aboard Cosmos launch vehicles. They are launched into a 1,020 km x 965 km orbits inclined 82.9 degrees with an orbital period is about 104 minutes. Transmitter power has been estimated at about 10 watts, making them very easy to receive.

A total of ten satellites are active at any one time in the constellation. Four are used by civilians, and six are used by the Russian military. Past analysis indicates a FSK binary signal transmitted at a rate of 50 bits per second.

These systems first appeared in 1967, each one transmitting on two frequencies:

149.910/399.760(military) 149.940/399.840(military)
149.970/399.920(military) 150.000/400.000(civilian)
150.030/400.080(military)

U.S. Transit Navigation Satellites

If you read the last issue of *ST* you know all about the new Global Positioning System (GPS) satellites. But where did all this space navigation technology start?

In 1958 the Navy contracted with the John Hopkins University's Applied Physics Laboratory (APL) to build the first U.S. navigation satellites called the Transit system. The first one was launched in 1959 and these launches continued with the system achieving a reliability record of 99.9 percent. Some of the Transit satellites operated for as long as ten years. Are they all dead and gone? Not hardly.

Today you can still hear Transit 5 which was launched 32 years ago. The satellite continues to send its normal telemetry except it has been speeded up by a factor of 2 or 3 times from what it was in its early days. This speeding up occurred around 1986 according to other listening post hobbyist. Normal telemetry signals may still be found on some of the Transits operating on 149.997 MHz. These are some oldies, but goodies, give them a try:

136.6500 MHz (TRANSIT 5) 149.9787 MHz
149.9875 MHz 149.9880 Mhz

The U.S. Navy is going ahead with plans to shutdown the Transit satellites at the end of this year, replacing the 32-year-old system with the Global Positioning System (GPS).

Changes Coming to NASA's Spacecraft Tracking Network

The NASA Indian Ocean Station (IOS) is scheduled to close September 30, 1996. The S-band equipment would be moved to Diego Garcia. NASA has also stated that it would like to have the UHF equipment moved to Diego Garcia to provide emergency communications support for the space shuttle. An option to return the equipment to Goddard Space Flight Center (GSFC) exists as well.

A major part of the space tracking network are the six Tracking and Data Relay Satellites on orbit. All of the TDRS satellites are in good health except for F-1. TDRS F-1 is being drifted to a new location at 49 degrees West to provide Expendable Launch Vehicle (ELV) support. As part of this support the Atlas launch vehicle launch on January 31 carried a TDRSS compatible transmitter to study converting it and other launch vehicles from a

A major part of the space tracking network are the six Tracking and Data Relay Satellites on orbit. All of the TDRS satellites are in good health except for F-1. TDRS F-1 is being drifted to a new location at 49 degrees West to provide Expendable Launch Vehicle (ELV) support.

terrestrial range tracking capability to the TDRS system. If these test prove productive, it will eliminate the need for the Advanced Range Instrumentation Aircraft (ARIA) tracking support.

As reported in the March/April 1996 issue of *Satellite Times*, the Dryden Flight Research Center has now supported 16 Mir orbits since November. DFRC considers 11 to have been successfully supported. Five orbits were unsuccessful due to scheduling problems. During the past three months, DFRC has been averaging 1 orbit per week of Mir support using two ICOM-820H transceivers, two yagi antennas, and two Yaesu antenna rotators to provide two-way communications with Mir. With this new capability in place Mir should be audible throughout the United States on its 143.625 MHz downlink.

And finally, a newly automated miniaturized tracking station built from off-the-shelf electronic components has been developed by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, CA. The station, called a low earth orbit (LEO) terminal and it is currently tracking and commanding NASA's Cosmic Background Explorer (COBE) without any operator intervention.

Mailbag

Don Henry VE6VAC of Vermilion, Alberta, Canada, writes, "your article in January/February issue on page 35 was excellent. At present I can receive NOAA and Meteor satellites in the 137 MHz band and I use a 12-foot dish for GOES on 1691.0 MHz. I have read that GOES sends down a VHF signal. Is it as strong as the 1691.0 MHz signal? Does it contain the same information as 1691.0 MHz?"

Well Don, the VHF frequency 137.080 MHz you are speaking of was used by the older GOES 2 & 3 satellites. I believe it was used to downlink housekeeping data and maybe some imagery. Anyone want to confirm this? In the meantime Don, give it a try and let us know if you find something.

Andrew Gast KC5LWY of Pasadena, Texas, writes, "I live in the suburbs of Houston, next to NASA. I often listen to the 2-meter repeater that the government employees have down on building 5, thats where mission control is housed. On Tuesday's at 10:00 p.m., local amateur radio satellite (AMSAT) hobbyist fire up their weekly net. They beam the net up to Galaxy 3, and on the Internet. JSC is really busy during shuttle missions. If you would like, I could share the frequencies?"

Andrew, please do pass along whatever you have available, that way everyone can take note and activate their own listening post to monitor the action.

Well thats it for this issue, next time we'll look at the 150.1-225.0 MHz band. Now it is time to see what you have been hearing at your satellite listening post. ST

Abbreviations used in this column

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

ARIA	Advanced Range Instrumentation Aircraft
AFB	Air Force Base
CW	Morse code (continuous wave)
G	Gigahertz
K	Kilohertz
KSC	Kennedy Space Center
LSB	Lower sideband
NASA	National Aeronautics and Space Administration
NEAR	Near Earth Asteroid Rendezvous spacecraft
USB	Upper Side Band
UTC	Coordinated Universal Time
W	West
WBFM	Wideband FM

K3840	AMSAT North America east coast net heard at 0200 in LSB with W8GUS-Ron as net control station. (Keith Stein-Woodbridge, VA)
K3860	Amateur radio station WA3NAN providing retransmission of space shuttle air-to-ground communications (Mission STS-75) at 0147 in LSB. Phone number of the station is (301) 286-6673 and they do welcome calls. (Stein-VA)
K10780	Clearance 1 calling Fisher, Cape Radio answers with a radio check at 1754 in USB. USS Moosbrugger (DD-980) calling Cape Radio, Cape Radio calling USS Moosbrugger, neither heard each other. USCGC Vigorous (WMEC-627) working USS Moosbrugger for radio check. All units then switched to 6937 USB, where Cape Radio called USS Moosbrugger for radio check. (Rick Baker-Austintown, OH). USS Moosebruger calling Cape Radio. Cape Radio said they were simulcasting on 10780 and 6937. Asked Moosebruger to respond with best freq heard. (Phil P.-CA) Lots of activity for space shuttle launch (Mission STS-75)-Keith.
K11175	NASA 1 was active at 1400 with a phone patch through MacDill. (Jeff Haverlah-Houston, TX) NASA 931 heard at 1900 with a radio check with Offutt AFB in USB. First called on 11176 and was advised of frequency change. Called on 11175 to confirm re-channel of radio. (Don Edwards-Northville, NY)
K11407	ARIA 1 and 2 heard at 2155 in USB setting up a data link after supporting launch of NASA's NEAR mission. NEAR was launched at 2043. (Baker-Austintown, OH)
K14295	Amateur radio station WA3NAN providing retransmissions of space shuttle air-to-ground communications (Mission STS-75) at 0715 in USB. (Stein-VA)
K15016	MacDill AFB heard working NASA 1 (Gulfstream-1159) at 2114 in USB. Sounded like they had just departed somewhere in Brazil, but I did not catch destination. (Don Edwards-NY)
M119.100	NASA 1 (Gulfstream-1159) heard departing Washington National Airport at 1300 in AM. This is NASA Administrator Daniel Goldin's aircraft. (Keith Stein-Washington, DC)
M121.750	Strong signal heard from Soyuz TM-23 at 1708 in WBFM about 4 1/2 hours after launch. Launch occurred at 1234. (Sven Grahn-Stockholm, Sweden)
M136.650	Weak signal from U.S. navigation satellite Transit 5BN 5, heard at 0333 in NFM. (Kim Pettersson SM1TDX-Gotland, Sweden)
M137.500	APT imagery was received from NOAA 12 at 0736 in NFM. (Tromso Satellite Station-Norway)
M137.620	APT imagery was received from NOAA 14 at 1241 in NFM. (Tromso Satellite Station-Norway)
M143.625	Heard voice from Mir space station crew returning from spacewalk at 2002 in NFM. (Ivan Artner-Budapest, Hungry) Caught a pass of the Mir at *ST* headquarters on a Bearcat 210XLT and discone at 1300. Heard the two Russian cosmonauts talking in Russian and Shannon Lucid in the background talking in English in NFM (probably working the 145.550 MHz amateur downlink). (Larry Van Horn-Brasstown, NC)
M145.550	Packet telemetry signal heard from Russian space station Mir at 0611in NFM. (Stein-VA)
M145.825	Amateur radio satellite DOVE (also known as OSCAR 17 or DO-17) was heard sending packet telemetry at 0257 in NFM. (Stein-VA)
M145.910	Cosmos 2123 amateur radio package (RS-12/13) was heard at 0820 sending strong CW signals between 145.910-145.950 MHz. (Lutz Schindler-Germany)
M146.835	Washington, D.C. local AMSAT net heard at 0200 in NFM. Net control station was WD8LAQ in Bowie, MD. (Stein-VA)
M147.100	The local AMSAT net was heard at 0300 in NFM on the WD5BDX repeater. (Andrew Gast-Pasadena, TX)
M147.450	Amateur radio station WA3NAN providing retransmission of space shuttle air-to-ground communications (STS-75) at 1552 in NFM. (Stein-VA)
M149.910	Possible Russian military navigation satellite Cosmos 2310 at about 1712 in NFM. (Jeff Hunt-Charlotte Hall, MD)
M149.940	Russian military navigation satellite Cosmos 2218 heard at 0014 in NFM. (Stein-VA)
M149.970	Russian military navigation satellite Cosmos 2327 heard at 0329 in NFM. Cosmos 2173 also heard at 2327. (Stein-VA)
M150.000	Russian civilian navigation satellite Cosmos 2315 heard at 1736. Nadezhda 3 also heard here and 400.0 MHz at 2021. The Tsikada spacecraft was heard at 2307 and Nadezhda 4 heard at 0238 All transmissions in NFM. (Stein-VA)
M186.000	Extremely strong wideband FM telemetry heard at 1707 from Soyuz TM-23. (Grahn-Sweden)
M259.700	Voice downlink was heard from space shuttle Atlantis (mission STS-76) during launch at 0821 in AM (Stein-VA) Caught the STS-76 crew during a pass on the last day of the mission in AM. Was also listening to WA3NAN on 7185 LSB at the time for the echo effect. (Van Horn-NC)
M922.750	Telemetry heard from Soyuz TM-23 at 1707. (Grahn-Sweden)
M926.100	Carrier signal heard from Soyuz TM-23 at 1707. (Grahn-Sweden)
G3.840	At 2330, the BBC World Service subcarrier on Satcom C3 (131.0 deg W) transponder 7 switched to BBC Domestic Radio 4 programming (Mike Gingell-Raleigh, NC).
G10.820	Live video from the Russian relay satellite Cosmos 2054 (15.8 deg W) showing Mir space station crew preparing for spacewalk at 1340. (Artner-Hungry)
G10.830	Live video from Russian relay satellite Cosmos 2054 (15.8 deg W) showing Soyuz TM-23 docking with Mir. (Artner-Hungry)
G11.163	Thai-Wave has been test broadcasting between 1800 to 2000 on Eutelsat 2 F3 (16 deg E), audio sub-carriers 6.60 and 7.20 are used (Mike Ginger-Guildford, UK).
G11.525	Intelsat K (21.5 deg W) providing live coverage of space shuttle launch (Mission STS-75) at 2000. (Artner-Hungry)

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

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

Classical music	E2, 22	6.30
KUCV-FM (90.9) Lincoln, Neb. (Neb. Public Radio)	S3, 2/4	5.76/5.94 (DS)
SuperAudio — Classical Collections	G5, 21	6.30/6.48 (DS)
WFMT-FM (98.7) Chicago, Ill.	G5, 7	6.30/6.48 (DS)
WQXR-FM (96.3) New York, N.Y., ID-*96.3 FM*	C4, 15	6.30/6.48 (DS)

Satellite Computer Services

Planet Connect, Planet Systems, Inc 19.2 kbps serv.	G4, 6	7.398
Planet Connect, Planet Systems, Inc 100 kbps serv.	G1, 9	7.80
Skylink, Planet Systems, Inc	G1, 9	7.265
	G1, 14	7.265
	G4, 6	7.264
Storyvision	G5, 3	7.30
Superguide	G5, 7	5.48

Contemporary Music

Safeway In-Store Radio — contemporary	S3, 18	5.78, 5.96, 6.48
SuperAudio — *Light and Lively Rock*	G5, 21	5.96, 6.12 (DS)

Country Music

CINC-FM (96.3) Thompson, Manitoba	E1, 2	6.40
Safeway In-Store Radio — country	S3, 18	6.12
SuperAudio — *American Country Favorites*	G5, 21	5.04/7.74 (DS)
Transtar III radio network	S3, 9	5.76/5.94 (DS)
WOKI-FM (100.3) Oak Ridge-Knoxville, Tenn., ID-*The Hit Kicker*	E2, 18	6.20
WSM-AM (650) Nashville, Tenn.	G5, 18	7.38, 7.56

Easy Listening Music

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

Foreign Language Programming

Antenna TV (Greece)	T3, 22	5.85
Arab Network of America radio network	G6, 10	5.80
CBC Radio-East (French)	E1, 20	5.38/5.58 (DS)
	E1, 20	7.36
CHIN-AM/FM (1540/100.7) Toronto, Ontario Canada, ID-*CHIN* — multilingual	E1, 2	7.89
Cosmos FM, Hellenic Public Radio, New York, N.Y. (Greek)	S2, 11	8.30
DZMM-Radyo Patrol (from Philippines)	G4, 24 (Ku-band)	6.80
French language audio service	E1, 15	6.12
India ethnic radio	E1, 2	7.61
Indian Sangeet Sager	E1, 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)	E1, 15	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
Radio Otto (Italian)	T402R,18	5.80
Russian-American radio network	SBS5, 14 (Ku-band)	6.20
The Clanny Channel (Spanish) — Anti-Castro Cuban clandestine programming-occ. audio	S2, 4	5.80
Trinity Broadcasting radio service (Spanish) SAP — religious	G5, 3	5.96
WCMQ-FM (92.3) Hialeah, Fla. (Spanish), ID-*Mega 92* — contemporary hit radio	S2, 4	7.74, 7.92
WCRP-FM (88.1) Guyama, P.R. (Spanish) — religious	G4, 6	6.53
WLIR-AM (1300) Spring Valley, N.Y. (Ethnic)	S2, 1	7.60
WNWK-FM (105.9) Newark, N.J.(Ethnic)	S2, 11	8.30
XEW-AM (900) Mexico City, Mexico (Spanish), ID-*LV de la America Latina*	M2, 8	6.80
XEW-FM (96.9) Mexico City, Mexico (Spanish), ID-*W-FM 96.9*	SD1, 7	7.38
XEWA-AM (540) Monterrey, Mexico (Spanish), ID-*Super Estelar* — contemporary music	M2, 8	7.38
XEX-AM (730) Mexico City, Mexico (Spanish), ID-*Frecuencia Libre*	M2, 14	6.80

Jazz Music

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

News and Information Programming

Arkansas Radio Network	G4, 6	6.20
Business Radio Network	C4, 10	8.06 (N)
	E1, 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
USA Radio Network — news, talk and information (Ch 2)	S3, 13	5.01 (Ch 1), 5.20
WCBS-AM (880) New York, N.Y. — news	G7, 19	7.38
WCCO-AM (830) Minneapolis, Minn.	G6, 15	6.20
WGN-AM (720) Chicago, Ill./Interstate Radio Network (overnight) — talk	E1, 2	5.22

Religious Programming

Ambassasor Inspirational Radio	S3, 15	5.96, 6.48 (DS)
American Spirit Network/KYND-AM (1520) Houston, Tex. — Religious/variety (weekends)	S3, 24	7.40
Brother Staire Radio	G5, 6	6.48
CBN Radio Network/Standard News	G5, 11	6.12
	C3, 1	6.20
Christian Music Network Lakeland, Fla	S2, 21	6.20, 76.0
Heaven Radio Network	G1, 17	7.92
Inspirational Music (no ID)	G5, 6	7.38
KILA-FM (90.5) Las Vegas, Nev. — SOS radio net.k	C4, 8	7.38/7.56 (DS)
Salem Radio Network	S3, 17	5.01
Trinity Broadcasting radio service	G5, 3	5.58/5.78 (DS)
WHME-FM (103.1) South Bend, Ind, ID-*Harvest FM*	G4, 15	5.58/5.78
WROL-AM (950) Boston, Mass. (occasional Spanish)	S3, 3	6.20
Z-music — Christian rock	G1, 6	7.38/7.56

Rock Music

CHOZ-FM (94.7) St. John's, Newfoundland Canada, ID-*Oz FM*	E2, 20	5.76/5.96 (DS)
CILQ-FM (107.1) Toronto, Ontario Canada, ID-*Q-107*	E1, 2	5.76/5.94 (DS)
Safeway In-Store — oldies	S3, 18	5.20, 5.40, 7.58
Seltech Radio Syndicated service — classic rock	E1, 2	5.40/5.58 (DS)
SuperAudio — *Classic Hits* - oldies	G5, 21	8.10/8.30 (DS)

Satellite Radio Guide

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

Speciality Formats

Aries In Touch Reading Service	C5, 24	6.48
	C4,10	7.87
Colorado Talking Book Network	C1, 2	5.58
C-SPAN I ASAP (program schedule)	C3, 7	5.58
C-SPAN II ASAP (program schedule)	C4, 19	5.58
Georgia Radio Reading Service	T401, 14 (Ku-band)	5.76
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	E1, 16	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
Eagle Radio Network	G6,14	7.56
For the People radio network — (Chuck Harder) talk and information	C1, 2	7.50
KTRT-AM (1270) Claremore, OK	T2, 2	5.60
Marinet Broadcasting	G6, 23	8.10
One on One Sports radio network — sports talk	E1, 2	7.51
Practical Radio Communications (audio distribution circuit)	T2, 2	7.90
Prime Sports Radio — sports talk and information	C1, 10	7.20
	S3, 24	5.80
Sun Radio Network — talk programs (backhauls)	C1, 15	7.58
Talk America — talk programs	S3, 9	6.80
Talk Radio Network — talk programs	C1, 5	5.80
Tech Talk Network	E2, 18	5.80
WWTN-FM (99.7) Manchester, TN — news and talk	G15,18	7.38,7.56

Variety Programming

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

Satcom K2 Transponder 12

Background music services: Some of these are Muzak ™ carriers and others are retail in-store network background music: .270, .390, .510, .630, .750, .870, .990, 1.110, 1.230, 1.350, 1.470, 1.590, 1.710, 1.830, 1.950, 2.190, 2.310, 3.330, and 4.255 MHz
Blank Audio carriers: .150, 2.945, and 2.990 MHz
Data Transmissions: 3.050, 3.110, 3.155, 4.115, 4.130, and 4.160 MHz
Generic News: 3.510 MHz
In-store networks: 2.070, 2.730, 3.240, 3.420, 3.600, 3.690, 3.780, and 3.860 MHz

Spacenet 3 Transponder 13

Ambassador Inspirational Radio: 1.420, 4.470, and 4.650 MHz
Blank Audio carrier: 2.500 and 3.390 MHz
Hot Tub Radio Party Network: 1.050 MHz
International Broadcasting Network: 4.830 MHz
Religious Backhauls (various): 1.235 MHz
Satellite Music Network — *Country Coast-to-Coast*: 3.570 and 3.750 MHz
Satellite Music Network — *Good Time Rock and Roll Oldies*: 2.670 MHz
Satellite Music Network — *Pure Gold*: 2.860 and 3.030 MHz
Satellite Music Network — *Starstation*: 3.930 and 4.110 MHz
"Unforgetable Music of All Time" music service: 2.130 and 2.310 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

Childrens Sunshine Network: 1.275 MHz
Data Transmission: .840 and 1.225 MHz
In-Touch — religious: 4.470 MHz
Salem Satellite Network: 4.650 and 5.010 Mhz
Satellite Music Network — *Traditional Country*: 3.570 and 3.750 MHz
Skylight — religious: 1.770 and 4.260 MHz
UPI Radio Network: .330 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, Wash — news, talk, and sports talk radio/Seattle Mariners MLB radio network
1405.40 (54.6)	Sports Byline USA/Sports Byline Weekend
1404.60 (55.4)	Talk America Radio Network
1404.00 (56.0)	Occasional audio
1403.80 (56.2)	Occasional audio/Free Enterprise Radio Network
1403.20 (56.8)	Motor Racing Network (MRN)
1400.80 (59.2)	WBAL-AM (1090) Baltimore, Md — news/talk/Baltimore Orioles MLB radio network
1397.40 (62.6)	Occasional audio
1397.20 (62.8)	WTMJ-AM (620) Milwaukee, Wis — talk radio/Univ. of Wisconsin college sports/Milwaukee Brewers MLB radio network
1393.40 (66.6)	WGN-AM (720) Chicago, Ill — talk radio/Interstate Radio Network (IRN)/Chicago Cubs MLB radio network
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, Ill — talk radio/Interstate Radio Network (IRN)/Chicago Cubs MLB radio network
1391.60 (68.4)	XEPRS-AM (1090) Tijuana, Mexico — Spanish language programming, ID - *Radio Express*
1390.60 (69.4)	Los Angeles Dodgers MLB radio network (English)
1390.40 (69.6)	Los Angeles Dodgers MLB radio network (Spanish)
1389.70 (70.3)	Occasional audio/data transmissions (burst)
1389.50 (70.5)	Data transmissions (burst)
1388.90 (71.1)	Occasional audio
1387.10 (72.9)	Michigan News Network (MNN)/Univ. of Michigan college sports
1386.70 (73.3)	Michigan News Network (MNN)
1386.50 (73.5)	WJR-AM (760) Detroit, Mich — talk radio/Detroit Tigers MLB radio network
1386.30 (73.7)	Illinois News Network
1385.80 (74.2)	WMAQ-AM (670) Chicago, Ill — news/Chicago White Sox MLB radio network
1385.10 (74.9)	For the People Radio Network
1384.20 (75.8)	California Angels MLB radio network
1383.80 (76.2)	KJR-AM (950) Seattle, Wash — sports talk radio
1383.40 (76.6)	Oakland A's MLB radio network
1377.90 (82.1)	Occasional audio
1375.40 (84.6)	USA Radio Network/Grow-wise Gardner Network
1374.10 (85.9)	Northwest Direct — news and talk/Oregon State college sports

Satcom K2 Transponder 2-Vertical (Ku-band)

1010.60	Foreign language audio service identifying as *Radio Tejan*

Spacenet 3 Transponder 13-Horizontal (C-band)

1207.90 (52.1)	Wisconsin Voice of Christian Youth (VCY) America Radio Network — religious
1207.20 (52.8)	Good News Radio Network — christian radio
1207.00 (53.0)	Good News Radio Network — christian radio
1206.70 (53.3)	Data Transmission
1206.55 (53.45)	ABC Satellite Music Network — adult contemporary *Starstation*
1206.30 (53.7)	ABC Satellite Music Network — adult contemporary *Starstation*
1206.00 (54.0)	ABC Satellite Music Network — modern country *Country Coast-to-Coast*
1205.85 (54.15)	ABC Satellite Music Network — modern country *Country Coast-to-Coast*
1205.65 (54.35)	"Unforgetable Music of All Time" music service
1205.40 (54.6)	"Unforgetable Music of All Time" music service
1204.45 (55.55)	KJAV-FM (104.9) Alamo, Tex — spanish language religious, Nuevo Radio Christiana Network
1204.25 (55.75)	Wisconsin Voice of Christian Youth (VCY) America Radio Network — religious
1202.25 (57.75)	ABC Satellite Music Network — golden oldies format *Pure Gold*
1202.10 (57.9)	ABC Satellite Music Network — golden oldies format *Pure Gold*
1201.90 (58.1)	Occasional audio
1201.70 (58.3)	Hot Tub Radio Party Network
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)

1445.00 (55.0)	WPGC-FM (95.5) Morningside, Md. — R&B format
1444.45 (55.55)	Data transmissions
1443.80 (56.2)	Voice of Free China (ISWBC) Taipei, Taiwan
1443.60 (56.4)	KBLA-AM (1580) Santa Monica, Calif. — *Radio Korea*
1443.40 (56.6)	Voice of Free China (ISWBC) Taipei, Taiwan
1438.30 (61.7)	WWRV-AM (1330) New York, N.Y. — Spanish religious programming and music, ID - *Radio Vision Christiana de Internacional*
1436.50 (63.5)	Radio Labio, Los Angeles, Calif — spanish talk radio
1436.30 (63.7)	KOJY-AM (540) Costa Mesa, Calif/KJQI-AM (1260) Beverly Hills, Calif — all news
1436.00 (64.0)	KUSC-FM (91.5) Los Angeles, Calif — fine arts, National Public Radio (NPR) affiliate
1435.70 (64.3)	KUSC-FM (91.5) Los Angeles, Calif — fine arts, National Public Radio (NPR) affiliate
1429.00 (71.0)	Occasional audio

Galaxy 4 Transponder 2-Vertical (C-band)

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

Galaxy 4 Transponder 3-Horizontal (C-band)

1405.00 (55.0)	Mutual Broadcasting System (MBS)/Georgia Southern college sports
1404.80 (55.2)	KOA-AM (850)/KTLK-AM (760) Denver, Colo — news and talk/Univ. of Colorado college sports/Colorado Rockies MLB radio network
1404.40 (55.6)	Tennessee Radio Network (TRN)/Univ. of Tennessee college sports
1404.00 (56.0)	South Carolina Radio Network/South Carolina State college sports
1403.50 (56.5)	International Broadcasting Network (IBN) — Lutheran religious programming/Home Front program (Sat 10a-2p Eastern Time)
1403.00 (57.0)	Minnesota Public Radio Network
1402.40 (57.6)	KNOW-FM (95.3) St. Paul, Minn — fine arts, Minnesota Public Radio (occasional audio)
1402.10 (57.9)	KNOW-FM (95.3) St. Paul, Minn — fine arts, Minnesota Public Radio
1398.50 (61.5)	Occasional audio
1398.30 (61.7)	WSB-AM (750) Atlanta, GA — news/talk/Univ. of Georgia college sports/Atlanta Braves MLB radio network
1397.80 (62.2)	Occasional audio
1397.50 (62.5)	Minnesota Talking Book network
1397.30 (62.7)	WSB-AM (750) Atlanta, GA — news/talk/Univ. of Georgia college sports/Atlanta Braves MLB radio network
1396.90 (63.1)	KRLD-AM (1080) Dallas/Ft Worth, TX - talk/Texas State Network flagship
1396.40 (63.4)	Georgia Network News (GNN)
1396.20 (63.8)	WCNN-AM (680) Atlanta, GA — all sports talk radio/Georgia Tech college sports
1396.00 (64.0)	WHO-AM (1040) Des Moines, Iowa — talk/Iowa News Network/Iowa college sports
1395.80 (64.2)	Kentucky News Network/Univ. of Kentucky college sports
1395.10 (64.9)	Occasional audio
1394.70 (65.3)	WHAS-AM (840) Louisville, Ky — adult contemporary music/Univ of Louisville college sports
1394.40 (65.6)	Minnesota Public Radio
1394.00 (66.0)	Minnesota Public Radio
1389.00 (71.0)	Occasional audio
1388.90 (71.1)	Data transmissions (burst)
1387.80 (72.2)	Data transmissions (constant)
1384.40 (75.6)	KOA-AM (850)/KTLK-AM (760) Denver, Colo — news and talk/Univ. of Colorado college sports/Colorado Rockies MLB radio network
1384.20 (75.8)	WSB-AM (750) Atlanta, Ga. — news and talk/Univ. of Georgia college sports/Atlanta Braves MLB radio network
1383.10 (76.9)	VSA Radio Network — Ag news/Texas A&M college sports
1382.60 (77.4)	Soldiers Radio Satellite (SRS) network — U.S. Army information and entertainment/Army college sports
1382.30 (77.7)	Motor Racing Network (occasional audio)
1382.00 (78.0)	WFAE-FM (90.7) Charlotte, N.C. — NPR affiliate/Univ. of South Carolina college sports
1381.80 (78.2)	WHO-AM (1040) Des Moines, Iowa — talk radio/Iowa News Network/Iowa college sports
1381.60 (78.4)	Alabama Radio Network/Univ of Alabama-Birmingham college sports
1377.40 (82.6)	Data transmission (packet burst/tones)
1377.10 (82.9)	In-Touch — reading service for blind
1376.00 (84.0)	Kansas Audio Reader Network

Galaxy 4 Transponder 4-Vertical (C-band)

1387.50 (52.5)	Dakota Sports network/Dakota News network

Single Channel Per Carrier (SCPC) Services Guide

1381.80 (58.2) Data transmissions
1379.00 (61.0) Louisiana Network/Louisiana Ag Network
1378.80 (61.2) WLAC-AM (1510) Nashville, Tenn. — news and talk/Road Gang truck driver radio network (overnight)/Louisiana State Univ. college sports
1377.50 (62.5) Mid-America News Network/Mid-America Ag Network
1377.30 (62.7) WLAC-AM (1510) Nashville, Tenn. — news and talk/Road Gang truck driver radio network (overnight)/Univ. of Tennessee college sports
1376.00 (64.0) Data transmissions
1375.60 (64.4) KISN-AM (570) Salt Lake City, Utah — sports talk/Buzz AAA minor league baseball radio network

Galaxy 4 Transponder 6-Vertical (C-band)

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

Galaxy 4 Transponder 1-Horizontal (Ku-band)

959.20 ABC Satellite Music Network — country and western *Real Country*
959.00 ABC Satellite Music Network — country and western *Real Country*

Anik E2 Transponder 19-Horizontal (C-band)

1086.00 (54.0) Blank audio carrier

Anik E1 Transponder 11-Horizontal (C-band)

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

Anik E1 Transponder 13-Horizontal (C-band)

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

Anik E1 Transponder 15-Horizontal (C-band)

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

Anik E1 Transponder 17-Horizontal (C-band)

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

Anik E1 Transponder 19-Horizontal (C-band)

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

Anik E1 Transponder 21-Horizontal (C-band)

1024.30 (75.7) Canadian weather conditions and warnings

SBS5 Transponder 2-Horizontal (Ku-band)

1010.60 (83.4) Wal-Mart in-store network (English)
1010.20 (83.8) Wal-Mart in-store network (English)
1009.80 (84.2) Sam's Wholesale Club in-store network (English)
1001.40 (92.6) Wal-Mart in-store network (English)
1001.00 (93.0) Wal-Mart in-store network (English and Spanish ads)
1000.60 (93.4) Wal-Mart in-store network (English)

RCA C5 Transponder 3-Vertical (C-band)

1404.80 (55.2) RFD Radio Service
1404.60 (55.4) WGN-AM (720) Chicago, Ill — news/talk
1400.60 (59.4) Learfield Communications/Missouri Net
1400.40 (59.6) Learfield Communications/Missouri Net
1400.20 (59.8) Occasional audio
1400.00 (60.0) Learfield Communications/Purdue college sports
1396.60 (63.4) Kansas Information Network/Kansas Agnet/Kansas State college sports
1396.40 (63.6) Nebraska Ag Network/Univ of Nebraska college sports/S.W. Missouri State college sports
1396.20 (63.8) Missouri Network/Univ. of Illinois college sports/St. Louis Cardinals MLB radio network
1396.00 (64.0) Occasional audio
1395.70 (64.3) Missouri Net/WIBW-AM (580) Topeka, Kan — news and talk/Kansas City Royals MLB radio network
1387.30 (72.7) WPTF-AM (680) Raleigh, N.C. — news and talk/North Carolina News Network
1386.40 (73.6) Learfield Communications/Univ. of Kansas college sports
1386.20 (73.8) Radio Iowa
1385.00 (74.0) People's Radio Network
1384.60 (75.4) North Carolina News Network/Capitol Sports Network
1384.40 (75.6) Capitol Sports Network/Univ of Duke college sports
1384.20 (75.8) Capitol Sports Network/East Carolina college sports
1384.00 (76.0) Occasional audio/ABC Direction Network
1383.80 (76.2) Occasional audio
1383.60 (76.4) Occasional audio
1383.40 (76.6) Capitol Sports Network/Sports Spectacular radio network
1382.90 (77.1) Missouri Net/Univ. of Missouri college sports
1382.60 (77.4) North Carolina News Network
1382.30 (77.7) Virginia News Network/Univ. of Virginia college sports
1382.10 (77.9) Learfield Communications/Missouri Net
1378.70 (81.3) Radio Pennsylvania Network
1378.50 (81.5) Radio Pennsylvania Network
1378.30 (81.7) Radio Pennsylvania Network/Philadelphia Phillies MLB radio network
1378.10 (81.9) Radio Pennsylvania Network

RCA C5 Transponder 21-Vertical (C-band)

1045.00 (55.0) Los Angeles Dodgers MLB radio network (English)
1043.60 (56.4) Unistar Music Radio — *Today's Hits, Yesterday's Favorites*
1043.40 (56.6) CNN Radio Network
1043.20 (56.8) Unistar Music Radio — *Today's Hits, Yesterday's Favorites*
1042.80 (57.2) Unistar Music Radio — *Original Hits*
1042.60 (57.4) Unistar Music Radio — *Original Hits*
1042.40 (57.6) Unistar Music Radio — *Good Times and Great Oldies*
1042.20 (57.8) Data transmissions
1042.00 (58.0) Unistar Music Radio — *Good Times and Great Oldies*
1041.80 (58.2) CNN Radio Network
1034.80 (65.2) Unistar Music Radio — *Country and Western*
1034.60 (65.4) Unistar Music Radio — *Country and Western*
1034.40 (65.6) Unistar Music Radio — *Hits from 60s, 70s, 80s, and Today*
1034.20 (65.8) Data transmissions
1034.00 (66.0) Unistar Music Radio — *Hits from 60s, 70s, 80s, and Today*
1033.70 (66.3) Occasional audio
1033.20 (66.8) Unistar Music Radio — *Country and Western*
1032.80 (67.2) Data transmissions
1032.40 (67.6) Unistar Music Radio — *Country and Western*

International Shortwave Broadcasters via Satellite

By Larry Van Horn and Robert Smathers

AFRICA NO. 1

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

ARAB REPUBLIC OF EGYPT RADIO

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

ARMED FORCES RADIO AND TELEVISION SERVICE (AFRTS)

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

BRITISH BROADCASTING CORPORATION (BBC)

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

C-SPAN AUDIO SERVICES

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

C-SPAN Audio 1

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

C-SPAN Audio 2

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

DEUTSCHE WELLE (DW)

P.O.Box 100 444, 50968 Cologne, Germany. Telephone: +49 221 389 4563 (voice), +49 221 389 3000 (fax)
Deutsche Welle services are available on the following satellites: Satcom C4/F4 (135 west) Tr 5 (3800 MHz V) 7.38/7.56 MHz audio, Astra 1A (19.2 east) on Tr 2 (11229 MHz V) 7.38/7.56 MHz audio, Eutelsat (13.0 east) Tr 27 (11163 MHz V) 7.02/7.20 MHz. audio, Intelsat K (21.5 west) Tr H7 (11605 MHz H), 7.38/7.56 MHz audio, and Intelsat 702 (1.0 west) Tr 23B (3.911 MHz RHCP) digital MPEG-2 subcarrier.

ISLAMIC REPUBLIC OF IRAN BROADCASTING (IRIB)

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

ISRAEL RADIO

P.O. Box 1082, Jerusalem 91010, Israel. Intelsat 702 (1.0 west) Tr 73 (11178 MHz V) 7.20 MHz audio.

LA VOIX DU ZAIRE

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

RADIO ALGIERS INTERNATIONAL

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

RADIO AUSTRALIA

GPO Box 428G, Melbourne, Vic. 3001, Australia. Telephone: +61 3 616 1800 (voice), +61 3 626 1899 (fax)
Palapa B2P (133.0 east) Tr 9 (3880 MHz H) 7.20 MHz audio

RADIO BELGRADE

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

RADIO BUDAPEST

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

RADIO CANADA INTERNATIONAL

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

RADIO EXTERIOR DE ESPANA (REE)

Apartado 156202, Madrid 28080, Spain. Telephone +34 13461083/1080/1079/1121 (voice); 34 13461097 (fax).
Eutelsat II F6 (Hot Bird 1 at 13.0 east) (11220 MHz H) 7.56 MHz audio and Hispasat 1A/B (31.0 west) Tr 6 (12149 MHz RHCP) 7.92 MHz audio.

RADIO FRANCE INTERNATIONAL (RFI)

B.P. 9516, Paris F-75016, France. Telephone: +33 1 42 30 30 62 (voice), +33 1 42 30 40 37 (fax)
RFI broadcast can be heard in French, 24-hours a day.on the following satellites: Intelsat 601 (27.5 west) Tr 23B (3915 MHz RHCP) 6.40 MHz audio to Africa/Middle east, 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. Satcom C1 (137.0 west) Tr 15 (4000 MHz V) 7.38 MHz audio.

