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Satellite Times™

Volume 1, Number 3 January/February 1995

In the Beginning

On September 8, 1983,
RCA Satcom 2R
was launched.

And now . . .

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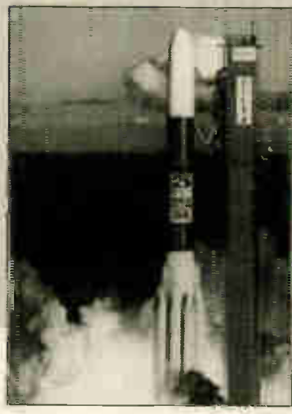
Satellite Times

Cover Story

Cover Photo: RCA Satcom F-2R lifts off the launch pad at Cape Canaveral, Fla. on September 8, 1983. (Photo courtesy of Martin Marietta AstroSpace)

In the Beginning . . .

By Steve Handler



A little over 11 years ago the then RCA Satcom F-2R was launched from Cape Canaveral. Late next month or in early March, GE Americom will retire GE Satcom F-2R from service. Steve Handler takes an in depth look at how a satellite is retired and what happens to the spacecraft after it is. *See story on page 10.*

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January/February 1995

Express from Japan to Australia

ST Satellite Profile

By Keith Stein

Last year was the 15th anniversary of the fall of Skylab, when Australia was showered with pieces of the United States' first space station. This month Australia will be a target again of another spacecraft re-entry. This time residents in Australia can feel a little more comfortable — this space event will be controlled. *See story on page 14.*

Shop Till You Drop

By Steve Handler

Shop at Home TV is big business, and communications satellites make it all possible. Steve Handler in his first "On-the-Air" column takes an in depth look at the Shop at Home TV industry including a complete guide to the shop-at-home networks. *See story starting page 18.*

QVC

HSN HOME SHOPPING NETWORK

USAF Weather Satellite Uncovers North Korean Mystery

By Larry Van Horn

Capturing weather satellite imagery can be a fun and educational pastime for satellite monitoring enthusiasts. However, sometimes weather satellite images reveal more than cloud formations and weather patterns. Two recent USAF weather satellite photos have uncovered an interesting mystery on the Korean peninsula. *Story begins on page 22.*

SCPC Audio Reception with the Universal SCPC-100

In the "Satellite Times Tests" column this issue, Larry Van Horn reviews the Universal SCPC-100 Satellite SCPC Audio Receiver (shown above). This unit is an inexpensive way to add a whole new world of audio signals to your home entertainment system.

DEPARTMENTS

ST

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DOWNLINK

By Larry Van Horn
Managing Editor

Teaching an Old Dog New Tricks!

Just about the time you think you have "learned everything there is to learn," along comes someone to show you the error of your ways. Now, I have been around this space stuff since I was knee high to my Dad, and I thought, "All this satellite stuff is a piece of cake; I really have it down to a science," but alas this is just not the case. I made an error in the pages of the last issueof *Satellite Times.*

The only saving grace is that I'm not alone on this one. In fact, I'm in pretty good company—most of the U.S. military establishment and NASA is wrong — thus the reason for the error in my ways. I trusted what I have read from them for years. Yes, yes, I know, there's a sucker born every minute.

To explain all this I have take you back to the beginning of the "Saga of the Epoch." Right before Thanksgiving, I received a fax from ST's own Dr. Theo Pappan. He pointed out to me in this fax that the Space Glossary I prepared for the November-December 1994 issue had an error in one of the listings. Here is the original listing:

> *Epoch Day:* This is the day and fraction of a day for the specific time the data is effective. This number defines both the Julian day (the whole number part of the value) and the time of day (fractional part of the value) of the data set. The Julian day figure is simply the count of the number of days that particular date is from the beginning of the year. (January 1 would have a Julian day of 1, Feb 28 would be 59) This number may range from 1.0 to 366.999999999 (taking into account leap years).

Now I know what a Julian date is as does just about every member of the U.S. military or so I thought. How many of you that were in the military remember those perpetual Julian date calendars. We used them to find the Julian date to put on the various forms we used in supply, maintenance and yes, even the folks at NORAD use to setup the reference epoch day. Well folks, the military is wrong, really wrong on this one. Those calendars will have to undergo a name change in order to be correct. I'll let Dr. T explain.

"The Julian period was devised in 1582 by Joseph Scaliger and named after his father Julius (not after the Julian calendar). Scaliger had Julian Day (JD) #1 begin on noon, January 1, 4713 B.C., the most recent time that three major chronological cycles began on the same day —

1) the 28-year solar cycle, after which dates in the Julian calendar (e.g., February 11) return to the same days of the week (e.g. Monday);
2) the 19-year lunar cycle, after which the phases of the moon return to the same dates of the year; and
3) the 15-year Indiction cycle, used in ancient Rome to regulate taxes. It will take 7,980 years to complete the period, the product of 28, 19 and 15.

"Julian date (JD also) is defined as the interval of time in days and fraction of a day since 4713 B.C., January 1, Greenwich noon. Astronomers find it convenient to express dates and long time intervals in days (Julian Period) rather than in years, months and days.

"Therefore, the Epoch for January 1 of any year is 1 (day of the year), but the Julian Date for 1 January 1994 is 2449353.5 and 1 January 1995 is 2449718.5. They are not the same are they? Well, they shouldn't be. (If you want the correct definition for Epoch, turn to page 91 and check out this issue's Space Glossary-Larry).

"Many 'experts' in the space program do not understand it and many people that write and sell satellite tracking programs continue to spread this incredible error."

Theo thank you for bringing "the torch of light that hath shown you the truth..." to the pages of *Satellite Times.* The wrong has been righted; I bow humbly to the north.

Finally, I would like to extend a warm welcome to two new ST columnist this month. Keith Stein, a free lance journalist and space analyst who is currently employed with a civilian contractor at NASA headquarters in Washington, D.C. He will be doing our space launch schedules section of the Satellite Services Guide.

Our other newcomer this month is Steve Handler. Some of you old timers in the shortwave field might remember some of Steve's work he did in the 1970s. Well folks, he is back and will be doing a column in each issue of ST on all those program channels that are available on your satellite dish that *Orbit, Onsat* and *Satellite TV Week* won't talk about. We call it "On-the-Air." Welcome aboard, gents, and we look forward to future installments in the pages of ST. ST

Letters to the managing editor of Satellite Times should be sent to the following address: Downlink, c/o Satellite Times, P.O. Box 98, Brasstown, NC 28902-0098.

Satellite Monitor

By Wayne Mishler, KG5BI

Life in rural America: is it for the birds?

If what happened recently in Arietta, New York, is any indication, life in rural America may soon be for the birds. Heavenly birds, that is. Satellites. Direct broadcast satellite TV, to be precise.

You see, Arietta is located 65 miles north of Albany in scenic Adirondack state park. It's 50 miles from supermarkets or doctors, not to mention movie theaters. Population: 301. TV channels: two, until the birds came. PrimeStar to be exact.

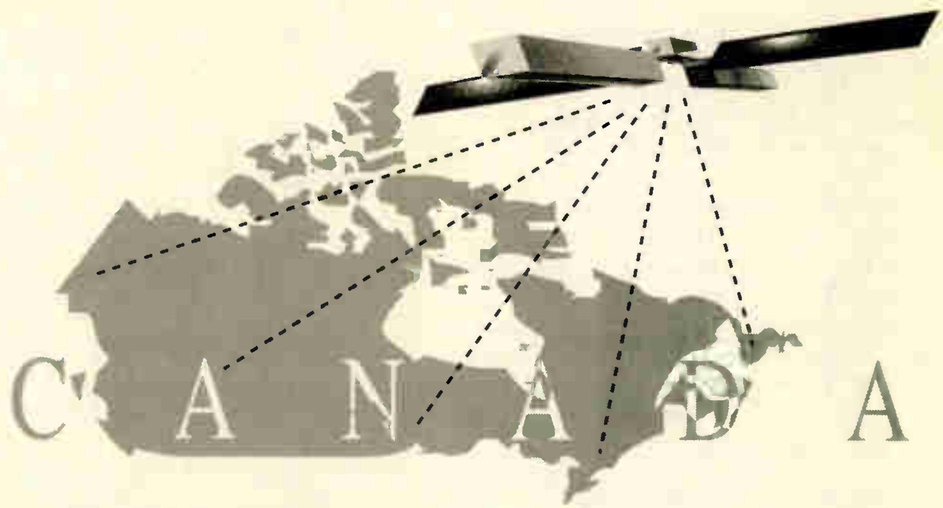
Yep. PrimeStar offered Arietta residents 77 channels of direct broadcast programs free for 60 days. Eighty-three families signed up – a 28% response! And strange things began to happen overnight, because of the birds. The number of people watching more than 15 hours of TV per week doubled. Those watching fewer than five hours per week dropped 75%.

What'd they watch? Well, educational program viewing more than tripled. About a third proclaimed HBO, 26% The Discovery Channel, 13% ESPN, 13% This Disney Channel and 13% CNN.

So says a survey done for PrimeStar by New York-based KRC Research and Consulting. The survey turned up some other interesting results: 70% of the Arietta customers liked the improved reception, 62% liked the greater channel selection, and 79% plan to "definitely continue" subscribing to PrimeStar, while another 17% are giving the idea serious consideration. In the DBS market, that's not chicken feed.

Canada to be covered by new telecommunications service

A new satellite service launched this fall promises to bring advanced mobile and stationary telecommunications to virtually every square inch of Canada.



This new service is being provided jointly by TMI Communications, of Ottawa, and GLENTEL, Inc., a diversified telecommunications company based in Burnaby, British Columbia. TMI owns and operates MSAT mobile satellite communications network. GLENTEL specializes in distribution, sales and service of cellular phones, paging products and two-way radios. It sells airtime for paging and two-way communications through several radio systems across Canada. It also offers discount long-distance telephone service to that nation's residents and businesses.

The agreement between the two firms promises to give Canadians access to mobile voice, fax and data no matter where they live, work or travel.

"MSAT will enable all Canadians to enjoy the benefits of staying in touch whether they're in their car, camp, truck or boat in Toronto, Timmins or somewhere out in the tundra," says Bob Ferchat, TMI chairman and CEO.

"We intend to offer our customers the widest selection of mobile and fixed satellite services," says Tom Skidmore, chairman, president and CEO of GLENTEL.

INTELSAT launches third VII spacecraft

A new satellite providing telephone, broadcasting and private network services went into orbit this fall over the Asia-Pacific region, located at 177 degrees east longitude. It is the third in a series of advanced INTELSAT VII spacecraft, the 703, offering a mix of Ku-band and C-band services, including several high-quality spot and zone-beam transponders for targeted coverage of key areas.

Minutes after being launched from Cape Canaveral, Fla., aboard a Martin Marietta Atlas IIAS vehicle, it was acquired by the tracking, telemetry, command and monitoring network in Perth, Australia. Its solar wings were deployed and oriented towards the sun. It was then maneuvered to raise its perigee to a geostationary position, and its antennas deployed. The satellite was scheduled to go into service in December after testing of its payload.

"The deployment of the 703 brings enhanced capacity for our customers in the Asia-Pacific region," says Irving Goldstein, INTELSAT director general and CEO. "Our goal is to continually introduce the latest in satellite technology as we replace retiring spacecraft in support of new telecommunications applications."

The U. S. based firm is planning to launch another bird, INTELSAT 704, in December. Testing and integration of this satellite has been completed at Aerospatiale facilities in Cannes, France. It is to be shipped to Cape Canaveral for launch in mid-December.

This series of satellites was designed to meet unique requirements of the Pacific Ocean region and is being considered for use throughout the INTELSAT system. It provides peak power levels up to 41.8

dBW at C-band and up to 51.4 at Ku-band. Each satellite in this series can 18,000 two-way telephone circuits, three analog TV channels, and 90,000 two-way circuits with digital compression capability. But the story does not end there.

"1995 will be a very busy year for us because we plan to launch five satellites including the VII, three VII-As, and the first of our newest series, the VIII," says Pierre Madon, INTELSAT vice president of engineering.

The VII-A spacecraft features a capacity for 22,500 two-way telephone circuits, three analog TV channels, and 112,500 two-way digital circuits.

The VIII offers similar capacities but will increase the number of TV channels with digital compression capabilities. Six of these spacecraft are under construction. The first is to be launched for Pacific Ocean region service in December, 1995.

African telecommunications to be consolidated in one bird

The Regional African Satellite Communication Organization (RASCOM) is planning to use a single satellite for all African operational leases, which is expected to have long-term consequences for African telecommunications in the future.

The satellite being considered for this use is an INTELSAT VII bird, to be launched in 1996 and positioned at 338.5 degrees east. It will feature high power for C-band and broadened Ku-band capabilities. The plan is an attempt at making more efficient use of telecommunications infrastructures in Africa with an eye toward creating a dedicated regional satellite communications for that region.

"The use of a single satellite will create a strong African community of users, improve regional capabilities with direct links, and reduce costs for several countries who currently pay transit fees," says Hamadoun Toure, INTELSAT director of sales for Africa and the Middle East. "We see this consolidation as pivotal to African telecommunications for the 21st century. We are building the core capabilities now," he says.

The decision culminates a long-term effort by RASCOM members to achieve a cost-effective solution to Africa's telecommunications problems, he points out.

Algerian TV and radio services confirmed

Observations have confirmed that Algerian TV and radio services are now being carried by Eutelsat II-F3 at 16 degrees east, with transponder frequency 11678 MHz (horizontal polarization). TV audio subcarrier is at 6.60 MHz. Algerian Radio in Arabic is on audio subcarrier at 7.02 MHz, in Kabyle (Berber) at 7.20 MHz, and in French at 7.38 MHz. In addition, Algerian TV and radio service in Arabic, are being transmitted by INTELSAT I-601 at 27.5 degrees west.

Egypt will launch satellite; build TV "city"

While RASCOM eyes consolidation of telecommunication services, Egypt plans to expand its entertainment satellite coverage and build an entire city devoted to television, radio and film production, according to a report by SAPA news agency in Johannesburg.

"We are soon going to launch our own satellite, Nilesat, and we are already moving strongly ahead with Nile TV," says Nabil Uthman, head of Egypt's (state) Information Office. Nilesat will reach Africa, the Middle East and parts of Europe.

Much of the entertainment programming for the satellite may come from a project that Uthman claims will be not only a massive television, radio, and telecommunications production center, but possibly the world's second largest film location exceeded only by Universal Studios in the U.S.

"Through this project we are placing ourselves and the African continent firmly in a position to compete with other top information outlets," Uthman says. "This is one way of dealing with growing competition from foreign services such as CNN."Brussels Euratel TV now carrying Libyan programming

The European Arab Company for Radio and Television (Euratel), which transmits from Brussels via Eutelsat II-F3 at 16 degrees east, has been carrying programming from Libyan television. The transmissions have been observed on transponder frequency 11163 MHz (horizontal polarization) with audio at 6.60 and 7.40 MHz.

Guangxi radio to broadcast via satellite

China's newly organized *Comprehensive News* of Guangxi People's Broadcasting Station is now transmitting 18 hours of programming daily. There are plans to broadcast the programs via China's Dongfanghong-3 satellite this year for reception by China and neighboring countries.

Indian TV channel changes frequencies

Channel 2 of All India Doordarshan television, previously received at 3985 MHz (C-Band) has changed transponders. It is now transmitting at 2575 MHz (S-band) on Insat-2B positioned at 93.5 degrees east, with audio subcarrier at 5.5 MHz. The channel, known as

Dd-2, has been transmitting in Hindi, English and Urdu at 0130-0430, 0430-0630 ("Ddi" Teletext service) and 0630-1830 UTC. News in Hindi is carried at 0240-0250 and 0830-0840 UTC. News in English is transmitted at 0840-0850 and 1630-1700 UTC. News in Urdu is given at 0850-0900 UTC. The bulletins in Hindi and English are relays from Dd-1, Insat-1D, positioned at 83.5 degrees east.

Japan firm would change broadcasting law

Japan Satellite Systems (JSAT), a communications satellite company financed mainly by Itochu Corporation and Mitsui and Company, Ltd., has petitioned Japan's Ministry of Posts and Telecommunications to revise that nation's broadcasting law regarding political neutrality and several other issues.

Political neutrality in broadcasting has become an issue in a case involving alleged biased news coverage by TV Asahi's former chief news editor. JSAT claims that a revision of the law is necessary in order for television channels to proliferate in the multimedia age. The Posts Ministry is considering the petition because this issue "affects the broadcasting sector as a whole."

Current regulations for private ground TV broadcasting companies also control communications satellite firms. Currently, political parties are not allowed to use satellite facilities. JSAT objects, saying "radio waves are no longer a rare commodity, and political neutrality can (only) be guaranteed by free access by all parties to broadcasting."

JSAT plans to start multichannel communications satellite broadcasting, using digital video compression, in 1996. This will enable them to broadcast four to 10 channels via a single relay station, in contrast to the present analog method, which handles only one channel per relay station.

Also, JSAT would relax rules affecting subscription charges, allowing higher fees for popular films and lower fees for B-grade films.

Under current law, one company can own no more than three communications satellite channels. It has been pointed out that this precludes unique services in the multimedia age, such as airing popular sports programs every 15 minutes on five channels. This is another issue being evaluated.

The Posts Ministry has set up an advisory body to consider legal revisions in preparation for the age of convergence of broadcasting and communications. Regarding JSAT's demands for legal revision, the ministry says "It is a fact that there has been a request. Since this is an issue that will affect the broadcasting sector significantly, we will consider it carefully."

Japan publishes guide on use of telecommunications frequencies

Japan has published an unprecedented frequency guide which it offers as policy for broadcasting during the multimedia age. The *Guide on Effective Use of Broadcast Frequencies* covers the use of "millimeter waves," redistribution of radio frequencies, and the joint use of broadcasting frequencies and telecommunications services.

Japan's Ministry of Posts and Telecommunications (MPT), who authored the guide, is interested in securing broadcast frequencies for mobile communications. This technology is expanding.

Their main thrust is to allocate millimeter waves, currently used in limited applications, for new types of mobile communications such as "wireless cards" useful in easing congestion on motorways, "vehicle-mounted radar" to prevent rear-end collisions, and wireless LANs (local area networks) capable of handling large-scale transmission of computer data.

The guide sets the goal of developing digital compression technology to achieve greater efficiency in transmitting information. It stresses a need to commercialize "dynamic frequency allocation technology" to allow regional allocation of broadcast frequencies for cellular telephone services.

It specifically targets the 2 GHz range for possible use in fixed telecommunications. Private sector firms use this range for utility and security functions. The guide proposes shifting these to ranges above 3 GHz and using the vacated frequencies for public land mobile telecommunications systems.

Two digital satellite radio broadcasters in Tokyo merge

Two satellite-based pay radio broadcasters in Tokyo have merged to form a new company. They are PCM Zipangu Communications and Nippon Music Congress. The new company resulting from their merger is Zipangu and Sky Communications, which will take over the digital radio programs previously broadcast independently by the firms. They reportedly were experiencing financial difficulties.

Poland now broadcasting western channels

Poland has announced that its western satellite channels FilmNet, Discovery, QVC and Country Music Television are being transmitted 12 hours daily and may soon be broadcast round the clock. Look for the channels on transponder 63 of the Astra-B telecommunications satellite.

Turksat-1B carries Kanal D and Kanal 6 TV

Two Turkish-language television stations, Kanal D ("Dogru Kanal" - "True Channel") and Kanal 6, have moved from Eutelsat II-F4 (7.0 degrees east) to Turksat 1-B, 42.0 degrees east.

The transponder frequency of Kanal D is 11029 MHz (horizontal polarization), audio subcarrier 6.6 MHz, color system PAL. Its hour are 0500-0010 UTC with news programs at 0635, 0700, 1000, 1700 and 2155 UTC. A Turkish-language radio station, Radio Kulup (Radio Club), has been heard broadcasting during 0800-1700 UTC on an audio subcarrier of Kanal D at 7.08 MHz.

Kanal 6 television operates from London. Its transponder frequency is 11080 MHz (horizontal polarization), with audio subcarrier 6.65 MHz, color system PAL. It carries news programs at 1600-1630 UTC.

Pakistan TV channel 2 seen on Asiasat-1

Pakistan TV Channel 2 (PTV-2) is now transmitting on Asiasat-1 positioned at 105.5 degrees east. Transponder frequency is 4100 MHz (vertical polarization), with audio subcarrier 6.6 MHz. Programs are aired in Urdu and English at 0200-0400, and 0800-1930 UTC. There is news in Urdu at 0230-0240, 1350-1355, 1600-1640 and 1920-1925 UTC (times may vary). New in English is broadcast at 1400-1415 UTC.

Satellite links Turks and Russian neighbors

A television link between Turkey and the republics of Central Asia and Azerbaijan is now being carried by the Turkish satellite Turksat 1-B, TASS news agency reports.

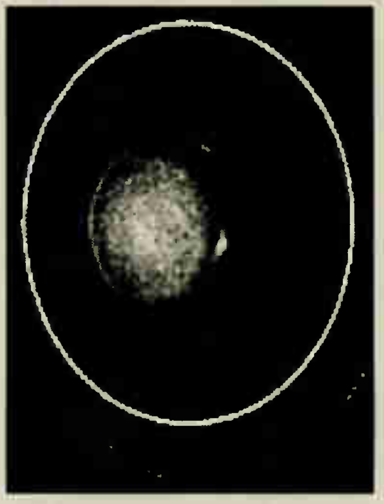
Television programs are beamed via the satellite to Turkmenistan, Uzbekistan, Kazakhstan, Kirghizia and Azerbaijan. Each of those republics is now linked to the Turkish telephone network via the satellite, according to reports from the Turkish postal and telegraph service.

Turkish Minister of Transport and Communications Mehmet Kostepen says much hope is pinned on the satellite. It promises closer ties between Turkey and Turkic republics of the former USSR, which have related cultures, languages and traditions.

South Africa launches educational satellite TV channel

The "most extensive distance television channel in South Africa" focusing on education, training, communication and life skills, began broadcasting in October from Johannesburg. The channel is being produced by the Africa Growth Network (AGN) which specializes in distance education, including basic literacy, numeracy, advanced management courses leading to an internationally recognized MBA. It serves business, educational organizations, governments, and individuals. ST

Hubble Images Show Rarely Seen Rings, Moons of Uranus

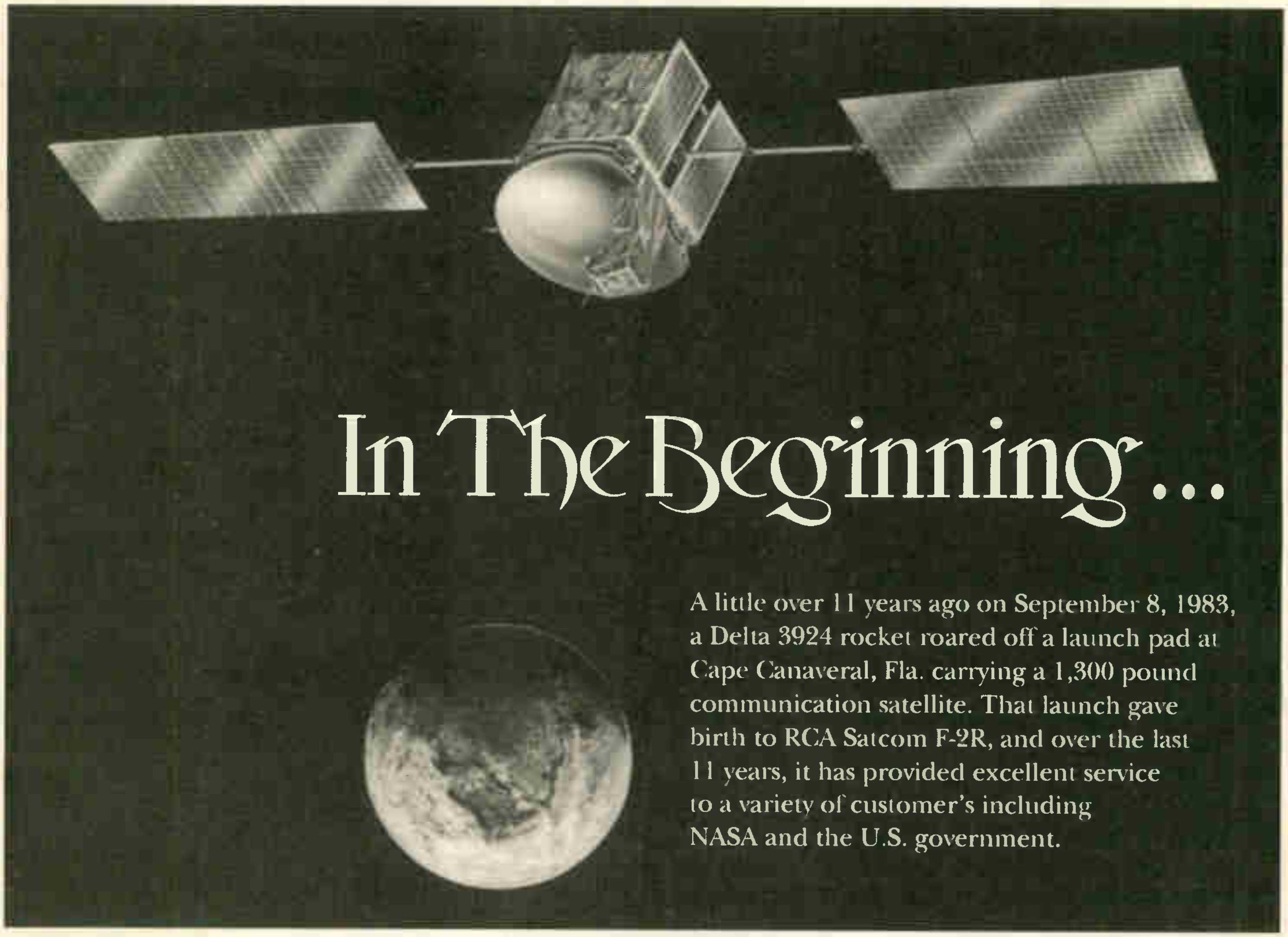


Spectacular new images of the planet Uranus taken by NASA's Hubble Space Telescope (HST) reveal the planet's rings, at least five of the inner moons, and bright clouds and a high altitude haze above the planet's south pole.

Hubble's new views were imaged by the Wide Field Planetary Camera on Aug. 14, 1994, when Uranus was 1.7 billion miles (2.8 billion kilometers) from Earth. Uranus' rings previously have been photographed in visible light and seen in such detail only by theVoyager 2 spacecraft as it flew by the planet in 1986. Since then, none of the planet's inner satellites has been observed and no high resolution observations of the rings have been possible.

In the new Hubble images, several of Uranus' rings are resolved, including the outermost Epsilon ring. The planet, which has a total of 11 concentric rings of dark dust, is tipped such that its rotation axis lies in the plane of its orbit, so the rings appear nearly face-on as seen from Earth and HST.

The detail in the HST observations will allow astronomers to determine the orbits of the moons more precisely, leading to a better understanding of the unusual dynamics of Uranus' complicated satellite system.



In The Beginning...

A little over 11 years ago on September 8, 1983, a Delta 3924 rocket roared off a launch pad at Cape Canaveral, Fla. carrying a 1,300 pound communication satellite. That launch gave birth to RCA Satcom F-2R, and over the last 11 years, it has provided excellent service to a variety of customer's including NASA and the U.S. government.

By Steve Handler

And now, later this month, GE Satcom F-2R,and its payload of 24 communications transponders is scheduled to be retired from service from its orbital slot at 72 degree west. The satellite is now owned by GE Americom (GE American Communications, Inc. a GE Capital Company). This satellite was only designed to operate for 10 years, but it has already exceeded that service lifetime by well over a year.

There are no set of FCC guidelines, nor are there any set of international regulations, which compel the owner of a satellite to dispose of a satellite in any predetermined fashion. There is a kind of "gentlemen's agreement" that consist of a sequence of events leading up to the shutting down of a satellite. This agreement insures that all the members of the satellite community take the appropriate steps to ensure that their satellites do not interfere or otherwise jeopardize the integrity of other satellites in geostationary orbit at 22,238 miles above the equator.

The useful life of a geostationary satellite is limited by several factors, including the continued operation of its payload (the communication transponders) and the amount of fuel left on the satellite than can be used to keep the spacecraft in a geostationary orbit. A satellite has thrusters or small rockets that are used for periodic north/south and east/west maneuvers (called "burns") to keep the satellite within it's assigned orbit.

While in a geostationary orbit, a satellite is required by government regulations to remain within 1/10th of a degree of its assigned orbit and this is known as the "orbital box". This "orbital box" is roughly equivalent to a box 80 miles square, (high and wide). Also satellites occupy an orbital slot (or position) and these are spaced at least 2 degrees in longitude apart or at least 800 miles distance between adjacent satellites.

Satcom F-2R is almost out of thruster fuel, even though the transponders are still operational. A satellite's transponders are not dependent on the on-board fuel system for power and continued operation.

GE has two options as F-2R nears it's end of life. They can boost the satellite up and out of geostationary orbit, or they can permit it to go into an inclined orbit and

At left: Artist conception of Satcom F-2R in orbit (Photo courtesy of GE Americom)

continue to operate for limited purposes. A satellite in a geostationary orbit keeps the same relative position in the sky at all times by traveling in it's orbit around earth at the same speed and direction as earth is moving. A satellite in an inclined orbit varies its position in the sky relative to any specific location on earth.

Fuel is usually the life limiting factor aboard any geostationary satellite. Unlike your automobile, there are no fuel gauges onboard a satellite. There are two methods used by most satellite operators to determine the exact amount of fuel onboard a satellite. These common techniques are routine bookkeeping and the "slosh test."

Routine bookkeeping is a simple concept. The amount of fuel remaining is calculated on a subtraction basis. The operators of the satellite knows the amount of fuel onboard when the satellite is launched. They then keep track of the duration of each thruster firing and they know the efficiency of each thruster. Given this information they can then calculate the amount of fuel used by the satellite. The estimated fuel used for each burn is subtracted from the total fuel onboard to calculate how much fuel is left. It is critical that the satellite operator leaves enough fuel in the satellite to boost it out of geostationary orbit at the end of its life so that another satellite can occupy that orbital slot in the future.

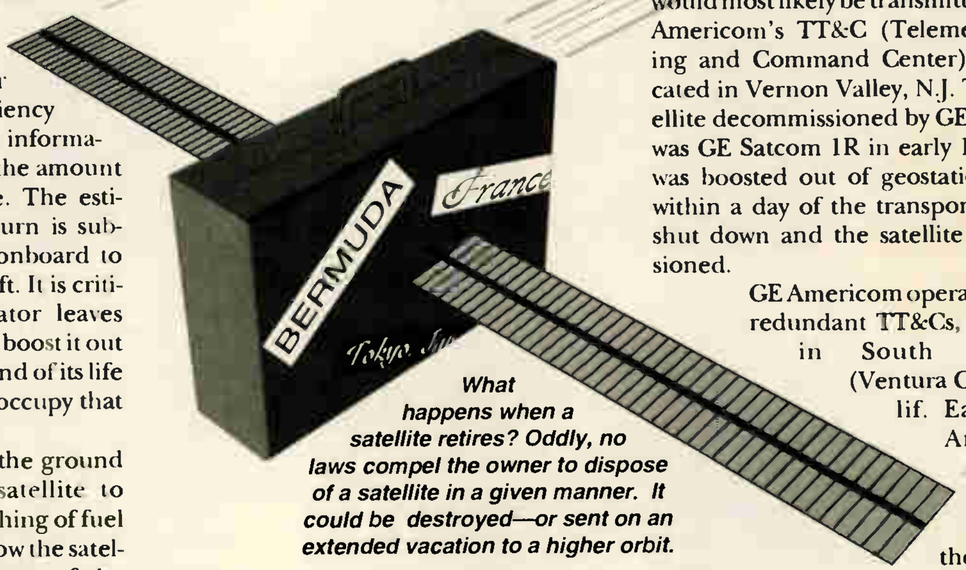
The "slosh test" involves the ground station commanding the satellite to wobble. This leads to the sloshing of fuel in the satellite's fuel tanks. How the satellite wobbles and the frequency of the wobble, corresponds to the fuel's mass or the amount of fuel on board. These are not a series of wild gyrations by the satellite. The movements are very subtle and consists of a gentle series of thruster micro-burst which only slightly de-stabilize the satellite.

What are GE's plans for F-2R?

A GE Americom spokesperson, Paul Manuele indicated that, based on the amount of fuel on board they plan to decommission the satellite in January, 1995. They will not put the satellite into an inclined orbit. They will use the remaining fuel on board to boost the satellite at least a 100 miles higher, out of geostationary orbit. There it will orbit for at least several hundred years until the orbit decays and it burns up on reentry to earth's atmosphere.

Mr. Manuele did note that the decision as to whether to decommission F-2R or place it in an inclined orbit in January is a business decision which is made by GE Americom management and may possibly change prior to the scheduled decommission. GE Americom has not applied to the FCC to keep the orbital slot. However, such an application could be made in the event that GE Americom had a satellite available.

Mr. Manuele indicated that, since GE services about 12,000 cable companies with fixed dishes (dishes that are unable to rotate to follow inclined orbital patterns), to permit the satellite to vary outside the geostationary "orbital box" would degrade the satellite's signals. In an inclined orbit, the customer receiving the signal would require a dish that is capable of tracking the satellite in order to optimize the signal. However, for a limited period of time, after the satellite ceases to be geostationary due to control burns not being performed, smaller C-band dishes that have wide angle beams would be able to receive usable signals from F-2R. One possible use for a satellite in an inclined orbit is by satellite news gathers (called "SNG). The satellite news gatherers typically operate in the Ku-band, (although some operate on C-band) and beam a signal from the source of a news event to the television networks or to news users such as *CNN*.



What happens when a satellite retires? Oddly, no laws compel the owner to dispose of a satellite in a given manner. It could be destroyed—or sent on an extended vacation to a higher orbit.

Retiring the Satellite

During the several weeks leading up to the retirement of F-2R, engineers at ground stations will perform a series of maneuvers and precise calculations that tells them the exact amount of fuel left aboard the satellite. The objective is to keep the satellite operating right up until the last moment when virtually all the fuel is used up.

The next step in decommissioning the satellite is to transmit the command to shut down the transponders. Then a command is to transmitted to the satellite to fire the thrusters and to boost the satellite out of geostationary orbit. The actual command to decommission F-2R would most likely be transmitted from GE Americom's TT&C (Telemetry, Tracking and Command Center) facility located in Vernon Valley, N.J. The last satellite decommissioned by GE Americom was GE Satcom 1R in early 1994, which was boosted out of geostationary orbit within a day of the transponders being shut down and the satellite decommissioned.

GE Americom operates two fully redundant TT&Cs, the second in South Mountain (Ventura County), Calif. Each of GE Americom's TT&C facilities provides their customers with international gateway services via Intelsat and PanAmSat, the Vernon Valley TT&C being the European gateway and the South Mountain TT&C being the Pacific and Asia gateway.

In anticipation of F-2R being decommissioned, its customers have been seeking alternate homes. In the case of the U.S. Government customers, GE switched them to Spacenet 2 in January of this year. One of the government customers, NASA TV, which had been operating on F-2R

Table 1: U.S. Domestic Communication Satellites

Location (deg west)	Satellite	Capacity	Launch Date	Est. End of Life
GE (with GTE)				
69	Spacenet 2	24 C-band/6 Ku-band	November 10, 1984	March 1997
72	Satcom F-2R	24 C-band	September 8, 1983	March 1995
81	Satcom K2	16 Ku-band	November 29, 1985	February 1997
85	Satcom K1	16 Ku-band	January 12, 1986	October 1996
	GE-1	24 C-band/24 Ku-band	June 1996	15 years
87	Spacenet 3	24 C-band/6 Ku-band	March 11, 1988	March 1998
93	GStar 3	16 Ku-band	September 8, 1988	January 1996 (Inclined orbit)
101	Spacenet 4	24 C-band/6 Ku-band	April 12, 1991	April 2001
103	GStar 1	16 Ku-band	May 8, 1985	May 1995
105	GStar 4	16 Ku-band	November 20, 1990	November 2002
125	GStar 2	16 Ku-band	March 28, 1986	June 1995
131	Satcom C3	24 C-band	September 10, 1992	May 2005
135	Satcom C4	24 C-band	August 31, 1992	March 2004
137	Satcom C1	24 C-band	November 20, 1990	March 2005
139	Satcom C5	24 C-band	May 21, 1991	August 2000
Hughes				
71	SBS 2	10 Ku-band	September 24, 1981	September 1996 (Inclined orbit)
74	Galaxy 6	24 C-band	October 12, 1990	October 2002
	SBS 3	10 Ku-band	November 11, 1982	September 1996 (Inclined orbit)
77	SBS 4	10 Ku-band	August 30, 1984	2005 (Inclined orbit)
91	Galaxy 7	24 C-band/24 Ku-band	October 27, 1992	2005
93.5	Galaxy 3	24 C-band	September 21, 1984	February 1995
95	Galaxy 3R	24 C-band/24 Ku-band	September 1995	12 years
95	SBS 6	19 Ku-band	October 12, 1990	November 2000
99	Galaxy 4	24 C-band/24 Ku-band	June 24, 1993	2005
123	SBS 5	14 Ku-band	September 8, 1988	September 1998
125	Galaxy 5	24 C-band	March 13, 1992	March 2004
133	Galaxy 1R	24 C-band	February 19, 1994	April 2006
AT&T				
85	Telstar 302	24 C-band	August 31, 1984	June 1996 (Inclined orbit)
	Telstar 402R	24 C-band/24 Ku-band	Date not announced	12 years
97	Telstar 401	24 C-band/16 Ku-band	December 15, 1993	February 2006
123	Telstar 303	24 C-band	June 19, 1985	September 1995

Note: This table does not include Mexican, Canadian or US DBS satellites.
Source: Mr. Doug Jessop, editor *North American Satellite Guide* ©, Keystone Communications ®

transponder 13 and also used transponder 5 for encrypted transmissions, was switched to Spacenet 2, transponder 9 and 5 respectively. (Spacenet 2 which was originally launched and owned by GTE Spacenet and was purchased by GE Americom in August 1993.)

On October 1, 1994, Prime Time 24, which operates WRAL-TV Raleigh-Durham, N.C. (CBS affiliate) on transponder 2, WABC-TV New York, N.Y. (ABC affiliate) on transponder 4, and WXIA-TV Atlanta, Ga. (NBC affiliate) on transponder 12 (all on Satcom F-2R), moved their operations to Galaxy 4 — transponders 14, 10 and 22 respectively. Mr. Manuele indicated that they assist their tenants in finding alternate satellite transponders to move to when the need arises. Both Prime Time 24 and the U.S. Government users (NASA, NOAA and the Department of Defense) have plans with GE Americom to relocate to GE-1, a new GE Americom satellite, when it is launched.

GE-1 is currently in production. Planned for launch on an Ariane launch vehicle in the last half of 1996, it will be located at 103 degrees west longitude. Currently that orbital slot is occupied by GStar 1, which is planned for decommission prior to the launch of GE-1. GE-1 is a hybrid satellite (a satellite that transmits on both C-and Ku-bands) with a total of 48 transponders — 24 C-band and 24 Ku-band. Along with the construction of GE-1, GE Americom is building a ground spare at the same time.

NBC will be an anchor customer on GE-1 who use some of the Ku-band transponders. Additionally, the U.S. Government (NASA, NOAA and Department of Defense) plans to locate on GE-1. Prime Time 24 also plans to locate on some of the C-band transponders on GE-1. GE Americom offers their customers the option of purchasing a transponder for the life of the satellite or entering into a lease for the transponder. There are several companies who either purchase or enter into a long term lease for transponders and then resell and broker out smaller portions of transponder time to companies who are in need of transponder time.

With the purchase of GTE Spacenet by GE Americom there is only three domestic operators of communications satellites in the United States — AT&T, GE Americom and Hughes Space Communications Company.

The retirement of Satcom F-2R is making a bad situation, worse. There is already a shortage of C-band frequency transponder capability caused by the retirement of some satellites and the failure of another. Indications are that this situation will not turn around in 1995. Table 1 list all the satellites in the U.S. domestic geostationary arc and the proposed satellite launches. Table 2 shows the total number of U.S. domestic transponders for each of the U.S. satellite operators currently in orbit and what will be available by the end of 1995. Both of these tables illustrate that C-band capacity will continue to decline in the foreseeable future.

So now it is set to begin — the retirement of a satellite — Satcom F-2R. The old workhorse will soon be boosted to its final orbit. A series of commands will be sent to the satellite to stow its solar panels and antennas. Batteries and traveling wave tubes will be shut off. And with the flick of a few switches, an old friend will be quietly put to sleep. ST

Table 2: Total U.S. Domestic Satellite Operators Transponder Capacity

	Current capacity		End of 1995	
	C-band	Ku-band	C-band	Ku-band
GE (with GTE)	192	114	168	82
Hughes	144	101	144	135
AT&T	72	16	48	16
Total Capacity	408	231	360	233

An avid TVRO enthusiast, Steve Handler scans the skys with his TVRO satellite dish to bring you an informative column about broadcasters, stations and programs, "On The Air" in Satellite Times. An author since 1970, his articles, books and publications have covered various aspects of radio and television communications.

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EXPRESS

From Japan to Australia

ST Satellite Profile

By Keith Stein

Last year was the 15th anniversary of the fall of Skylab, when Australia was showered with pieces of the United States first space station, burning up in earth's atmosphere, covering a large area southeast of Perth, Australia. Fortunately, the last orbit passed over the sparsely settled ranch country area of Western Australia.

Australia will be the target of another spacecraft reentry in January 1995, called Express. Residents in the southern hemisphere can feel a little more comfortable with this event, since its a planned, controlled, reentry into South Australia.

Express is the first concrete joint German/Japanese space program aimed at launching and recovering small unmanned, re-entry modules for microgravity and reentry technology experiments. The spacecraft will be targeted to land by parachute in the Woomera Prohibited Area (WPA) in South Australia (31.1 degrees south/136.8 degrees east).

The WPA consist of about 130,000 square km of desert terrain. Its southeast corner is located some 400 km northwest of Adelaide. The WPA is currently used for war material testing, which limits access to the area. The population of Woomera is around 1,800, some 500 being US nationals. Some infrastructure still remains from British and Australian missile activities that occurred between 1947 to the late 1970s. The range has been proposed for redevelopment to handle the Southern Launch Vehicle, capable of delivering 800 kilograms into low earth orbit (LEO). Woomera's advantages for operating as a launch site include a sparsely inhabited downrange area, and largely cloud-free weather. The small Wresat test satellite, launched into polar orbit by a US Redstone in November 1967, and the UK's Prospero in October 1971 are the only two satellites orbited from Woomera.

The Express project is being led by the German Space Agency, DARA, in Bonn, Germany. DARA is in charge of implementing all areas of the German Space Program, except for hypersonic technology.

Deutsche Aerospace (DASA) is the prime contractor. DASA provides several flight services ranging from 6 minute missions aboard their Texus sounding rocket, to their free-flying Eureca satellite carried aboard the U.S. space shuttle.

Collaboration with Japan has been agreed between DARA and the Ministry of International Trade & Industry (MITI), Japan's third largest government funding agency for space activities. Japan is responsible for the launch, while Germany provides the spacecraft and mission operations.

Express is scheduled for launch from Japan in January 1995. It will remain in orbit for about 5 to 6 days before landing in the WPA. This first mission is one of five planned, with the WPA remaining the preferred landing site for all flights.

The capsule was designed by KB (Design Bureau) Salyut in Russia, and built by NPO Lavoshkin. The capsule is based on a design used by KB Salyut for over 100 missions. Express consist of two major

Right: A photo of the Express Satellite (courtesy of Deutsche Aerospace)

components, a Re-entry Module (RM) and an attached Service Module (SM), totaling 765 kilograms (1,683 pounds) in weight.

The Re-entry Module will hold six scientific experiments, only one will operate during the orbital phase, the remaining five will activate during re-entry. The German-supplied experiments follow:

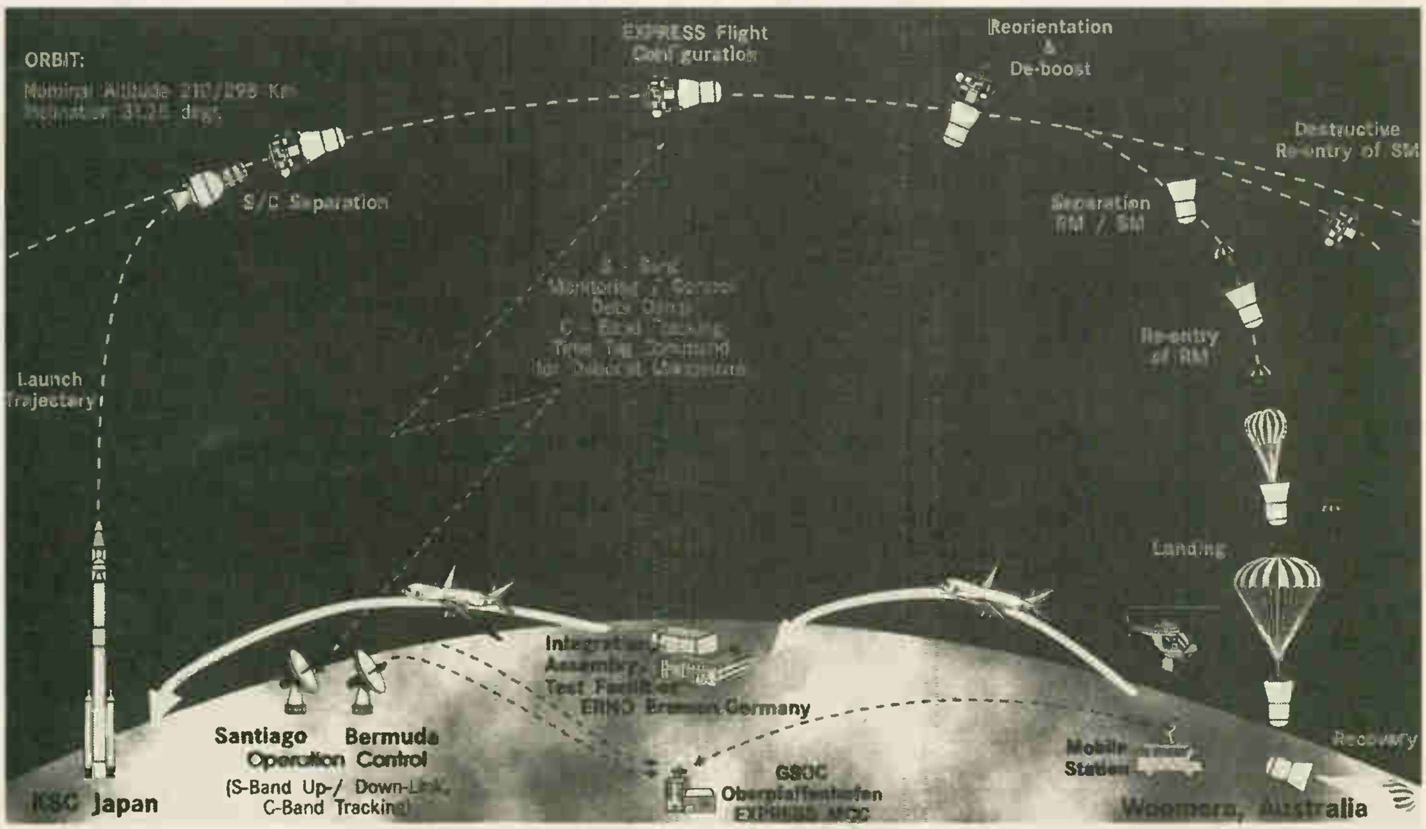
- Ceramic Tile Experiment (CETEX) — developed by DLR's Institute for Structures and Design, is a new material for heat protection. A tile of this material will be exposed to the extreme temperatures occurring during the reentry phase of the mission.
- Pyrometric Reentry Experiment (PYREX) — developed by Institute for Space Systems, integrated with CETEX, will make contact-free measurements of the temperature on the tile's back.
- Raflex Flow Experiment (RAFLEX) — developed by Hypersonic Technology Laboratory, is designed to examine the aerodynamic conditions during reentry by means of a complex system of pressure gauges.

The Japanese-supplied experiments follow:

- Reentry Technology Experiment (RTEX) — developed by the Institute of Space and Astronautical Sciences, designed to evaluate the radiative heat flow at the base surface of the capsule generated by the wake flow field.
- Catalyst Experiment (CATEX) — developed by Institute for Unmanned Space Experiment Free Flyer, consist of four autoclave chambers each containing 16 crystal samples. CATEX will develop high performance catalyst for the petroleum refinery.
- High Performance Material Experiment (HIPMEX) — developed by Research and Development Institute of Metals and Composites for Future Industries, is designed to determine temperature gradient on the back wall of the samples

The Service Module provides instruments for in-orbit and de-orbit operations of the mission, battery power, data communications, flight computer, and a retro-boost motor for the de-orbit burn. The Service Module is separated from the Re-entry Module immediately following the de-orbit burn.