RADIO VLAANDEREN INTERNATIONAL

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

RDP INTERNATIONAL

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

SWISS RADIO INTERNATIONAL

Giacomettstrasse 1, CH-3000 Bern 15, Switzerland. Telephone: +41 31 350 9222 (voice), +41 31 350 9569 (fax). SRI uses the following satellites for its external services: Astra 1A (19.2 east) Tr 9 (11332 MHz H) 7.38 MHz audio Multilingual/7.56 MHz English 24-hours, Eutelsat II (13.0 east) (11321 MHz V) 7.74 MHz. audio, Intelsat K (21.5 west) Tr 7 (11605 MHz H) 8.10 MHz audio multilingual 24 hours, and Satcom C4 (135 west) Tr 5 (3800 MHz V) 8.10 MHz.

TRANS WORLD RADIO (TWR)

Astra 1A (19.2 east) Tr 16 (11436 MHz V) 7.38/7.56 MHz audio with German language

International Shortwave Broadcasters via Satellite

programming from Evangeliums Rundfunk and TWR-UK. Astra 1C (19.2 east) Tr 38 (11038 MHz V) 7.38 MHz audio Multilingual from TWR-Europe.

TUNIS INTERNATIONAL RADIO

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

VATICAN RADIO

I-00120, Vatican City State, Italy. Telephone: +396 6988 3551 (voice), +396 6988 3237 (fax) Eutelsat II F1 (13.0 east) Tr 32 (11554 MHz H) 7.74 MHz audio. Reports at presstime indicate that Vatican Radio will be downlinking on two Intelsat C-band birds (34.5 wesr and 66 east) by the fourth quarter of 1995.

VOICE OF AMERICA (United States Information Agency)

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

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

NTSC system baseband subcarrier frequencies

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

PAL system baseband subcarrier frequencies

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

VOICE OF THE ARABS

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

VOICE OF SAHEL

Niger Radio and Television Service. Transmissions of the domestic radio shortwave service have been reported on Intelsat 702 at 1.0 west. No other details are available at this time.

VOICE OF THE IRAQI PEOPLE (CLANDESTINE)

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

WORLD HARVEST INTERNATIONAL RADIO, WHRI-South Bend, Indiana

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

WORLD RADIO NETWORK

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*.

North American Service Schedule

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

UTC/EDT/PDT	SERVICE/PROGRAM
0000/2000/1700	ABC Radio Australia - Melbourne
0100/2100/1800	YLE Radio Finland - Helsinki
0130/2130/1830	Radio Sweden - Stockholm
0200/2200/1900	Radio Prague (Slovakia)
0230/2230/1930	Radio Austria International - Vienna
0300/2300/2000	Polish Radio - Warsaw
0330/2330/2030	Radio Budapest (Hungary)
0400/0000/2100	Radio Telefis Eireann (RTE) - Dublin, Ireland
0500/0100/2200	Channel Africa - Johannesburg, South Africa (Mon-Sat)
0530/0130/2230	BBC Europe Today (Mon-Fri) Glen Hauser's World of Radio (Sat) UN Radio from New York (Sun)
0600/0200/2300	Swiss Radio International - Berne
0630/0230/2330	Radio Canada International - Montreal
0700/0300/0000	ABC Radio Australia - Melbourne
0800/0400/0100	KBS Radio Korea International - Seoul
0900/0500/0200	Voice of Russia - Moscow
0930/0530/0230	Radio Netherlands - Hilversum
1030/0630/0330	Channel Africa - Johannesburg, South Africa (Mon-Sat) Radio Romania International - Bucuresti (Sun)
1100/0700/0400	Radio Australia - Melbourne
1200/0800/0500	Radio Telefis Eireann (RTE) - Dublin, Ireland
1300/0900/0600	Radio Prague (Slovakia)
1330/0930/0630	RTHK - News from Hong Kong (Mon-Fri) Radio Romania International - Bucuresti (Sat) UN Radio from New York (Sun)
1400/1000/0700	YLE Radio Finland - Helsinki
1430/1030/0730	Radio Vlaanderen International - Brussels Calling
1500/1100/0800	Radio France International - Paris
1600/1200/0900	Voice of Russia - Moscow
1630/1230/0930	Radio Netherlands - Hilversum
1730/1330/1030	Radio Telefis Eireann (RTE) - Dublin, Ireland
1800/1400/1100	ABC Radio Australia - Melbourne
1900/1500/1200	Blue Danube Radio - Vienna (Mon-Fri) Glen Hauser's World of Radio (Sat) SABC Network Africa (Sun)
1930/1530/1230	Radio Vlaanderen International - Brussels Calling
2000/1600/1300	BBC Europe Today (Sun-Fri) UN Radio from New York (Sat)
2030/1630/1330	Polish Radio - Warsaw
2100/1700/1400	Radio Telefis Eireann (RTE) - Dublin, Ireland/News and Both Sides
2300/1900/1600	Radio Netherlands - Hilversum

WRN2 — Galaxy 5 (125.0 west) Tr 6 (3820 MHz V) 6.20 MHz audio. New 24 hour multi-lingual channel for North America designed for the re-broadcasting of programs in a variety of languages for domestic FM/AM relays and cable distribution. WRN program information can be heard daily on North American WRN1 service at 1025 and 1725 UTC.

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.

Africa/Asia-Pacific Service

WRN1 - Intelsat 702 (1 west) Tr 23B (3911.5 MHz Circular-Polarization) MPEG2 Audio Stream and Asiasat 2 (100.5 east) Tr 10B (4000 MHz H) 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 0 1480 4320 (voice), +358 0 1481 169 (fax) E-mail: *rfinland@yle,mailnet.fi* Most of YLE's broadcasts to Europe are available on Eutelsat II F1 (13.0 east) Tr 27 (11163 MHz V) 8.10 MHz. audio, and Asiasat 2 (100.5 east) Tr 10B (4000 MHz H) early this year.

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 and programming where 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**

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)	
140-141	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
211	Tell a Friend (DTV)	Contest
212	Turner Network Television (TNT)	TV programming
213	Home Shopping Network (HSN)	Home Shopping
214	Home and Garden TV (HGTV)	Home Improvement
215	E! Entertainment TV (E!)	Speciality
216	MuchMusic (MUCH)	Music Videos
217	Black Entertainment TV (BET)	Entertainment
219	American Movie Classics (AMC)	Movies
220	Turner Classic Movies (TCM)	Movies
221	Arts and Entertainment (A&E)	TV
222	The History Channel (HIST)	History
223	The Disney Channel East (DIS1)	Movies/Kids
224	The Disney Channel West (DIS2)	Movies/Kids
225	The Discovery Channel (DISC)	Science/TV documentary
226	The Learning Channel (TLC)	Science/TV documentary
227	Cartoon Network (TOON)	Cartoons
229	USA Network (USA)	TV
230	Trio (TRIO)	TV
232	The Family Channel (FAM)	TV
233	WTBS-Ind Atlanta, Ga.(TBS)	Superstation
235	The Nashville Network (TNN)	Country/Outdoors
236	Country Music TV (CMT)	Country Music Videos
240	The Sci-Fi Channel (SCFI)	Science Fiction
242	C-SPAN 1 (CSP1)	Congress-House of Representatives
243	C-SPAN 2 (CSP2)	Congress-U.S. Senate
245	Bloomberg Information Television (BIT)	News
246	CNBC (CNBC)	Financial/Talk
247	America's Talking (AT)	Talk
248	The Weather Channel (TWC)	Weather
250	Newsworld International (NWI)	News
252	CNN International (CNNI)/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)	Movies
273	Encore-Westerns (WSTN)	Movies
274	Encore-Mystery (MYST)	Movies
275	Encore-Action (ACTN)	Movies
276	Encore-True Stories (TRUE)	Movies
277	Encore-WAM! (WAM!)	Movies
278	Encore (ENC)	Movies
282	WRAL Raleigh, N.C. (CBS)	Network TV
283	KPIX San Francisco, Calif (CBSW)	Network TV
284	WNBC New York, N.Y. (NBC)	Network TV
285	KNBC Los Angeles, Calif. (NBCW)	Network TV
286	KRMA Denver, Colo. (PBS)	Network TV
287	WJLA Washington, D.C. (ABC)	Network TV
288	KOMO Seattle, Wash. (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 Calendar (DTV)	Promo
302	DirecTV Sports Schedule (DTV)	Promo
303	Newsport (NWSP)	Sports
304	The Golf Channel (GOLF)	Sports
305	Classic Sports Network (CSN)	Sports
306	Speedvision (SV)	Sports
307	Outdoor Life Channel (OL)	Sports
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
331	Prime Sports West (PSW)	Sports
332	SportsChannel Pacific (SCP)	Sports
330-348	NFL Sunday Ticket	Sports
336	DirecTV Sports Schedule (DTV)	Promo
350	NFL Sunday Ticket/NBA League Pass	Sports
356	NFL Sunday Ticket/NBA League Pass	Sports
380	DirecTV Sports Schedule (DTV)	Promo
388	Major League Baseball (MLB)	Sports
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

Direct Broadcast Satellite (DBS) Systems

519	Music Choice — Progressive Country (MC19)	Audio
520	Music Choice — Contemporary Country (MC20)	Audio
521	Music Choice — Country Gold/Classic Country (MC21)	Audio
522	Music Choice — Big Bands Nostalgia (MC22)	Audio
523	Music Choice — Easy Listening (MC23)	Audio
524	Music Choice — Classic Favorites (MC24)	Audio
525	Music Choice — Classics in Concerts (MC25)	Audio
526	Music Choice — Contemporary Christian (MC26)	Audio
527	Music Choice — Gospel (MC27)	Audio
528	Music Choice — Big Kids Music (MC28)	Audio
529	Music Choice — Sounds of the Seasons (MC29)	Audio
530	Music Choice — Bluegrass (MC30)	Audio
531	Music Choice — Rock New Release Show (MC31)	Audio
599	NRTC Radio Service (NRTC) For private use only	

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

899	USSB Programming Higlights	Promo
910	Special Event Programming (BIG2)	Special Events
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'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
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
142	ESPN2	Sports
160	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	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	TBS Atlanta, Ga.	Superstation
232	KTLA Los Angeles, Calif.	Superstation
234	WPIX New York, N.Y.	Superstation
240	WGN Chicago, Ill.	Superstation
241	WNBC-NBC New York, N.Y.	Network TV
243	WRAL-CBS Raleigh, N.C.	Network TV
245	WJAL-ABC Washington, D.C.	Network TV
247	FOXNet	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 1	Movies
311	Showtime 2	Movies
312	Showtime 3	Movies
320	Cinemax 1	Movies
321	Cinemax 2	Movies
322	Cinemax 3	Movies
500	PPV 1 (events)	Pay per view
501	PPV 2	Pay per view
502	PPV 3	Pay per view
503	PPV 4	Pay per view
504	PPV 5	Pay per view
600	RAI (Italy)	International
602	ART	International
700	Preview Channel	Promo
900	Business TV	Financial
901	Business TV	Financial
DISH CD ™		
950	Young Country	Audio
951	Country Gold	Audio
952	Country Currents	Audio
953	Jukebox Gold	Audio
954	70's Song Book	Audio
955	Foreground Music	Audio
956	Adult Contemporary	Audio
957	Album Adult Alternative	Audio
958	HitLine	Audio
959	Classic Rock	Audio
960	Modern Rock	Audio
961	Hard Rock	Audio
962	Hip Hop	Audio
963	Urban Beat	Audio
964	Latin Styles	Audio
965	Fiesta Mexicana	Audio
966	Eurostyle	Audio
967	Mainstream Jazz	Audio
968	Contemporary Jazz Flavors	Audio
969	Expressions	Audio
970	Contemporary Instrumentals	Audio
971	Symphonic Classical	Audio
972	Light Classical	Audio
973	Beautiful Music	Audio
974	Mature Vocals	Audio
975	Contemporary Christian	Audio
976	Children's	Audio

Direct Broadcast Satellite (DBS) Systems

By Larry Van Horn

ExpressVu (Canada)

ExpressVu

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 where 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). 60-CD quality channels of music as well as 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 and programming where not available at presstime.

Primestar (United States)

PRIMESTAR®

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
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, Mass.	Network TV
112	WSB-ABC Atlanta, Ga.	Network TV
117	WUSA-CBS Washington, D.C.	Network TV
120	KTVU-FOX Oakland/San Francisco, Calif	Network TV
124	WHYY-PBS Philadelphia, Penn.	Network TV
131	ESPN	Sports
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

S8S 6 (SBS6) 74º West

1	11717-H	Data transmissions
2	11749.5-V	Occ video/IBM TV [B-MAC]
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)

S8S 4 (S8S4) 77º West (Inclined orbit)

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

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/occ video
5	11847-H	NBC contract channel
6	11876.5-V	Occ video
7	11906-H	NBC contract channel (network feeds)
8	11935.5-V	Chinese Communications Channel [Oak]
9	11965-H	NBC-Mountain
10	11994.5-V	[Compressed video]
11	12024-H	NBC contract channel (network feeds)
12	12053.5-V	FM² services
13	12083-H	NBC NewsChannel
14	12112.5-V	Occ video
15	12142-H	Data transmissions
16	12171.5-V	[Compressed video]

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

Telstar 402R (T402) 89ºWest

5	11850-V	Occ video
6	11863-H	Occ video
7	11910-V	Occ video
9	11956-V	AT&T Tridom dish aiming slate
10	11984-H	Occ video
13	12095-V	Occ video
15	12157-V	DMX for Business (digital data)

Some of T402R transponders belong to the Alphastar DBS service. Infomation on this DBS service will be presented in the *Satellite Times* DBS section of the Satellite Services Guide as information becomes available. AT&T Tridom also has leased some transponders.

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]/ANTN (Half-transponders)/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. Infomation on this DBS service will be presented in the *Satellite Times* DBS section of the Satellite Services Guide as information becomes available.

Telstar 401 (T401) 97º West

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

Galaxy 4 (K4) 99º West

1	11720-H	SCPC services/Data transmissions
2	11750-V	Data transmissions
3	11750-H	FM² services/MUZAK/Data transmissions
4	11780-H	FM² services/Planet Connect computer service (19.2 kbps)/ Data transmissions
5	11810-V	Data transmissions
6	11810-H	Occ video
7	11840-H	*Jong Ten* - Chinese/Taiwan all-news service
8	11870-V	Occ video
9	11870-H	Occ video
10	11900-H	CNN Airport Network [SA MPEG]
11	11930-V	Occ video (half-transponders common)
12	11930-H	Occ video/Channel One (occ)/ Microsoft TV (occ)
13	11960-H	Occ video/FOX SNG (occ)
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) [scrambled unknown system]
19	12080-H	Data transmissions
20	12110-V	Occ video (half-transponders common)
21	12110-H	Asian-American TV Network
22	12140-H	Family Net [Digicipher]
23	12170-V	CBS Newsnet and affiliate feeds (half-transponders)
24	12170-H	The Filipino Channel [Oak]

Spacenet 4 (S4) 101º West

24	12140-H	E.M.G. courses [digicipher]

DBS-1 101.2º W./DBS-2 & D8S-3 100.8º W.

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

GSTAR-1 (GST1) 103º West

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

GSTAR-4 (GST4) 105º West

1	11730-H	Data transmissions
2	11791-H	Data transmissions
3	11852-H	CNN Newsource (Primary) [Leitch]/some feeds in clear
4	11913-H	Occ video
5	11974-H	Occ video
6	12035-H	Occ video
7	12096-H	CNN Newsbeam/Occ video
8	12157-H	Occ video/CNN Newsource International
9	11744-V	Data transmissions
11	11866-V	Occ video
12	11927-V	Occ video
13	11988-V	CNN Newsbeam/occ video
15	12110-V	CNN Newsbeam/occ video
16	12171-V	Occ video

Anik E2 (A1) 107.3º West

1	11717-V	Telesat Digital Video Compression
2	11743-V	Data transmissions/DirectPC Canada
3	11778-V	Data transmissions
4	11804-V	Much Music
5	11839-V	Canadian Parliamentary Access Channel [Shaw/Rogers video compression]
6	11865-V	Moviepix!; The Movie Network [video compression]
7	11900-V	Rogers Network [video compression]
8	11926-V	Rogers Network [video compression]
9	11961-V	Data transmissions
10	11987-V	Data transmissions
11	12022-V	Showcase TV (West)
12	12048-V	Saskarchewan CommunicaNetwork
13	12083-V	Data transmissions
14	12109-V	Data transmissions
15	12144-V	Telesat Canada stationkeeping (GLACS)
16	12170-V	Knowledge Network
17	11730-H	Discovery Channel Canada [Oak]
18	11756-H	Occ video/Tempo Business TV
19	11791-H	Bravo! Canada
20	11817-H	Life Network
21	11852-H	Data transmissions
22	11878-H	Data transmissions
23	11913-H	Showcase TV (East)
24	11939-H	Ontario Legislature
25	11974-H	La Chaine (TV Ontario's French lanaguage service)
26	12000-H	TV Ontario (English)
27	12035-H	Data transmissions
28	12061-H	Data transmissions
29	12096-H	ASN
30	12122-H	Telesat Canada stationkeeping (GLACS)
31	12157-H	CBC Newsworld
32	12183-H	RDI

Solidaridad 1 SD1 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
6	11865-V	NovaNet FM² Services
17	11730-H	Woman's Television Network East and West [video compression]
18	11756-H	Data transmissions
19	11791-H	Data transmissions
20	11817-H	SCPC/Data transmissions/New Country Network, Access Network of Alberta [Shaw video compression]

Anik C3 (C3) 114.9º West (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 119ºWest

Satellite is still testing at presstime. A complete channel guide for TheDISH Television Network will presented in the DBS section of *Satellites Times* Satellite Service Guide as information becomes available. This satellite operates in the 12.2-12.7 GHz range.

S8S 5 (SBS5) 123º West

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

GSTAR-2 (GST2) 125º West

6	12035-H	Occ video
8	12157-H	Occ video
9	11744-V	Data transmissions
11	11866-V	GSTAR-2 ID slate/Occ video
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) 69º	Galaxy 6 (G6) 74º	Telstar 302 (T2) 85º	Spacenet 3 (S3) 87º	Telstar 402R (T4) 89º	Galaxy 7 (G7) 91º	Galaxy 3R (G3R) 95º	Telstar 401 (T1) 97º	Galaxy 4 (G4) 99º	Spacenet 4 (S4 101º
1	SC New York [V2+]	Tokyo BS New York feeds	(none)	(none)	The Babe Channel/o/v	Sega Channel [digital]	TVN Theatre 1 [V2+]	Exxxtasy (Adult) Promo/VTC	SCPC services	Data Transmissio
2	(none)	o/v	American Independent Network (AIN)	Nebraska Educational TV	TVN Promo Channel	CBS West [VC1]	TVN Theatre 2 [V2+]	Data Transmissions	SCPC services	STARZ! 2 [V2+]
3	USIA Worldnet TV	SCPC services	(none)	WSBK-Ind Boston [V2+]	o/v	Action PPV [V2+]	TVN Theatre 3 [V2+]	Parmount Syndication feeds/o/v	SCPC services	Data Transmissio
4	H.TV (Spanish)	o/v	(none)	Nebraska Educational TV (NETV)	Shop at Home	fX East	TVN Theatre 4 [V2+]	Fox feeds	SCPC services	Encore-Western [V2+]
5	NASA Contract Channel-o/v [Leitch]	NHK New York feeds	(none)	Univision [V2+]	Group W Videoservices/o/v	fX West	TVN Theatre 5 [V2+]	o/v	BBC Breakfast News/o/v	Data Transmissio
6	Data Transmissions	NHK (TV Japan) feeds	(none)	(none)	o/v	Game Show Network [V2+]	TVN Theatre 6 - Letterbox [V2+]/TVN Promos (occ)	Buena Vista TV feeds	Sheperd's Chapel Network (Rel)	KNBC-NBC Los Angeles (PT24W) [V2+]
7	o/v	National Empowerment TV	(none)	Data Transmissions	Cable Video Store [V2+]	The Golf Channel [V2+]	America's Choicemail (infomercials)	Fox feeds-East	o/v	Basil Bassett Bing
8	Data Transmissions	(none)	(none)	Data Transmissions	o/v	o/v	Gospel Music TV	PBS X	Telemundo [SA MPEG]	KOMO-ABC Seatt (PT24W) [V2+]
9	NASA TV	MuchMusic U.S. [V2+]	(none)	WPIX-Ind New York [V2+]	Data Transmissions	o/v	TVN Theatre 9 - adultTVision (adult) [V2+]	Fox feeds East	o/v	Data Transmissio
10	Data Transmissions	Arab Network of America (ANA)	ABC West [Leitch]	Data Transmissions	o/v	United Arab Emirates TV Dubai	Showtime East 2 [V2+]	Fox feeds West	WJLA-ABC Washington, DC (PT24E) [V2+]	FOXNet (PT24E) [V2+]
11	SC Philadelphia [V2+]	FOX News Feeds/o/v	(none)	CNN feeds	The Outdoor Channel	Estacion Montellano (Spanish Rel)/o/v	o/v	ABC feeds	o/v	STARZ! East [V2+
12	Data Transmissions	TV Asia [digicipher]	(none)	Data Transmissions	o/v	(none)	MCI Andover Contract Channel/o/v	ABC NewsOne feeds	o/v	o/v
13	Data Transmissions	RTPi	(none)	SCPC/FM2 services	o/v	CSN/Kaleidoscope/F-SS/The Box [Digicipher]	o/v	Fox feeds East	o/v	Data Transmissio
14	Data Transmissions	Cornerstone TV WPCB-TV (Rel)	(none)	CNN [B-MAC]	o/v	Independent Film Channel [V2+]	o/v	Fox West	WRAL-CBS Raleigh (PT24E) [V2+]	America's Lost Children TV Netwo
15	HERO Teleport [Digicipher]	Midwest Sports Channel [V2+]	(none)	KTLA-Ind Los Angeles [V2+]	Spice (adult) [V2+]	Intro Television [V2+]	Superior Comm Contract Channel/o/v	Exxxtasy 2 (adult) [V2+]	World Harvest TV (Rel)	Data Transmissio
16	Data Transmissions	o/v	(none)	CNN International [B-MAC]	Adam and Eve (adult) [V2+]	(none)	HBO 2 East [V2+]	o/v	CBS West [VC1]	NPS Promo Chann
17	Data Transmissions	Keystone Comm Contract Ch/MSG II-o/v	(none)	FM2/SCPC services	o/v	Via TV (Home Shopping)	Cinemax 2 East [V2+]	o/v	CBS East/o/v [VC1]	Data Transmissio
18	(none)	o/v	o/v	US Sat.Corp (infomercials)/ In-store audio	Kelly Broadcast Systems contract channel/o/v	Teleport Minnesota/CBS feeds/o/v	Univision feeds	o/v	CBS feeds/o/v [VC1]	STARZ! West [V2+
19	Data Transmissions	University Network/Dr. Gene Scott (Rel)	(none)	SSN Sportsouth [V2+]/ American Collectables Network	Channel America	CBS East [VC1]	HBO 3 [V2+]	United Paramount Network/o/v	CBS East/o/v [VC1]	Data Transmissio
20	Armed Forces Radio & Television Service [B-MAC]	CNN Headline News Clean Feed [V2+]	ABC East (contingency channel) [Leitch]	(none)	o/v	Prime Sports Showcase	HBO 2 West [V2+]	ABC East [Leitch]	CBS East [VC1]	Data Transmissio
21	SC New England [V2+]	o/v	(none)	SSN Pro Am Sports (Pass) [V2+]	o/v	BET on Jazz	o/v	ABC East [Leitch]	WB Syndication-Network/CBS feeds/o/v	Data Transmissio
22	SC New York Plus [V2+]	o/v	(none)	Data Transmissions	ABC feeds - L.A. Bureau	NewsTalk Television	RAI Italian TV o/v	ABC West [Leitch]	WNBC-NBC New York (PT24E) [V2+]	Data Transmissio
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 Transmissio
24	(none)	o/v	(none)	America One	PandaAmerica (Home Shopping)	International Channel [V2+]	ELIX [V2+]	Exxxtasy Premier (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) 107.3°	Solidaridad 1 (SO1) 109.2°	Telesat E1 (A2) 111°	Morelos 2 (M2) 116.8°	Telstar 303 (T3) 123°	Galaxy 5 (G5) 125°	Satcom C3 (F3) 131°	Galaxy 1R (G1) 133°	Satcom C4 (F4) 135°	Satcom C1 (F1) 137°	
CBC-H English Eastern	(none)	Data Transmissions	Data Transmissions	(none)	Disney East [V2+]	Family Channel West [V2+]	Comedy Central West [V2+]	American Movie Classics (AMC) [V2+]	Prime Network [V2+]	1
The Sports Network [Dak]	(none)	(None-off)	Data Transmissions	(none)	Playboy (Adult) [V2+]	The Learning Channel	Spanish language networks [SA MPEG]	Request TV PPV [Digicipher]	KMGH-ABC Denver [V2+]	2
Telelatino (digital)/Data Transmissions	SCPC services	Data Transmissions	Data Transmissions	(none)	Trinity Broadcasting (Rel)	Viewer's Choice PPV [V2+]	Encore [V2+]	Nickelodeon East [V2+]	KRMA-PBS Denver [V2+]	3
Cancom Digital Video Compression	(none)	Data Transmissions	Data Transmissions	(none)	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	(none)	CNN [V2+]	Faith and Values Channel/ACTS (Rel)	Classic Arts Showcase	Deutsche Welle TV (German	KDVR-Fox Denver [V2+]	5
CBC Newsworld [Dak]	(none)	(None-off)	Data Transmissions	(none)	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	XXplora - adult [V2+]	WGN-Ind Chicago [V2+]	C-SPAN 1	Disney West [V2+]	Bravo [V2+]	SSN Prime Sports West [V2+]	7
Global TV (Leitch)/Global feeds	(none)	Climaxxx (adult) [V2+]	XHGC canal 5/Q-CVC	(none)	HBO West [V2+]	QVC-2 Fashion Channel	Cartoon Network [V2+]	Prevue Guide	NBC-East	8
CBC-N English Atlantic	o/v	(None-off)	(none)	XXXpose - adult [V2+]	ESPN [V2+]	Music Choice [digital]	ESPN2 Blackout [V2+]/SAH	QVC Network	Syndicated Entertainment TV (SET)	9
Cancom Digital Video Compression	Mexican Parliament	(None-off)	SEP	XXXpose-XXXplore (adult) Promo	MOR Music	Home Shopping Club Spree	America's Talking [V2+]	Home Shopping Network (HSN)	SSN Prime Sports SW [V2+]	10
CBC-A French	(none)	(None-off)	XEIPN canal 11	XXXtreme/ClimaXXX Promo	Family Channel East [V2+]	Newsport [V2+]	Eternal Word TV Network (Rel)	The Box - move to G7-13 [digital]	Network One [N1 [V2+]	11
Cancom Digital Video Compression	Data Transmissions	(None-off)	Data Transmissions	(none)	Discovery West [V2+]	History Channel [V2+]	Valuevision	Nustar (Promo Channel)	Data Transmissions	12
CBC-C English Pacific	(none)	(None-off)	(none)	(none)	CNBC [V2+]	The Weather Channel [V2+]	Encore [Digicipher]	Travel Channel [V2+]	SC Chicago [V2+]	13
Cancom Digital Video Compression	Data Transmissions	Exxxtreme TV/The Cupid Network (adult) [V2+]	XEW canal 2	(none)	ESPN2 [V2+]	New England Sports Network [V2+]	ESPN Blackout [V2+]/SAH	Fit TV	KUSA-NBC Denver [V2+]	14
5DTV o/v	Multivision [Digicipher]	(None-off)	Data Transmissions	(none)	HBO East [V2+]	Showtime East [V2+]	CNN International-CNNI [V2+]	WWOR-Ind New York [V2+]	SC Cincinnati Ohio/Florida [V2+]	15
CTV (Green)	Data Transmission	(None-off)	Canal 22 o/v	(none)	Cinemax West [V2+]	MTV West [V2+]	Turner Classic Movies [V2+]	Request TV 1 [V2+]	Prime Sports West/ Prime Deportiva [Digicipher]	16
CBC Feeds	(none)	(None-off)	o/v	(none)	TNT [V2+]	Movie Channel East [V2+]	The New Inspirational Network (Rel)	MTV East [V2+]	SSN Prime Sports (various) [V2+]/Cal-Span	17
Video Catalog Channel (5DTV)	o/v	(None-off)	Clara Vision (Rel)	(none)	TNN [V2+]	Nickelodeon West [V2+]	HBO Multiplex [Digicipher]	Viewer's Choice [Digicipher]	Prime Alternatives	18
TV Northern Canada (TVNC)	Multivision [Digicipher]	o/v	(none)	(none)	USA East [V2+]	Showtime/MTV [Digicipher]	Cinemax East [V2+]	C-SPAN 2	FOXNet [V2+]	19
CJON-TV Newfoundland TV (NTV)	(none)	o/v	Data Transmissions	(none)	BET [V2+]	Jones Intercable [Digicipher]	Home and Garden Network	Showtime West [V2+]	o/v	20
Telesat Digital Video Compression	(none)	SCPC services/ Data Transmissions	(none)	(none)	MEU	Comedy Central East [V2+]	USA West [V2+]	Discovery East [V2+]	Sportchannel alternatives	21
XXXotica [V2+] (5DTV)	(none)	(None-off)	XHIMT canal 7/TeleCasa	Antenna TV [V2+]/ o/v	CNN-HN [V2+]	Your Choice TV [Digicipher]	Nostalgia Channel	Movie Channel West [V2+]	SSN PSNW [V2+]	22
CBC-E English	(none)	(None-off)	(none)	(none)	A&E [V2+]	E! Entertainment TV [V2+]	Test Pattern Color Bars	VH-1 [V2+]	KWGN-Ind Denver [V2+]	23
CTV (Red)	(none)	(None-off)		TVN Promo Channe	Showtime/Movie Channel [SA MPEG]	Digital Music Express Radio (DMX) [Digital]	Global Shopping Network/Speedvision [digicipher]	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 242 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: Molniya Space Consultancy: Mr. Phillip Clark; Kaman Sciences Corporation: Dr. Nicholas Johnson; University of New Brunswick: Mr. Richard B. Langley; U.S. Space Command/Public Affairs: Major Don Planalp; Naval Space Command/Public Affairs: Gary Wagner; NASA NSSDC/WDC-A, Goddard Space Flight Center; and *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 is drifting.

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)	0.3E	Met (L)
18952	1988-018B Telecom 1C (France)	1.5E#	Dom FSS/Gov-Mil (C/Ku)
23730	1995-067A Telecom 2C (France)	3.0E	Dom FSS/Gov-Mil (X/C/Ku)
20929	1990-095A DSP F-15 (USA)	4.0E	Mil-Early Warning (S/X)
23712	1995-060A USA 115 (DFS-2/Milstar-2)	4.0E	Mil-Comm (P/S/K)
19919	1989-027A Tele X (Sweden)	5.1E	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)	6.0E/i	Mil-Comm (P/S/X)
22028	1992-041B Eutelsat II F4	6.9E	Reg FSS (Ku)
21056	1991-003B Eutelsat II F2	10.0E	Reg FSS (Ku)
19596	1988-095A Raduga 22 (Russia)	11.3E/i	Dom FSS/Gov-Mil (X/C)
22269	1992-088A Cosmos 2224 (Russia)	11.7E#	Mil-Earl Warning (X)
22557	1993-013A Raduga 29 (Russia)	11.8E#	Dom FSS/Gov-Mil (X/C)
20777	1990-079B Eutelsat II F1	13.1E	Reg FSS (Ku)
21055	1991-003A Italsat 1 (Italy)	13.5E	Dom-Telephone (S/K/Ka)
23537	1995-016B Hot Bird 1 (Eutelsat II F6)	14.0E	DTH (Ku)
21803	1991-083A Eutelsat II F3	16.0E	Reg FSS (Ku)
19688	1988-109B Astra 1A	19.2E	Reg DTH (Ku)
21139	1991-015A Astra 1B	19.2E	Reg DTH (Ku)
23331	1994-070A Astra 1D	19.3E	Reg DTH (Ku)
23686	1995-055A Astra 1E	19.7E	Reg DTH (Ku)
22653	1993-031A Astra 1C	19.8E	Reg DTH (Ku)
14234	1983-077A Telstar 3A (301) (USA)	19.9E#	Dom FSS-Saudi Arabia (C)
19331	1988-063B Eutelsat 1 F5	21.4E#	Reg FSS (VHF/Ku)
13010	1981-122A Marecs 1 (ESA)	22.7E/i	Int Mar-EUR (L/C)
22175	1992-066A DFS 3 (Germany)	23.5E	Dom BSS (S/Ku/K)
18351	1987-078B Eutelsat 1 F4 (ECS 4)	25.4E/i	Reg FSS (VHF/Ku)
20659	1990-054A Gorizont 20 (Russia)	25.9E/i	Dom/Gov FSS (C/Ku)
20706	1990-063B DFS 2 (Germany)	28.5E	Dom BSS (S/Ku/K)
21894	1992-010B Arabsat 1C	31.6E	Reg FSS/BSS (S/C)
19765	1989-004A Gorizont 17 (Russia)	33.7E/i	Dom/Gov FSS (C/Ku)
21821	1991-087A Raduga 28 (Russia)	34.8E#	Dom FSS/Gov-Mil (X/C)
23775	1996-005A Gorizont 31 (Russia)	39.4E#	Dom/Gov FSS (C/Ku)
23200	1994-049B Turksat 1B (Turkey)	42.0E	Reg FSS (Ku)
19928	1989-030A Raduga 23 (Russia)	44.5E/i	Dom FSS/Gov-Mil (X/C)
14421	1983-105A Intelsat 507	47.1E/i	Int FSS/Mar (L/C/Ku)
22981	1994-008A Raduga 1-3 (Russia)	48.8E#	Dom FSS/Gov-Mil (X/C)
21038	1990-116A Raduga 1-2 (Russia)	49.5E/i	Dom FSS/Gov-Mil (X/C)
19687	1988-109A Skynet 4B (UK)	53.1E/i	Mil-Comm (P/S/X/Ka)
22245	1992-082A Gorizont 27 (Russia)	53.3E#	Dom/Gov FSS (C/Ku)
13636	1982-006A DSCS II E15 (USA)	57.0E/i	Mil-IOR reserve operational (S/X)
14675	1989-069B DSCS III A2 (USA 44)	57.0E/i	Mil-IOR primary operational (P/S/X)
15629	1985-025A Intelsat 510	57.0E/i	Int FSS (C/Ku)
22913	1993-074A DSCS III B10 (USA 97)	60.E/i	Mil-IOR primary operational (P/S/X)
20667	1990-056A Intelsat 604	60.3E	Int FSS (C/Ku)
20315	1989-087A Intelsat 602	62.8E	Int FSS (C/Ku)
20918	1990-093A Inmarsat 2 F1	64.4E#	Int Mar-IOR (L/C)
13636	1982-106A DSCS II F16 (USA 43)	64.8E/i	Mil-IOR reserve operational (S/X)
13595	1982-097A Intelsat 505	64.9E/i	Int FSS/Mar (L/C/Ku)
23461	1995-001A Intelsat 704	66.0E	Int FSS (C/Ku)
23636	1995-040A PanAmSat 4 (PAS 4)	68.5E	Int FSS (C/Ku)
23448	1994-087A Raduga 32 (Russia)	69.9E#	Dom FSS/Gov-Mil (X/C)
20083	1989-048A Raduga 1-1 (Russia)	70.1E/i	Dom FSS/Gov-Mil (X/C)
22963	1993-002A Gals 1 (Russia)	70.7E	Dom BSS (Ku)
23717	1995-063A Gals 2 (Russia)	71.0E	Dom BSS (Ku)
20410	1990-002B Leasat 5 (USA)	71.6E/i	Mil-IOR reserve (P/S/X)
22787	1993-056A USA 95 (UFO-2)	71.7E/i	Mil-IOR primary (P/S)
12474	1981-050A Intelsat 501	72.0E/i	Int FSS (C/Ku)
23589	1995-027A USA 111 (UFO-5)	72.0E/i	Mil-IOR reserve (P/S/K)
08882	1976-053A Marisat 2	72.1E/i	Int Mar-IOR (P/L/C)
21111	1991-010A Cosmos 2133 (Russia)	73.4E#/d	Mil-Early Warning (X)
22027	1992-041A Insat 2A (India)	74.0E	Dom FSS/BSS/Met (S/C)
23327	1994-069A Elektro 1 (Russia)	76.0E#	Met (L)
23680	1995-054A Luch 1-1 (Russia)	77.1E/i	Tracking & Relay SDRN-2 (Ku)
20953	1990-102A Gorizont 22 (Russia)	77.1E/i/d	Dom/Gov FSS (C/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)
23653	1995-045A Cosmos 2319 (Russia)	80.0E#	Data Relay (C)
21759	1991-074A Gorizont 24 (Russia)	80.2E/i	Dom/Gov FSS (C/Ku)
20643	1990-051A Insat 1D (India)	82.8E	Dom FSS/BSS/Met (S/C)
23010	1994-012A Raduga 31 (Russia)	82.9E	Dom FSS/Gov-Mil (X/C)
22836	1993-062A Raduga 30 (Russia)	84.9E#	Dom FSS/Gov-Mil (X/C)
19548	1988-091B TDRS F3 (USA)	85.3E/i	Gov (C/S/Ku)
18922	1988-014A PRC 22 (China)	88.6E/i	Dom FSS (C)
22880	1993-069A Gorizont 28 (Russia)	90.1E#	Dom/Gov FSS (C/Ku)
23765	1995-003A Measat 1 (Malaysia)	91.3E	Dom FSS/DTH (C/Ku)
22724	1993-048B Insat 2B (India)	93.2E	Dom FSS/BSS/Met (S/C)
23731	1995-067B Insat 2C (India)	93.3E	Dom FSS/BSS/Met (S/C)
23426	1994-082A Luch 1 (Russia)	95.3E#	Tracking & Relay CSDRN (Ku)
20263	1989-081A Gorizont 19 (Russia)	96.6E/i	Dom/Gov FSS (C/Ku)
20473	1990-011A PRC 26 (China)	98.4E#	Dom FSS (C)
19683	1988-108A Ekran 19 (Russia)	98.8E/i	Dom BSS (P)
22210	1992-074A Ekran 20 (Russia)	99.2E#	Dom BSS (P)
23723	1995-064A AsiaSat 2	100.7E	DTH (C/Ku)
21922	1992-017A Gorizont 25 (Russia)	102.5E#	Dom/Gov FSS (C/Ku)
20558	1990-030A Asiasat 1	105.1E	DTH (C/Ku)
20570	1990-034A Palapa B2R	107.7E	Reg FSS (C)
23176	1994-040B BS-3N (Japan)	109.8E	Dom BSS (Ku)
20771	1990-077A BS-3A (Yuri 3A)(Japan)	109.9E#	Dom BSS (Ku)
21668	1991-060A BS-3B (Yuri 3B)(Japan)	110.0E	Dom BSS (Ku)
19710	1988-111A PRC 25 (China)	110.3E#	Dom FSS (C)
17706	1987-029A Palapa B-2P	112.8E	Reg FSS (C)
23768	1996-003A Koreasat 2 (Mugunghwa 2)	115.2E	Dom FSS (Ku)
23639	1995-041A Koreasat 1 (Mugunghwa 1)	115.6E	Dom FSS (Ku)
14985	1984-049A Chinasat 5 (Spacenet 1)	115.6E	Dom FSS (C/Ku)
21964	1992-027A Palapa B4	117.9E	Reg FSS (C)
20217	1989-070A GMS-4 (Himawari 4)	119.7E#	Met (P/L)
23779	1996-006A Palapa C-1	124.8E/d	Reg FSS (C/Ku)
21132	1991-014A Raduga 27 (Russia)	127.7E/i	Dom FSS/Gov-Mil (X/C)
23649	1995-043A JCSAT 3 (Japan)	127.9E	Dom FSS (Ku)
22907	1993-072A Gorizont 29 (Rimsat 1)	130.0E#	Reg FSS (C/Ku)
23651	1995-044A N-Star A (Japan)	131.5E	Dom/Mob FSS (S/C/Ku/Ka)
18877	1988-012A CS 3A (Sakura 3A)(Japan)	131.6E	Dom FSS (C/K)
23781	1996-007A N-Star B (Japan)	135.7E	Dom/Mob FSS (S/C/Ku/Ka)
19508	1988-086A CS 3B (Sakura 3B) (Japan)	135.8E	Dom FSS (C/K)
23185	1994-043A Apstar A1 (China)	137.9E	DTH (C)
20107	1989-052A Gorizont 18 (Russia)	139.9E/i	Dom/Gov FSS (C/Ku)

Geostationary Satellite Locator Guide

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
23522	1995-011B GMS-5 (Himawari 5)	140.0E#	Met (P/L)
23108	1994-030A Gorizont 30 (Rimsat 2)	141.9E	Reg FSS (C/Ku)
20923	1990-094A Gorizont 21 (Russia)	144.5E/i	Dom/Gov FSS (C/Ku)
20066	1989-046A DSP F-14 (USA)	145.0E	Mil-Early Warning (S/X)
19874	1989-020A JCSAT 1 (Japan)	149.9E	Dom FSS (Ku)
18316	1987-070A ETS V (Japan)	150.1E/i	Experimental (L/C)
18350	1987-078A Optus A3 (Aussat K3)	151.8E	DTH (Ku)
20402	1990-001B JCSAT 2 (Japan)	153.9E	Dom FSS (Ku)
23227	1994-055A Optus B3 (Australia)	155.9E	DTH/Mob (L/Ku)
22253	1992-084A Superbird A1 (Japan)	157.9E	Dom FSS (Ku/K)
22087	1992-054A Optus B1 (Aussat B1)	159.9E	DTH/Mob (L/Ku)
21893	1992-010A Superbird B1 (Japan)	162.0E	Dom FSS (Ku/K)
16275	1985-109C Optus A2 (Aussat 2)	163.9E/i	DTH (Ku)
23175	1994-040A PanAmSat 2 (PAS-2)	169.0E	Int FSS (C/Ku)
12046	1980-087A OPS 6394 (FltSatCom F4)(USA)	171.9E/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)
23305	1994-064A Intelsat 703	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)
15236	1984-093C Leasat 2 (USA)	177.3W/i	Mil-POR primary (P/S/X)
09478	1976-101A Marisat 3	177.3W/i	Int Mar-POR (P/L/C)
19121	1988-040A Intelsat 513	176.9W#	Int FSS (C/Ku)
23467	1995-003A USA 108 (UFO-4) (USA)	176.6W/i	Mil-POR (P/S/K)
21639	1991-054B TDRS F5 (USA)	174.2W	Int FSS/Gov (C/S/Ku)
18631	1987-100A Raduga 21 (Russia)	170.2W/i	Dom FSS/Gov-Mil (X/C)
20499	1990-016A Raduga 25 (Russia)	170.1W/i	Dom FSS/Gov-Mil (X/C)
23613	1995-035B TDRS F7 (USA)	149.9W#	Int FSS/Gov (C/S/Ku)
21392	1991-037A Satcom C5 (Aurora II)(USA)	138.9W	Dom FSS (C)
20945	1990-100A Satcom C1 (USA)	137.1W	Dom FSS (C)
23581	1995-025A GOES 9 (USA)	135.4W	Met (P/L/S)
22096	1992-057A Satcom C4 (USA)	134.1W	Dom FSS (C)
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)	130.0W/i	Mil-EPAC reserve operational (P/S/X)
21906	1992-013A Galaxy 5 (USA)	125.1W	Dom FSS (C)
16649	1986-026A Gstar 2 (USA)	125.0W#	Dom FSS (Ku)
17561	1987-022A GOES 7 (USA)	124.1W/i	Met (P/L/S)
15826	1985-048D Telestar 3D (USA)	123.0W#	Dom FSS (C)
19484	1988-081B SBS 5 (USA)	123.0W	Dom FSS (Ku)
22988	1994-009A USA 99 (DFS-1/Milstar 1)	120.0W	Mil-Comm (P/S/K)
23754	1995-073A EchoStar 1 (USA)	119.0W	DTH (Ku)
16274	1985-109B Morelos B (Mexico)	116.9W	Dom FSS (C/Ku)
13652	1982-110C Anik C3 (Canada)	114.9W/i	Dom FSS (Ku)
23313	1994-065A Solidardad 2 (Mexico)	113.0W	Dom FSS (L/C/Ku)
21726	1991-067A Anik E1 (Canada)	111.1W	Dom FSS (C/Ku)
22911	1993-073A Solidaridad 1 (Mexico)	109.2W	Dom FSS (L/C/Ku)
21222	1991-026A Anik E2 (Canada)	107.3W	Dom FSS (C/Ku)
03029	1967-111A ATS 3 (USA)	106.4W/i	Exp comm (VHF/C)
08697	1976-017A Marisat 1	106.3W/i	Int Mar-AOR (P/L/C)
15643	1985-028C Leasat 3 (USA)	106.0W/i	Mil-CONUS reserve (P/S/X)
23696	1995-057A USA 114 (UFO-6)	105.5W/i	Mil-CONUS (P/S/K)
20946	1990-100B Gstar 4 (USA)	105.1W	Dom FSS (Ku)
08747	1976-023B LES 9 (USA)	103.9W/i	Mil-Exp comm (P/Ka)
08746	1976-023A LES 8 (USA)	103.8W/i	Mil-Exp comm (P/Ka)
15677	1985-035A Gstar 1 (USA)	103.1W	Dom FSS (Ku)
23435	1994-084A DSP F-17 (USA)	103.0W	Mil-Early Warning (S/X)
22930	1993-078A DBS 1 (USA)	101.3W	DTH (Ku)
23553	1995-019A MSAT-2 (USA)	101.2W	Mobile (L/X)
21227	1991-028A Spacenet 4 (USA)	101.1W	Dom FSS (C/Ku)
23598	1995-029A DBS 3 (USA)	101.0W	DTH (Ku)
23192	1994-047A DBS 2 (USA)	100.9W	DTH (Ku)
17181	1986-096A USA 20 (FltSatCom F7)(USA)	100.1W/i	Mil-CONUS primary (P/S/X/K)
22796	1993-058B ACTS (USA)	100.0W	Exp Comm (C/K/Ka)
22694	1993-039A Galaxy 4 (USA)	99.1W	Dom FSS (C/Ku)

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
22927	1993-077A Telstar 401 (USA)	97.0W	Dom FSS (C/Ku)
23741	1995-069A Galaxy 3R (USA)	95.1W	Dom/DTH (C/Ku)
19483	1988-081A Gstar 3 (USA)	93.2W/i	Dom FSS/Mob (L/Ku)
16650	1986-026B SBTS 2 (Brazil)	92.1W	Dom FSS (C)
22205	1992-072A Galaxy 7 (USA)	91.1W	Dom FSS (C/Ku)
23670	1995-049A Telstar 402R (USA)	89.7W	Dom FSS (C/Ku)
18951	1988-018A Spacenet 3R (USA)	87.2W	Dom FSS (L/C/Ku)
15237	1984-093D Telestar 3C (302) (USA)	85.2W#	Dom FSS (C)
16482	1986-003B Satcom K-1 (USA)	85.1W	Dom FSS (Ku)
16276	1985-109D Satcom K-2 (USA)	81.0W	Dom FSS (Ku)
15235	1984-093B SBS 4 (USA)	77.0W/i	Dom FSS (Ku)
12309	1981-018A Comstar D4 (USA)	76.3W/i	Dom FSS (C)
23051	1994-022A GOES 8 (USA)	76.1W#	Met (P/L/S)
14133	1983-059B Anik C2 (Argentina)	76.0W/i	Dom FSS (Ku)
20873	1990-091B Galaxy 6 (USA)	74.2W	Dom FSS (C)
20872	1990-091A SBS 6 (USA)	74.2W	Dom FSS (Ku)
15642	1985-028B Anik C1 (Argentina)	71.9W	Dom FSS (Ku)
12855	1981-096A SBS 2 (USA)	71.1W/i	Dom FSS (Ku)
23199	1994-049A Brazilsat B1 (Brazil)	70.3W	Dom FSS (C)
15385	1984-114A Spacenet 2 (USA)	70.1W	Dom FSS (C/Ku)
23536	1995-016A Brasilsat B2 (Brazil)	65.2W	Dom FSS (C/X)
15561	1985-015B SBTS 1 (Brazil)	63.0W#	Dom FSS (C)
21940	1992-021B Inmarsat 2 F4	54.2W/i	Int Mar-AOR-W (L/C)
23571	1995-023A Intelsat 706	53.1W	Int FSS (C/Ku)
23628	1995-038A DSCS III B7 (USA)	52.5W/i	Mil-WLANT primary operational (P/S/X)
23528	1995-013A Intelsat 705	50.1W	Int FSS (C/Ku)
22314	1993-003B TDRS F6 (USA)	45.8W/i	Gov (C/S/Ku)
19217	1988-051C PanAmSat 1 (PAS 1)	45.2W	Int FSS (C/Ku)
23764	1996-002A PanAmSat 3R (PAS 3R)	43.1W	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)	41.2W	Int FSS/Gov (C/S/Ku)
12089	1980-098A Intelsat 502	40.7W/i	Int FSS (C/Ku)
23413	1994-079A Orion 1 (USA)	38.4W	Int FSS (Ku)
20523	1990-021A Intelsat 603	34.7W	Int FSS (C/Ku)
20401	1990-001A Skynet 4A	34.0W/i	Mil-comm (P/S/X/Ka)
14077	1983-047A Intelsat 506	31.4W/i	Int FSS/Mar (L/C/Ku)
22116	1992-060A Hispasat 1A (Spain)	30.4W	Dom BSS/FSS (Ku)
22723	1993-048A Hispasat 1B (Spain)	30.1W	Dom BSS/FSS (Ku)
23168	1994-038A Cosmos 2282 (Russia)	28.3W#	Mil-Early Warning (X)
21765	1991-075A Intelsat 601	27.7W	Int FSS (C/Ku)
21653	1991-055A Intelsat 605	24.6W	Int FSS (C/Ku)
22112	1002-059A Cosmos 2209 (Russia)	24.1W#	Mil-Early Warning (X)
20253	1989-077A USA 46 (FltSatCom 8)	22.6W/i	Mil-AOR primary (P-Charlie/S/X/K)
21989	1992-032A Intelsat K	21.6W	Int FSS (Ku)
16101	1985-087A Intelsat 512	21.3W#	Int FSS (C/Ku)
15391	1984-115A NATO III D	21.2W/i	Mil-Comm (P/S/X)
19621	1988-098A TDF 1 (France)	19.1W	DTH (Ku)
20705	1990-063A TDF 2 (France)	19.0W	DTH (Ku)
19772	1989-006A Intelsat 515	18.1W	Int FSS (C/Ku)
21047	1991-001A NATO IV A	17.9W/i	Mil-Comm (P/S/X)
20391	1989-101A Cosmos 2054 (Russia)	16.2W/i	Tracking & Relay WSDRN (Ku)
21149	1991-018A Inmarsat 2 F2	15.6W/i	Int Mar-AOR-E (L/C)
15386	1984-114B Marecs B2	15.2W/i	Int Mar-AOR (L)
10669	1978-016A Ops 6391 (FltSatCom 1) (USA)	14.7W/i	Mil-AOR reserve (P-Alpha/S/X)
23132	1994-035A USA-104 (UFO-3)(USA)	14.5W/i	Mil-AOR primary (P/S)
23319	1994-067A Express 1 (Russia)	14.1W	Int FSS (C/Ku)
21789	1991-079A Cosmos 2172 (Russia)	14.0W/i	Data Relay (C)
23267	1994-060A Cosmos 2291 (Russia)	13.5 W#	Data Relay (C)
22009	1992-037A DSCS III B12 (USA 82)	12.0W/i	Mil-ELANT primary operational (P/S/X)
22041	1992-043A Gorizont 26 (Russia)	11.5W#	Dom/Gov FSS (C/Ku)
22912	1993-073B Meteosat 6 (ESA)	10.2W#	Met (L)
21813	1991-084A Telecom 2A (France)	8.1W	Dom FSS/Gov-Mil (X/C/Ku)
21805	1991-080B DSP F-16 (USA)	7.0W	Mil-Early Warning (S/X)
21939	1992-021A Telecom 2B (France)	5.0W	Dom FSS/Gov-Mil (X/C/Ku)
20776	1990-079A Skynet 4C (UK)	1.0W#	Mil (P/S/X/Ka)
23124	1994-034A Intelsat 702	1.0W	Int FSS (C/Ku)
20762	1990-074A Thor/Marcopolo 2 (BSB R-2)	0.6W	Reg BSS (Ku)
20168	1989-062A TV Sat 2 (Germany)	0.5W	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 Up 145.860 870 880 890 145.900 Robot (CW) 29.403 / 145.820
	Bcn	29.357 (CW)
RS-12/13 (Notes 3, 6 & 7)	K (h/A)	Dn 29.410 420 430 440 29.450 Up 21.210 220 230 240 21.250 Robot (CW) 29.454 / 21.129
	Bcn	29.408
RS-15 (Note 13)	A (v/a)	Dn 29.354 29.364 29.374 28.384 29.394 Up 145.858 145.868 145.878 145.888 145.898
UoSat 11 (UO-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

The Radio Amateur Satellite Corp.

Satellite	Mode		Frequencies										
JAS-1b (FO-20) (Notes 11 & 13)	JA Linear	Dn	435.800	810	820	830	840	850	860	870	880	890	435.900
		Up	146.000	990	980	970	960	950	940	930	920	910	145.900
	Bcn	435.795 (CW)											
	JD [a] Dgtl	Dn											435.910
		Up	145.850		145.890		145.910						
OSCAR 22 (UO-22) (Note 11)	[c]	Dn		435.120									
		Up	145.900		145.975								
KITSAT A (KO-23) (Note 11)	[c]	Dn		435.173									
		Up	145.850		145.900								
KITSAT B (KO-25) (Note 11)	[c]	Dn	435.175		436.500								
		Up	145.870	145.980									
IT-AMSAT (IO-26) (Note 11)	[a,c]	Dn		435.820 (Sec.)		435.867							
		Up	145.875	145.900	145.925	145.950							
EYESAT /AMRAD (AO-27) (Note 11)	[b,a]	Dn	436.800										
		Up	145.850										
POSAT (PO-28) (Notes 11 & 13)	[c]	Dn	435.250	435.280									
		Up	145.925	145.975									
MIR (Note 15)	[b]	Up & Dn & FM voice		145.550									
SHUTTLE (SAREX) (Note 15)	[b]	Dn		145.840									
		Up	144.450	144.470									

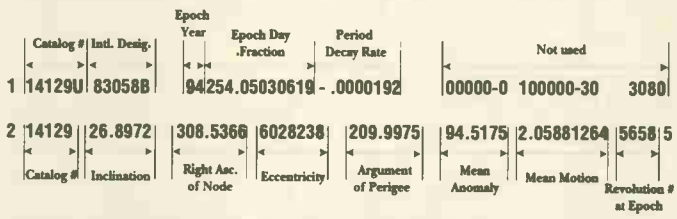
Compiled by

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 96093.67373864 -.00000142 00000-0 10000-3 0 4090
2 14129 26.3003 216.4285 5992601 3.6677 359.1205 2.05883895 68313
OSCAR 11 (UoSAT 2, UoSAT 11, UO-11)
1 14781U 84021B 96092.52725029 .00000061 00000-0 18193-4 0 8738
2 14781 97.7955 86.6825 0011572 342.2479 17.8320 14.69439046646392
Cosmos 1861 (Carries Radio Sputnik 10/11, RS-10/11)
1 18129U 87054A 96095.63249349 .00000047 00000-0 35276-4 0 1916
2 18129 82.9252 202.8896 0012848 6.9496 353.1836 13.72363682440089
OSCAR 13 (AMSAT OSCAR 13, AO-13)
1 19216U 88051B 96095.30108507 .00000560 00000-0 26337-3 0 1801
2 19216 57.3193 125.2728 7396646 35.8163 356.3991 2.09742852 28299
OSCAR 16 (PACSAT, AMSAT OSCAR 16, AO-16)
1 20439U 90005D 96092.24919969 -.00000021 00000-0 85377-5 0 9705
2 20439 98.5612 178.7921 0012304 68.4619 291.7872 14.29970125323071
OSCAR 17 (DOVE, DO-17)
1 20440U 90005E 96094.79778993 -.00000011 00000-0 12634-4 0 9714
2 20440 98.5624 181.8937 0012532 60.3332 299.9096 14.30112175323460
OSCAR 18 (WEBERSAT, WO-18)
1 20441U 90005F 96093.24681040 -.00000005 00000-0 14891-4 0 9754
2 20441 98.5636 180.3186 0012983 64.8748 295.3776 14.30081939323248
OSCAR 19 (LUSAT, LO-19)
1 20442U 90005G 96095.20726641 -.00000033 00000-0 40928-5 0 9718
2 20442 98.5596 182.7053 0013244 60.2871 299.9640 14.30189289323541
OSCAR 20 (JAS 1B, FUJI 2, FUJI OSCAR 20, FO-20)
1 20480U 90013C 96093.52166386 .00000008 00000-0 99527-4 0 8679
2 20480 99.0364 132.7350 0540110 296.0534 58.5957 12.83232649288184
COSMOS 2123 (Carries Radio Sputnik 12/13, RS-12/13)
1 21089U 91007A 96094.47555590 .00000056 00000-0 42733-4 0 8785
2 21089 82.9189 244.7341 0030560 79.8845 280.5749 13.74068286258778
OSCAR 22 (UoSAT-F, UoSAT 5, UO-22)
1 21575U 91050B 96094.68704518 .00000012 00000-0 18345-4 0 6773
2 21575 98.3546 163.2593 0007654 120.2585 239.9355 14.37017868247364
OSCAR 23 (KITSAT-A, KITSAT 1, KO-23)
1 22077U 92052B 96093.75607187 -.00000037 00000-0 10000-3 0 5670
2 22077 66.0781 347.3955 0009961 319.0929 40.9322 12.86295714171107
OSCAR 25 (KITSAT-B AMSAT OSCAR 25, KO-25)
1 22830U 93061H 96095.21622247 -.00000020 00000-0 89076-5 0 4745
2 22830 98.4768 162.1162 0012691 48.7652 311.4619 14.28105085131474
OSCAR 26 (ITAMSAT, ITALY OSCAR 26, IO-26)
1 22826U 93061D 96096.26215427 -.00000037 00000-0 24026-5 0 4634
2 22826 98.5888 173.2667 0010056 81.5694 278.6626 14.27798901131599
OSCAR 27 (EYESAT A, AMSAT OSCAR 27, AO-27)
1 22825U 93061C 96095.62955976 -.00000018 00000-0 10095-4 0 4642
2 22825 98.5888 172.4947 0009540 83.5304 276.6970 14.27690815131490
OSCAR 28 (POSAT 1, PO-28)
1 22829U 93061G 96093.26346104 -.00000017 00000-0 10442-4 0 4556
2 22829 98.5864 170.4259 0010934 76.4087 283.8312 14.28115601131193
RADIO ROSTOK (Radio Sputnik 15, RS-15)
1 23439U 94085A 96092.28971349 -.00000039 00000-0 10000-3 0 1232
2 23439 64.8183 147.4407 0163371 212.6233 146.4512 11.27524160 52111

WEATHER SATELLITES
Geostationary Spacecraft
GOES 7 (Standby - USA)
1 17561U 87022A 96093.57223459 -.00000049 00000-0 10000-3 0 8372
2 17561 2.9176 69.9174 0004812 347.0541 225.6776 1.00356145 16548
GOES 8 (Operational - USA)
1 23051U 94022A 96095.51264951 -.00000258 00000-0 00000+0 0 4990
2 23051 0.1365 264.7291 0001266 156.9839 241.0801 1.00269630 14621
GOES 9 (Operational - USA)
1 23581U 95025A 96095.33876476 .00000077 00000-0 00000+0 0 1662
2 23581 0.0669 61.3265 0002263 269.2690 209.5296 1.00283080 15182
ELEKTRO 1 (Russia)
1 23327U 94069A 96095.66832984 -.00000104 00000-0 00000+0 0 1391
2 23327 0.1672 236.6583 0006868 190.6981 82.3854 1.00271444 5266
METEOSAT 5 (MOP 2 Operational - ESA)
1 21140U 91015B 96094.83272207 -.00000010 +00000-0 +00000-0 0 01560
2 21140 000.3960 073.8038 0001902 252.6096 166.2898 01.00264501020864
METEOSAT 6 (Operational - ESA)
1 22912U 93073B 96094.33807870 -.00000093 00000-0 10000-3 0 4286
2 22912 0.2289 295.2624 0001790 50.6935 317.4553 1.00271417 7103
HIMAWARI 4 (GMS 4 Standby - Japan)
1 20217U 89070A 96095.58054398 -.00000370 +00000-0 +10000-3 0 03413
2 20217 001.6448 075.4372 0001844 080.1888 006.7306 01.00266821024683
HIMAWARI 5 (GMS 5 Operational - Japan)
1 23522U 95011B 96091.31765659 -.00000293 00000-0 10000-3 0 1101
2 23522 0.4721 327.9190 0001602 211.6378 263.9278 1.00277382 3671

Near Polar/Polar Orbiting Spacecraft
NOAA 12 (Operational - morning spacecraft - USA)
1 21263U 91032A 96095.78165815 .00000106 00000-0 66271-4 0 8823
2 21263 98.5655 116.9771 0013569 123.9797 236.2666 14.22607191254025
NOAA 14 (Operational - afternoon spacecraft - USA)
1 23455U 94089A 96095.85109625 .00000014 00000-0 32432-4 0 5533
2 23455 98.9387 41.5776 0010648 87.0849 273.1539 14.11578449 65106
DMSP B5D2-7 (USAF)
1 23233U 94057A 96095.70488030 .00000104 00000-0 79874-4 0 7258
2 23233 98.8401 155.5235 0013383 33.3014 326.8995 14.12693733 82453
DMSP B5D2-8 (USAF)
1 23533U 95015A 96095.85007627 .00000005 00000-0 26234-4 0 4564
2 23533 98.8405 99.2617 0006092 268.0241 92.0233 14.12731456 53276
Meteor 3-5 (Operational - Russia)
1 21655U 91056A 96094.21626900 .00000051 00000-0 10000-3 0 8780
2 21655 82.5561 13.4134 0014251 3.6165 356.5053 13.16845760222800
Meteor 2-21 (Inactive - Russia)
1 22782U 93055A 96093.38548552 .00000052 00000-0 34119-4 0 4736
2 22782 82.5474 47.2102 0021469 186.6441 173.4427 13.83050545130658
Meteor 3-6 (Inactive - Russia)
1 22969U 94003A 96095.81912681 .00000051 00000-0 10000-3 0 2442
2 22969 82.5575 312.2672 0016655 63.2980 296.9790 13.16735767105392
Okean 4 (Active Oceanographic Research - Russia)
1 23317U 94066A 96095.24579236 .00000047 00000-0 37401-5 0 1430
2 23317 82.5452 127.0600 0025610 325.4214 34.5349 14.74008188 79640
Sich 1 (Active Oceanographic Research - Russia)
1 23657U 95046A 96094.56769781 .00000101 00000-0 12198-4 0 688
2 23657 82.5322 269.2381 0026585 294.6204 65.2235 14.73462332 31845

$1005.95 Value,
Now Only
$399.95
Order GPS 22/OPK-4

SHIPPING
$14 UPS
$18 Priority Mail
$20 Canadian UPS
$21.50 Canadian APP

Save 60% on ICOM GP-22 Global Positioning System *With $506 Worth of Accessories!*

The superb ICOM GP-22 receiver alone has sold for $499.95 for nearly two years, but now Grove is offering the receiver **PLUS** an accessory kit valued at $506 for the incredible price of only **$399.95**—that's a $605 discount off the regular combined price of $1,005.95! The included OPK-4 kit includes an external antenna, mounting bracket, car power adaptor, and NMEA interface for connection to other navigational equipment.

The GP-22 uses the same precision satellites that helped us win the Gulf War. This tiny (2-1/2" x 5-1/4", 11 oz.) earth station fits in the palm of your hand! The easy-to-read digital display reveals bearing information from up to five earth-orbiting satellites, providing your latitude and longitude to within 300 feet (limited by the Department of Defense)—even your altitude!

Easy to use. Track your direction or return to a precise location. Create a route. Confirm your waypoints. Compute estimated time of arrival (ETA). Display heading, speed, bearing and range. Computer world and local time.

Powered by rechargeable battery pack. Includes carrying case, cigarette lighter power cord, AC wall adaptor/charger, illustrated instruction book. Prices subject to change due to yen fluctuations.

Great for mobile applications! The included OPK-4 kit includes an external antenna (shown on dash above and at far right), mounting bracket and navigational interface!

GROVE ENTERPRISES, INC.
1-800-438-8155; 704-837-9200;
FAX 704-837-2216
7540 Highway 64 West
Brasstown, NC 28902

ACCESSORIES

BAT 1	AA Alkaline Batteries	$ .79
BAT 13	Rechargeable Nicad batteries	$2.75

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-77	May 1996/ Endeavour*	28.4/160	9 days	Spacehab-04
STS-78	June 1996/ Columbia**	28.4/160	16 days	LMS

*Crew Assignment: CDR-John Casper, PLT-Curtis Brown, MS-Mario Runco, MS-Marc Garneau, MS-Andrew Thomas.
**Crew Assignment: CDR-Terence Henricks, PLT-Kevin Kregel, MS-Susan Helms, MS-Richard Linnehan, MS-Charles Brady, MS-Jean-Jacques Favier, MS-Robert Brent Thirsk.

SITS	Downlink Frequency Assignment:
VHF/UHF Voice	145.55 (FM/packet) 243.0(AM) 259.7(AM) 279.0 296.8 MHz(AM)
UHF Carrier	416.5 MHz
S-band TLM	2217.5 2250.0 2287.5 MHz
C-band TRK	5400-5900.0 MHz

Russian Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
June 1996	Soyuz	Baikonur	Progress M-32
June 1996	Proton	Baikonur	Tempo 1
July 1996	Soyuz	Baikonur	Soyuz TM-24

Tempo 1	Downlink Frequency Assignment:
Ku-band	12.2-12.7 Ghz

Soyuz TM-24	Downlink Frequency Assignment:
VHF Voice	121.750 MHz (FM voice)
VHF TLM	166.0 MHz (250 kHz wide FM telemetry)
L-band TLM	922.750 and 926.100 MHz

U.S. Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
May 1996	Delta II	CCAS	Galaxy IX
May 1996	DC-XA	VAFB	none
May 1996	Atlas IIA	CCAS	GE-1
May 1996	Pegasus XL	VAFB	MSTI-3
June 1996	Pegasus XL	VAFB	TOMS
June 1996	Delta II	CCAS	Navstar GPS
June 1996	LLV	VAFB	Clark
June 1996	Titan 4	???????	Classified
July 1996	LLV-1	VAFB	LEWIS
July 1996	Pegasus XL	VAFB	FAST
July 1996 EHF F7	Atlas		CCAS

Delta II	Downlink Frequency Assignments:
S-band TLM	2244.5 2241.5 2252.5 MHz
C-band TRK	5765.0 MHz

Atlas	Downlink Frequency Assignments:
S-band TLM	2202.5 and 2211.0 MHz

GE-1	Downlink Frequency Assignments:
C-band	3.7 - 4.2 GHz
Ku-band	11.73 - 12.17 GHz

Pegasus XL	Downlink Frequency Assignments:
UHF-band	416.5 MHz
S-band TLM	2288.5 MHz
C-band TRK	5765.0 MHz

L-1011 A/C	Downlink Frequency Assignments:
L-band	1480.5 MHz telemetry
L-band	1727.5 MHz Chase video
S-band	2250.5 MHz video downlink
C-band	4583.5 MHz video downlink
C-band	5765.0 MHz transponder downlink

TOMS	Downlink Frequency Assignments:
S-band TLM	2273.5 MHz

Navstar GPS	Downlink Frequency Assignments:
S-band TLM	1227.5 MHz

LEWIS	Downlink Frequency Assignments:
S-band TLM	2275.3 MHz

FAST	Downlink Frequency Assignments:
S-band TLM	2215.0 MHz

European Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
May 1996	Ariane 5	French Guiana	CLUSTER (4), Phase 3-D
May 1996	Ariane 4	French Guiana	PALAPA C2
May 1996	Ariane 4	French Guiana	AMOS 1

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

Telecom 2D Downlink Frequency Assignment: S-band TLM & TRK 2207.130 MHz.

List of Abbreviations and Acronyms

AMOS	Israel telecommunications satellite.
CCAS	Cape Canaveral Air Station.
CDR	Commander.
Clark	This high resolution satellite will locate utility pipelines & cables, and help town planners at construction sites.
Cluster	The four spacecraft will study the bow shock, dayside cusp, magnetopause, and the geomagnetic tail of Earth's electromagnetic field.
DC-XA	Delta Clipper-Experimental Advanced vehicle was developed by McDonnell Douglas Space Systems as a single stage to orbit (SSTO) rocket.
FAST	Fast Auroral Snapshot Explorer. Spacecraft to investigate the processes operating within the auroral region.
Galaxy	Hughes telecommunications satellite with principal applications including network TV, radio, VSAT, business video and data services.
GE-1	General Electric telecommunications satellite that will cover the continental United States including Alaska and Hawaii.
GHz	Gigahertz.
K-band	10.90 to 17.15 Ghz
Lewis	This spacecraft will carry a 384-channel HSI Hyper Spectral Imager that will have commercial applications in forestry, agriculture, water, land-use management & environment monitoring.
LMS	Life and Microgravity Spacelab designed to perform research through

Satellite Launch Schedules

	experiments in a stable low-gravity environment, emphasizing life sciences and microgravity sciences.
MHz	Megahertz.
MS	Mission Specialist.
MSTI-3	Planned launch into the same orbit as MSTI-2, the MSTI-3 satellite will conduct dynamic stereo observations of tactical missile launches and Earth backgrounds.
Navstar	U.S. Air Force Global Positioning Satellite for military and civilian navigation services.
PALAPA	Geosynchronous satellite communication system for the Republic of Indonesia.
PHASE 3D	Fourth launch of the third generation of amateur radio satellites.
PLC	Payload Commander, a member of the Shuttle crew having overall crew responsibility for planning, integration, and on-orbit coordination of payload mission activities.
PLT	Pilot.
Progress	Unmanned supply ship launched to the Russian Mir space station.
RNG	Ranging.
S-band	2000 to 2300 Mhz
Soyuz TM	Manned mission to carry replacement crews to the Russian space station Mir.
SpaceHab	U.S. company providing commercially-owned pressurized module for conducting experiments in a man-tended environment. Also a series of payloads to be flown on the Space Shuttle.
Tempo 1	A high power DTH satellites owned by Tempo, a subsidiary of Tele-Communications Inc.
TLM	Telemetry.
TOMS	Total Ozone Mapping Spectrometer will study stratospheric ozone.
TRK	Tracking.
UHF	Ultra High Frequency (390 to 499 MHz)
UHF F7	U.S. Navy communications satellite replacing Fleet Satellite Communications Network.
VAFB	Vandenberg Air Force Base, Calif.
VHF	Very High Frequency (30 to 300 MHz)
WBFM	Wide Band FM

Keith Stein is a space analyst/freelance writer based in Woodbridge, Virginia.

Updates for Previous Launches

By Phillip Clark, Molniya Space Consultancy

International Designation	Comment
1981-050A	INTELSAT 501 was manoeuvred off-station over 91º E approximately Jan 16-17, 1996 and was relocated over 71º E Feb 11, 1996.
1983-058A	EUTELSAT-1 F-1 was manoeuvred off-station over approximately 47º E Jan 27, 1996 and was still drifting to the west at the end of February.
1987-022A	GOES 7 was manoeuvred off-station over 226º E approximately Jan 26, 1996: it was still drifting to the east at the end of February.
1988-018B	Telecom 1C was manoeuvred off-station over 2º E during Jan 29-30, 1996 and had its longitude re-stabilised over 0º E approximately Feb 6, 1996.
1990-102A	Gorizont 22 was manoeuvred off-station over 39-40º E approximately Feb 7, 1996 and was still drifting to the east at the end of the month. Note: Gorizont 31, 1996-005A, had been stationed over 40º E Feb 2, 1996.
1994-038A	Cosmos 2282 has not made a station-keeping correction since Oct 8-10, 1995 and has drifted off-station over 335º E: at the end of February 1996 it had drifted to 331.5º E and is presumably no longer operating.
1995-011A	Add the following orbital data for the Space Flyer Unit as it manoeuvred prior to its capture by the shuttle orbiter Endeavour (STS-72, 1996-001A):- 1995 Dec 6.31, 28.45 deg, 94.00 min, 466 km, 475 km 1995 Dec 7.39, 28.46 deg, 94.15 min, 472 km, 483 km 1995 Dec 21.87, 28.45 deg, 94.33 min, 481 km, 491 km 1995 Dec 22.46, 28.44 deg, 94.08 min, 470 km, 478 km 1996 Jan 18.65, 28.45 deg, 94.08 min, 469 km, 478 km The Space Flyer Unit was grappled using the robot arm in Endeavour's payload bay Jan 13, 1996 at 1057 UTC and berthed in the payload bay Jan 13 at 1139.It returned to Earth to the Kennedy Space Center in the shuttle's payload bay Jan 20 at 0742.
1995-025A	After being boosted off-station Dec 5, 1995, GOES 9 was relocated over 224-225º E approximately Jan 22, 1996.
1995-047A	Soyuz-TM 22 with Russian cosmonauts Gidzenko and Avdeyev and ESA astronaut Reiter undocked from the Mir Complex front longitudinal port (+X) Feb 29, 1996 at 0720 UTC and landed near Arkelyk in Kazakhstan at 1042 UTC. Reiter completed the longest flight to date by a non-FSU citizen.
1995-067B	INSAT 2C was relocated from 95º E to 93º E during Feb 1-12, 1996: orbital data during the relocation were not issued and thus it is not possible to give dates for the manoeuvres away from the original location and for stabilisation at the new location.
1995-068A	Add the following orbital data for Cosmos 2323:- 1996 Jan 9.31, 64.85 deg, 675.74 min, 19,086 km, 19,175 km
1995-068B	Add the following orbital data for Cosmos 2324:- 1995 Dec 28.81, 64.83 deg, 675.66 min, 19,114 km, 19,142 km
1995-068C	Add the following orbital data for Cosmos 2325:- 1995 Dec 28.81, 64.83 deg, 675.74 min, 19,113 km, 19,147 km
1995-070A	Progress-M 30 undocked from the -X port (on Kvant 1) of the Mir Complex Feb 22, 1996 at 0726 UTC and was de-orbited over the Pacific Ocean at 1428.
1995-072A	Add the following orbital data for IRS 1C:- 1996 Jan 14.21, 98.71 deg, 101.29 min, 819 km, 821 km
1995-073A	Add the following orbital data for EchoStar 1:- 1996 Jan 22.61, 0.11 deg, 1,436.16 min, 35,765 km, 35,810 km. The satellite is located over 240-241º E.
1995-074A	The X-Ray Timing Explorer (XTE) has been re-named the Bruno B Rossi X-Ray Timing Explorer (RXTE).