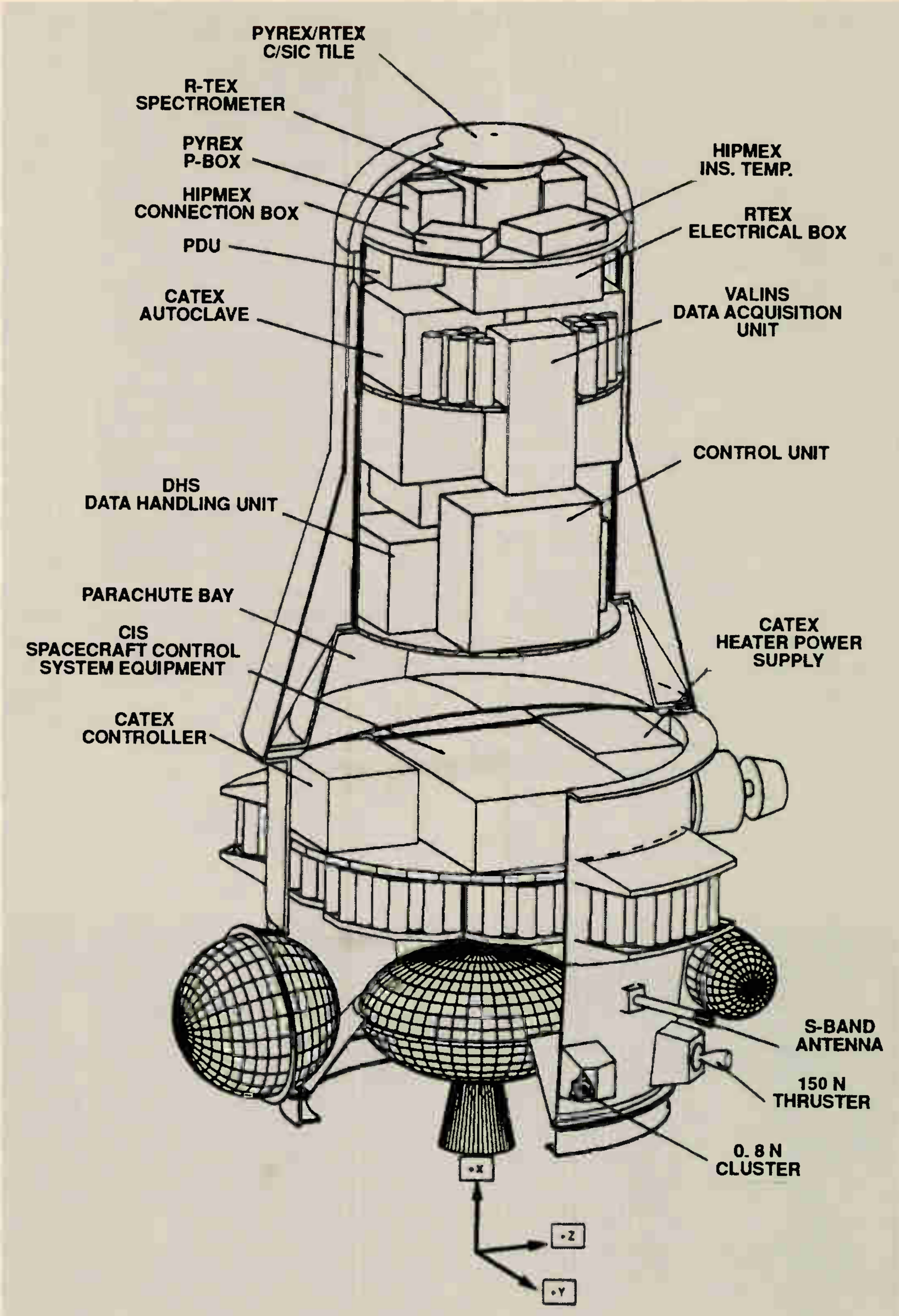
The spacecraft will be launched from the Kagoshima Space Center (KSC), Japan, (31.25 degrees north/131.1 degrees east) on the 8th, and last, M-3SII rocket. The M-3SII will be replaced in 1995 by the upgraded solid-fueled M-5 launch vehicle (the M-5 will be described later). The



small class launcher will be fired from Uchinoura-cho which lies on the east coast of the Ohsumi Peninsula. The thirty year-old facility is managed by the Japanese Institute of Space and Astronomical Sciences (ISAS).

Due to objections from fishermen over the noise and hazards associated with rocket launches, launches are restricted to two periods each year in Japan-January 15 to the end of February and August 1 to September 15.

The vehicle will be launched with an elevation angle of 78 degrees. The overall length of the booster is 27.78 meters with a diameter of 1.41 meters, with a launch mass of 61,700 kilograms. The nine year-old expandable rocket has a 100% success rate performing seven missions between 1985-93. The Express spacecraft will be released from the launch vehicle about 6 minutes into the flight, injected into a orbit of 210 km x 400 km (130 miles by 250 miles) and inclined to the equator 31.1 degrees.



Research and development of the M-3SII booster, built primarily for a Halley's comet fly-by mission, Japan's first interplanetary mission, began in 1981. The vehicle consist of three solid-fueled stages with two strap-on boosters, and a kick stage that is added optionally for high energy missions such as interplanetary flights. The M-3SII is capable of launching payloads up to 880 kilograms (1,940 pounds).

The first two M-3SII launches injected the first Japanese interplanetary probes, Sakigake and Suisei, toward a Halley's Comet fly-by in 1985.

In 1989, ISAS was given approval by the Space Activities Commission to embark on the development of a new 'M' launch vehicle to replace the M-3SII currently in use. The new rocket, named M-5, will have a 8.2 ft (2.5 meters) diameter, and capability of placing up to 1,950 kilograms (4,300 pounds) into orbit, an 80% overall increase from the M-3SII. First launch is scheduled for 1995.

Mission operations for Express are the responsibility of the German Space Operations Center (GSOC), who will utilize three global ground stations for tracking, telemetry and command purposes. Existing ground stations at Bermuda and Santiago will be used, along with the Tjaliri tracking station to the west of Coober Pedy, Australia. The Santiago station will make the first contact with Express, about 36 minutes after launch. The duration of each station pass will range between 5-9 minutes.

For those die hard satellite tracking fans, and with some elaborate equipment, Express will be transmitting in S and C-band. The S-band telemetry and telecommand system consist of two transmitter/receivers, two telemetry command decoders, and two circular radiating antennas. Telemetry/telecommand frequency characteristics have a uplink of 2035.5 MHz, with a downlink of 2201.7057 MHz at a RF power of 2.5 watts and data rate of 32 kbps. The C-band radar system consist of one system for the Service Module, and one for the Reentry Module. Each system is comprised of a C-band transponder with RF power divider and 2 antennas receiving uplink on 5690 MHz, and transmitting downlink on 5765 MHz.

Telemetry and tracking systems for the M-3SII booster are housed in the 2nd stage of the vehicle. The radar transponder systems employed on the M-3SII vehicle are C-Band and L-Band.

Stations between 31 degrees north, and 31 degrees south latitude will have the best opportunity to monitor transmissions.

A command will be issued from GSOC to initiate the re-entry sequence. This sequence consists of spacecraft orientation to the required thrust angle, spacecraft spin-up, re-entry boost motor firing for 15.2 seconds, spacecraft spin-down, and RM/SM separation.

Following the re-entry command sequence, the capsule (Re-entry Module) will make a soft landing approximately 80 km south west of Coober Pedy, Australia. An S-band beacon on the capsule, activated by the pullout of the parachute canopy at 6 km height, will enable helicopters to locate the touchdown point. The capsule will then be transported by helicopter from the landing point back to Woomera for data dump and experiment removal.

The Service Module is not designed to survive re-entry, and will break apart and mostly burn-up in the atmosphere at about 80 km, except for up to 11 fragments which are likely to reach ground, they will not be recovered.

De-orbit motor ignition will occur at 60 degrees east longitude, above the Indian Ocean. The Re-entry Module will then pass over the West Australian coast at an altitude of 110 km, and then over the West Australian/South Australian border at an altitude of 60 km.

The European Space Agency (consisting of 11 European nation members) is also planning to launch a Atmospheric Re-entry Demonstrator, weighing 2.8 metric tons (6,100 pounds), scheduled for launched in April 1996 aboard Europe's new Ariane 5 heavy-lift launcher, now in development. A contract valued at some 30 million ($36 million) was signed Sept. 30 by ESA's Director-General Jean-Marie Luton and Aerospatiale Chairman Louis Gallois.

Demonstrator is intended to measure re-entry phenomena. The data will be used to help European engineers design a proposed Apollo-type crew-carrying capsule.

Re-entry demonstrator's under structure will be made of aluminum, with a heat shield made of phenolic resin-coasted silica, which will protect the capsule against the high temperatures it will face upon re-entry into the Earth's atmosphere.

The capsule will orbit the Earth once and land off the west coast of South America, with the aid of three parachutes. The capsule will deploy three balloons on splashdown to enable it to float long enough for recovery ships to retrieve it.

Belgium's Societe Anonyme Belge de Constructions Aeronautiques of Brussels will be responsible for supplying the capsule's structure.

In the future, Japan is looking to use Australia's air base at Woomera for test flights of it's space shuttle. Japan's Science and Technology Agency (STA) has proposed using the Woomera air base as a test site to conduct take-off and landing experiments with the Japanese space shuttle "Hope", to establish landing technology.

This is the first time that Japan has set up a full-scale test base for space research in a foreign country. The agency wants to begin conducting tests next year once a agreement is reached with local authorities.

Automatic landing experiments will be conducted jointly by the STA's National Aerospace Laboratory and the National Space Development Agency of Japan (NASDA).

Experimental models weighing about 760 kilograms each (6.1 meters long and 3.8 meters wide), one-third the size of real models, will be taken up by helicopters to a height of 1,500 meters and let loose at the speed about 160 km per hour. They then will land automatically using ground control systems. ST

FIGURE 1: *M-3SII Typical Flight Sequence*

Flight Time (min:sec)	Events
00:00	1st stage and strap-on boosters ignition
00:05	Movable nozzle thrust vector control starts
00:06	1st stage liquid injection thrust vector control starts
00:35	Movable nozzle thrust vector control stops
00:36	Solid motor for roll control starts
00:40	Strap-on boosters separation.
00:55	1st stage liquid injection thrust vector control stops
01:20	Solid motor for roll control stops
01:24	1st stage separation
01:26	2nd stage ignition, 2nd stage liquid injection thrust vector control & roll side jets start
02:21	2nd stage liquid injection thrust vector control stops
02:22	Pitch and yaw side jets start
02:35	Nose fairing separation
03:15	3rd stage spin up starts
04:06	2nd stage separation
04:08	3rd stage ignition
06:00	3rd stage separation

Keith Stein is a space analyst/freelance writer based in Springfield, Virginia. Keth also does the Satellite Launch Schedule column in the ST Satellite Services Guide.

Shop Till You DROP


QVC is an ever-changing electronic superstore, introducing 250 new products every week to viewers in more than 50 million homes.

But be careful if you're hopelessly attracted to shop-at-home TV stations, lest the thing that drops the fastest is your bank balance.

By Steve Handler

"Shop till you drop" and "charge it" are two sayings women love to hear when they go out shopping. Now imagine, ladies, going shopping and never having to leave the confines of your own living room. Yes sir, with a TV and satellite dish system, you can join the latest rage in the video revolution, Shop-at-Home TV.

Shop at Home TV is big business, and communications satellites make it possible. Last year the sales of QVC and the Home Shopping Network, two of the leading players in this growing field, exceeded two billion dollars. These televised shopping retailers sell a wide variety of products including jewelry, apparel, cookware, electronics and collectibles.

QVC

QVC, which stands for Quality, Value and Convenience, went on the air in November, 1986, and currently operates two channels. Their original channel QVC which is their main or primary channel, operates from studios at West Chester, Penn. They transmit 24 hours a day on GE Americom's F-4 satellite (also known as Satcom C-4) using channel 9. Their second channel is QVC 2 with studios located at Silvercup Studios in New York. QVC 2 transmits on GE Americom's F-3 satellite (also called Satcom C-3) using channel 8.

In November 1992, QVC moved to their primary channel on F-4 with a 12 year lease at an average monthly cost of $224,000 and the transponder is protected and non-preemptible. In December 1992, the QVC Fashion Channel, which evolved into QVC 2, moved to the F-3 satellite with a protected, non-preemptible transponder lease at a monthly cost that averages $205,000 over a 12 year lease.

Typically, satellite owners lease transponders on a protected, transponder protected, or unprotected basis.

A protected transponder means that, if the customer's transponder fails, the signal would be transferred to a spare transponder on the same satellite. If no spare transponder were available, an unprotected transponder customer on the same satellite would be displaced. In the event that a satellite should fail, the protected transponder's customers would be moved to another satellite owned by the same company that owned the failed satellite.

Another class of lease is the transponder protected transponder which means that, if the customer's transponder fails, the signal would be transferred to a spare transponder on the same satellite. If no spare transponder were available, an unprotected transponder customer on the same satellite would be displaced. However, if a satellite should fail, transponder protected customers would not be guaranteed the ability to moved to another satellite.

An unprotected transponder has no back up transponder available, and may be interrupted when the transponder is required by a protected user.

Transponder customers lease their transponders with the level of protection that the customer desires for its use. There are many factors that a transponder customer who uses satellites to feed its programming to cable systems or over the air broadcast television stations might consider when leasing a transponder. Among them are: the level of protection they need to reduce the chance that their programs would be off the air in the event of a transponder failure or satellite failure, and cost. A protected transponder lease usually costs more than a transponder protected lease. An unprotected transponder lease usually costs less than either a protected transponder or transponder protected.

QVC reaches an estimated 3 million satellite dish owners, as well as approximately 80% of all cable television subscribers in the United States (about 47 million cable TV homes). The cable systems that carry QVC programming rebroadcast to their subscribers the same satellite signals that C-Band satellite dish owners watch.

Typically the network uses a one hour or multiple hour program format to showcase each particular type of product or product theme. Those programs include

Broadcasting live from its studios in West Chester, Pa., QVC reaches more than 50 million homes across the U.S. This is the view that the announcer gets.

"Warm & Cozy Linens", "Cooking with T-Fal", "In the Kitchen with Bob", "Gifts Under $50", "Gold Sampler" and "The Jewelry Showcase". For instance, "Hi Tech Toys & Electronics" recently was seen in a two hour slot from 5 p.m. to 7 p.m. Eastern Time on Saturday and featured such items as cordless telephones, computers and other electronic items.

The network's marketing approach appears to be soft sell. From their various sets, to the tone of the on air personalities' voices, to the description of the item, QVC attempts to engender a friendly atmosphere. QVC's on air personalities not only talk about the merchandise, but interact with their viewers. Customers are put on the air and talk to the on air personalities. This sometimes includes a discussion about why the customer bought a particular item being displayed or items that sold earlier in the day.

QVC employs about 4,500 people and last year had sales exceeding 1.2 billion dollars. Jewelry is the most popular type of merchandise sold. Taking the first half of 1994 as an example, approximately 41% of QVCs sales were jewelry, and approximately 19% were apparel and accessories. The remaining items included housewares, electronics, collectibles and other items.

Grupo Televisia, S.A. de C.V. and QVC have formed a joint venture with QVC owning 50%, and on November 15, 1993 began broadcasting "CVC" from studios in Tijuana, Mexico. CVC is transmitted on Morelos 2, channel 8 on a part time basis and on Solidaridad 1 channel 13 and is re-broadcast in Mexico on cable systems and broadcast television.

Home Shopping Network, Inc (HSN) began national operations in 1985. The Home Shopping Club (HSC) is a wholly owned subsidiary of HSN and currently has approximately 5 million active member households. The Home Shopping Club's retail sales programs are produced in its studios in St. Petersburg, Florida.

In 1993, HSN had annual sales of $1.05 billion dollars and averaged 158,000 incoming telephone calls per day. Their production facilities cover over 13,800 square feet of space. The programs are transmitted by HSN's satellite uplink facility to the satellite transponders leased by HSN/HSC which re-transmit the signal to the satellite dish owners, as well as to local cable system operators and broadcast television stations who carry HSC. The HSC programs are broadcast 24 hours a day.

HSN/HSC lease three full time transponders from GE Americom. On Satcom F-4 channel 10 HSC leases a "protected" basis transponder and is used for HSC 1. Channel 10 on GE Americom's F-3 satellite is the home of HSC 2 and it is leased on a "protected" basis. GE Americom's F-2R satellite channel 11 is the final channel and is leased on a "transponder protected" basis for HSC Spree.

GE Americom launched F-4 in August, 1992 and F-3 in September, 1992. HSN/HSC has leased their transponders on F-3 and F-4 for the life of each of the satellites,

At both QVC and the Home Shopping Network (shown here), phenomenal sales necessitate huge phone-in sales centers and require careful management to provide the correct number of phone lines and agents as the calling volumes fluctuate.

which is estimated to be 12 years. As of writing this column, GE Americom's F-2R is going to be retired in early 1995. HSN/HSC expects to replace the F-2R transponder used for HSC Spree prior to F-2R being retired from service.

After watching each of the QVC and HSC channels, I found that each company had their own distinctive way of presenting the products. Even if you are not interested in the shop at home concept you may wish to tune in. I was impressed with the quality of the broadcast production and found some of the programs I watched to be both interesting and informative. I considered more than once during my research for this article for reaching for the phone to place an order for an item.

In the future, I will be writing the "ON THE AIR" column for *Satellite Times* and we will explore the diverse world of satellite broadcasting and programs available to satellite dish owners. We hope to enrich your viewing enjoyment and provide you with a sample of what's "ON THE AIR." ST

Big-name stars like Suzanne Somers help prime the sales pump at the Home Shopping Network.

Shop Till You Drop List

Satellite	Channel	Network	800 Order Number
F4	07	HSN Direct (Part time use)	800 218-4433
F4	09	QVC Network	800 345-1515
F4	10	Home Shopping Club Channel "HSC 1"	800 284-3100
G1	09	Shop-at-Home	800 366-4010/800 927-6468
G1	12	Valuevision	800 788-2454
G1	14	Shop-at-Home	800 927-6468/800 366-4010
G1	15	Shop-at-Home	800 927-6468/800 336-4010
F3	08	QVC "Q2"	800 345-1331
F3	10	Home Shopping Club Channel "HSC 2"	800 284-3200
M2	08	CVC (Part time use)	915 628-8585
SD1	13	CVC (Spanish language)	
T1	01	Showcase of Savings	800 531-9113/800 950-3011
G3	13	Video Catalog Channel VCC13"	800 200-0221
G3	15	Video Catalog Channel	800 546-1234
G3	17	Shop-at-Home	800 927-6468/800 366-4010
G3	19	Via TV	800 948-4288
G3	21	America's Collectibles	800 600-8882
G3	24	Worldwide Collectibles	800 522-3700
F2	11	Home Shopping Club "Spree" Channel	800 284-3400

Audio Information:

6.2/6.8 MHz wide audio for QVC, QVC2, HSC, HSC2, HSC Spree, Valuevision, Worldwide Collectibles

6.2 MHz wide audio for CVC

6.8 MHz wide audio for Shop-at-Home, Video Catalog Channel, VCC13, Via TV. America's Collectibles

Miscellaneous:

HSC customer service number is 800 284-3900

USAF Weather Satellite Uncovers

North Korean Mystery

By Larry Van Horn

One favorite pastime for a lot of satellite monitoring enthusiasts is the capturing and viewing of weather satellite imagery. Looking back on planet Earth from space at weather satellite photos can be fun and educational. But some weather enthusiasts have found that weather satellite photos can be used for more than just spotting cloud formations and weather patterns.

North Korea is a mysterious case in point. The two photos accompanying this article were imaged on two moonless and cloudless nights over the Korean peninsula. They were taken from an orbiting U.S. Air Force weather satellite known as DMSP or Defense Meteorological Satellite Program. The lights from South Korea cities (center) are quite prominent and almost fill up the borders of that country in both photos. By contrast, in North Korea, the land mass is dark, even though skies are completely clear over the country. The one lone light source visible in North Korea appears to come from the country's capital, Pyongyang.

Melbourne, Florida satellite meteorologist Hank Brandli, who captured these photos on his home computer, has some theories to explain the remarkable division of brightness in the south and the stark darkness in the north.

"The lack of economic development, the possibility that North Korea was on a war footing, and the possible mourning of North Koreans over the death of their great leader, Kim Il Sung", Brandli said in a telephone interview, "are some possible theories for the North Korean blackout."

Kim Il Sung died of a heart attack at age 82 in July. After his death, the country was plunged into a period of mourning. These two DMSP photos were taken on September 3 and 26, 1994.

Another theory offered by Brandli involved the crisis over North Korea's refusal to allow inspection of their nuclear facilities. That crisis could have prompted North Korea to impose a blackout throughout the country.

Also in stark contrast to the darkness of North Korea is the industrial development of Japan that can be seen in the lower right hand portion of both pictures. The lights from the major cities of Nagasaki and Hiroshima dominant that portion of each the pictures.

Dots of lights in the Sea of Japan off the eastern coastline of South Korea are from Japanese fishing vessels. These boats use bright lights at night to attract fish.

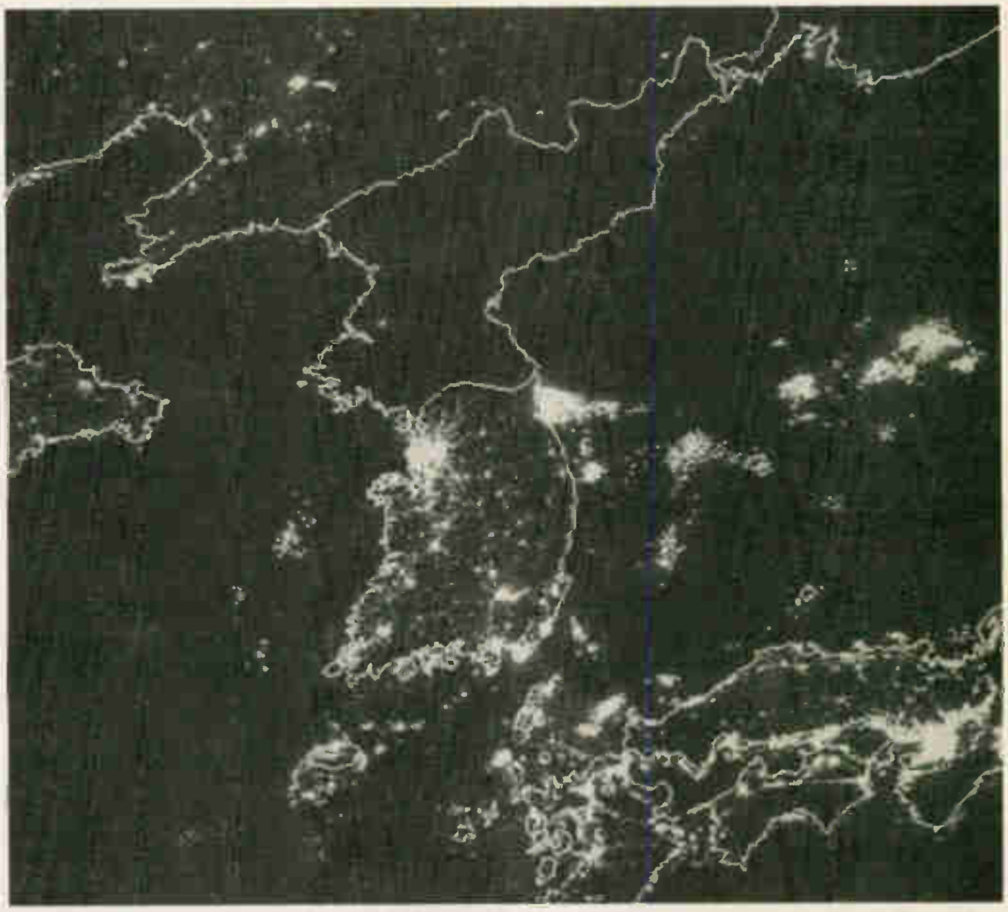
"You can see there are a lot of vessels fishing at night in the Sea of Japan. That sea appears to be being sucked dry of fish," Brandli said.

Another interesting feature to note in these images is the movement of the Japanese fishing fleets. In the September 3 photo the majority of the fishing vessels were in the middle of the Sea of Japan. By September 26, the fishing vessels were just

The polar-orbiting, sun-synchronous USAF DMSP weather satellite took this image of the Korean peninsula and surrounding area on a moonless, cloudless night in September, 1994 from 450 nautical miles up. The photo shows city lights and the bright lights used by fishing boats offshore to attract fish. Nothing unusual here—or is there? Note the near total blackout of lights in North Korea.

off the eastern South Korean coastline. In both photos, only a small number of fishing vessels are visible to the west of South Korea in the Yellow Sea.

The USAF images included with this article have a ground resolution of 1.86 miles (3 km) and the spectral interval is 0.4 to 1.1 microns. Both photos were taken with low light equipment operating aboard the DMSP satellite.



It's another night in September, 1994. The fishing fleet has moved, but North Korea remains virtually blacked out.

The DMSP Program

The Defense Meteorological Satellite Program has been collecting weather data for U.S. military operations for more than two decades. Air Force Space Command's 50th Space Wing at Falcon Air Force Base, Col., provides command and control support for DMSP satellites.

Three operational DMSP Block 5D-2 satellites orbit the earth at about 450 miles (720 km) in a sun-synchronous, polar-orbit and scan an area 1,800 miles (2880 km) wide. Each satellite covers the earth in about 12 hours. Using their primary sensor, the Operational Linescan System, these satellites take visual and infrared imagery of cloud cover.

Besides the Operational Linescan System, DMSP satellites have sensors which measure atmospheric moisture and temperature levels, Xrays, and electrons that cause auroras. The satellites can also locate and determine the intensity of auroras, which are electromagnetic phenomena that can interfere with radar operations and long-range communications.

A relatively new sensor of growing importance on DSMP is the SSM/I "Microwave Imager." This sensor measures electromagnetic energy emitted from the Earth's surface and atmosphere to image weather characteristics. The SSM/I provides critical data for tracking tropical storms and directing evacuation of threatened areas. Derived meteorological parameters include atmospheric moisture content. cloud liquid water content. cloud location, ground moisture content, ice coverage, rain intensity, surface temperatures and surface wind speed over water.

This information aids military commanders in making decisions at home or on the battlefield. During the Persian Gulf War, DMSP proved essential to the Allied Forces. Satellites provided four hours of dedicated direct weather support daily to the theater of operations. This enabled planners to provide efficient and safe air operations in the area.

Tracking stations at Fairchild Air Force Base, Wash., New Boston Air Force Station, N.H., Thule Air Base, Greenland and Kaena Point, Hawaii, receive DMSP weather data and electronically transfer them to the two military weather centers at Offutt Air Force Base, Neb., and Monterey, Calif. Naval vessels with special equipment can also receive data directly from these satellites.

There are a total of five Block 5D-2 DMSP satellites in orbit; two are fully operational and one is partly operational. The remaining two are used for research and development. The Block 5D-2s were launched from Vandenberg AFB, Calif., beginning in December 1982. These newer-generation satellites have many improvements over early models, including more sensors with increased capabilities and a longer life span.

U.S. Air Force DMSP weather satellites are manufactured by General Electric. Transmissions from these satellites are normally encrypted, but Satellite Times has received several unverified reports that the Air Force occasionally sends DMSP imagery in the clear. One of the DMSP transmit frequencies is believed to be on 2207.0 MHz carrying High Resolution Picture Transmission (HRPT) type imagery. ST

THE SATELLITE

SLEUTH

By Dr. Theo Pappan
C.N.E.S.S.

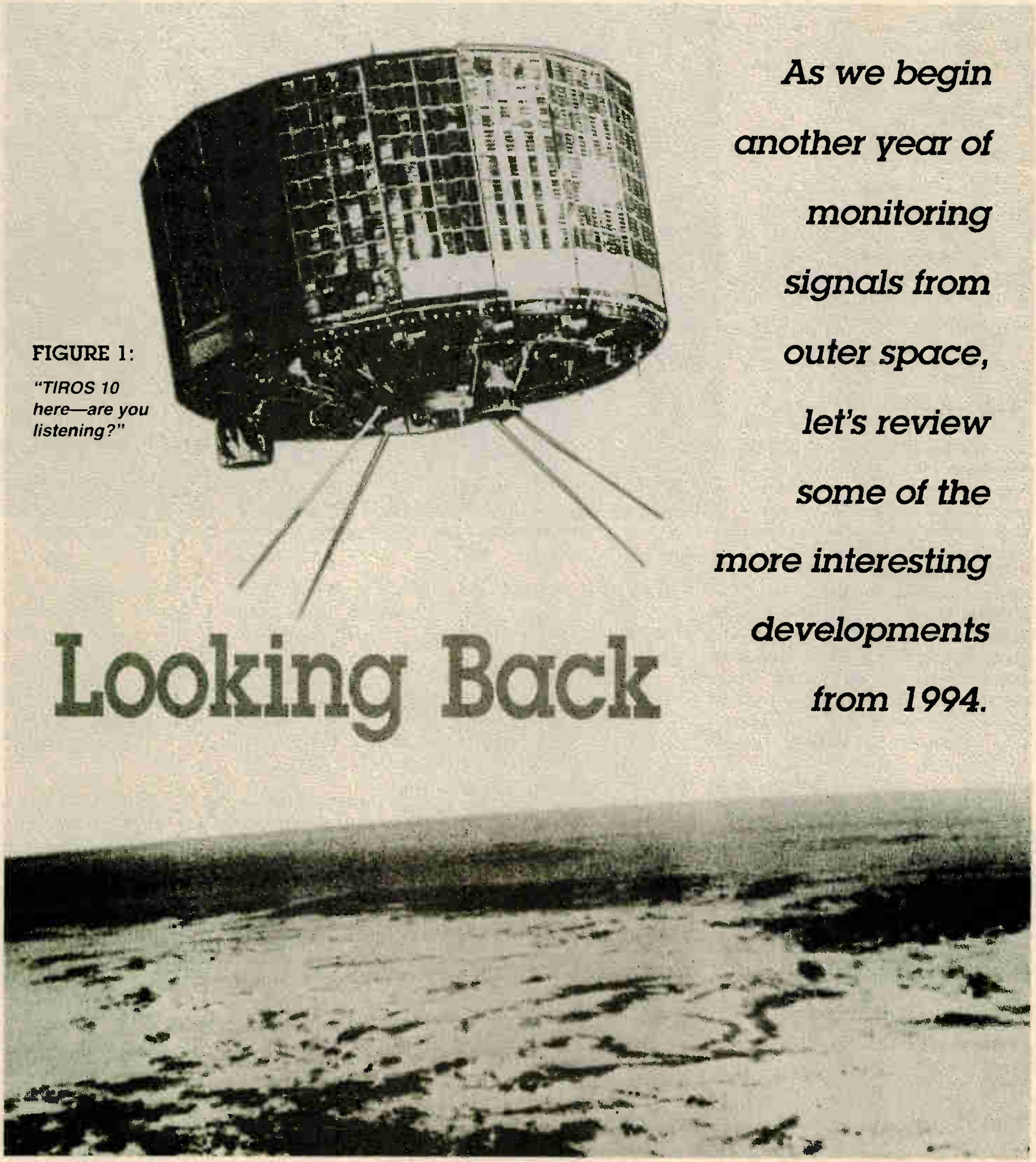


FIGURE 1: *"TIROS 10 here—are you listening?"*

Looking Back

As we begin another year of monitoring signals from outer space, let's review some of the more interesting developments from 1994.

"If you are going to look for TIROS 10 you should be aware that although many people list it on 136.230 MHz, you will find it is now transmitting on 136.235 MHz. It transmits least and weakest when it is in eclipse for a large part of its orbit and when it gets a lot of sunlight you may hear the image transmission systems come on."

One of the more intriguing aspects of satellite sleuthing near Earth orbiting spacecraft is whenever you find and identify a signal you hear, it's as though you were the first one to do it. It may be a derelict piece of space junk 35 years old that hangs on to life by the last of its tortured solar cells and it may have been heard over the years by a dozen before you, but when you listen to it and work out what it is, you own it! There is something about the satisfaction of ferreting out where that signal is coming from that makes all the chasing and pondering worthwhile.

One person who has learned this non-secret is Gary Davis from Philadelphia. Gary began hearing signals on +136.230 MHz back on February 9, 1994. His first recorded AoS-LoS of note was 0019-0024 UTC. His second reception occurred at 0155-0202 UTC which gave him a preliminary period of 97 minutes. He converted that and got a Mean Motion of about 14.8 (Minutes in Solar Day/ Period = MM so: 1436/97 = 14.8). That put the satellite up there at about 600 km.

At first only a dead carrier was noted. Then, with other people listening on the frequency, more was heard. Thomas Mishler from Lapeer, Michigan also heard the signal and noted two carriers about 1.5 kHz apart. Additional passes were monitored and AoS/ LoS times were recorded. The period was fine tuned from these observations and the orbit became more defined. With three people from different parts of the U.S. tracking the satellite Thomas soon had enough data to describe the orbit. The satellite's orbit provided only 3 passes per station and progressed from East to West (other stations were in Pennsylvania and Michigan, similar latitudes, but 9 degrees difference in longitude. When the east most station heard the first pass of the day, it was noisy or couldn't be heard by the more western stations. When the last pass for the east station was noisy, it could still be heard without noise by the stations further west and when they heard the last pass of the day, the Eastern station couldn't hear anything. This was evidence that it was in a polar orbit (>80 degrees). The apogee and perigee were likely in the 600-700 km range for a circular orbit as deduced from the period in minutes between passes.

Several objects fit the developing orbital pattern and it didn't take long to narrow it down to one in particular. A fresh set of Two Line Elements (TLEs) and the Instant Track satellite tracking program printed out pass times that exactly matched what Thomas had observed. The unseen bird was none other than TIROS 10 (a Television InfraRed Observation Satellite) launched on a Thor Altair booster out of Vandenberg Air Force Base on July 2, 1965 (International Designator — 1965-051A; Satellite Catalog number 1430). This little cylinder (about a half a meter in diameter and a little more than a meter long) was covered with solar cells now burned by solar radiation and pockmarked by tiny craters caused by dust-like particles traveling at fantastic speeds. (see figure 1)

NASA had put this satellite up over 29 years ago and abandoned it 27 years ago on July 3, 1967. But somehow this little spacecraft (it only weighed 127 kg or 300 lbs before it was launched into space) kept on working, if only by putting out a carrier or two.

That normally would have been the end of the story. Most people would make a final note in their logbook and add another name to their list of identified satellite signals and forget about it. But Gary didn't forget about it. He kept the satellite elements current in his computer and whenever his tracking program showed TIROS 10 coming into range he tuned to that frequency and listened for it. For the next few days interest was concentrated on hearing two and then three carriers associated with this satellite. Then a new signal was heard elsewhere and it was so intriguing that all the listening post dropped the TIROS 10 object (and everything else they were watching) and concentrated on listening to the new signal.

Things quieted down again near the end of March 1994. Through April his logs show the signal getting stronger and stronger with more and more signals being multiplexed. In May 1994, he noted that signals from the mysterious satellite that were initially "weak" to "very weak" were now "strong". On April 19, 1994 he heard APT-like signals coming from this long-ago decommissioned bird. In June 1994 he heard a "wobble" in the carrier frequency due to the power controller being unable to cope with too little energy from the solar cells and practically no capacity in the rechargeable batteries. As time went by and the months passed, he heard all the seasonal effects of sunlight and eclipse on the spacecraft as it came into range while still in eclipse and therefore was silent. Later he heard its signal become unstable and disappear long before it reached predicted LoS when it entered eclipse.

All these things would not have been heard and all that they taught him about how a satellite behaves in space would not have been learned, had he not continued to listen to the signals after the satellite was identified.

If you are going to look for TIROS 10 you should be aware that although many people list it on 136.230 MHz, you will find it is now transmitting on 136.235 MHz. It transmits least and weakest when it is in eclipse for a large part of its orbit and when it gets a lot of sunlight you may hear the image transmission systems come on and it will sound like an APT bird, but TIROS 10 transmits no images of the Earth. The sensors, no doubt, failed long ago and only the synchronizing portion of the image signal is actually output from the satellites' transmitter.

This spacecraft has been up there and operating in some manner or another for nearly 30 years. It will likely continue to operate as it has been, in various modes depending on solar illumination, for many years to come until some catastrophic incident takes out something in the power controller systems. You can listen to this satellite now and in the future, and if you take good notes you will be able to plot the changes in the transmissions from the transmitter over the seasons of the year. Look for it before AoS and after LoS. Note what happens as it comes out of and goes into eclipse. Pay attention to the signal strength during a pass and see how it differs from AM to PM passes and day to day through the seasons. This spacecraft is a free experiment put up there just for us to play with and try to understand. We don't need to start a giant cookie sale to raise $40 million to build and launch a new satellite just to learn how it behaves in space, we have one handed to us at no additional charge from NASA. Take advantage of it! And now for something a little harder to hear.

Satellites that put out a signal all the time (even if it's just a beacon) or at least whenever it is in sunlight are pretty hard not to hear. Something that takes a little more looking and hunting for are those spacecraft that are commanded from Earth ground stations and/or operate from internally programmed sequences.

Satellites that put out a signal all the time (even if it's just a beacon) or at least whenever it is in sunlight are pretty hard not to hear. Something that takes a little more looking and hunting for are those spacecraft that are commanded from Earth ground stations and/or operate from internally programmed sequences. Most modern spacecraft have "fail safe" or "safing" feature that in the event of loss of contact with the ground will put the spacecraft into a mode of listening for commands and occasionally calling for "help". Or maybe it sings out every now and then to let small and remote ground stations scattered around the world know it's within range and OK to send up data or a message.

One such satellite can be heard with relative easie by listening on 137.720 MHz. This bird can be heard just about anywhere in the world because of its 82.5 degree inclination. Settled into a 950 km circular orbit, it provides for a nice long pass each time it comes by. If some of you think that orbit sounds familiar, you are right if you were thinking of a Meteor 2-nn series mission. The Russian (CIS) APT satellite uses the same orbit. In fact, Meteor 2-21 uses the same identical orbit because TemiSat (the satellite we are talking about) was launched as extra cargo on the same booster as Meteor 2-21 on Aug 31, 1993.

TemiSat is an Italian data-relay satellite and was the first "Western" spacecraft to be orbited by the former Soviet Union. In the past, instruments and complete systems have been attached to CIS orbital systems, but this was the first "piggyback" launch of another satellite. It's a small object (only about 32 kilos or 70 lbs), but it can relay digital transmissions of data from a thousand or more sensor packages on Earth back to Telespazio, the owner/operator's ground station in Fucino, Italy. Telespazio's success with this initial mission will result in more data being relayed by TemiSat and possibly the launch of a second satellite that was built at the same time and which was placed into storage in Germany by the spacecraft's builder Kayser-Threde.

We are likely to see more and more satellites like this as use of a space-born platform to relay data from remote or dispersed sites becomes common because it can be done so cheaply.

Meanwhile, we can listen to the various transmissions this satellite is making. Transmissions from TemiSat were first heard on 137.720 MHz in the Western hemisphere when the spacecraft was in the "separation" or "safing" mode. This mode occurred after launch when the spacecraft was separated from the booster until it made contact with ground control in Italy. This mode is also set if the spacecraft loses contact with the ground station for longer than the preset number of hours.

Measurements and timings made shortly after launch indicated a range of timings for this cycle: Transmitter on for 20 to 29 seconds (a variation of 9 seconds has been noted), transmitter off; spacecraft listening for 2:20 to 3:03 minutes (a variation of 43 seconds has been noted). The variation in the timings is thought to be due to the vagaries of the timing devices on board the spacecraft.

The sequence of events used to identify this satellite are:

1) Transmitter is turned on
2) Series of synchronizing start pulses is sent
3) Telemetry data burst at < 600 bps is sent
4) Series of synchronizing stop pulses is sent
5) Transmitter is turned off

The spacecraft then listens for a signal from the ground station on another frequency for approximately 2 to 3 minutes. It then repeats the sequence.

The signal appears to be audio frequency shift keying (AFSK) and can easily be heard in the narrow band FM mode on most scanners and other receivers. The signal is strong and stable with no noticeable frequency or amplitude variations. If you have any digital signal decoding abilities, you may want to try reading the data being sent. The routine is repeated several times en each pass and you should have no trouble getting a good copy.

Since the initial days early after its launch TemiSat has changed its transmission pattern and recently "modes" other than that described above have been heard.

Listen in on this interesting signal and let us know what you hear.

And now, the envelope please.

Although we have only published two issues of *Satellite Times* in 1994, one reader of the some of the articles I published in *Monitoring Times* has diligently pursued the mysterious signals from "beyond" with a vigor seldom seen. He caught the satellite sleuthing fever only a year ago and has spent half his wages on toll charges to Ma Bell and the other half on a brand spanking new ICOM R-7000 when it became clear to him that he had to hear "all those signals". His undying pursuit (no, passion) to track and identify not only near-Earth satellites, but far-Earth satellites has cost him family, friends, food and much-much more. He can no longer recall his cat's name and has forgotten how to drive. He is now a mere hollow shell of his former self, but has logbooks that document an exciting year "in space".

Therefore, for time and energy expended in the field of satellite tracking above and beyond the realm of normal human activity, we proudly present the 1st annual (1994) award for "Satellite Tracking and Monitoring" to Gary Davis of Philadelphia. Penn. The award this year is accompanied by the very large (and heavy) National Air and Space Museum book. Congratulations Gary, this huge volume will be on its way just as soon as I can get the house mortgaged to pay for the shipping costs.

To all the rest of you out there, thanks for your response and keep those cards and letters coming. We have no other purpose than to share your stories and seek the answers to the many unknowns for all of us.

This month we have a letter from Mr. Richard Fader of Fort Lee, New Jersey. Mr. Fader asks. "I have a 1983 Dodge. Whenever it gets hot, the heater comes on and the glove compartment door pops open. What can I do?" Well Mr. Fader, you are asking the wrong person, I think you want Click and Clack the Tappet Brothers.

We'll see the rest of you next time. ST

TemiSat is an Italian data-relay satellite and was the first "Western" spacecraft to be orbited by the former Soviet Union. In the past, instruments and complete systems have been attached to CIS orbital systems, but this was the first "piggyback" launch of another satellite.

FIGURE 2: *Initial orbital parameters:*

I.N.D.	Common Name	Cat #	Launch Date	Launch Site	Inc.	Per (min)
	Apogee (km)	Perigee (km)	M.M.			
1993 055A	Meteor 2-21	22782	31 Aug 1993	Plesetsk	82.53	104.0
967	933	13.83				
1993 055B	TemiSat	22783	31 Aug 1993	Plesetsk	82.53	104.0
957	932	13.83				
1993 055C	rocket body	22784	31 Aug 1993	Plesetsk	82.54	104.1
966	933	13.83				

DOMESTIC

TVRO

By Dr. Frank Baylin

Where Do We Go from Here?

It is clear that the new direct-to-home (DTH) small-dish digital "direct broadcast systems" (DBS) are here to stay. DirecTV/USSB® are now turning on 10,000 customers weekly and should reach the half million subscriber mark by year end. PrimeStar® should have nearly 200,000 subscribers at this time. A total of ten million customers are predicted to sign on by the year 2000. Furthermore, other would-be DBS entrants are claiming their stakes. EchoStar, a subsidiary of Echosphere Corporation, plans to launch two high powered satellites in 1995 and offer consumers yet another alternative to cable.

But how will this new DBS industry impact the existing 3 million or more large-dish C-band systems installed in the United States? Will the direct-to-home satellite broadcast industry be controlled by just a few giants or will the grass-roots nature of this business persist? Will video dialtone vault telephone companies into the forefront as cable/telephone providers? After all, well above 99% of American dwellings are hooked into the all-pervasive telephone network. How do wireless cable systems fit into this picture. These are important questions to consider as we approach the 21st century and as the information superhighway rapidly grows its tentacles.

The C-band industry began to thrive in the early 1980s because it provided an alternative to cable and, in many instances, was the only source of programming. It grew out of the efforts of a handful of talented electronic tinkerers who demonstrated how a satellite reception system could be created for a reasonable cost. While it proved a viable technology, the main attraction to most was initially the novelty of intercepting programming intended for cable TV networks and the opportunity it allowed some to "beat the system." Soon after HBO began scrambling its signal in late 1985 with use of the VideoCipher II technology, the hackers again beat the system and a sizable portion of the owners of home TVROs received programming free-of-charge.

What was once considered an irritation to either be ignored or easily defeated grew into a strong industry that launched a few of the original pioneers such as Chaparral Communications and Echosphere Corporation into position of considerable financial success. The subsequent introduction of the VideoCipher II+ system and the partial enforcement of strong anti-piracy laws in the early 1990s encouraged major programmers to view the home TVRO industry as a viable marketplace.

Today some predict that the new small dish technology spells the end to C-band satellite television. DBS apparently has room only for financial giants willing and capable of investing millions in advanced satellites, digital video compression systems and advertising. The most astute financial experts believe that at most two or three of the DBS players will survive the competition.

In fact C-band satellites are and will remain a valuable component in our communication system. Hundreds of millions of dollars are invested in existing satellites that have in-orbit lifetimes now approaching fifteen years and new satellites are either in construction or planning stages. Most cable TV operators receive and will continue to receive their audio and video feeds via C-band satellites. Of course, Ku-band spacecraft operating in the FSS Ku-band range (11.2 to 11.7 GHz) as well as the new DBS satellites will also carry some of this load. There will also continue to be a wider selection of programming available on C-band for some time to come.

However, there is also little doubt that the heyday of C-band home reception systems has passed. Existing systems will continue to function and some level of sales activity will continue. This depends to some extent upon the sales ability of individual satellite equipment dealers. But the new DBS and to some extent wireless cable systems will take siphon some customers away.

Wireless cable systems use a microwave transmitter operating at 2.5 to 2.7 GHz with a 5 to 40 miles radius to deliver programming to small receive dishes. It is "wireless" cable via a local headend. Many dozens of wireless systems are now either operating or in planning stages and offer direct competition to cable TV. This technology has the advantage of delivering local services as well as programming captured from satellite.

Aside from the issue of availability of programming and the ability of C-band systems to scan the arc for novel feeds, it would appear compressed digital DBS broadcasts that can transmit six or more high quality programs via one transponder leave C-band systems in the dust. Not so. When PrimeStar® introduces DigiCipher II technology in early 1995 (a "sidecar" will be retrofitted onto existing receivers) General Instruments, the DigiCipher and VideoCipher manufacturer, will likely introduce a backwards-compatible module to replace the VideoCipher II+ in C-band receivers. At this point, large-dish systems would still "scan the arc" for unusual audio and video programming, but also be able to tune into PrimeStar® broadcasts. The transition to compressed digital broadcasts on C-band will also begin resulting in greater availability of special interest, narrowcast programs. Of course, compression will be available to both wireless and wired cable TV systems.

Owners of C-band systems have another interesting route to follow. A dual-band feed that receives conventional linearly polarized C-band signals as well circularly polarized DirecTV/USSB® signals in conjunction with both a low cost C-band and a DSS® receiver, can receive the best of both worlds. The C-band receiver would have no need for a VideoCipher II+ module since premium programming would be received via the DirecTV/USSB® route and thus would be relatively low cost.

But has the adventure gone? To some extent this is true. The days of building inexpensive 5 meter dishes to receive domestic

Continued on page 30

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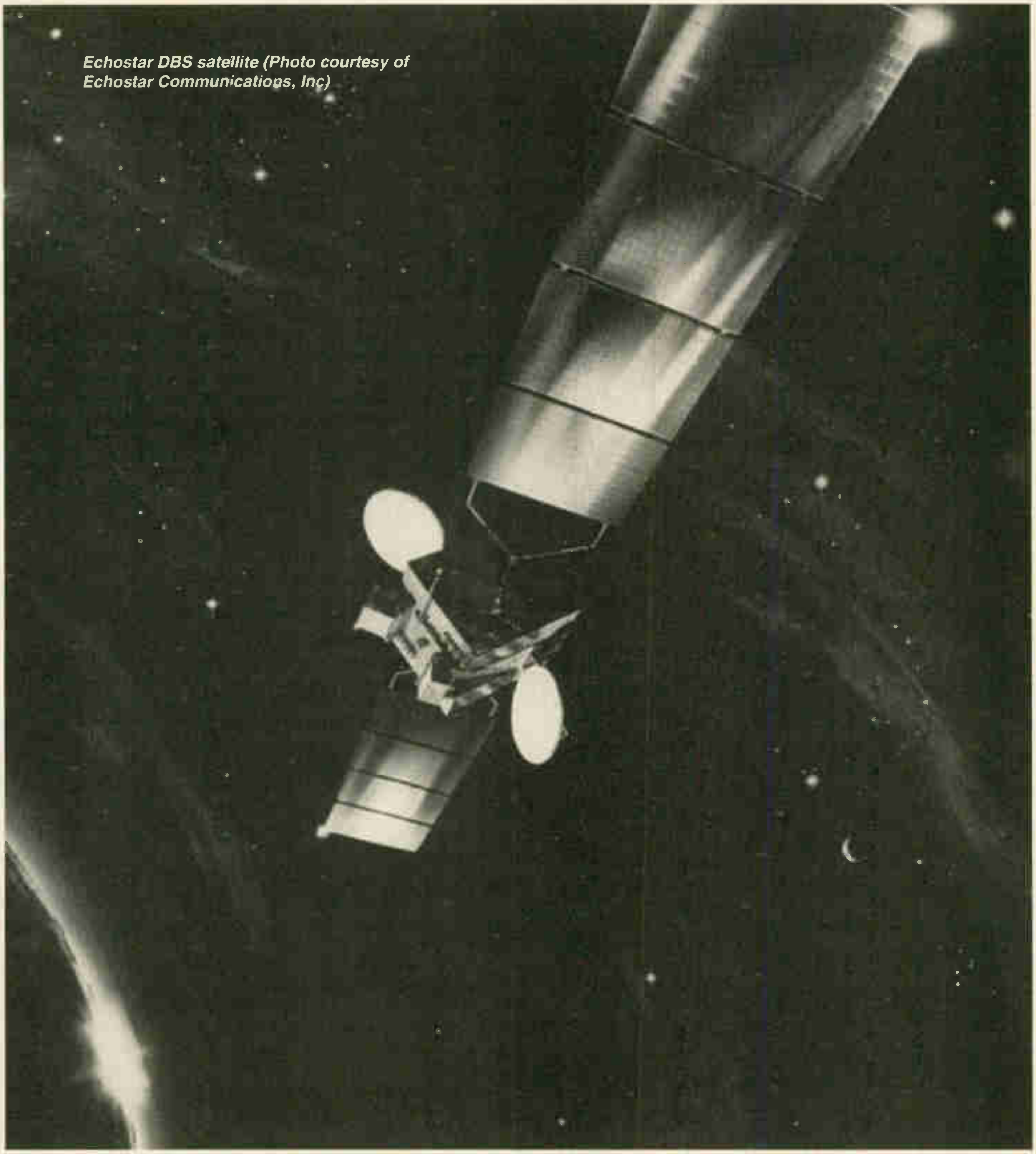
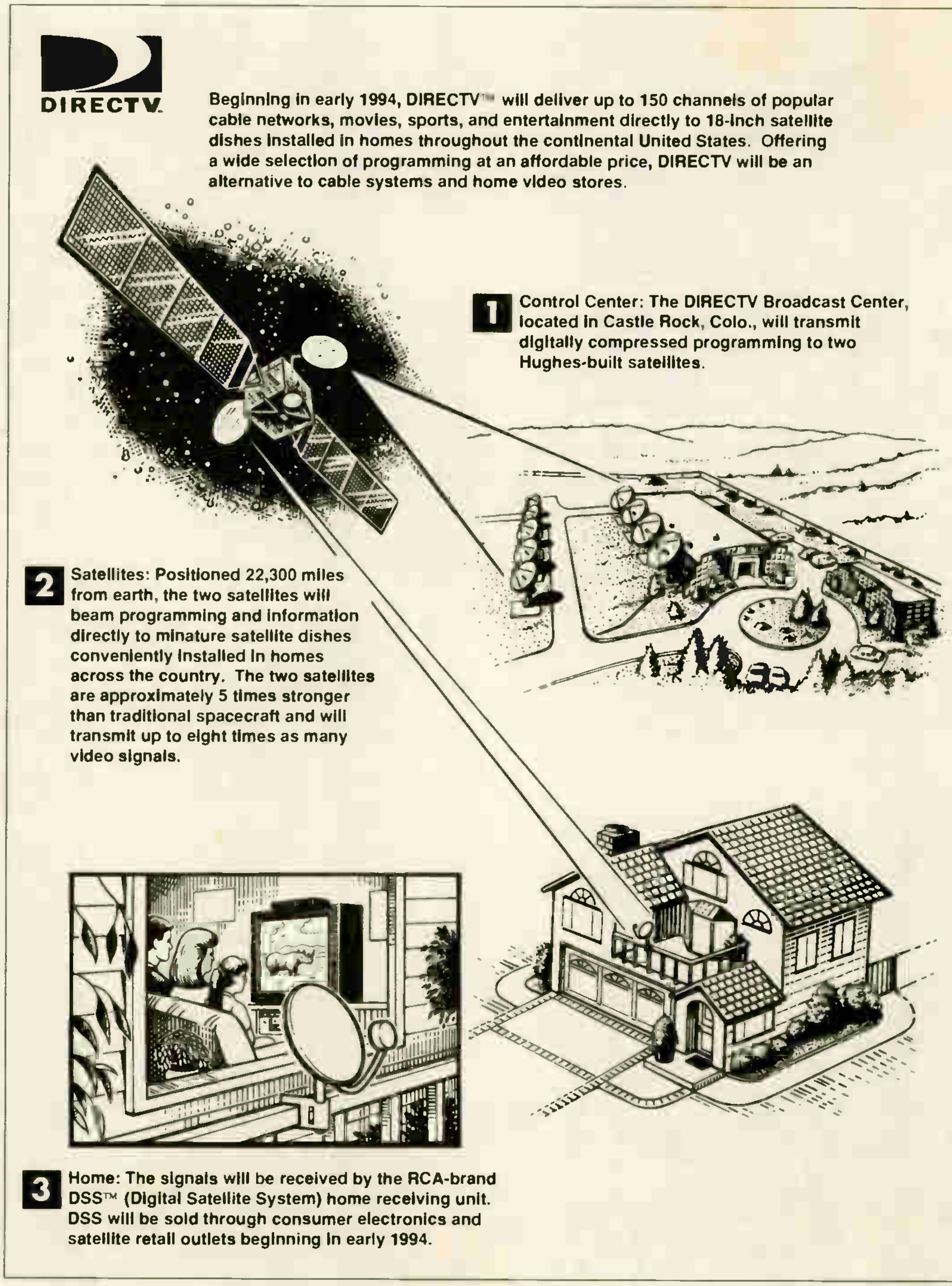

Echostar DBS satellite (Photo courtesy of Echostar Communications, Inc)

Nine groups have filed for DBS licenses with the Federal Communications Commission, but only six intend to build and operate direct-to-home television broadcast systems. One DBS system is now operational, the DirecTV/USSB venture.

transmissions in garages are probably gone. However, many serious satellite dealers will make the transition to selling both C-band and DBS systems as well as complete home entertainment and home theater components. But hackers may still throw a monkey-wrench into the works and create both some damage and some excitement.