START Laumch Failure March 28, 1995

The correct launch time for this flight is 1995 Mar 28.38 (0900 UTC): the time of 1000 UTC originally quoted was based upon Russian announcements giving a Moscow Time figure and it was not realised that Moscow Summer Time was in operation.

Maiden Flight of Japan's J-1 Launch Vehicle

This launch is not included in the body of this launch listing since it was a sub-orbital test flight. The first J-1 was launched from the Tanegashima site 1996 Feb 11.96 (2300 UTC) in a two-stage version . The second stage and HYFLEX (Hypersonic Flight Experiment) payload (mass-1,048 kg) reached an apogee of about 110 km. After re-entry the HYFLEX lifting body came down by parachute and splashed down in the Pacific Ocean, about 300 km NE of the Ogasawara Islands: the flotation bag attachment failed and the payload sank into the Ocean.

Satellites Drifting on Geosynchronous Orbit

This new sub-section will list the satellites in geosynchronous orbit which have previously been reported as having been manoeuvred off-station and which are still drifting at the end of the second month to which lis listing refers.

International Designation	Satellite Name	Date Off-Station	Comments
1982-017A	INTELSAT 504	Nov 26, 1995	Drifting to the west
1982-110B	SBS 3	Jun 1, 1995	Drifting to the west
1983-026B	TDRS 1	Dec 11, 1995	Drifting to the east
1983-059C	Palapa-B 1	Oct 1995	Drifting to the west
1987-022A	GOES 7	Jan 26, 1996	Drifting to the east
1989-041B	DFS 1	Dec 13-14, 1995	Drifting to the east

ST SATELLITE LAUNCH REPORT

By Phillip Clark, *Molniya Space Consultancy*

How to Use the Satellite Launch Report

The "Satellite Launch Report" is a complete list of satellite launches which took place during January and February 1995. The format of the listing is as follows:

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

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

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

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

Launch Date/Time	Int Des	Satellite		Mass
Epoch	Incl	Period	Perigee	Apogee
1996 Jan 11/0941	1996-001A	Endeavour (STS-72)		98,430 kg
1996 Jan 12.31	28.44 deg	91.04 min	191 km	460 km
1996 Jan 13.17	28.45 deg	94.01 min	469 km	472 km
1996 Jan 14.91	28.45 deg	90.69 min	304 km	313 km
1996 Jan 11/0941	1996-001B	SPARTAN 206/OAST Flyer		1,198 kg
1996 Jan 14.63	28.45 deg	90.67 min	303 km	312 km

Tenth flight of shuttle orbiter Endeavour, carrying six astronauts: B K Duffy (commander), B W Jett Jr (pilot), L Chiao (mission specialist, MS-1 and EVA crewman), W E Scott (MS-2 and EVA crewman), K Wakata (NASDA crewman, MS-3) and D T Barry (MS-4, EVA crewman). Mass quoted above is that projected for the time of landing. Performed rendezvous with Japanese-launched SFU (Space Flyer Unit, 1995-011A): satellite was grappled by shuttle's remote manipulator Jan 13 at 1057 UTC and berthed in payload bay 1139 UTC. Shuttle returned to Kennedy Space Center Jan 20 at 0742 UTC.

SPARTAN 206 (Shuttle Pointed Autonomous Research Tool for Astronomy) carried experiments for the OAST (Office of Aeronautics and Space Technology). Satellite carried four experiments: REFLEX (Return Flux Experiment), GADACS (Global Positioning System [GPS] Attitude Determination and Control Experiment), SELODE (Solar Exposure to Laser Ordinance Device) and SPRE (SPARTAN Packet Radio Experiment). It was deployed from the shuttle's payload bay Jan 14 at 1132 UTC and was grappled by the shuttle's remote manipulator Jan 16 at 0947 UTC.

Launch Date/Time	Int Des	Satellite		Mass
Epoch	Incl	Period	Perigee	Apogee
1996 Jan 12/2310	1996-002A	PAS 3R		2,918 kg
1996 Jan 12.76	6.92 deg	655.07 min	256 km	36,959 km
1996 Feb 11.99	0.07 deg	1,436.05 min	35,775 km	35,797 km
1996 Jan 12/2310	1996-002B	MEASAT 1		1,450 kg
1996 Jan 12.76	7.02 deg	630.68 min	206 km	35,760 km
1996 Jan 30.68	0.21 deg	1,436.00 min	35,761 km	35,808 km

PAS 3R is a communications satellite built by Hughes Space and Communications for the PanAmSat Corporation. Mass quoted above is at launch: on station it was 1,753 kg and the dry mass is 1,318 kg. Located over 317º E. Satellite replaces PAM 3 which was lost following the Ariane launch failure of December 1, 1994. MEASAT 1 (Malaysian/East Asian Satellite) is a communications satellite built by Hughes Space and Communications for Binariang in Kuala Lumpur (Malaysia). Mass quoted above is at launch: on station it was 839 kg and the dry mass is 626 kg. Planned operating longitude is 91.5º E.

Launched from Kourou by an Ariane 44L: third stage and mini-SPELDA left in orbits similar to the first ones listed fo the satellites.

1996 Jan 14/1110	1996-003A	Mugunghwa 2		1,459 kg
1996 Jan 14.51	21.01 deg	646.52 min	1,358 km	35,421 km

Also called KOREASAT 2, Mugunghwa 2 is a Lockheed-Martin Series 3000 communications satellite, launched for Korea Telecom. Mass of the satellite quoted above is at launch: on station at the beginning of its life it would be 833 kg and the dry mass is 641 kg. Initially located over 114-115º E, but to be operated over 116º E. Launched by a Delta-2 (7920) from Cape Canaveral: second stage left in a 25.32 deg, 103.54 min, 385-1,467 km orbit, third stage (PAM-D) in an orbit similar to the first one shown above for the satellite.

1996 Jan 16/1534	1996-004A	Cosmos 2327		795 kg?
1996 Jan 17.31	82.98 deg	104.69 min	950 km	1,009 km

Military navigation satellite in the "Parus" network: co-planar with Cosmos 2266, indicating that this is a replacement for the failed Cosmos 2321 launch (1995-052A) in October 1995. Satellite built by NPO Prikladnoi Mekhaniki. Launched by a Cosmos-3M from Plesetsk: second stage of launch vehicle is in an orbit similar to the satellite.

1996 Jan 25/0955?	1996-005A	Gorizont 31	2,125 kg?	
1996 Jan 28.80	1.51 deg	1,478.16 min	36,543 km	36,669 km
1996 Feb 2.68	1.52 deg	1,436.41 min	35,763 km	35,822 km

Launch announcement indicated that this was the final launch of a Gorizont communications satellite. Built by NPO Prikladnoi Mekhaniki. Located over 39-40º E. Launched from Tyuratam using a Proton-K (4) vehicle: third stage left in a 51.63 deg, 88.30 min, 186-195 km orbit, fourth stage (Block DM-2) in an orbit similar to the first one listed for the satellite. Launch time is estimated.

Launch Date/Time	Int Des	Satellite		Mass
Epoch	Incl	Period	Perigee	Apogee
1996 Feb 1/0115	1996-006A	Palapa-C 1		2,989 kg
1996 Feb 1.74	21.82 deg	1,935.12 min	255 km	39,869 km
1996 Feb 12.79	0.22 deg	1,509.96 min	35,521 km	38,920 km
1996 Feb 13.78	0.11 deg	1,435.97 min	35,495 km	36,074 km

Palapa-C 1 is a communications satellite, launched for PT Satelindo, Indonesia and built by Hughes. Mass quoted above is at launch: on-station the mass is 1,775 kg. Satellite initially located over 123-124° E, but is to be operated over 113° E. Launched from Cape Canaveral using an Atlas-2AS: second stage (Centaur) in an orbit similar to the first one listed for the satellite.

1996 Feb 5/0719	1996-007A	N-STAR b		3,420 kg
1996 Feb 5.53	6.96 deg	630.86 min	172 km	35,804 km
1996 Feb 15.33	0.09 deg	1,436.10 min	35,753 km	
35,820 km				

Communications satellite launched for Space Systems/Loral (California) and NTT and NTT/DoCoMo (Japan): satellite built by Space Systems/Loral. Mass quoted above is at launch: on station it is 2,062 kg and the dry mass is 1,618 kg. Satellite located over 136° E. Launched from Kourou by an Ariane 44P: third stage (H-10-3) in an orbit similar to the first one listed for the satellite.

1996 Feb 14/1901		INTELSAT 708	4,576 kg
Failed to rech orbit			

Maiden launch of CZ-3B vehicle. INTELSAT 708 was a communications satellite launched for INTELSAT, prime contractors Space Systems/Loral. Planned for operations over 310° E. Within seconds of the launch the first stage inertial platform failed with the vehicle veering off-course and crashing close to the launch pad. Launch vehicle was basically the CZ-3A which had flown successfully twice in 1994, with the first stage supplemented by the strap-on boosters used on the CZ-2E launch vehicle.

1996 Feb 17/2043	1996-008A	NEAR	805 kg
Heliocentric orbit			

NEAR (Near Earth Asteroid Rendezvous) mission is the first to be dedicated to the study of asteroids. Satellite built by the Applied Physics Laboratory of the John Hopkins University. On June 27, 1997 there is an opportunity for the spacecraft to fly 1,200 km from the asteroid 253 Mathilde, although this is a secondary mission objective. A gravity-assist will be given to the spacecraft when it passes 478 km above the Earth on January 22, 1998. Spacecraft scheduled to reach asteroid 433 Eros in early 1999: encounter manoeuvres should begin January 9 with the first close approach at 500 km over the asteroid's sunlit side coming on February 6. NEAR should then enter orbit around the asteroid, initially 200-400 km although the orbit will be lowered and circularised once the shape and dynamics of the asteroid are known. Launched from Cape Canaveral by a Delta-2 (7925): second stage left in a 26.00 deg, 158.74 min, 173-6,494 km orbit, third stage (PAM-D) reached heliocentric orbit with the payload.

1996 Feb 19/0058	1996-009A	Gonets-D 1		225 kg?
1996 Feb 19.42	82.58 deg	113.94 min	1,400 km	1,414 km
1996 Feb 19/0058	1996-009B	Gonets-D 2		225 kg?
1996 Feb 19.42	82.57 deg	114.02 min	1,407 km	1,414 km
1996 Feb 19/0058	1996-009C	Gonets-D 3		225 kg?
1996 Feb 20.13	82.58 deg	114.07 min	1,410 km	1,417 km
1996 Feb 19/0058	1996-009D	Cosmos 2328		225 kg?
1996 Feb 19.97	82.58 deg	114.07 min	1,411 km	1,415 km
1996 Feb 19/0058	1996-009E	Cosmos 2329		225 kg?
1996 Feb 19.73	82.58 deg	114.15 min	1,412 km	1,422 km
1996 Feb 19/0058	1996-009F	Cosmos 2330		225 kg?
1196 Feb 19.81	82.58 deg	114.22 min	1,412 km	1,427 km

Gonets-D satellites are the civilian/commercial version of the "Strela-3" military communications satellites which have been flying as sextets since 1985: Cosmos 2328-2330 are three standard "Strela-3" satellites. Payloads are built by NPO Prikladnoi Mekhaniki. The satellites were launched into the same orbital plane as Cosmos 2299-2304 (1994-086A-F). Gonets-D test payloads were flown as Cosmos 2199 and Cosmos 2201 in 1992. Of the objects 1996-009A-F which have been catalogued, it is uncertain which are actually the Gonets-D satellites and which are the three "Strela-3" Cosmos payloads: therefore the names shown above might be subject to revision. Launched from Plestsk using Tsyklon vehicle: Tsyklon third stage (S5M) is in an orbit slightly higher that the satellites.

1996 Feb 19/0832	1996-010A	Raduga 33		2,000 kg?
1996 Feb 21.19	48.60 deg	645.84 min	242 km	36,502 km

Military communications satellite, built by NPO Prikladnoi Mekhaniki. After launch the fourth stage ignited to place the satellite into a geosynchronous transfer orbit. At about the time that the fourth stage (Block DM-2) should have re-ignited to raise the orbit to a geosynchronous one, it exploded producing about 200 fragments. On-board sequencer separated the Raduga satellite after the explosion. Launched from Tyuratam using a Proton-K (4): third stage discarded in a 51.62 deg, 88.29 min, 186-194 km orbit.

1996 Feb 21/1234	1996-011A	Soyuz-TM 23		7,150 kg?
1996 Feb 21.57	51.62 deg	88.84 min	200 km	234 km
1996 Feb 22.63	51.65 deg	90.42 min	279 km	311 km
1996 Feb 23.83	51.65 deg	92.45 min	391 km	398 km

Two-manned spacecraft, carrying Y I Onufriyenko (commander) and Y V Usachov to the Mir Complex. Docked with the Mir Complex at the rear (-X) port on Kvant 1 Feb 23 at 14.21 UTC: crew are due to remain on board Mir until mid-July 1996. Launched from Tyuratam using a Soyuz-U2 vehicle: third stage (Block I) discarded in an orbit similar to the first one listed for the satellite.

1996 Feb 22/2018	1996-012A	Columbia (STS-75)		103,370 kg
1996 Feb 22.95	28.47 deg	90.52 min	297 km	303 km
1996 Feb 24.46	28.48 deg	90.50 min	294 km	304 km
1996 Mar 6.25	28.45 deg	90.22 min	280 km	290 km
1996 Feb 22 20.18	1996-012B	TSS-1R		518 kg
1996 Feb 26.60	28.47 deg	91.85 min	316 km	414 km

Shuttle mission carrying seven astronauts: A M Allen (commander), S J Horowitz (pilot), J A Hoffman (mission specialist, MS-1), M Cheli (ESA astronaut from Italy, MS-2), C Nicollier (ESA astronaut from Switzerland, MS-3), F R Chang-Diaz (MS-4) and U Guidoni (Italian payload specialist, PS-1). Payload bay carried TSS-1R and support equipment (total mass 5,506 kg) plus USMP-3 (United States Microgravity Payload, mass 2,427 kg). Mass quoted above is the pre-launch figure projected for landing (103,388 kg) less the mass of the separated TSS-1R satellite. Launched from Kennedy Space Center and returned there Mar 9 at 1358 UTC.
TSS-1R was a re-flight of the TSS-1 (Tethered Satellite System) which was previously flown on STS-46 in 1992. Spherical satellite was deployed from the shuttle's cargo bay Feb 25 at 2045 UTC and the connecting tether allowed the satellite to retreat to a distance of 19 km. On Feb 26 at 0130 UTC the tether broke and unintentionally the satellite was launched into orbit as a separate object.

1996 Feb 24/1124	1996-013A	Polar		1,258 kg
1996 Feb 25.81	85.98 deg	936.97 min	186 km	50,495 km

Polar is a magnetospheric research satellite, built by Lockheed Martin Astro Space. The dry mass is 730 kg. Launched from Vandenburg Air Force Base using a Delta-2 (7925): Delta-2 second stage discarded in a 85.93 deg, 95.61 min, 183-913 km orbit, third stage (PAM-D) is in an orbit similar to the satellite.

GROVE COMMUNICATIONS EXPO

Educators to Meet at Expo

By Larry Van Horn
Expo '96 Publicity Chairman

To most of us who read the pages of *Monitoring Times* and *Satellite Times* magazines, radio monitoring is nothing more than a hobby. But the same technology we use in our radio shack can also be used as a powerful teaching tool in the nation's classrooms. Unfortunately, most educators are not aware that this technology exists, what resources are available, nor how to integrate radio into the curriculum. To help get this information to educators, Grove Enterprises will sponsor a special one day forum at this year's *Communications Expo*.

In announcing this special event, Bob Grove, President of Grove Enterprises, said, "With the intrusion of computer and communication technology into every phase of our lives, Americans feel they are losing control and comprehension of their environment. This year the *Grove Expo* is making a special outreach to classroom instructors, demonstrating and informing them of the myriad uses of radios and computers in our society. Teachers in attendance will become better equipped to prepare the youth of today to meet the challenges of tomorrow."

This special event will be kicked off at 9:00 a.m. on Friday, October 18, 1996, with opening remarks to the forum participants by Bob Grove.

At 9:30 a.m., *Monitoring Times*/*Satellites Times* Internet columnist, Bill Grove, will give a presentation on *Education and the Net*. The Information Superhighway brings to the classroom one of the most powerful teaching aids in the educator's toolkit. Students and teachers alike will find more information available to them on the net than they ever imagined. During this forum, Bill will show some of the best educational sites on the Internet and demonstrate ways in which these resources can be used in the classroom.

Bob Grove will return to the podium at 10:30 a.m. to talk about *Shortwave Radio - Listening to the Global Village*. Although teachers do their best to make foreign languages, social studies, and other courses of study come alive in the classroom, nothing can compare with personal experience. Bob will show how an inexpensive shortwave radio can help bring the world to the student's desk.

The QSL card of educator Carole Perry, who uses amateur radio in her Staten Island classroom.

A shortwave radio allows foreign languages to be heard in their actual dialect; social and political struggles can be monitored directly from the lips of those who are fighting to bring democracy to their country. Science educators can successfully employ shortwave radio to demonstrate radio wave behavior and atmospheric propagation, along with solar influences on the electromagnetic spectrum.

One person who has been using radio in her classroom for more than ten years is the 1993 *Monitoring Times* convention keynote speaker, Mrs. Carol Perry, WB2MGP. She will start the afternoon sessions off with a forum entitled *Reading, 'Riting, and Radio*. Carol will show how she uses amateur radio in her Staten Island classroom to make a school curriculum come alive. Handouts, sample lesson guides, and important addresses to enhance the learning experience for students will be provided.

Satellite Times magazine "View From Above" columnist Dr. Jeff Wallach will make a presentation at 2:15 p.m. on *Mission to Planet Earth*. Jeff will discuss how to receive weather satellite imagery directly into the classroom. Information on hardware, software, and what's up there to view will be discussed in this lively one-hour forum.

Space and computers still hold a fascination for our school children. Dr. TS Kelso of the *Satellite Times* staff will have a 3:30 p.m. session that will discuss methods which combine these subjects to teach a variety of related classroom subjects. Kelso will present a broad range of suggestions that will help grab students' attention and make teaching fun.

Extracurricular Activities!

In addition to all the scheduled presentations mentioned above, there are several additional activities available to educators during the day on Friday. The *Grove Expo* is proud to offer a unique opportunity for educators. We have assembled an outstanding panel of international shortwave broadcasters from around the world who will be available to speak to educators one-on-one starting at 11:30 a.m until 4:00 p.m. These broadcasters will be available to answer specific questions from educators on information about their country as well as provide critical insights into their cultures and societies.

Participants in the above seminars will also have access to the *Expo* commercial exhibits and can attend the live demonstrations of radio astronomy technology being conducted by the Society of Amateur Radio Astronomers throughout the day on Friday.

The cost for the entire educators' program is only $10. Registration for this exciting one day event can only be taken by mail. Requests for a seat at the forum must be in writing on the educational institution's letterhead and payment must be enclosed with the request. But you must hurry, as seating for this exciting program is extremely limited and a sellout is expected.

Educators registered for Friday's program who wish to participate in the rest of the weekend's acitivities will receive a $10 discount off the $55 Expo registration, or may sign up for single seminars at $5 each ($5 discount).

For more information email **expo96-info@grove.net**, or write to: Educator's Forum, c/o Judy Grove, P.O. Box 98, Brasstown, NC 28902.

"Share the experience—bring a friend!"

Come to Grove Communications EXPO '96

If you are interested in **electronic communications**, the **Grove Communications Expo** is your event of the year! Expo '96 in Atlanta, to be held **Oct. 18-20**, unites you with hundreds of like-minded communications enthusiasts who assemble to **exchange information, introduce new products, and offer technical help**. This is an outstanding opportunity for you to move into the information age! This year's expanded program includes over **50 seminars, forums, demonstrations and events** in the following areas:

- **Computers and the Internet**
- **Shortwave and scanner monitoring**
- **Satellite communications**
- **Radio astronomy**

As in recent years, the Expo will feature exhibits by top-name vendors, a hands-on listening post, club booths and prizes. Tours will be conducted to the **Delta Communications Center, Atlanta Fire Communi-cations, Atlanta/Fulton County Communi-cations Center** and more.

Keynote speaker at this year's banquet will be **Ron Parise, NASA astronaut** and astronomer. Parise, WA4SIR, has made two trips into space aboard the shuttle and operated the shuttle's amateur radio experiments (**SAREX**). Several special workshops, forums and exhibits will be sponsored this year by the Society of Radio Astronomers (**SARA**), which will be conducting their fall conference in conjunction with the Expo!

Other knowledgeable and enjoyable speakers include **Bob Grove, Larry Van Horn, Jacques d'Avignon, Rich Arland, Ken Reitz, Richard Barnett, Doug Smith, John Fulford, Bill Grove, Kevin Carey, Jeff Wallach, George Zeller, Keith Stein, John Catalano, T.S. Kelso, Doug Graham, Bob Wyman, Don Dickerson, Bob Evans, Tom Taylor, Jorge Rodriguez, Ian McFarland, Carole Perry, Steve Dye, Donald Dickerson, John Magliacane, and Keith Baker.**

Atlanta Airport Hilton
October 18-20, 1996

Registration is $55 per person (take $10 off if you bring a first-time registrant with you). Rooms at the Airport Hilton available at the convention rate of $76 per night, single or double occupancy. Call 1-800-Hiltons.

GROVE COMMUNICATIONS EXPO

For more information and schedules, set your web browser to **http://www.grove.net/hmpgexpo.html**, e-mail us at **expo96-info@grove.net**, phone us at **1-800-438-8155**, or fax us at **1-704-837-2216**.

By John A. Magliacane, KD2BD

The First Amateur Newsletter Read In Space

SpaceNews... Perhaps you've seen it on packet radio, read via satellite, caught it on the Internet, or bumped into it on a telephone BBS. But just what is *SpaceNews* all about, and how did it get its start?

SpaceNews is a weekly, non-commercial, electronic newsletter that carries news and information of interest to those involved in Amateur satellite communications. *SpaceNews* started in November 1987 when I posted several OSCAR satellite news items to a local packet radio bulletin board system (BBS) in Neptune, New Jersey. The bulletins were patterned after the news broadcasts made by OSCARs 9 and 11. In fact, most of the news carried in these early reports were based on information captured from news broadcasts made by these satelliites using nothing more than a Commodore 64 computer, an indoor "coat hanger" yagi, a used 2-meter rig, and some "homebrew" software. Despite the frugal working conditions, users of the packet radio BBS enjoyed the reports and some felt the quality and content of the bulletins warranted distribution beyond the local Monmouth County, New Jersey area.

With the help of packet radio BBS sysop Mr. Dave Trulli, NN2Z, circulation of *SpaceNews* to other packet radio bulletin board systems began in the mid-Atlantic and New England states. Back then, the Amateur Packet Radio Network (AMPR) was only a skeleton of what it is today.

Messages were easily lost in their transport across the network, and lengthy news bulletins easily clogged the network preventing other (some might say "more important") messages from passing through, much to the dismay of packet radio BBS sysops. Bulletin IDs, identifiers that are unique to a packet radio bulletin, were just getting their start in 1987, and not all BBS software in use supported them. Bulletin IDs were created to avoid duplication of messages as they propagated from BBS to BBS via different paths.


COMPUTERS TUNED TO 'SPACE NEWS'

Above, the shack of KD2BD where SpaceNews is created every week. This station communicates via packet radio, satellites, and the Internet. At right, an article featuring SpaceNews and its author appeared in the Asbury Park Press, New Jersey's second largest newspaper, in 1994.

A rocky beginning

Much of the feedback received as the result of *SpaceNews* creation and circulation in 1987 was strongly negative. The packet radio network was in its infancy and just couldn't pass lengthy messages reliably. However, as more and more packet users and BBS sysops found *SpaceNews* a valuable information source and a valuable asset to their local BBS, the feedback turned more positive.

A gateway to success

The ARRL magazine *Gateway* carried an article about *SpaceNews*, effectively spreading the word of its existence across the country. The article sparked an interest in Mr. Tad Cook, KT7H, of North Bend, Washington. Tad was already forwarding packet radio bulletins via landline using "PC Pursuit" software to a friend in California in an effort to speed the delivery of information carried across the packet network. While the PC Pursuit network was helpful on the west coast, there was still the problem of getting *SpaceNews* from the east coast of New Jersey to KT7H in the state of Washington in a manner that was faster and more reliable than the standard packet radio bulletin transfer rate.

In order to allow packet messages to pass more quickly through the packet network, each *SpaceNews* issue was broken into four or more "byte-sized" chunks and sent individually to KT7H as private packet mail. The scheme worked, thanks to the efforts of those involved, and *SpaceNews* began to flood the west coast packet radio network in a timely manner.

Unix to the rescue!

Hearing of the efforts of NN2Z and KT7H to circulate *SpaceNews*, Mr. John Decatur, KA2QHD of Ocean Township, New Jersey offered the use of his home built Unix computer system as a method of transporting *SpaceNews* across the United States. John's computer was networked to other Unix machines around the country and around the world through a UUCP (Unix-to-Unix Copy) connection that was far more reliable than the Amateur Packet Radio Network.

An extensive Unix network backbone was in place between major Universities such as Rutgers University, Princeton, the University of California at Berkeley, and major corporations such as AT&T, Concurrent Computer Corporation, Masscomp,

and UUNet. In addition to electronic mail transfer via UUCP, John's Unix box also had access to Usenet, a world-wide news and information network that still exists today.

Both UUCP mail transfer to selected *SpaceNews* distributors and global Usenet news postings aided in the circulation of *SpaceNews*. An added advantage of the Usenet postings was that it opened the eyes of space scientists and researchers around the globe to the activities of the amateur space program. Some were even convinced enough to get their ham radio licenses.

On Usenet, circulation of *SpaceNews* started out in the rec.ham-radio and sci.space newsgroups. Over time, the **rec.ham-radio** newsgroup changed identity and became known as **rec.radio.amateur.misc**. Meanwhile, a moderated newsgroup called sci.space.news was created by Mr. Peter Yee specifically for electronic journals such as *SpaceNews*, and official press releases from NASA. Since the UUCP network had gateways to MCI Mail, Compuserve, and Arpanet, packet radio users who had access to these networks worked to supplement packet radio distribution of *SpaceNews*.

AMSAT's Plan

The Arpanet and many UUCP connected Unix-based computers slowly grew into what today is referred to as the "Internet". As the Internet began to grow, Dr. Tom Clark, W3IWI, President emeritus of the Radio Amateur Satellite Corporation of North America (AMSAT-NA) connected an "AT" computer he named "Tomcat" (Tom Clark's AT) to the Internet at the Goddard Spaceflight Center. Tom Clark's computer ran PC-based NOS software, a network operating system designed by Phil Karn, KA9Q, that provided TCP/IP (Transport Control Protocol / Internet Protocol) file transfers in a manner similar to the Unix operating system. Tomcat was used in an effort to move AMSAT's electronic mail and bulletin distribution from TeleMail to the Internet, which by virtues of its many gateways, had a lot more flexibility. Dr. Clark strongly encouraged that *SpaceNews* be distributed on his system as well and that it be given the same treatment and follow the same packet radio network distribution as official AMSAT News Service bulletins.

Dr. Clark's Tomcat system functioned primarily as a test-bed for moving AMSAT messaged from TeleMail to the Internet. It clearly showed the vast superiority of Internet file transfer over that of TeleMail. However, as the use of the Tomcat system increased, so did the strain on the system and frequency of system crashes, and it soon became obvious that a more robust networking platform was required for reliable distribution of AMSAT News Service bulletins, Keplerian orbital data bulletins, and *SpaceNews*.

Unix to the rescue...again!

While AMSAT-NA jumped on the "information superhighway" with a PC, Brian Kantor, WB6CYT at the University of California at Berkeley had a Unix machine serving as a mail "exploder" that easily transported over 15,000 mail messages a day to their proper destinations with a single hitch. The vast superiority of Unix's "sendmail" transport mechanism was clearly evident, and the desire to replace Tomcat with a Unix workstation was expressed by Dr. Clark. Eventually, a used Unix workstation was made available for use by AMSAT-NA. It was named "amsat.org", and currently lives on the Internet supporting several mailing lists and several thousand subscribers, 24 hours a day. A second system made available by Qualcomm Incorporated in San Diego, California serves as a World Wide Web server for AMSAT-NA. Its URL is **http://www.amsat.org**.

TABLE 1

Mir BBS directory listing from March 1991 showing the March 4, 1991 issue of *SpaceNews* among the messages read by the cosmonauts on the space station

Msg #	Stat	Date	Time	To	From @ BBS	Subject
42	P	91/03/09	04:37	U2MIR	KA1SU	Hello Musa
41	PR	91/03/09	03:21	ALL	U2MIR	qsl
40	PR	91/03/09	03:02	U2MIR	VO1SA	Greetings
39	PR	91/03/09	03:00	U2MIR	VO1XC	GREETINGS
38	PR	91/03/09	02:54	U2MIR	KI4TD	GREETINGS
37	PR	91/03/09	02:51	U2MIR	KC4UZA	hello agai
36	PR	91/03/09	01:31	U2MIR	F3NW	TOMORROW
35	PR	91/03/08	20:37	U2MIR	TR8CA	* SpaceNews 04-Mar-91 *
34	PR	91/03/08	20:36	U2MIR	TR8CA	PHOTOS
33	P	91/03/08	16:30	KJ9U	U2MIR	LIST 02.03.91

2538 Bytes free
Next message Number 43

The official seal of Wall Township, New Jersey. The tower shown in the upper right hand corner represents one of several radio towers used by Marconi's American Wireless Company to make the first transoceanic radio transmission from Wall Township, New Jersey. The dish antenna depicted in the lower left is symbolic of the Diana radar dish that was successful in making the first moonbounce communications on January 10, 1946 from Wall Township by the US Signal Corps.

SpaceNews: The weightless version

Of course, the $64,000 question still remains: How did *SpaceNews* become the first amateur newsletter read it space?

The answer is a bit unclear. In March 1991, VE1AIC posted a directory listing of all the messages stored on the packet radio BBS on the Russian space station Mir to the packet radio network. It came as quite a shock to the author to see *SpaceNews* listed in the messages not only posted to the Mir BBS, but also among the messages read by the cosmonauts onboard the space station. The station who uploaded *SpaceNews* to Mir was TR8CA in Gabon, Africa, and the posting was made only a few short days after *SpaceNews* had been released to the world from its origination in Wall Township, New Jersey. Clearly the Unix-based *SpaceNews* distribution backbone and the efforts of many hams around the world proved their worth.

Today, *SpaceNews* is edited on and distributed from a 33-MHz 486DX PC running under the Linux operating system. Thanks to several language translators, it is available not only in English, but also Chinese, Spanish, Portugese, and Italian. English versions are posted every week to the packet radio network, uploaded to the AMSAT-OSCAR-16 digital communications satellite, and distributed among the **rec.radio.info**, **sci.space.news**, and **rec.radio.amateur.misc** Internet newsgroups.

LOS

SpaceNews continues going strong after eight years of weekly reports due to the encouragement received through the many letters of support received each week from avid fans, and due to the valiant efforts of those who continue to distribute *SpaceNews* via the packet radio network and translate it into languages other than English. While considerable time and effort is expended in the creation of *SpaceNews* every week, it is clear from the interest of its many readers, the effort is well worth it. ST

TABLE 2
The April 1, 1996 Issue of SpaceNews

SB NEWS @ AMSAT $SPC0401
* SpaceNews 01-Apr-96 *

BID: $SPC0401

SpaceNews

MONDAY APRIL 1, 1996

SpaceNews originates at KD2BD in Wall Township, New Jersey, USA. It is published every week and is made available for unlimited free distribution.

* DOHOP SATELLITE NEWS *

Following in the footsteps of Ray Soifer, W2RS, who accomplished cross satellite radio contacts using OSCAR's 6 and 7 in 1974/5, Pat, G3IOR, and Dave, G4CUO, achieved "DOHOP" success with OSCAR-10 to RS-6 on CW on 07-May-84 at 0711 GMT. After many attempts, they finally made successful contact and also contacted Heinz, DL1CF, using OSCAR-10 and RS-5 on 21-Sep-84 under less-than optimum conditions.

The next attempt was to link from OSCAR-13 to OSCAR-12. After weeks of trying John, WA3ETD, called on SSB voice to make the first double hop across the pond. John commented, "Guess we made a little history on this one, Dave". The contact was made using 70-cm USB for an uplink, 2-meters across on LSB, and a downlink on 70-cm USB on 24-Nov-87 at 2136 GMT.

Enter the 1990's with RS-10/11 and RS-14. This time with a team of interested satellite hams including Ron, G3CAG, John, G4ZHG, Ian, G0NKA, Ted, G6HMS, and Richard, G7MUB, along with their mentor Pat, G3IOR, planned their cross satellite contacts on the chance that RS-14 would be switched to mode "B". Little did they think that Leo, UA3CR, would take the experiments seriously. Ian made a request for RS-14 to be switched to mode "B" via packet radio and (surprise surprise), a reply was received that read, "Which day would you like, and which transponder"? Leo then put the team in direct contact with Andy, RK3KP, at RS3A via packet radio.

The team had six weeks to practice the technique of working through two satellites travelling towards each other at a combined speed of 36,000 km per hour. Compensating for the double reversed Doppler shift as the two satellites passed was part of the challenge. Many hours of practice were spent when Europe had gone to bed, and the QRM was at minimum. Confirmation arrived that Andy would switch RS-14 over to mode "B" on 07-Feb-93 for three orbits before the satellite was out of his range.

During the first orbit, orbital predictions and final operating frequencies were finalized with the DOHOP team which had grown to include LZ2JH, DJ2MHJ, DJ0MY, and many SWLs calling in on a DOHOP net on 80-meters. Others were in contact via 2-meter FM. The moment that signals were heard from RS-14 will remain one of the most memorable occasions for the team. The satellite had been switched over, just for a bunch of hams in Sherwood Forest.

On the second orbit, all of the members teamed up on the transponder 4 minutes before DOHOP time. With 30 seconds to go, all stations changed from RS-10 (2-meters up) to RS-14 (70-cm up). Window time was 3 minutes, 10 seconds. The first station to appear out of the noise was the newest member, Richard, G7MUB, with a good (5x3) signal followed by the rest of the team. Good signals were copied with very unusual Doppler shift. The time was 0012 GMT.

By the third orbit at 2:00 AM local time, the team was ready for the big hop across the pond. Unfortunately, the word that the transponder on RS-14 was switched on had not got across due to problems with the 20-meter link. With a window of only two minutes, the first station heard was F8SH followed by W1NU and K2WER, all on CW along with Ron, G3CAG, and John, G4ZHG.

The team considered its experiments a success, and the results were compiled and sent via packet radio to Leo, UA2CR. Unfortunately, the switching had repercussions with DB2OS and AMSAT-DL, and no further switching was made available. Nevertheless, the enterprising team had put a new name into the Amateur world: "DOHOP".

RS-14's transponder closure signalled the end of many DOHOP experiments. The DOHOP team members have been working DX stateside on RS-15. To date, the members have 44 states worked with 38 confirmed. On RS-10, 88 countries have been worked with 80 confirmed, and on RS-12, 26 countries have been worked with 12 confirmed. RS-12 has recently been switched to mode "KT" and has excellent downlink signals on 2-meters between 145.910-145.950 MHz. With this change, DOHOP experiments can once again commence. Orbit times for RS-12 to FO-20 double-hop contacts are being calculated. Signals from John, K1FX in Connecticut are very good across the pond via RS-12/FO-20. John is looking into 70-cm equipment to complete his link.

The new DOHOP challenge involves taking signals from RS-12 using an uplink on 21.220 MHz using CW or LSB crosslinked on 145.920 MHz, to FO-20 inverted in the transponder for a downlink on 435.880 MHz, plus Doppler shift. That's going from HF to VHF to UHF via two satellites! FO-20's 100 kHz passband is little used. Normally the middle 20 kHz of the passband is where most of the activity on the satellite can be found. This leaves 80 kHz for experiments such as DOHOP. Unfortunately, FO-20 is almost a seasonal satellite, with it's apogee and perigee changing every three months. When it's apogee is in the northem hemisphere, the footprint is very good for North America with W1 to W0 and all VE areas. When it's in the South, the footprint is very small and the Doppler shift is a problem.

Over the upcoming weeks, if RS-12 remains in "KT" mode, the DOHOP team will establish a pattern of orbits for both RS-12 and FO-20

which have mutual windows. Providing you can see one of the satellites, you can participate in the experiment. When RS-12 is in range, call "CQ DOHOP de callsign" on 21.220 MHz using CW or LSB voice. You might not hear FO-20, but if the mutual window is good then other stations may. If FO-20 is in range, then listen around 435.880 MHz plus Doppler using USB. The experiment will work if stations practice the art of tracking two satellites.

The DOHOP team will publish predictions on packet radio, and would appreciate any feedback from stations interested in the experiment. Replies should be addressed to Ian, G0NKA @ GB7DTX.GBR.EU. Thanks for your help. It is much appreciated by the team.
[Info via Dave Rowan, G4CUO with thanks to Ian, G0NKA for the relay.]

* 1200 BAUD PACSAT USE *

Last week, Chuck, W9ODI, conducted a seven day use survey of the AMSAT-OSCAR-16 and LUSAT-OSCAR-19 "Pacsat" satellites. These satellites contain digital communication transponders that operate at a data rate of 1200 bits per second.

Looking at those who uploaded or downloaded files at least once during the week, Chuck found that there were 125 stations active on the satellites with 40 being in the United States. The countries represented include:

6	Germany
5	Spain
6	France
4	UK
8	Italy
3	Denmark and Finland
17	Argentina
8	Canada
8	Australia
6	New Zealand

In addition, Oman, Uraguay, Chile, Panama, Israel, Norway, Costa Rica, Netherlands, South Africa, Mexico, and Paraquay were also noted in the survey.

Chuck points out that one of the reasons for the lack of activity on the 1200 bps birds lies in the difficulty in running an automated station with BPSK modulation. Some pacsat modems have been found to establish phase lock when not correctly tuned to the BPSK downlink from the satellite. While the modem may "lock" into the signal and supply proper AFC signals to the downlink receiver, little, if any, data can be demodulated if the downlink receiver is not properly tuned. W9ODI typically downloads 80 to 110 thousand bytes of data on a busy pass, while at other times, particularly during the week, the satellites are unused and practically empty. This is a clear indication that most groundstations are operated manually.
[Info via Chuck Parmelee, W9ODI]

* ARRL ON AO-16 *

The following message was recently posted to the AMSAT-OSCAR-16 satellite:

To : ALL
From: W1INF
Time: 171607UTC
Date: 28 Mar 1996

Hello:
This is W1INF, labortory station of the American Radio Relay League in Newington, Connecticut, USA. Whenever possible, we monitor AO-16 passes over our area that occur between 1500 and 1800 UTC, Monday through Friday.
73 . . . Steve, WB8IMY (operator)

* THANKS! *

Thanks to all who provided news items and sent messages of appreciation to SpaceNews, especially:
VK1NH WP4MWK WB5LMJ

* SpaceNews AVAILABILITY *

SpaceNews is available regularly on Usenet in the rec.radio.info, rec.radio.amateur.misc, and sci.space.news newsgroups, and on packet radio BBSs worldwide as well as the AMSAT-OSCAR-16 Pacsat satellite. It can also be retrieved using the File Transfer Protocol (FTP) at pilot.njin.net (128.6.7.38) from the /pub/SpaceNews subdirectory. You may also "finger magliaco@pilot.njin.net" for a copy of the latest issue, or access it via the World Wide Web at the following URL: http://www.cs.indiana.edu/finger/pilot.njin.net/magliaco/w.

* FEEDBACK/INPUT WELCOMED *

Comments and input for SpaceNews should be directed to the editor (John, KD2BD) via any of the paths listed below:

WWW:	http://www.njin.net/~magliaco/
PACKET:	KD2BD @ KS4HR.NJ.USA.NA
INTERNET:	kd2bd@amsat.org, magliaco@email.njin.net
SATELLITE:	AMSAT-OSCAR-16, LUSAT-OSCAR-19

ST THE VIEW FROM ABOVE

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

EMWIN Test Transmitted on GOES-8:

NOAA is currently conducting tests of the Emergency Manager Weather Information Network (EMWIN) over a sub-channel on GOES-8 WEFAX downlink. EMWIN is a new service to provide weather data products to the user community.

As an integral part of its mission, the National Weather Service (NWS) recognizes the need to provide the emergency management community with access to a set of basic NWS warnings, watches, forecasts, and other products at no recurring cost.

EMWIN is now evolving into a fully operational and supported NWS service in partnership with the Federal Emergency Management Agency (FEMA), and other public and private organizations. EMWIN broadcasts is making basic realtime weather data available, and providing access to stored sets of unenhanced weather data, using a variety of techniques and technologies. Each method of transmission has advantages and disadvantages over the others, hence this multilayered approach to enable multiple methods of availability.

EMWIN is a supplement to other NWS dissemination services, which include: NOAA Weather Radio (NWR), NOAA Weather Wire System (NWWS), Family of Services (FOS), and NEXRAD Information Dissemination Service (NIDS).

The EMWIN data is currently being sent over VHF radio channels, commercial satellites, and now via test transmissions on GOES 8. The broadcasts consists of a 'packet' digital transmission, which requires the appropriate radio receiver, demodulator, and personal computer software to decode and display the weather data.

Some of the weather data products currently transmitted over EMWIN include "readable text" products, of which there are dozens. These include local and national watches and warnings. The following are a few of the weather products transmitted on the EMWIN broadcasts:

EQR	Earthquakes
FAA.	Terminal forecast
FLW	Flood warnings
FFW	Flash flood warnings
FFA	Flash flood advisories
HLS	Local hurricane statements
HUR	National hurricane statement
LFP	Local forecasts
NOW	Short term state forecast
OTH	State weather summaries
RVR	River stages
SAO	Surface/aviation observations
SMW	Special marine broadcasts
SPS	Special weather statements
SFP	State forecasts
STP	State police reports
SUM	Weather summaries
SVR	Severe thunderstorm warnings
SVS	Severe weather statements
SWR	State weather roundups
TOR	Tornado
WSW	Winter storm watches
ZFP	State zone forecasts

Some graphic data products including cloud, dewpoint, fronts, humidity, isohyets, lightning, marine, precipitation, pressure, radar, temperature, and wind charts are available on EMWIN. GOES WEFAX rebroadcasts are also included as part of the broadcast.

EMWIN Transmission Protocol

The format of EMWIN transmissions is public domain. The digital NWS data, whether ASCII text or binary, is sent as 1 KB packets. Each file or product is sent as one or more packets, which are numbered '1..N' within the given product. Because the data is packetized, a particular product can be gracefully interrupted by a high priority warning or alert product and then resumed later in the broadcasts. The broadcasts are receive-only — thus the receiver has no means of notifying the transmitter of any block errors or requesting retransmission of individual blocks. Instead each product is transmitted at least twice, to "fill in" any blocks received in error by the receiver.

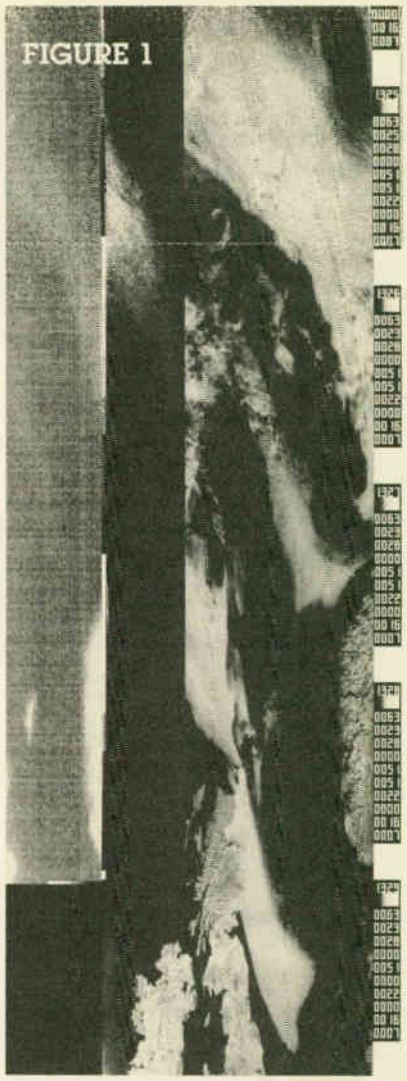


FIGURE 1

Each packet of data contains the following fields:

a) Six bytes of ASCII 0 (NUL) to clear any receiver buffer.
b) /PF followed by an 8-character filename, a period, and a three character filetype.
c) /PN followed by the block number — the number of this block (1..N) within this file.
d) /PT followed by the total number of blocks (N) being sent for this file.
e) /CS followed by a checksum number — the sum of all bytes in the 1024-byte data portion of this packet, as a 16-bit decimal.
f) /FD followed by the date/time stamp of this file — in the format of — MM/DD/YY HH:MM:SS AM — without space padding.
g) ASCII 32 (SP) fill — to pad the total bytes in fields b..h to a full line of 80 bytes.
h) ASCII 13 (CR) and ASCII 10 (LF) to enhance readability.
i) The data, as a 1024-byte block; if the remaining data of the product is less than 1024 bytes. This block is NUL-filled so that each packet's data block is always 1024 bytes long
j) Six bytes of ASCII 0 (NUL) to clear any receiver buffer.

An example of a typical packet header is: /PFZFPSFOCA.TXT/PN 3 /PT 5 /CS 63366 /FD2/10/95 5:24:26 PM

The current VHF broadcasts are receivable as async 1200,8,N,1. The content of the NWS weather products (in the 1024-byte blocks) may be plain ASCII text or graphics or imagery. The products are not encrypted, but will often be compressed. Interpretation of the content of the products is up to the receivers' software.

EMWIN Transmissions Broadcast Areas and Frequencies

Washington, D.C. metropolitan area via VHF radio from Silver Spring, MD on 163.350 MHz, and is receivable (once demodulated) as normal async 1200,8,N,1.

Norman, OK area by VHF radio on 169.025 MHz, and is receivable as normal async 1200,8,N,1.

Tulsa, OK area by VHF radio on 165.0125 MHz, and is receivable as normal async 1200,8,N,1.

EMWIN data is also being broadcast nationwide by PBS as an independent experiment on their Telstar 401 satellite.

Satellite broadcast is one trial method used by the NWS for disseminating the data stream. The goal is to make the datastream available nationwide, but not to provide detailed support (i.e. funding, manpower, or equipment) for state and local efforts to redistribute the datastream after downlinking.

Although satellite broadcast permits broad geographic coverage, the receiving equipment currently can be more expensive than other methods for individual users. Groups of interested users, such as state and local agencies, can get together to receive the downlink data and redistribute it. Local distribution is typically via terrestrial broadcast frequencies, for inexpensive reception by multiple users within a region.

A satellite broadcast is being provided by the Public Broadcasting Service (PBS), but this is not yet permanent. PBS has voluntarily uplinked the EMWIN datastream since 1995 as an independent experiment. PBS has added EMWIN data to its uplink which is sent to Telstar 401, a geostationary telecommunications satellite used by the Corporation for Public Broadcasting for distribution of TV programming to local PBS stations nationwide. PBS stations (and other users) can then receive the downlink signal from the satellite.

The EMWIN data is currently accessible on the Telstar 401 satellite transponder 5A, channel 5, PBS secondary audio program (SAP), center frequency 11836.5 MHz, vertically polarization. However, the EMWIN signal presently is being multiplexed as part of the PBS uplink and additional costly (digicipher) equipment is thus required to receive and extract the EMWIN signal. User groups in several states have formed to pool resources to receive the PBS downlink signal, and redistribute the EMWIN data by broadcast or other means. The users groups in portions of Oklahoma, California, Oregon, Ohio, and Kansas are receiving the PBS downlink.

GOES-8 Transmissions

The EMWIN data is now being broadcast by the NWS on the GOES-8. The initial test for interference with the WEFAX downlink signal was done in March 1996. An extended test of the GOES EMWIN downlink started on April 2, 1996. The downlink frequency used for the EMWIN datastream is 1690.6 MHz (400 kHz lower than the standard WEFAX 1691.0 MHz signal).

The signal can be received with various sized dishes, passed through a down converter, and received as an IF signal at 137.1 MHz. This does not require a Digicipher unit and the cost is now approaching that required for typical VHF radio reception. NWS hopes to conduct more tests to determine the minimal, low-cost equipment requirements for EMWIN reception.

Where to find more information on EMWIN:

NOAA requests that users of EMWIN contact them at: **kbashford@smtpgate.ssmc.noaa.gov**. They would like you to let them know your status regarding EMWIN reception. Are you actively receiving the datastream? Are you echoing or rebroadcasting the datastream? If so, what radio frequency or other distribution method are you using? Are you willing to help new users in your area?

To contact them by mail, write to: K. Kay, NWS EMWIN Project Manager, National Weather Service, W/OSO12, 1325 East-West Highway, SSMC2, #16330, Silver Spring, Maryland 20910 or phone them at: (301) 713-0191 extension 172.

Information on the World Wide Web about EMWIN may be found at: **http://www.nws.noaa.gov/oso/oso1/oso12/document/emwin.html** and **http://www.nws.noaa.gov/oso/oso1/oso12/document/winrad.html**.

There are two vendors now supporting the reception of the EMWIN weather data products. These vendors market receivers, demodulators, and the PC Windows software to decode, display, and store the text and graphics data products from the VHF and satellite transmissions of EMWIN. Please contact the vendors below for more information and pricing.

Commercial Receivers and Demodulators may be obtained from: Maryland Radio Center, Inc, 8576 Laureldale Drive, Laurel, MD 20724, (301) 725-1212, (800) 447-7489, BBS with demo software (301) 725-8307

SkyWalker Data Systems, Inc, 7303 West 35th Street, Tulsa, OK 74107; (918) 445-1488

NOAA K-L-M Spacecraft Update

The past several columns of *The View from Above* have reviewed the Advanced Very High Resolution Radiometer (AVHRR/2) instrument on the NOAA polar orbiting satellites, and the High Resolution Picture Transmission (HRPT) and Automatic Picture Transmission (APT) image products that are transmitted in the direct readout mode. The weather satellite community is about to have a new generation of AVHRR instruments (AVHRR/3) that will orbit aboard the next series NOAA polar-orbiting weather satellites.

The next three satellites to be launched by NOAA will be very similar in data format to NOAA 12 and the previous Advanced TIROS-N satellites you have been receiving APT and HRPT imagery from. The satellites launched after NOAA-M will be of a more advanced design, with an all digital

downlink that will require changes to your ground station equipment.

The AVHRR/3 instrument is being manufactured by ITT. The characteristics of the NOAA K-M downlinks will remain essentially unchanged from those of the TIROS-N series (NOAA 8 through NOAA 14) with several minor exceptions. The ITT AVHRR/3 instrument will have six data channels (five channels transmitting out of the six available), and channel 3 will be slightly modified. The calibration constants for the six spectral channels will also different for the AVHRR/3 series on NOAA K-M.

Table 1 shows the general HRPT transmission characteristics for the AVHRR/3 instrument.

With this new instrument there is a change on channel 3. There will now be a channel 3A and channel 3B. A flag in one of the HRPT words (Word 7, Bit 10) will indicate which of the AVHRR/3 channel 3 sensors (3A or 3B) is operating. When channel 3B is selected, the patch temperature data is output every scan line (during the backscan), and every other scan line when channel 3A is selected.

What does this all mean for the Direct Readout user community and the APT images we receive on our ground station personal computers? The channel identification wedge will change in the NOAA K-M series.

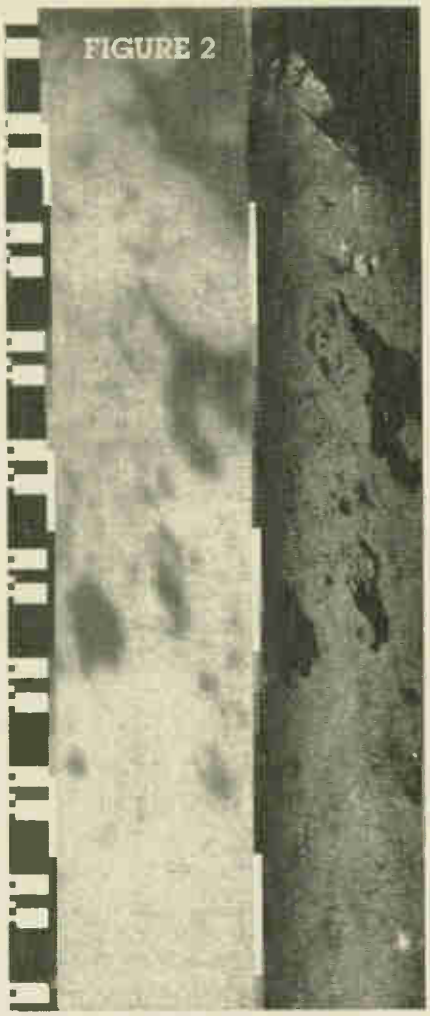
The six possible channels are channels 1, 2, 3A, 3B, 4, or 5. The modulation index of wedge 16 will equal one of the first six grey scale wedges. Wedge 3 will correspond to channel 3A being in use, while wedge 6 will correspond to channel 3B being in use. All other channel numbers will be the same as the number of the corresponding grey scale wedge.

The wedges are of course used to calibrate your temperatures in the APT imagery. Most of the software vendors will have to provide an update for the temperature

TABLE 1

HRPT Transmission Characteristics:

Line Rate:	360 lines/minute
Data Channels:	5 transmitted, 6 available
Data Resolution:	1.1 km per pixel
Carrier Modulation:	Digital Split Phase (phase modulated)
Transmitter Frequency:	1698.0 or 1707.0 MHz
Transmitter Power:	6.35 watts
Polarization:	Right Hand Circular
Transmission Rate:	665400 bits/sec (split phase)



calibration equations when NOAA K is launched and placed into service. Other than the differences noted in the channel 3 wedges, the imagery and data reception should appear identical to what you are used to receiving from the NOAA polar orbiting satellites. NOAA K is currently slated for an early 1997 launch date. Until then, NOAA 9, 10, 12 and 14 will continue to provide good APT imagery to the amateur community.

The real change in the NOAA POES systems will take place when NOAA-O and -P are launched either late this century or early next century. These spacecraft will employ an entirely new AVHRR instrument that will provide digital data for both high and low resolution imagery.

The current series of NOAA polar orbiters broadcast digital 1 km resolution HRPT and 4 km analog (visible) APT imagery. The spacecraft also store onboard global coverage data with 4 km resolution, and some limited coverage 1 km HRPT data.

The new NOAA-0 and -P series spacecraft will broadcast digital (high speed) 1 km HRPT data, digital (not analog) low speed LRPT (Low Resolution Picture Transmission) data, and have enough onboard tape storage for global 1 km data. There are indications that NOAA/NESDIS plans to publish design specifications for a 'black-box' that can convert the digital LRPT signal to an analog format for users that do not wish to update their analog APT receiving equipment (LRPT and APT data formats are NOT compatible!).

The digital LRPT imagery will have many benefits over the current analog APT signal, including 'noise' reduction in the APT image, digital storage on magnetic media, and digital manipulation and enhancement of the LRPT data.

While some of the technical design considerations are not finalized, future Direct Readout systems will provide a more sophisticated digital format that can be easily manipulated (enhanced) by ground station software. The Dallas Remote Imaging Group (DRIG) is currently gathering technical specifications on the LRPT format, ground station requirements, and proposed launch schedules, and will report its findings in an upcoming column here in *Satellite Times.*

Russian Okean Imaging Satellite active over Europe:

DRIG member and active weather satellite enthusiast, John Boyd has sent us several APT images from the Okean 1-7 satellite which has been active over Europe the past few months. Figure 1 shows an image of Norway and the U.K. from Okean 1-7 in the radar, sounder, and visible light over a cloudless England. Figure 3 shows the White Sea and Kola Peninsula from satellite's sounder and radar spectral bands.

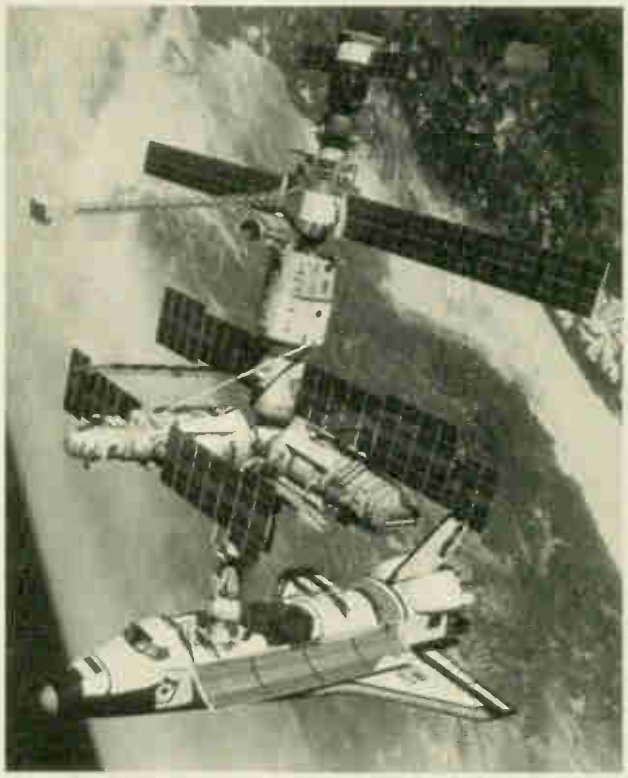
John has a Internet web home page on the DRIG worldwide web site which has more Russian Okean and Meteor satellite images taken over Europe. Point your web browser to URL address: **http://www.drig.com/~johnb**.

The DRIG World Wide Web site is being expanded to cover not only weather satellite data products, but general satellite tracking, frequencies, VHF satellite activity, amateur radio, Global Positioning Systems, and much more. To join the DRIG group contact us at: **http://www.drig.com**

The DRIG BBS can be accessed from our home page by clicking on the DRIG BBS (bbs.drig.com) link.

Until next time, we hope you continue to enjoy the many facets of direct readout weather satellite imagery and the *View from Above!* ST

Hear the Mir, and more ...



The **Uniden BC9000XLT** makes it easy. This superb desktop scanner is for serious monitors of the 25-550, 760-1300 MHz (less cellular) spectrum—and the missing cellular frequencies can be restored by adding our discounted GRE Super Converter! The BC9000XLT features 500 memory channels, tuning knob, 16-digit alphanumeric display with adjustable brightness, powerful 2.2 watts of audio, tone control, and CTCSS tone squelch option.

The intuitive layout of the panel makes operating a breeze! An illuminated keypad and rubber-padded tilt feet combine with the large tuning knob for additional comfort during periods of serious signal searching. Search lockout of up to 50 frequencies prevent unwanted interruptions. This scanner means business.

The GRE Super Converter, reduced to $79.95 when purchased with the BC9000XLT, gives this unit no-gap coverage in the 800 MHz range (unlawful to monitor conversations!).

Purchase now and you will receive absolutely free Grove's new 1996 Grove FCC Database—a spectacular compendium of all the licensees in the FCC Master File! Public safety, railroad, business, industrial, broadcast, maritime, and many, many others. Sort by service, state, callsign. antenna height, output power, county, and many more!

Call now and order this incredible package now and we'll have it on your doorstep in two days!

Please visit our site on the World Wide Web: **www.grove.net**

GROVE ENTERPRISES, INC.
1-800-438-8155; 704-837-9200;
FAX 704-837-2216
7540 Highway 64 West
Brasstown, NC 28902

Order SCN 30
Only **$369.95**
and CVR 3
Only **$79.95**

Reduced from $84.95 for this special package only.

and get the 1996 FCC Database CD FREE!

SHIPPING
$11 2nd Day UPS
$18 US Mail
$18.50 Canadian UPS
$22.50 Canadian APP

BC9000XLT ACCESSORIES		
ACC 130	CTCSS tone board	$46.95
Installation Fee		$20.00
BRK 2	Mounting bracket w/ cig. power cord	$15.95

Donald E. Dickerson, N9CUE

How to Receive Inmarsat Satellites

Inmarsat is a name that should be familiar to most of the *Satellite Times* readers. If it isn't, then settle back in that easy chair with this issue's column.

We will be taking a look at the Inmarsat organization, its history, the services it offers and most importantly, how you can receive these satellites in you listening post.

The move to satellites has been changing the radio landscape for some time now. As more and more users of the HF radio spectrum make this move to satellites, there has been less and less to hear on HF. Foreign broadcasters are not the only ones leaving the HF bands to move to satellites. Many utility services are also moving their operations to the satellite spectrum .

At first, this may seem like bad news, and perhaps it is in a way if you enjoy HF communications. And yet nothing stays the same and change is a part of life. It is an especially large part of life in our ever-changing technology driven times. There is good news in this change. Many of the users of the previous users of the HF spectrum can be found on the satellites of the Inmarsat organization. And the best news of all is most of the signals carried on these satellites are in the clear and unencrypted. While the change to these new utility bands will require changes in your receiving equipment, it's good to know you may be able to again hear some old friends and make some new ones as you rediscover satellite radio listening. But first, lets find out a little bit about Inmarsat.

Inmarsat (International Maritime Satellite) organization has been launching satellites and providing worldwide communications for ships, aircraft, land mobile and portable units since the early 70's.

There are currently four operational Inmarsat spacecraft in geostationary orbit. These satellites are:

F-1	295.5 degrees West	Indian Ocean (IOR)
F-2	15.5 degree West	Atlantic Ocean East (AOR-E)
F-3	192.0 degrees West	Pacific Ocean (POR)
F-4	55.0 degrees West	Atlantic Ocean West (AOR-W)

Four additional spacecraft are in orbit as spares located at 55.5 and 35.0 degrees West and 66.0 and 180.0 degrees East. The four operational spacecraft are able to maintain worldwide coverage, with the exception of the polar regions. These are second generation spacecraft. The third generation spacecraft will have ten times the communications capacity as their predecessors. They will in addition carry an onboard navigation packaged that will use the enhanced Global Positioning System (GPS) satellites for monitoring position and service data.

Inmarsat operates four Satellite Control Centers (SCC) worldwide. The main control station is located in London at Inmarsat headquarters. The other stations are located at Fucino, Italy, Beijing, China, Santa Paula, California and Southbury, Connecticut. These stations monitor and control the satellites in orbit and maintain telemetry, tracking and command (TT&C).

Another type of station associated with the system is the Network Control Center (NCC). These stations are responsible for the operation and management of the spacecraft communications payload. These stations monitor traffic and assign frequencies for the various services accessing the spacecraft. NCC's interface with commercial telephone and radio networks. Each nation that is a signatory to Inmarsat owns and operates its own ground station which provide interface to local telephone/data networks.

Aeronautical Mobile

The newest service offered by Inmarsat is the aeronautical service. Inmarsat spacecraft use 3.619-3.62/6.439-6.44 GHz to communicate with NCC stations in this service and 1.544-1.545 GHz to communicate with the aircraft. The NCC uses a 10 meter dish to link with the satellite. They can provide telephone, facsimile and data services for passengers and crew of specially equipped aircraft.

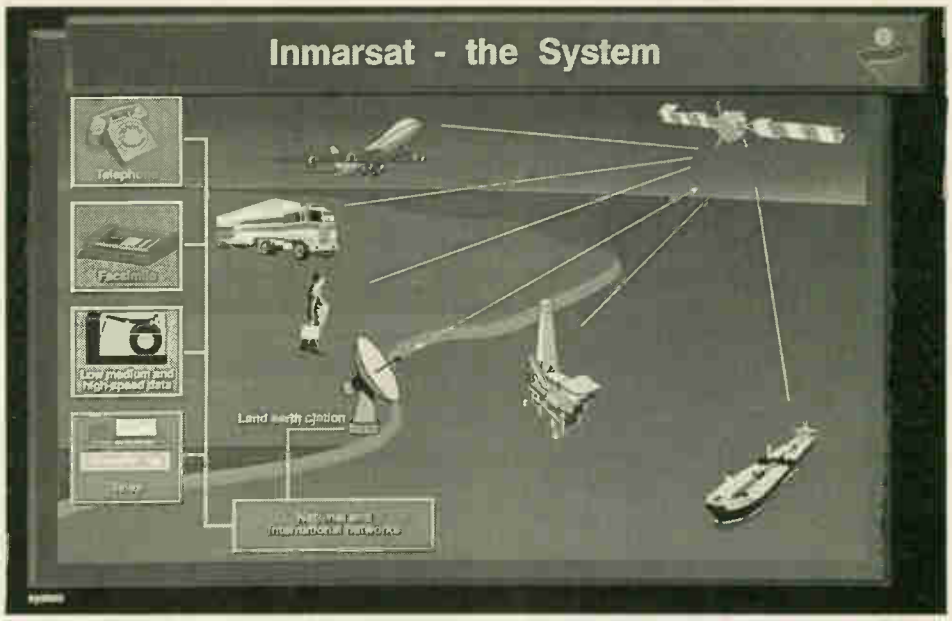
Voice signals are converted into digital code for quality and security in the aero service with transmissions rates of 9.6 kbps. A set of four RF channels are required to provide the full range of voice and data services, two each for full duplex operation. P-channel is a time division multiplex (TDM) channel used for packet-data communications. This can be used to supplement or replace the ACARS (aircraft communications addressing and reporting system). The R-channel is used for call in/request information. C-channel is for full duplex voice and data up to 9.6 kbps. The T-channel can be used for long messages and is also used to support air traffic control (ATC) functions via satellite.

Data transmissions conform with CCITT X.25 and X.75 packet-data parameters and will support IOS-8208 communications. This will allow the use of personal computers in the system. These systems also conform with ARINC 741 communication standards.

When a call is initiated by an airborne user, picking up the handset powers up the satellite data unit (SDU). It commands the onboard antenna to steer toward the proper satellite on the R-channel. Once contact has been established, a pair of C-channels is used for voice or a T-channel is chosen for long duration data transmissions.

Flight crew applications, though not yet implemented, could allow operational and support services to be preformed with greater efficiency when outside of terrestrial VHF communications range. Flight plans and weather updates could be filed by voice or data modes. The packed mode (automatic dependent surveillance) could be used in a polling mode to receive regular automatic transmissions from the aircraft on location and status.

Inmarsat also provides a air-to-ground call procedure for cockpit use only. It would allow the captain or pilot to access the air traffic control system or airline operations centers. In addition, such diverse services as



medical emergencies or duty free shopping can be conducted from the aircraft.

Maritime Service

All sorts of maritime vessels from cruise ships to oil tankers use Inmarsat satellite terminals. Inmarsat provides the same services we discussed under the aero-band (voice, data, fax etc) to maritime concerns. The maritime service offers four different terminals.

Inmarsat-A, the original satellite terminal offers analog, unencrypted voice and data services. There are a large number of these terminals onboard ships and it is also used by government agencies and military. Inmarsat-B is a digital version of the A terminal. The A terminals are being phased out over time. Monitors will still find that there are plenty of communications to hear in analog modes on Inmarsat spacecraft.

Inmarsat-M is a smaller more mobile terminal which provides digitized voice at 4.8 kbps and fax/data up to 2.4 kbps. Inmarsat-C is a cost effective store-forward data messaging, position reporting and remote monitoring terminal for small vessels and operates at 600 bps in ARQ (Automatic Reply and Query) mode. With the C-link service anyone with the required computer equipment (computer, modem and software) can receive messages as can any telex station worldwide, even non-subscribers.

Inmarsat has two other projects in the works. One is called Inmarsat-P which is a satellite based paging system. The second system is called Project-21. It is an effort to provide worldwide handheld satellite phone service by the year 2001. Inmarsat may launch it's own LEO's for this project or may lease system space from other companies already launching satellites.

How to Hear Inmarsat

With the above background in mind, let's see what we have to do to listen-in on Inmarsat traffic. Analog transmissions from Inmarsat-A terminals will use FM voice and packet data modes. Most transmissions are in the clear. The spacecraft will be downlinking these signals in the 1.530-1.545 GHz range. This means you will need a receiver or scanner which is able to tune these frequencies. Icom makes a couple of receivers that fit the bill nicely, the 7100 or the older 7000. Both have the required frequency coverage and FM mode needed to monitor these communications. AOR also makes a couple receivers that can tune this range.

Here comes the challenge if you are not already TVRO equipped. You will need a dish antenna, the larger the better is a practice that still applies. At some locations you may be able to get buy with a four to six foot dish depending on the preamplifier you use. Go ahead and experiment with whatever you have or can afford.

Let's say you already have a TVRO dish. You will need to make or buy a feed horn for 1.5 GHz. It can be mounted beside your current TVRO feed horn. Next you will need a RF preamplifier. This should be mounted close to the feed horn. An in-line amp for the same frequency may be required if you have any long runs of coax or are trying to use a cheap brand of coax. Some people have reported good luck with generic RG-6 or 8n coax. I prefer the better grades, especially at these frequencies. You need to keep line losses to a minimum. Don't undermine the performance of your $1,300.00 receiver with $3.00 worth of cheap coax.

BE SURE you don't destroy that receiver of yours by allowing any DC current onto your antenna connector. BEFORE you connect any coax from a TVRO or similar receiving system to your VHF/UHF communications receiver you MUST be sure to add a through tap or DC block to the line to keep the voltage, used to power the inline amplifiers, from entering the front-end of your radio. That mistake could be enough to make you take up stamp collecting or gardening. Also be sure to use good quality connectors, use as few as you can in line as you can cut your signal strength in half with a in-line connector or a bad solder joint.

Excellent quality and affordable feed horns, amps and other satellite accessories can be purchased at Swagur Enterprises. Stu Gurske who owns the company can also provide you with all the components you need to monitor the Inmarsat birds at a very affordable price. Ask Stu for his apartment dweller special. For more information, see the ad in this issue of *Satellite Times*. In fact with the Inmarsat system we have just described you also have the beginnings of a GOES WEFAX weather satellite station. Swagur Enterprises can turn your 7000 or 7100 into a Inmarsat/GOES monitoring post. Their number is (608) 592-7409.

Once you have your station setup, manually turn your antenna to 15.5 or 55.0 degrees West (on the east coast) or 192.0 degrees West (on the west coast) for one of the three Inmarsat spacecraft within range of U.S. listeners. Plug in 1.537 GHz into the receiver and adjust the antenna until you hear the audio from AFRTS (Armed Forces Radio and Television Service). AFRTS is transmits on all four Inmarsat spacecraft at 1.537 GHz and can be used as a beacon to tune in the satellites. As you tune across the 1.53-1.545 GHz range you will notice a mixture of voice, data and foreign language communications cluttering your dial, just like you would hear in the HF utility bands, well almost, it's actually better!

A Inmarsat listening post is fairly simple to setup and the results are fantastic. If you enjoy listening to the utility bands in the HF spectrum then Inmarsat satellite reception will let you enjoy even more utility type communications in the personal communications satellite spectrum. ST

NAVIGATION SATELLITES

By Steve Dye, *sdeye99@aol.com*

Differential GPS

Welcome to *Satellite Times'* new *Navigation Satellite* column. Through this column I hope to spread the word about satellite navigation and in particular GPS, thus educating readers in its science and application. I will approach this column in such a way that readers will get the chance to learn more about satellite navigation from two perspectives: technology and industrial.

Each column will feature the latest innovations by the industry featuring the applications and improvements they offer to our lives and industry in general. The engineering side of it all will supplement the article I wrote in the last issue of *Satellite Times*, expanding on certain areas and I will incorporate readers' questions should I receive any. I encourage readers to send me mail either by Internet or via the magazine postal address with questions they have on GPS and satellite navigation. My Internet address is **sdye99@aol.com**.

Differential GPS

Let's kick off this column where I finished up in the last issue's feature article, with a look at differential GPS (DGPS). In that article, I discussed the level of accuracy that can be achieved with standard off-the-shelf GPS receivers. These receivers, though providing phenomenal accuracy, are limited by a number of factors that include atmospheric delay, timing errors and geometric precision to name a few.

However, what if you want one meter accuracy or more? What if you wanted to nail the location of a receiver to with a tolerance less than a meter? Well, it is possible, and is achieved by the use of differential GPS. A different type of receiver is used for DGPS; one equipped to receive additional information, encoded in a terrestrial signal that has been transmitted from a position with precisely known global coordinates.

FIGURE 1:
Application of Differential GPS

If a terrestrial transmitter can be located at a point in which its global position is precisely known, then any position calculations it derives from the GPS constellation can be compared to these known coordinates, and a correction factor derived. With this, correction factors for each satellite can be determined and then catered for in the receiver for the kind of errors normally experienced from GPS reception.

The differential GPS system basically consists of a GPS receiver located at a known site, equipped with hard and software that will calculate the differences between the GPS receivers calculations (in terms of timing from each satellite) and what they should be based on the known coordinates of the differential station. The difference or differential signal is sent to a location usually via cable, and transmitted on a separate frequency, to be received by differential GPS receivers. The algorithms that function in the DGPS receiver, process the correction factors received and apply this to correct the reading the DGPS receiver outputs. It should be noted here that the differential signal sent from the DGPS station is constantly changing since the conditions that cause the inaccuracies are forever varying. Orbit variations, timing accuracy and atmospheric conditions are continually changing variables, and the need to continually cater for these changes is required.

Figure one illustrates in block diagram format, the basic principle behind DGPS, while figure two illustrates a typical real life application. In figure two, the location of a law enforcement patrol vehicle and a freight truck can be followed accurately by use of DGPS. The global position of the receiver is fed back to the control center of that agency, via a wireless network. This form of application is quite common and in widespread use.