It is rumored that VideoCipher II+ is already hacked. But the legal risks of selling components are great enough to protect the system. The VideoCrypt system that is the security backbone of the DirecTV/USSB® digital satellite system, as has been its look-alike cousin used in Europe, will likely be compromised. To date, nine updated smart cards have been issued in Europe to recover system security. What if the American system is hacked. It would certainly be easier and less risky for pirates to mail a credit-card sized smart card from overseas to American customers than to illegally modify a VideoCipher II+ in the United States. When this system is hacked, sales may skyrocket, an effect that would be similar to the one that occurred in the C-band marketplace in the late 1980s. After all, the lure of something for nothing is strong. But what if illegal subscribers are then presented with a more secure system after millions have purchased systems. Then who wins.



What about video dialtone which could throw the 747-sized monkey wrench into the works. There is no doubt that, if the world economy survives the long haul, within twenty to thirty years hundreds of audio and video programs will be distributed from national and perhaps international headends to subscribers via optical fiber "telephone" lines. In the United States, the fiber backbones have been completed and feeder lines are now being constructed. But one major stumbling block still remains the cost of converting from an optical to an electrical signal at the end-user site. The transition will probably occur over a period of decades. But technology does take surprising twists and turns. ST

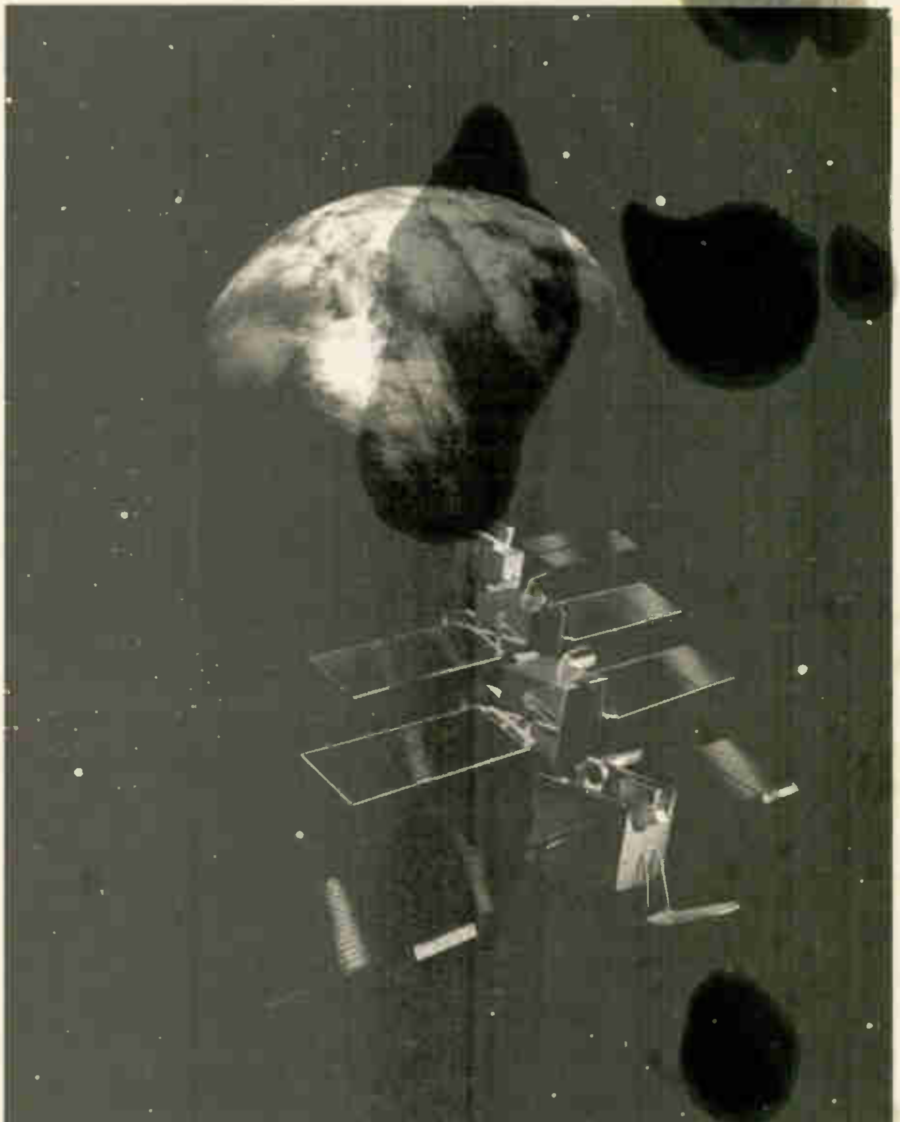
Dr. Frank Baylin, president of Baylin Publications, has served the industry as author and consultant since the early 1980s. He has authored and co-authored more than ten books as well as software and a video. He has recently published a new book "Miniature Satellite Dishes The Digital Television Revolution" available for $20 plus 4 s/h. Interested readers can also obtain a free catalog from his company by writing Baylin Publications at 1905 Mariposa, Boulder, CO 80302 or by calling 800-483-2423.

INTERNATIONAL
TVRO

By George Wood
(SMOIIN/KA6BIN)

In the early morning hours of November 1st an Ariane rocket carried the long-awaited Astra 1D satellite into orbit. When it becomes operational and joins the other three Astra satellites at 19 degrees East, it will add 16 more Ku-band TV channels to the 50 currently at Europe's foremost satellite position.

Besides providing 66 channels at just one position, and thus dispensing with the need for antenna rotors, Astra requires very small dish antennas. In most of the coverage area antennas just 2 feet in diameter are all that are needed and there are even some hi-tech horn and flat plate antennas that will do the job in half as much less space. In fringe areas like Scotland and northern Scandinavia Astra dishes can reach three or four feet, while in areas of Finland and Eastern Europe that are technically outside the Astra footprint, TVRO monitors are forced to use much larger dishes, but still smaller than your average American C-band monster.



Actually, two of the Astra 1D frequencies have been alive for the past year, via the Astra 1C satellite. Transponder 63, on 10.921 GHz, is being used by the Dutch channel RTL-4, while the Scandinavian-Benelux pay film channel FilmNet has been using transponder 64, on 10.935 GHz, until recently for an extra channel to the Benelux.

The problem facing TVRO monitors in Europe has been that these channels, along with the other new transponders on Astra 1D, lie outside the original Astra frequency band, the ordinary European satellite band between 10.950 and 11.700 GHz. Astra 1A transmits on transponders 1 to 16 on frequencies between 11.200 and 11.450 GHz. 1B, with transponders 17 to 32, continues up to 11.700 GHz. When 1C arrived last year, it carried transponders numbered between 33 and 48, but put them into the unfilled lower gap of the band between 10.950 and 11.200 GHz.

All this is part of the usual bandwidth covered by European satellite receivers. But when Astra realized it had a good thing going and ordered a fourth satellite, it put transponders 49 to 64 between 10.741 and 10.921 GHz, below the reach of standard European receivers. Now everyone has to retool to pick up on those new frequencies.

When Astra 1C put transponders 63 and 64 on the air last year, many monitors discovered they could tweak their receivers' offset bandwidth to pull reception down far enough in frequency to pick up the higher of the two channels, transponder 64. That was hard to maintain on a regular basis, but an enterprising British company called Global Technology quickly marketed a small and inexpensive converter that shifted the Astra 1D frequencies up 500 MHz, and made reception of the mostly uncoded RTL-5 on transponder 64 possible.

The converters have sold well in anticipation of Astra 1D, and now that the satellite is there, there's a definite market. I've heard that Global Technology took out a huge insurance policy on the 1D satellite to cover the cost of the thousands of converters manufactured just before the launch. Now it's a seller's market for those converters, but they all would have been worthless had 1D not gone into orbit. Additionally, most of the European satellite receivers that have entered the market in the last year have included an extended bandwidth, to provide 1D reception.

Actually, like Astra 1C, 1D carries two transponders that rightfully belong to the next satellite in the series, in this case Astra 1E, scheduled for launch in June. Onboard the new spacecraft are

The problem facing TVRO monitors in Europe has been that these channels, along with the other new transponders on Astra 1D, lie outside the original Astra frequency band, the ordinary European satellite band between 10.950 and 11.700 GHz.

transponders for channels 65 (11.719 GHz) and 66 (11.739 GHz). These are above the usual European satellite band, but close to the European DBS band, so there are probably many receivers already in service that cover those frequencies.

Astra and British Sky Broadcasting

Before we look at the programming on the new satellite, let's backtrack and check out the existing Astra services, including British Sky Broadcasting, the company that to many people in Britain is synonymous with Astra. In reality BSkyB, as it's known, is more synonymous with Rupert Murdoch, it's founder and major owner.

Nowadays Murdoch, besides his extensive newspaper and publishing interests, owns Fox Broadcasting and the new Fox Network in the US, as well as Asia's largest satellite broadcaster, Star-TV. Murdoch's interests are truly turning into a global media empire. But BSkyB was Murdoch's first TV venture, and it had its modest beginnings as Europe's first English-language satellite broadcaster, on the very first ECS-1 satellite.

Back then, Sky Channel, as it was known, broadcast in the clear, and was popular among both the dish owners and cable viewers of the late 80's. Most of these were outside Britain. The British, probably because they have had four of the best TV channels in the world, have been slow to take to satellite, and much slower to take to cable. On the other hand, the Benelux countries were practically 100 percent cabled at an early date. Up in Scandinavia, another area where English is widely understood, and where each country traditionally has had only one, or at most two, public service broadcasters, and no commercial services at all until recently, many people bought dishes as soon as they appeared on the market. Sky's biggest audience must have been in Scandinavia and the Benelux.

Murdoch is generally regarded as a media genius, but I am convinced that he blundered badly when the first Astra satellite was launched. He immediately moved Sky Channel to Astra, and began launching new channels. He also decreed that his channels would henceforth be restricted to Britain and Ireland only. The reason was that he didn't want to have to pay royalties for all of Western Europe. Of course, since there was no reliable coding system in those days, TVRO viewers could continue to tune in. But cable systems had legal obligations and restrictions, and one by one they were compelled to pull the plug on Murdoch's channels. With them went the bulk of the audience. It has taken Murdoch years to recover from the self-inflicted wound.

Eventually Murdoch's original Sky Television bought out the failed DBS company British Satellite Broadcasting, and the new British Sky Broadcasting was created. On the first three Astra satellites it includes the general entertainment channel Sky One (who's schedule is liberally filled with programs from Murdoch's Fox network in the U.S.), the news channel Sky News, Sky Sports, and three pay film channels Sky Movies, the Movie Channel, and Sky Movies Gold.

This summer, half a year later than originally announced,

Figure 1: *Astra 1A, 1B, and 1C Channel*

Ch	Service	Transponder Frequency (GHz)	Language
1	RTL 2	11.214	German
2	RTL Plus	11.229	German
3	TV3 Sweden (D2-MAC)	11.244	English/Swedish
4	Eurosport	11.258	English/German/Dutch
5	Vox	11.273	German
6	SAT 1	11.288	German
7	TV1000 (D2-MAC)	11.303	Swedish/English (pay)
8	Sky One	11.317	English (pay channel)
9	Teleclub	11.332	German (pay channel)
10	3-SAT	11.347	German
11	FilmNet+ (to Scandinavia)	11.362	English (pay channel)
12	Sky News	11.377	English
13	RTL 4	11.391	Dutch (partly coded)
14	Pro 7	11.406	German
15	MTV Europe	11.421	English
16	Sky Movies Plus	11.435	English (pay channel)
17	Premiere	11.464	German (pay channel)
18	The Movie Channel	11.479	English (pay channel)
19	ARD	11.493	German
20	Sky Sports	11.509	English (pay)
21	DSF (Sports)	11.523	German
22	VH-1	11.538	English (pay channel)
23	UK Gold	11.553	English (pay channel)
24	JSTV/Country Music TV	11.567	Japanese (pay)/English
25	N3	11.582	German
26	Sky Gold	11.597	English/Hindi (pay)
27	TV3 Denmark (D2-MAC)	11.611	Danish
28	CNN International	11.626	English
29	n-tv (News)	11.641	German
30	Cinemania	11.656	Spanish (pay channel)
31	TV3 Norway (D2-MAC)	11.670	English/Norwegian
32	Documania	11.685	Spanish (pay channel)
33	ZDF	10.964	German
34	UK Living	10.979	English (pay channel)
35	Children's/Family Channel	10.994	English (pay)
36	Sogecable	11.009	Spanish (pay channel)
37	Cartoon Network/TNT	11.023	Eng/French/Swed/Nor.
38	QVC (Shopping)	11.038	English (pay)
39	West 3	11.053	German
40	Sogecable	11.068	Spanish (pay channel)
41	Learning Channel/Discovery	11.082	English (pay)
42	Bravo/Adult Channel	11.097	English (pay)
43	MDR	11.112	German
44	Galavision	11.127	Spanish (Mexico)
45	BFS 3	11.186	German
46	Nickelodeon/TV Asia	11.156	English (pay channels)
47	Sky Soap/Travel/Sports 2	11.171	English (pay channels)
48	SWF 3	11.186	German
63	FilmNet Central Europe	10.921	Polish, Hungarian, etc.
64	RTL-5	10.936	Dutch (partly coded)

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BSkyB finally launched Sky Sports 2 on the last available Astra 1C transponder (47). That was intended to make room for the abundance of sports programming BSkyB had bought. Just as Murdoch's Fox captured the rights to American football out from under CBS, Murdoch's BSkyB won the rights to Britain's most important football, soccer, away from the BBC, a parallel strategy on two continents.

However, since most major sports events happen on weekends, Sky Sports 2 only operates from Friday afternoons to Sunday night. As I mentioned in the last issue, Murdoch signed a deal with one of his competitors in the Far East, to broadcast a Chinese-language channel over the Sky Sports 2 transponder at night. The rest of the gap was filled in October, when Sky Soap, featuring venerable American soap operas like "As the World Turns" and "Peyton Place", was launched on transponder 47 during the days, with Sky Travel, a travel channel in connection with Murdoch's new travel agency, during the evenings.

The Sky Travel story has a Dark Side. A few months ago when a new Travel Channel appeared on Intelsat and expressed interest in moving to Astra, talks were reportedly held with Sky on some kind of co-operation. Those discussions came to nothing, but while the Travel Channel is still languishing away on distant Intelsat, Sky has launched its own travel channel. The pattern seems to be repeating: The Sci-Fi Channel is expected to appear on European screens soon, probably via Eutelsat's new Hot Bird-1 satellite, and not Astra. But talks have reportedly been held with BSkyB on working together, and now, curiously, BSkyB is reportedly considering launching its own Sky Sci-Fi channel on Astra 1D. There may be a lesson here.

Murdoch's News International developed its own coding system for the PAL TV standard used by most European broadcasters. Called Videocrypt, it's been cracked on a regular basis by hackers, but until recently never on a widespread enough basis to cause alarm.

All this changed when the Astra 1C satellite was launched in 1993. Astra 1C attracted many English-language programs that had been on Intelsat 601 — Discovery, the Children's Channel, Country Music Television, and the classic TV show and film channel Bravo. There were several new stations as well — the Family Channel, Nickelodeon, QVC, and Turner Broadcasting's TNT/Cartoon Network package from the U.S., and a new British channel aimed at women called UK Living.

The latter is a joint effort by the BBC and the independent British Thames Television (which lost the local license to broadcast to London a few years ago). It followed their earlier Astra 1B channel, UK Gold, which carries classic British shows from the BBC and Thames archives.

The amazing thing was that Murdoch and BSkyB succeeded in convincing virtually of these channels, even though most of them had been on the air to all of Europe in the clear, to come under the BSkyB umbrella, use the Videocrypt coding standard, and restrict their broadcasts to the British Isles only.

A few, like Turner's TNT and Cartoon Network, refused. MTV came close to suing Murdoch when publicity for the new package, called Sky Multichannel, claimed the uncoded MTV was part of the package, which it wasn't. The Children's Channel and Discovery, which already had large audiences on cable in Scandinavia and the Benelux, had to work out alternative arrangements to

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keep those viewers despite Murdoch's Videocrypt coding.

It's hard to understand why a shopping channel like QVC would want to code its signals and deny any possible viewers a chance to see its offerings. Recently the channel's American head Barry Diller announced that QVC would be uncoding and leaving the BSkyB package. He has reportedly accused BSkyB of failing to deliver promised audiences.

But the blow that has rebounded on Murdoch and led to the biggest smartcard hack in European satellite history, was when Sky One coded (until the launch of Multichannel, Sky One had been in the clear). Because Sky One carries "Star Trek: the Next Generation" twice every weeknight....suddenly Trekkers across the continent were denied their daily dose. And the hackers among them got mad, and went to work.

What emerged was the "Season 7 hack" named after TNG's final season. Unlike previous card-only efforts, it used a PC linked to an expired Sky smartcard. And it worked. Diagrams outlining the hack were spread from Germany across the computer bulletin boards of Europe, back to Britain.

And Sky got very worried.

Royalites in the Satellite Age

There's an important ideological question here. BSkyB restricts its subscriptions to the British Isles because it only wants to pay royalties for Britain and Ireland. But Britain is part of the 12 nation European Union (EU) and the 16 nation European Economic Area (EEA). Under EU and EEA regulations, goods and services sold in any member country have to be made available to residents of all member countries. BSkyB is obviously not in compliance with those regulations, which very likely take precedence over royalties agreements.

Of course, the agreements were drawn up in an age when rights for Britain meant terrestrial rights for transmissions that could reach every citizen in that country and nowhere else. In the satellite age, with coding and subscription distribution, it doesn't really matter where the viewers are geographically. Stations know exactly how many subscribers they have, and should pay for the rights accordingly, by number of actual viewers and not where they are located.

It's hard to say when the law will catch up to reality. No one from outside Britain has sued BSkyB yet in the EU courts, but it is just probably a matter of time. Interestingly, what makes the proliferation of hackers and decoders in Germany possible is a provision in the law there that says it isn't illegal to sell decoders for programming that isn't available for subscription in Germany!

BSkyB has struck back, with a new series of smartcards that have replaced those covered by the Season 7 hack. The card pirates were also the victim of an elaborate sting operation by BSkyB last year, when the pirates were tricked into paying a fortune for out-of-date code. The new series of BSkyB smartcard has yet to hacked, but it is probably just a matter of time.

Apparently Murdoch's Videocrypt is the coding system being used by DirecTV and USSB on the new American DBS package. This gives American and European hackers a common target, and an opportunity for joint efforts. Murdoch's obvious desire to own the global standard may be his undoing.

BSkyB's other tactic has been to try to market some of the Multichannel package to various European countries, in co-operation with FilmNet, as something called Multichoice. But, while Multichoice seems to be mentioned in the British media a lot, it is keeping a low profile in the rest of Europe. When I attended the recent Vision 94 Show, the biggest satellite TV show held in Scandinavia, Multichoice's only publicity concerned packages to small cable systems.'More to the point, none of Murdoch's own channels are included in the Multichoice offerings, just FilmNet and the non-BSkyB channels that used to be in the clear until Multichannel came along. And until Sky One is available to European viewers, the hacking will undoubtedly continue.

Recently, the Sky Multichannel package has been augmented by VH-1, which had been promised "early in 1994", and didn't appear until August. Nick at Nite, which was also promised "early in 1994" has yet to arrive. But when VH-1, Sky Soap, and Sky Travel entered the line-up, Sky suddenly upped its rates by around 5 dollars a month. Besides the "great new channels", the company also threw in a new monthly program guide, which only lists the Multichannel offerings, and nothing from the BBC, Britain's independent television, or non-Multichannel satellite broadcasters.

Considering that Rupert Murdoch also owns "TV Guide", it is a poor effort, and no competition for Britain's several existing TV guides and many newspaper TV supplements. Many Sky subscribers have written letters to British satellite magazines, complaining about the rate hike and the poor quality of the magazine, and vowing to cancel their subscriptions. The publicity campaign launched at the same time as the rate hike had as its slogan "No Turning Back", which to many irate subscribers must have seemed like rubbing salt into the wound.

Other Channels

There are more channels on the first three Astra satellites than the Multichannel offerings. The most popular must be CNN International, MTV, and Turner's TNT/Cartoon Network combination. There are also the ethnic channels TV Asia (for South Asians in Europe) and JSTV (for Japanese), the softporno Adult Channel, the Swedish, Norwegian, and Danish versions of TV3 and the Scandinavian film channels TV1000 and FilmNet. There's also the uncoded sports channel Eurosport, with sound tracks in English, German, and Dutch, and Spanish reportedly on the way.

There are four coded Spanish Astra transponders, two Dutch channels, Galavision from Mexico, and no less than 15 German-language outlets. Many British viewers ask why most English channels are only available by subscription (even those filled with advertising), while virtually all the German channels are in the clear? The answer is that the German channels are all relays of profitable terrestrial channels, while the English- channels are only carried on satellite.

Recently FilmNet converted its coded outlet on transponder 64 from a service to the Benelux into a new Central European

Back in late September, the British magazine "What Satellite TV" published a list of proposed Astra 1D channels, but this must have been largely a case of wishful thinking, as the list contains 11 English language channels and only one German channel along with two unknowns.

channel, with separate soundtracks or subtitles planned in Polish, Hungarian, Czech, and Slovakian.

The only major Western European language not found on Astra is French: the French have been faithful to their own Telecom satellites. The French soundtrack on Eurosport has been moved to a new Telecom Eurosport channel, and Ted Turner's TNT/Cartoon Network has been denounced in both France and Belgium for carrying a French soundtrack. (No one has objected to the soundtracks in German, Dutch, or Swedish.) Yogi Bear is apparently actually perceived by the French government as a cultural threat. The condemnation came the same week a French government minister praised the high cultural value of MTV, so there is something not quite logical at work here. Turner's retaliated by having Quick Draw McGraw publicize a drawing contest for youngsters using some horribly mispronounced French words is hilarious.

1D Programming

Astra's owners, the Luxembourgian company SES, cautioned viewers not to buy special equipment for Astra 1D before the programming on the new satellite was officially announced. And, closed-mouthed as ever before the launch, SES said absolutely nothing about which channels they were negotiating with. As I write this column, it's still unclear. Unusually, there has been very little speculation about the new channels, quite unlike the situation when Astras 1B and 1C were launched. Even at the Vision 94 Show here in Stockholm shortly after the launch, the people at the Astra exhibit could say nothing about the new programming.

This may be because a coup was in the offing and was narrowly averted at the last minute. According to reports, SES's Director-General Pierre Meyrat tried to sell most of the capacity of Astra 1D, and the upcoming 1E and 1F satellites as well, to a small circle of major customers, namely Rupert Murdoch, FilmNet's South African owner Nethold, and the German media conglomerates Bertelsmann and the Kirsch Group.

The SES board decided the company would have sacrificed its principle of independence towards program suppliers if it had permitted the arrangement, and on October 20th Meyrat was relieved of his duties.

Back in late September, the British magazine "What Satellite TV" published a list of proposed Astra 1D channels, but this must have been largely a case of wishful thinking, as the list contains 11 English language channels and only one German channel along with two unknowns. Since the German Telekom bought a 16.7 percent share of SES at the beginning of this year, and Astra is already the main home of German-language channels, more are bound to come, and the list is questionable at best.

For what it's worth, here's some of the speculation: It's almost certain that between 4 and 6 transponders have gone to British Sky Broadcasting. BSkyB already has three pay film channels on the old Astras. Reportedly Murdoch will give two of these channels, Sky Movies and the Movie Channel, two more transponders each on Astra 1D, so they can run staggered schedules. This is called "video-nearly-on-demand" (VNOD) and by giving customers three opportunities to watch a film (once on each transponder with an hour between each start), this is supposed to mimic the future video-on-demand services looming over the vast expanses of open bandwidth on the fiber optic networks of the future information superhighway.

Until now, it had been thought that proper VNOD would begin with the digital transponders of Astra 1E, when each transponder can carry up to eight discrete signals. The plans mentioned previously had each transponder dedicated to a recent blockbuster hit film, with a new start every 20 minutes, which is considered close enough to on-demand as you can get on a satellite. Once an hour is a considerable departure from the original idea.

Besides Sky Movies 2 and 3 and the Movie Channel 2 and 3, Astra 1D may carry one or two more BSkyB channels. Four transponders are said to be set aside for tests of digital television.

Digital Radio

Digital radio is coming soon to Astra, courtesy of two American rivals. DMX is to initially launch a 30 channel DTH (direct to home) service from Astra in April, 1995. A full package of up to 86 channels will follow. Subscriptions will be handled in the UK by BSkyB, by Multichoice in Scandinavia and the Benelux, and by Selco in Germany.

DMX's rival, DCR, known as Music Choice Europe over here, is also talking to Astra about launching a service. They want to carry at least 50 channels of digital music, including 35 of general interest, 4 classical, and 11 regional channels. But MCE's DTH plans are less definite than DMX's.

Astra's Future

The Astra 1E satellite is due to launch in June, carrying a further 18 transponders, numbers 65 to 82, using frequencies above the standard European satellite band between 11.700 and 12.060 GHz (65 and 66 already being include on Astra 1D). Astra 1F, scheduled for launch in 1996, is to carry transponders 81 to 103, on 12.070 to 12.470 GHz.

While SES has been closed-mouthed over who has booked transponders on Astra 1C, the company has already announced that France's pay film channel Canal Plus has signed an agreement for four 1E transponders and two on 1F. These satellites will be the first in the Astra system specifically dedicated to digital transmissions. Each of the 1E and 1F transponders will be able to transmit between four and eight digital programs simultaneously. It's hoped that this will lead to a proliferation of new channels and VNOD services, giving satellite a chance to continue to compete with cable.

That's it for this time. By the next issue, all the dust should have settled, and we'll be able to see exactly what is happening at 19 degrees and 13 degrees East, as Astra and Eutelsat begin the battle in earnest for European TVRO monitors. ST

INTRODUCTION

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

How to Use the Satellite Service Guide

The various sections of the SSG include:

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

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

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

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

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

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

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

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

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

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

Satellite Radio Guide

By Robert Smathers

CLASSICAL

Classical Music	E1, 9	6.32 (N)
	E2, 9	6.32 (N0
KUCV-FM, Lincoln, Neb. (Nebraska Public Radio)	S3,2/4	5.76/5.94 (DS)
Superadio Classical Collections	G5,21	6.30/6.48 (DS)
WFMT-Chicago, Ill.	G5, 7	6.30/6.48 (DS)
WQXR-New York, N.Y.	F4,15	6.30/6.48 (DS)

CONTEMPORARY

CHIN-AM/FM, Toronto, Ontario, Canada (Multilingual)	E2,20	6.83
E1,13(Ku)	6.83	
CKRW-AM, Whitehorse, Yukon, Canada (Adult Contemporary, oldies)	E1,18	5.41, 6.80
CJCA-AM, Edmonton, Alberta, Canada	E1,24	5.80
In Store Contemporary	S3,18	5.78, 5.96, 6.48
Superadio Light and Lively Rock	G5,21	5.96, 6.12 (DS)
VOCM-AM/FM, St. Johns, Newfoundland, Canada (Adult Contemporary)	E1,12	6.20
WVTY-FM, Pittsburgh, Pa. USA (Adult Contemporary)	F2,16	7.32

COUNTRY

CHON-FM, Whitehorse, Yukon, Canada	E1,12	5.40
CISN-FM, Edmonton, Alberta, Canada (Country 104)	E1,18	7.53/7.62 (DS)
In Store Country	S3,18	6.12
Superadio American Country Favorites	G5,21	5.04/7.74 (DS)
Transtar III Radio Network	S3, 9	5.76/5.94 (DS)
WOKI-FM, Oak Ridge-Knoxville, Tenn.	G3,15	6.20
WSM-AM, Nashville, Tenn.	G5,18	7.38, 7.56
WSM-FM, Nashville, Tenn.	F4,24	7.38

EASY LISTENING

CHFI-FM, Toronto, Ontario, Canada (Soft Adult Contemporary)	E1, 8	5.41/5.58 (DS)
	E1,6/10/12/14	6.80
Horizon	E1,22	7.62 (N)
In Store Easy Listening	S3,18	6.32, 7.22, 7.40
Superadio Soft Sounds	G5,21	5.58/5.76 (DS)
United Video Easy Listening	F4, 8	5.895 (N)
WZEZ-FM, Nashville, Tenn. (Soft Adult Contemporary, The Wave)	G3,13	6.20

FOREIGN LANGUAGE

Antenna FM (Greek)	G3, 9	5.88, 6.20
CBC Radio-French (East)	E1,20	5.38/5.58 (DS)
	E1,20	7.38/7.58 (DS)
	E1,10(Ku)	5.38/5.58 (DS)
CFGL-FM, Laval, Quebec (French)	E2, 5	7.62
CITE-FM, Montreal, Quebec Canada (French, Soft Adult Contemporary)	E2, 5	5.78
	E1,21(Ku)	6.12, 6.20
Adult Contemporary, station doesn't identify itself	E1, 9	7.58
	E2, 9	7.58
CJVB-AM, Vancouver, British Columbia, Canada (Ethnic)	E1,15(Ku)	6.12
CKAC-AM, Montreal, Quebec Canada1 (French, Adult Contemporary)	E2, 5	6.44
Foreign language/music	S3,15	5.76
French Canadian audio information service	E2,21	6.46 (N)
French language audio service	E1,21(Ku)	6.55
	E1,24(Ku)	6.55
French language rock station	E2,20	7.72/7.83 (DS)
	E1,13(Ku)	7.72/7.83 (DS)
French music	E1,21(Ku)	6.12/6.20 (DS)
	E1,24(Ku)	6.12/6.30 (DS)
Indian Sangeet Sager	E1,29(Ku)	6.12
Irish Music (Sat 1430-0000 UTC)	S3, 3	6.20
La Nueva Cadena Radio Christiana (Spanish)	F2, 5	5.96
RAI Satelradio (Italian)	F1,15	7.38
Radio Sedeye Iran (Farsi)	S3,15	6.20 (N)
Radio Sonora-Mexico (Spanish)	SD1,6	6.80
Radio Tropical (Haitian Creole)	S2,11	7.60
WCMQ-FM, Hialeah, Fla. USA (Spanish)	S2, 4	7.74, 7.92
WLIR-AM, Spring Valley, N.Y. (Ethnic)	S2, 1	7.60
WNTL-AM, Indian Head, Md. USA (Arabic)	G6,10	6.80, 6.20
WNWK-FM, Newark, N.J. USA (Ethnic)	S2,11	8.30
XEL-AM, Mexico City, Mexico (Spanish)	SD1,5	7.38
XEW-FW, Mexico City, Mexico (W-FM 96.9)	SD1,7	7.38
XEWA-AM, Monterrey, Mexico (Spanish, Super Estelar)	M2, 8	7.38
XEVZ-AM 1590 AM - rock (Spanish)	M2,22	6.80
XEX-AM/FM, Mexico City, Mexico (Spanish, La Super)	M2,14	7.38

JAZZ

KLON-FM, Long Beach, Calif.	G5, 2	5.58/5.76 (DS)
Superaudio New Age of Jazz	G5,21	7.38/7.56 (DS)
WQCD-FM, New York City, N.Y. USA	C4, 6	6.20

NEWS AND INFORMATION

Business Radio Network	F4,10	8.06 (N)
C-SPAN ASAP (Program Schedule)	F3, 7	5.58
C-SPAN II ASAP (Program Schedule)	F4,19	5.58
CJAD-AM, Montreal, Quebec, Canada	E1, 2	6.525 (N)
CNN Headline News	G5,22	7.58
CNN Radio News	S3, 9	5.62
	G5, 5	7.58
	GST2-2,6(Ku)	6.30
WCBS-AM, New York, N.Y.	G4,20	7.38
	G7,19	7.38
WCCO-AM, Minneapolis, Minn.	G6,15	6.20

RELIGIOUS

Ambassasor Inspirational Radio	S3,15	5.96, 6.48 (DS)
Brother Staire Radio	G5, 6	6.48
CBN Radio Network	G5,11	6.30/6.48 (DS), 6.12
	C3, 1	6.20
Christian Music Service	S2,23	6.20, 7.60
IBN Radio Network	F1,20	7.38
Religious music (easy listening)	G7,14	7.78
KILA-Las Vegas, Nev. (SOS Radio Network)	F4, 8	7.38/7.56 (DS)
Salem Radio Network	S3,15	5.43, 6.34
	S3,17	5.01
Solid Gospel (gospel music)	G7,14	7.58
Trinity Broadcasting radio service	G5, 3	5.58/5.78 (DS)

Satellite Radio Guide

Trinity Broadcasting radio service (Spanish, SAP)	G5, 3	5.96
WROL-AM, Boston, Mass. (occ spanish)	S3, 3	6.20

ROCK

CFMI-FM, New Westminister, British Colombia, Canada (Album Rock, Rock 101)	E1,22	6.80
CFNY-FM, Toronto, Ontario, Canada (FM-102)	E1, 2	6.12/6.30 (DS)
CHOZ-FM, St. John's, Newfoundland, Canada (OZ-FM)	E2,20	5.76/5.96 (DS)
CILQ-FM, Toronto, Ontario, Canada (Q-107)	E1, 2	5.76/5.94 (DS)
CIRK-FM, Edmonton, Alberta, Canada (K-97)	E1,18	7.80 (N)
Rock Radio Network	E1,27(Ku)	6.12/6.30 (DS)
Superadio Prime Demo	G5,21	5.22/5.40 (DS)

SPECIALITY FORMATS

CFRN-AM, Edmonton, Alberta, Canada (Oldies)	E1,18	6.435
Colorado Talking Book Network	C1, 2	5.58
Georgia Radio Reading Service	T401,14(Ku)	5.76
In Store Oldies	S3,18	5.20, 5.40, 7.58
In Touch (reading service)	F5,24	6.48
Nebraska Talking Book Network	S3, 2	6.48
Superaudio Big Bands (Sun 0200-0600 UTC)	G5,21	5.58/5.76 (DS)
Superadio Classic Hits (oldies)	G5,21	8.10/8.30 (DS)
Superadio In Touch (reading service)	F4,10	7.87 (N)
Voice Print (reading service)	E1,13	7.44 (N)
Yesterday USA (nostalgia)	G3,17	6.20
	G7,14	5.76

VARIETY

AEN Michael Reagan (0100-0700 UTC)	F3, 1	6.20
American Urban Radio	S3, 9	6.30/6.48 (DS)
Cable Radio Network	F3,23	7.24 (N)
CBC Radio	E1,13	5.40, 5.58
CBC Radio (occasional)	E1,20	5.78
CBC-FM, Atlantic	E1,13	6.12/6.30 (DS)
CBC-FM, Eastern	E1,13	5.76/5.94 (DS)
CBM-AM/FM, Montreal, Quebec, Canada (Fine Arts/Variety)	E1,20	6.12
CBU-FM, Vancouver, British Columbia, Canada (Variety)	E1,22	5.76/5.94 (DS), 7.42
CFWE-FM, Edmonton, Alberta (Variety Music)	E1,18	7.875 (N)
	E1,14(Ku)	6.45
CBKA-FM/MBC Radio, La Ronge, Saskatchewan, Canada (Multilingual)	E1,18	7.71 (N)
CJRT-FM, Toronto, Ontario, Canada (Fine Arts/Jazz-nights)	E1,26(Ku)	5.76/5.94 (DS)
CKER-AM, Edmonton, Alberta, Canada (Adult Standard, Ethnic-night)	E1,18	7.42 (N)
CKNM-FM, Yellowknife, NWT, Canada	E1,14	5.41
(Country/Ethnic)	E1,18	7.92
CKUA-AM/FM, Edmonton, Alberta, Canada (Variety)	E1, 9(Ku)	5.76/5.94 (DS)
For the People Talk Radio	F1, 2	7.50
Independent Broadcasters Network	F1,20	7.38
Interstate Radio Network	E1, 2	5.22
KBVA-FM, Bella Vista, Ark.	G4, 6	5.58/5.76 (DS)
KNOW-St Paul, Minn. (Minnesota Public Radio)	F4,10	8.26 (N)
KSKA-FM, Anchorage, Alaska (Variety/Fine Arts)	F5,24	7.38/7.56 (DS)
KSL-AM, Salt Lake City, Utah	F1, 6	5.58
KUCV-FM, Lincoln, Neb. (Nebraska Public Radio)	S3, 2	5.76/5.94 (DS)
Media One (Jazz and World Beat)	T2,15	7.48
Mutual Broadcasting Network	E1, 2	7.54
Network One radio service	F1,11	7.48
Omega Radio Network	G3,17	5.80
One on One Sports Radio network	E1, 2	7.45
Peach State Public Radio (Georgia)	T401,14(Ku)	5.40/5.58 (DS)
Prime Sports Radio	C1,10	7.20
Seltech Radio Syndicated service	E1, 2	5.40/5.58 (DS)
Skylink Discussion channel	G1,15	5.80
Startalk Radio Network (talk/nostalgia music)	G3,11	7.38
Talk America	S3, 9	6.80
The Weather Channel (occasional audio)	C3,13	6.80
The Weather Channel (background music)	C3,13	7.78
USA Radio Network	S3, 5	5.40, 5.76, 5.94, 6.12
	S3,13	5.01(Ch 1), 5.20(Ch 2)
United Video background music service	F4, 8	5.90

Single Channel Per Carrier (SCPC) Services Guide

By Robert Smathers

Spacenet 2 Transponder 12 (C-band)

1202.300	USIA Radio Marti, Spanish broadcast service to Cuba

Galaxy 6 Transponder 3 (C-band)

1405.600	KIRO-AM (710), Seattle, Wash — news/talk/ sports talk radio, Seattle Seahawks NFL radio network
1405.400	Sports Byline USA (occ audio) — sports talk/ KQED-FM (88.5), San Francisco, Calif — NPR affiliate (occ audio)
1404.600	Talk America radio network
1404.000	American Sports radio network
1403.800	WTMJ-AM (620), Milwaukee, Wis — talk radio, Green Bay Packer NFL/Univ of Wisconsin sports radio networks/Milwaukee Bucks NBA radio network
1403.200	Motor Racing Network (occ audio) plus other occ audio
1402.800	Illinois State News Network plus other occ audio
1402.200	Data transmissions
1400.800	WBAL-AM (1090), Baltimore, Md — news/talk radio, Univ of Maryland sports radio network
1398.300	WGN-AM (720), Chicago, Ill — talk radio, Chicago Bears NFL radio network
1398.000	Detroit Lions NFL/Michigan State sports radio networks
1397.800	Tampa Bay Buccaneers NFL (occ audio)/Florida State Univ sports radio network
1397.600	Univ of Florida sports radio network/occ audio
1397.200	WTMJ-AM (620), Milwaukee, Wis — talk radio, Green Bay Packers NFL/Univ of Wisconsin sports radio networks/Milwaukee Bucks NBA radio network
1394.700	Sun Radio Network
1394.500	WSB-AM (750), Atlanta, Ga — talk radio, Atlanta Falcons NFL/Univ of Georgia sports radio networks
1393.600	Florida's Radio Network plus other occ audio/ Orlando Magic NBA radio network
1393.400	WGN-AM (720), Chicago, Ill — talk radio, Chicago Bears NFL radio network, Interstate Radio Network plus other occ audio
1393.200	Occ audio
1393.000	James Madison Univ sports radio network/Occ audio
1392.700	WGN-AM (720), Chicago, Ill — talk radio, Chicago Bears NFL radio network, Interstate Radio Network
1392.300	Occ audio
1391.600	XEPRS-AM (1090), Tijuana, Mexico — Spanish language programming, ID - "Radio Express"
1391.200	Miami Dolphins NFL radio network/Occ audio
1389.700	Occ audio, data transmissions (burst)
1389.500	Data transmissions (burst)
1388.900	One on One Sports Radio Network/WINS-AM (1010), New York City, N.Y. — news (occ audio)/Florida A & M sports radio network
1387.750	Data transmissions
1387.500	KWKW-AM (1330), Los Angeles, Calif — Spanish language programming, Spanish Information Service, ID - "Radio Lobo"
1386.700	Michigan News Network/Central Michigan sports radio network
1386.500	WJR-AM (760), Detroit, Mich — talk radio/ Detroit Pistons NBA radio network
1385.800	WMAQ-AM (670), Chicago, Ill — news
1385.100	For the People radio network
1384.800	KFMB-AM (760), San Diego, Calif — news/talk radio
1384.200	KMPC-AM (710), Los Angeles, Calif — talk radio, L.A. Rams NFL radio network
1383.800	KJR-AM (950), Seattle, Wash — sports talk radio/Seattle Supersonics NBA radio network
1383.400	Occ audio
1382.800	Independent Broadcasters Network
1377.900	Los Angeles Laker NBA radio network
1376.700	Radio Labio Network — Spanish language programming
1375.400	USA Radio Network
1374.100	Northwest Direct — news/talk radio/Oregon State sports radio network/Portland Trailblazers NBA radio network

Satcom K1 Transponder 12 (Ku-band)

1313.100	Customized IGA spots

Spacenet 3 Transponder 1 (C-band)

1437.200	Associated Press (AP) 3 radio network
1435.000	Associated Press (AP) 2 radio network
1433.400	Associated Press (AP) 1 radio network

Spacenet 3 Transponder 13 (C-band)

1207.900	Wisconsin Voice of Christian Youth (VCY) America Radio Network — religious
1207.650	Wisconsin Voice of Christian Youth (VCY) America Radio Network — religious
1207.450	Wisconsin Voice of Christian Youth (VCY) America Radio Network — religious
1207.200	Good News Radio Network — christian radio
1207.000	Good News Radio Network — christian radio
1206.700	Data Transmission
1206.550	ABC-Satellite Music Network — adult contemporary, Starstation
1206.300	ABC-Satellite Music Network — adult contemporary, Starstation
1206.000	ABC-Satellite Music Network — modern country, Country Coast-to-Coast
1205.850	ABC-Satellite Music Network — modern country, Country Coast-to-Coast
1205.650	ABC-Satellite Music Network — traditional music format, Stardust
1205.400	ABC-Satellite Music Network — traditional music format, Stardust
1204.450	KJAV-FM (104.9), Alamo, Tex — Nuevo Radio Christiana Network, Spanish language religious
1204.250	Wisconsin Voice of Christian Youth (VCY) America Radio Network — religious
1203.550	Salem Radio Network —religious
1203.350	Salem Radio Network —religious
1203.150	Salem Radio Network —religious
1203.000	ABC-Satellite Music Network — urban contemporary, The Touch
1202.800	ABC-Satellite Music Network — urban contemporary, The Touch
1202.250	ABC-Satellite Music Network — golden oldies format, Pure Gold
1202.100	ABC-Satellite Music Network — golden oldies format, Pure Gold
1201.900	ABC-Satellite Music Network — modern rock, The Heat
1201.700	ABC-Satellite Music Network — modern rock, The Heat
1201.500	ABC-Satellite Music Network — Classic Rock
1201.300	ABC-Satellite Music Network — Classic Rock

Galaxy 4 Transponder 1 (C-band)

1444.450	Data transmissions
1443.800	Voice of Free China (ISWBC)
1443.600	WYFR, Oakland, Calif "Family Radio Network" (ISWBC) — religious programming/talk
1443.400	Voice of Free China (ISWBC)
1438.300	WWRV-AM (1330), New York, N.Y. — Spanish religious programming/music, ID - "Radio Vision Christiana de Internacional"
1436.000	KUSC-FM (91.5), Los Angeles, Calif — fine arts, National Public Radio (NPR) affiliate
1435.700	KUSC-FM (91.5), Los Angeles, Calif — fine arts, National Public Radio (NPR) affiliate
1428.100	National Public Radio (NPR) feeds
1427.800	Occ audio
1421.700	Data transmissions
1418.250	Data transmissions
1417.800	Data transmissions
1417.500	Data transmissions

Galaxy 4 Transponder 2 (C-band)

1403.400	Data transmissions
1402.600	WVAQ-FM (101.9), Morgantown, W Va — West Virginia Metro News
1402.000	WVAQ-FM (101.9), Morgantown, W Va — West Virginia Metro News
1399.000	Occ audio/Texas Tech football/Oklahoma State sports radio network/San Antonio Spurs NBA radio network
1398.800	Progressive Farmers Network
1398.400	WBNS-FM (97.1), Columbus, Ohio — oldies, ID - "B-97"/Ohio Network/Ohio State sports radio network
1398.200	Occ audio/Iowa State sports radio network
1398.000	Oklahoma News Network/Univ of Oklahoma sports radio network
1397.600	Ohio Network/Agri Broadcasting Network (Ohio)/WBNS-FM (97.1), Columbus, Ohio — oldies, ID - "B-97"/Cleveland Browns NFL radio network/Ohio State sports radio network
1397.400	Ohio Network/WKNR-AM (1220), Cleveland, Ohio — sports talk/Cleveland Cavaliers NBA radio network
1397.200	Occ audio/Univ of Tulsa sports radio network/ Oklahoma State sports radio network

Galaxy 4 Transponder 3 (C-band)

1405.000	Mutual Broadcasting System — some syndicated talk shows and news cuts
1404.800	KOA-AM (850)/KTLK-AM (760), Denver, Colo — news/talk, Oenver Broncos NFL radio network/ Univ of Colorado radio network/Denver Nuggets NBA radio network
1404.600	ABC Information network programming/Penn State sports radio network
1404.000	ABC Information network programming, Tennessee Radio Network farm news
1403.800	WNTL-AM (1030), Indian Head, Md — multicultural programming
1403.500	International Broadcasting Network — Lutheran religious programming, Home Front program (Sat 10a-2p)
1403.000	Minnesota Public Radio Network
1402.400	KNOW-FM (95.3), St. Paul, Minn — fine arts, Minnesota Public Radio (occ audio)
1402.100	KNOW-FM (95.3), St. Paul, Minn — fine arts, Minnesota Public Radio
1401.800	BBC World Service
1398.500	KLIF-AM (570), Ft. Worth, Tex — talk radio, Dallas Mavericks NBA radio network
1398.300	KRLD-AM (1080), Dallas, Tex — talk radio, Texas Radio Network
1398.000	ABC Radio News (Standard) Occ audio
1397.800	KTRH-AM (740), Houston, Tex — news/talk radio, Houston Oilers NFL radio network/ Houston Rockets NBA radio network
1397.500	Minnesota Talking Book Network
1397.300	WFBC-AM/FM (1330/93.7), Greenville, S.C. — news/talk/oldies, Clemson University sports radio network flagship network
1396.900	Spanish Information Service (SIS) radio network (Spanish)
1396.700	ABC Radio News (Standard), Tennessee Radio Network plus other occ audio/Florida States Univ sports radio network
1396.400	Georgia Network News/Univ of Georgia sports radio network
1396.200	WCNN-AM (680), Atlanta, GA — all sports talk radio
1396.000	WJZE-FM (100.3), Washington, DC — oldies, ID - "Oldies 100"
1395.800	ABC Radio News (Standard), Occ audio/Univ of Kentucky sports radio network
1395.500	American Public Radio - Monitor Radio programming
1395.100	National Public Radio (Channel 12)
1394.600	WHAS-AM (840), Louisville, Ky — adult contemporary, Univ of Louisville sports radio network

Single Channel Per Carrier (SCPC) Services Guide

1394.400	National Public Radio (Channel 11)
1394.000	National Public Radio (Channel 10), American Public Radio carrying Monitor Radio programming
1393.000	Occ audio
1392.600	National Public Radio (Channel 9), American Public Radio
1392.300	National Public Radio (Channel 8)
1392.000	Occ audio
1391.700	National Public Radio (Channel 7)
1391.100	Associated Press (AP) radio network — news
1389.200	Occ audio
1388.900	Data transmissions (burst)
1388.400	KSJV-FM (91.5), Fresno. Calif — spanish programming, ID - "Radio Bilingue" (network serving stations in several western states)
1388.100	National Public Radio (Channel 6)
1387.800	Data transmissions (constant)
1387.500	National Public Radio (Channel 5)
1387.200	National Public Radio (Channel 4)
1396.800	National Public Radio feeds
1386.200	KSJV-FM (91.5), Fresno, Calif — Spanish programming, ID - "Radio Bilingue" (network serving stations in several western states)
1385.800	National Public Radio (Channel 3) and occ U.S. Naval Observatory Master Clock
1385.400	U.S. Naval Observatory Master Clock and National Public Radio (Channel 2)
1384.700	National Public Radio (Channel 1)
1383.700	Mutual Broadcasting Network/Independent Network News (INN)
1383.400	KRLD-AM (1080), Dallas, Tex — talk radio, Texas State News network
1383.100	Mutual Broadcasting System and VSA Radio Network — Ag news
1382.900	Minnesota Radio Network/Minnesota Viking NFL radio network/Univ of Minnesota sports radio network/Minnesota Timberwolves NBA radio network
1382.600	Soldiers Radio Satellite (SRS) network — U.S. Army information and music/Army sports radio network
1382.300	Motor Racing Network (Occ audio)
1382.100	WFAE-FM (90.7), Charlotte, N.C. — NPR affiliate
1382.000	Univ of Tennessee sports radio network/Occ audio
1381.800	WHO-AM (1040), Des Moines, Iowa — talk radio/Univ of Iowa sports radio network
1381.600	Alabama Radio Network
1381.400	Occ audio/Baylor sports radio network
1377.400	Data transmission (packet burst/tones)
1377.100	In-Touch — reading service for blind
1376.000	Kansas Audio Reader Network

Galaxy 4 Transponder 4 (C-band)

1387.500	Dakota Sports network/Dakota News network
1387.100	Mutual Broadcasting System
1385.100	Mississippi Radio Network auxiliary channel
1384.800	Mississippi Radio Network
1381.800	Data transmissions
1379.000	Louisiana Network/New Orleans Saints NFL radio network/ Louisiana Tech sports radio network
1378.800	WWL-AM (870), New Orleans, La — talk radio/ Louisiana Network
1378.600	Arkansas Radio Network/Univ of Arkansas sports radio network
1378.100	Data transmissions
1377.800	Bible Broadcasting Network — religious
1377.500	Bible Broadcasting Network — religious
1377.300	WWL-AM, New Orleans, La — talk radio, Louisiana Network/Tulane Univ sports radio network/S.W. Louisiana sports radio network
1376.000	Data transmissions
1375.600	KISN-AM (570), Salt Lake City, Utah — sports talk/Utah Jazz NBA radio network

Galaxy 4 Transponder 1 (Ku-band)

973.200	Data transmissions
971.100	Data transmissions
969.000	Data transmissions
968.400	Data transmissions
966.900	Data transmissions
959.700	Oldies music
959.500	Oldies music
959.200	Satellite Music Network, Real Country — country and western music
959.000	Satellite Music Network, Real Country — country and western music
958.800	Data transmissions
958.000	Data transmissions
957.900	Occ audio
957.700	Russian-American Radio Network — foreign language audio service
957.500	Russian-American Radio Network — foreign language audio service

Anik E1 Transponder 11 (C-band)

1246.000	Radio Canada International
1245.500	Canadian Broadcasting Company (CBC) Radio — Yukon service
1243.800	Data transmissions

Anik E1 Transponder 13 (C-band)

1206.000	Canadian Broadcasting Company (CBC) Radio — southwestern Northwest Territories service
1205.500	Canadian Broadcasting Company (CBC) Radio — southwestern Northwest Territories service — Occ carrier

Anik E1 Transponder 14 (C-band)

1166.000	Canadian Broadcasting Company (CBC) Radio — eastern Northwest Territories service

Anik E1 Transponder 17 (C-band)

1126.000	Canadian Broadcasting Company (CBC) Radio — northern Northwest Territories service
1125.500	Canadian Broadcasting Company (CBC) Radio — Newfoundland and Labrador service

Anik E1 Transponder 19 (C-band)

1086.000	Canadian Broadcasting Company (CBC) Radio — Quebec and Labrador service
1085.500	Canadian Broadcasting Company (CBC) Radio — CBQ-FM (101.7), Thunder Bay, Ont —fine arts and variety

Anik E1 Transponder 21 (C-band)

1024.300	Weather Conditions/Warnings
1019.000	CKRW-AM (610), Whitehorse, Yukon Territory — adult contemporary and oldies

Note: This transponder also has 62 other carriers consisting of data transmissions and 6 blank audio carriers.