To illustrate the improvement in accuracy, tables 1 and 2 show what is known as an error budget, and depicts the various delays experienced, and indicates the improvement in accuracy DGPS can offer. Notice how receiver noise and multipath errors do not improve with the use of DGPS. The reason being these are locally induced errors. DGPS is only capable of correcting errors that are common to both the remote receiver and the DGPS station. The receiver noise and prevailing multipath errors the receiver experiences, cannot be known or foreseen at the DGPS station. Secondly, selective availability (SA) causes errors that can be virtually eradicated since any errors induced by this means can be

corrected at the DGPS site since its global position is precisely known. One other point to note is the global positioning accuracy in the horizontal plane using DGPS. Table 2 quotes a figure of 1.3 m accuracy in the horizontal plane and, according to Trimble, can be improved upon by new receivers capable of sub-meter accuracy.

The improvement in accuracy is incredible; down to a meter and in some cases sub meter accuracy is possible. Use of this method has opened up a plethora of applications for industry. The list of applications is too numerous to mention them all, but in the pursuit of writing this column, I hope to cover many. The following applications will illustrate quite vividly the power of GPS.

TABLE 1

Typical Error Budget (in meters) for GPS and DGPS

Error Type	GPS	DGPS
Obital Errors	2.5	0
Ionosphere	5	0.4
Troposphere	0.5	0.2
Satellite Clocks	1.5	0
Receiver Noise	0.3	0.3
Multipath	0.6	0.6
SA.	30	0

TABLE 2

Typical Poisitioning Accuracy

Plane	GPS	DGPS
Horizontal	50	1.3
Vertical	78	2
3-D	93	2.8

Applications

A typical application in industry is in the maritime field. Ships and vessels, equipped with DGPS receivers can now be guided through difficult and crowded harbor entrances. Another plus being that if you know where you are, you know where you may or may not fish or dump. Too many oil tankers run aground for anyone's liking these days, and with the aid of DGPS, a tanker will know if it is in an area it should not be. This has far reaching implications and would benefit the maritime industry as well as the environment immensely.

Other applications such as those in the aviation field have an application which I personally would like to see more of. NASA and the FAA experimented with landing a passenger aircraft using DGPS as opposed to the traditional instrument landing system (ILS). Every time the nose wheel hit the tarmac, it was in the center. This too has far reaching implications in the industry : difficult or impossible landing in fog without the need for low visibility landing systems is not impossible. The economic benefits of landing at the intended airport every time with an additional safety factor speak for themselves.

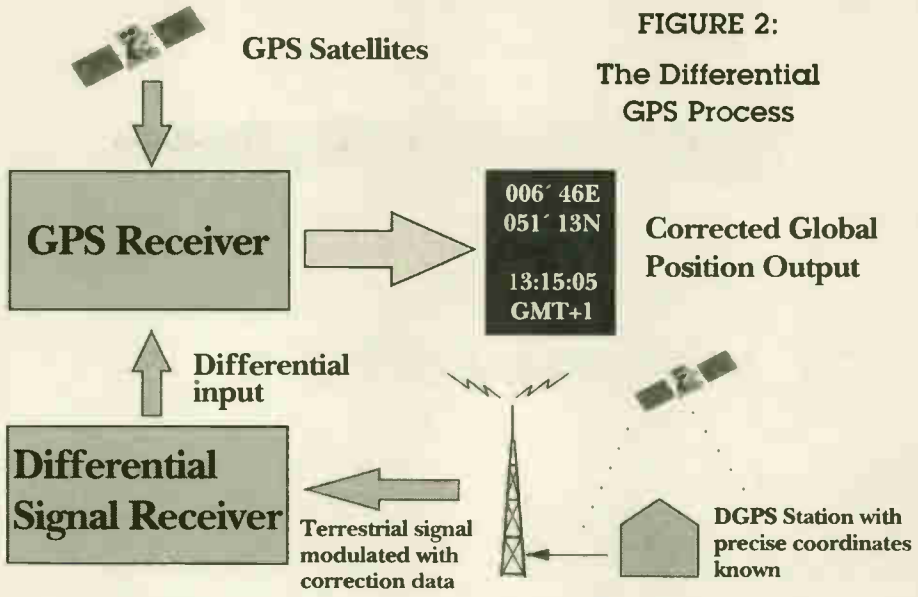


FIGURE 2: The Differential GPS Process

The software navigational / mapping programs that use GPS technology provide the user with spot on accuracy, enable a user, completely unfamiliar with a town to navigate as if they knew it. Every square meter on our globe's surface has a coordinate, so why not let GPS guide us to it? These software mapping packages in conjunction with DGPS take their users to their destination with ease, so look out for upper range models now featuring GPS navigation

Innovation in the use of satellite navigation is as diverse as its application. One innovative use not only illustrates the breadth of such applications, but also the forward thinking and cleverness people have. Scientists at the USGS (United States Geological Survey) in Pasadena, California, are actually measuring the shifting of the earth's crust and the movement of large structures such as the Pacoima Dam as a result of seismic activity in the area. By placing receivers at certain locations, and monitoring the shifting that takes place, the receivers positions can be quantified with acceptable tolerances.

The principle is rather straightforward, if the earth moves, (so to speak) so does the receivers antenna, and thus its global position. This is one certain way of monitoring the effect of an earthquake, and using the results to form a mathematical model that will enable accurate predictions to be made. Dr. Ken Hudnut, a Geophysicist at the survey, actively involved in this project collects the data , processes it, and has it placed on the World Wide Web within a day. For readers interested in this, all information is indexed at the following Internet Web URL address: **http://tango.gps.caltech.edu/.**

GPS Terminology

In the world of GPS, there are many terms that may leave one slightly perplexed or somewhat bemused. To relieve some of the readers from the headache that may ensue as a result of coming across such terminology, I will start with this issue ST's A-Z list of GPS terminology. So, to end this issue's column, here are the first of many GPS terms I hope to familiarize you all with.

Accuracy
The extent of conformity between the measured / calculated position and the actual position. Such systems employing radio navigation present the accuracy as a statistical measure of system error.

Anywhere fix
The ability for a receiver to report a position anywhere without the need for an external input providing an estimate.

Automatic Vehicle Location (AVL)
A system that will transmit to a remote location, the global coordinates (in the case of GPS use) or an approximate location of a vehicle suitably equipped with this system

Availability
The percentage of time, a service is available in a pre-defined geographic area. In the case of GPS, a theoretical 100% availability exists. However, in dense urban areas and under extreme conditions, the availability would reduce.

Bandwidth.
The bandwidth of a signal is the portion of the spectrum it occupies. A signal ranging from 10 to 11.5 MHz has a 1.5 MHz bandwidth.

Block I, II, IIR and IIF satellites
This naming scheme represents the GPS satellites' various types and era of use. The type I were prototypes, starting in 1978, the type II are the fully operational 24 satellites in use today. The block IIR satellites are for replenishment purposes and the IIF ones being those for future generation. ST

Jeff Lichtman

Jupiter Revisited

Remember all the excitement and hype prior to the crash of comet Shoemaker Levy SL-9, in July 1994 and all the speculations of scientists and amateurs on what was and was not going to happen?

Now that Jupiter is rising high again in the evening sky, we should start to position ourselves, our receivers, and our antennas to start observing the Jovian giant. The planet is at an angle not very desirable for receiving the disturbances, which eminate from the Jovian atmosphere. Who knows what will come forth as a result of the collision. Some speculate that the radio emission will be stronger.

Lets review some of Jupiter's characteristics. Jupiter is the largest planet within our solar system and was named by the Greeks for one of their main gods. The planet is the fifth planet from our sun and has a diameter of 138,000 kilometers (86,000 miles), with a mass of approximately 318 times that of the earth. The planet has a grasp on twelve satellites (moons). If the mass of Jupiter was a bit greater, it would have begun a fusion process, the same as our sun. Just think, we might have been living (or not) in a double star system (Arthur C. Clark 2010). Jupiter completes one orbit around the sun in a little less than twelve years. The probable atmosphere consists of hydrogen, helium, neon, methane and ammonia with some argon included.

Jupiter radio emissions was discovered by Bernard Burke and Ken Franklin in the winter of 1954. (Burke, B. F.; and Franklin, K. L.: Observations of a Variable Radio Source Associated with the Planet Jupiter. Journal of Geophysics Res., vol 60, no. 2, June 1955, pp. 213-217.) They observed this emission at the frequency of 22.2 MHz. at a declination of +22 degrees (In Australia).

There are three types of radio emission attributed to the planet. At 3 centimeters, the thermal emission is caused by the thermal motion of molecules in the Jovian atmosphere. Between 3 and 70 centimeters, the decimetric emission is thought to be the result of electrons spiraling in the Jovian magnetic field, this is called cyclotron emission if radiating electrons are nonrelativistic, and synchrotron emission if they are relativistic. Refer to the following chart (Carr, T. D.; among Others: Spectral Distribution of the Decametric Radiation from Jupiter in 1961. Astrophysics Journal, vol. 140 no. 2, Aug. 1964, pp. 778-795).

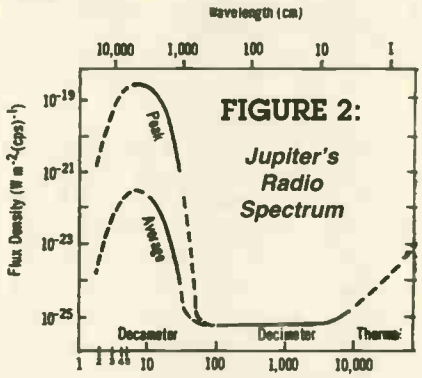
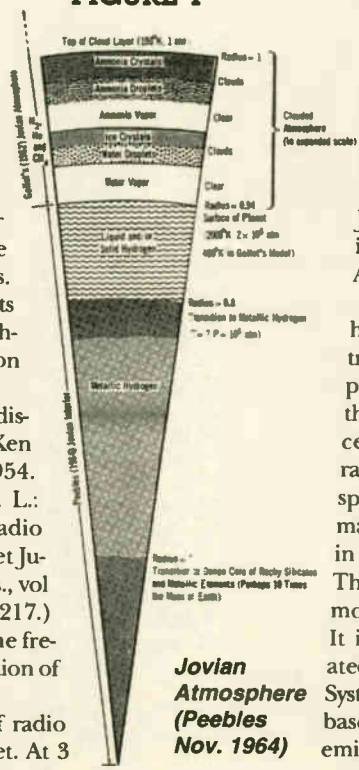


FIGURE 2:
Jupiter's Radio Spectrum

FIGURE 1



Jovian Atmosphere (Peebles Nov. 1964)

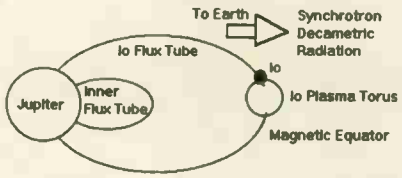
The radio signals we hear are generated by electromagnetic fields on Jupiter. As described above, these signals may be received in the frequency range of 15-40 MHz. Strong sporadic bursts of non-thermal energy may be detected in the range of 18-40 MHz. This energy is believed to be more synchrotron radiation. It is believed to be generated by the interaction of System III (Rotational period based on electromagnetic emissions in decametric and decimetric measurements with a rotational period of 9h 55m 29.71s) with the moon Io. This energy is also generated within the electromagnetic lobes. Jupiter's magnetic field is similar to a dipole antenna much like the earths magnetic field, only 2000 times stronger. The calculated surface field measurement for Jupiter is approximately four Gauss (unit of magnetic field strength) compared to the earth's magnetic field of .5 Gauss. The axis of the Jovian magnetic field is tilted 11 degrees from it's rotational axis and is offset 10,000 km from the center of the planet.

What appears to be the major cause of the magnetic disturbances in the Jovian atmosphere is the interaction between Jupiters System III electromagnetic lobes and the moon Io, the inner most major

Lets discuss the key factors for the detection of Jupiter noise storms. Frequencies to be observed are best determined by the observer.

The actual recording of Jovian storms require a maximum usable frequency (MUF) below the frequency you are planning to monitor. The MUF is the maximum usable frequency which radio waves may be propagated by atmospheric skip. If the atmosphere is reflecting signals back towards earth, then it stands to reason that the atmosphere will also reflect the Jovian signals back out into space.

FIGURE 3: Jovian Storm



The best time to observe Jovian magnetic storms is between the hours of midnight and 6 a.m., when the MUF has dropped below your observing frequency. You will have a better opportunity to detect noise storms at the higher frequencies, i.e. 22-23 MHz. than at 18 MHz. due to the effects of the MUF. Night observations greatly reduce the effects of atmospheric and solar effected signal skip

FIGURE 4: De Predictions

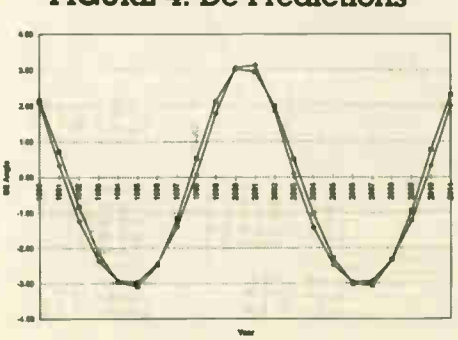
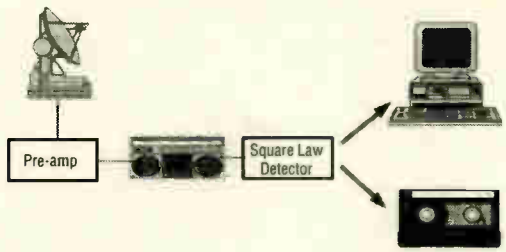


FIGURE 5: Basic Block



or reflection, which would interfere with the detection of the weaker signals from Jupiter.

Some amateurs have detected Jovian storms at frequencies between 23 and 40 MHz. However this may require a more complex antenna and receiver system due to the reduction of Synchrotron emission output from Jupiter.

The requirements for observing a Jovian storm are as follows:

- A magnetic storm is occurring.
- Jupiter must be within the window of your antenna.
- For Io based storms, Io is inferior to Jupiter (Io is between Jupiter and Earth) to detect Io related disturbances.
- The MUF must be below the observation frequency. This allows the Jovian radiations to pass through the atmosphere.
- Jupiter's declination (De) angle must be close to zero.

Monitoring Jovian storms at decametric frequencies appears to be strongly correlated with a low De. If the De is low, less than +-1 degree, the greatest amount of energy will be beamed at the observer. The De angle for 1994 through 1996 are at the greatest negative angle. Hence, infrequent detection of Jovian storms. Figure 4 shows the De for the years 1990 through 2011. The equipment set-up is not very complicated, and best of all, it won't break your piggy bank. Figure 5 illustrates a basic set-up.

The first item required is the dipole antenna or if space is no problem, a large corner reflector Yagi or DDRR (Directional Discontinuity Ring Radiator) antenna. For simplification, lets talk about a half wave dipole. The dipole is constructed of two pieces of wire both measuring 11 feet, 4 inches. This is connected to piece of RG-58U or RG-8 Mini Foam. The center conductor is soldered to one of the two sections of wire and the outer shield is soldered to the other. The antenna should be on an east-west baseline and elevated at least seven feet above the ground.

The preamplifier should be of good quality, although not always necessary if the receiver is of good sensitivity. The preamp may be home built or purchased from any of the ham radio companies. Figure 6 illustrates a simple design.

The receiver may be any good quality communications receiver capable of receiving frequencies of 18-23 MHz. Selectivity is very important in reducing the effect of nearby radio emissions. You must have a clear channel. In addition, the receiver should have the capability of disabling the AGC (Automatic Gain Control).

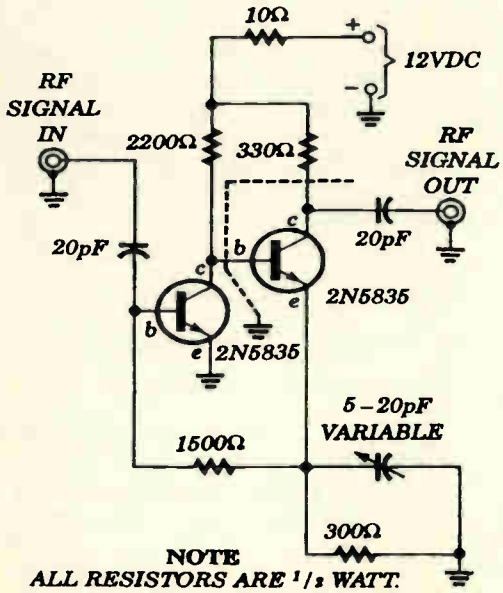


FIGURE 6: Preamp Schematic

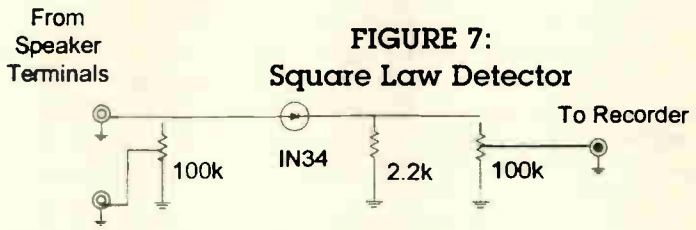


FIGURE 7: Square Law Detector

The detector (Square Law) is an interface between the receiver and the recording device. Refer to figure 7.

The recording devices should be either a tape recorder, ink type chart recorder, or preferably, an A/D recorder (Analog to Digital).

Prior to the comet crash, the Society of Amateur Radio Astronomers (SARA) Tom Crowley, (Now current SARA president) volunteered to head up a Jupiter Collision Commission. Tom put in many hours creating how-to-publications and observing procedures. During the collision, reports on detection of storms and comet hits came flooding via the internet and by the postal service.

My suggestion, for those interested in Jupiter observations, is to read all the current information available. In addition, a very good piece of software developed by Dr. John Bernard for determining Jovian storms is helpful. The price of this software is very reasonable, $10.00 for individuals and $5.00 for schools, each requires $2.00 postage U.S. or $5.00 Foreign. Partial proceeds from the sale of this software goes to the Robert M. Sickels Mentor Program for students. This may be obtained from Jeffrey M. Lichtman, Radio Astronomy Supplies, 190 Jade Cove Drive, Roswell, GA 30075. (Proceeds payable to Jeffrey M. Lichtman).

Amateurs are winners! NASA credited SARA with the exact timing for one of the hits. The data was presented at a meeting at John Hopkins University and centered around the Space Telescope Institute in Baltimore. This shows us that amateurs can do the job!

I will be reporting more on Jupiter as the year goes by. We expect much information from the Galileo probe. I would like to encourage all interested in doing Jupiter observations to let me know and I will forward your names to the correct person. I also encourage you to join with SARA and become involved with the Jupiter Commission. SARA membership information may be obtained from V. Caracci, SARA Membership Services, 247 N. Linden St., Massapequa, N.Y. 11758.

In closing, I would like to remind you of my challenge to our readers (January/February 1996 *ST*). If you are doing radio astronomy, please send us your radio astronomy project information. It will be judged for originality and creativity.

I would like to thank the president of SARA, Mr. Tom Crowley of Atlanta, for his help and material for this article. Partial information was taken with permission from Mr. Crowley's new publication, A Methodology For Determining the Optimal Observational Times of Jovian Electomagnetic Disturbances in the Decametric Frequencies. Further information was obtained from NASA publication NASA SP-3031. ST

ST WHAT'S NEW

by Wayne Mishler, KG5BI

Chips off the New Block

New chips simplify DBS reception

Two improved and relatively inexpensive chips that promise to simplify and help standardize the process of descrambling Direct Broadcast Satellite (DBS) signals were announced April 1 by Hyundai Electronics America of Milpitas, California. The two chips integrate several functions of demodulating and decoding DBS signals and replace many of the components previously required in this process.

"The news here is pretty straightforward: Hyundai made a solution that is more integrated than what was previously available. Our two chips make DBS set top boxes easier to manufacture, eliminate a number of components, and allow for smaller set top boxes. The next step is to put all of these features on one chip," says Susan Shaw of Hyundai.

The two-chip set is priced at about $65 in commercial quantities. Both chips are scheduled to go into full production this summer. Details are available from Hyundai (408) 232-8000.

New family of satellite audio products introduced

SatScan Electronics Corporation of Sultan, Washington, has introduced the first of a family of products that offer professional-quality audio reception of SCPC and FM2 signals from C- and Ku-band satellites.

The $479 SCPC Explorer audio receiver is sleek in appearance, user friendly, and has the ability to lock on frequency for superior quality listening,. It has an adjustment that allows the user to manually correct for the inevitable LNB local oscillator frequency error.

"Once that adjustment is made, any subsequent changes in frequency or channel will be dead on frequency," says SatScan president Michael G. Lee, K7GSG.

The Explorer has a 160-channel memory that comes preloaded with many popular SCPC stations. Of course you can change them and input your own favorites.

For the technical minded, the Explorer is a superhetrodyne receiver using a digital synthesizer as a local oscillator. It tunes to and demodulates SCPC signals provided at the output of a block downconverter. It operates on an input frequency of 950 to 1450 MHz. It's operating frequency is displayed in 10 KHz steps. It has a first IF frequency of 70 MHz and the second IF of 10.7 MHz. Bandwidth is 100 KHz @ 3 db, and 350 KHz @ 40 db.

But you don't need to know all that to enjoy the Explorer, which comes with a six-month warranty. It's front panel is sheer simplicity. There are only seven controls: power, tuning speed, tuning display, up, down, memory and enter. And there's no guessing about what frequency the Explorer is tuned to. It looms up on the receiver's large digital display. You can select any of three display formats – downlink frequency, downconverter output frequency, or IF frequency. This format can be easily changed at any time, even while listening or tuning.

Even when the receiver is turned off, Explorer's SmarTracker Digital AFC keeps one eye open. As long as the LNB at the dish antenna remains powered, and the Explorer is tuned to a station when turned off, SmarTracker continues to track your station despite any LNB drift. When you turn the receiver back on, the Explorer will be in perfect tune – even if you switch to other SCPC stations.

Depending on your system, there are several options for keeping power to the LNB. But even if power is lost, the Explorer will enable you to find your desired station quickly and easily.

SatScan also offers a new stereo FM2 receiver similar in appearance to the Explorer. For information on SatScan products, you can call the company at (360) 793-7533, or write to P.O. Box 1109, Sultan WA 98294.

Universal announces new satellite audio receiver

Universal Electronics Inc., of Columbus, Ohio, offers a new microprocessor-controlled SCPC audio receiver that sells for about $399 and includes direct frequency readout, direct transponder tuning, 50-channel memory, automatic LNB drift compensation, automatic companding, selectable bandwidth, automatic tuning indicators, digital frequency

lock-on, commercial-grade digital synthesizer, and numerous other commercial receiver features.

The Universal SCPC-200 Audio Receiver is easy to tune and covers all SCPC channels on any satellite, says Universal president Thomas P. Harrington. "We furnish our SCPC Channel Guide with each unit," he says.

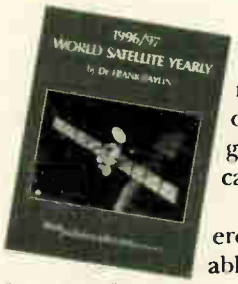
The receiver's audio section produces broadcast quality sound with low distortion via line output or 8-Ohm speaker output. Its input frequency ranges from 950 to 1450 MHz. It is compatible with all C-band and Ku-band channels. Made in the USA.

For information contact Universal Electronics Inc. at (614) 866-4605, 4555 Groves Road Suite 12, Columbus, Ohio 43232.

Presses roll on new edition of World Satellite Yearly

Baylin Publications has announced the publication of it 1995-96 World Satellite Yearly, featuring up-to-date information on satellite programming and reception equipment.

Five sections explore the function and use of broadcast satellites, new details of compressed digital video and audio meth-



ods, and programming available on all of the world's geostationery broadcast satellites.

This 848-page reference source is available from Baylin for $90 plus $5 for shipping. Air shipment outside of North America is $40 per book. You can reach Baylin at (303) 449-4551.

Fiber optic guide goes on sale

The Fiber Optic Reference Guide – a primer for newcomers to the fiber optics industry and a reference for industry veterans – went on sale in March. The $34.95 guide surveys fiber optics technology and the industry without plunging into esoteric equations and other complexities. The only equations presented are those necessary to deal with the technology in real-world applications, such as cable TV and telecommunications.

It gives you a brief history of fiber optic technology, fundamentals, materials, sources, light detectors, interconnection devices, system design, applications, video over fiber, data over fiber, and testing and measurement techniques, among other things.

Author David R. Goff is vice president of engineering of Force, Inc., at Christianburg, Va., which specializes in design and manufacture of a wide range of fiber optic communications devices. He previously did instrumentation research and worked as a fiber optic systems engineer.

You can order toll free by calling (800) 366-2665 or fax your request for more information to (617) 928-2620.

Swagur releases new catalog

Swagur Enterprises of Middleton, Wisc., recently distributed its catalog of weather satellite reception equipment and software.

Featured in the catalog is the well-known OFS WeatherFax software which, when used in conjunction with a shortwave receiver and Swagur interfaces, lets you look at ocean currents, temperatures, cloud systems, and to see how storms form, mature and die.

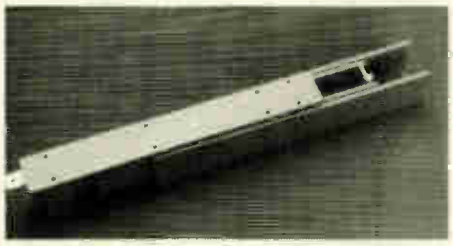
Swagur also illustrates what they call their apartment dwellers special – a 3-foot dish mounted in a window, feeding a shortwave receiver via their Bias-T amplifier. Satellite signals go from the receiver to a Swagursat demodulator to a computer which processes and display the weather images on a computer monitor screen.

This is a must for satellite weather hobbyists, and is available from Swagur Enterprises, P. O. Box 620035, Middleton WI 53562-0035. You can also reach them by phone or fax at (608) 592-7409 or on the Internet at URL: http://www.execpc.co./~swagur.

Sliding chassis bracket supports half a ton!

Looking for a sliding mount with muscle? Consider the Chassis Trak bottom mount slides available from General Devices of Indianapolis, Indiana.

These telescoping slides can support 1,200 pounds or more depending on how many are used.



They're made of heavy gauge cold rolled steel with stainless steel rollers. And they lock at the fully closed and fully extended positions. They are ideal for large electronic enclosures, power supplies, telecommunications racks, generators, battery back-up trays and air conditioning units, among other uses.

You can call ((800) 626-9484 for information and literature. Or fax (317) 898-2917.

EchoStar publishes satellite TV guide

The EchoStar Communications Corp., which now delivers direct-to-home satellite television products and services to customers worldwide, recently introduced its new "DISH Entertainment Magazine" – a printed guide to the company's programming schedules.

This tabloid-size publication is available to DISH Network customers for $3.95 per month.

"DISH Entertainment Magazine provides complete daily programming information to our customers," says EchoStar president Carl Vogel." It includes descriptive program grids, an alphabetical movie section, and information on specials and sports listings.

Drake unveils new receiver decoders

The R. L. Drake Company of Miamisburg, Ohio, has unveiled two integrated receiver decoder units offering customary high-end performance.

The ESR800XT, first integrated receiver decoder in Drake's line of international products, has a threshold extension of less than 3 db, which means it can receive weak signals via small antennas. Audio threshold, noise reduction, and companding circuitry can be adjusted for superior stereo audio.

The unit comes equipped with an 800 programmable channel memory which can store video, audio, and antenna settings. You can give priority to 400 favorite channels, making it relatively easy to move favorite channels with a few keystrokes. The favorite channel feature eliminates cumbersome searching through satellites to locate desired channels.

There are six selectable multi-lingual on-screen display menus through which you can select Arabic, English, French, German, Portuguese and Spanish languages.

And the unit uses two programmable bandwidth filters along with a dual input tuner for LNB connections.

The ESR2000XT is an advanced receiver that offers global operation and versatility. It comes equipped with a 2,000 programmable channel memory capable of storing video, audio and antenna settings and, like the 800, allows you to choose and manage up to 400 favorite channels.

Drake designed the ESR2000XT to be programmed to track inclined orbit satellites with an optional accessory. This allows users to watch programs from satellites on inclined orbits such as the Russian Gorzinot satellites.

This receiver has several other features new to Drake international equipment. It has four rear-panel SCART connectors to simplify interconnecting the receiver with other video equipment such as recorders and decoders. There is a parental lockout feature which can be used to block out unwanted programming. There are also convenient front panel controls, an infrared remote, a programmable eight-event timer for video recording, and automatic signal peaking. ST

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

Orbital Data on the WWW

A lot can change between columns here at *Satellite Times*. Last time, we began a series of articles on benchmarking of satellite tracking software and were supposed to finish it up in this issue. Little did I realize as we were putting that last issue to press that by the time I got around to writing the next one, I'd be doing so from a new house.

FIGURE 1 Celestial WWW
Celestial BBS on the Internet

Moving is always a great opportunity for change. It forces changes in patterns that we've grown accustomed to—sometimes whether we like it or not. Of course, every time I've moved since 1985, one of the big changes has been to quickly set up the *Celestial BBS* at its new home. Over the years, the *Celestial BBS*—a major source of orbital elements and satellite tracking software—has moved from Sunnyvale, CA to Austin, TX to Fairborn, OH to Wright-Patterson AFB, OH and finally to Montgomery, AL.

At first, it seemed that this move would be a relatively painless one for the BBS. After all, we were only moving a distance of a mile or so and could actually transfer the telephone number. Except for a couple of hours to pack everything, move it, and set it back up, it looked like it could be done without much impact on the BBS's users.

We hit the first snag, however, when we discovered that the new house was only wired for two lines. Since my wife and I both do a lot of work at home and most of it has some aspect of remote communications, we already needed both lines. Having *BellSouth* come out and install a new line would add cost and cause delay of a week in getting the new BBS back up and operating.

That's when I began to realize it was time to consider Plan B. Traffic on the *Celestial BBS* had been dropping precipitously as the popularity of the Internet and the World Wide Web (WWW) rocketed. From an average daily high of 70 calls a day (and 100-130 calls a day during many US space shuttle missions—not bad for a one-line BBS), traffic had dropped to only a handful of calls each day. Many users were getting the data via **anonymous ftp** at **archive.afit.af.mil** in the **pub/space** directory and wondering why they couldn't access the rest of the material from the *Celestial BBS* via the Internet. Many of these users were looking for ways to avoid considerable long-distance charges while calling from places as far away as Australia and Japan.

The solution, of course, seemed obvious. Why not set up a WWW site to replace the BBS? After all, that would avoid the need to install a new telephone line and allow me to begin operation before the BBS shut down. It would also remove many of the problems with BBS operations, such as noisy phone lines or system lock ups while I was away from home. In addition, I would avoid major hardware and software upgrades which were needed to remove some operating limitations (the *Celestial BBS* was still running on a 386 machine running *MS-DOS*).

Well, Plan B didn't get too far when I began to realize that the five free megabytes of transfers a day offered by our Internet Service Provider (ISP) wouldn't be nearly enough to support the traffic I anticipated for such a site. In fact, that would only be about a hundred downloads a day of the master two-line orbital elements list. I've always been a strong proponent of free access to information and believe the payback for operating the BBS out of pocket, with the generous donations of a few financial supporters, has been instrumental in helping satellite tracking to evolve to where we are today. The thought of charging for access put a major crimp in Plan B.

Grove to the Rescue

That's where the great folks at *Grovelink* and *Satellite Times* came to my rescue. I approached them with a proposal to host the WWW site for the *Celestial BBS* on their new WWW server. Having immediate access to the most current orbital element sets for the *Satellite Times* readers would be a real plus. And what better column than *Computers & Satellites* to kick it off. To my delight, they were every bit as enthusiastic about the idea as I was! As a result, within a matter of days, we had the new *Celestial WWW* site stood up and operating at **http://www.grove.net/~tkelso/**.

A Guided Tour

The initial design of the *Celestial WWW* is pretty basic right now, providing primarily NORAD two-line orbital element sets and some supporting documentation. Even at that, though, the site is receiving 100-150 hits a day. Let's take a quick look at what's already available before talking about what's to come.

The home page will be the stepping-off point for our tour. The adventure begins right below the newly-designed logo for the WWW site (see Figure 1). Besides having links to our hosts and an easy way to send me feedback, ask questions, or make suggestions, there are currently three major sections to the site: Current Data, Historical Archives, and Documentation.

The *Current Data* page contains just that: the most current data from the NORAD two-line orbital element sets. This data is normally updated every US government work day. The master list contains orbital data for a wide range of satellites—everything from amateur radio satellites to constellations such as GPS, Glonass, GOES, and many others. In addition, it also includes element sets for all new launches for the first thirty days after they are catalogued,

making the data available as soon as possible after launch.

Perhaps more useful are the functional element sets which cover specific groups of satellites—amateur radio, weather, navigation, and various geosynchronous constellations. These sets make it easy for users to quickly find the data they need. Of particular note are the special-interest element sets near the top of the page—element sets for things like the Mir space station, US space shuttle missions (while on orbit), and other satellites which are making the news (such as TSS 1—the tethered satellite that got away from STS 76).

All of the two-line element sets are formatted using the standard *MS-DOS* format where each line ends with a carriage return/line feed (CR/LF). This should make the process of downloading the elements, for direct use in various satellite tracking packages, pretty straightforward.

The *Historical Archives* are a treasure trove of information for many satellite users. Do you need orbital data for a weather or earth resources satellite (e.g., NOAA or Landsat) in order to geolocate an image? Well, you can find those and much more in this section. Historical element sets are available for various classes of satellite missions (e.g., weather and earth resources) from 1980 to the present. In most cases, this means that you can find *all* the two-line element sets generated for a particular satellite since launch!

Maybe you don't need every element set for these satellites. Instead, you're simply looking for element sets for 1994 for NOAA 11. At the bottom of the *Historical Archives* page are links to yearly archives for each of the satellites on this page. To find the 1994 data for NOAA 11, simply click on '1994' and then click on 'NOAA 11' in the 'NOAA' section of the 'Weather Satellites' table.

All this data wouldn't be of much use without appropriate documentation and that's where the final section comes in. The *Documentation* page presently contains some fundamental information for using the NORAD two-line element sets. The first item is a description of the NORAD two-line element set format. While most satellite tracking software already knows how to translate the two-line element set at input, users are often curious as to what each field represents. Here's where you can find out.

Of course, you should remember that you still need to use the NORAD SGP4 orbital model with these data to get the most accurate results. Orbital elements such eccentricity do not have exactly the same mathematical meaning in different orbital models and the user should not assume otherwise. For a complete description of the NORAD orbital models, including FORTRAN source code, look at the link titled *Project Spacetrack Report Number 3.*

You may notice that the format of this document is different than what you're used to. Many documents you'll find on the WWW are in either HTML or plain ASCII text. But this report contains many mathematical equations used to describe the various orbital models and neither HTML or ASCII can adequately represent these equations. Enter the portable document format (PDF) created by *Adobe* (the creators of *PostScript*) called *Acrobat.* This format permits true WYSIWYG on the WWW and free viewers are available from *Adobe* for not only *Microsoft Windows* but *Macintosh* and *Unix* platforms, as well. Links for further information on *Adobe Acrobat* and to download the *Acrobat* viewers are included on this page.

The *Documentation* section also provides links to some timely information about recent and upcoming satellite launches. The *SPACEWARN Bulletin* is a monthly publication which gives basic information about each satellite launch. The site maintained by the *Committee on Space Research (COSPAR)* contains archives of these bulletins going back several years. *Jonathan's Space Report* is a weekly newsletter with information on current launches, decays, and discussion of various satellite news items. It is an excellent resource for staying up on what's in orbit.

Plans For the Future

It may seem that the *Celestial WWW* already has quite a lot of information, but we've only just begun! Let me leave you with just a hint of things to come. One of the major items currently missing from the system are the vast software archives on satellites and astronomy which were available via the *Celestial BBS.* I will be reviewing those archives and either putting the programs online or adding links to the most current versions. Obviously, this will be a major effort, but one that should be well worth the effort.

In the *Historical Archives* section, we'll be adding a form for special requests. While the current archives are quite extensive, I'm sure many users will have special requirements and we want to be able to respond to special requests in a timely fashion. Once the form is online, you'll know we're ready to supply this service.

Help and additional reference materials will be a major addition to the new site. Soon, there will be a *Help* page which mirrors the *Current Data* page. Here, when you click on NOAA 11, you'll find links to basic information describing the satellite, operating frequencies, operational status, images, and other related information. The Internet is a gold mine of such information, but finding what you need can be tough. We hope to tie it all together for you.

Of course, being a professor, one of my basic missions is education. Past issues of this column have served as a basic tutorial on satellite tracking and will continue to do so. For those of you who have missed some of the earlier issues, I'll be putting them out in *Adobe Acrobat* format to serve as a major reference. And, to supplement these issues, I'll provide the source code and executables discussed in my columns (such as our last issue) to help you follow along. I'll also be building a Frequently Asked Questions (FAQ) list to address basic recurring issues.

One final note on the technology. While the tables on the new Celestial WWW look best under Netscape Navigator 2.0 because of its incorporation of the HTML 3.0 standards for tables, this browser, with its plug-ins, will allow us to push the envelope with new technologies like *Java, Amber* (an enhanced *Acrobat*), and *VRML*. Imagine interactive demonstrations of basic orbital theory to help you get up to speed on a particular topic—it's coming!

Conclusion

Hopefully, the things we've just discussed will make it easier for you to learn about and understand orbital mechanics and to get the software and data to be able to apply what you've learned. Of course, it isn't a substitute for *Satellite Times* (it's still hard to do this Internet stuff while waiting in the doctor's office), which has a wealth of other outstanding material, but I think you'll find it provides considerable enhancement to each issue.

As always, if you have questions or comments on this column, feel free to send me e-mail at my *new* e-mail address: **tkelso@grove.net,** or write care of *Satellite Times.* And be sure to let the folks at *Satellite Times* know how you feel about the new WWW site and thank them for their support. Until next time, keep looking up! ST

By Bill Grove
bill@grove.net

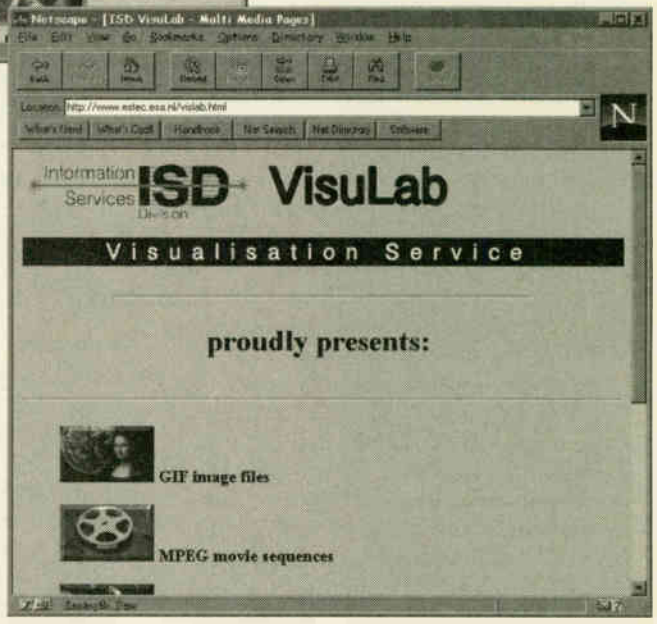
Satellite Web Sites

Since the start of this column in *ST*, I have tried to pass to you as many sites to visit on the Internet as possible, without making this column just another "hot site" list. In this issue, I have the double pleasure of not only offering you a detailed report of an amazing site, but I also have a large list of satellite-based sites on the World Wide Web.

The site that deserves such detail this month is the European Space Agency. They have not only put a lot of time into the detail of the material available, but have put a lot of time into the design of the page. Although it can be viewed with Netscape 1.2 and lower, I would highly recommend that you try to view this page with Netscape 2.0 or higher (available from **http://home.netscape.com/comprod/mirror/client_download.html**). They are using the new java language on the page to do an impressive scroll at the top of their homepage showing a collage of space photos.

This page opens a gate to the realm of space in cyberspace. Right from the homepage, you have jumps to services, publications, programs and the latest space news. Following one of these links, I was lead to **http://www.estec.esa.nl/vislab.html** which is a true multimedia pleasure! On this site, you can get pictures, movies and more links to pages dedicated to such projects as Hubble, Soho, Cluster and ISO. These pages lead to more movies and graphics. These delightful animations, although slow to download due to size, are a pleasure to watch. Very professional and organized, they are well worth the download time for those people truly dedicated to space.

Even though these sites are European, the speed at which they download and view is quite impressive. I hadn't had much luck in the past with many European sites, but my whole time viewing all these ESA pages was almost perfect, with very few delays or speed losses. The information and detail in the pages seems to be contiguous throughout the pages. An example would be a document on telecommunications satellite, where they detailed both the past and future launches in a easy-to-read yet informative manner. I'm one of those people who is distracted very easily while reading, but these pages delivered information that I wanted and needed quickly, but without leaving out important details. The reason I point this out so heavily is that many web pages get bogged down with either details or with graphics. These ESA pages are what other agencies and businesses should look at as an example of quality on the Web.



In the publication section of the ESA pages, many of ESA's past periodicals and articles appear in full-form. Their *Earth Observation Quarterly, Microgravity News* and *Preparing For The Future* all have many past issues online. Hopeful and optimistic views of the future can be found in the *RendezVous With The New Millennium* at **http://esapub.esrin.esa.it/pointtosp/sp1187.html.**

The ESA pages are some of the best I've seen dealing with space, but if they aren't enough for you, just hop over to their Other Agencies page at **http://www.esrin.esa.it/htdocs/esa/other_agencies.html** and jump to 17 other agencies and institutions! Just bookmark ESA's homepage (along with *Satellite Times*, of course!) and you'll have enough space information to last you for many, many months! I hope that you will visit their site and drop an email to them to let them know how they're doing. I will continue to monitor the site and let you know of any major changes or updates.

As always, if you see a site on the Internet that you think would be of interest to the rest of the world, let me know and you may see it turn up in future articles! Send links and information to **bill@grove.net**.

This list contains 69 addresses to various pages on the WWW that contain satellite information. This list was compiled by Josh R. Williams

AMSAT	http://www.amsat.org
AMSAT-UK	http://www.mcc.ac.uk/AMSAT/
CDDIS (Crustal Dynamic Data Information System)	http://cddis.gsfc.nasa.gov/CDDIS_FULL.HTML
Celestial WWW	http://www.grove.net/~tkelso
Coast Guard (NAVSTAR)	http://navcen.uscg.mil
Dallas Remote Imaging Group	http://www.drig.com/
Dave Cottle's Home Page	http://www.ozemail.com.au/~dcottle
Don Barlett's GPS Page	http://io.datasys.swri.edu/GPS.html
Elements / Keplerian Mailing List	http://www.cts.com/browse/garym/elements
ELIRIS (Earth, Land and Integrated Resources Information Systems)	http://www.soonet.ca/eliris/GPS.htm
EuroMir95	http://www.op.dlr.de/EUROMIR95/
European Satellite Information	http://www.funet.fi/index/esi/
European Space Agency	http://www.esrin.esa.it/
Global Position System (GPS)	http://www.utexas.edu/depts/grg/gcraft/notes/gps/gps.html
GOES Information Page	http://jester.colorado.edu/GOES_page.html
GOES Launch Information	http://www.noaa.gov/news_flash/goes_news.html
HearSat-L	http://www.grove.net/hearsat.html
Interactive GPS Satellite Prediction	http://sirius.chinalake.navy.mil/cgi-bin/sat-pred-query
Intl Journal of Small Satellite Engineering	http://www.ee.surrey.ac.uk/EE/CSER/UOSAT/IJSSE/ijsse.html
John Beadles Home Page	http://galaxy.einet.net/editors/john-beadles/introgps.htm and
	http://galaxy.einet.net/editors/john-beadles/sum_his.htm#1957
Jonathan's Space Report	http://hea-www.harvard.edu/QEDT/jcm/space/jsr/jsr.html
JPL's NAVSTAR Home Page	http://milhouse.jpl.nasa.gov
J.R.W. Satellite Page	http://www.gatecom.com/~jrwsat
Keith Stein's Listening Post	http://www.newspace.com/publications/casr/home.html
Kilroy	ftp://kilroy.jpl.nasa.gov/pub/space/elements
Magliacane Space News Home Page	http://www.njin.net.80/~magliaco
MirWatch	http://www.skypoint.com/subscribers/benhuset/mw-new.html
Multispectral LANDSAT Information	http://edcwww.cr.usgs.gov/glis/hyper/guide/landsat
NASA Ames ER-2 Information	http://airsci-www.arc.nasa.gov/ER-2/AIRPROGL.HTM
NASA Newsroom	http://www.hq.nasa.gov/office/pao/NewsRoom/today.html
NASA Shuttle Web	http://shuttle.nasa.gov/
NASA Shuttle Web: Shuttle Sightings	http://shuttle.nasa.gov/current/orbit/orbiter/sighting/
NASA Spacelink	http://spacelink.msfc.nasa.gov/
National Aeronautics and Space Admin.	http://www.nasa.gov/
National Reconnaissance Office	http://www.nro.odci.gov/
NOAA	http://www.noaa.gov/
NOAA Defense Meteorological Satellite Program	http://www.ngdc.noaa.gov/dmsp/dmsp.html
OIG (Orbital Information Group)	http://oigsysop.atsc.allied.com/
Onboard Navigation System Development	http://fdd.gsfc.nasa.gov/FDD_onboard.html
Paul Traufler's WinTrak Page	http://www.traveller.com/~wintrak/
Planet Earth Home Page	http://www.nosc.mil/planet_earth/nasa.html
Predictions for Individual Satellites	http://www.acs.ncsu.edu/scripts/HamRadio/sattrack.perl
SAREX	http://www.nasa.gov/sarex/sarex.html
Satellite Information	http://free.rmnet.it/~djsnoop/sat/info.html

Satellite Technical Information	http://defiant.gsfc.nasa.gov/530homepage.html
Satellite Times	http://www.grove.net/hmpgst.html
Satellite Tracking Resources	http://www-leland.stanford.edu/~iburrell/sat/sattrack.html
SatPasses	http://ssl.berkeley.edu/isi_www/satpasses.html
SatTrack	http://www.primenet.com/~bester/sattrack.html
Small Satellites Home Page	http://www.ee.surrey.ac.uk/EE/CSER/UOSAT/SSHP/sshp.html
Southeastern Michigan AMSAT Net	http://www.oeonline.com/%7Ejsmyth/index.html
Space Systems and Concepts Division	http://freedom.larc.nasa.gov/ssc:d_home.html
SPACEWARN Home Page	http://nssdc.gsfc.nasa.gov/spacenews/spacewarn.html
SPARTAN Packet Radio Experiment	http://w3eax.umd.edu/spre.html
STS Countdown	http://www.ksc.nasa.gov/shuttle/countdown/countdown.html
STS 1988 Reference Manual	http://www.ksc.nasa.gov/shuttle/technology/sts-newsref/stsref-toc.html
TDRSS Home Page	http://taygeta.gsfc.nasa.gov
The Amateur Satellite Observers of Southeast Virginia	http://www1.seva.net/~jbyrd/
The Earth Satellite Ephemeris Service	http://www.chara.gsu.edu/sat.html
Thematic LANDSAT Information	http://sun1.cr.usgs.gov/glis/hyper/guide/landsat_tm
The Satellite DX Foundation	http://www.accessone.com/~emunger/KA7LDN/index.html
The Satellite Encyclopedia	http://www.u-net.com/arrow/tse/
The Shuttle / Mir Programme	http://www.rzg.mpe.de/~bdp/vsohp/mir-shuttle.html
Time Directorate	http://tycho.usno.navy.mil
Tucson Amateur Packet Radio	http://www.tapr.org/tapr/
UARS Project	http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/UARS_project.html
Visual Satellite Observers Home Page	http://www.rzg.mpe.de/~bdp/vsohp/satintro.html
Web Satellite Ground Station	http://gndstn.sp.nps.navy.mil/
WorldSpace Global Satellite Digital Audio Broadcasting	http://webworqs.com/worldspace/ ST

THE BEGINNER'S COLUMN

By Ken Reitz, KC4GQA

Tracking Those Elusive AMSATS (Cheaply!)

Do you have to be an heir to the Malcolm Forbes fortune in order to get started in the satellite monitoring hobby? Do you need the latest Pentium computer to track amateur radio satellites? Can you really find all you need at the bottom of your closet? The answers are No, No, and Yes!

In fact, I'm going to show you how you can have a reliable satellite tracking program and the computer to run it on for as little as $20. Am I out of my orbit? Did my third stage fail to ignite? Is my brain as wobbly as a Chinese launch vehicle? No comment. Let tell you fellow Beginners, you no longer need to worry about the anemic condition of your checking account in order to get started in this interesting aspect of the monitoring hobby.

Getting Started

You may have noticed the two page spread in the SSG section of this magazine entitled *Amateur Satellite Frequency Guide*, There are 17 amateur radio satellites and two manned spacecraft listed in that section this section of the magazine, all of which transmit single sideband (SSB) voice, CW (Morse code) or packet (digital) messages. And, you may have noticed that between your 2-meter handi talkie and a shortwave receiver, you actually have enough equipment to at least listen in.

A common experience that people have is they tune in the downlink frequency of a spacecraft to hear the action, but often nothing is heard. Why? The simple reason is that the satellite is not in range.

Unlike terrestrial amateur communications, which use the various layers of the ionosphere to bounce radio signals around, satellite communications is mostly done "line of sight". This means that, unless the satellite is within "sight" of your location, you will hear nothing. So how do you know where the satellites are and when they'll be near enough for you to hear them? That's where the satellite tracking program comes in.

How It Works

Once a satellite achieves orbit it more or less maintains a predictable route around the planet. This path is based on a lot of fancy physics and you'd need a computer to figure it all out. Computer programs have been written to be able to predict just where a satellite will be on any given hour of any given day of any year for quite a few years to come.

Today's sophisticated personal computers, with their multi-tasking, high speed computing capability, and enormous memory capacity, would seem perfect for this sort of assignment. But, without a tracking program you will have no idea where a satellite is or when it will be within range of your location.

Typical tracking programs for your PC cost from $100 to several hundred dollars. These sophisticated programs not only track every thing that moves in near space, but take control of your receivers, transmitters and antennas as well. Heck, if you just add some simple voice programs to the mix, you can be in the kitchen rummaging through the refrigerator while the computer earns worked 100 countries (DXCC) via satellite award.

But, suppose you don't have a computer. Suppose you're not sure you would enjoy this aspect of the electronics revolution. Should you really cough up some big bucks for a computer and satellite tracking program just to see what it's all about?

Silicon Dinosaur

There is an alternative. Back in 1985 America was being introduced to the concept of a computer for the home by way of the Commodore 64. At the time, it was not cheap. With an outboard disc drive and printer, it would cost the equivalent of a basic 486 today. Equipped with a TV channel 3-4 modulator, the computer images were seen on your TV set. Of course, by today's standards, these little computers don't cast much of a shadow.

Still, the lowly C-64 actually has quite a few things going for it. For one thing, these units are noiseless. Heat dissipation was never a concern so there's no need for the ubiquitous computer fan noise.

The C-64 is quite small and takes up very little desk space, since the CPU is built into the keyboard cabinet and the keyboard has only 12 extra keys over the standard typewriter keyboard. The C-64 was ruggedly built. Units which saw years of service and just as many years being kicked around from one closet to the next still work flawlessly.

This little computer is surprisingly versatile and can still be a productive part of your radio shack. Many hams use them as stand-alone packet terminals. Using the Digicom 64 modem and software, these little giants are doing yeoman service in thousands of ham stations in this country. Other software makes it possible to send and receive radio teletype (RTTY) and morse code (CW) in addition to packet radio. I've usesd Microlog's SWL cartridge program for years to monitor W1AW's daily teleprinter bulletins.

But, the best reason of all to get a C-64 is the price. They're usually free. If you know anyone who has one, it's more than likely yours for the asking. Occassionally you'll see them for sale at hamfests and you may

have to pay $10-50 for one. That's because hams know they still have value in the amateur environment. The rest of civilization has written them off as about as useful as a rotary dial telephone.

Yesterday's Technology Today

In 1985 Bob Dalleske, W6AMW, wrote a tracking program for the C-64 called Super VR85. It was very popular in the amateur radio community and, when it was offered by AMSAT, the official organization of the Radio Amateur Satellite Corporation, several thousand were snapped up. Many hams still use their C-64s in radio related work. In a way, it's a good example of appropriate use of technology. Why tie up an expensive Gigabite 2000 for amateur radio use when your kids could be playing video games on it with other teenagers across the country and racking up big online charges!

When you first boot the VR85 you'll notice something you haven't experienced in a long time: The C-64 is slow witted. You can do your income taxes or read a novel while you're waiting for the program to load. Once you get used to the speed you'll find this is a very easy program to use.

All the current satellites are listed in the menu and, after you enter your exact location, you may select the satellite from that menu which you would like to track. Having made your selection, a tracking map appears on the screen with the satellite indicated and surrounded by a ring which represents the "footprint" or area on the globe which is in range of the satellite.

As stated in the VR85 material "...A musical announcement of the arrival and departure of a satellite in your area is given in case you're not watching the screen. Below the map are displayed the name of the satellite, the date of observation, orbit number, universal time, azimuth, elevation, distance between you and the satellite, suborbital latitude and longitude, transponder mode, and orbital position...A mutual acquisition list of 36 cities from throughout the world complements the map footprint. This table tells you exactly when each given city is accessible from your location..."

The program is shipped to you with the latest Keplerian orbital elements configured for 15 satellites and there is room to add 5 more. You can add or update element sets (found in each issue of *ST* or at Dr. TS Kelso's Celestial Web BBS on the internet at URL: http://www.grove.net/~tkelso) at any time. Built-in date correction takes leap year and astronomical time corrections into account through the year 2016.

Bottom Line Time

Ordinarily, it would be difficult to recommend a product having to do with satellites that was 11 years old. But if the words "credit application denied" or "account overdrawn" or "Not Sufficient Funds" make you think you can't get involved in amateur radio satellites, this should change your mind.

True, if money is no object and you're a veteran satellite DXer and you already have a great computer, this is of no use. But, if you want to get started and are willing to risk a couple of bucks, this could be a great introduction. Pick up a C-64 at a dumpster near you and send $20 ppd to: RLD Research, Box 888, McCloud, CA 96057 for the VR85 tracking program. Tell Bob that *Satellite Times* sent you.

Mailbag

Dr. Jan Leszczynski of New Haven, West Virginia, was able to obtain information on programming from TV Polonia (Poland). He says programming is transmitted every day (18 hours) directly from Warsaw via PanAmSat 1 at 45 deg West. He would like to know if their digital transmissions are in the same format as used by our DSS satellites and, if so, could modifications be made to allow reception. He also enclosed the name and address of a company selling TV Polonia receiving systems.

My guess is that they are incompatible systems and I would get in touch with the company offering receiving systems and get on board. The address is Polish Television U.S.A., 1114 N. Milwaukee Avenue, Chicago, IL 60622, Phone 312-252-0444. Thanks for this information and good luck.

Reuel Jones of California wants to be able to listen to religious and talk shows as listed in the *ST* Satellite Services Guide. He would like to be able to use the smallest dish for best results.

Even though you're only listening to audio, you'll still need to bring in as much signal as you can. Given the power of today's C-band satellites and how close they are in the sky to each other, it would be smart to stay above the six foot mark. Anything smaller and you'll experience ingress from signals of nearby satellites and you'll be losing a lot of the signal. There will be more "noise" in the received signals. At six feet and up, the noise diminishes and the signal is very clear.

Dana Williams of Virginia Beach, Virginia, has a C-band system and a few questions:

Regarding DigiCipher technology, will these receivers be able to receive the digital radio services currently being transmitted? Will trade-ins be offered by manufacturers to get people to buy the new digital receivers?

First, I doubt that they will tune in all or even any of the currently transmitted digital services. Again, it's a question of compatibility and right now there are quite a few digital formats in use. Secondly, I doubt if there will be trade-ins. I imagine that everyone will be so eager to get the new digital receivers that production will probably be backlogged ala the DSS debacle.

How do you hook up an ICOM R-100 to the dish for SCPC reception?

You'll need a 950-1450 MHz splitter which has a DC block on one leg (this is to avoid sending the voltage intended for the LNB into your R-100 which would ruin it). These sell for about $15 from Skyvision (800-543-3025). Plug the cable from the dish into the input of the splitter and plug your satellite receiver into the leg without the DC block and your R-100 into the leg with the DC block. Set the R-100 to FM and, by tuning the R-100 through the frequencies between 940 and 1450 Mhz, you should be able to hear SCPC signals.

Can GE Satcom C5 be seen from my location? and what are SEDATS services offered on this satellite?

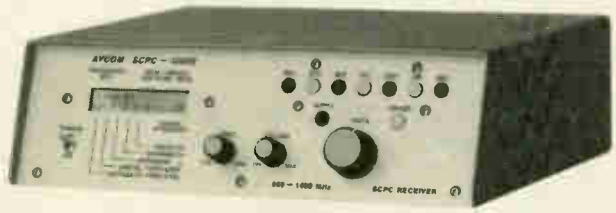
Since C5 is the western-most satellite in our portion of the Clarke Belt and you are as far east as a person can get without getting wet, I'd say your chances of getting decent reception are slim. This is because your dish is practically staring into the ground only a few degrees off the horizon. Any trees, building, etc. will block the signal. In addition, a look angle that close to the horizon causes the dish to pick up "ground noise", naturally occuring noise in the C-band range, which interferes with the satellites' signal. DATS and SEDATS are just two of the digital radio transmission schemes for which you'll need DATS or SEDATS receivers specifically to receive the programming. They are, to my knowledge, not available. ST

SATELLITE TIMES TESTS

By Ken Reitz, KS4ZR

AVCOM SCPC-1000D Receiver

Radio networks have been around since the first quarter of this century when the broadcast industry was young. And, until the advent of satellite broadcasting, networks distibuted their programming on dedicated telephone lines from network headquarters to the affiliate stations.



By the late 1970's the radio industry joined the space age and began feeding programming to affiliates by satellite. By today's standards such transmissions were primitive and expensive. Even so, it was still cheaper than the telephone company (Telco) lines.

At that time network broadcasters would transmit on a very narrowband carrier of its own which was called single channel per carrier (SCPC). Initially these transmissions were broadcasts on a single sideband carrier and were called SSB/SCPC. Later, in order to improve audio fidelity, these transmissions were transmitted on an FM carrier and called FM/SCPC.

In the early years of satellite TV the only available SCPC receivers were designed for commercial use and cost around $10,000.

Consumer SCPC Receivers

Among the vagaries of SCPC reception are that transmissions, besides being narrowband, are usually "companded," a transmission method in which the signal is squeezed into a narrow carrier at the transmitter and "expanded" at the receiving end. Most low noise block downconverters (LNBs) lacked the stability to allow for drift-free reception of these signals.

In the mid-80's satellite enthusiasts finally had a consumer grade SCPC receiver in the Heil SC-1. This unit, however, lacked expanding circuitry and had a mechanical digital readout which gave only a general sense of frequency. At $450, though, the price was right and the company was selling them as fast as they could make them.

Following on heels the Heil receiver, Universal Electronics introduced their SCPC-100 which also attempted to address reception of SCPC signals at an affordable price. Introducing such features as electronic tuning, channel memory and LED readout, the SCPC-100 soon became the sole competitor in the consumer SCPC field after the disappearance of the Heil receiver from the market.

Old Kid On The Block

Long time commercial satellite receiver manufacturer and maker of sophisticated spectrum analyzers, AVCOM of Virginia has now joined the battle with its own consumer grade SCPC receiver. They have made commercial SCPC receivers for 15 years and with their SCPC-1000D receiver AVCOM shows that a quality, inexpensive SCPC receiver for consumers is a reality.

AVCOM has answered virtually every issue involving the shortcomings of earlier efforts with success. This is obviously a result of their experience with years of design and real-world tests of their equipment. Their experience shows. Let's take a look at the product.

The SCPC-1000D Features

Measuring 11.5" wide x 10" deep and 3" high, the AVCOM SCPC-1000D, with its sloped front panel, greenish/gray cabinet, and visible round head screws, looks more like piece of bench test gear than a radio. It won't exactly match anything on your family room bookshelves. This receiver weighs in at just under 4 pounds.

The front panel features no-nonsense, sturdy knobs, an old-fashioned metal toggle switch and a series of round momentary buttons which effect the tuning, store frequencies in memory and calibrate the unit to your LNB drift.

The main feature on the front panel is the two line LCD display which lights up the color of anti-freeze and shows frequency, bandwidth, and expansion ratio among other vital bits of information. The layout is clean and easy to use.

The back panel features five connectors. On the extreme left is a threaded "F" connector for 950-1450 MHz RF Input from the dish. On the right is a BNC connector which allows the unit to be connected to a spectrum analyzer. Next to that are two RCA connectors. One is a low level line-out so the receiver can be connected to the auxiliary input of your stereo system. The other is to power an 8 ohm speaker (two knobs on the front panel control the volume and tone of the speaker). The last jack is an input for a 12-18 volt power supply which is provided with the unit.

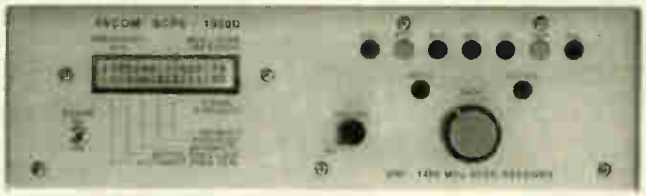
Drifting Away

Now, before we get our eager little hands on this product, let's examine a crucial peculiarity of SCPC reception. As mentioned previously, these transmissions are very narrow banded and, when you try to tune in these signals, it's necessary to have a very stable LNB. We have to try to limit the amount of drift in the LNB which, in turn, will cause the SCPC receiver to tune off frequency. Now, this is not a problem when viewing wide band TV pictures or listening to wideband FM subcarriers. If there is any instability in the LNB you'll never know it from receiving these signals.

For my first test of the SCPC-1000D I used a 40 degree California Amplifier Phase Locked Loop LNB. This is an extrememly stable LNB and there was no apparant drift of the frequecies as they were stored in memory and recovered. The trouble with these LNBs is that they are very expensive (three or four times the cost of a normal LNB).

For my next test I used my seven year old Drake 40 degree HEMT LNB. The results were quite satisfactory. Why? A unique feature with the SCPC-1000D is the LNB Compensation adjustment. As the instructions make clear "...this adjustment, if properly done, allows the SCPC-1000D to subtract away any long-term frequency error from your Low Noise Block downconverter, so

that station frequencies can be displayed correctly, and so that they can be stored/recalled correctly,too." It's a terrific idea.



The Road Test

Setting up the SCPC-1000D is a breeze. You will, however, need a 950-1450 MHz splitter so that you can feed one leg of the splitter to the SCPC receiver and the other leg to your satellite receiver. These splitters are widely available from the usual TVRO mail order catalogs and will cost about $15 with shipping.

The instructions are sparse but adequate, and Avcom knows you'll end up throwing them away. That's why they have all the necessary setup instructions (including the LNB compensation prodecure) printed on a label stuck firmly on the top of the cabinet.

After following the simple instructions it's merely a matter of turning your dish to the satellites which have SCPC traffic and tuning through the frequencies by turning the large "DATA" knob on the front panel. Enter frequencies as you like and store them in the 100 channel memory bank. But you'll have to make choices as there are twice that number of SCPC channels in operation! Once a frequency is stored, the bandwidth and expansion ratio are also stored. You'll need to keep a log in which to write what channels you've stored and where they're located.

I found tuning the receiver with the PLL LNB too easy. Using the Satellite Service Guide in the latest *Satellite Times*, I sought and found every frequency listed (and a number which weren't). Entering the frequencies in the memory and tuning back and forth between channels and between satellites, the receiver always locked on the desired channel. A two digit signal strength indicator on the LCD display shows a relative signal reading. It seems that AVCOM have taken all the challenge out of SCPC reception!

The Real World

Or have they? How likely is it that the average TVRO enthusiast is going to spend as much as $400 just for a decent LNB? Most people are going to use what they have. And what they have, if they're lucky, is a 20-40 degree HEMT LNB. So, how does the SCPC-1000D work with the garden variety LNB? Thanks to the LNB Compensation circuitry, very well. The most noticable difference is in the tuning, it's a little harder to tune but nothing like chasing the drifting frequencies of lesser receivers. And, once tuned, signals stay on frequency without drift for as long as one cares to listen.

I know what you're thinking, "Well, what about the sound? How does it sound!" Good question. As you might expect, audio quality is to great extent a subjective exercise. Tuning into NPR music channels the audio was crisp and undistorted. There was none of the "clipping" often heard on other SCPC radios which don't have the expansion feature. While lacking a full range in the bass, the mid and high range audio sounded clean. But, isn't something missing?

Yes, you'll note that this is a monaural receiver and if you're really intent on stereo reception, you'll need to buy two units and tune each audio channel seperately. That's not a fault of the receiver, no consumer grade SCPC receiver offers stereo reception. But, it's unlikely you'll miss it anyway. Most SCPC programming is of a variety where stereo reception is hardly critical.

The Last Word

The long list of SCPC services in *Satellite Times*' SSG includes dozens of radio stations, news networks, sports networks, religious and ethnic programming, you'll hear Chinese, Spanish, French, Inuit languages and many reading services for the sight impaired. Accessing this programing can be done in a number of ways with various results, but the best results I've seen with a consumer grade SCPC radio is with the AVCOM SCPC-1000D satellite receiver. AVCOM has a suggested retail price of $799 with an introductory price for this product throughout 1996 of $475.

Some readers will want to set up a standalone SCPC system in which the receiver has its own dish and is used just for listening. If you do this you'll need to buy a seperate power inserter to power the LNB and a power supply to power the inserter. AVCOM makes a power inserter for $38 and appropriate inserter power supplies may be bought at Radio Shack.

For more information on the AVCOM SCPC-1000D contact Charles Odom at AVCOM of Virgninia, Inc at (804) 794-2500. You can also receive the manufacturers documentation online via AVFAX at (804) 379-0500. The mailing address is: AVCOM of Virginia, 500 Southlake Blvd, Richmond, VA 23236. Be sure to tell Charles you heard about the SCPC-1000D in *Satellite Times*. ST

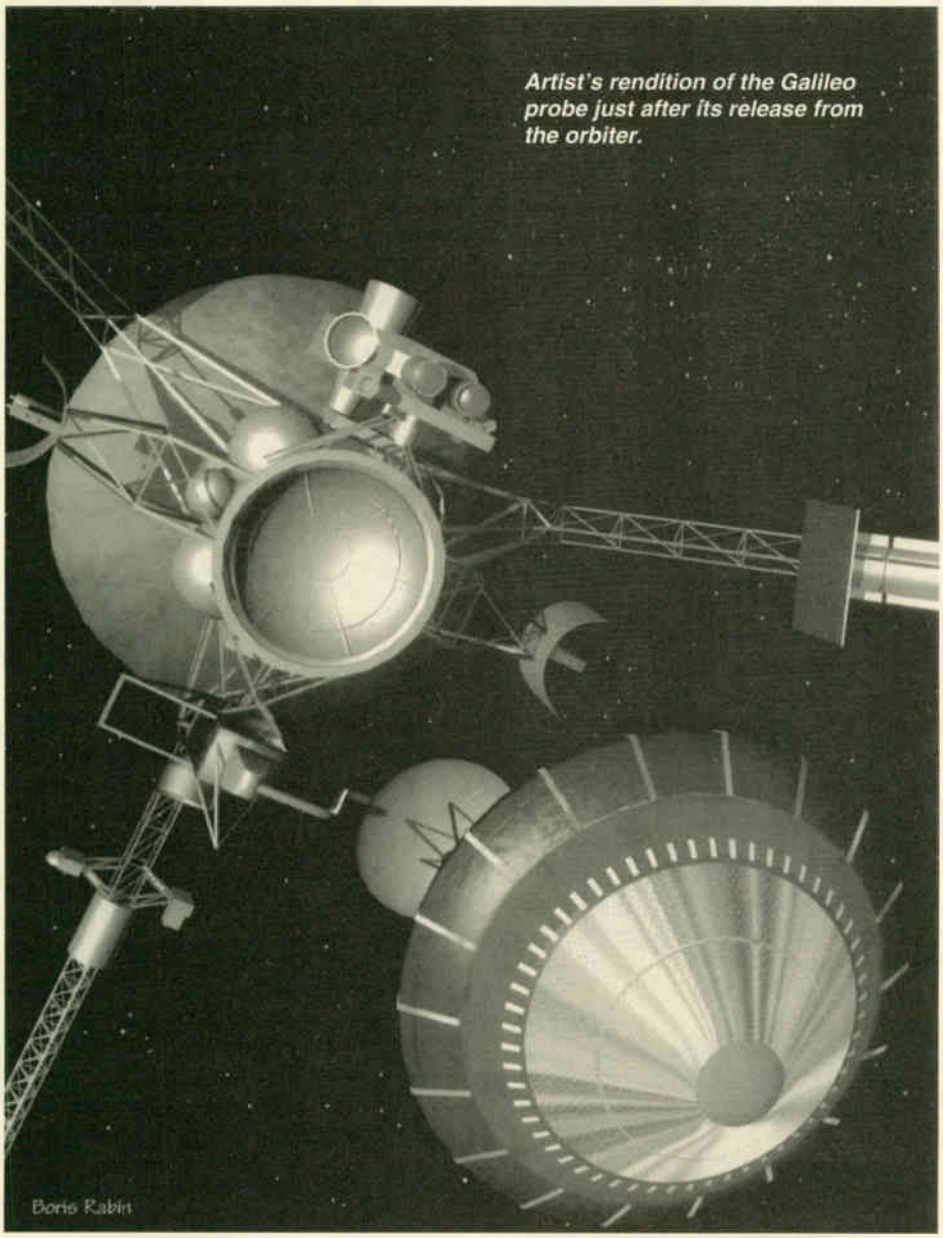
ST SATELLITE PROFILE

By Philip Chien, Earth News

Galileo Probe

Last December 7th, the Galileo spacecraft arrived at Jupiter and successfully entered orbit around the giant planet. The probe completed its mission, surviving the most difficult planetary entry ever attempted.

The spacecraft was built by Hughes Aircraft, based on the same design used for the large Pioneer Venus probe which was launched in 1978. While the Galileo probe's design was similar to the Venusian probe there were a couple of significant differences. After entry Galileo would encounter a relatively benign atmosphere and reasonable temperatures, in comparison with Venus's highly corrosive, high temperature atmosphere. On the other hand, while the Pioneer Venus probe encountered an entry velocity of 12 km / sec, Galileo's probe encounter speed was over four times faster - 50 km / sec.



Artist's rendition of the Galileo probe just after its release from the orbiter.

Early testing of prototype planetary probes dropped from balloons (see article name page xx) and a suborbital Scout rocket sending a probe back in to the Earth's atmosphere in 1971 convinced NASA that it was feasible to send a spacecraft in to another planet's atmosphere.

Sending a probe in to the atmosphere of an outer planet was considered an extremely important goal for the mission. NASA's science panels considered the Galileo mission to have three roughly equal objectives — high quality mapping of Jupiter's large moons, studies of Jupiter's atmosphere, and the probe mission. Even though the probe would last under two hours and the rest of the mission would last for two years the uniqueness of in situ data from an outer planet made it an extremely high priority objective.

Galileo's launch finally came, on October 18, 1989 aboard the shuttle Atlantis. The delays had increased its cost to a whopping US$1.3 billion. (The entire Voyager program, with two spacecraft and six planetary encounters came to approximately US$500 million) The unique shuttle orbital inclination of 34.3 degrees was chosen to match the orbital plane needed to reach Venus.

On February 10, 1990, Galileo made its flyby of Venus, collecting some science along the way. This was the closest the spacecraft would come to the Sun, and the hottest thermal environment it would encounter. On December 8, 1990 it made its first flyby of the Earth.

Now that Galileo was beyond Earth's orbit it was safe to open up the heat-sensitive high gain antenna (HGA). It wasn't expected to be a tricky or difficult task, but fate turned it into the project's most difficult problem. The spacecraft's spin was not as fast as predicted, indicating that the antenna had not opened up completely.

A long analysis and failure investigation board concluded that the most probable cause was the lubricant on the mechanism, which had worn away over time. A similar

Galileo spacecraft before attachment to the Inertial Upper Stage. Galileo was launched from the Shuttle Atlantis.

folding antenna is used for NASA's Tracking Data and Relay Satellites (TDRS) and has never caused any problems with those satellites though. The high gain antenna problems would not affect the probe's mission though. It was only supposed to send back a relatively small amount of data, which could be returned with the low gain antenna.

On October 29, 1991 Galileo made the first ever flyby of an asteroid. Gaspra turned out to be a fairly lumpy piece of rock. On December 8, 1992 Galileo made its second and final flyby of the Earth-moon system. On August 28, 1993 Galileo made its second flyby of an asteroid, Ida. Close examination of Ida's images showed that it had its own moon, which was eventually named Dactyl.

The probe was passive through Galileo's side trips through the solar system. Every couple of months it was powered up by the orbiter to verify its health. The probe was mounted in front of Galileo's main engine so it was absolutely necessary for the probe to be ejected for the rest of the mission to be accomplished. In addition since the probe did not have any propulsion system the orbiter had to release it with exactly the right force and direction.

On July 12, 1995 the probe was released from the orbiter at a precisely calculated velocity and direction, and given the international designation 1989 84E. The orbiter made a small maneuver with its main engine, both to test the engine and to aim it away from Jupiter to ensure that it wouldn't follow the probe in to Jupiter's atmosphere.

For the next five months the probe flew by itself, without any way for ground controllers to know what was happening. The only working component was a timer to activate its systems just before its arrival at Jupiter. The probe was powered by a Lithium Sulfur Dioxide (Li-SO2) battery, selected because it could last for several years with little loss in performance and then provide a lot of power for a relatively short period of time.

On December 7, 1995, the probe and orbiter arrived at Jupiter. The orbiter made a flyby of the moon Io to reduce its velocity and then rotated its radio relay antenna towards the probe's predicted location. The Galileo orbiter relay link consisted of a 1.1 meter parabolic antenna.