SBS5 Transponder 2 (Ku-band)

1001.000	Wal-Mart In-store Network
1009.800	Sam's Club Office Supplies In-store Network
1010.200	Sam's Club In-store Network
1010.600	Wal-Mart In-store Network

RCA C5 Transponder 3 (C-band)

1404.800	RFD Radio Service
1404.600	Wyoming News Network/Univ of Wyoming sports radio network
1404.400	KNHN-AM (1340) Kansas City, Kan — news/talk radio, ID - "CNN 1340 Voice of the Heartland"/ Kansas State sports radio network
1400.600	Brownfield Network plus other occ audio/ Indiana Univ sports radio network
1400.400	Brownfield Network plus other occ audio
1400.200	Occ audio
1400.000	Brownfield Radio Network plus other occ audio/ Purdue Univ sports radio network
1396.600	Kansas Information Network/Kansas Agnet/S.W. Missouri State sports radio network
1396.400	Nebraska Ag Network/Illinois Univ sports radio network/Nebraska sports radio network
1396.200	KMOX-AM (1120), St. Louis, Mo — news/talk radio, Missouri Network/Univ of Missouri sports radio network
1395.700	WIBW-AM (580), Topeka, Kan — news/talk radio, Missouri Net/Kansas City Chiefs NFL radio network/Univ of Missouri sports radio network
1390.000	Occ audio
1387.300	WPTF-AM (680), Raleigh, N.C. — news/talk radio/North Carolina News Network
1386.900	Brownfield Network Farm — Ag news/Univ of Kansas sports radio network
1386.200	Radio Iowa/Iowa Univ sports radio network
1386.000	People's Radio Network
1384.600	North Carolina News Network and Capitol Sports Network/Washington Redskins NFL radio network
1384.400	Occ audio/Duke Univ sports radio network
1384.200	Occ audio/East Carolina Univ sports radio network/Washington Bullets NBA radio network
1384.000	Occ audio
1383.600	Occ audio
1383.400	Occ audio/North Carolina State sports radio network
1382.900	Missouri Network/Univ of Missouri sports radio network
1382.600	North Carolina News Network
1382.300	Virginia News Network/Univ of Virginia sports radio network
1378.700	Radio Pennsylvania Network/Philadelphia Eagles NFL radio network
1378.500	Radio Pennsylvania Network/Washington Redskins NFL radio network/Philadelphia 76ers NBA radio network
1378.300	Radio Pennsylvania Network/Villanova sports radio network
1374.600	National Association of Broadcasters (NAB) — Occ audio and various sports radio network broadcasts (Occ audio)

RCA C5 Transponder 9 (C-band)

1281.000	Armed Forces Radio and Television Service (AFRTS) 2
1280.700	Armed Forces Radio and Television Service (AFRTS) 1

RCA C5 Transponder 21 (C-band)

1045.000	Occ audio
1043.600	Unistar Radio — Today's Hits, Yesterday's Favorites
1043.400	CNN Radio Network
1043.200	Unistar Radio — Today's Hits, Yesterday's Favorites
1042.800	Unistar Radio — Original Hits
1042.600	Unistar Radio — Original Hits
1042.400	Unistar Radio — Good Times and Great Oldies
1042.200	Data transmissions
1042.000	Unistar Radio — Good Times and Great Oldies
1041.800	CNN Radio Network
1034.400	Unistar Radio — Hits from 60s, 70s, 80s, and Today
1034.200	Data transmissions
1034.000	Unistar Radio — Hits from 60s, 70s, 80s, and Today
1033.200	Unistar Radio — Country/Western
1032.800	Data transmissions
1032.400	Unistar Radio — Country/Western
1029.000	Occ audio

International Shortwave Broadcasters via Satellite

By Larry Van Horn and Robert Smathers

WORLD RADIO NETWORK ONE SCHEDULE

North American Service Schedule

Galaxy 5, Transponder 6 (WTBS), 3.820 GHz. — vertical polarization, audio subcarrier 6.80 MHz. and via cable systems - contact WRN for details. All broadcast are daily unless otherwise indicated. WRN program information can be heard daily on North American service at 0525, 1125 and 1825 UTC.

* indicates program also carried by C-SPAN 1 audio service Monday-Friday.
+ indicates program also carried by C-SPAN 1 audio service Saturday-Sunday.

UTC	SERVICE/PROGRAM	EST/PST
0000	Polish Radio - Warsaw	1900/1600
0030	Radio Netherlands - Hilversum	1930/1630
0130	Radio Sweden - Stockholm	2030/1730
0200	YLE Radio Finland - Helsinki	2100/1800*+
0230	KBS Radio Korea International - Seoul	2130/1830
0330	Israel Radio - Jerusalem	2230/1930
0400	Vatican Radio - Vatican City	2300/2000
0430	Radio Netherlands - Hilversum	2330/2030
0530	BBC Europe Today (Mon-Sat)	0030/2130
	BBC International Call (Sun)	0030/2130
0600	Deutsche Welle - Cologne	0100/2200
0700	Radio Canada International - Montreal	0200/2300
0730	Swiss Radio International - Berne	0230/2330
0800	ABC Radio Australia - Melbourne	0300/0000*+
0900	KBS Radio Korea International - Seoul	0400/0100*+
1000	Radio Moscow International - Moscow	0500/0200*
1030	Radio Netherlands - Hilversum	0530/0230
1130	Central Europe Today from Budapest (Mon-Fri)	0630/0330
	Radio Swiss International - Berne (Sat-Sun)	0630/0330
1200	Radio Australia - Melbourne	0700/0400*+
1300	Radio Telefis Eireann (RTE) - Dublin, Ireland	0800/0500+
1400	Radio France International - Paris	0900/0600*
1500	YLE Radio Finland - Helsinki	1000/0700*
1530	Radio Vlaanderen International - Brussels Calling	1030/0730*
1600	ABC Radio Australia - Melbourne	1100/0800*
1700	Radio Moscow International - Moscow	1200/0900*
1730	Radio Netherlands - Hilversum	1230/0930*
1830	Radio Telefis Eireann (RTE) - Dublin, Ireland	1330/1030*
1900	Radio Australia - Melbourne	1400/1100*
2000	Blue Danube Radio - Vienna (Mon-Fri)	1500/1200
	Glen Hauser's World of Radio (Sat)	1500/1200
	UN Radio and BBC Europe Now (Sun)	1500/1200
2030	Radio Vlaanderen International - Brussels Calling	1530/1230
2100	Radio Sweden - Stockholm	1600/1300
2130	BBC Europe Today (Sun-Fri)	1630/1330
	BBC International (Sat)	1630/1330
2200	Radio Telefis Eireann (RTE) - Dublin, Ireland	
	News and Both Sides Now	1700/1400

European Service Schedule

Astra-1B, Transponder 22 (VH-1 TV), 11.538 GHz. — vertical polarization, audio subcarrier 7.38 MHz. and via cable systems — contact WRN for details. All broadcast are daily unless otherwise indicated, time zone is Central European Time (CET).

UTC	SERVICE/PROGRAM	CET
0000	Hugarian Radio - Budapest	0100
0030	Radio Sweden - Stockholm	0130
0100	National Public Radio (US) All Things Considered	0200
0230	Israel Radio - Jerusalem	0330
0300	Vatican Radio - Vatican City	0400
0330	Radio Netherlands (Mon-Sat) - Hilversum	0430
	C-SPAN Weekly Radio Journal (Sun)	0430
0430	Radio Canada International - Montreal	0530
0500	Central Europe Today from Budapest (Mon-Fri)	0600
	Glen Hauser's World of Radio (Sat)	0600
	UN Radio and BBC Europe Now (Sun)	0600
0530	BBC Europe Today (Mon-Sat)	0630
	BBC Science Magazine (Sun)	0630
0600	National Public Radio (US) All Things Considered	0700
0730	PRI Market Place (Tue-Sat)	0830
	PRI Dialogue (Mon)	0830
	National Public Radio (US) Horizons (Sun)	0830
0800	ABC Radio Australia - Melbourne	0900
0900	KBS Radio Korea International - Seoul	1000
1000	Radio Moscow International - Moscow	1100
1030	Radio Netherlands - Hilversum	1130
1130	Radio Canada International - Montreal	1230
1200	National Public Radio (US) Morning Edition (Mon-Fri)	1300
	National Public Radio (US) Fresh Air (Sat-Sun)	1300
1300	National Public Radio (US) Morning Edition (Mon-Fri)	1400
	National Public Radio (US) Weekend Edition (Sat-Sun)	1400
1400	Radio France International - Paris	1500
1500	YLE Radio Finland - Helsinki	1600
1530	Radio Vlaanderen International - Brussels Calling	1630
1600	ABC Radio Australia - Melbourne	1700
1700	ORF Blue Danube Radio (Mon-Fri)	1800
	Glen Hauser's World of Radio (Sat)	1800
	UN Radio and BBC Europe Now (Sun)	1800
1730	Radio Netherlands - Hilversum	1830
1830	Radio Telefis Eireann (RTE) - Dublin, Ireland	1930
1900	National Public Radio (US) (Mon-Fri)	
	Talk of the Nation, Part 1	2000
	PRI Monitor Radio Weekend (Sat-Sun)	2000
2000	National Public Radio (US) (Mon-Fri)	
	Talk of the Nation, Part 2	2100
	National Public Radio (Sat) Afropop Worldwide	2100
	National Public Radio (Sun) Rhythm Revue	2100
2100	Radio Sweden - Stockholm	2200
2130	Polish Radio - Warsaw	2230
2200	PRI Market Place (Mon-Fri)	2300
	National Public Radio (US) Horizons (Sat)	2300
	PRI Dialogue (Sun)	2300
2230	National Public Radio (US) All Things Considered	2330

WRN One schedules are subject to change. Program information is available on Astra 1B VH-1 text page 222/MTV text 535. All programs in English unless otherwise noted. WRN network information can be heard on the European service daily at 0525, 1225 and 1925 CET. For more information about WRN write or call: WRN, 408 The Strand, London WC2R ONE, Telephone: +44 71 304 4343

C-SPAN AUDIO SERVICES

C-SPAN AUDIO 1

Satcom C3 (F3), Transponder 7 (C-SPAN 1), 3.840 GHz. — vertical polarization, audio subcarrier 5.20 MHz. All broadcast are daily and live feeds unless otherwise indicated.

UTC	SERVICE/PROGRAM	EST/PST
0100	Radio Havana Cuba - Havana	2000/1700
0200	YLE Radio Finland - Helsinki	2100/1800
0230	Classical Music (taped)	2130/1830
0300	Deutsche Welle - Cologne	2200/1900
0400	Classical Music (taped)	2300/2000
0500	China Radio International - Beijing	0000/2100
0600	Radio Austria - Vienna	0100/2200
0700	Classical Music (taped)	0200/2300
0800	ABC Radio Australia - Melbourne	0300/0000
0900	KBS Radio Korea International - Seoul	0400/0100
1000	Radio Msscow International -Moscow (Mon-Fri)	0500/0200
	Classical Music (taped) (Sat-Sun)	0500/0200
1030	Classical Music (taped)	0530/0230
1100	Radio Japan - Tokyo	0600/0300
1200	Radio Australia - Melbourne	0700/0400
1300	Open House (Mon)	0800/0500

International Shortwave Broadcasters via Satellite

	Canadian Broadcasting Compnay (CBC) As It Happens (Mon-Fri)	0800/0500
	Radio Telefis Eireann (RTE) - Dublin, Ireland	0800/0500
1400	Radio France International - Paris (Mon-Fri)	0900/0600
	Radio France International - Paris (Sat) Rendezvous (taped)	0900/0600
	Canadian Broadcasting Company (Sun) Sunday Morning	0900/0600
1430	Radio France International - Paris (Mon-Fri)	0930/0630
	Radio Sweden - Stockholm (Sat) Sweden Today (taped)	0930/0630
	Canadian Broadcasting Company (Sun) Sunday Morning	0930/0630
1500	YLE Radio Finland - Helsinki (Mon-Fri)	1000/0700
	Classical Music (Sat) (taped)	1000/0700
	Canadian Broadcasting Company (Sun) Sunday Morning	1000/0700
1530	Radio Vlaanderen International - Brussels Calling (Mon-Fri)	1030/0730
	Classical Music (Sat) (taped)	1030/0730
	Canadian Broadcasting Company (Sun) Sunday Morning	1030/0730
1600	Radio Australia - Melbourne)Mon-Sat)	1100/0800
	Canadian Broadcasting Company (Sun) Sunday Morning	1100/0800
1700	Radio Moscow International - Moscow (Mon-Fri)	1200/0900
	C-SPAN Weekly Radio Journal (Sat) (taped)	1200/0900
	Classical Music (Sun) (taped)	1200/0900
1730	Radio Netherlands - Hilversum (Mon-Fri)	1230/0930
	C-SPAN Weekly Radio Journal (Sat) (taped)	1230/0930
	Classical Music (Sun) (taped)	1230/0930
1800	Radio Netherlands - Hilversum (Mon-Fri)	1300/1000
	Classical Music (Sat-Sun) (taped)	1300/1000
1830	Radio Telefis Eireann (RTE) - Dublin, Ireland (Mon_Fri)	1330/1030
	Classical Music (Sat-Sun) (taped)	1330/1030
1900	Voice of America (VOA) - Washington, D.C. (Broadcast last 6 hours until 0100 UTC)	1400/1100

C-SPAN AUDIO 2

Satcom C3 (F3), Transponder 7 (C-SPAN 2), 3.840 GHz. — vertical polarization, audio subcarrier 5.40 MHz. BBC World Service in English is broadcast continuously 24 hours a day on this audio subcarrier. For more information about C-SPAN audio services , write or call: Tom Patton, C-SPAN Audio Networks, 400 North Capitol Street, NW, Suite 650, Washington, D.C. 20001, Telephone: (202) 626-4649

DEUTSCHE WELLE (DW)

Satcom C4 (F4), Transponder 5 (Deutsche Welle TV), 3.800 GHz. — vertical polarization.
Deutsche Welle programming in German and 39 other languages has been noted on the following audio subcarriers on this transponder: 7.02, 7.22, 7.42, 7.58, 7.78, 7.95 and 8.30 MHz.
For more information about Deutsche Welle satellite services, write: Deutsche Welle, Radio & TV International, D-50588 Cologne, Germany.

RADIO FRANCE INTERNATIONAL (RFI)

Spacenet 2, Transponder 4 (Sur), 3.780 GHz. — vertical polarization, audio subcarrier 7.40 MHz.
Telstar 303, Transponder 22 (SCOLA), 4.140 GHz. — horizontal polariztion, audio subcarrier 6.20 MHz.
Anik E2, Transponder 21 (TV 5), 4.120 Ghz. - horizontal polarization, audio subcarriers 5.4 and 6.12 MHz.

RFI broadcast can be heard in a variety of languages throughout a 24 hour period.
For more information on RFI satellite broadcast write to: Radio France International, B.P. 9516, F-75016, Paris, France.

VOICE OF AMERICA (United States Information Agency)

The Voice of America (VOA) transmits a variety of audio programs in various languages on the following audio subcarriers and satellites.

NTSC 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 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.

Satellites:

Eutelsat II F1, 13.3 deg east, Transponder 27, 11.163 GHz., PAL system
Intelsat 510, 66.0 deg east, Transponder 38, 4.1775 GHz., PAL system
Intelsat 601, 27.5 deg west, Transponder 14, 3.995 GHz., PAL system,
Intelsat 601, 27.5 deg west, Transponder 21, 3.742 GHz., PAL system
Spacenet 2, 69.0 deg west, Transponder 2H, 3.760 GHz., NTSC system
Intelsat 508, 180 deg west, Transponder 14, 3.974 GHz., PAL system

For more information on the VOA write to: Voice of America, Washington, D.C. 20547

ARMED FORCES RADIO AND TELEVISION SERVICE (AFRTS)

Spacenet 2, Transponder 20 (AFRTS), 4.100 GHz. - vertical polarization, audio subcarrier 7.41 MHz. AFRTS Radio Service can be heard on this transponder carrying a variety of radio network news and sports programming for servicemen, their families overseas and sailors aboard Navy ships.
For more information on AFRTS write: AFTRS-BC, 10888 La Tuna Canyon Road, Sun Valley, CA 91352-2098

WORLD HARVEST INTERNATIONAL RADIO, WHRI-South Bend, Indiana

Galaxy 4, Transponder 15 (World Harvest TV Network), 4.000 GHz. — horizontal polarization
Religious broadcaster WHRI/KHWR uses audio subcarriers to feed three shortwave broadcast transmitters as follows:

7.46/7.55 MHz. WHRI programming relayed to shortwave broadcast transmitters in Indianapolis, Indiana for transmissions beamed to Europe and Americas.
7.64 MHz. KHWR programming relayed to a shortwave broadcast transmitter in Naahlehu, Hawaii for transmissions beamed to the Pacific and Asia.

For more information on WHRI qrite to: P.O. Box 12, South Bend, IN 46624.

DBS/Primestar Channel Guide

By Robert Smathers

DirecTV™ Channel Guide

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

100	DirecTV Previews	(Previews)
102-190	Direct Ticket Pay Per View	(PPV)
200	Previews	(Previews)
202	CNN	(News)
203	Court TV	(Speciality)
204	CNN Headline News	(News)
206	ESPN 1	(Sports)
208	ESPN 2	(Sports)
212	TNT	(TV)
215	E! Entertainment TV	(Speciality)
216	MuchMusic	(Music Videos)
220	Turner Classic Movies (TCM)	(Movies)
222	The Disney Channel (East)	(Movies/Kids)
224	The Disney Channel (West)	(Movies/Kids)
225	The Discovery Channel	(Science/TV)
226	The Learning Channel (TLC)	(Science/TV)
227	Cartoon Network	(Cartoons)
229	USA Network	(TV)
230	Trio	(TV)
232	The Family Channel	(TV)
233	WTBS-Ind, Atlanta, GA	(Superstation)
235	The Nashville Network (TNN)	(Country)
236	Country Music TV (CMT) Videos)	(Country Music
240	The Sci-Fi Channel	(Science Fiction)
242	C-Span 1	(Congress)
243	C-Span 2	(Congress)
245	Bloomberg Direct	(News)
246	CNBC	(Financial/Talk)
247	America's Talking	(Talk)
248	The Weather Channel (TWC)	(Weather)
250	Newsworld International	(News)
254	The Travel Channel (TTC)	(Travel Shows)
256	Arts & Entertainment	(TV)
268	STRZ	(Movies)
270	Previews	(Previews)
271	Encore	(Movies)
272	Encore Love Stories	(Movies)
273	Encore Westerns	(Movies)
274	Encore Mystery	(Movies)
275	Encore Action	(Movies)
276	Encore True Stories	(Movies)
277	Encore WAM!	(Movies)
282	WRAL-CBS, Raleigh, N.C.	(Network TV)
284	WXIA-NBC, Atlanta, Ga.	(Network TV)
286	PBS	
287	WABC-ABC, New York, N.Y. (Network TV)	
289	WFLG-FOX, Chicago, Ill.	(Network TV)
298	TV Asia	(Ethnic Programming)
300-399	Regional and PPV Sports	
305	Prime Sports	(Sports)
306	Prime Sports	(Sports)
308	Prime Sports	(Sports)
309	Prime Sports	(Sports)
310	KBL Sports Network (KBL)	(Sports)
311	Super Sports	(Sports)
314	Sunshine	(Sports)
316	Pro AM Sports (PASS)	(Sports)
317	Prime Sports	(Sports)
319	Prime Sports	(Sports)
322	Home Sports Entertainment (HSE)	(Sports)
323	Prime Sports	(Sports)
325	Prime Ticket	(Sports)
326	Prime Sports	(Sports)
330-348	NFL Sunday Ticket	(Sports)
402	Playboy	(Adult)
501	Music Choice — Hit List	(Audio)
502	Music Choice — Dance	(Audio)
503	Music Choice — Hip Hop	(Audio)
504	Music Choice — Urban Beat	(Audio)
505	Music Choice — Reggae	(Audio)
506	Music Choice — Blues	(Audio)
507	Music Choice —Jazz	(Audio)
508	Music Choice —Jazz Plus	(Audio)
509	Music Choice — Contemporary Jazz	(Audio)
510	Music Choice — New Age	(Audio)
511	Music Choice — Electric Rock	(Audio)
512	Music Choice — Modern Rock	(Audio)
513	Music Choice — Classic Rock	(Audio)
514	Music Choice — Rock Plus	(Audio)
515	Music Choice — Metal	(Audio)
516	Music Choice — Solid Gold Oldies	(Audio)
517	Music Choice — Soft Rock	(Audio)
518	Music Choice — Love Songs	(Audio)
519	Music Choice — Progressive Country	(Audio)
520	Music Choice — Contemporary Country	(Audio)
521	Music Choice — Country Gold	(Audio)
522	Music Choice — Singers & Standards	(Audio)
523	Music Choice — Easy Listening	(Audio)
524	Music Choice — Classic Favorites	(Audio)
525	Music Choice — Classics in Concerts	(Audio)
526	Music Choice — Contemporary Christian	(Audio)
527	Music Choice — Gospel	(Audio)
528	Music Choice — For Kids Only	(Audio)

DBS/Primestar Channel Guide

USSB Channel Guide

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

963	All New Channel (ANC)	(News)
965	Video Hits One (VH-1)	(Rock Music Videos)
967	Lifetime	(TV)
968	Nickelodeon (Nick)	(TV/Kids)
970	Flix	(Movies)
973	Cinemax (East)	(Movies)
974	Cinemax 2	(Movies)
975	Cinemax (West)	(Movies)
977	The Movie Channel (East)	(Movies)
978	The Movie Channel (West)	(Movies)
980	HBO (East)	(Movies)
981	HBO 2 (East)	(Movies)
982	HBO 3	(Movies)
983	HBO (West)	(Movies)
984	HBO 2 (West)	(Movies)
985	Showtime (East)	(Movies)
986	Showtime 2	(Movies)
987	Showtime (West)	(Movies)
989	MTV	(Rock Music Videos)
990	Comedy Central	(Comedy)
999	USSB Background	

Primestar Channel Guide

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

1	HBO (East)	(Movies)
2	HBO 2 (East)	(Movies)
3	HBO 3	(Movies)
7	Cinemax (East)	(Movies)
8	Cinemax 2	(Movies)
13	TV Japan (English) (not included in $50 a month package)	
14	TV Japan (Japanese) (not included in $50 a month package)	
15	Future Service	
17	Future Service	
19	Future Service	
30	Encore 2	Love Stories (Movies)
31	Encore 3	Westerns (Movies)
32	Encore 4	Mystery (Movies)
33	Encore	Encore (Movies)
34	The Disney Channel (East)	(Movies/Kids)
35	The Disney Channel (West)	(Movies/Kids)
47	C-SPAN	(Congress)
49	The Weather Channel (TWC)	(Weather)
51	Cable Network News (CNN)	(News)
52	CNN Headline News	(News)
55	PreVue Channel	(Program Guide)
56	Future Service	
58	Turner Network Television (TNT)	(TV)
59	Turner Classic Movies (TCM)	(Movies)
63	WTBS-Ind, Atlanta, Ga. (TBS)	(Superstation)
65	The Discovery Channel (TDC)	(Science TV)
66	The Learning Channel (TLC)	(Science TV)
68	Arts & Entertainment (A&E)	(TV)
70	USA Network	(TV)
71	The Sci-Fi Channel	(Sci-Fi TV)
72	The Family Channel	(TV)
73	The Cartoon Channel	(Cartoons)
74	Future Service	
77	The Nashville Network (TNN)	(Country)
78	Country Music TV (CMT)	(Country)
111	WBZ-NBC, Boston, Mass.	(Network TV)
114	WPLG-ABC, Miami/Ft. Lauderdale, Fla	(Network TV)
117	WUSA-CBS, Washington, D.C.	(Network TV)
120	KTVU-FOX, Oakland/San Francisco, Calif	(Network TV)
124	WHYY-Philadelphia, Penn.	(Network TV)
131	ESPN	(Sports)
132	Future Service	
141	New England Sports Network (NESN)	(Sports)
142	Madison Square Garden Network (MSG)	(Sports)
143	Empire Sports Network	(Sports)
144	KBL Sports Network (KBL)	(Sports)
145	Home Team Sports (HTS)	(Sports)
146	SportSouth	(Sports)
147	Sunshine	(Sports)
148	Pro American Sports (PASS)	(Sports)
149	Future Service	
151	Prime Sports Net-Upper Midwest	(Sports)
152	Prime Sports Net-Midwest	(Sports)
153	Prime Sports Net-Rocky Mountain	(Sports)
154	Home Sports Entertainment (HSE)	(Sports)
155	Prime Sports Net-Inter-Mountain West	(Sports)
156	Prime Sports Net-Northwest	(Sports)
157	Future Service	
158	Prime Ticket	(Sports)
201	Viewer's Choice	(PPV)
202	Request 1	(PPV)
203	Request 5	(PPV)
204	Hot Choice	(PPV)
205	Continuous Hits 1	(PPV)
206	Continuous Hits 2	(PPV)
207	Continuous Hits 3	(PPV)
208	Request 2	(PPV)
209	Request 3	(PPV)
210	Request 4	(PPV)
301	Classic Hits	(Audio)
302	America's Country Favorites	(Audio)
303	Lite 'n' Lively Rock	(Audio)
304	Soft Sounds	(Audio)
305	Classic Collections	(Audio)
306	New Age of Jazz	(Audio)

Satellite Transponder Guide

By Robert Smathers

	Spacenet 2 (S2) 69 deg	Satcom F2R (F2) 72 deg	Galaxy 6 (G6) 74 deg	Telstar 302 (T2) 85 deg	Spacenet 3 (S3) 87 deg	Galaxy 7 (G7) 91 deg	Galaxy 3 (G3) 93.5 deg	Telstar 401 (T1) 97 deg	Galaxy 4 (G4) 99 deg	Spacenet 4 (S4) 101 deg	Anik E2 107.3
1	SC New York [V2+]	Channel America	o/v	Data Transmissions	SCPC/FM2 (AP) services	BBC Breakfast News/o/v	o/v	Exxxtasy (Adult) [V2+]/Movie Greats Network/VTC/o/v	SCPC services	Data Transmissions	The We Netw
2	GEMS TV (Spanish) [V2+]	(none)	o/v	o/v	Nebraska Educational TV (NETV)	CBS-West [VC1]	SSN Empire [V2+]	(none)	SCPC services	Data Transmissions	o/
3	USIA Worldnet TV	Madison Square Garden 2 [V2+]/NHK feeds/o/v	SCPC services	o/v	WSBK-Ind Boston [V2+]	Action PPV [V2+]	Data Transmissions	Parmount news feeds/o/v	SCPC services	Data Transmissions	Dat Transmi
4	Canal de Canales SUR (Spanish)	(none)	o/v	o/v	Nebraska Educational TV (NETV)	fX-East	Data Transmissions	FOX feeds [occ Leitch]	SCPC services	Data Transmissions	CBC New Intl [Le
5	NASA Contract Channel [Leitch]	Main Street TV	NHK New York feeds	HBO 2 East [V2+]	(none)	fX-West	RTPI Eurovideo	o/v	o/v	Data Transmissions	CFTM-Mo (Fren
6	Data Transmissions-G	Merchandise and Entertainment TV (MET)	Univision feeds [SA MPEG-DVC]/o/v	Barry Bargain Home SHopping/o/v	(none)	o/v	Data Transmissions	Buena Vista TV feeds	National Christian Network (Rel)	KNBC-NBC Los Angeles (PT24W) [V2+]	Dat Transmi
7	(none)	Skyvision Shopping Channel	o/v	Satellite City Home Shopping/o/v	Data Transmissions	The Golf Channel	TV Asia [V2+]	FOX feeds East [occ Leitch]	o/v	Data Transmissions	Dat Transmi
8	Data Transmissions	WPLG-ABC Miami [V2+]	o/v	o/v	Data Transmissions	Phoenix Grayhound Park [Leitch]/o/v	Door Darshan (India)/o/v	PBS X	Telemundo [GI Digicipher]	KOMO-ABC Seattle (PT24W) [V2+]	Globa [Leitch]/ fee
9	NASA TV	Unid Svc [BMAC]	MuchMusic U.S. [V2+]	HBO 3 East [V2+]	WPIX-Ind New York [V2+]	o/v	Antenna Satellite TV [V2+]/Satellite Market USA	FOX feeds [occ Leitch]	BBC Breakfast News/o/v	Data Transmissions	(non
10	Data Transmissions-G	WUSA-CBS Washington [V2+]	Arab Network of America (ANA)	o/v	Data Transmissions	Caribbean Super Station/Wierd TV/Your Choice TVo/v	ESPN Internatioanl [B-MAC]	FOX feeds [occ Leitch]	WABC-ABC New York (PT24E) [V2+]	WFLD-Fox Chicago (PT24) [V2+]	Da Transm
11	SC Philadelphia [V2+]	Home Shopping Club Spree (HSC)	Data Transmissions	o/v	CNN feeds	Estacion Montellano (Spanish rel)/o/v	Keystone International (Rel)	ABC feeds [Leitch]	o/v	o/v	Da Transm
12	Data Transmissions	Informercials/o/v	o/v	Data Transmissions	Data Transmissions	VSN/o/v [B-MAC]	University Network-Dr Gene Scott (Rel)	ABC Newsone Channel	o/v	KPIX-CBS San Francisco (PT24W) [V2+]	CTV (
13	Data Transmissions	Outdoor Channel	Independent Film Channel [V2+]	FLIX [V2+]	SCPC/FM2 services	o/v [B-MAC]	Video Catalog Channel (VCC)	FOX feeds East [occ Leitch]	o/v	Data Transmissions	o/
14	Data Transmissions	WBZ-NBC Boston [V2+]	Cornerstone TV WPCB-TV (Rel)	HBO 2 West [V2+]	CNN [Leitch]	Familynet	Via TV Overnight/o/v	FOX feeds West [occ Leitch]	WRAL-CBS Raleigh (PT24E) [V2+]	Data Transmissions	o/
15	Data Transmissions	NPS Preview Channel	Midwest Sports Channel [V2+]	Cupid Network TV (Adult) [V2+]	KTLA-Ind Los Angeles [V2+]	TVI [V2+]	Video Catalog Channel (VCC)	Prostar Sports [B-MAC]	World Harvest TV (Rel)	Data Transmissions	o/
16	Data Transmissions	SSN KBL [V2+]	o/v	TV Erotica (Adult) [V2+]/o/v	CNN International [Leitch]	o/v [B-MAC]	ESPN International [B-MAC]	Exxxtasy Promo Channel/o/v	CBS West [VC1]	Data Transmissions	CTV (
17	Data Transmissions	American Independent Network (AIN)	Tokyo BS New York feeds	All News Channel [V2+]	FM2/WEFAX services	Dubai TV	Shop at Home (SAH)	o/v	CBS East [VC1]/o/v	Data Transmissions	Global s feed
18	(none)	(none)	o/v	o/v	Infomercials	CBS feeds/o/v	ABC feeds [Leitch]/o/v	N.C. Open Net/o/v	CBS feeds [VC1]/o/v	Data Transmissions	Exxx (adult
19	Data Transmissions	NHK New York feeds	o/v	o/v	SSN Sportsouth [V2+]/American Infochannel (AIC)	CBS-East [VC1]	Via TV Shopping	o/v	CBS East [VC1]	Data Transmissions	TV No Canada
20	Armed Forces Radio & Television Service [B-MAC]	(none)	CNN Headline News Clean Feed [V2+]	La Cadena de Milagro (Spanish Rel)	o/v	Natl Empowerment TV (NET)	o/v	ABC feeds [Leitch]	CBS East [VC1]	Data Transmissions	Newfour (N
21	New England Cable News (NECN)	o/v	Penn Ntl Horse Racing [Oak]/o/v	Cinemax 2 East [V2+]	SSN Pro Am Sports (Pass) [V2+]	BET Jazz	America's Collectables Network (ACN)	ABC East [Leitch]	Warner Brothers Syndication/CBS feeds/o/v	Data Transmissions	TV 5 (
22	Newsport [V2+]	(none)	Belmont Park Horse Racing [B-MAC]/o/v	ABC TV Contingency Channel	Data Transmissions	The Talk Channel	o/v	ABC West [Leitch]	WXIA-NBC Atlanta (PT24E) [V2+]	Data Transmissions	3 A Broad (R
23	SC New England [V2+]	(none)	Worship TV (Rel)	Showtime 2 [V2+]	SSN Home Teams Sports (HTS) [V2+]	fX Movies	o/v	ABC feeds [Leitch]	Ostrich-Emu TV/RAI/o/v	Data Transmissions	EXXX TV/Th Netwo [
24	SC New York Plus-o/v [V2+]	o/v	Pimlico Track Horse Racing [Leitch]/o/v	o/v	(none)	Best of NASA TV/o/v	World Collectables Network (WCN)	o/v	CBS Newsnets feeds	Data Transmisslosn	CTV

Satellite Transponder Guide

By Robert Smathers

(A1) deg	Solidaridad 1 (SD1) 109.2 deg	Telesat A2 (E1) 111 deg	Morelos 2 (M2) 116.8 deg	Telstar 303 (T3) 123 deg	Galaxy 5 (G5) 125 deg	Satcom C3 (F3) 131 deg	Galaxy 1R (G1) 133 deg	Satcom C4 (F4) 135 deg	Satcom C1 (F1) 137 deg	
ather ork	(none)	Data Transmissions	Data Transmissions	TVN 1 PPV [V2+]	Disney East [V2+]	Family Channel West [V2+]	Comedy Central West [V2+]	American Movie Classics (AMC) [V2+]	o/v	1
/	SCPC services	The Sports Network [Oak]	Data Transmissions	TVN 2 PPV [V2+]	Playboy (Adult) [V2+]	The Learning Channel	Spanish Language Services [SA MPEG]	Request TV PPV [GI Digicipher]	KUSA-ABC Denver [V2+]	2
a ssions	SCPC services	Data SCPC	Data Transmissions	TVN 3 PPV [V2+]	Trinity Broadcasting (Rel)	Viewer's Choice PPV [V2+]	Encore [V2+]	Nickelodeon East [V2+]	KRMA-PBS Denver [V2+]	3
sworld itch]	(none)	Data SCPC	Data Transmissions	TVN 4 PPV [V2+]	Sci-Fi [V2+]	Lifetime West [V2+]	TV Food Network [GI Digicipher]	Lifetime East [V2+]	SC Pacific [V2+]	4
ontreal ich)	o/v	Data SCPC	Data Transmissions	TVN 5 PPV [V2+]	CNN [V2+]	VISN/ACTS (Rel)	Classic Arts Showcase	Deutsche Welle TV (German)	KDVR-Fox Denver [V2+]	5
a ssions	Telemax	WDIV-NBC Detroit [Oak]	Data Transmissions	TVN 6 PPV [V2+]	WTBS-Ind Atlanta [V2+]	Court TV	Z-Music	Madison Square Garden 1 [V2+]	KMGH-CBS Denver [V2+]	6
a ssions	XEQ-TV canal 9	Data SCPC	Data Transmissions	TVN 7 PPV [V2+]	WGN-Ind Chicago [V2+]	C-SPAN 1	Disney West [V2+]	Bravo [V2+]	SSN Primeticket [V2+]	7
l TV Global ds	(none)	CHCH-Ind Hamilton [Oak]	XHGC canal 5	TVN 8 PPV [V2+]	HBO West [V2+]	QVC Fashion Channel	Cartoon Network [V2+]	Prevue Guide	NBC-East	8
ie)	o/v	The Weather Network (English)	XHFM Super Canal [B-MAC]	TVN 9 PPV/CVS [V2+]	ESPN [V2+]	Music Choice [digital audio]	ESPN2 Blackout [V2+]/SAH	QVC Network	o/v	9
a ssions	Mexican Parliament	WXYZ-ABC Detroit [Oak]	SEP	Spice 2 (adult) [V2+]	MDR Music	Home Shopping Club 2	America's Talking	Home Shopping Club 1	SSN HSE [V2+]	10
a ssions	(none)	CBC-North Pacific feed	CMC [B-MAC]	Data Transmissions	Family Channel East [V2+]	Prime Network [V2+]	Eternal Word TV Network (Rel)	The Box	Network One 'N1'	11
llue)	Data Transmissions	WTOL-CBS Toledo [Oak]	Data Transmissions	Data Transmissions	Discovery West [V2+]	History Channel	Valuevision	Nustar (Promo Channel)	o/v	12
/	(none)	CBC feeds/o/v	XEIPN canal 11	TVN PPV o/v [V2+]/o/v	CNBC [V2+]	The Weather Channel [V2+]	Encore [GI Digicipher]	Travel Channel [V2+]	SC Chicago [V2+]	13
/	Data Transmissions	WTVS-PBS Detroit [Oak]	XEW canal 2	o/v	ESPN2 [V2+]	New England Sports Network [V2+]	ESPN Blackout [V2+]/SAH	Cable Health Club	KCNC-NBC Denver [V2+]	14
/	Multivision [GI Digicipher]	CBFT-CBC (French)	Data Transmissions	Data Transmissions	HBO East [V2+]	Showtime East [V2+]	CNN International [V2+]	WWOR-Ind New York [V2+]	SC Ohio/Florida/Cincinnati [V2+]	15
reen)	Data Transmissiosn	CBC Newsworld [Oak]	o/v	TVN PPV o/v [V2+]/o/v	Cinemax West [V2+]	MTV West [V2+]	Turner Classic Movies [V2+]	Request TV 1 [V2+]	Newsport [V2+]	16
condary /o/v	(none)	CBC feeds/o/v	o/v	Adam & Eve (Adult) [V2+]	TNT [V2+]	Movie Channel East [V2+]	The New Inspirational Network (Rel)	MTV East [V2+]	SSN Prime Network Rocky Mtn [V2+]	17
sy II [V2+]	(none)	CITV-Ind Edmonton [Oak]	o/v	(none)	TNN [V2+]	Nickelodeon West [V2+]	HBO Multiplex [GI Digicipher]	Viewer's Choice [GI Digicipher]	SSN Prime Network Upper Midwest [V2+]/STEP/o/v	18
thern (TVNC)	Multivision [GI Digicipher]	CBC feeds//o.v	CNI News	(none)	USA East [V2+]	Showtime/MTV [GI Digicipher]	Cinemax East [V2+]	C-SPAN 2	FoxNet	19
land TV V)	(none)	CBMT-CBC (English)	Data Transmissions	Spice/TVN 10 PPV (Adult) [V2+]	BET	Jones Intercable [GI Digicipher]	Home and Garden Network	Showtime West [V2+]	International Channel [V2+]	20
ench)	(none)	SCPC services	(none)	o/v	MEU	Comedy Central East [V2+]	USA West [V2+]	Discovery East [V2+]	Prime Ticket Networks [GI Digicipher]	21
els isting l)	Caliente Jai Alai/Caliente greyhound racing	BCTV-CTV Vancouver [Oak]	XHIMT canal 7	SCOLA	CNN/HN [V2+]	Americana TV	Nostalgia Channel	Movie Channel-West [V2+]	SSN PSNW [V2+]/STEP/o/v	22
eme Cupid (adult) +]	(none)	CBC-North Atlantic feed	(none)	TVN PPV o/v [V2+]/o/v	A&E [V2+]	E! Entertainment TV	(none)	VH-1 [V2+]	KWGN-Ind Denver [V2+]	23
Red)	(none)	Superchannel [Oak]	XHDF canal 13	TVN Preview/TVN PPV o/v [V2+]	Showtime/Movie Channel [SA MPEG]	Digital Music Express Radio [Digital Audio]	Univision (Spanish)	CMT [V2+]	SSN Sunshine [V2+]	24

Unscrambled/ non-video

Subscription

Not available in U.S.

o/v = occasional video

Ku-band Satellite Transponder Services Guide

By Robert Smathers

Spacenet 2 (S2) 69 deg

21	11900	TV ASAHI [Leitch]
22	11980	Occasional video

SBS 2 (SBS2) 71 deg (Inclined Orbit)
(Occasional video on all transponders)

SBS 3 (SBS3) 74 deg (Inclined Orbit)
(Occasional video on all transponders)

SBS 4 (SBS4) 77 deg (Inclined orbit)
(Occasional video on all transponders)

Satcom K2 (K2) 81 deg

1	11729	NBC-East
2	11758.5	Data Transmissions
3	11788	NBC-Pacific (Spot Beamed to West Coast)
4	11817.5	Cyclesat
5	11847	NBC-Contract Channel
6	11876.5	Occasional video
7	11906	NBC-Contract Channel
8	11935.5	North American Chinese TV Network [Oak]
9	11965	NBC-Mountain
10	11994.5	(none)
11	12024	NBC-Contract Channel
12	12053.5	FM² Services
13	12083	NBC-NBC NewsChannel
14	12112.5	Occasional video
15	12142	NBC-Contract Channel
16	12171.5	(none)

Satcom K1 (K1) 85 deg

1	11729	(none)
2	11758.5	Primestar DBS [Digicipher]
3	11788	Primestar DBS [Digicipher]
4	11817.5	Primestar DBS [Digicipher]
5	11847	Primestar DBS [Digicipher]
6	11876.5	Primestar DBS [Digicipher]
7	11906	Primestar DBS [Digicipher]
8	11935.5	Primestar DBS [Digicipher]
9	11965	Primestar DBS [Digicipher]
10	11994.5	Primestar DBS [Digicipher]
11	12024	Primestar DBS [Digicipher]
12	12053.5	Primestar DBS [Digicipher]
13	12083	Primestar DBS [Digicipher]
14	12112.5	(none)
15	12142	Primestar DBS [Digicipher]
16	12171.5	Primestar DBS [Digicipher]

Spacenet 3R (S3) 87 deg

19	11740	(none)
20	11820	(none)
21	11900	(none)
22	11980	(none)
23	12060	Oregon Educational Network (West Spot Beam)
24	12140	NYNET (SUNY) Ed Net/NY Lottery feeds (East Spot Beam)

Galaxy 7 (K7) 91 deg

1	11720	Occasional video/The People's Network (TPN)
2	11750	(none)
3	11750	Compressed Video
4	11780	Occasional video
5	11810	(none)
6	11810	(none)
7	11840	Fil Sat - Philipino programming
8	11870	(none)
9	11870	(none)
10	11900	Occasional video
11	11930	Occasional video
12	11930	Asian American TV Network
13	11960	Occasional video
14	11990	Occasional video
15	11990	The Asian Network (TAN)/Occasional video
16	12020	Occasional video/Microsoft TV (occasional)
17	12050	Westcott Communications ASTN [B-MAC]/ANTN
18	12050	Occasional video
19	12080	Occasional video
20	12110	(none)
21	12110	TCI Promo Channel [B-MAC]
22	12140	BBC 9PM News (PAL)/Occasional video
23	12170	(none)
24	12170	(none)

GSTAR-3 (GST3) 93 deg (Inclined Orbit)

1	11730	SCPC Transmissions
2	11791	(none)
3	11852	Occasional video
4	11913	Occasional video
5	11974	Data Transmissions
6	12035	(none)
7	12096	ID Channel
8	12157	(none)
9	11744	Data Transmissions
10	11805	(none)
11	11866	(none)
12	11927	(none)
13	11988	Data Transmissions
14	12049	(none)
15	12110	ID Channel
16	12171	(none)

SBS 6 (SBS6) 95 deg

1	11717	Occasional video
2	11749.5	SCPC Transmissions
3	11774	Occasional video
4	11798.5	Occasional video
5	11823	Occasional video
6	11847.5	Comsat Video Enterprises [B-MAC] (half-transponders)
7	11872	Occasional video
8	11896.5	Comsat Video Enterprises [B-MAC] (half-transponders)
9	11921	(none)
10	11945.5	Comsat Video Enterprises [B-MAC] (half-transponders)
11	11963	CONUS Communications (half-transponders)
12	11994.5	CONUS Communications (half-transponders)
13	12019	CONUS Communications (half-transponders)
14	12043.5	CONUS Communications (half-transponders)
15	12075	Occasional video
16	12092.5	Massachusetts Educational Network/Occasional video
17	12110	Occasional video
18	12141.5	Comsat Video Enterprises [B-MAC] (half-transponders)
19	12174	Occasional video

Telstar 401 (T401) 97 deg

1	11730	SCPC Transmissions
2	11743	National Tech University (Digital Video)
3	11790	South Carolina Educational TV
4	11798	ABC Affiliate and Network feeds (half-transponders)
5	11845	PBS [Digicipher]
6	11855	SERC/PBS Regionals/Stations (half-transponders)
7	11902	PBS Educational Services (half-transponders)
8	11915	PBS Stations/Regionals and Backhauls
9	11957.5	PBS Digital Video/SCOLA [Digicipher] and VSATs
10	11980.75	Louisiana Public TV feeds [Digicipher]
11	12040	Occasional video (half-transponders common)
12	12046	(none)
13	12095	(none)
14	12108	Georgia Public TV (half-transponders)/Peachtree Educational Network (lower half)
15	12147	ABC Affiliate and Network feeds (half-transponders)
16	12167	ABC Affiliate and Network feeds (half-transponders)

Galaxy 4 (K4) 99 deg

1	11720	SCPC Services
2	11750	Data Transmissions
3	11750	FM² Services/MUZAK
4	11780	FM² Services
5	11810	(none)
6	11810	(none)
7	11840	National Weather Networks/Occasional video
8	11870	Occasional video
9	11870	Occasional video
10	11900	Occasional video
11	11930	Occasional video (half-transponders common)
12	11930	Channel One/Occasional video
13	11960	WMNB (Russian)/Occasional video
14	11990	Occasional video (half-transponders common)
15	11990	Occasional video
16	12020	FM² Services
17	12050	CBS Newsnet and Affiliate feeds (half-transponders)
18	12050	Occasional video
19	12080	Occasional video
20	12110	Occasional video (half-transponders common)
21	12110	Occasional video/Muslim TV (occasional)
22	12140	Occasional video
23	12170	CBS Newsnet and Affiliate feeds (half-transponders)

Spacenet 4 (S4) 101 deg

19	11740	(none)
20	11820	Occasional video
21	11900	(none)
22	11980	Occasional video
23	12060	(none)
24	12140	Occasional video

GSTAR-1 (GST1) 103 deg

1	11730	Data Transmissions
2	11791	(none)
3	11852	Occasional video
4	11913	(none)
5	11974	Data Transmission
6	12035	(none)
7	12096	Healthcare Satellite [B-MAC]/Video Compression
8	12157	(none)
9	11744	Data Transmissions
10	11805	(none)
11	11866	Occasional video
12	11927	(none)
13	11988	Occasional video
14	12049	(none)
15	12110	(none)
16	12171	(none)

GSTAR-4 (GST4) 105 deg

1	11730	Data Transmissions
2	11791	Data Transmissions
3	11852	CNN Newsource (Primary) [Leitch]/some feeds in clear
4	11913	Occasional video
5	11974	Sears Teleconference Network [BMAC]
6	12035	Occasional video
7	12096	CNN feeds/Occasional video
8	12157	Occasional video
9	11744	Data Transmissions
10	11805	(none)
11	11866	Occasional video
12	11927	Occasional video
13	11988	Occasional video
14	12049	(none)
15	12110	CNN Newsource (Secondary)
16	12171	(none)

Anik E2 (A1) 107.3 deg
(Data transmissions have been noted on four transponders, all others have no activity except as noted below)

5	11839	Occasional video (Continental Beam)
6	11865	Occasional video (Continental Beam)
11	12022	MovieMax
27	12035	MoviePix
29	12096	TV Ontario (without audio)

Solidaridad 1 SD1 109.2 deg
(No video has been seen on any Ku transponder)

Anik E1 (E1) 111 deg

1	11717	Data Transmissions
2	11743	Telesat Services
3	11778	Partial Channel Services
4	11804	Partial Channel Services
5	11839	MuchMusic simulcast
6	11865	NovaNet FM² Services
7	11900	Video Compression Services
8	11926	Digital Video Services
9	11961	Alberta Access
10	11987	CBC Parliamentary Channel
11	12022	The Family Channel [Oak]
12	12048	CBC Newsworld feeds
13	12083	MuchMusic
14	12109	TV 5 (French)
15	12144	Knowledge Network
16	12170	Saskatchewan CommunicaNetwork
17	11730	(none)
18	11756	(none)
19	11791	(none)
20	11817	(none)
21	11852	Radio Quebec
22	11878	Quatre Saisons
23	11913	Canal Famille [V2+]
24	11939	Musique Plus
25	11974	La Chaine
26	12000	TV Ontario (English)
27	12035	Super Ecran [V2+]
28	12061	Ontario Legislature
29	12096	Reseau des Sports [V2+]
30	12122	The Family Channel [V2+]
31	12157	The Movie Network [V2+]
32	12183	Atlantic Satellite Network

Anik C3 (C3) 114.9 deg (Inclined Orbit)
(This satellite rarely has video transmissions)

Morelos 2 (M2) 116.8 deg
(No video has been seen on any Ku transponder)

SBS 5 (SBS5) 123 deg

1	11725	Comsat Video Enterprises [B-MAC] (half transponders)
2	11780	SCPC Services
3	11823	(none)
4	11872	Comsat Video Enterprises [B-MAC] (half transponders)
5	11921	(none)
6	11970	Data Transmissions
7	12019	Occasional video
8	12068	Comsat Video Enterprises [B-MAC] (half transponders)
9	12117	Comsat Video Enterprises [B-MAC] (half transponders)
10	12166	ID Channel/MegaBingo/Occasional video
11	11748	Data Transmissions
12	11898	Occasional video
13	11994	Occasional video
14	12141	Occasional video

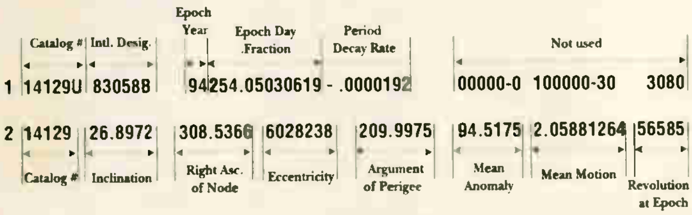
GSTAR-2 (GST2) 125 deg

1	11730	Data Transmissions
2	11791	Data Transmissions
3	11852	Data Transmissions
4	11913	Occasional video
5	11974	SCPC Transmission
6	12035	CNN International [Leitch]
7	12096	Occasional video
8	12157	(none)
9	11744	Data Transmissions
10	11805	Bluffs Run Greyhound racing/Occasional video
11	11866	Data Tranmissions
12	11927	Occasional video
13	11988	(none)
14	12049	CNN Airport Channel
15	12110	Occasional video
16	12171	Occasional video/CourtTV backhauls (half-transponders)

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 (AO-10)
1 14129U 83058B 94311.32676368 -.00000015 00000-0 10000-3 0 3265
2 14129 26.7622 299.3734 6026132 225.3511 66.0715 2.05879904 57764
UOSAT 2 (UO-11 or UOSAT 11)
1 14781U 84021B 94310.56576702 .00000288 00000-0 56544-4 0 7513
2 14781 97.7830 318.6110 0011606 169.3215 190.8239 14.69266564571215
COSMOS 1861 (Carries RS-10/11 or Radio Sputnik 10/11)
1 18129U 87054A 94312.28419451 .00000024 00000-0 97023-5 0 9855
2 18129 82.9283 222.3286 0011750 352.1989 7.8981 13.72343756369676
OSCAR 13 (AO-13)
1 19216U 88051B 94311.77313192 -.00000578 00000-0 10000-4 0 9943
2 19216 57.6728 221.5174 7242728 354.2960 0.7033 2.09727084 17526
OSCAR 14 (UO-14)
1 20437U 90005B 94310.76860690 .00000053 00000-0 37647-4 0 506
2 20437 98.5842 33.5630 0011552 129.0962 231.1249 14.29862086249965
OSCAR 16 (AO-16 or PACSAT)
1 20439U 90005D 94310.18902854 .00000042 00000-0 33360-4 0 8484
2 20439 98.5937 34.3825 0011579 131.2453 228.9728 14.29915986249892
OSCAR 17 (DO-17 or Dove)
1 20440U 90005E 94311.24897052 .00000067 00000-0 42697-4 0 8498
2 20440 98.5949 35.8030 0011920 127.6618 232.5643 14.30056538250062
OSCAR 18 (WO-18 or Webersat)
1 20441U 90005F 94310.24734789 .00000045 00000-0 34147-4 0 8526
2 20441 98.5903 34.8008 0012471 131.2497 228.9760 14.30029556249927
OSCAR 19 (LU-19 or Lusat)
1 20442U 90005G 94309.72613139 .00000048 00000-0 35432-4 0 8478
2 20442 98.5955 34.5831 0012701 132.1376 228.0884 14.30127722249863
JAS 1-B (FO-20 or Fuji Oscar 20)
1 20480U 90013C 94310.34766368 -.00000068 00000-0 -81630-4 0 7454
2 20480 99.0599 75.4542 0541272 17.5975 344.3085 12.83227255222368
INFORMTR-1 (Oscar 21, AO-21 or RS-14)
1 21087U 91006A 94312.30803601 .00000094 00000-0 82657-4 0 5366
2 21087 82.9431 36.0504 0036748 43.1477 317.2548 13.74546744189383
COSMOS 2123 (RS-12/13 or Radio Sputnik 12/13)
1 21089U 91007A 94312.92871192 .00000057 00000-0 44309-4 0 7517
2 21089 82.9228 264.0976 0030790 66.7330 293.7056 13.74049799188520
UOSAT-F (UO-22 or Oscar 22)
1 21575U 91050B 94310.18725857 .00000072 00000-0 38991-4 0 5545
2 21575 98.4230 21.7218 0006985 223.4037 136.6589 14.36940909173473
KITSAT A (KO-23)
1 22077U 92052B 94311.06824367 -.00000037 00000-0 10000-3 0 4473
2 22077 66.0849 340.8303 0015177 253.3426 106.5929 12.86288640105160
EYESAT 1 (AO-27)
1 22825U 93061C 94310.23017478 .00000022 00000-0 26525-4 0 3461
2 22825 98.6393 24.5230 0008751 149.0577 211.1118 14.27640114 57950
ITAMSAT (IO-26)
1 22826U 93061D 94311.25197435 .00000058 00000-0 41077-4 0 3443
2 22826 98.6415 25.5936 0009322 147.2919 212.8838 14.27746215 58109
POSAT 1 (PO-28)
1 22829U 93061G 94311.23759661 .00000071 00000-0 46337-4 0 3381
2 22829 98.6391 25.6230 0010449 134.5637 225.6395 14.28049150 58117
KITSAT B (KO-25)
1 22830U 93061H 94309.68881537 .00000039 00000-0 32854-4 0 3526
2 22830 98.5402 19.7798 0011958 119.3404 240.8978 14.28070059 57895

WEATHER SATELLITES

GOES 2
1 10061U 77048A 94311.52745027 .00000062 00000-0 00000+0 0 4503
2 10061 11.4510 44.0135 0001184 48.1126 8.9557 1.00282637 8556
METEOSAT 2
1 12544U 81057A 94313.19483623 -.00000252 00000-0 10000-3 0 7984
2 12544 7.0345 56.9726 0028813 77.4030 121.5965 0.98726287 9923
GOES 6
1 14050U 83041A 94312.35381493 .00000062 00000-0 10000-3 0 3076
2 14050 5.9054 59.5636 0001893 7.7226 334.2197 1.00256623 14227
NOAA 9
1 15427U 84123A 94312.98464692 .00000112 00000-0 83271-4 0 220
2 15427 99.0313 5.0346 0014873 167.6917 192.4617 14.13658253510716
NOAA 10
1 16969U 86073A 94312.95143837 .00000088 00000-0 55677-4 0 9242
2 16969 98.5087 317.5422 0012284 269.4324 90.5445 14.24914622423114
GOES 7
1 17561U 87022A 94312.49477808 -.00000063 00000-0 10000-3 0 1047
2 17561 1.8591 74.6047 0003111 350.1036 49.2945 1.00270649 11428
METEOSAT 3
1 19215U 88051A 94312.14407329 -.00000262 00000-0 10000-3 0 300
2 19215 2.0385 71.5364 0001674 193.1467 118.9020 1.00256794 11358
METEOR 3-2
1 19336U 88064A 94309.85074543 .00000051 00000-0 10000-3 0 3465
2 19336 82.5428 223.4311 0015585 270.5024 89.4307 13.16969787301904
NOAA 11
1 19531U 88089A 94312.94799001 .00000085 00000-0 70684-4 0 8418
2 19531 99.1852 305.4979 0012581 84.9855 275.2752 14.13024720315584
METEOSAT 4
1 19876U 89020B 94308.47542381 -.00000075 00000-0 10000-3 0 817
2 19876 0.7710 67.3599 0002291 166.9030 332.2417 1.00270349 767
GMS-4
1 20217U 89070A 94309.52744529 -.00000292 00000-0 10000-3 0 1078
2 20217 0.5321 74.7783 0000471 41.0521 258.5604 1.00263944 19511
METEOR 3-3
1 20305U 89086A 94313.12269504 .00000044 00000-0 10000-3 0 1893
2 20305 82.5428 169.7684 0006948 310.0994 49.9497 13.04409283241794
METEOR 2-20
1 20826U 90086A 94310.26691595 .00000092 00000-0 69566-4 0 8571
2 20826 82.5259 32.9333 0014041 15.9164 344.2442 13.83592825207402
MOP-2
1 21140U 91015B 94310.02617477 -.00000016 00000-0 00000+0 0 8294
2 21140 0.2210 21.7080 0003956 287.4533 105.1746 1.00274189 15695
METEOR 3-4
1 21232U 91030A 94309.83617087 .00000050 00000-0 10000-3 0 7557
2 21232 82.5405 69.4530 0012517 187.5098 172.5843 13.16464704169997
NOAA 12
1 21263U 91032A 94312.95682621 .00000160 00000-0 91142-4 0 2594
2 21263 98.6052 337.4621 0012676 172.9565 187.1791 14.22464829181083
METEOR 3-5
1 21655U 91056A 94309.68357763 .00000051 00000-0 10000-3 0 7538
2 21655 82.5557 16.8097 0012356 200.1256 159.9390 13.16834922155081
METEOR 2-21
1 22782U 93055A 94310.81803276 .00000035 00000-0 18717-4 0 3568
2 22782 82.5464 93.4167 0021888 183.3335 176.7685 13.83017384 59805
METEOR 3
1 22969U 94003A 94309.95165922 .00000051 00000-0 10000-3 0 1204
2 22969 82.5588 316.2359 0014022 273.2119 86.7396 13.16725582 37503
GOES 8
1 23051U 94022A 94311.23330153 -.00000197 00000-0 00000+0 0 2176
2 23051 0.1413 263.6129 0004049 341.3150 155.4572 1.00280587 1736
NADEZHDA 4
1 23179U 94041A 94311.50487669 -.00000249 00000-0 -27262-3 0 533
2 23179 82.9470 312.1550 0037439 329.8968 30.0034 13.75658878 15994

Information and updated two line orbital element sets for amateur, weather, TVRO and other satellites are also available on-line on several bulletin board systems worldwide or directly from NASA's Goddard Space Flight Center via Internet Telnet at the following address: oig1.gsfc.nasa.gov.

Geostationary Satellite Locator Guide

By Larry Van Horn

This guide shows the orbital locations of active geostationary satellites at publication deadline. Current launch developments can be followed in ST's Space Launch Report column. Satellite location information was supplied to *Satellite Times* by NASA's Goddard Space Flight Center-Orbital Information Group. Satellite background information was supplied by Phillip Clark, Molniya Space Consultascy; Dr. Nichols Johnson, Kaman Sciences Corporation; NASA NSSDC/WDC-A, Goddard Space Flight Center, Mr. Adam Johnson; U.S. Air Force Space Command and the U.S. Naval Space Command.

Radio Frequency Band Key

P band	230 - 1,000 MHz
L-band	1,000 - 2,000 MHz
S band	2,000 - 4,000 MHz
C band	4,000 - 8,000 MHz
X band	8,000 - 12,500 MHz
Ku band	12.5 - 18 GHz
K band	18 - 26.5 GHz
Ka band	26.5 - 40 GHz
Millimeter	> 40 GHz

Service Key

BSS	Broadcasting satellite service
Dom	Domestic
FSS	Fixed satellite service
Gov	Government
Int	International
Mar	Maritime
Met	Meteorology
Mil	Military
Mob	Mobile
Reg	Regional

"i" indicates inclined orbit, orbital inclination greater than 2 degrees
"d" indicates the satellite is drifting, moving into a new position or at end of life.

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
18952	1988-018B Telecom 1C (France)	3.1E	Dom/Gov/Mil (C/Ku)
20193	1989-067A Sirius/Marcopolo 1(BSB R-1)	5.1E	Reg BSS (Ku)
19919	1989-027A Tele X (Sweden)	5.2E	Reg BSS (Ku)
22921	1993-076A USA 98 (NATO 4B)	5.9E	iMil (C)
22028	1992-041B Eutelsat II F4	7.0E	Reg (Ku)
21056	1991-003B Eutelsat II F2	10.0E	Reg (Ku)
22557	1993-013A Raduga 29 (Russia)	11.3E	Gov/Mil (C)
22269	1992-088A Cosmos 2224 (Russia)	11.8E	Mil-Early Warning
19596	1988-095A Raduga 22 (Russia)	12.7E	iGov/Mil (C)
20777	1990-079B Eutelsat II F1	13.0E	Reg (Ku)
21055	1991-003A Italsat 1 (Italy)	13.3E	Dom-Telephone (S/Ku/Ka)
21803	1991-083A Eutelsat II F3	15.9E	Reg (Ku)
22653	1993-031A Astra 1C	19.1E	Reg BSS (Ku)
21139	1991-015A Astra 1B	19.2E	Reg BSS (Ku)
19688	1988-109B Astra 1A	19.2E	Reg BSS (Ku)
15383	1984-113B Arabsat 1D (Anik D2)	19.6E	Reg FSS/BSS (C)
19331	1988-063B Eutelsat 1 F5	21.6E	Reg (Ku)
22175	1992-066A DFS 3 (Germany)	23.5E	Dom BSS (Ku/Ka)
20706	1990-063B DFS 2 (Germany)	28.5E	Dom BSS (Ku/Ka)
18351	1987-078B Eutelsat 1 F4 (ECS 4)	30.9E	Reg (Ku)
21894	1992-010B Arabsat 1C	31.3E	Reg FSS/BSS (S/C)
20041	1989-041B DFS 1 (Germany)	33.5E	Dom BSS (Ku/Ka)
21821	1991-087A Raduga 28 (Russia)	35.3E	Gov/Mil (C)
20953	1990-102A Gorizont 22 (Russia)	40.3E	Dom/Gov (C/Ku)
23200	1994-049B Turksat 1B (Turkey)	42.0E	Reg FSS (Ku)
23010	1994-012A Raduga 31 (Russia)	44.3E	Gov/Mil (C)
22981	1994-008A Raduga 1-3 (Russia)	48.8E	Gov/Mil (C)
21038	1990-116A Raduga 1-2 (Russia)	49.6E	Gov/Mil (C)
22245	1992-082A Gorizont 27 (Russia)	52.6E	Dom/Gov (C/Ku)
19687	1988-109A Skynet 4B (UK)	52.9E	Mil (P/C/Millimeter)
14421	1983-105A Intelsat 507	55.8E	iInt FSS/Mar (L/C/Ku)
20667	1990-056A Intelsat 604	59.9E	Int FSS (C/Ku)
14675	1984-009A DSCS III A2 (USA)	60.0E	Mil-IOR primary (P/C)
20315	1989-087A Intelsat 602	62.9E	Int FSS (C/Ku)
20918	1990-093A Inmarsat 2 F1	64.5E	Intl Mar (L/C)
13636	1982-106A DSCS II F16 (USA)	65.5E	iMil-IOR reserve (C)
21016	1990-112A Raduga 26 (Russia)	65.3E	dGov/Mil (C)
13595	1982-097A Intelsat 505	65.5E	iInt FSS/Mar (L/C/Ku)
15629	1985-025A Intelsat 510	66.0E	Int FSS (C/Ku)
20083	1989-048A Raduga 1-1 (Russia)	69.6E	iGov/Mil (C)
20499	1990-016A Raduga 25 (Russia)	70.1E	iGov/Mil (C)
23319	1994-067A Express 1 (Russia)	70.1E	Regional (C/Ku)
22963	1993-002A Gals 1 (Russia)	71.1E	Dom BSS (Ku)
20410	1990-002B Leasat 5 (USA)	71.6E	iMil-IOR reserve (P)
08882	1976-053A Marisat 2	72.2E	iIntl Mar (P/L)
22787	1993-056A USA 95 (UFO-2)	72.4E	iMil-IOR primary (P)
22027	1992-041A Insat 2A (India)	73.9E	Dom (S/C)
11622	1979-098B DSCS II E15 (USA)	77.7E	dMil-IOR reserve (C)
22931	1993-078B Thaicom 1 (Thailand)	78.4E	Reg (C/Ku)
23267	1994-060A Cosmos 2291 (Russia)	79.6E	Data Relay (C)
21759	1991-074A Gorizont 24 (Russia)	79.9E	Dom/Gov (C/Ku)
21111	1991-010A Cosmos 2133 (Russia)	79.9E	Mil-Early Warning
20693	1990-061A Cosmos 2085 (Russia)	80.4E	Data Relay (C)
20643	1990-051A Insat 1D (India)	82.3E	Dom BSS/Met (S/C)
22836	1993-062A Raduga 30 (Russia)	84.9E	Gov/Mil (C)
13969	1983-026B TDRS 1 (USA)	84.6E	iGov (C/Ku)
23314	1994-065B Thaicom 2 (Thailand)	86.5E	Reg (C/Ku)
18922	1988-014A PRC 22 (China)	87.4E	Dom (C)
22880	1993-069A Gorizont 28 (Russia)	90.3E	Dom/Gov (C/Ku)
23327	1994-069A Elektro 1 (Russia)	90.3E	Met (L)
12474	1981-050A Intelsat 501	91.3E	iInt FSS (C/Ku)
22724	1993-048B Insat 2B (India)	93.3E	Dom BSS/Met (S/C)
20263	1989-081A Gorizont 19 (Russia)	96.8E	iDom/Gov (C/Ku)
20473	1990-011A PRC 26 (China)	98.0E	Dom (C)
19683	1988-108A Ekran 19 (Russia)	98.9E	iDom BSS (P)
22210	1992-074A Ekran 20 (Russia)	99.0E	Dom BSS (P)
21922	1992-017A Gorizont 25 (Russia)	103.2E	Dom/Gov (C/Ku)
20558	1990-030A Asiasat 1	105.3E	Reg (C/Ku)
20570	1990-034A Palapa B2R	107.9E	Reg (C)
23176	1994-040B BS-3N (Japan)	109.7E	Dom BSS (Ku)
21668	1991-060A BS-3B (Yuri 3B)(Japan)	109.8E	Dom BSS (Ku)
20771	1990-077A BS-3A (Yuri 3A)(Japan)	109.9E	Dom BSS (Ku)
19710	1988-111A PRC 25 (China)	110.5E	Dom (C)
17706	1987-029A Palapa B-2P	112.8E	Reg (C)
14985	1984-049A Chinasat 5 (Spacenet 1)	115.5E	Dom (C/Ku)
21964	1992-027A Palapa B4	117.7E	Reg (C)
23305	1994-064A Intelsat 703	120.0E	Intl FSS (C/Ku)
21132	1991-014A Raduga 27 (Russia)	127.8E	Gov/Mil (C/Ku)
22907	1993-072A Gorizont 29 (Rimsat 1)	130.0E	Dom/Gov (C/Ku)
18877	1988-012A CS 3A (Sakura 3A)(Japan)	131.5E	Dom (C/Ka)
14134	1983-059C Palapa B1 (Indonesia)	134.0E	iRegional (C)
19765	1989-004A Gorizont 17 (Russia)	134.2E	iDom/Gov (C/Ku)
19508	1988-086A CS 3B (Sakura 3B) (Japan)	135.8E	Dom (C/Ka)
23185	1994-043A Apstar A1 (China)	137.9E	Reg FSS (C)
20107	1989-052A Gorizont 18 (Russia)	140.0E	iDom/Gov (C/Ku)
20217	1989-070A GMS 4 (Himawari 4)	140.0E	Met (P/L)
23108	1994-030A Gorizont 30 (Rimsat 2)	142.6E	Reg (C/Ku)
20923	1990-094A Gorizont 21 (Russia)	145.2E	Dom/Gov (C/Ku)
19874	1989-020A JCSAT 1 (Japan)	149.9E	Dom (Ku)
18316	1987-070A ETS V (Japan)	150.3E	iReg (L/C)

Geostationary Satellite Locator Guide

OBJ NO.	INT-DESIG/COMMOM NAME	LONG (DEG)	TYPE SATELLITE
23227	1994-055A Optus B3 (Australia)	152.5E	Dom/Mob (l/Ku)
20402	1990-001B JCSAT 2 (Japan)	153.9E	Dom (Ku)
18350	1987-078A Optus A3 (Aussat K3)	155.9E	Dom (Ku)
22253	1992-084A Superbird A (Japan)	157.9E	Dom (Ku/Ka)
22087	1992-054A Optus B1 (Aussat B1)	160.1E	Dom/Mob (L/Ku)
21893	1992-010A Superbird B (Japan)	162.0E	Dom (Ku/Ka)
16275	1985-109C Optus A2 (Aussat 2)	164.0E	Dom (Ku)
23175	1994-040A PanAmSat 2 (PAS-2)	169.0E	Reg (C/Ku)
12046	1980-087A OPS 6394 (Fltsatcom F4)	172.3E	iMil-POR reserve (PBravo)
22871	1993-066A Intelsat 701	174.0E	Int FSS (C/Ku)
20202	1989-069A DSCS III B9 (USA)	175.0E	iMil-WPAC primary (P/C)
15873	1985-055A Intelsat 511	177.1E	Int FSS (C/Ku)
21814	1991-084B Inmarsat 2 F3	177.4E	Mob-POR (L/C)
16117	1985-092C DSCS III B5 (USA)	180.0E	Mil-WPAC reserve (P/C)
14786	1984-023A Intelsat 508	180.0E	iInt FSS/Mar (L/C/Ku)
09478	1976-101A Marisat 3	177.8W	iIntl Mar-POR (P/L/C)
15236	1984-093C Leasat 2 (USA)	177.5W	iMil-POR primary (P)
12994	1981-119A Intelsat 503	176.9W	iInt FSS (C/Ku)
21639	1991-054B TDRS F5 (USA)	173.2W	Gov (C/Ku)
19548	1988-091B TDRS F3 (USA)	171.3W	Gov (C/Ku)
18631	1987-100A Raduga 21	169.4W	iGov/Mil (C)
14365	1983-098A Galaxy 2 (USA)	145.9W	dDom (C)
21392	1991-037A Satcom C5 (Aurora II)(USA)	139.0W	Dom (C)
20945	1990-100A Satcom C1 (USA)	136.9W	Dom (C)
22096	1992-057A Satcom C4 (USA)	134.9W	Dom (C)
22915	1993-074A DSCS III B14 (USA)	135.0W	Mil-EPAC primary (P/C)
23016	1994-013A Galaxy 1R (USA)	132.9W	Dom (C)
22117	1992-060B Satcom C3 (USA)	130.8W	Dom (C)
13637	1982-106B DSCS III A1 (USA)	130.1W	iMil-EPAC reserve (P/C)
21906	1992-013A Galaxy 5 (USA)	124.9W	Dom (C)
16649	1986-026A Gstar 2 (USA)	124.9W	Dom (Ku)
15826	1985-048D Telestar 3D (USA)	122.9W	Dom (C)
19484	1988-081B SBS 5 (USA)	122.8W	Dom (Ku)
16274	1985-109B Morelos B (Mexico)	116.7W	Dom (C/Ku)
13652	1982-110C Anik C3 (Canada)	114.9W	iDom (Ku)
23313	1994-065A Solidardad 2 (Mexico)	112.8W	Dom (C/Ku)
17561	1987-022A GOES 7 (USA)	111.6W	Met (L)
21726	1991-067A Anik E1 (Canada)	111.0W	Dom (C/Ku)
22911	1993-073A Solidaridad 1 (Mexico)	109.1W	Dom (C/Ku)
21222	1991-026A Anik E2 (Canada)	107.2W	Dom (C/Ku)
08697	1976-017A Marisat 1	106.4W	iIntl Mar-AOR (P/L)
08747	1976-023B LES 9 (USA)	105.8W	iMil (P/C)
20946	1990-100B Gstar 4 (USA)	105.0W	Dom (Ku)
03029	1967-111A ATS 3 (USA)	104.6W	iExp
15643	1985-028C Leasat 3 (USA)	104.5W	iMil-CONUS reserve (P)
15677	1985-035A Gstar 1 (USA)	102.9W	Dom (Ku)
22930	1993-078A DBS 1 (USA)	101.2W	Dom BSS (Ku)
21227	1991-028A Spacenet 4 (USA)	101.0W	Dom (C)
23192	1994-047A DBS 2 (USA)	100.7W	Dom BSS (Ku)
22796	1993-058B ACTS (USA)	100.0W	Exp (Ka)
17181	1986-096A USA 20 (Fltsatcom F7)(USA)	99.6W	Mil-CONUS primary (P/C)
22694	1993-039A Galaxy 4 (USA)	99.0W	Dom (C/Ku)
22927	1993-077A Telstar 401 (USA)	97.0W	Dom (C/Ku)
08746	1976-023A LES 8 (USA)	96.2W	iMil (P/C)
20872	1990-091A SBS 6 (USA)	94.9W	Dom (Ku)
15308	1984-101A Galaxy 3 (USA)	93.4W	Dom (C)
19483	1988-081A Gstar 3 (USA)	93.2W	iDom (Ku)
22205	1992-072A Galaxy 7 (USA)	90.9W	Dom (C/Ku)
23051	1994-022A GOES 8 (USA)	90.0W	Met (L)
22988	1994-009A USA 99 (Milstar 1)	90.0W	Mil (P/K)
18951	1988-018A Spacenet 3R (USA)	87.0W	Dom (L/C/Ku)
15237	1984-093D Telestar 302 (USA)	85.0W	Dom (C)
16482	1986-003B Satcom K-1 (USA)	84.9W	Dom (Ku)
16276	1985-109D Satcom K-2 (USA)	80.9W	Dom (Ku)
15235	1984-093B SBS 4 (USA)	76.9W	Dom (Ku)
14133	1983-059B Anik C2 (Argentina)	75.7W	iDom (Ku)
12309	1981-018A Comstar D4 (USA)	76.0W	iDom (C)
19215	1988-051A Meteosat P2 (ESA)	75.0W	iMet (L)
23132	1994-035A USA-104 (UFO-3)(USA)	74.8W	i/dMil-POR primary (P)
20873	1990-091B Galaxy 6 (USA)	74.0W	Dom (C)
13651	1982-110B SBS 3 (USA)	73.9W	iDom (Ku)
15642	1985-028B Anik C1 (Argentina)	71.7W	Dom (Ku)
14328	1983-094A Satcom F2R (USA)	71.8W	Dom (C)
12855	1981-096A SBS 2 (USA)	70.8W	iDom (Ku)
16650	1986-026B SBTS 2 (Brazil)	70.1W	Dom (C)
15385	1984-114A Spacenet 2 (USA)	70.0W	Dom (C/Ku)
23199	1994-049A Brazilsat B1 (Brazil)	69.9W	Dom (C)
15561	1985-015B SBTS 1 (Brazil)	64.9W	Dom (C)
21940	1992-021B Inmarsat 2 F4	53.8W	iIntl Mob-AOR-W (L/C)
19121	1988-040A Intelsat 513	53.1W	Int FSS (C/Ku)
20203	1989-069B DSCS III B10 (USA)	52.5W	Mil-WLANT primary (P/C)
14077	1983-047A Intelsat 506	50.0W	iInt FSS (C/Ku)
22314	1993-003B TDRS F6 (USA)	47.6W	Gov (C/Ku)
19217	1988-051C PanAmSat 1 (PAS 1)	45.0W	Reg (C/Ku)
16116	1985-092B DSCS III B4 (USA)	42.5W	Mil-ATL reserve (P/C)
19883	1989-021B TDRS F4 (USA)	40.8W	Gov (C/Ku)
20523	1990-021A Intelsat 603	34.5W	Int FSS (C/Ku)
20401	1990-001A Skynet 4A	33.9W	Mil (P/C)
14234	1983-077A Telstar 301 (USA)	33.8W	dDom (L/C/Ku)
12089	1980-098A Intelsat 502	33.3W	i/dInt FSS (C/Ku)
13083	1982-017A Intelsat 504	31.4W	iInt FSS (C/Ku)
22116	1992-060A Hispasat 1A (Spain)	30.1W	Dom (Ku)
22723	1993-048A Hispasat 1B (Spain)	30.0W	Dom (Ku)
21765	1991-075A Intelsat 601	27.6W	Int FSS (C/Ku)
19928	1989-030A Raduga 23 (Russia)	24.9W	iGov/Mil (C)
21653	1991-055A Intelsat 605	24.5W	Int FSS (C/Ku)
20253	1989-077A USA 46 (Fltsatcom 8)	24.1W	iMil-AOR primary (P-Charlie/K)
23168	1994-038A Cosmos 2282 (Russia)	24.0W	iMil-Early Warning
22112	1992-059A Cosmos 2209 (Russia)	23.6W	Mil-Early Warning
15391	1984-115A NATO III D	23.4W	iMil (P/C)
21989	1992-032A Intelsat K	21.4W	Int FSS (Ku)
16101	1985-087A Intelsat 512	21.2W	Int FSS (C/Ku)
20168	1989-062A TV Sat 2 (Germany)	19.2W	Dom BSS (Ku)
19621	1988-098A TDF 1 (France)	18.9W	Dom BSS (Ku)
20705	1990-063A TDF 2 (France)	18.8W	Dom BSS (Ku)
19772	1989-006A Intelsat 515	17.9W	Int FSS (C/Ku)
21047	1991-001A NATO IV A	17.8W	iMil (P/C)
20391	1989-101A Cosmos 2054 (Russia)	15.7W	iTracking & Relay WSDRN (Ku)
21149	1991-018A Inmarsat 2 F2	15.5W	iIntl Mob-AOR-E (L/C)
15386	1984-114B Marecs B2	15.0W	iIntl Mar (L)
10669	1978-016A Ops 6391 (FltSatCom 1)(USA)	14.6W	iMil-AOR reserve (P-Alpha)
21789	1991-079A Cosmos 2172 (Russia)	14.0W	Data Relay (C)
20659	1990-054A Gorizont 20 (Russia)	13.6W	iDom/Gov (C/Ku)
18384	1987-084A Cosmos 1888 (Russia)	13.6W	iData Relay (C)
22009	1992-037A DSCS III B12 (USA)	12.0W	Mil-ELANT primary (P/C)
22041	1992-043A Gorizont 26 (Russia)	10.9W	Dom/Gov (C/Ku)
22912	1993-073B Meteosat 6 (ESA)	9.5W	Met (L)
21813	1991-084A Telecom 2A (France)	7.9W	Dom/Gov/Mil (C/Ku)
19876	1989-020B Meteosat 4 (MOP 1)(ESA)	7.7W	Met (L)
21939	1992-021A Telecom 2B (France)	4.9W	Dom/Gov/Mil (C/Ku)
20776	1990-079A Skynet 4C (UK)	0.9W	iMil (P/C)
23124	1994-034A Intelsat 702	1.0W	Int FSS (C/Ku)
20762	1990-074A Thor/Marcopolo 2 (BSB R-2)	0.2W	Reg BSS (Ku)
21140	1991-015B Meteosat 5 (MOP 2)	0.1W	Met (L)

Amateur Satellite Frequency Guide

The Radio Amateur Satellite Corp.

Satellite | **Mode** | **Frequencies**

OSCAR 13 (AO-13) (Note 1)

Mode																	
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															145.985

Mode						
S (u/S)	Dn	2400.711	720	730	740	2400.747
	Up	435.601	610	620	630	435.637
Bcn		2400.650				

OSCAR 10 (AO-10) (Note 2)

Mode																	
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		145.910															

RS 10/11 (Notes 3,) 4 & 5

Mode								
A (v/A)	Dn	29.360	370	380	390	29.400	Robot	29.403
	Up	145.860	870	880	890	145.900		145.820
Bcn		29.357						

RS-12/13 (Notes 3,) 6 & 7

Mode								
K (h/A)	Dn	29.410	420	430	440	29.450	Robot	29.454
	Up	21.210	220	230	240	21.250		21.129
Bcn		29.408						

UoSat 11 (UO-II)

Mode				
Bcns	Dn	145.826	435.025	2401.500
	Up	None		

PACSAT (AO-16) (Notes 8, 9 & 12)

Mode					
[a]	Dn	437.025 (Sec) 437.050			
	Up	145.900	145.920	145.940	145.960

DOVE (DO-17) (Notes 10 & 12)

Mode			
[b,c]	Dn	145.825	2401.220
	Up	None	

WEBERSAT (WO-18) (Note 12)

Mode			
[a]	Dn	437.075	437.100 (Sec)
	Up	None	

LUSAT (LO-19) (Notes 8 & 12)

Mode					
[a]	Dn	437.125	437.150 (Sec)		
	Up	145.840	145.860	145.880	145.900

JAS-Ib (FO-20) (Note 12)

Mode												
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										

Mode					
JD [a] Dgtl	Dn				435.910
	Up	145.850	145.890	145.910	

Amateur Satellite Frequency Guide

The Radio Amateur Satellite Corp.

Satellite	Mode		Frequencies									
OSCAR 21 (RS-14) Trans. #1	B (u/V) Linear	Dn	145.852	860	870	880	890	900	910	920	930	145.932
		Up	435.102	094	084	074	064	054	044	034	024	435.022
	Dgtl	Dn								145.983		
(Notes 11 & 12)		Up	435.016	435.155		435.193		435.041				
	Bcns	145.819							145.952		145.983	
Trans. #2	B (u/V)	Dn	145.866	870	880	890	900	910	920	930	940	145.946
		Up	435.123	119	109	099	089	079	069	059	049	435.043
	Bcns	145.800	145.838	145.948								
OSCAR 22 (UO-22)	[c]	Dn		435.120								
		Up	145.900		145.975							
KITSAT A (KO-23)	[c]	Dn		435.173								
		Up	145.850		145.900							
KITSAT B (KO-25)	[c]	Dn	435.175		436.500							
		Up	145.870	145.980								
IT-AMSAT (IO-26)	[a,c]	Dn	435.820 (Sec.)		435.867							
		Up	145.875	145.900	145.925	145.950						
EYESAT /AMRAD (AO-27)	[b,a]	Dn	436.800									
		Up	145.850									
POSAT (PO-28) (Note 13)	[c]	Dn	435.250	435.280								
		Up	145.925	145.975								
MIR	[b]	Up & Dn & FM voice		145.550								
ARSENE (Note 14)												

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

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.

S. 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. The AO-21 RUDAX supports a number of digital modes. Recently, it has been used n a "bent pipe" DSP experiment which permits conventional FM signals to be processed and retransmitted as conventional FM signals. This provides a single channel "repeater-like" capability. This Mode is periodically interrupted for telemetry and other digital transmissions, somtimes including digitized voice.
12. 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)
13. PO-28 is available to amateurs on an intermittent, unscheduled basis.
14. Arsene has experienced failures of both 2 meter and S Band downlinks.

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-63	February 1995/ Discovery*	51.6/170	8 days	SPACEHAB-3
STS-67	February 1995/ Endeavour**	28.5/190	14 days	ASTRO-2

**Crew Assignment: CDR-James D. Wetherbee, PLT-Eileen M. Collins, MS-C. Michael Foale, MS-Bernard A. Harris, Jr, MS-Vladimir G. Titov (Russia), MS-Janice Voss Ford*

***Crew Assignment: CDR-Stephen S. Oswald, PLT-William G. Gregory, MS(PLC)-Tamara E. Jernigan, MS-John M. Grunsfeld, MS-Wendy B. Lawrence, PS-Samuel T. Durrance, PS-Ronald A. Parise*

***STS** Downlink Frequency Assignment: VHF Voice 259.7 and 296.8 MHz, S-band TRK 2041.9 MHz, S-band TLM 2106.4 MHz, TTC&V (TDRSS) 2217.5 and 2287.5, K-band TLM (TDRSS) 15003.4 GHz*

Japan Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
January 1995	M-3S2	KAGOSHIMA	EXPRESS
February 1995	H-2	TANEGASHIMA	GMS-5/SFU

***H-2** Downlink Frequency Assignment: 290.000 MHz*

***EXPRESS** Downlink Frequency Assignment: S-band TM/TC 2201.7057 MHz, C-band radar 5765 MHz.*

***GMS-5** Downlink Frequency Assignment: S-band TLM and TRK 2280.721 MHz*

***SFU** Downlink Frequency Assignment: S-band TLM 2263.6018 MHz*

China Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
January 1995	Long March 2E	Xichang	APTSTAR 2

***APTSTAR 2** Downlink Frequency Assignment: C-band 3.700-4.200 GHz, Ku-band 12 GHz*

European Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
January 1995	Ariane 4	Kourou	ERS-2
February 1995	Ariane 4	Kourou	INTELSAT 706
March 1995	Ariane 4	Kourou	DBS-3
March 1995	Ariane 4	Kourou	HELIOS 1

***Ariane 4** Downlink Frequency Assignment: S-band 2203, 2206, and 2218 MHz, C-band TRK 5745 and 5790 MHz*

***ERS-2** Downlink Frequency Assignment: S-band TLM and TRK 2225.00 MHz, X-band-Link 1 8140.000 MHz, and X-band-Link 2 8040.000 MHz.*

***INTELSAT 706** Downlink Frequency Assignment: S-band TLM 3625 MHz*

***HELIOS-1** Downlink Frequency Assignment: S-band TLM and TRK 2200.2220 MHz, X-band TLM 8253.000 MHz*

U.S. Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
January 1995	Atlas 2	CCAS	UHF F/O 4
January 1995	Pegasus XL	VAFB	SEASTAR
January 1995	DC-X	WSTF	Delta Clipper X
January 1995	DC-X	WSTF	Delta Clipper X
February 1995	Atlas 2AS	CCAS	INTELSAT 705
March 1995	Delta 2	VAFB	RADARSAT/ SURFSAT
March 1995	Atlas 2A	CCAS	MSAT USA
March 1995	Atlas 2	CCAS	GOES-J

***UHF F/0 4** Downlink Frequency Assignment: UHF-band 243-270 MHz, and EHF-band approximately 20 GHz*

***SEASTAR** Downlink Frequency Assignment: S-band TLM 2272.5 MHz, and L-band TLM 1702.5*

***INTELSAT 705** Downlink Frequency Assignment: S-band TLM 3625 MHz, 3704-4198 MHz, 10.954 - 11.191 GHz, 11.458 - 11.694 GHz, 11.704 - 11.941 GHz, 12.504 - 12.741 GHz*

***Delta 2** Downlink Frequency Assignment: S-band TLM 2244.5, S-band TLM 2241.5, S-band TLM 2252.5, C-band TRK 5765 MHz*

***RADARSAT** Downlink Frequency Assignment: S-band TLM and TRK 2230.0, X-band-Link 8105.000 MHz, and X-band-Link 8230.000 MHz*

***MSAT USA** Downlink Frequency Assignment: L-band 1530 - 1559 MHz, Ku-band 10.75 - 10.95 GHz or 11.7 - 11.9 GHz*

***GOES-J** Downlink Frequency Assignment: L-band TLM 1682.5, 1683.0, and 1694.0 MHz, S-band TLM and TRK 2209.086, 2208.586 MHz, 2214.0 MHz*

Russia Expendable Launch Vehicles

Launch Date	Launch Vehicle	Launch Site	Payload
January 1995	Cyclone	Plesetsk	SMOLSAT 1,2,3,4,5,6
January 1995	Zenit 2	Baikonur	GURWIN 1
January 1995	Zenit 2	Baikonur	NIKA-T 1
January 1995	Cyclone	Plesetsk	INTERBALL AURORA
January 1995	Proton	Baikonur	EXPRESS 3
January 1995	Cyclone	Plesetsk	INTERBALL TAIL
January 1995	Soyuz	Baikonur	PROGRESS M-26
March 1995	Soyuz	Baikonur	SOYUZ TM-21

***GURWIN 1** Downlink Frequency Assignment: 435.225 and 435.325 MHz*

***PROGRESS M-26** Downlink Frequency Assignment: 165.000 MHz, 166.000 MHz, and 922.755 MHz*

***SOYUZ TM-21** Downlink Frequency Assignment: 121.750 MHz*

Satellite Launch Schedules

List of Abbreviations and Acronyms

APSTAR 2	Asia Pacific Telecommunications Satellite owned by Chinese government-backed companies.
ASTRO-2	Program designed to obtain ultraviolet (UV) data on astronomical objects using a UV telescope flying on SPACELAB.
C-band	3700 to 6500 MHz
CCAS	Cape Canaveral Air Station
CDR	Commander
DBS	U.S. Direct Broadcast Satellite for TV communications.
DC-X	Delta Clipper-X was developed by McDonnell Douglas Space System as a single stage to orbit (SSTO) launch vehicle.
ERS-2	Earth Resources Satellite-2 will monitor coastal zones, open oceans, polar regions and on an experimental basis, land remote sensing.
EXPRESS	German unmanned reentry capsule designed to conduct microgravity and reentry technology experiments.
GAS(2)	Alternate name for the Small Self-contained Payload (SSCP) program, providing standard canisters to accommodate low-cost space experimentation.
GHz	Gigahertz
GMS-5	Japan Geostationary Meteorological Satellite-5 will monitor cataclysmic events such as hurricanes, typhoons, and regional weather.
GOES	U.S. NOAA weather satellite.
GURWIN 1	Gurwin 1 Techsat will include an amateur digital store & forward transponder, earth-observing camera, GPS navigation receiver and radiation detectors.
HELIOS	Helios will provide the Italian, Spanish and the French defense systems with remote sensing data.
INTELSAT	Communications satellite for the International Telecommunications Satellite organization (INTELSAT).
INTERBAL	Interball will study solar radiation interaction and acceleration mechanisms in the magnetosphere leading to precipitation into the auroral zones.
K-band	10.90 to 17.15 GHz
L-band	500 to 1549 MHz
MHz	Megahertz
MS	Mission Specialist
MSAT	MSAT (a joint Canada-NASA project) will provide voice, message, and data communications.
MS(PLC)	Mission Specialist (Payload Commander)
NIKA-T	KB Photon is developing the enhanced NIKA for long duration microgravity missions up to 120 days.
PANAMSAT	U.S. telecommunications satellite for Pan American Satellite of Connecticut.
PLT	Pilot
PROGRESS	Resupply cargo ship bringing food, water, air, and equipment to the manned Mir space station.
PS	Payload Specialist
RADARSAT	Remote free flyer sensing satellite that will monitor land, sea and ice for five years over the poles (U.S./Canadian).
S-band	2000 to 2300 MHz
SFU	Space Flyer Unit will carrying Japanese microgravity experiments in orbit for 6-9 months and then be retrieved by the U.S. space shuttle.
SMOLSAT	The Smolsat consortium, NPO PM, NPO Precision Instruments, and Moscow's Soyuz medinform Program Management, plan a 36-satellite operational system to work through 2kg handheld terminals.
SOYUZ	A 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.
SURFSAT	Summer Undergraduate Research Fellowship Satellite will radiate S,X, KU, and KA band signals to provide beacons for acquisition by NASA's Deep Space Network (DSN) for system calibration, test, and training.
TDRSS	Tracking and Data Relay Satellite System
TLM	Telemetry
TRK	Tracking
TTC&V	Tracking, Telemetry, Commanding, and Voice
UHF F/O	Ultra High Frequency Follow/On satellite designed to provide and replace older military communications systems.
VAFB	Vandenberg Air Force Base
VHF	Very High Frequency (30 to 300 MHz)
WSTF	White Sands Test Facility
X-band	8000 to 10,999 MHz

SATELLITE LAUNCH REPORT

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

How to Use the Satellite Launch Report

The "Satellite Launch Report" is a complete list of satellite launches which took place during September and October 1994. 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 Epoch	Incl	Int Des Period	Satellite Perigee	Mass Apogee
1994 Sep 9/0029		1994-058?	TELSTAR 402	3,331 kg
Orbital data unknown				

TELSTAR 402 is a communications, television and data transmission satellite, built by Martin Marietta Astro Space for AT&T. Mass quoted above includes propellant: in geosynchronous orbit this would drop to 1,880 kg. Satellite planned for deployment over 89 degrees west. Launched from Kourou by Ariane 42L.

Contact was lost with TELSTAR 402 after a successful launch into geosynchronous transfer orbit, the loss of signal coinciding with the planned pressurisation of the satellite's propellant tanks. Some reports suggest that the satellite disintegrated in orbit. USSPACECOM has only suggest that the satellite disintegrated in orbit. tracked one object from the launch (1994-058A: orbit 6.90 deg, 630.11 minutes, 222-35,715 km) which has been nominally assigned to the satellite: however if the satellite did disintegrate then it would be reasonable if the tracked object were to be the intact Ariane third stage since debris from a disintegrated satellite would be difficult for USSPACECOM to track in a geosynchronous transfer orbit.

Astronauts during the STS-64 mission captured this photo of the Spartan-201 spacecraft, the earth and the moon. (Photo courtesy of NASA)

Launch Date/Time Epoch	Incl	Int Des Period	Satellite Perigee	Mass Apogee
1994 Sep 9/2222		1994-059A	Discovery (STS-64)	95,671 kg
1994 Sep 10.15	57.01 deg	89.71 min	254 km	266 km
1994 Sep 15.98	57.01 deg	89.34 min	235 km	248 km
1994 Sep 9/2222		1994-059B	SPARTAN 201	1,288 kg
1994 Sep 13.90	57.00 deg	89.68 min	253 km	265 km

Six astronauts carried aboard the shuttle: Richard N Richards (commander), L Blaine Hammond Jr (pilot), J M (Jerry) Linenger (mission specialist, MS-1), Susan J Helms (MS-2), Carl J Meade (MS-3) and Mark C Lee (MS-4). Mass quoted above is that projected for landing which took place at Edwards Air Force Base Sep 20 at 2113 UTC. Launch was from Kennedy Space Center, Fla.