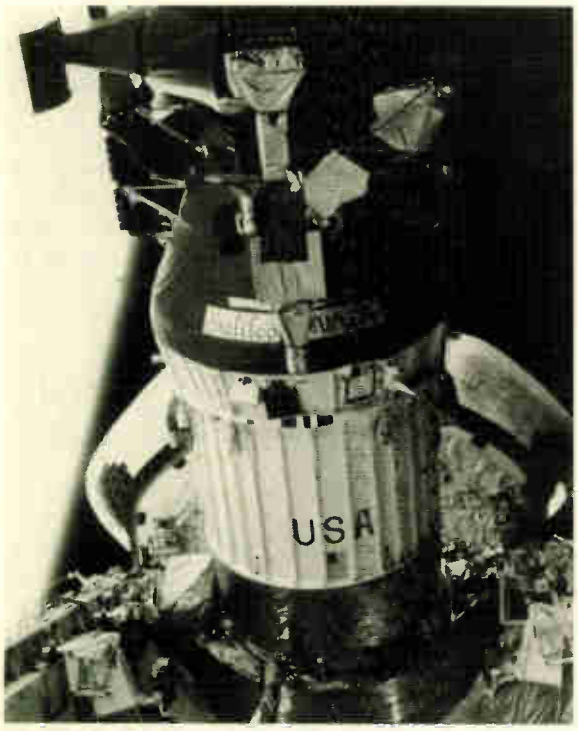
Six hours before atmospheric entry, the Probe came to life to begin preparing for the atmospheric entry. Three hours before entry the only scientific experiment not designed for studies of the atmosphere started to take measurements.

The Energetic Particle Instrument (EPI) measured the radiation (high energy charged particles) in the previously unexplored inner regions of Jupiter's magnetosphere — the gigantic region about the planet where the magnetic field of Jupiter dominates the interplanetary magnetic field produced by the Sun. The EPI discovered a new intense radiation belt between Jupiter's ring and the uppermost atmospheric layers. This belt is approximately 10 times as strong as Earth's Van Allen radiation belts. A surprise discovery in this new radiation belt occurred with the finding of high energy Helium ions of unknown origin.

When the Probe hit Jupiter's atmosphere the Earth was 933,700,000 kilometers (580,000,000 miles) away. The deacceleration force went up to 230 g's. For a short period the shockwave in front of the probe was twice as hot as the Sun's surface (15,555 degrees Celsius or 28,000 degrees Fahrenheit). Infrared telescopes on the ground viewed the entry area at 6.5 degrees North latitude and 4.5 degrees West longitude, but as expected, were not able to see any signs of the impact.

On the other hand radio telescopes were carefully listening to the probe's radio transmissions. The probe transmitted two signals at 1387.0 and 1387.1 MHz with right hand and left hand polarized signals. Its transmitter generated only 23 watts of power. The antenna was a cup dipole with a 25 cm cylindrical cavity — open at one end and fed by a crossed dipole pair. The predicted performance was a 3 db beamwidth of 56 degrees, and a peak gain of 9.8 dB.

The attempt to listen to the probe's carrier directly was not a stunt to see how faint a signal could be detected, but a bonus for one of the scientific investigations - an investigation which uses the probe's radio transmitter as its only hardware. By listening to the doppler shift of how the carrier frequency changed scientists can determine how winds influenced the probe's descent.



Galileo in the cargo bay of the Shuttle Atlantis prior to being launched.

The carrier frequency was carefully monitored by the receiver aboard the Galileo orbiter spacecraft, but that data could only detect a one-dimensional value - how fast the probe was moving from or away the orbiter. By collecting the probe's signal from the Earth it would be possible to get a value from a different viewing angle to obtain additional scientific information. Initial results from the signal received by the Orbiter indicate that the winds below the clouds are 540 km/hour (330 mph) and roughly independent of depth.

After entry the heat shield was dropped and a protective cover was ejected to expose the R-F measuring instruments to the Jovian atmosphere. The probe was designed to last for about an hour — with three possible fates. The battery could run out of power, the Jovian environment's high pressure and temperature could destroy the probe, or the amount of time assigned to the relay could run out. After finishing the probe relay function the orbiter had to reposition itself for the main engine orbital insertion burn.

The probe's parachute opened late, causing the scientific instruments to start collecting data 53 seconds later than planned. So the measurements begin at .35 atmospheres instead of the planned .1 atmosphere level. For 56.7 minutes the probe's instruments collected data about Jupiter's environment. At that point the probe descended to a level where the incredible pressure of Jupiter's atmosphere crushed its components.

With only a small amount of telemetry all engineers could determine during the entry process was two simple checks to verify that the probe's carrier was received by the orbiter. The carrier checks verified that the probe successfully survived its 5 months on its own, and the challenging entry through Jupiter's atmosphere.

By the time Galileo's engine started firing the probe was already gone - destroyed by the incredible pressure and temperature of the Solar System's largest planet. Humanity had added 339 kg (746 lbs) of aluminum, titanium, silicon, and other materials to Jupiter's upper atmosphere.

The probe's unique scientific data was taped on the orbiter's data recorder, and the most critical data was also stored in the orbiter's memory as a backup. Over the next couple of months the data was transmitted back to Earth using Galileo's low gain antenna. Fortunately the data collecting was not slowed down by the U.S. government's temporary shutdown.

Scientists were ecstatic with the results, carefully analyzing the data which was returned by their instruments. The data from the probe's instruments proved that it was worth the effort, and justified the high priority for the probe's mission.

As the plunge into Jupiter's atmosphere began, the Atmosphere Structure Instrument (ASI) started to probe the uppermost regions of the atmosphere through its influence on the probe's motion. The objective of this investigation was to measure the temperature, pressure, and density structure of Jupiter's atmosphere.

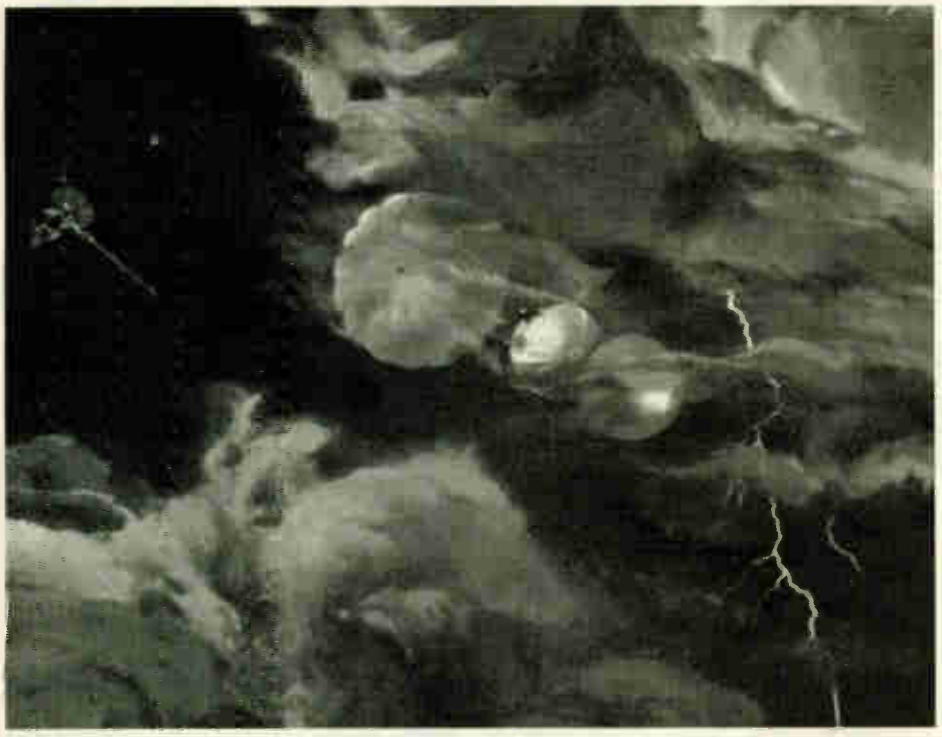
Temperature and pressure were directly measured during the parachute descent phase of the mission. Initial results include the detection of upper atmospheric densities and temperatures that are significantly higher than expected. An additional source of heating beyond sunlight appears necessary to account for this result. In the lower reaches of the atmosphere, temperatures were found to be close to the expected temperatures. The vertical variation of temperature in the 6-15 atm pressure range (about 90-140 km below visible clouds) indicates the deep atmosphere is dryer than expected and is convective.

The Nephelometer (NEP) instrument was to detect and characterize cloud particles in the immediate vicinity of the Probe as it descended to different levels. This was the closest instrument on the probe to a camera. While it didn't take images it did measure cloud particles by shining a laser beam across a short distance to a small mirror deployed just outside the Probe. This experiment has found several surprising initial results. No thick dense clouds were found, in contrast to expectations based on analysis of telescopic and flyby spacecraft observations of the planet and simple theoretical models. In fact only very small concentrations of cloud and haze materials were found along the entire descent trajectory. Only one well-defined distinct cloud structure was found, and this layer appears to correspond to a previously postulated ammonium hydrosulfide cloud layer.

The variation of the amount of sunlight with depth and the variation of infrared radiation with depth were measured by the Net Flux Radiometer (NFR). Large variations in the brightness of the sky in different directions were noticed until an abrupt drop-off in the variation occurred below a pressure level of 0.6 atm, indicating a cloud layer which is most likely the previously postulated ammonia cloud layer — believed to correspond to the uppermost cloud layer on Jupiter. No other significant cloud layers were found — in particular the tenuous cloud layer detected by the NEP was not seen by NFR. Moreover, the cloud seen by the NFR was not seen by NEP. The simplest explanation for the results from these two cloud-detecting experiments appears to be that the clouds are patchy and that the Probe went through a relatively clear area.

The Lightning and Radio Emission Detector searched for optical flashes and radio waves emitted by lightning discharges. The instrument measured signals in the range of 10 Hz to 100 kHz. No optical lightning flashes were observed in the vicinity of the Galileo Probe. Many discharges were observed at radio frequencies.

The form of the radio signals indicates discharges are far away (roughly one Earth diameter away), and the lightning bolts are much stronger than Earth's. Radio wave intensity suggests the lightning activity is 3-10 times less than on Earth. Therefore, the initial analysis implies that lightning activity on Jupiter is very different than on Earth.



The probe as it might have appeared during the descent into the hostile Jovian atmosphere.

The unusual form of the radio signals from lightning indicates more work on lightning discharge physics on Jupiter is needed. Ideas of water cloud distribution and heat escape from Jupiter may need revision.

The Neutral Mass Spectrometer (NMS) experiment's objective was to accurately determine the composition of the atmosphere. Initial results indicate the atmosphere has less water than expected. The atmosphere appears to have less than expected carbon in the form of methane gas. Also, slightly less sulfur than expected in the form of hydrogen sulfide appears to be present. Noble ("inert") gas concentrations differ from expectations as well, including a notable depletion of the gas Neon. Little evidence for organic molecules was found. The Helium Abundance Detector experiment very accurately measured the abundance of Helium. The abundance of Helium was found to be significantly less than that in the Sun.

Data was transmitted by the instruments at a rate of only 128 bits per second, with a total of less than 64K of memory. In today's computer terms all of the scientific data from the Galileo probe spacecraft could be stored on one $5 memory chip — with room to spare.

As we go went to press the Galileo Orbiter made one final burn of its main engine to raise its perijove out of Jupiter's most intense radiation belts. The first encounter with one of the satellites will be Ganymede, scheduled for June 27th.

If you have Internet access and a Web browser you can access the latest summaries of publicly released data from the probe's scientific results at the URL address:**http://ccf.arc.nasa.gov/galileo_probe/.** ST

World Radio Network Schedules

WRN1 - European English Service

Astra 1B (19 degrees east) Transponder 22, (VH-1),11.538 GHz, V-Polarization, Audio Subcarrier 7.38 MHz, All programmes in English. WRN program information can be heard daily at 0125, 1025 and 2050 BST. Program information is also available on VH-1 Text page 222, 223, and 224.

All times BST (For Central European Time add one hour)
0000 - Radio Budapest
0030 - Radio Netherlands
0127 - Earth & Sky (Daily Science Series)
0130 - Radio Prague
0200 - NPR All Things Considered (rpt)
0300 - CBC As It Happens (Mon-Fri)
0300 - CBC tba (Sat)
0300 - CBC tba (Sun)
0400 - Polish Radio Warsaw
0430 - BBC Europe Today (Mon-Fri)
0430 - Glen Hauser's World of Radio (Sat)
0430 - UN Radio From New York (Sun)
0500 - YLE Radio Finland
0530 - Radio Austria International
0600 - NPR All Things Considered (rpt)
0730 - PRI Market Place (Tuesday-Saturday)
0730 - PRI Sound Print (Sunday)
0730 - PRI Dialogue (Monday)
0800 - ABC Radio Australia
0900 - Radio Swiss Int'l (Mon-Sat)
0900 - C-Span Weekly Radio Journal (Sunday)
0930 - Radio Canada Int'l (Mon-Fri)
0930 - UN Radio (Sat)
1000 - Radio Prague
1030 - Radio Netherlands
1127 - Earth & Sky (Daily Science Series)
1130 - Channel Africa, Johannesburg (Mon-Sat)
1130 - Glen Hauser's World of Radio (Sun)
1200 - NPR Morning Edition (Monday-Friday)
1200 - NPR Press Club (Sat)
1200 - NPR Weekly Edition (Sun)
1300 - NPR Morning Edition (Monday-Friday)
1300 - NPR Weekend Edition (Saturday & Sunday)
1400 - Radio France International
1500 - Voice of Russia (Mon-Sat)
1500 - VOA Communications World (Sun)
1530 - Radio Vlaanderen International
1600 - ABC Radio Australia
1700 - ORF Blue Danube Radio (Monday-Friday)
1700 - Glen Hauser's World of Radio (Sat)
1700 - SABC Network Africa (Sun)
1730 - Radio Netherlands
1825 - News in Esparanto from Polish Radio Warsaw
1830 - RTE News at Six
1900 - Radio Austria International
1930 - YLE Radio Finland
2000 - RTHK - News from Hong Kong (Mon-Fri)
2000 - UN Radio from New York (Sat)
2015 - Health Watch (Sat)
2000 - Radio Romania International (Sun)
2030 - KBS Radio Korea International
2100 - Radio Sweden
2130 - Polish Radio Warsaw
2200 - NPR All Things Considered
2300 - PRI The World (Mon-Fri)
2300 - NPR All Things Considered (Sat & Sun)

WRN2 - European Multi-lingual Service

Eutelsat II F-1 (13 degrees East) Tr 25 (NBC), 10.987 GHz, V-Polarization, Audio Subcarrier 7.38 MHz. Please note that at all other times the schedule for WRN1 - Europe is broadcasts.

All times BST (Subtract five hours for Eastern Time)
0309 - Vatican
0745 - Vatican end
0830 - Vatican start (Sunday only)
0930 - Vatican start (Mon-Sat only)
1130 - Vatican end (not Wednesday)
1200 - Vatican end (Wednesday only)
1200 - Radio Studio Delta start (Mon-Fri only)
1300 - Delta end (Mon-Fri only)
1300 - Vatican start
1530 - Vatican end
1530 - Radio Studio Delta start (Mon-Fri only)
1630 - Delta end
1630 - Vatican start
2230 - Vatican end
2230 - Radio Studio Delta start (Mon-Fri only)
2330 - Delta end (Mon-Fri only)

WRN 2 - N. American Multi-lingual Service

Galaxy 5 (125 degrees West) Tr 6 (TBS) 3.820 GHz, V-Polarization, Audio Subcarrier 6.2 MHz. Please note that programmes listed below with an asterisk (*) are subject to pre-emption without notice. WRN programme information is available on TBS Text page 204.

All times Eastern (For UTC add five hours)
0030 - *Radio Netherlands in Dutch
0125 - *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, Regional broadcasts in Finnish
1030 - YLE, News in Finnish
1100 - YLE, Features in Finnish
1120 - YLE, Slow speed Finnish
1130 - YLE, News in English
1200 - *WRN Announcements, until....
1400 - *Radio Sweden, News in Swedish
1430 - *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, Rock Music & Talk in Finnish (Mon-Fri)
1830 - YLE, Phone-in for children in Finnish (Sat&Sun)
1900 - YLE, News in Swedish
1930 - YLE, News in English
2000 - YLE, Light music in Finnish
2100 - YLE, Documentaries in Finnish (Mon-Thu)
2100 - YLE, Chuch Bells & Concert in Finnish (Sat)
2100 - YLE, New Classical releases in Finnish (Sun)
2130 - YLE, Light Music in Finnish (Fri only)
2200 - YLE, News in English
2230 - YLE, News in Finnish
2300 - YLE, News in Finnish
2310 - YLE, Religious programme in Finnish (Sun-Fri)
2320 - YLE, News in Swedish
2323 - YLE, Programme Preview in Finnish
2330 - Radio Austria International in German

WRN 1 - Africa/Asia-Pacific Service

Intelsat 702 (1 degree West) Tr 23B, 3.9115 GHz, Circular-Polarization, MPEG2 Audio Stream and AsiaSat-2 (100.5 degrees East) Tr 10B, 4.000 GHz, H-Polarization, MPEG2 Audio Stream.

All times UTC. For South African Standard Time add two hours and for Australian Eastern Time add eleven hours.
0030 - Radio Netherlands
0127 - Earth & Sky (Daily Science Series)
0130 - Radio Prague
0200 - Voice of Russia
0230 - Radio Sweden
0300 - NPR All Things Considered (rpt)
0430 - BBC Europe Today (Mon-Fri)
0430 - Glen Hausers' World of Radio (Sat)
0430 - BBC Int'l Call (Sun)
0500 - YLE Radio Finland
0530 - Radio Austria International
0600 - NPR All Things Considered (rpt)
0730 - RTE Dublin
0930 - Radio Canada Int'l (Mon-Fri)
0930 - UN Radio (Sat)
1000 - Radio Prague
1030 - Radio Netherlands
1127 - Earth & Sky (Daily Science Series)
1130 - Channel Africa, Johannesburg (Mon-Fri)
1130 - BBC Science Magazine (Saturday)
1130 - Glen Hausers' World of Radio(Sunday)
1200 - NPR Morning Edition (Monday-Friday)
1200 - NPR Press Club (Sat)
1200 - NPR Weekly Edition (Sun)
1300 - RTE Dublin
1400 - Radio France International
1500 - Voice of Russia (Mon-Sat)
1500 - VOA Communications World (Sun)
1530 - Radio Vlaanderen International
1600 - ABC Radio Australia
1700 - ORF Blue Danube Radio (Monday-Friday)
1700 - Glen Hausers' World of Radio (Sat)
1700 - BBC Int'l Money Prog & Sports Zone (Sun)
1730 - Radio Netherlands
1830 - RTE Dublin
1900 - Voice of America - World News & Mission Bosnia
1930 - YLE Radio Finland
2000 - Radio Deutsche Welle - News from Germany
2050 - Esperanto from Polish Radio
2100 - Radio Sweden
2130 - Polish Radio Warsaw
2200 - RTE Dublin

STOCK EXCHANGE

Satellite Times assumes no responsibility for misrepresented merchandise.

*Ads for **Stock Exchange** must be received 45 days prior to publication date. All ads must be paid in advance to Satellite Times.*
Ad copy must be typed for legibility.

***NON-COMMERCIAL SUBSCRIBER RATES:** $.25 per word — Subscribers only! All merchandise must be personal and radio-related.*

***COMMERCIAL RATES:** $1.00 per word. Commercial line ads printed in bold type.*

***1-3/4" SQUARE DISPLAY AD:** $25 per issue. Send camera-ready copy or copy to be typeset. Photo-reduction $5 additional charge. For more information on commercial ads, contact Debbie Davis, 704-837-6412.*

GE SUPERRADIO III, custom designed with up to four noise-free SCA Channels. Performance guaranteed. Credit Card orders accepted. (800) 944-0630.

FOR SALE: Uniden 4900 new in box with two remote controls. Will pay shipping, $550 or best offer. WANTED: GOES Weather Satellite Equipment. (203) 288-4477

WANTED: Three first issues of *Satellite Times* Magazine. Please contact Steven anytime at 61-2-315-8805/Australia.

SATELLITE TIMES ADVERTISERS' INDEX

ABC NewsOne and NBC News Channel Schedules

(See Pages 34-36 for more information)

ABC NewsOne

Telstar T401 channel 12 (C-band)

Weekday Schedule

1:30-2:00 a.m.	Late Pacific feed (Pacific feed/late sports)
4:30-5:00 a.m.	Sunrise feed
5:00-9:30 a.m.	Updates as warranted of sunrise feed
6:30-7:30 a.m.	Sunrise feed (rebroadcast of 4:30 a.m. feed)
9:30-10:00 a.m.	Franchise feed (feature, environmental, m edical, entertainment and business items)
10:00-10:15 a.m.	Morning feed (Good Morning America news repeats)
11:15-11:30 a.m.	Late morning sports feed
11:30-11:45 a.m.	Late morning news feed
1:45-2:00 p.m.	Midday feed (national and international)
2:45-3:15 p.m.	Regional feed (Midwest and Southeast items)
3:15-3:30 p.m.	Washington feed
3:30-4:35 p.m.	Specials feed
3:45-4:00 p.m.	Midwest feed
4:00-4:15 p.m.	National feed
4:15-4:30 p.m.	Midwest feed
4:30-4:45 p.m.	Southeast feed
4:45-5:15 p.m.	National feed
5:15-5:30 p.m.	Southeast feed
5:30-5:45 p.m.	Southeast feed
5:45-6:15 p.m.	National feed
6:15-6:45 p.m.	Mountain feed
6:45-7:15 p.m.	Pacific feed
7:30-7:45 p.m.	Specials feed
7:45-8:15 p.m.	Extra feed (World News Tonight natural sound rebroadcast)
8:30-9:00 p.m.	Evening feed (national and regional items)
9:15-9:30 p.m.	Specials feed
9:30-9:45 p.m.	Sports feed
10:00-11:15 p.m.	Late feed (updated national, regional & sports items)

Telstar T401 channel 21 (C-band)

Weekday Schedule

4:00-4:15 p.m.	National feed
4:15-4:30 p.m.	Sports feed
4:30-4:45 p.m.	Northeast feed
4:45-5:15 p.m.	National feed
5:15-5:30 p.m.	Northeast feed
5:30-5:45 p.m.	Sports feed
5:45-6:15 p.m.	National feed
6:15-6:25 p.m.	Sports feed

Telstar T401 channel 11 (C-band)

Weekday Schedule

5:15-5:30 p.m.	Southwest feed
5:30-5:45 p.m.	Southwest feed
5:45-6:00 p.m.	Midwest update

Weekend Schedule

1:30-2:00 a.m.	National feed
6:30-7:00 a.m.	National feed
10:00-11:00 a.m.	Affiliate showcase
2:45-3:00 p.m.	Specials feed
4:00-4:30 p.m.	National feed
5:00-6:15 p.m.	National feed
8:30-9:00 p.m.	National feed
9:45-10:00 p.m.	Specials feed
10:00-11:15 p.m.	National feed

NBC News Channel

GE Americom K2 transponder 13 (Ku-band)

Weekday Schedule

1:05 a.m.	Sports update (especially Western highlights)
5:00 a.m.	Business brief
9:00 a.m.	Specials (features, medical items, franchises, and series)
10:00 a.m.	Olympics feed (Olympic related material)
10:30 a.m.	National and international summary
11:30 a.m.	Producer briefing
12:00 p.m.	Weekend specials (Fridays only)
12:15 p.m.	Promotional feeds
1:00 p.m.	Foreign summary
1:30 p.m.	National summary
2:00 p.m.	Regional 1 (all regions)
2:45 p.m.	Political feed (political news)
3:00 p.m.	Sports
3:30 p.m.	National summary
4:00 p.m.	Regional 2 (Eastern regions)
4:45 p.m.	National update
5:05 p.m.	Regional 3 (Central regions)
5:45 p.m.	National update
6:05 p.m.	Regional 4 (Mountain/Pacific regions)
7:00 p.m.	Political feed
7:30 p.m.	National news rebroadcast
8:00 p.m.	National and international summary
8:30 p.m.	Regional 5 (all regions)
9:45 p.m.	National update
10:15 p.m.	Sports highlights
10:50 p.m.	Time slot to interrupt sports feed for late breaking news, if necessary.
11:15 p.m.	Regional 6 (West Region)
12:30 a.m.	National summary, and "This day in history"

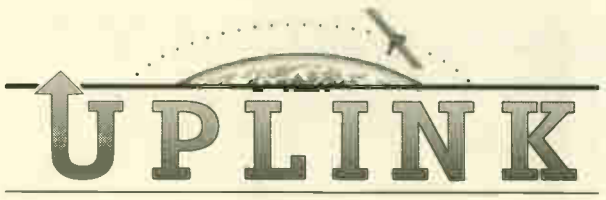
Weekend Schedule

5:00 a.m.	National and international update
7:00 a.m.	National and international update
10:00 a.m.	National and international
12:00 p.m.	Weekend specials (rebroadcast from Friday)
1:00 p.m.	Foreign summary
1:30 p.m.	National summary
3:30 p.m.	National and international summary
4:00 p.m.	Regional (all regions)
4:45 p.m.	National update
5:00 p.m.	Sports highlights
5:45 p.m.	National update
6:15 p.m.	Regional (all regions)
7:30 p.m.	Sports
8:00 p.m.	National news rebroadcast
9:45 p.m.	National update
10:15 p.m.	Sports highlights
10:50 p.m.	Time slot to interrupt sports feed for late breaking news, if necessary.
12:30 a.m.	National summary, and "This day in history"
1:05 a.m.	Sports and Western highlights

GE Americom K2 transponder 7 (Ku-band)

Weekday Schedule

4:00 a.m.	National and international update
5:30 a.m.	National and international update



By Bob Grove, Publisher
E-mail address: st@grove.net

Do Satellites Bode the End of Shortwave Radio?

There has been a great deal of speculation bandied about lately about the demise of shortwave broadcasting as a result of the success of the new satellite broadcast technology. Hobby journalists bemoan the impending loss of shortwave listening (SWL) as though a sharp decline had already begun, the result of higher-efficiency satellite targeting.

While it is true that satellite systems may be more efficient, have better fidelity, and cost less to maintain than global shortwave broadcasting facilities, those aren't the only considerations. To the contrary, standing in the face of satellites' advanced digital compression algorithms, the shortwave broadcasters are developing an amplitude modulated data system (AMDS) to enable suitably equipped receivers to automatically select frequencies which favor band conditions for the listener.

Not that the shortwave luminaries are antiquated sticks in the mud or have their collective heads in the sand — far from it. A consortium of nine leading worldwide broadcasters has been holding regular meetings to agree on standards for satellite-carried digital audio broadcasting (DAB), slow in coming, but sure to arrive.

And several of the radio broadcasters already share satellite spectrum, most visibly (or audibly) the BBC with 24 hour service on C-SPAN. Advances in cable and dish TV will allow hundreds of additional channels to be used for English-speaking and non-English-speaking programs. But this raises a serious question: Just because the channels are there, does that mean anyone will listen to them? And if they don't, will the broadcasters use them?

Shortwave listeners (SWLs) often covet their hobby as zealously as do doll collectors and Trekkies, unaware that they compose a niche, a minuscule minority, absorbed in a fascinating, tiny preoccupation. Hobby writers seem to see these broadcasters in the cloistered light of their own perspective, not realizing the bigger picture. The broadcasters are more pragmatic, recognizing that they must put their energies where they will reap the most benefit.

Let's take a snap quiz. Who will get the most listeners, Rush Limbaugh or Glenn Hauser? If you don't know who Glenn Hauser is, the point is well made. If you do know who Glenn Hauser is, the point is still well made. Let's look at it another way. If a Middle East country wants to proselytize to an underdeveloped nation, is it more likely that the efforts would be directed toward expensive satellite terminals or inexpensive portable radios?

If religious broadcasters with their sharply focussed evangelism saw overwhelming advantage to abandoning the short waves for satellites, they'd all be up there, but they're not. Cost isn't the major factor, they have plenty of that coming from their outreach and that's the key: the numbers and the revenue are harvested on the shortwave bands.

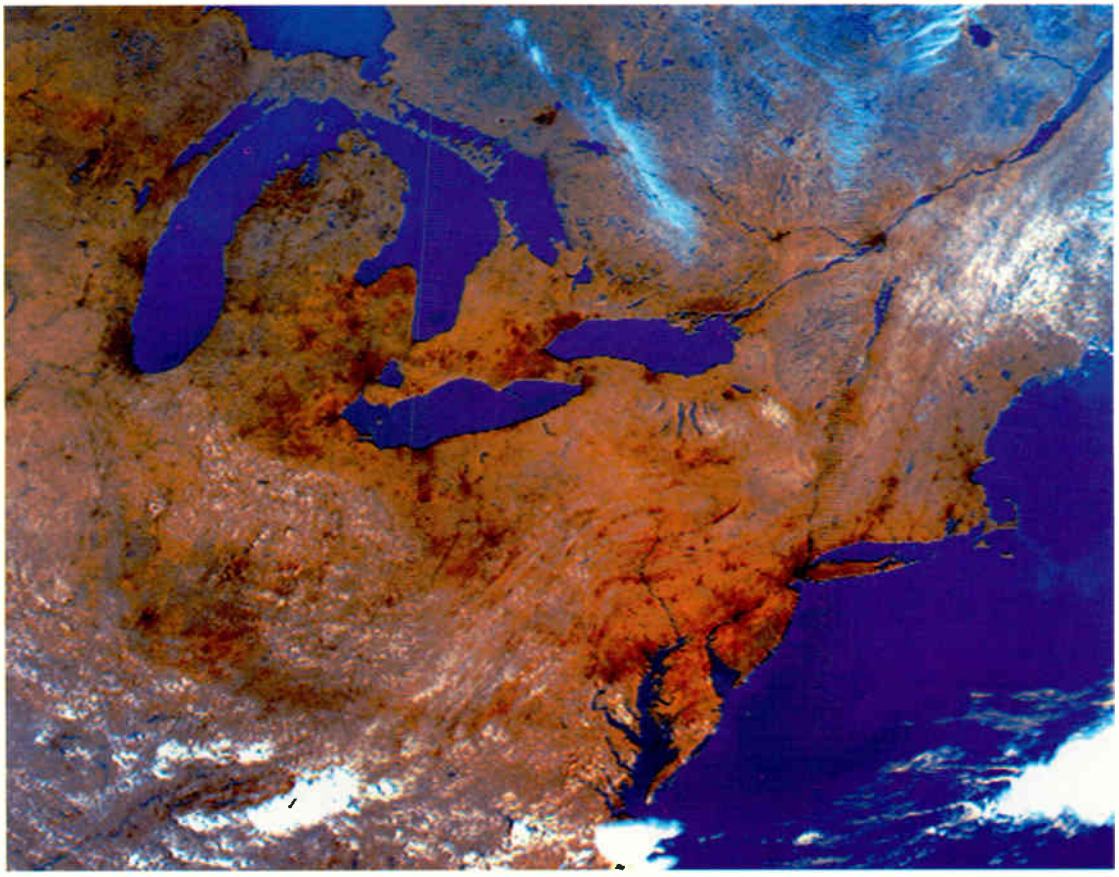
In order to more realistically prognose the survival of public international shortwave broadcasting, it is necessary to take an objective look at the purpose of this service. Why do these global broadcasters exist? What is their mandate?

For the most part, these government sponsored information services are secular evangelists, missionaries for their cultural and political persuasions, hoping to influence the impressions or acceptances of other nations, other cultures. After several decades they have both experience and investment in high frequency radio; it has worked up to now and there is no reason to suspect that it will not continue to work in the foreseeable future.

Satellites are technologically vastly superior to the older analog modes used by the longer wavelength radio services; no one has any quarrel with this. Data exchange, graphic information, text, music — all of these are enjoying the bandwidth and digital compression techniques which developed concurrently with the space age technical aristocracy.

Shortwave radio, on the other hand, endures not because it is technically superior; quite to the contrary, because it is technically inferior. It is a backbone system, it is in place, it works satisfactorily, it is more affordable to hear, and people listen to it. For these reasons, and probably more, it will be with us for some time to come. ST

IT'S EASY TO CAPTURE REALTIME IMAGES LIKE THIS DIRECTLY FROM SPACE ON YOUR PC!



◄ Section of multi-spectral false-colorized NOAA APT image of North East US. This image was created directly from a raw image file using the new MFCOLOR software from Weather Dynamics.

To find out more about the MFCOLOR software log onto the MultiFAX BBS (716-425-8759). Download dozens of images as well as software, demos, and up-to-date orbital elements.

There is no charge to use the MultiFAX BBS, it operates 24 hours a day and supports up to 28.8KB modems.

MultiFAX offers **two** professionally featured weather satellite demodulators: One model plugs directly into the expansion slot of your IBM compatible desktop PC, the other model interfaces to your PC (laptop, notebook, or desktop) through the parallel port-perfect for "crowded" computers or **portable** applications.

Both versions offer the same powerful capabilities-PLL circuitry for perfectly straight edges on NOAA, GOES, and Meteosat images. 4800 8-bit samples per second-capture ALL the high APT resolution the NOAA satellites can provide (2-3 miles) in visible and infrared (simultaneously) with a full 12 minute recording.

Version 7 Software Features Include: Integrated Satellite Tracking • Kansas City Tracker Support • Capture Images to Hard Disk or Memory • PLL Sampling • NOAA, Meteor, GOES, Meteosat, HF Fax • "Point & Shoot" User Interface with Mouse Support • 1024x768x256 Colors/64 Gray Levels • Zoom • Simple, Powerful Image Enhancement • 10 User Definable Enhancement Palettes • False Colorization • Unattended Recording • Visible and IR • Animation • Calibrated IR Temperature Readout • "3D" Enhancement • Use Your Images with Hundreds of Other Programs • Printer Support • 2-3 Mile Resolution (NOAA) • 3.5 Million 8 Bit Pixels for full NOAA Recording • Latitude/Longitude and Map Overlay (US included) • Reference Audio Tape • Clear, Complete 85+ page Illustrated User's Manual • Much More...

The NEW MultiFAX MF-R1 Weather Satellite Receiver!

- ✔ Synthesized Tuning - 10 Programmable Memories
- ✔ 137-138 MHz in 5 KHz Steps
- ✔ NOAA & Meteor APT
- ✔ GOES & Meteosat Fine Tuning for Downconverter
- ✔ Two Independently Adjustable Audio Outputs
- ✔ 12 VDC (switchable) at Antenna for Pre-Amp
- ✔ Introductory Price under $250!

Call or Write for Complete Details

Minimum requirements: IBM Compatible Computer with 640 KB Memory and either 1) An 8 or 16 bit ISA slot for the internal card **OR** 2) A parallel port (LPT1, LPT2, or LPT3) for the external unit • VGA Card and Monitor • Hard Drive or RAM Disk with 4MB Available Space • Receiver and Simple Antenna (dish not required for high resolution polar orbiting satellites)

Please write or call for more details on MultiFAX demodulators, receivers, antennas, and downconverters. Internal demodulator with software: Just $289 plus S&H.

MultiFAX • Route 1, Box 27 • Peachland, NC 28133 • 704-272-9028
MasterCard/Visa FAX: 704-272-9036 BBS: 716-425-8759

THE SECRET IS OUT!

Advanced Audio at a Very Affordable Price

We couldn't keep it a secret any longer! ICOM's taken its acclaimed Next Generation technology and applied it to the world of receivers! The all new IC-R8500 features many updates of the same performance found in its renowned big brother, the IC-R9000, yet it comes at a fraction of the price!

IF Shift and APF!

Signals come in loud & clear! An IF-Shift function rejects nearby interfering signals in SSB modes. An APF (audio peak filter) provides tone control when in FM and boosts specific frequencies when in CW.

And to continue keeping signals coming in loud & clear, an AFC (auto frequency control) compensates for any FM, FM-N and WFM station frequency drift.

Extra-Wide Coverage! All Modes!

Cover frequencies from 100 kHz to 1,999.99 MHz* using 10 Hz tuning steps. You'll receive SSB (USB, LSB), AM (Normal, Narrow, Wide), FM (Narrow, Normal), WFM, and CW!

Built-in Hardware for the Next Generation

The IC-R8500 is designed to grow along with your communication needs. Built right in is the famous ICOM-developed CI-V computer control interface and an industry standard RS-232C port. This allows for advanced software control and for the programming of up to 800 memory channels (20 banks of 40 channels), straight off of a PC.

Come to Dayton '96 and experience the IC-R8500's superior sound. With so many new & advanced capabilities, we couldn't keep this receiver a secret for long.

Other IC-R8500 Features:

- High Stability (<30 MHz: ±100 Hz, V/UHF: ±3 ppm)
- 1000 Memory Scans: 20 Banks of 40 Channels, 100 Skip Scans, 100 Auto Write Memory Scans
- Selectable AGC Time Constant
- S-Meter Squelch (in addition to ordinary noise squelch)
- Noise Blanker (SSB/AM)
- 3 Antenna Connectors
- 12 VDC/120 VAC

ICOM'S ON THE WEB!
http://www.icom america.com/icom

SEE THE IC-R8500 AT DAYTON '96

Call ICOM's brochure hotline: (206) 450-6088. Or contact ICOM Technical Support in the HamNet forum on CompuServe @75540,525 (Internet: 75540.525 @ compuserve.com.) *Specifications are guaranteed 0.1 to 1000 MHz and 1240 to 1300 MHz. This device has not been approved by the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased until the approval of the FCC has been obtained. All stated specifications are subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. CompuServe is a registered trademark of CompuServe, Incorporated, an H&R Block Company. R8500396Y

ICOM

ICOM
THE NEXT GENERATION