SPARTAN 201 was deployed from the shuttle payload bay Sep 13 at 2136 UTC and recovered Sep 15 at 2101 UTC after an independent flight, undertaking solar studies.

1994 Sep 21/1753		1994-060A	Cosmos 2291	2,300 kg *
1994 Sep 22.94	1.48 deg	1,442.20 min	35,902 km	35,910 km
1994 Oct 1.07	1.53 deg	1,436.13 min	35,758 km	35,817 km

Geizer communications and data relay satellite, launched as part of the Potok system. Believed to be used primarily for military applications. Orbit stabilised over 80 degrees east. Launched from Tyuratam using a four-stage Proton vehicle. Proton third stage left in a 51.62 deg, 88.32 minutes, 186-197 km orbit, the fourth Block DM-2 stage was left in an orbit similar to the first one quoted for the satellite.

Launch Date/Time Epoch	 Incl	Int Des Period	Satellite Perigee	Mass Apogee
1994 Sep 27.58		1994-061A	Cosmos 2292	500 kg *
1994 Sep 28.18	82.99 deg	108.93 min	400 km	1,954 km

Satellite is a sphere flown for passive monitoring of the Earth's upper atmospheric density. Launched from Plesetsk (actual time not announced: the time quoted above in decimals of a day UTC is estimated) using the Intermediate Cosmos vehicle: launch vehicle second stage is in an orbit similar to that of the satellite.

1994 Sep 30/1116		1994-062A	Endeavour (STS-68)	101,170 kg
1994 Sep 30.50	57.00 deg	88.90 min	214 km	227 km

STS-68

Carries six astronauts: Michael A Baker (commander), Terrence W Wilcutt (pilot), Thomas D Jones (payload commander and mission specialist, MS-4), Steven L Smith (MS-1), Daniel W Bursch (MS-2) and Peter J K Wisoff (MS-3). Mass quoted above is that projected for landing. Main payload is SLR-2 (Space Radar Lab), mass 10,794 kg, which remained in the shuttle's payload bay.

1994 Oct 3/2242		1994-063A	Soyuz-TM	207,150 kg ?
1994 Oct 4.00	51.65 deg	88.76 min	194 km	233 km
1994 Oct 16.20	51.65 deg	92.46 min	393 km	397 km

Spacecraft carrying three crew members: Alexandr S Viktorenko (commander), Yelena V Kondakova (flight engineer) and Ulf Merbold (German cosmonaut on a commercial mission for the European Space Agency). Docked with the Mir Complex Oct 6 at 0028 UTC. Viktorenko and Kondakova are due to remain in orbit until March 1995 (with V V Polyakov, launched aboard Soyuz-TM 18), Kondakova completing the longest flight by a woman: Merbold returned aboard Soyuz-TM 19 in early November 1994.

1994 Oct 6/0636		1994-064A	INTELSAT 703	3,720 kg
1994 Oct 7.47	25.88 deg	687.70 min	283 km	38,577 km
1994 Oct 15.54	0.24 deg	1,436.52 min	35,662 km	35,928 km

Communications satellite, built by Space Systems/Loral for INTELSAT. Mass of the satellite quoted above is at launch; on station the mass is approximately 2,550 kg and the dry mass is 1,495 kg. Satellite initially located over 121 degrees east. Launched from Cape Canaveral by Atlas 2AS: launch vehicle second stage (Centaur) is in an orbit similar to the first one quoted above for the satellite.

INTELSAT

Launch Date/Time Epoch	 Incl	Int Des Period	Satellite Perigee	Mass Apogee
1994 Oct 8/0107		1994-065A	Solidaridad 2	2,776 kg
1994 Oct 8.29	3.91 deg	639.03 min	188 km	36,207 km
1994 Oct 27.48	0.22 deg	1,436.05 min	35,772 km	35,794 km
1994 Oct 8/0107		1994-065B	THAICOM 2	1,080 kg
1994 Oct 9.18	3.92 deg	638.98 min	227 km	36,166 km
1994 Nov 3.89	0.04 deg	1,436.24 min	35,698 km	35,881 km

Solidaridad 2 is a communications (telephone, TV, data relay and mobile services) satellite, operated by Telecomunicaciones de Mexico and built by Hughes Space and Communications Co. Mass quoted above is at launch: on station it is 1.672 kg and the dry mass is 1,291 kg. Located over 113 degrees west.

THAICOM 2 is a telecommunications satellite (including data relay and voice transmission), operated by Shinawatra Satellite Public Co Ltd (Bangkok), once more built by Hughes Space and Communications Co. Mass quoted above is at launch: on station it is 628 kg and the dry mass is 437 kg. Initially located over 85 degrees

The Sun produced a flare above the Space Shuttle Endeavour's payload bay during the STS-68 mission in this 35mm view. Visible is part of the hardware for the Space Radar Laboratory-2 (SRL-2). Six NASA astronauts spent eleven days aboard Endeavour in Earth-orbit, in support of the SRL-2 mission. (Photo courtesy of NASA)

east, but to be operated over 78.5 degrees east. Launched by Ariane 44L from Kourou: Ariane third stage is in an orbit similar to the first listed for Solidaridad 2.

Launch Date/Time Epoch	Incl	Int Des Period	Satellite Perigee	Mass Apogee
1994 Oct 11.60	1994-066A		Okean 4	1,900 kg *
1994 Oct 12.27	82.55 deg	97.70 min	632 km	666 km

Eighth Okean-O satellite to be launched, the first four flights being within the Cosmos programme (Cosmos 1500, 1602, 1766 and 1869). All-weather oceanographic satellite built by NPO Yuzhnoye, carrying a 1.5 km resolution radar, visual and infra-red sensors and a radiometer. Plaunched from Plesetsk by Tsyklon vehicle (the launch time was not announced and therefore an estimated launch time is quoted above in decimals of a day): Tsyklon third stage is in an orbit similar to that of the satellite.

1994 Oct 13.68	1994-067A	Ekspress 1		2,500 kg *
1994 Oct 14.44	0.21 deg	1,441.60 min	35,862 km	35,927 km
1994 Oct 31.37	0.21 deg	1,436.39 min	35,777 km	35,808 km

First flight of new-generation communications satellite, built by NPO Prikladnoi Mekhaniki and planned to replace Gorizont satellites. Like Gals, it has the capability for controlling latitude (not available on earlier satellites) as well as longitude. Stationed over 70 degrees east. Launched by four stage Proton vehicle from Tyuratam: Proton third stage was in a 51.61 deg, 88.36 minutes, 193-194 km orbit, fourth stage (Block DM-2) in an orbit similar to the first one listed above for the satellite. In the absense of an announced launch time, an estimated time (in decimals of a day UTC) is quoted above.

1994 Oct 15/0505	1994-068A	IRS P2		804 kg
1994 Oct 16.24	98.69 deg	101.74 min	798 km	883 km

First successful launch of India's PSLV (Polar Satellite Launch Vehicle), placed IRS (Indian Remote Sensing) payload into orbit. Previous flight of PSLV on Sep 20, 1993. Launched from Sriharikota: fourth stage of PSLV is in an orbit similar to that of the satellite.

Launch Date/Time Epoch	Incl	Int Des Period	Satellite Perigee	Mass Apogee
1994 Oct 31/1430	1994-069A		Elektro 1	2,560 kg
1994 Oct 31.37	1.43 deg	1,438.95 min	35,765 km	35,920 km
1994 Nov 1.51	1.30 deg	1,441.21 min	35,851 km	35,922 km

First flight of long-promised satellite to inaugurate the GOMS (Geostationary Operational Meteorological Satellite) programme announced in 1975. Elektro satellite, built by VNII Elektromekaniki, might also be carrying a military communications package. Planned to be stationed over 76 degrees east. Launched by four stage Proton vehicle from Tyuratam: Proton third stage was in a 51.66 deg, 88.32 minutes, 189-193 km orbit, fourth stage (Block DM-2) in an orbit similar to the first one listed above for the satellite.

Updates for Previous Launches

1993-018A Cosmos 2238 was manoeuvred off-station and retired from operations on Sep 21, 1994. The following orbital data show the pre- and post-retirement orbits:

1994 Sep 20.95	65.02 deg	92.78 minutes	403 km	419 km
1994 Sep 21.39	65.02 deg	90.94 minutes	228 km	414 km

The satellite is now decaying from orbit.

1994-037A FSW-2 2 equipment module decayed from orbit Sep 13, 1994.

1994-042A Cosmos 2283 was recovered approximately Sep 29.8, 1994.

1994-044A Cosmos 2284 was recovered approximately Sep 11.9, 1994

1994-049B Add the following orbital data for Turksat 1B:

1994 Sep 5.10	0.03 deg	1,433.90 minu.	35,725 km	35,762 km
1994 Sep 13.18	0.04 deg	1,435.98 min.	35,779 km	35,790 km

The final orbit has the satellite located over 42 degrees east.

1994-052A Add the following orbit for Progress-M 24 after it docked at the rear of the Mir Complex:

1994 Sep 7.82	51.65 deg	92.69 minutes	395 km	398 km

1994-052A Progress-M 24 undocked from the Mir Complex Oct 4, 1994 at 1856 UTC and was de-orbited Oct 4, 1994 at 2144 UTC.

1994-053A Cosmos 2290 has performed a series of orbital manoeuvres: the post- manoeuvre orbits are listed.

1994 Oct 1.21	64.81 deg	89.84 minutes	210 km	323 km
1994 Oct 14.60	64.81 deg	89.89 minutes	207 km	331 km
1994 Oct 20.47	64.82 deg	90.13 minutes	200 km	361 km
1994 Oct 29.35	64.81 deg	90.32 minutes	214 km	366 km

1994-062A Add the following orbital data for Endeavour (STS-68):

1994 Oct 7.67	56.99 deg	88.61 minutes	199 km	212 km

The shuttle landed at Edwards Air Force Base, Calif Oct 11, 1994 at 1702 UTC. ST

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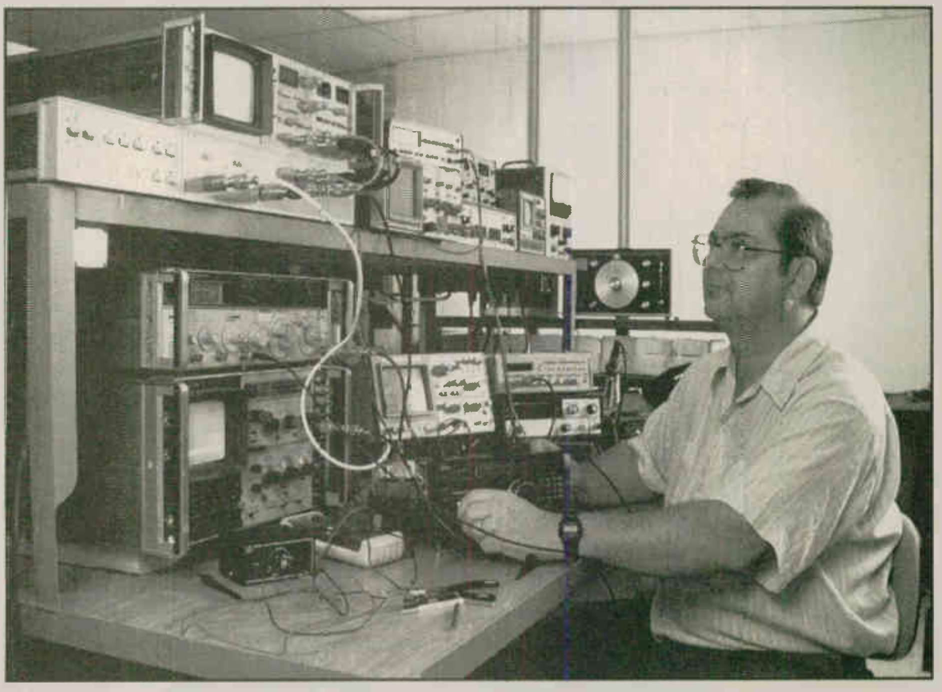

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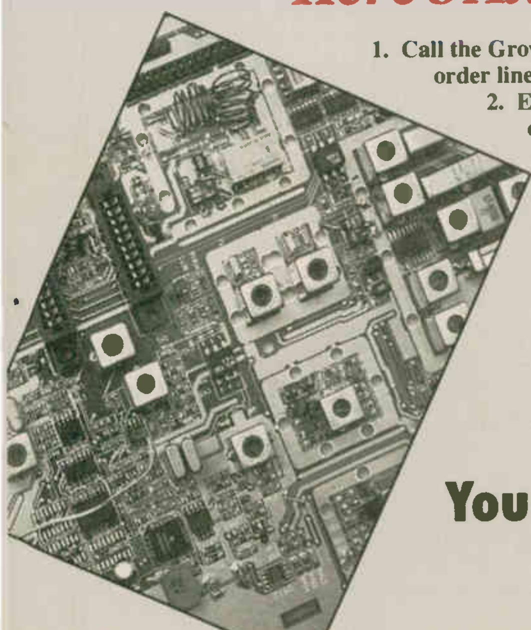

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NASA SPACE NEWS

Important Step Taken To Determine Age, Size of Universe

Astronomers using NASA's Hubble Space Telescope (HST) have taken an important step toward determining the age and size of the universe.

In a recent NASA announcement, scientist have been able to calculate with considerable precision the distance to a remote galaxy, M100, in the Virgo cluster of galaxies.

The ability to make accurate distance measurements over vast reaches of space will help provide a precise calculation of the expansion rate of the universe, called the Hubble Constant, which is crucial to determine the age and size of the universe.

"Although this is only the first step in a major systematic program to measure accurately the scale, size, and age of the universe," noted Dr. Wendy L. Freedman, of the Observatories of the Carnegie Institution of Washington, "a firm distance to the Virgo cluster is a critical milestone for the extragalactic distance scale, and it has major implications for the Hubble Constant."

HST's detection of Cepheid variable stars in the spiral galaxy M100, a member of the Virgo cluster, establishes the distance to the cluster as 56 million light-years (with an uncertainty of +/- 6 million light-years). M100 is now the most distant galaxy in which Cepheid variables have been measured accurately.

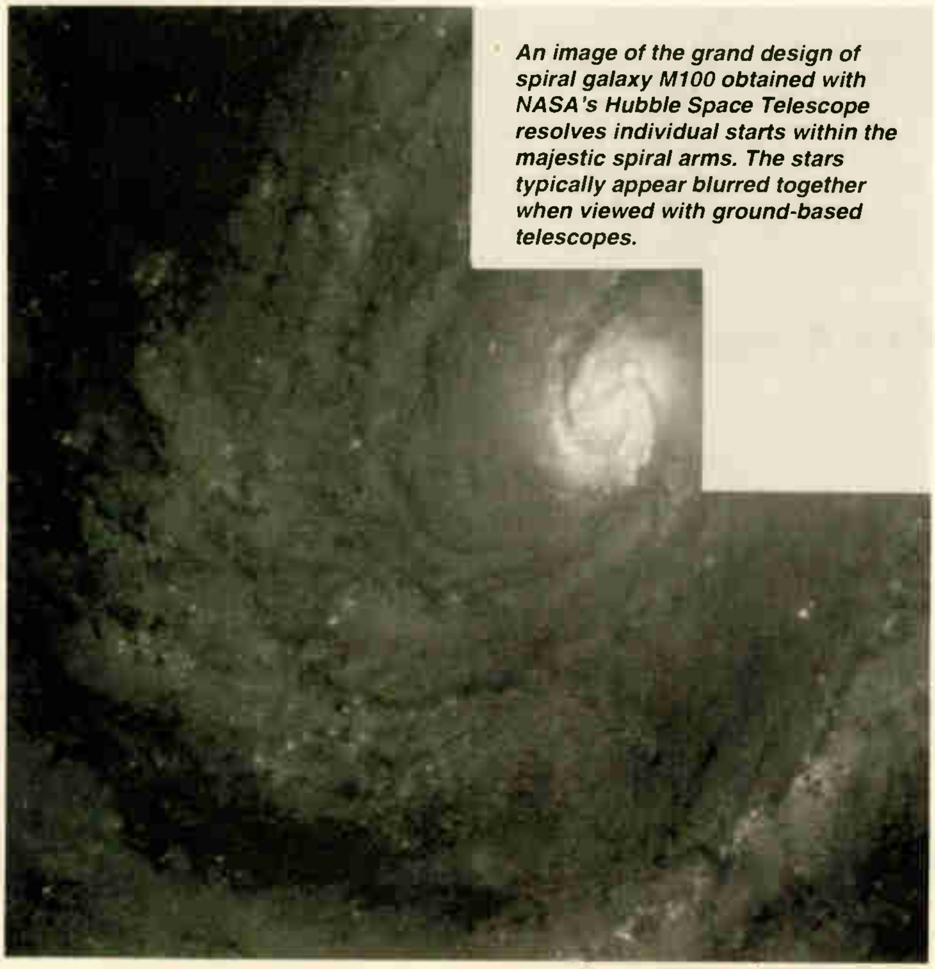
The precise measurement of this distance allows astronomers to calculate that the universe is expanding at the rate of 80 km/sec per megaparsec (+/- 17 km/sec). For example, a galaxy one million light-years away will appear to be moving away from us at approximately 60,000 miles per hour. If it is twice that distance, it will be seen to be moving at twice the speed, and so on. This rate of expansion is the Hubble Constant.

The team of astronomers is jointly led by Freedman, Dr. Robert Kennicutt (Steward Observatory, University of Arizona), and Dr. Jeremy Mould (Mount Stromlo and Siding Spring Observatories, Australian National University).

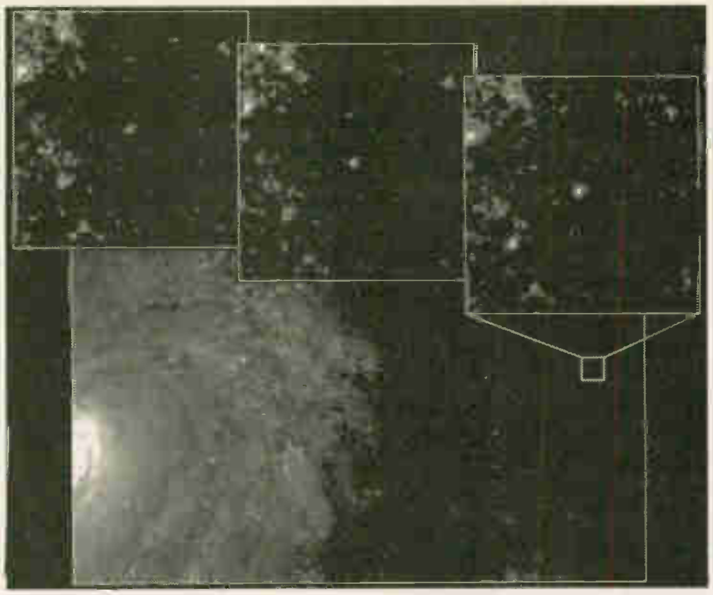
Dr. Mould noted, "Those who pioneered the development of the Hubble Space Telescope in the 1960s and 1970s recognized its unique potential for finding the value of the Hubble Constant. Their foresight has been rewarded by the marvelous data that we have obtained for M100."

Using Hubble's Wide-Field and Planetary Camera (WFPC2), the team of astronomers repeatedly imaged a field where much star formation recently had taken place, and was, therefore, expected to be rich in Cepheids—a class of pulsating stars used for determining distances. Twelve one-hour exposures, strategically placed in a two-month observing window, resulted in the discovery of 20 Cepheids. About 40,000 stars were measured in the search for these rare, but bright, variables. Once the periods and intrinsic brightness of these stars were established from the careful measurement of their pulsation rates, the researchers calculated a distance of 56 million light-years to the galaxy. (The team allowed for the dimming effects of distance as well as that due to dust and gas between Earth and M100.)

Many complementary projects are currently being carried out from the ground with the goal of also providing values for the Hubble Constant. However, they are sub-



An image of the grand design of spiral galaxy M100 obtained with NASA's Hubble Space Telescope resolves individual starts within the majestic spiral arms. The stars typically appear blurred together when viewed with ground-based telescopes.



Hubble Space Telescope image of a region of the galaxy M100 shows a class of pulsating star called Cepheid Variable, which are reliable distance indicators to galaxies.

ject to many uncertainties which HST was designed and built to circumvent. For example, a team of astronomers using the Canada-France-Hawaii telescope at Mauna Kea recently has arrived at a distance to another galaxy in Virgo that is similar to that found for M100 using HST — but their result is tentative because it is based on only three Cepheids in crowded star fields.

"Only Space Telescope can make these types of observations routinely," Freedman explained. "Typically, Cepheids are too faint and the resolution too poor, as seen from ground-based telescopes, to detect Cepheids clearly in a crowded region of a distant galaxy."

Although M100 is now the most distant galaxy in which Cepheid variables have been discovered, the Hubble team emphasized that the HST project must look into even more distant galaxies before a definitive number can be agreed on for the age and size of the universe. This is because the galaxies around the Virgo Cluster are perturbed by the large mass concentration of galaxies near the cluster. This influences their rate of expansion.

Refining the Hubble Constant

These first HST results are a critical step in converging on the true value of the Hubble Constant, first developed by the American astronomer Edwin Hubble in 1929. Hubble found that the farther away a galaxy is, the faster it is receding away from us. This "uniform expansion" effect is strong evidence the universe began in an event called the "Big Bang" and that the universe has been expanding ever since.

To calculate accurately the Hubble Constant, astronomers must have two key numbers: the recession velocities of galaxies and their distances as estimated by one or more cosmic "mileposts," such as Cepheids. The age of the universe can be estimated from the value of the Hubble Constant, but it is only as reliable as the accuracy of the distance measurements.

The Hubble Constant is only one of several key numbers needed to estimate the universe's age. For example, the age also depends on the average density of matter in the universe, though to a lesser extent.

A simple interpretation of the large value of the Hubble Constant, as calculated from HST observations, implies an age of about 12 billion years for a low-density universe, and 8 billion years for a high-density universe. However, either value highlights a long-standing dilemma. These age estimates for the universe are shorter than the estimated ages of some of the oldest stars found in the Milky Way and in globular star clusters orbiting our Milky Way. Furthermore, small age values pose problems for current theories about the formation and development of the observed large-scale structure of the universe.

Cosmic Mileposts

Cepheid variable stars rhythmically change in brightness over intervals of days (the prototype is the fourth brightest star in the circumpolar constellation Cepheus). For more than half a century, from the early work of astronomers Edwin Hubble, Henrietta Leavitt, Allan Sandage, and Walter Baade, it has been known that there is a direct link between a Cepheid's pulsation rate and its intrinsic brightness. Once a star's true brightness is known, its distance is a relatively straightforward calculation because the apparent intensity of light drops off at a geometrically predictable rate with distance. Although Cepheids are rare, once found, they provide a very reliable "standard candle" for estimating intergalactic distances, according to astronomers.

Besides being an ideal hunting ground for the Cepheids, M100 also contains other distance indicators that can in turn be calibrated with the Cepheid result. This face-on, spiral galaxy has been host to several supernovae, which are also excellent distance indicators. Individual supernovae (called Type II, massive exploding stars) can be seen to great distances, and can be used to extend the cosmic distance scale well beyond Virgo.

As a crosscheck on the HST results, the distance to M100 has been estimated using the Tully-Fisher relation (a means of estimating distances to spiral galaxies using the maximum rate of rotation to predict the intrinsic brightness) and this independent measurement also agrees with both the Cepheid and supernova "yardsticks."

HST Key Projects are scientific programs that have been widely recognized as being of the highest priority for the HST and have been designated to receive a substantial amount of observing time on the telescope. The Extragalactic Distance Scale Key Project involves discovering Cepheids in a variety of important calibrating galaxies to determine their individual distances. These distances then will be used to establish an accurate value of the Hubble Constant.

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

The Wide Field and Planetary Camera 2 was developed by NASA's Jet Propulsion Laboratory, Pasadena, CA, and is managed by the Goddard Space Flight Center for NASA's Office of Space Science, Washington, DC. ST

AMATEUR RADIO SATELLITES

By John A. Magliacane, KD2BD

Tracking Transponders

In the last issue of Satellite Times we reported on several Amateur satellites that carry FM beacon transmitters and presented some hints on how these satellites can be monitored with simple, low-cost receiving equipment. In this issue we will discuss communication transponders and explore some methods that can be used to receive SSB voice and CW communications carried over Amateur satellites having active linear transponders.

In the early days of satellites, communications via satellite were made with large and reflective surface areas in an effort to reflect RF radio signals directed toward them back to the earth.The early "Echo" satellites are good examples of passive communication satellites designed to bounce radio signals directed toward them back to earth. Since they carried no electronics, they required no electrical power to perform their functions and operated over very wide frequency ranges. However, their performance left a lot to be desired. Early reflective spheres placed in earth orbit did more then reflect RF back to earth. They also scattered it widely into space, completely missing its target. Resonant "needles" were also placed in orbit and tried, but in either case it took a very powerful uplink signal to develop a usable downlink signal beyond the horizon.

Later communication satellites worked around this problem by carrying an active transponder as a payload. A communications transponder is a piece of electronics that receives radio signals in one segment of the radio spectrum, amplifies them linearly, translates or shifts their frequency to another segment of the radio spectrum, and retransmits them with an output signal greater than the signal received. The first Amateur satellite to carry an active transponder into orbit was OSCAR 3 back in 1965. Since transponders carry active electronic circuits, they must be powered for operation, but since they amplify the signals they receive before retransmitting them, it takes far less uplink power to develop a usable downlink signal when communicating through an active transponder.

Since active transponders have system gains greater than unity, they must translate their downlink signals to another frequency segment to avoid feedback oscillation. The usual practice in the Amateur Radio Service has been to translate uplink and downlink signals between different Amateur bands. This provides enough frequency separation to allow full crossband duplex communications without the need for a large, bulky, and expensive duplexers both in the satellite and at the ground stations wishing to communicate through the satellite. The first and only Amateur satellite to carry an in-band transponder was OSCAR 3. OSCAR 3's 50 KHz-wide transponder had an input passband that started at 145.100 MHz, and an output passband that started 800 KHz higher at 145.900 MHz.

Linear transponders faithfully translate any RF emission to another frequency range without distortion. They do this by linearly amplifying their input signals, mixing them with a stable local oscillator to perform the frequency translation, and filtering and amplifying the result prior to feeding the output signal to another antenna system. If the output signal is the result of the input signal and the local oscillator frequencies adding together, the transponder is said to be non-inverting. In other words, an input signal that rises in frequency will produce an output signal that also rises in frequency. Likewise, an upper sideband voice signal on the input of the transponder will produce an upper sideband output emission. If the output signal is the result of the input signal and the local oscillator subtracting, the transponder is said to be inverting. An input signal that rises in frequency produces an output that falls in frequency. Similarly, an upper sideband voice signal on the input produces lower sideband on the output. Many of the transponders carried on OSCAR satellites process their input signals through several stages of frequency conversion, but their operations are characterized by a single translation equation.

TABLE 1

Amateur band designators used in identifying OSCAR transponders

21 MHz	H-Band
29 MHz	A-Band
145 MHz	V-Band
435 MHz	U-Band
1270 MHz	L-Band
2400 MHz	S-Band
5600 MHz	C-Band
10000 MHz	X-Band
24000 MHz	K-Band

Transponder Monitoring

The easiest linear transponder downlinks that can be monitored are those carried on the Russian Radio Sputnik-10 and Radio Sputnik-12 satellites. Both these satellites have downlinks in the Amateur 10-meter band and are easily copied using an HF receiver and a dipole antenna. The decline of solar activity and reduction in the MUF have made reception of 10-meter downlinks easy since the Earth's ionosphere offers very little attenuation to HF signals originating from outer space.

At press time, the RS-10 satellite was operating in Mode V/A (see Table 2), accepting signals between 145.860 MHz and 145.900 MHz in the 2-meter Amateur band, and relaying those signals to the 10-meter band between 29.360 MHz and 29.400 MHz. The downlink passband edges of RS-10 are surrounded by a pair of CW beacon transmitters on 29.357 MHz and 29.403 MHz. One beacon transmits satellite telemetry and "codestore" messages from the control station, while the second beacon serves as the downlink of an "autotransponder" called a 'Robot' that calls CQ and responds to stations calling it with a short reply that includes a QSO number for QSL purposes. QSL cards for 'Robot' contacts are available through DF4XW or Andrey Mironov, ul.V-Voloshinoj, d.11, kv.72, station Perlovskay, 141014, Moscow region, Russia, C.I.S.

RS-10's transponder passband is wide enough to handle several simultaneous SSB and CW contacts. These are easily heard as the satellite comes into range. Since the downlink is on a low frequency, Doppler shift due to the satellite's motion and the Earth's rotation is under 1 KHz and is very small. The same cannot be said for the VHF uplink. Most of the signal drift heard on downlink signals are therefore the result of Doppler shift on the uplink signals. The proper operating practice is to adjust either the ground station or transmitter that is operating on the highest frequency to maintain a constant downlink frequency as heard

TABLE 3

Predicted attitude of OSCAR-10 for selected dates in 1995. Data is by James Miller, G3RUH.

Date	ALON	ALAT	SA	ILL %	SEL	SAZ	Arg P	RAAN
1995 Jan 23 [Mon]	201	-19	16	96	-25	121	244	287
1995 Feb 20 [Mon]	199	-19	44	71	30	150	252	283
1995 Mar 20 [Mon]	196	-19	72	29	-27	179	259	278
1995 Apr 17 [Mon]	193	-18	79	18	-15	203	266	274
1995 May 15 [Mon]	190	-18	52	60	0	223	274	270
1995 Jun 12 [Mon]	188	-17	25	90	17	242	281	265
1995 Jul 10 [Mon]	185	-17	-1	100	32	265	288	261
1995 Aug 7 [Mon]	182	-16	-27	88	39	295	296	256
1995 Sep 4 [Mon]	179	-15	-54	57	34	326	303	252
1995 Oct 2 [Mon]	176	-14	-82	13	20	351	310	248
1995 Oct 30 [Mon]	173	-12	-70	34	0	9	318	243
1995 Nov 27 [Mon]	170	-11	-41	74	-20	27	325	239
1995 Dec 25 [Mon]	167	-9	-13	97	-37	51	332	234

Key

ALON (deg)	Attitude longitude in orbit plane coordinates (BLON)
ALAT (deg)	Attitude latitude in orbit plane coordinates (BLAT)
SA (deg)	Sun Angle
ILL%	Percentage illumination = 100*COS(SA)
SEL (deg)	Sun's elevation above orbit plane
SAZ (deg)	Sun's azimuth in orbit plane coordinates

Orbit plane coordinates: longitude is measured clockwise from perigee; latitude is measured up from the orbit plane.

in the ground station receiver. In the case of Mode V/A, the uplink transmitter frequency is adjusted during a satellite pass to maintain a constant downlink frequency.

The RS-10 satellite travels along with a Russian navigation satellite and another Amateur satellite, RS-11, all on the same space platform. RS-10 and RS-11 are essentially identical spacecraft with similar transponders and capabilities. RS-11 is turned off at the present time and serves as a backup should RS-10 fail.

RS-12 is in a similar situation, sharing a space platform with a navigation satellite and another Amateur payload, RS-13. At press time, RS-12 is active on Mode H/A, accepting uplink signals between 21.210 MHz and 21.250 MHz in the Amateur 15-meter band, and generating downlinks in the Amateur 10-meter band between 29.410 MHz and 29.450 MHz. Beacons can be heard on 29.408 MHz and 29.454 MHz.

Advanced Monitoring

Monitoring communications taking place through any of the other OSCAR satellites carrying linear transponders requires a VHF, UHF, or higher, SSB receiver and antenna system. As always, there are expensive ways of setting up a receiving station, and there are "cheap and dirty" ways of accomplishing essentially the same task for far less cost. A good 2-meter multi-mode receiver (or transceiver) can form the basis of a good OSCAR satellite monitoring station. A 2-meter receiver will directly receive Mode U/V transponder downlinks from OSCAR-10 and OSCAR-13 with the addition on an antenna system and perhaps a low-noise pre-amplifier. A 10-meter receiver can be used to receive 2-meter signals with the addition of a receiving converter. The addition of 435 MHz, 1270 MHz, and 2400 MHz downconverters will allow reception of these bands by converting signals received in these bands down to 145 MHz. Downconverters can sometimes be mounted directly at the antenna feedpoint to reduce the loss of the transmission line feeding the receiver, thus improving the received signal to noise ratio.

Good VHF and UHF reception requires a low noise figure receiver (or downconverter) front-end. It is usually best to have a noise figure of under 1 dB. Such noise figures are easily achieved with gallium arsenide field effect transistors (GaAsFETs). Circularly polarized yagis with gains of 13 dBc or higher are generally used on 145 MHz and 435 MHz. Loop yagis are popular on 1270 MHz, and parabolic reflectors with a helical feeds are a good choice for 2400 MHz work.

Some Amateurs use scanning receivers as low-cost downconverters to receive VHF and UHF signals on their HF general coverage receivers. They usually tap off the first I.F. (typically 10.7 MHz or 21.4 MHz) of the scanner and feed it into their HF rig so they can tune in SSB, CW, and PSK signals not heard by the FM demodulator in the scanner. Improved performance can be realized by using a low-noise preamplifier ahead of the scanner, and can rival the performance of a very expensive UHF all-mode rig.

TABLE 2

Transponder Mode Designations - Old and New

Uplink Band	Downlink Band	Old Designation	New Designation
21 MHz	29 MHz	Mode K	Mode H/A
21 MHz	145 MHz	Mode T	Mode H/V
145 MHz	29 MHz	Mode A	Mode V/A
145 MHz	435 MHz	Mode B	Mode U/V
435 MHz	145 MHz	Mode J	Mode V/U
435 MHz	2400 MHz	Mode S	Mode U/S
1270 MHz	435 MHz	Mode L	Mode L/U

Newer satellite may combine several uplink bands into single or multiple downlink bands. The transponder designations will use the convention: uplink band(s)/downlink band(s).

Tuning in the OSCARs

OSCAR-10 suffered a electronics malfunction several years that has made commanding of the spacecraft impossible. With no way of adjusting the attitude of the satellite, the solar panels drift in and out of sunlight. When the satellite experiences extended periods of darkness, its battery supply runs down and users cease operation of the transponder. Another consequence of the loss of control is the antennas on the satellite do not always point toward the Earth. The result is weak and fading signals that are difficult to copy even by well equipped stations. Still, there are other times when the satellite can be heard with very strong signals. I've been able to hear signals down to OSCAR-10's transponder noise floor using an indoor antenna on several occasions when the satellite was close to perigee. OSCAR-10's VHF downlink passband covers a range between 145.825 MHz and 145.975 MHz with a beacon carrier that can be heard intermittently on 145.810 MHz.

OSCAR-13 is OSCAR-10's "younger brother". It's VHF downlink extends between 145.825 MHz and 145.975 MHz, and has a beacon on 145.812 MHz that carries telemetry and news in CW, RTTY, and PSK. It's S-band downlink passband covers the spectrum between 2400.711 MHz and 2400.747 MHz.

The FUJI-OSCAR-20 satellite carries both analog and digital communication transponders. It's analog transponder downlink passband extends from 435.800 MHz to 435.900 MHz, and carries a CW beacon on 435.795 MHz when the analog transponder is active. Otherwise, the PSK beacon/ digital transponder downlink channel can be heard carrying 1200 bit per second data on 435.910 MHz.

LoS

Well, that's all the time we have in this pass. In the next issue of Satellite Times, we will pick up the pace a bit and begin discussing some of the latest developments in the Amateur Satellite Program. Happy DXing! ST

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

The Active Polar Orbiting Weather Birds

In this issue will we start out with a review of the active polar orbiting weather satellites, and what you can expect to hear and image during the next few months. As we have discussed in previous columns, the United States and Commonwealth of Independent States (C.I.S.) have a fairly active constellation of the polar orbiting weather satellites, although not every platform is active all the time. The trick is to be able to predict when and where these satellites will be transmitting Automatic Picture Transmission (APT) imagery. This month's column will provide some tips and techniques for finding those active (and sometimes new) birds rising over your horizon.

Utilizing a current set of Keplerian elements (the radar observation data points provided by the U.S.Air Force that allow prediction programs to plot the positions of the satellites) will help you define the Acquisition of Signal (AoS) and Loss of Signal (LoS) times for individual satellites. But how do you know if the radiometers (image sensors on the satellites) will actually be transmitting imagery as the satellite passes your location? The best way is to turn on your weather satellite receiver, tune it to the appropriate frequencies, and listen!

Once a signal is acquired, your APT ground station captures the imagery and stores it to disk. Some of the more advanced receivers and APT software allow you to actually log the time, date, and frequency of the signals being captured to a file in your personal computer. Matching up the time and date of the signal acquisition with the satellite tracking program predictions will verify which specific satellite your station has acquired.

One interesting point is that if a signal is heard on a specific frequency that your satellite tracking program did not predict, it is very possible you have just stumbled across a new satellite platform, or an older satellite that has recently begun transmitting once again. This event recently happened at the Dallas Remote Imagery Group (DRIG) lab with Russian Okean 1-7 satellite (more on this later).

The United States NOAA 9-12 (NOAA 13 is no longer operational) satellites have a fairly predictable schedule of transmissions which are easily tracked. National Oceanic and Atmospheric Administration (NOAA) does schedule the APT transmissions on their satellites when orbits are such that two spacecraft may be transmitting at the same time, on the same frequency. This is called a conflict alert, and one of the satellite transmitters may have to be shut off to reduce interference until the orbits separate again.

In contrast to the U.S. weather satellite system, the large constellation of Russian Meteor polar orbiters often change their transmission schedules and frequencies they transmit on. Figure 1. is a listing of the current U.S. and Russian weather satellite platforms, their active status, and current frequencies as of early November 1994.

The Russians often switch the Meteor satellite (Meteor 2-21, 3-4, 3-5, etc.) transmitters on and off depending on lighting conditions on orbit, new launch conflicts (other satellites such as Okean 1-7), etc. The best way to determine what is currently active is to monitor 137.300, 137.400, and 137.850 MHz and match the active transmissions up with the predictions from your satellite tracking programs. Occasionally on old, inactive satellite is switched back on and may be observed transmitting imagery or just a dead carrier.

FIGURE 1

Active Weather Satellites

Satellite	Frequency	Active
NOAA 9	137.620 MHz	On
NOAA 10	137.500 MHz	Off (Conflict with NOAA 12)
NOAA 11	137.620 MHz	Burst on, no image (problem with spacecraft?)
NOAA 12	137.500 MHz	On
NOAA 13	137.620 MHz	Spacecraft deactivated
NOAA-J		Launch scheduled for Dec 4, 1994 — Vandenberg Air Force Base, Calif.
Meteor 2-21	137.850 MHz	Off
Meteor 3-5	137.850 MHz	On
Okean 1-7	137.400 MHz	Off after transmitting for several weeks — launched Oct 11, 1994

Russians Launch New Okean Remote Sensing Satellite

On Oct. 11, 1994, the C.I.S. launched a new remote sensing platform, the Okean 1-7 (International Designator 1994-006A — Satellite Number 23317). This satellite was first observed transmitting by DRIG member Esko Novaro on 137.400 MHz with both visible and radar imagery evident. This serendipitous find was a good example of coming across a new satellite launch, based on signal acquisition at a time not predicted by the satellite tracking program for a particular ground station reference point. It is truly exciting to realize you have listened to a radio signal from a brand new satellite, and indeed, may be one of the first observers to log the frequency! Figure 2. is an APT image of the OKEAN 1-7 transmissions.

In the late 1970's, the former USSR began testing a new series of instruments that would complement standard meteorological payloads and provide information on ocean and ice conditions. After testing various equipment on four test launches during 1979-1981, the first prototype Okean satellite was orbited in 1983 as Kosmos 1500. This was followed by three other Kosmos prototype launches. The first operational spacecraft (Okean-O) was launched in 1988.

Okean satellites are a series of oceanographic payloads with real aperture side-looking radars, visible, an IR imagery. The Russians indicate these satellites "....are for all-weather monitoring conditions, all-weather monitoring of wind-in-

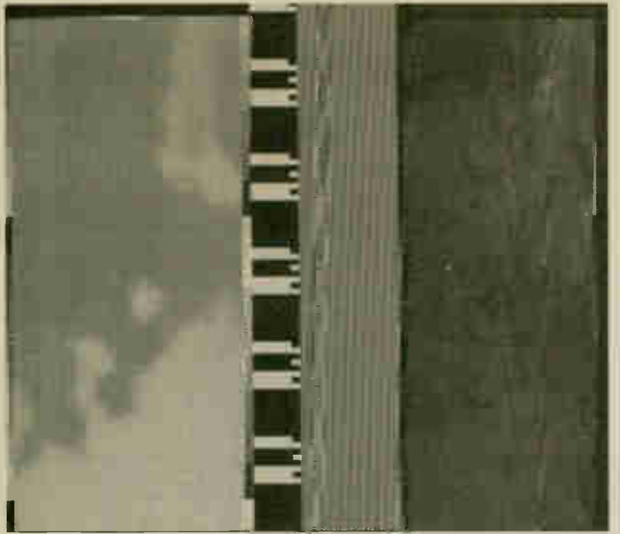


FIGURE 2: ***APT image from Okean 1-7 satellite (Photo courtesy of the Dallas Remote Imaging Group)***

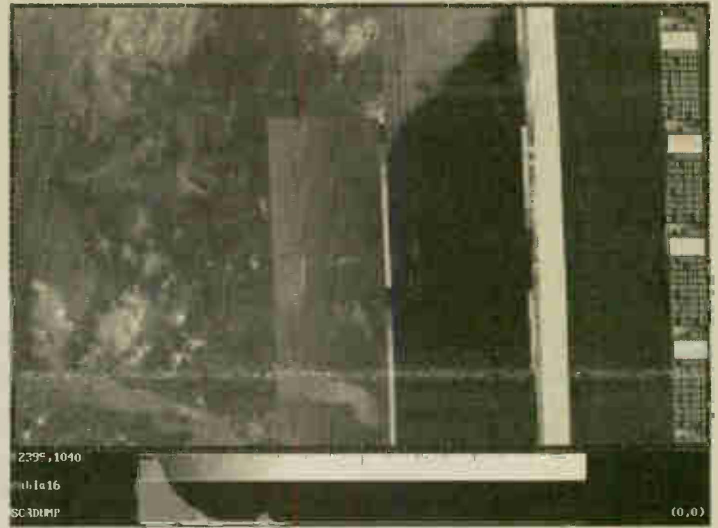


FIGURE 3: ***Okean satellite image of Florida and Cuba (Photo courtesy of the Dallas Remote Imaging Group)***

duced seaway, storm and cyclone regions...radar and optical monitoring of dynamic phenomenon and the ocean surface zones, internal waves, upwelling, etc.....". U.S. intelligence analysis believe this series was the precursor to advanced intelligence satellites monitoring U.S. Navy movements...similar to the U.S. White Cloud satellites. Figure 3 is an older image from an Okean satellite showing Cuba and Florida in the image swath.

Late reports indicate that Okean 1-7 is no longer transmitting on 137.400 MHz while over the U.S., and these initial transmissions may have been for testing and calibration purposes only.

C.I.S. Launches Elektro Geostationary Spacecraft

There have been several reports that the C.I.S. has launched its long-awaited Elektro (GOMS) geostationary spacecraft. This is the C.I.S. equivalent of the U.S. GOES constellation of geostationary meteorological satellites. The Elektro spacecraft is international designator 1994-069A and satellite number 23327. It is currently located at 88 degrees east, and is a three-axis stabilized spacecraft.

NOAA-J Launch in December

The NOAA-J meteorological satellite is scheduled to be launched from Vandenberg Air Force Base, Calif. on Dec. 4, 1994. The spacecraft will be launched into a near-polar orbit at 2:00 a.m. local time. Your "View from Above" editor has been invited by NASA/NOAA to attend the launch and make a presentation afterward to an educator's conference. The highlights of the launch, with photographs and initial imagery will be presented in a future "View from Above" column.

Final Report on NOAA 13 Satellite Failure

The National Aeronautics and Space Administration (NASA) and NOAA have released the final investigation report on the failure of NOAA 13. NOAA I, later designed NOAA 13, was launched on Aug. 9, 1993 into a 870 km. near polar orbit from Vandenberg Air Force Base, Calif.

During orbit number 175, 12 minutes after the satellite's last communication with the NOAA Command and Data Acquisition site in Wallops Island, Va., the satellite failed. When controllers communicated with the satellite and found it operating normally on orbit 175, they followed standard procedures and turned their attention to other operational satellites. Controllers did not communicate with the NOAA-13 platform again until orbit 177.

At that point the operations crew noted battery low voltage and high temperature flags on all three batteries, which were the first indications of a problem, the board reported. Controllers were unable to acquire a signal from the spacecraft on orbit 178, the board indicated, and orbits 179 and 180 were not monitored because the spacecraft did not pass over either ground station at Wallops Island, Va. or Fairbanks, Alaska. On orbit 181, the satellite recovery procedures were started, however, to no avail. No further signals were received from the spacecraft.

The 12-member investigation board at NOAA found that a short circuit prevented the solar array current from powering the spacecraft and recharging the batteries. In the board's 36 page report, it indicated that the failure most likely occurred in a battery charge assembly on the spacecraft. Based on telemetry from the satellite, the board indicated the most probable cause was a 1.25 inch screw that extended too far below an aluminum plate designed to dissipate heat. The pointed end of the screw penetrated the insulation and made contact with a radiator plate, causing the short circuit. The short circuit effectively prevented the solar arrays from powering the spacecraft, forcing the spacecraft to rely on its batteries.

Without power from the solar arrays, the batteries could not recharge and exhausted their power, leaving the satellite with no power to operate its instruments or to communicate with the ground.

"...The board concluded that the design of the charge assembly is prone to failure of this type.....the design requires meticulous construction procedures, and there are many areas where a short could occur...." said Jeremiah Madden, of NASA's Goddard Space Flight Center.

The board made 21 recommendations for future NOAA spacecraft, included as appendices to the Report. The recommendations included a thorough review of and modification of work in process by experienced personnel, modification of the heat sink in the battery charge assembly, and improvements in some of the spacecraft's software routines. The failure team also recommended that NOAA upgrade its ground stations so that health and safety telemetry may be taken from operational satellites during every orbit.

To correct the NOAA-13 deficiencies on the NOAA-J spacecraft modifications in the area where the failure most probably occurred have already been made, according to Charles Thienel, Associate Director of Flight Projects for meteorological satellites at NASA's Goddard Space Flight Center.

GOES 8 Status Update

The post-launch test period for GOES 8 ended on Oct. 26, just prior to the hand-over of the satellite to NOAA for routine operations. There were 237 of the planned 313 post launch tests that were successfully completed, and another 31 are currently underway. Some testing will continue, with minimum interference to routine operations, through the end of December. In early 1995, NOAA plans to move GOES 8 to replace Meteosat-3 at 75 degrees west as the 'east' bird (it is currently at 90 degrees west).

The GOES 8 sector center points are as follows:

EA2=38N 85W	EB1= 34N 78W
EC1=20N 94W	KF1=37N 97W
EA3=38N 100W	EB2=33N 94W
ED1=00N 90W	

The sectors EA2, EA3, EB2, EC1, and KF1 are transmitted at H+00 and HH+30. ED1 is transmitted at H+15; EC1-W and ED1-WV are transmitted at H+45. These are image sectors that are centered as listed above, an using the water vapor enhancement curves as described in the GOES Users Guide.

How to Interpret GOES Header Codes

An educator from Miami, Fla. recently called the DRIG office requesting information on how to interpret the header line on the GOES imagery transmitted by the various services. Since this is an often-asked question, we thought it useful to provide a brief summary of those headers as is shown in Figure 4.

If you are currently operating an APT, WEFAX, or HRPT ground station, please send in your images to DRIG and we will gladly publish them here in *Satellite Times*! You may simply upload the image to the DRIG BBS at (214) 394-7438 for conversion to hardcopy. We look forward to hearing from all our ST readers and discussing their questions on remote imaging from space! ST

FIGURE 4

GOES imagery header interpretation

Sample GOES Imagery Coded Identification Header:

1230	11JN94	29A-2		01044	18162	DB5
a	b	cde f	g	h i	j	k...

a. Greenwich Mean Time in hours and minutes indicating times of actual picture start
b. Calendar day, month, year
c. Line Stretcher/Data buffer Identification
d. Satellite Identification
   1-SMS-1 2=SMS-2 3=GOES-1 4=GOES-2 5=GOES-3
   6=GOES-4 7=GOES-5 8=GOES-6 9=GOES-7
e. Image Type
   F=Full Disk IRE=Equivalent IR SectorA,B,C,D = Denotes Visible sectors as well as the mode of operation
f. Resolution of image in kilometers
   1=1 km 2=2 km 4=4 km E=7 km (IR) sector
g. Enhancement curve identified for InfraRed IR data only. Two letters (AA through ZZ) in this position identifies the enhancement curve displayed. A single letter, Z, identifies the enhancement curve used on full-disk IR data. No letters signifies no enhancement was used.
h. Starting Scan line number from the image (Y axis)
I. Vernier correction factor for starting scan line number
j. The X axis element number of the midpoint on each horizontal line contained in the sector.
k. Vernier correction factor for sector location

__Section Location codes:__

1. Major NESDIS hub for which the sector was generated:
   S=San Francisco W=Washington complex
   K=Kansas City WB=4km. geographic sector with 2 km resolution
   D=Washington, D.C WC=7 km geographic or Full Disk, 4km.
   M=Miami H=Honolulu
   A=Anchorage G=New Orleans
2. Sector Resolution in kilometers, except for equivalent IR products
   A= 1 km B=2 km C=4 km D=7 km
3. Identifier number for specific standard sector (1-9)

SWAGUR Enterprises

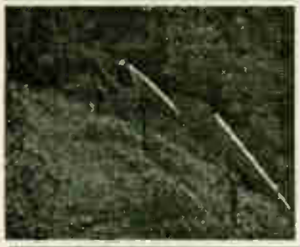
Box 620035 - Middleton, W I 53562-0035

Voice - Fax Phone 608-592-7409

The SWAGURSAT allows the owners of ICOM R7000 & R7100 receivers to receive WEFAX images in full resolution (i.e. 40 KHz). The SWAGURSAT is in use all over the world. It has received favorable reports in several magazines. Many feel the SWAGURSAT approach is the more cost effective because you do not have to invest funds in a dedicated receiver which will only listen from 137 to 138 MHz. The SWAGURSAT allows you to use a general coverage receiver which can be used on many other frequencies as well. The cost of the SWAGURSAT is only $220.00 plus $8.75 US ($25.00 foreign) shipping & handling.

SWAGUR-AMP. This is our new Low Noise Amplifier (LNA). It covers the range of from 1500 to 1700 MHz. It has a noise figure of 0.7 dB, a gain of 35 dB and it is powered by 12 volts DC which is supplied to the LNA through its feed line (coax). It is 2-5/8 inches long, 1-7/8 inches wide and 1 inch deep. It is rigidly mounted to our feed horns with an "L" bracket thereby reducing the strain on the "N" connectors. The cost of the SWAGURAMP is only $199.95 plus $8.75 US ($25.00 foreign) shipping & handling.

SWAGUR-HORN. - C. This feed horn was developed to be used with a satellite dish. It receives circularly polarized signals, like those sent by orbiting satellites. It also receives linearly polarized signals. You can attach your own Low Noise Amplifier (LNA) or purchase one from us. The feed horn measures approximately 6-1/8 inches in diameter by 5-1/8 Inches long. It has a single "N" connector on its back plane. Why spend a lot of money on a combiner, lossy connectors and matching sections when receiving the polar orbiters or GOES satellites? The cost of the SWAGURHORN - C is only $120.00 plus $8.75 US ($25.00 foreign) shipping & handling.



SWAGUR-DISHES. Our satellite dishes range in size from 2 feet to 10 feet. The dishes are all painted, spun solid aluminum. They can be purchased with or without a mounting ring attached. We also supply polar mounts and struts for mounting feed horns. We can provide complete dish assemblies. These assemblies can include a feed horn and low noise amplifiers. Prices vary according to your requirements. A 2 foot dish without mounting ring is $27.00 while a 10 foot dish with polar mount, feed horn and struts is $715.00. Shipping and handling depends upon dish size.

SWAGUR-HOODS. Our camera hoods allow you to photograph your computer or television screen without the usual problems. These hoods give the camera a steady base and focusing becomes very easy. The hoods block stray light and glare from reflecting into the camera lens. These hoods work with your 35mm camera or we can supply a special Polaroid camera for black & white or color instant pictures. Prices range from $70.00 to $550.00. Our hoods fit most 35mm cameras. Shipping and handling charges depend upon the size of hood you want.

WEFAX SOFTWARE. We can provide OFS WeatherFAX software for use with your image capturing system. The cost of the new PCMCIA (credit card) plug-in card and software for laptop computers is $495.00. This card will also work with desktop computers if you use the buss adapter board. The original WeatherFAX card for desktop computers is still available for only $445.00 which includes the software.

Donald E. Dickerson, N9CUE

A Space Odyssey

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

Odyssey is designed to provide its customers with a worldwide, personal communications network via satellite. Odyssey will provide subscribers with voice, data, paging and messaging services to other portable and mobile users around the world. The customer will use a small, cellular compatible, phone style handset to communicate via the Odyssey space network.

TRW hopes to begin launching elements of their personal communications satellites (PCS) system by the third quarter of 1998 and with full constellation of 12 satellites in orbit by 1999.

The Odyssey PCS system architecture is based on a series of satellites placed into a medium earth orbit (MEO). This is one of the unique features of Odyssey system. These spacecraft will orbit in three planes with a 50 degree inclination, at roughly 10,354 km or 6,420 miles altitude.

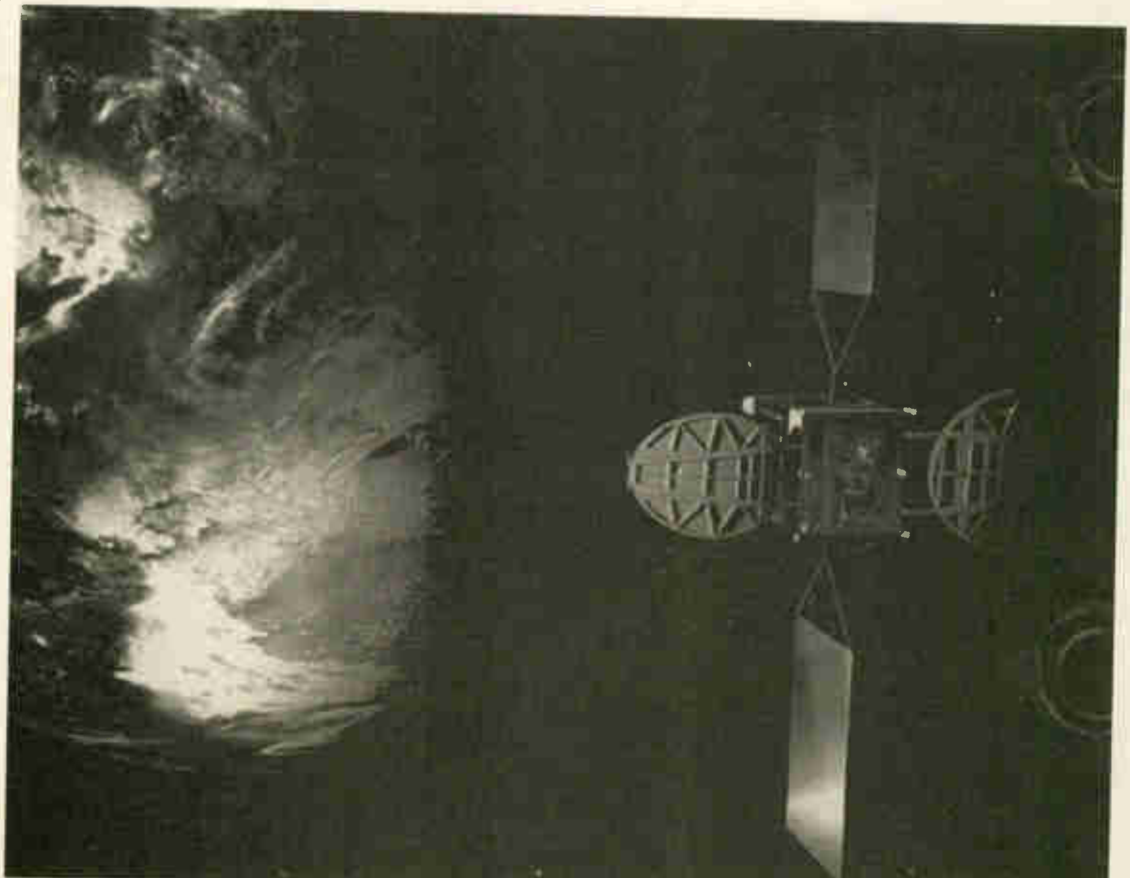
As few as 9 satellites will be needed to provide worldwide coverage to customers. Utilizing the 12 satellite configuration would keep two satellites visible at all times from each land region. Each spacecraft would be able to provide service to any particular location for approximately two hours and provide a high enough elevation angle to avoid interference from terrain, trees, buildings and other manmade objects (one satellite in each land region would always be above 30 degrees elevation).

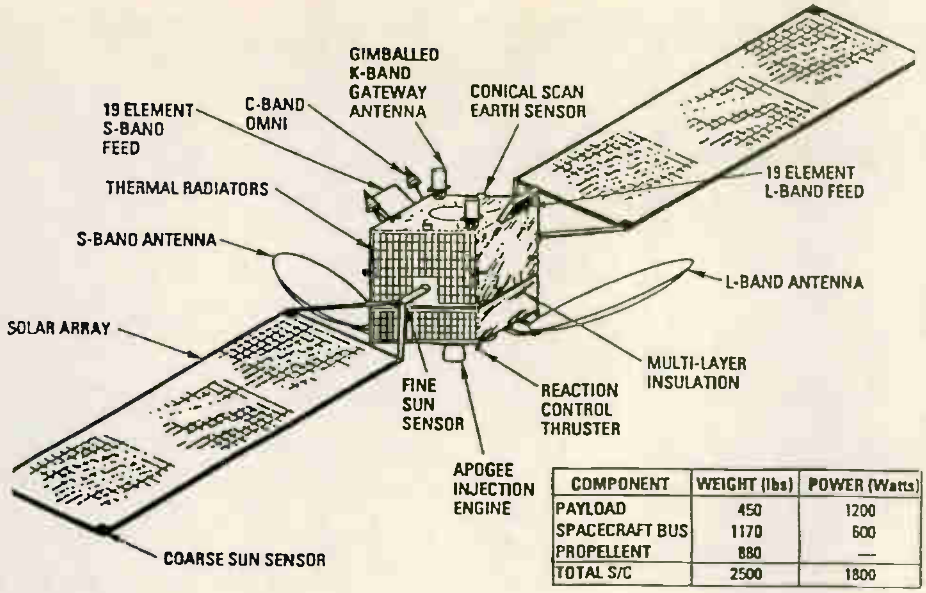
It's the medium earth orbit that will make Odyssey the unique system it is. This orbit allows you to provide world wide coverage with the least amount of satellites. A low earth orbit or LEO system would require between 48 and 77 spacecraft to provide the same coverage. MEO constellations also allow the spacecraft to avoid atmospheric drag, which shortens the life span of LEO spacecraft.

Low altitude satellites can also encounter high levels of radiation from the Van Allen Belt while over the South Atlantic in an area known as the South Atlantic Anomaly. Van Allen radiation bombardment can damage or completely destroy spacecraft systems if proper shielding is not employed.

The main advantage MEO systems have over geosynchronous systems is considerable savings in launch cost, lower spacecraft power requirements, better propagation characteristics, and the most important item of all, low-cost, low-power, light-weight, omni-directional hand-held transceivers that customers can carry and use just like their cellular phone.

In the Odyssey satellite system, these transceivers will use both terrestrial and





COMPONENT	WEIGHT (lbs)	POWER (Watts)
PAYLOAD	450	1200
SPACECRAFT BUS	1170	600
PROPELLENT	880	—
TOTAL S/C	2500	1800

satellite based communications systems, truly making them a user friendly Space Phone. When the customer is out of range of ground based cellular systems, his handset will automatically access one of the waiting spacecraft of the Odyssey system.

How does this system work?

Let's first take a look at the spacecraft. It is based on TRW's very successful Fltsatcom spacecraft which provides communications for the US Navy, Air Force and the National Command Authority. The Odyssey spacecraft will weigh in at over 2500 pounds (1125 kg) with a power capability of 1800 watts in orbit. TRW plans to use the Atlas 2AS-class boosters to launch two spacecraft at a time into orbit. Even though the spacecraft will be in an orbit that avoids some of the radiation problems encountered at lower orbits, each satellite will be radiation hardened against both the Van Allen Belt and solar flare radiation. This, along with improvements in micro-electronics, should help each spacecraft realize a life expectancy of 15 years.

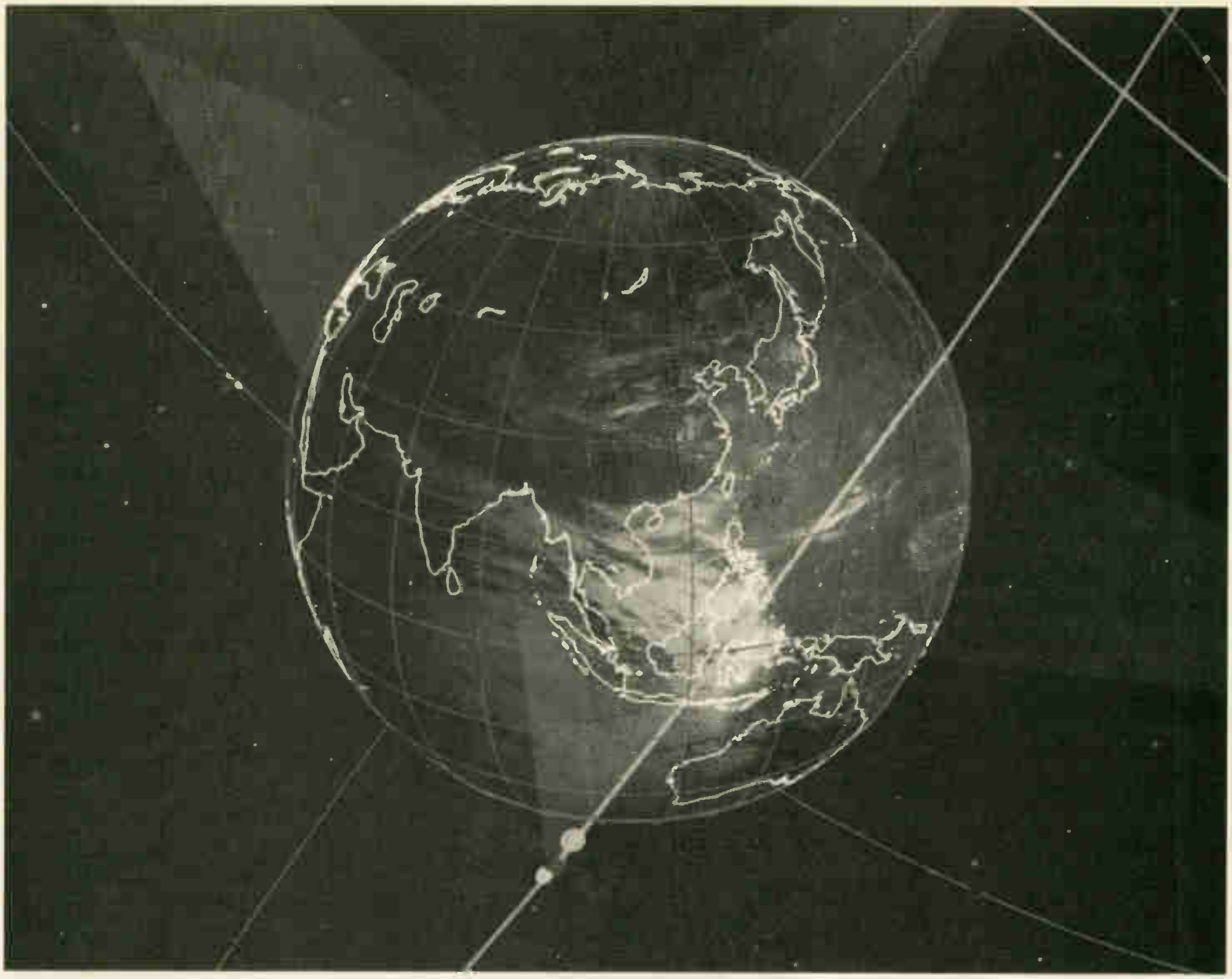
The spacecraft is a square with two solar wings. the top portion of the spacecraft is used by the apogee engine, the bottom is covered with K, C, S and L band omni antennas. There is a S- and L-band reflector on each side of the spacecraft. Each reflector has a 19 element configuration attached. This 19 beam array is steerable and will allow phone conversations to continue without cell-to-cell handoff interruptions other systems might incur.

Each of the beams will have a 5 degree beamwidth. Each beam will also be assigned one third of the frequency allocation for this service (MSS or Mobile Satellite Service). This means that the 16.5 MHz wide satellite band will have three 5.5 MHz channels — three channels for uplinks and three channels for downlinks.

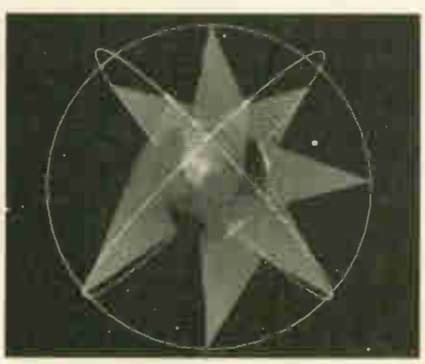
O.K., so now you think you've found a weakness in the system, or at least a bottle neck because there are only three channels, right?

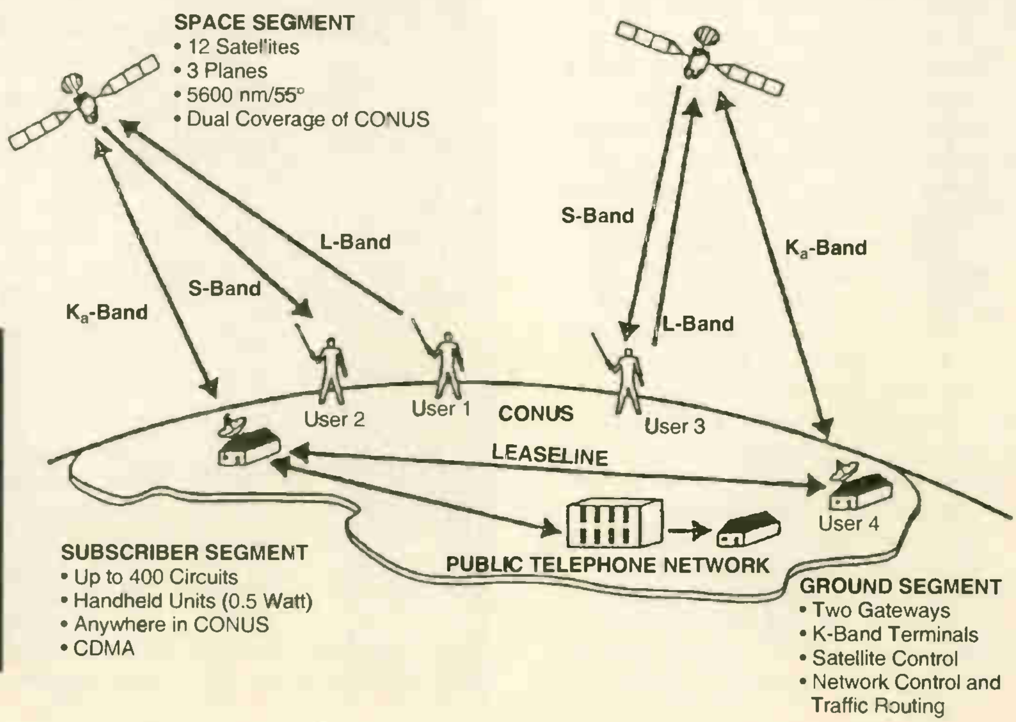
Think again. The three downlink channels will be in the S-band. They will be centered at 2486.42, 2491.75 and 2497.06 MHz. The uplink channels will be centered on 1612.32, 1618.25 and 1623.58 MHz in the L-band. I say centered because Odyssey will use Spread Spectrum (SS) techniques. These SS transmissions from the spacecraft will use a code division multiple access (CDMA) format. SS/CDMA was chosen over time division multiple access (TDMA) and frequency division multiple access (FDMA) formats because it does not require complicated and expensive frequency coordination between multiple users. Another smart design feature of the Odyssey spacecraft is that they will not process any signals, but simply relay them between ground stations, both users and gateways which interface terrestrial systems as needed. This keeps the satellite communications packages simple to design and inexpensive to operate.

TRW's system calls for the use of two Ka-band ground stations in the U.S., one on each coast of the United States. There will be a total of 10-11 of the ground or gateway stations worldwide. These gateways would provide control of the spacecraft systems, monitor telemetry and process the signals from the users as needed and interface with ground telephone systems, computer networks etc. Each ground station will be



Odyssey System Overview





equipped with four 16.4 foot (492 cm) tracking antennas. They will be spaced 18.6 miles (30 km) apart. Three of the antennas will be used to communicate with a main satellite passing overhead. The 4th antenna will track a second satellite so handover, when necessary, will take place without any disruption to the user. The antenna spacing is an important factor in this diversity reception technique. Rain can attenuate Ka-band signals causing signal outages. Rain cells are usually smaller than 18.6 miles. This should keep at least one of the antennas in the clear regardless of the weather conditions, assuring proper signal strength.

The ground stations will control the beam and frequency assignments for each caller by way of an order wire. This is a industry name for the control channel, possibly in the C-band. Each of the 19 beams have their own channel assignments and CDMA code. The typical cell or area covered by a single beam antenna is approximately 500 miles (800 km) in diameter. Both channel coordination and satellite handoff, during long telephone conversations, are preformed without the customer noticing.

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

How the System Works

So now lets take a walk through the system as we place a call from our Odyssey handset. You turn the phone on and punch in your number. If you are out of range of ground based cellular, your handset will access on of the two Odyssey spacecraft overhead. You will be uplinking a signal on the order wire for coordination of your call at the same time your voice/data channel will be uplinked using Spread Spectrum on a frequency in the L-band (1.6 GHz) with half a watt RF output. You will be assigned the beam with the strongest signal to a ground station. The spacecraft will then downlink your signal in a frequency division multiplex (FDM) format at 20 GHz. The ground station will then access another spacecraft with a 30 GHz FDM signal if your calling Europe, for example. If the party on the other end is using a Odyssey handset the signal will be downlinked using SS/CDMA on a 2.4 GHz frequency. Your handset will then receive a 2.4 GHz S-band signal from the spacecraft to complete the loop. If the party you were calling has a regular telephone. The ground station will dump your signal into a public switched telephone network (PSTN).

User cost are expected to be $250-300 for the cellular phone-style handset, a $24 monthly charge, and 65 cents/minute access fees, though these may vary.

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

Odyssey is the first personal communications satellite system we have looked at in detail. We have also reviewed some of the ground breaking research and development that NASA/JPL and their contractors have done in this area. We will, in future columns, consider other proposed mobile satellite services. See you next time around. ST

By Jeffery M. Lichtman

Radio Astronomy and Other Civilizations

"Are we alone in the universe?" This is a question many people have asked themselves while gazing up at a star filled sky since the beginning of man's existence.

Two philosphers thought about this question many centuries ago. The first one was Lucretius, a Romam philospher, 1st century BC and the other was Teng Mu, 13th century philospher. Mu wrote;

> Heaven and earth are large, yet in the whole of space they are but as a small grain of rice. It is as if the whole of empty space were a tree, and heaven and earth were one of its fruits. Empty space is like a kingdom, and heaven and earth no more than a single individual person in that kingdom. Upon one tree there are many fruits, and in one kingdom many people. How unreasonable it would be to suppose that besides the heaven and earth which we can see there are no other heavens and no other earths?

Scientists have been studying the evolution of the universe and have concluded that it came into existence 15 billion years ago from one gigantic explosion usually referred to as "The Big Bang". Clouds of gas and dust were blown out in all directions. These clouds of gas and dust started to coalesce some 5 to 10 billion years ago. These clouds are what we now know as galaxies. Our Milky Way is just one of the millions of galaxies containing billions of stars each.

Our planet is a mere speck on the beach of the shores of the universe. Located about 20 thousand light years (Light Year=9.46 x 10^{12} km) from the edge of our galaxy and 30 thousand light years from the center as shown in figure 1.

NASA was conducting a project SETI (Search for Extraterrestial Intelligence) with projects such as the Microwave Observing Project (1000 - 3000 MHz), Sky Survey and the HRMS (High Resolution Microwave Survey). An amendment was introduced and passed in Congress by Senator Richard Bryan from Nevada on October 23, 1993 to end funding for the HRMS program. In effect, the program a detection of extraterrestial intelligence would have to find funding elsewere in order to survive.

The SETI Instutite, a non-profit California corporation located at the NASA Ames Research Center, Moffett Field, CA, is now conducting Project Phoenix. In a recent phone call to Robert Arnold, Research Assistant at the institute, he elaborated on how the Phoenix project is getting ready to start a 5 month all sky survey at the Parkes Radio Observatory, located at Mopra, Australia. In addition, they are seeking 3 million dollars a year from the private sector to fund on going programs. YES! they will accept your donations.

Amateurs Take up the Slack

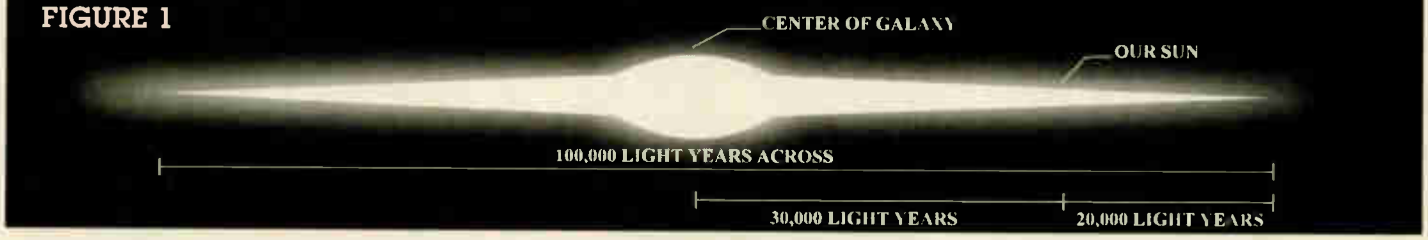
Over the past 10 years, a few SARA (Society of Amateur Radio Astronomers) members have mounted their own private searches. Robert Stephens was the first amateur radio astronomer I met conducting a private SETI search. Bob purchased an abandoned over-the-horizon radar site overlooking the Great Slave lake in northern Alberta, Canada. The site was originally used to detect possible missle attacks. Bob is a talented person with a high degree of knowledge of receiver and computer technology and fabrication. Bob purchased and built all the equipment that would be needed to conduct his own research. The site unfortunately was bought out from under him by a sneeky developer interested in building condos.

Bob has since packed up and moved to another part of Canada to continue his work. He has struggled to obtain private funding over the years for his corporation and he has not given up his day job. In a recent phone conversation, he is still interested in conducting a SETI search if the proper individuals and funding could be found. He will even supply all the necessary receiving equipment.

Another independent search has been mounted by SARA member Robert Gray of Chicago, IL. Robert's "Small SETI Radio Telescope" has been in operation since 1983. The system consists of a fully steerable 12 foot parabolic antenna with a helical feed (circularly polarized) which has a 3 degree beamwidth. In addition, to the sensitive receiving equipment he has a 256 channel spectrum analyzer, microcontroller and a CompuPro 8-bit microcomputer.

The specs on receiver sensitivity are impressive. The receiver can detect a 1000 milliwatt transmission from a 300 foot antenna at a range of up to 50 light years. Robert has been searching for the elusive WOW signal first detected at the OSU (Ohio

FIGURE 1



State University) Big Ear Radio Telescope. This signal was detected at OSU some years back, the signal fit all the parameters and when the technician saw the printout, his comment was WOW! needless to say, the name stuck. Robert is also planning a system to search for isotropically detectable beacons — a class of interstellar signal which would be strong enough to detect with an omnidirectional antenna.

FIGURE 3: *BAMBI Radio Telescope (Courtesy of BAMBI)*

A more recent endeavor has been mounted by SARA members Bob Lash and Mike Fremont in California, in the wake of the cancellation of the NASA all-sky survey. This SETI capable radio telescope is also known as the BAMBI (Bob And Mikes Big Investment) project. The system, now in full operation, was designed for work in the 4 GHz range. The system for Phase I is a standard radio astronomy total power system. Phase II is designed for narrow band SETI as shown in figure 2.

Bob and Mike both agree that the radio sky at 4 GHz is an interesting place. While sources emitting by the synchrotron (a continious polarized radiation emitted by fast moving electrons spiraling around magnetic lines of force in the prescence of a magnetic field) (e.g. supernova remnants and radio galaxies) are less intense than at lower frequencies, thermal sources such as hot ionized gas clouds of hydrogen (areas of star formation) and other thermal emissions from the plane of the galaxy are actually stronger.

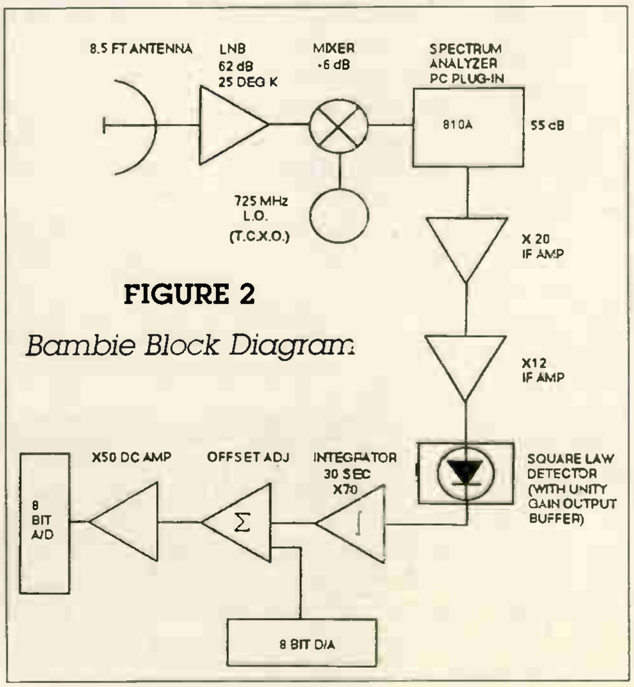


FIGURE 2

Bambie Block Diagram

Data reduction for this project will be run on a high resolution FFT (Fast Fourier Transform) spectral analysis on the output of the spectrum analyzer using IBM-PC computers as shown in figure 3.

With all the stars above and all these sensitive receivers and dishes pointed at the sky, do you think there is a chance of hearing a faint wisper? As Bob Stephens put it when asked by a CBS news crew, do you think there is anyone out there? He responded, "If You Don't Try, You'll Never Know".

There are many areas of SETI not mentioned, some of those deal with the biological aspects and also a new branch called visual SETI. For those of you interested in further reading, a comprehensive reading list may be obtained from the Planetary Society, 65 North Catalina Ave., Pasadena, CA 91106 (818) 793-5100. Further information and donations may also be addressed to the SETI Institute, 2035 Landings Dr., Mountain View, CA 94043. My thought is, that any of you requesting information should include a small monetary amount to cover mailing etc. since the SETI Institute is a non-profit organization and trying to achieve alot with dwindling funds.

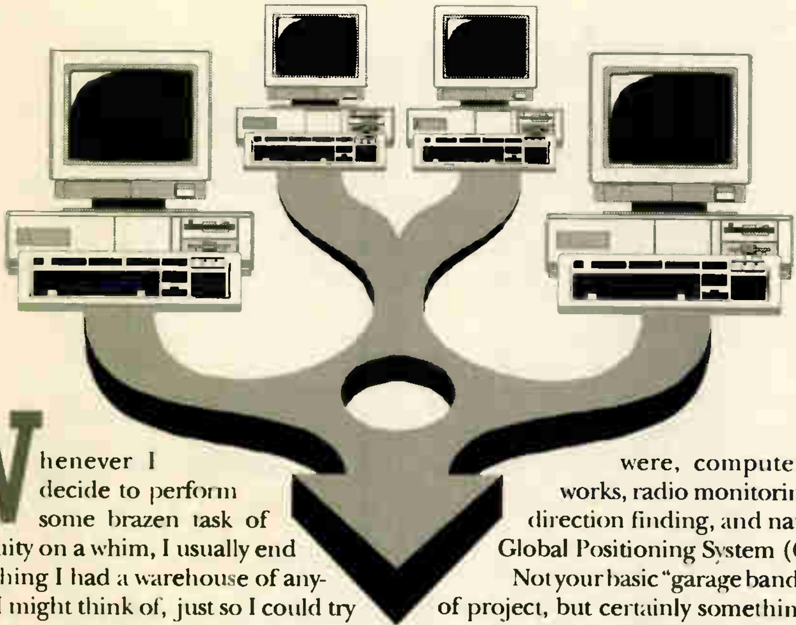
A SETI publication is available for a $29.00 charter subscription from; SETI Quest, 174 Concord St., Peterborough, NH 03458-0874. (603) 924-7408. This publication is extremely informative and covers all aspects of SETI, including visual SETI. It is well worth the money.

Those of you who are interested in the area of SETI, radio astronomy or want membership information. may contact the Society of Amateur Radio Astronomers, 247 N. Linden St., Massapequa, N.Y. 11758. ST

I would like to thank Robert Arnold of the SETI Institute, Bob Lash, Mike Fremont, Robert Gray and Robert Stephens for material used in this article.

By Todd D. Dokey

Electronic Mayhem or Yet Another Use for GPS



Whenever I decide to perform some brazen task of ingenuity on a whim, I usually end up wishing I had a warehouse of anything I might think of, just so I could try it out. For this little project, as usual, this was not the case — no warehouse. However, my room (that cave of hoarded reports, information and just plain junk) was made to disgorge sufficient parts for a weekend "hands on" experiment.

Naturally it was not to go entirely as expected. It easily reached the point of, "why did I ever think I wanted to do this today?" — which is usually about 2/3 of the way into the deal and more than 1/2 the way through the day. So you finish, out of tenacity, because you don't really want to clean the mess up without results or admit defeat in public!

Everyone supposes it is always a "no-brainer" installation. (They are, aren't they?) — just ask Murphy. This time was no exception to the rule. It all started out when some of us techno-geeks (that's "dweebs" in some circles) decided to play around combining technological themes. These themes were, computer networks, radio monitoring and direction finding, and naturally Global Positioning System (GPS).

Not your basic "garage band" kind of project, but certainly something that can be thrown together if one has the parts on hand. (Being a pack-rat at heart, I did have most of the parts on hand even though I almost needed a GPS receiver to find them in my room!) Another useful ingredient in these projects is what military drill instructors call, "Want-to" and " Gotta have it."

Installing computer equipment can sometimes be quite a headache. All the installations in the world never seem to quite prepare you for the one you currently are involved in completing. Its always supposed to work!

The basics of this quick and dirty setup consisted of three IBM compatible PCs running their assorted versions of DOS and three ethernet cards. The cabling between the machines was coax. One of the machines on the network was a 486/66 box, so we decided to use this one as a file server and time reference standard.

Most network software permits you to time synchronize a local PC from the host PC of your choice over the network. If you do not have a GPS or other time reference receiver attached to your network in some fashion, you can access accurate time by using time code programs like TimeSet or Navytime (see your favorite BBS) which use your modem to call the National Institute of Standards and Technology (NIST) or U.S. Navy modems that are set up for this very purpose. These programs permit you to time synchronize your PC to the atomic clock at either institution.

Once you have a central PC that is the "clock" for the rest of the network, you can have the network software access the PC used for the time/date standard, and synchronize to it. As you might guess, a PC clock can drift over time. In some cases while a PC does a great deal of thrashing in a database or other high demand or time specific operation (some digital mode decoding software is so time related it throws the system clock off), the internal clock time can shift by several minutes. In addition, speaking generally, most network time synchronizers do not update the time/date continuously, but pick the time off on demand (once) when you execute the command to go get the time. Keep these things in mind if you have problems with your time accuracy.

The cabling can be a headache if you have not done this very often. The easiest mistakes to make are these: 1) That you think you can plug the BNC connectors onto two machines without using terminating plugs on their respective "T" connectors (you try to plug the coax end-to-end/card-to-card. It is NOT like TV cable or antenna leads in this respect). 2) You poorly crimped on the male connector (or poorly stripped and screwed on a screw-type BNC connector).

Such practices can lead to short circuits, open circuits and general mayhem especially if it is a quasi-connected piece of cable that shows a connection long enough to give you hope, but nothing else! 3) You think some scrap of the wrong type of coaxial cable will be just fine.

These are some of the most common reasons a network will not come up the first time. The next cause is (generally speaking) the drivers for the network card and the network software itself may take up more memory than your old PC has to spare, or you may have memory and IRQ conflicts with other things you have loaded into your PC. This is all I will say on this subject, because now we are entering the area of personal preferences and the differences between PC and network software/hardware brands. Too big to cover in one column!

None of this was too tricky so far. The two slower computers were then attached to Icom CI-V interface adaptor (because that is what I have on hand) for radio control of a small fleet of Icom radios and one of the computers was additionally connected with an Universal M-8000 multimode decoder.

Sharing information was next and easy to set up using off the shelf network software. The 486 held commonly shared directories so that the "users" could all examine each other's monitoring work. I hope I do not need to warn you too harshly about stealing software! We shared the output data and databases we had built, but NOT the programs! Each machine had its own program to run. In fact, we took turns testing various software packages to see which ones we could live with under the networking environment. We even tested some beta versions of a standalone/network control program called TRACS.

The directory structure consisted of: 1) Databases of things to search for. 2) Output data of new things that had been found. 3) A junk directory for some data conversion routines we set up to share the different file formats around the network. We all had an attach to share a common printer on the 486 machine. The M-8000 has its own printer, but captured Radioteletype (RTTY) information could be obtained to disk or to the network printer by means of radio control software (which thought it was sending to a local printer).

This was all good and well until we added the extra fun of a PC GPS card to the 486 to go get us some good time/date/position data. This was not a logjam for the weak! It was not too difficult to set the card up and get the GPS data to come over. It took a bit to get everything loading into the PC correctly (network, GPS, etc.) The biggest problems were mostly Radio Frequency Interference (RFI) troubles. With the common "grid" of toys growing and ever interconnected to each other, the Electromagnetic Interference (EMI)/RFI hash was getting a bit thick.

Step one was to find ourselves a good ground. In most garages this is not too difficult to do. Find the water heater and you have found a cold water pipe! In some cases you will also be next to the supply line from the city water main, which generally has a grounding rod driven next to it and things like the house ground, phone line and cable TV ground strapped to it. Of course, did anyone have a nice long piece of heavy enough wire? (I think this is where Murphy came in for a visit). Time to move the network!

We grounded the computer chassis, the monitors and the decoder. Surprisingly enough, I have never gotten large amounts of noise out of the printers I use. Most monitors are pretty noisy because they are not completely shielded. If you are a radio monitor, I suggest you invest in a well shielded monitor (I like Nokia myself).

All good and well. The software routines for the GPS card took a bit of configuring and skull-duggery to pull together quickly. After we had GPS time code data cranking the 486 PC's clock around, it was not hard to go get the time from the 486 by using the network's existing synchronization utility.

I know, I mentioned Radio Direction Finding (RDF) in this whole business. We never got around to using our position data from the GPS card to scheme ourselves into well calibrated bearings on makeshift directional antenna systems. I believe it would be an interesting test to set up this same type of system over a wide area network (WAN) and not only trade information on frequencies being hunted, but simultaneously hunt the same frequency and obtain the bearings from the individual machine locations based upon their respective (and in this case, their separate) GPS receivers.

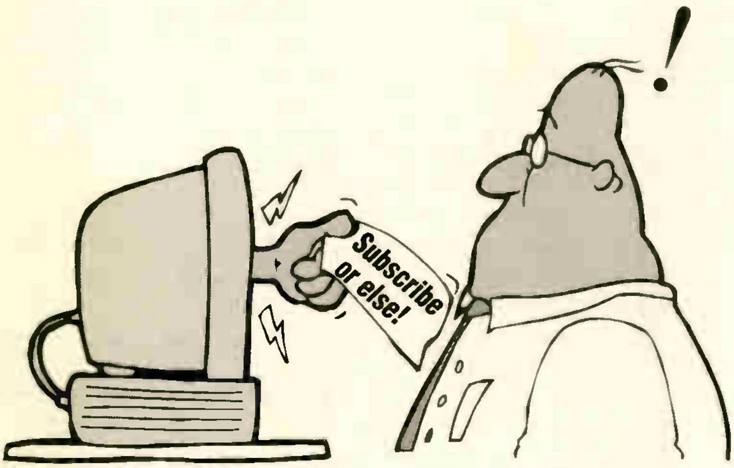
Making these systems work over a 4-wire leased line data circuit across a pair of statistical multiplexors or some similar set of devices is also a "no-brainer" — but only if you have had experience with data circuits and a few different STAT-MUXs!

I bet the whole thing could be made to work with the Grove frequency list CD and interface with a Rockwell/Collins mapping terminal to calculate the locations against the bearings and come up with an on-screen map display of the point of origin (which could be compared to the Grove FCC list for relevancy). That data could be fed to hand held GPS receivers for field operatives to use in finding the transmitter sites and...

Nah, I'll do that next weekend. ST

What's New

by Wayne Mishler, KG5BI



New electronic magazine features current frequencies and more

For about a dime a day you'll soon be able to subscribe to a new electronics magazine entitled *eCommAction DX Airwaves*. It promises up-to-date HF, VHF and UHF frequencies of satellites, aircraft, pirates, spies, government, military, press, CW, packet, fax, RTTY and AMTOR transmissions worldwide. It will also offer free classified advertising, blue-book prices of communications equipment, personal voicemail and E-mail, hard-copy intelligence reports and other information not commonly found in communications publications. The magazine will be updated hourly. And all you will need to tap into this treasure chest of communications information is a PC, modem, telephone and of course a subscription.

The magazine is being produced by James Tunnel, author of *Master Frequency File* and *Latest Intelligence*, in cooperation with the U. S. Defense Intelligence Agency, National Security Agency, Satellite Mapping Center, International Telecommunications Union, ITU World Telecommunications Forum Management Committee, AT&T Worldwide Intelligent Network, Federal Aeronautics Administration, and unnamed members of other organizations.

"My goal is to show the radio hobbyist what's really out there, frequencies being used right now by clandestine broadcasters and pirate stations, and how to hear them with receivers commonly in use," says Tunnel.

There will be a toll-free 800 telephone number which subscribers can call from anywhere in the world to report frequency findings. This information will be entered into the network for use by other subscribers. As a bonus, all subscribers will receive two frequency database computer programs on diskette. They are free. One covers VHF and UHF; the other HF.

eCommAction DX Airwaves is scheduled to launch in January, 1995. The price of a one-year subscription is $29.95. Send orders to DataPort, P. O. Box 3172, Ygnacio Valley Station, Walnut Creek CA 94598.

It's elementary dear Watson: education by satellite TV, that is...

An elementary education satellite network will be available to schools nationwide this fall through DIRECTV® programming.

Galaxy Classroom is expected to create an interactive global classroom for more than 10 million students ranging from kindergarten through fifth grade in 20,000 schools by the end of this decade. Several elementary schools have already begun receiving the program's interactive language arts and science curricula through digital receivers provided by DIRECTV®. These video broadcasts have been teaching writing and reading, and generating interactive discussion between students using fax machines and computers.

TV talk shows go satellite

"America's Talking," a new NBC 24-hour cable network, is being included in DIRECTV's ® Total Choice package of programming.

The new network features live, interactive programming focusing on information, entertainment and news. Experts and celebrities join viewers in conversation.

The network line-up includes *Alive & Wellness* which looks at alternative medicines and treatments, an interactive advice show called *Ask E. Jean*, and *Straight Forward*, an in-depth interview program hosted by Roger Ailes, president of America's Talking and CNBC.

"DIRECTV® possesses the unique ability to deliver this new conversation-oriented service to consumers nationwide," says Jim Ramo, DIRECTV executive vice president.

America's Talking is currently available in 11 million cabled homes. This is expected to grow to 35 million in the next three years through DIRECTV® and cable.

Astroguide Trax III features superior reliability

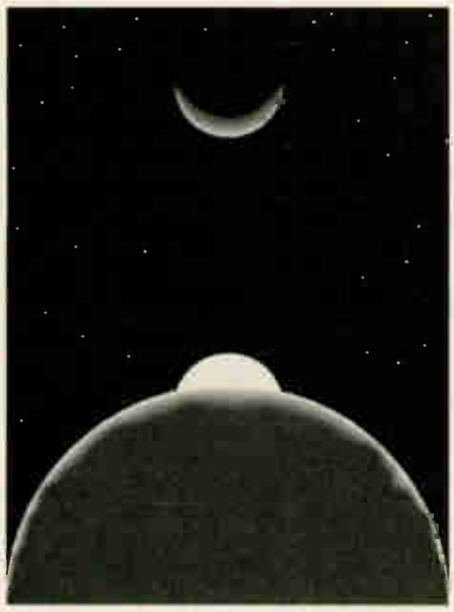
Astroguide recently added a new improved satellite tracking system to its product line. The Astroguide Trax III offers the same features of the Trax IIE plus several refinements such as increased reliability, ease of use and user friendliness.

The Trax IIE was known for its bull dog tenacity for automatically locking onto satellites even when they deviate from normal geostationery orbit. It will remain in Astroguide's product line as a low cost inclined orbit tracker covering 800 stations worldwide.

The Trax III was designed for the broadcast market. Its programming contains floating point equations for satellite locations. Users can input latitude and longitude of the earth station and the unit will automatically find the pre-programmed satellites without additional programming. Astroguide says the Trax III can reduce the tracking signal loss to near zero so that inclined orbit operations are as reliable as with geostationery satellites.

Satellite tracking systems such as the Trax IIE or Trax III help users compensate for the deviation of wayward satellites which are vulnerable to hazards of space such as launch errors. One in twenty satellites is lost during launch. Damage from jolts and misfirings of maneuver rockets sometimes send satellites into the wrong orbit. Even a successfully launched satellite may be influenced by the heat of the sun, gravity of the moon, solar flares and drag of outer atmospheric traces. With age, satellites can deviate from the geosynchronous belt and be difficult for a ground station to follow without a reliable tracking system.

The Trax III and Trax IIE are available from Astroguide, 1403 Fifth St., LaSalle IL 61301-2245, telephone (815) 224-2700, fax (815) 224-2701.



How'd we get to the moon?

The 21st Century Science & Technology magazine is making you an offer they hope you can't refuse: a one-year subscription plus a copy of a 385-page illustrated book entitled *How we got to the moon: The Story of the German Space Pioneers* for $30. That's $8 off the regular price. The book, authored by Marsha Freeman, is available without the subscription for $15.

Send orders with check or money order to 21st Century, P. O. Box 16285, Washington DC 20041.

New videotape explains digital video compression

Don't look now, but your digital video may need compressing. Then again, maybe not. If you're not sure, then it's a safe bet you could benefit from a new videotape entitled *The New Age of Digital Video Compression* from Shelburne Films.

The tape explains how digital video compression technology is radically changing the face of television, broadcasting and computers. If any of these are important elements of your world, then this tape may be for you.

Digital video compression technology may not sound very exciting, but it could turn out to be one of the most revolutionary and far reaching technologies of the century. It's already having a profound effect on many different areas of electronic communications. This includes satellite broadcasting, computer multimedia, telephone video, and others.

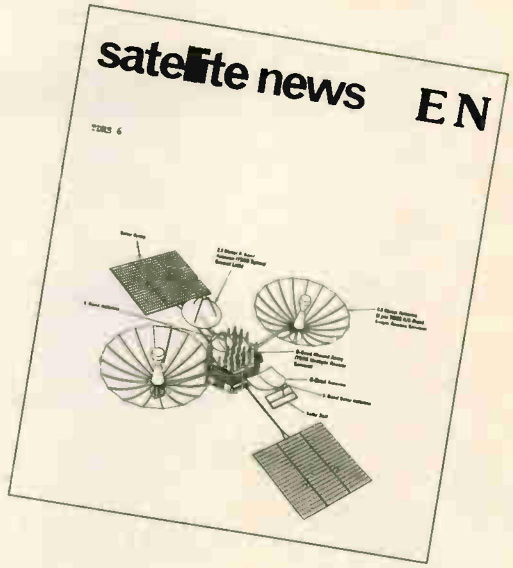
In Shelburne's tape, such cryptic sounding concepts as "discrete cosine transform" and "MPEG encoding" become clear, understandable, and even fun through animated computer graphics, simple language, and concise anologies.

Narrator Mark Long, technical author and satellite industry consultant, begins with basic and fundamental concepts and leads viewers through increasingly complex issues in gradual, easy to understand steps.

The *New Age of Digital Video Compression* is like a short course on the technical concepts used in video compression. Subjects like "motion compensation", "quantization," and "I, P and B frames" are demystified and made easy to grasp through the use of computer animation. Actual samples of compressed video are shown at various MPEG encoded data rates.

Much of the video compression story is heard directly from leading industry figures who helped develop the technology and pioneer its use, including representatives of United States Broadcasting, DIRECTV, Compression Labs, General Instrument, Scientific Atlanta, PanAmSat, and TV/COMM International.

The tape is one of a series on satellite communications for use in classroom and corporate training programs. Information on the series is available from Shelburne Films, P. O. Box 6, Reedsville OH 45772, telephone (614) 378-6297, fax (614) 378-6191.



England-based satellite publication available in U.S.

Satellite News, printed and distributed from editorial offices in England, covers space activities including satellite launches and spacecraft data and is now available in the U.S. for $6 per monthly issue plus $20 for shipping, handling, and bank fees.

Topics include orbital data, technical reviews, new developments, launch dates, military space operations, and more. A subscription includes a free news bulletin with updates on launches, re-entries, orbits, and transmissions.

To order, send your name, address, and check to Geoffrey Falworth, 15 Whitefield Road, Penwortham, Preston PR1 OXJ, England. Be sure to specify how many issues you would like to receive.

STAR TV adds new movie channel

Following the launch of its first encrypted channel, STAR TV will soon add another subscription-supported movie channel on the southern beam of AsiaSat 1, featuring western movies.

Other services of STAR TV on AsiaSat1 include the free-to-air Channel, the Chinese Channel, Prime Sports, STAR-plus, BBC World Service Television and Zee TV. STAR TV leases a dozen transponders for TV broadcasts via on AsiaSat1. ST

If you have a new product, book, or service to announce in Satellite Times, *send it to What's New, % Wayne Mishler, P.O. Box 41, Beaver, Arkansas 72613-0041.*

SATELLITE TIMES TESTS

By Larry Van Horn, N5FPW

Universal SCPC-100 SCPC Satellite Audio Receiver

Up until the time that *Satellite Times* hit the streets, single channel per carrier or SCPC signals were one of those hidden signals carried on communications satellites transponders that went largely unnoticed by most TVRO owners. A few hard core techno-geeks knew that these hidden signals existed and what equipment was needed to hear them, but the bulk of the home dish crowd didn't. Now the telephones here at the *Satellite Times* office ring off the hook with BUD owners (Big Ugly Dishes) wanting information on how to listen to this new world of SCPC audio signals and what equipment is available to monitor them on their home satellite systems.

What equipment do I need to hear SCPC signals?

This is probably the most common question we get on our technical lines regarding satellites and there are several options you have to receive these signals. Tom Harrington in this month's Satellite Technical Forum will explore all the various options for SCPC reception and the basics you need to know about receiving these audio signals. In this issue of *Satellite Times,* ST Tests will review an inexpensive receiver designed to pick up SCPC audio signals, the Universal SCPC-100.

The Universal SCPC-100 audio receiver is an easy-to-use SCPC receiver which will receive all SCPC audio programming with satisfactory results. The receiver only takes 3-minutes to hook up to your satellite system with the furnished coax jumper.

Some of the more notable features include:

- Stable microprocessor controlled tuning which uses only two push buttons to change frequency. There are no tuning knobs and the receiver is frequency agile.

- 50-channel program memory with instant one button memory channel recall. The memory is non-volatile (will hold memory even when power is off).

- Tunes the full frequency range (950-1450 MHz) sent from the satellite LNB to the satellite receiver system.

- Fully compatible with existing block downconverter systems. Hooking up the SCPC-100 to your satellite system will not disable the video signal when it is in use.

- Easy to read -inch LED's, four digits, 7 segment numbers.

- Receives all C-band and Ku-band SCPC channels and programming.

- When using a scanner or VHF/UHF receiver as a SCPC receiver, a high frequency passive or active splitter is required to operate the satellite receiver and the scanner or communications receiver for SCPC reception. A high frequency splitter is not required for SCPC reception with the SCPC-100.

Universal Electronics, Inc
4555 Groves Road, Suite 12
Columbus, Ohio 43232
Phone: (614) 866-4605
Fax: (614) 866-1201

You are going to have to purchase a speaker because the SCPC-100 does not have one built in. Any 4 or 8 ohm speaker will work fine. A couple of good choices would be the Radio Shack cube speaker, R/S No. 40-1250 or the R/S No. 40-1999 speaker.

If drift is a problem, you might want to replace your existing C- and Ku-band LNB with a stable LNB or a Phase Lock Loop LNB for the bands you want to use the SCPC-100 on. More about this in a moment.

The SCPC-100 in Operation

Operation of the SCPC-100 is quite simple and the instruction manual is well written and illustrated. These instructions were so easy to use, I had the SCPC-100 operational and my first SCPC signal tuned in within ten minutes after I had taken the receiver out of the box. Stations were easy to tune in, although at first I did have some problems with drift and it also appeared that the SCPC-100 seemed to be off frequency on each SCPC signal that I received.

Drift is probably the biggest problem you will encounter when using this receiver and it is not the fault of the SCPC-100, but your own satellite system LNB. The manufacturers of the SCPC-100 can not control the frequency stability of your LNB at your dish. The majority of the recent, well known LNB's are very good, but some do change frequency with extreme temperature variations. These variations do not affect your satellite video (signal) picture because the TVRO signals are extremely broad band in frequency. A SCPC signal (channel) is very narrow in bandwidth; therefore, a shift in the frequency due to temperature changes at the dish and LNB at times could shift the location of the SCPC service you are trying to receive. Bottom line, any shift of SCPC channels is not caused by the SCPC-100 receiver.

If drift does cause a problem with your SCPC reception, you should seriously consider replacing your LNB with a more stable or phased lock loop LNB. Universal Electronics is a good source for obtaining either of these types of LNBs.

One nice feature incorporated into the SCPC-100 is the ability to recalibrate all the stored memory channels to compensate for LNB drift. When storing SCPC channels into memory, you should establish one SCPC channel in the SCPC-100 memory banks for each SCPC satellite/transponder you have programmed into the receiver for use as a reference memory channel. When you notice your SCPC memories starting to drift, switch to the reference memory channel for that satellite/transponder, press and hold both the memory and tune buttons, and use the up or down buttons to retune the reference channel. Once you have retuned your reference memory channel, release the memory and tune buttons, and the new programmed offset will now be applied to all the stored SCPC channels in the receiver memory bank.

The problem of SCPC stations appearing to be off frequency was easily cured with one phone call to the pleasant staff at Universal Electronics. Owner Tom Harrington suggested that I take a look at the skew my Drake had set for the channel I was tuned into. I grabbed my Drake remote, changed the skew, and could hear the signal tune in properly as the skew changed.

While the frequency readout was easy to see, it is a analog readout. You will not get a direct frequency readout of the actual LNB frequency (like the listings in the SSG section of *Satellite Times*) the receiver is tuned to. Universal has recently issued to all its SCPC-100 owners a new SCPC station guide based on the analog readout of the SCPC-100. This should prove really helpful in finding SCPC audio services on the SCPC-100.

Bottom Line

Unless you already have one, purchasing an Icom R-100 or R-7100 and dedicating it to SCPC only receiver duty is not as cost effective as purchasing a Universal SCPC-100 receiver. The SCPC-100 sells for $439.00 plus shipping and handling and will give its owner satisfactory results. The receiver is available from Grove Enterprises. The SCPC-100 is an excellent product for the price if you want a dedicated SCPC receiver as part of your home entertainment system.

Manufacturer Specifications

Tuning Range:950-1450 MHz, vertical and horizontal polarization, C- or Ku-band
Tuning Steps:8 kHz, with variable tuning speeds
Frequency Stability: ±20 kHz
Input Frequency:950-1450 MHz
Input Impedance:75 ohms — coax cable
Audio Output (Speaker):1.5 watts, 3 to 8 ohms
Line Output:600 ohms for amplifier systems
Unit Power Requirements:16 volts, AC, 50-60 hertz
Source Voltage:Included power module 110 volts AC, 50-60 hertz
International Voltage:16 volts AC, 50-60 hertz
Input connector:"F" type, 75 ohm
Output connector:"F" type, 75 ohm
Operating Environment:60-90 degrees F
Tuning Display: " LED, 4 digits
Tuning Control:Microprocessor controlled, non-volatile 50 channel memory band, one-touch instant channel recall
Memory Bank:50 channel, 1 button instant recall

Physical Specifications

Cabinet Size:14" wide, 2.5" high, 7.5" deep
Weight: 5 lbs

This receiver is made and assembled in the U.S.A.

By Ken Reitz, KC4GQA

Your Letters and Other Curiosities

Satellite Times readers have inquiring minds and here at the Beginner's Column we endeavor to give satisfaction. So, this month we'll get into the mailbag and cover a few other items of interest as well. We'll take a look at the future of amateur radio satellite communications and I'll provide a list of interesting frequencies for you to monitor with no more investment than your current shortwave radio and scanner.

Let's Get Started

Ed Gallagher, of San Diego, Calif., writes: "I am a graduate student...and I am considering investing in a satellite dish and receiver...My primary motivations for purchase are two: I would like to receive direct, live broadcasts of European and English League Football (i.e. soccer), and I would like to receive Japanese-language TV and radio programming. Is this possible from southern California and, if so, how cheaply can this be done?"

One of the great promises of satellite television has been the visual linking of continents and cultures. Until recently world citizens have been content with listening to shortwave broadcasts for such information. For now those options remain. But it's clear that with each year the world gets closer to becoming a global video village.

I have a friend who lives nearby and is originally from England. After advising him on the various options for satellite delivery he chose the Primestar® service. He is thrilled at the coverage of soccer he finds on the various sports networks. In addition, Primestar® is the only such service which carries TV Japan featuring programming in Japanese and English.

Dick Jansson, WD4FAB, AMSAT-NA Vice President, Engineering poses inside the new AMSAT Phase 3-D spaceframe, giving a perspective of the overall size of the satellite currently under construction in Orlando, Florida. Built with donations from AMSAT's international membership and the on-loan talent of its many volunteers, this satellite would carry a price tag of over $100 million dollars if built commercially. (Photo courtesy of AMSAT-NA by Keith Baker, KB1SF AMSAT Public Affairs)

One attractive aspect of the Primestar® service is that you pay only for the installation (typically $200) and a monthly programming fee depending on which services you wish to subscribe. The actual receiving equipment is owned by Primestar®. In the event that they have to upgrade the equipment they will do so at no additional expense to their customers. For further information about Primestar® call 1-800-PRIMESTAR you'll be prompted through a series of touch-tone questions and answers on your way to getting the information sent to you.

Really Global View

ST reader Jerry Dunham, ham radio callsign N7MUX, lives in the Philippines and asks, "...What English language programming would I be able to receive from the 'local' satellites? What size of dish would I need?"

The answer to the question of size is the same for everyone. Buy the biggest dish you can afford. The reason is that, particularly for fringe footprint C band viewers, a greater reflective surface area translates to a better signal. The actual size limits will depend on your location within the footprint of the signal. For example, if you live in the midwest of America you'll get great pictures from a 7 foot dish. If you live in Florida you'll need a 10 foot dish. If you live in the Philippines you'll need at least a 12 foot dish and a very low noise temperature LNB.

Best reception will most likely be from the Palapa series satellites all of which feature programming in English. Since many of the transponders on these satellites are "spot beamed" (directed at a particular location) all programming on the satellites may not be visible from your location. The best source of information on these and other satellites outside our own International Telecommunications Union (ITU) region 2 is "1995 WRTH Satellite Broadcasting Guide" published by Billboard and sold by Grove Enterprises, (BOK79) $24.95 plus $5.50 UPS shipping.

Sound Questions

Bill Perrelli of Hamden, Conn. writes, "...I am into satellite subcarriers...do you know where I could pick up a stereo processor for tuning in satellite audio 5 to 8 Mhz and below?"

For those not familiar with satellite audio subcarriers, here's a thumbnail sketch: Most domestic C or Ku band satellites have 12 transponders which transmit signals with a vertical and horizontal polarity. By orienting the antenna probe in the feedhorn of the dish either vertically or horizontally we get 24 channels. Each channel carries a transmitted signal (called a "carrier") which has the audio and video information which, when processed by your satellite receiver, produces the programming you watch and hear. These channels are so wide that there's room for more than just the program video and audio. In fact, depending on how narrow the bandwidth is, many audio programs can be sent along with the video. This is why channel 7 of Satcom C3, C-SPAN, also has the BBC World Service (5.4 Mhz), ASAP (5.58 Mhz), C-SPAN's program schedule, and C-SPAN Audio 1 (5.22 Mhz), foreign radio service rebroadcasts. All these signals "ride" the same carrier to the satellite.

One way to increase the number of audio subcarriers is to transmit a main unmodulated carrier, in other words, a carrier without the video. Since no space is spent sending video information (colors, etc.) there's more room for audio subcarriers. Such a system devised by Wegener Communications is called FM Squared (FM^2). This is a proprietary system used for services such as those found on Spacenet 3 channel 13, notably, Satellite Music Networks' six format radio services.

All modern satellite receivers have built-in stereo processors. To listen to any of the audio subcarriers listed in the Satellite Services Guide of this magazine simply follow the instruction manual that came with your receiver. Older satellite receivers often had manual switches for the 6.20 Mhz and 6.80 Mhz primary program audio, but could tune nothing in between. So, receiver manufacturers often built separate stand-alone stereo processors which, through a connecting cable from the "baseband" output on the satellite receiver, could tune the rest of the subcarriers. Receiver design changes occurred so rapidly in the mid to late 1980s that hundreds if not thousands of factory sealed, stand-alone stereo processors still in the box were left unsold. Typically these sell from \$25 to \$250 depending on type and condition. Masspro, Drake, and Janeil are some of the more prolific names in processors. A call to your local satellite dealer will doubtless unearth one of these units. A frequency translator converts the audio frequencies below the receiver's capability to a tunable range. The translator typically sells for \$100. A source for Masspro stereo processors and translators is Universal Electronics, Inc., 4555 Groves Road, Suite 13, Columbus, OH 43232 or call (615) 866-4605.

Starting In Satellite TV

Jim Meyer, ham radio callsign WT2W of Auburn, N.Y. writes that he's been a ham for over 25 years and has worked the amateur radio satellites. Now Jim has a hankering to see what's up in the Clarke Belt. He's not interested in entertainment, but in building a receiving system from used equipment and tinkering.

Well, Jim, you're in good company. Tens of thousands of us have been playing with domestic broadcast satellite reception for a long time and find it an interesting hobby. Getting started in satellite TV via the used equipment route is a good idea. There's a lot to be learned and the price is right! Your best bet is to contact your local satellite dealers. Call everyone listed in your Yellow Pages under "Satellite Television" and take notes. If you live in a rural area, invest in a few toll calls to nearby cities. You might be surprised with the results. I find that some dealers are priced extremely high on used equipment and others are fair.

There's less and less in the way of NOS (New Old Stock) equipment around. One source for such gear is Long's Electronics. The have a particularly impressive line of outdated (fiberglass, spun aluminum) dishes. These are selling for a fraction of their new cost. The catch here is usually the shipping or freight charge as most have to be shipped via truck and the minimum rate is often \$50 or more. Contact Long's Electronics at (800) 633-4984 or (205) 956-6767 or FAX (205) 956-6772 and ask about these dishes. You should know, too, that these include no mounts or feed supports. You'll have to make that part up yourself. But, that's the fun of having a hobby!

Another source is hamfests. If you are a ham operator then you're already familiar with hamfests, but for the uninitiated they are flea markets for radio and electronics enthusiasts. It's possible to get some fabulous bargains at a hamfest and it's also possible to get really ripped-off. The key is to know what you're looking for and be willing to take a chance. Savvy TVRO (TV receive only) hobbyists that I know have found unbelievable bargains at hamfests. The less aware can part with a fair amount of cash for an electronic boat anchor. This is why I suggest starting at your local dealer. This person has a reputation and is eager for your repeat business.

New Phase for AMSAT

The brightest star in the amateur satellite constellation has yet to be launched. AMSAT Phase 3-D, as this new generation of amateur radio satellite is called, is in the lengthy process of being built. When it is finished and successfully launched it will usher in a new era of amateur radio communications. You'll be able to put your monitoring station to the test by listening to satellite signals in the HF, VHF, UHF, S, C, X, and K bands. What's more, due to the highly elliptical orbit of the Phase 3-D, it will be available for hours at a time instead of only a few minutes a day. But it won't be just for listening either. Two digital television cameras will afford planetary and close-up real-time views of the Earth which you will be able to see at home. This is the most exciting development in amateur radio since the old spark gap days!

Tornado Watching

Lee Dumas, in Tryoll, Okla., wants to know if there are any real-time imaging satellites displaying land-based Doppler radar. Living in "Tornado Alley", Lee would like to be able to watch severe weather as it develops.

Well, Lee, I'm sorry to report that there is no such service as yet. The only thing that even comes close is the Weather Channel which displays local Doppler radar of developing severe weather systems. It seems like a great idea though and I hope that future weather satellite developments will allow for such display. ST

By Tom Harrington, W8OMV

Discover SCPC Audio Services on the Satellites

Many users of Satellite TV systems confuse SCPC Services with Audio Subcarrier Services. The two are distinctly different. The family of audio subcarrier transmissions are linked to the satellite video wave form and use this method to carry the audio subcarrier signal. The SCPC signals have their own independent carrier and spot frequency throughout the transponder on which they are being carried. The bandwidth of the SCPC signal is a very narrow bandwidth in comparison to a satellite video signal or an audio subcarrier. A typical narrow bandwidth SCPC signal is 7.5 Khz, a typical wideband is 15 Khz.

SCPC is an acronym for Single Carrier Per Channel. It is also referred to as Single Channel Per Carrier. In simple terms: each SCPC signal (channel) has its own low level carrier. Most SCPC services are carried on dedicated full-use transponders, i.e., the entire transponder is divided up into many SCPC carriers. The transponder's power is also divided by the number of SCPC channels (carriers) that are actively being used. (See Figure 1)

An additional explanation of SCPC is: a full transponder on a satellite that carries a multitude of somewhat low level carriers divided into the entire useable frequency of a single transponder. As opposed to an audio subcarrier/video services which has a single carrier per transponder that carries the video information (0 to 5 Mhz) and also carries the audio subcarrier on the 5 to 8 Mhz section. (See Figure 2)

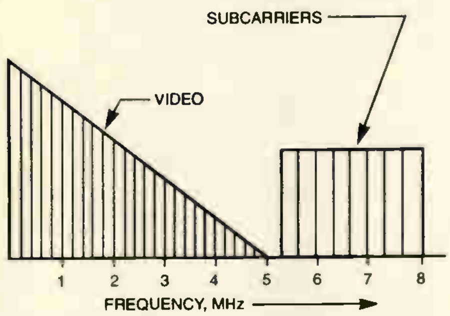


FIGURE 2: ***The standard subcarrier frequency plan. 6.8 MHz for video sound with 8 more 15 kHz audio channels.***

Companding and Bandwidth

Some SCPC signals are companded (compressed) in order to compress the high or peak deviation levels of the transmitted audio before the signal is demodulated. This companding step allows more channels to be used in the total transponder. The ground receiving station then expands the signal and demodulates this signal for reception. Companding ratios are standard 3:1, 2:1, and 1:1 (1:1 is a normal non-companded signal). You can disregard companding in the consumer SCPC receivers now in the market as these units have microprocessing capabilities that will closely match most companded SCPC signals. A commercial SCPC receiver will have expander boards or expander capabilities built into the unit which will match the companding of the transmitted signal. (See Figure 3)

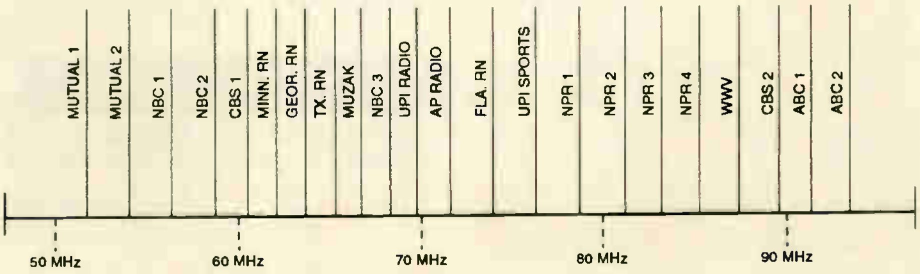


FIGURE 1: ***Typical (not actual) FM/SCPC single transponder service assignments on a full transponder.***

What Services/Programming Will we Find on SCPC?

A short answer is that there are many services of all types in about any broadcast area. The following is a partial list of types of SCPC services:

- A full range of sports programs and games (e.g. NFL, NBA, NHL, NCAA) - A sportsmans' dream come true, sports, sports!
- National, regional and state radio networks with varied programming
- Music of all types and in various languages
- Ethnic programs of all types and languages
- Religious radio networks, all faiths
- Un-edited news feeds from all major and minor news networks, (e.g., UPI, AP, CNN, USA News, State and Regional News)
- National Public Radio from many stations and from national NPR.
- Business radio with all market reports from the financial capitals of the world
- Talk shows, all your favorite national syndicated shows.
- Self-help shows, a large variety of types and formats
- Reading services for the sight impaired
- A list of SCPC services available in the U.S. domestic satellite arc is in the Satellite Services Guide (SSG) Section of this issue of *Satellite Times*—there are literally hundreds of SCPC services worldwide.

How to Receive SCPC Services On Your Satellite System

There are several basic systems that can be easily assembled by the average person for a reasonable price. Any system must meet these requirements:

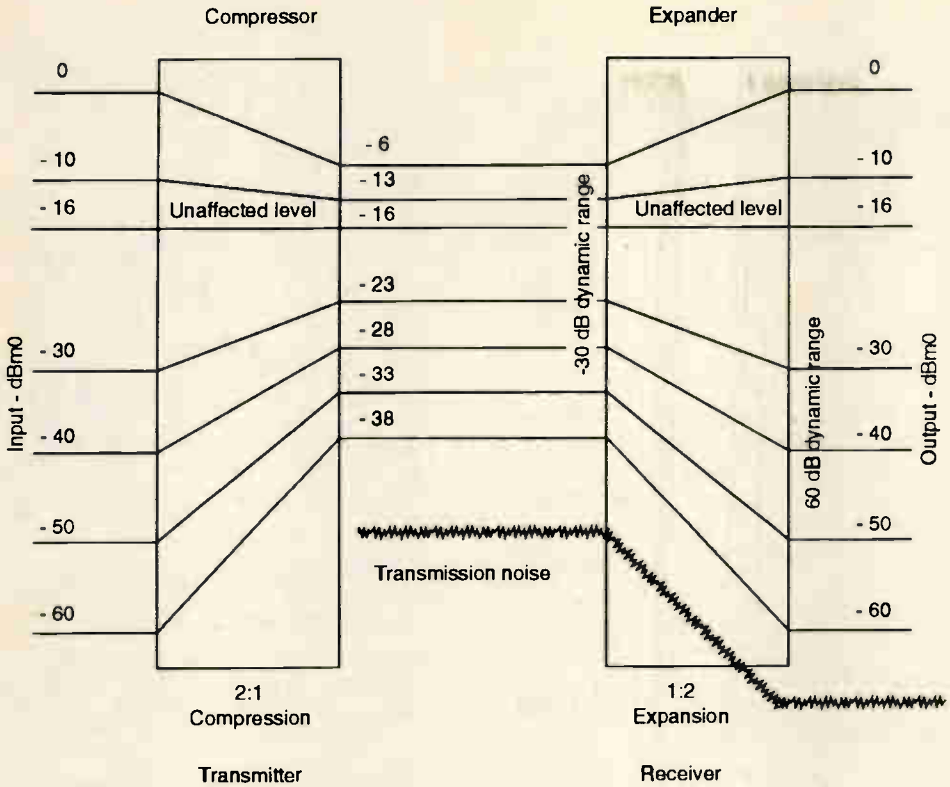


***FIGURE 3:** "Companding" showing 2:1 and levels of compression and re-expansion to original levels.*

A. The receiver must be able to tune from 950 to 1450 Mhz with continuous coverage of this range of frequencies (tapped at the output of LNB).
B. Receiver must have an FM mode with selective bandwidth, wide and narrow.
C. Ability to fine tune the frequency in small steps to obtain a full-quieting signal.
D. A proper AFC system, Automatic Frequency Control to follow any drift from the LNB.

Several Full-Coverage Scanners for SCPC Reception

There are several high-quality, continuous-coverage scanners (receivers) that will receive SCPC signals on your satellite system. The units shown here all have the required frequency coverage to tune SCPC. These quality scanners are not inexpensive. The units are rated as follows:

1. Best all-round receiver for SCPC reception is the ICOM R-7100, which covers from 25 to 2000 Mhz in the required FM modes, wide and narrow bandwidths, plus all other modes. (See Figure 4)
2. Another ICOM receiver that works well for SCPC reception is the ICOM R-100 Receiver. This compact, little receiver covers a frequency range of 100 Khz to 1850 Mhz. It has the following modes - AM, FM-narrow and FM-wide, a memory bank, plus other features. (See Figure 5)

How to Tune SCPC On Scanners

WARNING NOTE: It is very important that you do not allow any voltages to be induced into any scanner antenna input. This voltage could destroy your scanner! Please check the input coax that will be attached to scanner antenna with a sensitive volt ohmmeter. A DC voltage block unit can be used if the presence of any voltage is found on the coax. This 75 Ohm DC block will protect your equipment against DC voltages from line-powered equipment. These can be obtained from your satellite dealer or Radio Shack Part Number 15-1259.

Most of the recent scanner receivers have very accurate digital frequency readouts that allow frequency entry with a keyboard pad. When using these scanners (receivers) for SCPC work, you will be tuning to the intermediate frequency (IF) of each service you are seeking. The frequencies you will tune on your receiver will start at 950 Mhz and go up to 1450 Mhz on the scanner's display, which will cover the complete SCPC frequency range.

The receiver is placed in the FM mode, selection of bandwidth should be made after tuning in a paricular channel to obtain the best quality audio. (See Figure 6)

At this point, it is important to call attention to several features that a dedicated SCPC receivers has that will not be found in scanner-type receivers:

DEVIATION: Scanner receivers are built to receive signals that have a set deviation standard used for commercial VHF/UHF reception. SCPC work requires a deviation standard that is set for satellite reception.

BANDWIDTH: The second area of difference between scanner receivers and dedicated SCPC receivers is bandwidth. In some scanner receivers, the narrow bandwidth selection is too narrow for SCPC work and the wide bandwidth setting is too wide. The results of these settings on scanner receivers will result in audio distortion and possible noisy SCPC signals.

The Dedicated SCPC Receiver

The dedicated SCPC audio receiver (i.e.-Universal SCPC-100) is a cost-effective, easy-to-use unit which will receive all SCPC channels with satisfactory results and only requires a 3-minute hookup to your regular satellite system using the furnished coax jumper cable. The general features of the Universal SCPC-100 is as follows:

- Stable microprocessor controlled tuning with two buttons. No knobs. Frequency agile.


***FIGURES 4 AND 5:** ICOM's R7100 (left) and R100 work well for SCPC reception.*

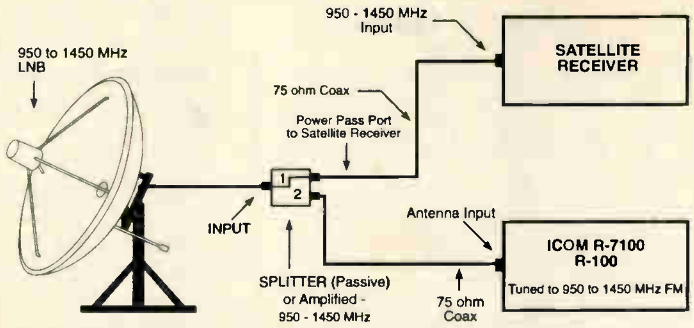


FIGURE 6: ***SCPC equipment hookup using the ICOM R7100 Receiver, or other high-quality scanner with 50 to 1450 MHz freuency coverage plus FM, wide and narrow bandwidth feature. Splitter is HFS-2 high frequency type, power pass one port only or amplified splitter.***

- 50-channel program memory with instant one-button recall. Non-volatile, holds memory when power is off.
- Receives full range of programming on 950-1450 Mhz from your satellite system.
- Fully compatible with existing block downconverter systems. Does not disable your video when in use.
- Easy-to-read, 1/2-inch LED's, four digits, 7 segment numbers.
- Receives high-quality music from hundreds of stations, single channel per carrier, can be used with your stereo system through the line-out connector to the amplifier.
- Simple 3-minute hookup and easy to use.
- Receives all C-Band and Ku-Band SCPC channels and programming from 950 to 1450 MHz—no user fees or subscription charges for any of the SCPC services.

Possible Drift Factor on SCPC Signals

Most quality scanners (receivers) are very stable after a short warm-up period. Any drift of SCPC signals is directly related to the frequency drift due to temperature changes in the LNB located at the dish. The dielectric resonant oscillators (DRO), which are used in most TVRO LNB's, are susceptible to changes in outside temperatures causing frequency drift at the scanner.

If you experience frequency drift of the SCPC signals, you can compensate for this drift by identifying a known SCPC channel or service in *ST*'s SCPC section of the Satellite Services Guide and note the difference in frequency between that which is shown in SSG and the actual frequency reading on the dial of the scanner's display. Then, apply this plus-or-minus factor to all your SCPC tuning.

There are several factors that must be understood regarding the stability of an LNB.

A. The Kelvin degree rating of your LNB has absolutely nothing to do with the frequency stability of the LNB. A 30° Kelvin rated LNB will not be more stable than a 45° Kelvin rated LNB. The standard home TVRO LNB has a drift factor of plus or minus 2 Mhz which is acceptable for a wideband video transponder that is 36 Mhz wide with only one carrier present on the transponder.

B. The SCPC channel (transmission) is narrowband and ranges from 7.5 Khz to 15 Khz. In SCPC work, 7.5 Khz is narrow and 15 Khz is wide. The SCPC transponder carries many channels (signals), each with its own carrier. This is where SCPC got its name, SCPC, single channel per carrier.

C. Any serious SCPC work requires an ultra-stable LNB. There are some commercial DRO (Dielectric Resonating Oscillator) LNB's that can hold a tolerance of plus or minus 100 Khz in a temperature range of -30° to +50° C. These are special LNB's and are classified as ultra-stable. An LNB marked "commercial" is not necessarily a high-stability LNB.

The most stable LNB for SCPC work is the Phase Locked Loop LNB. These units have a stability range of plus or minus 15 to 20 kHz drift in a temperature range of -30° to +50°C. (See Figure 8)

SCPC Frequency Definition and Tuning

When tuning SCPC signals using a scanner that covers a tuning range of 950 to 1450 Mhz, each SCPC channel or service can be logged in at the 1st conversion frequency in that block of frequencies. Of course, there will or can be a block of channels for transponders in the odd polarity along with another block of channels on the even-numbered transponders. For example, if the transponder is on odd numbers (i.e., 1, 3, 5, 7, 9, 11, etc.), and you have your polarity on your satellite receiver set to an odd transponder, you will be able to tune SCPC channels on all odd-numbered transponders providing these transponders are being used for SCPC transmissions. Likewise, the same holds true for even-numbered transponders (i.e., 2, 4, 6, 9, 10, etc.).

All commercial SCPC audio receivers tune in the 2nd IF (Intermediate Frequency) range from 50 Mhz to 90 Mhz for each transponder. The fact that the commercial receiver can tune to each transponder's frequency range is why commercial SCPC guides list the SCPC frequen-

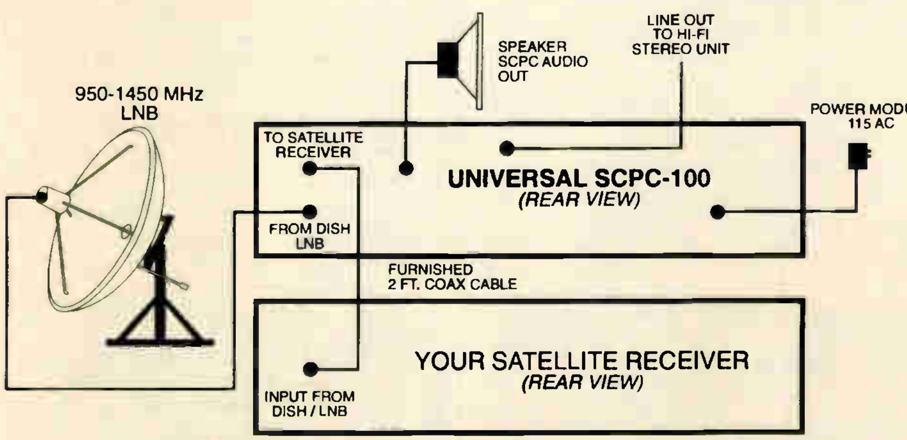


FIGURE 7: ***Universal SCPC-100 home TVRO SCPC audio receiver (left) with diagram showing hookup to the home satellite system.***

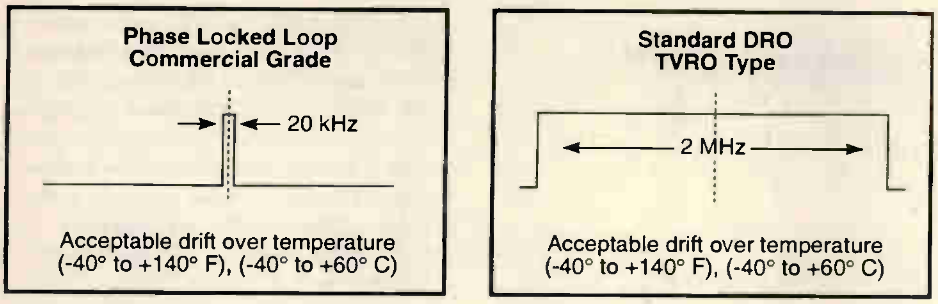


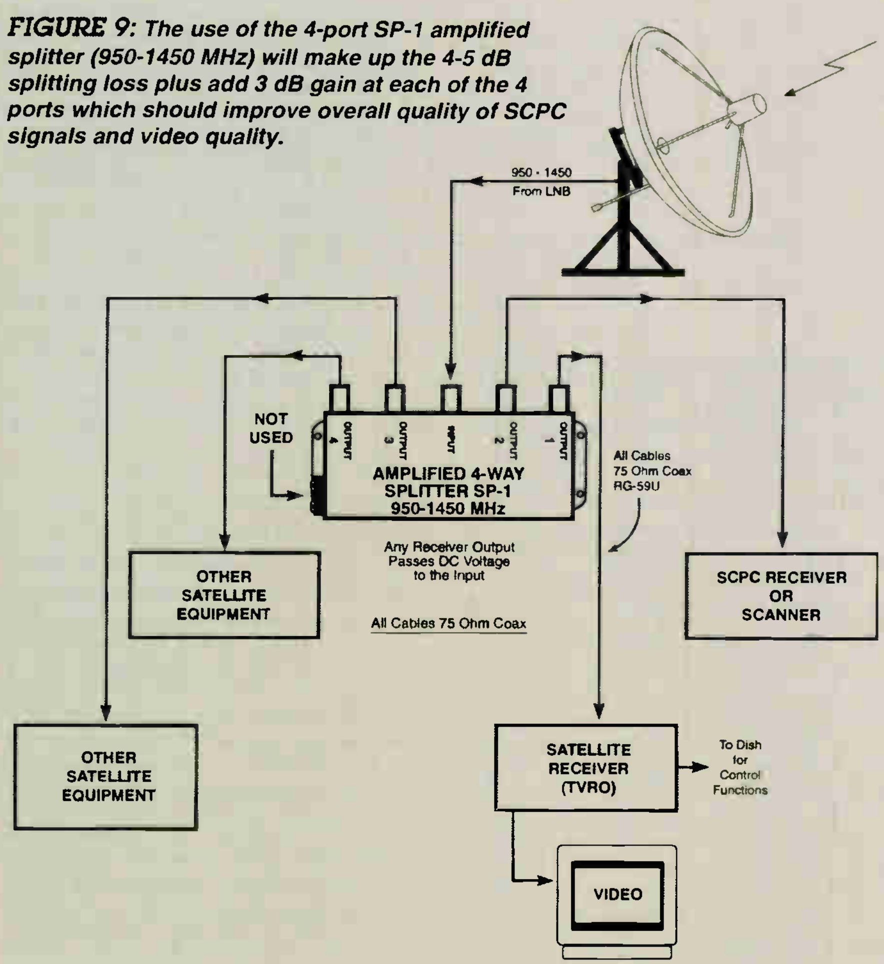
FIGURE 8: ***Phase Locked Loop vs. DRO Local Oscillator Frequency Drift over Temperature.***

cies in the 50 Mhz to 90 Mhz range versus the 950-1450 MHz as noted in *Satellite Times*. *(Editors Note: Due to the popularity and availability of VHF/UHF communication receivers such as the Icom R-7100 and R-100, the listings in the SCPC section of ST's Satellite Services Guide reflect 1st IF LNB frequencies vice 2nd IF frequencies used by the commercial SCPC receivers).* Frequencies will be listed as 55.20 Mhz, 72.60 Mhz, etc. because this is the 2nd IF frequency of the commercial SCPC receivers for each tuned transponder (Refer again to Figure 1). Also, Figure 10 shows an additional satellite hook-up which will allow the reception of a variety of different satellite services.

SCPC audio will open up another world of enjoyment from your TVRO satellite system. These services are easy to tune and use. They are available to any dish owner at no charge as long as the programming is not put to commercial use. More information on SCPC audio can be found in a variety of publications and in the new book, *Tune to Satellite Radio on Your Satellite System*, available from Grove Enterprises (Bok 84) $16.95 plus $5.50 UPS shipping. This book covers all phases of Satellite Audio Services, Audio Subcarriers, FM², FM/FM, SCPC Services and other transmission modes. ST

Tom Harrington has been active in radio, electronics and satellite work for over 35 years, covering radioteletype, microwave and satellite data transmissions systems. He has authored many books on data transmissions, satellite transmission systems and has contributed articles for numerous electronics and satellite publications. Tom operates Universal Electronics which manufactures custom data systems. He has developed several innovations which are widely used in the space and satellite fields. Tom is a life member of the ARRL, QCWA, EAA and holds amateur radio license W8OMV.

FIGURE 9: ***The use of the 4-port SP-1 amplified splitter (950-1450 MHz) will make up the 4-5 dB splitting loss plus add 3 dB gain at each of the 4 ports which should improve overall quality of SCPC signals and video quality.***



ST Ask Larry

By Larry Van Horn, N5FPW

Questions or tips sent to "Ask ST", are printed in this column as space permits. If you desire a personal reply, mail your questions along with a self-addressed, stamped envelope (no telephone calls, please) to Ask ST, c/o Satellite Times, P.O. Box 98, Brasstown, NC 28902.

Q. With VHF weather satellites gradually being phased out in favor of high resolution microwave satellites, will converters become readily available for receivers like the ICOM R7000 to receive the new ones? (Doug Chandler-W. Sedona, AZ)

A. **Probably not--at least not readily available. Even with an appropriate frequency downconverter, the bandwidth required to produce a good facsimile picture would be different from that in a receiver. Either the filter would have to be changed in the receiver or a separate IF stage would be needed to handle the converted image frequency.**

For those dedicated WEFAX watchers, there are specialized receivers and converters already on the market.

Q. What are the modes and channel spacing increments used in the 225-400 MHz military aircraft band by military satellites? (Joseph Girdler-San Juan Capistrano, CA)

A. **When monitoring satellite downlinks in the 240-270 MHz portion of this band, voice transmissions use FM (15 kHz deviation), SSB or even digital encryption. Over the last several years, the Department of Defense has been slowly decreasing bandwidth to allow more signals on each military satellite channel. It is not uncommon to see 5 kHz spacing on the Fleetsatcom wideband channel 23.**

Q. Is there any chance of hearing the Space Shuttle transmission direct here in Europe? (Gil Torbeck-HQ USEUCOM)

A. Absolutely, when the Shuttle makes its passes north of the equator. It all depends upon your latitude, the orbital inclination of the Shuttle and your equipment. Listen on 259.7 MHz AM (primary) and 296.8 MHz (secondary) for direct Shuttle-to-ground communications, and to WA3NAN on or near the following frequencies for shuttle audio rebroadcasts. All frequencies are in kilohertz (kHz).

3860 (LSB) 7185 (LSB) 14295 (USB)
21395 (USB) 28650 (USB)

Best results are being reported from listeners with good outside antennas.

In the future, will I be able to use a satellite dish antenna for international broadcast reception? (Carlos Rocca-Chicago, Ill.)

A. **As the lead feature in the September/October 1994 issue of ST points out, rebroadcast of shortwave programs can be heard on a standard C band satellite system. A TVRO dish antenna cannot be used for reception in the shortwave frequency range. It would not have gain or directionality at the longer wavelengths.**

Q. Is UTC (Coordinated Universal Time) used in ST the same as Greenwich Mean Time (GMT)? (Ed Martin-Cleveland, Ohio)

A. **The very same. There is a fractional variation due to switch-over to laboratory precision, but it doesn't affect your clock or mine! GMT has been abandoned officially. The Royal Observatory in England closed several years ago and all the time facilities throughout the world then changed to the UTC time standard. No one broadcast GMT anymore. Use UTC, it's the official world time now.**

ST *Satellite Listening Tip*

When using an Icom R7100 receiver to locate new satellite signals, tune through the frequency range you are going to explore the first time with no antenna connected. Write down the frequencies of any weak signals and carriers you hear as you tune. These signals are probably internally generated in the receiver and could be confused with a weak satellite signal. Once you have noted these internal signals in the frequency range you are going to scan, hook your antenna back up and start your search for satellite signals confident that you will know whether the signal is internal or external to your setup.

Q. I would like to receive weather pictures from 137-138 MHz satellites, but I need to filter out the strong terrestrial interference outside of that range. Is there a filter available to remove these "outside" frequencies? (John Pyle-Peterborough, England).

A. **Interference is a funny thing. In order to eliminate it, you must know what frequency is causing the problem. Once that bit of information is found, you then can buy or develop a filter to eliminate it. If you are using a conventional double conversion scanner for weather satellite reception, you are probably getting image from the 118 MHz portion of the aircraft band. If that is where the interference is coming from then consider the Grove FTR5 filter with the 30 dB notch. It will reduce or eliminate images that originate in the 100-220 MHz range. If you have a bad case of interference in originating in the 118-137 Mhz range then the Grove FTR8 filter will take care of the problem. Bottom line, you must first know what frequency is causing the problem in order to cure it.**

Q. What are the minimum requirements to hear satellite subcarrier services like "elevator music", stock market reports and news services? (Barney Fontenot-San Antonio, TX).

A. **For signal reception you will need a standard TVRO terminal (Satellite TV dish and receiver) with baseband video output and a general coverage shortwave receiver with stable SSB capability. For printed news copy you will need a demodulator like the Infotech M8000 and a video monitor (and/or printer). Alternatively, you could use an AEA PK-232 demodulator with an IBM-PC compatible computer (and printer for permanent copy). You can use the receiver to tune some the transponders marked FM[2] listed in the 'Satellite Transponder Guide' in this issue of *Satellite Times*. This is where you usually find the kind of services you mentioned in your question.** ST

SPACE INTEREST GROUPS

ST's Space Interest Groups list those local, national and worldwide groups you can join directly that promote space and space activities. If you belong to a space group and haven't seen it listed in *Satellite Times* write today and ask for a Space Group listing form. Your group will be listed each month, and will be featured in a group profile at least once, as well as receiving a complimentary *ST* subscription for group use. Write to: SIG Editor, c/o Satellite Times, P.O. Box 98, Brasstown, NC 28902-0098.

Space Group Profile: 'Sky Report'

Advanced Business Machines in Freehold, NJ sponsors a very interesting voice telephone service called the 'Sky Report'. This reports includes predictions for visual observation of the brighter naked eye satellites in orbit. A couple of the favorite targets frequently mentioned on the 'Sky Report' include the Russian space station MIR and the Space Shuttle when in orbit.

Planets that are currently visible in the evening sky are regularly announced. Callers can also get information on times and viewing instructions for special astronomical events such as eclipses.

Jay Respler runs this interesting service and you can reach the 'Sky Report' at (908) 866-8808, 918-1000, 957-8700, 505-8011 and 545-6000. The category for the "Sky Report" is 8888. There is no charge for this service.

Jay also helps out on the ByteWise® BBS in the astronomy section of the board. He compiles and posts regularly the two line orbital element sets for 121 of the brightest satellites in orbit. The Bytewise® BBS permits first time callers to sample many of the systems capabilities. All first time callers automatically get an account which is good for 30 days. This BBS can be reached by calling (908) 363-2760.

Amateur Satellite Corporation
(AMSAT)
P.O. Box 27
Washington, DC 20044
(301)-589-6062

ASERA Ltd
PO Box 184
Ryde, NSW, Australia, 2112
email: lindley@syd.dit.csiro.au
Membership $A100 (dual subscription), Subscriptions $A25 (newsletter only) $A50 (journal only).

British Interplanetary Society
27/29 South Lambeth Road
London SW8 1SZ
ENGLAND
Membership: No dues information available at present.

Canadian Space Society
43 Moregate Crescent
Bramalea, Ontario
CANADA L6S 3K9
Answering Machine: (416)-626-0505
CSS BBS: (905)-458-5907 (8N1, up to 2400 buad)
Membership: Annual dues are $25/year ($15/year for full-time students, $100/year for corporate members).

National Space Society
Membership Department
922 Pennsylvania Avenue, S.E.
Washington, DC 20003-2140
(202)-543-1900
Membership: $20 (youth/senior) $35 (regular).

The Planetary Society
65 North Catalina Avenue
Pasadena, CA 91106
(818)-793-5100
email psociety@delphi.com
Membership: $5/year

Space Access Society
4855 E Warner Rd #24-150
Phoenix, AZ 85044
(602)-431-9283 voice/fax
hvanderbilt@bix.com
Membership: $30/year, $1000/lifetime; includes email updates. $50 for email plus mailed hardcopy ($25 extra outside the US).

Space Station Future Fighters
16582 Space Center Blvd
Houston, TX 77058-2039
Fax: (713) 488-7903
Membership: All volunteer, No formal membership or dues. Presently conducting a national petition drive in support of the international space station. Send a stamped self-addressed envelope for free information and a blank copy of the petition.

Space Studies Institute
258 Rosedale Road
PO Box 82
Princeton, NJ 08540
Membership: $25/year. Senior Associates ($100/year and up) fund most SSI research.

Students for the Exploration and Development of Space
MIT Room W20-445
77 Massachusetts Avenue
Cambridge, MA 02139
(617)-253-8897
email: odyssey@athena.mit.edu
Membership: Dues determined by local chapter.

United States Space Foundation
PO Box 1838
Colorado Springs, CO 80901
(719)-550-1000
Membership: Charter $50 ($100 first year), Individual $35, Teacher $29, College student $20, HS/Jr. High $10, Elementary $5, Founder & Life Member $1000+

World Space Foundation
Post Office Box Y
South Pasadena, California 91030-1000
(818)-357-2878
Membership: Contributing Associate, minimum of $15/year (but more money always welcome to support projects).

STOCK EXCHANGE

Satellite Times assumes no responsibility for misrepresented merchandise.

Ads for **Stock Exchange** must be received 45 days prior to publication date. All ads must be paid in advance to *Satellite Times*.
Ad copy must be typed for legibility.

NON-COMMERCIAL SUBSCRIBER RATES: $.25 per word — *Subscribers only!* All merchandise must be personal and radio-related.

COMMERCIAL RATES: $1.00 per word. Commercial line ads printed in bold type.

1-3/4" SQUARE DISPLAY AD: $50 per issue. Send camera-ready copy or copy to be typeset. Photo-reduction $5 additional charge. For more information on commercial ads, contact Beth Leinbach, 704-389-4007.

Rocky Top Satellite Parts. Order or request price list at 1-800-837-6430 or 208 Fleming Street, Murphy, NC 28906.

GE Superadio III, custom designed with up to four noise-free SCA Channels. Performance graranteed. Credit Card orders accepted. (800) 944-0630.

SATELLITE EQUIPMENT: Uniden SQ-590 w/SCPC, no module (New $550; Zephyrus SCPC-700, 2 channel 2:1 and 3:1 (New), Cost $1900 Sell $1150, 3-Norsat high-stability LNB, Ku-Band /- 100kHz $100 each; Drake ESR-324B Receiver, 750-1450, $50. Call J. Evans (614) 866-4605.

Commercial GOES Weather Satellite Receiver FG-701. Copy images from GOES/GMS/METEOSAT ON 1691 & 1694.5. a complete dual frequency, triple conversion microwave reciever with built in LNA and switchable bandwith demodulator. New cost is $3500. One used unit for sale, only $1500 (UPS prepaid in US). T. Pappan, POB 1592, Owosso, MI 48867-1592.

For Sale: Universal M-7000 with Video/Fax options, Magnavox Model 80 monitor, all cables, manuals, original boxes and almost $75 worth of RTTY/Fax books. $775 less than 3 years old in beautiful shape! Call between 5:00 and 8:00 PM EST ONLY! Ask for Mike, Package deal only. (419) 536-7579.

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Space Glossary

The following are some terms used in the satellite business and are described in layman's terms. Some of the definitions in the Space Glossary were written by Thomas C. Johnson, KF8NX, for PC-Track, a shareware satellite tracking program for the IBM PC, and are used here by permission.

ALTITUDE (ALT): The distance between a satellite and the point on the earth directly below it, same as height.

AQUISITION OF SIGNAL (AoS): The time at which a particular ground station begins to receive radio signals from a satellite.

APOGEE: The point in a satellite's orbit farthest from the Earth's center.

ARGUMENT OF PERIGEE: This value is the number of degrees from the ascending node the perigee point occurs. The perigee point is the point where the satellite is the closest to the earth (assuming an orbit which is elliptical to some degree). This number may be entered as a real value between 0.0 and 360.0.

ASCENDING NODE: Point at which the satellite crosses the equatorial plane from the southern hemisphere to the northern hemisphere. (See RIGHT ASCENSION OF THE ASCENDING NODE.)

AZIMUTH (AZ): The angle measured in the plane of the horizon from true North clockwise to the vertical plane through the satellite.

CATALOG NUMBER: A 5-digit number assigned to a cataloged orbiting object. This number may be found in the NASA Satellite Situation Report and on the NASA Two Line Element (TLE) sets.

COORDINATED UNIVERSAL TIME (UTC): Also known as Greenwich Mean Time (GMT). Local time at zero degrees longitude at the Greenwich Observatory, England. Uses 24 hour clock, ie. 3:00 pm is 1500 hrs.

CULMINATION: The point at which a satellite reaches its highest position or elevation in the sky relative to an observer. (Known as the Closest Point of Approach)

DECAY RATE: This is the rate of decay of the orbital period (time it takes to complete one revolution) due to atmospheric friction and other factors. It is a real number measured in terms of Revolutions per Day (REV/DAY).

DECLINATION (DEC): The angular distance from the equator to the satellite measured positive north and negative south.

DIRECT BROADCAST SATELLITE (DBS): Commerical satellite designed to transmit TV programming directly to the home.

DOPPLER SHIFT: The observed frequency difference between the transmitted signal and the received signal on a satellite downlink where the transmitter and receiver are in relative motion.

DOWNLINK: A radio link originating at a spacecraft and terminating at one or more ground stations.

DRAG: The force exerted on a satellite by its passage through the atmosphere of the Earth, acting to slow the satellite down.

EARTH-MOON-EARTH (EMR): Communications mode that involves bouncing signals off the moon.

ECCENTRICITY (ECC): This is a unitless number which describes the shape of the orbit in terms of how close to a perfect circle it is. This number is given in the range of 0.0 to less than 1.0. An perfectly circular orbit would have an eccentricity of 0.0. A number greater than 0.0 would represent an elliptical orbit with an increasingly flattened shape as the value approaches 1.0.

ELEMENT SET: (See ORBITAL ELEMENTS.)

ELEVATION (EL): Angle above the horizontal plane.

EPHEMERIS: A tabulation of a series of points which define the position and motion of a satellite.

EPOCH: Is the year (less the first two digits) plus the day of the year plus the decimal day for the time the observation was made for a two line element set. These are osculating elements and refer to the time a radar return was received or a visual (laser) observation was made.
The day of the year figure is simply the count of the number of days that particular date is from the beginning of the year. (January 1 would have a day of the year of 1. Feb 28 would be 59.) This number may range from 1.0 to 366.99999999 (taking into account leap years). Most references commonly call this a Julian date, it is not!

EQUATORIAL PLANE: An imaginary plane running through the center of the earth and the Earth's equator.

EUROPEAN SPACE AGENCY (ESA): A consortium of European governmental groups polling resources for space exploration and development.

FOOTPRINT: A set of signal-level contours, drawn on a map or globe, showing the performance of a high-gain satellite antenna. Usually applied to geostationary satellites.

GROUND STATION: A radio station, on or near the surface of the earth, designed to receive signals from, or transmit signals to, a spacecraft.

INCLINATION (INC): The angle between the orbit plane and the Earth's equatorial plane, measured counter-clockwise. 0 (zero) degrees inclination would describe a satellite orbiting in the same direction as the Earth's rotation directly above the equator (orbit plane = equatorial plane). 90 degrees inclination would have the satellite orbiting directly over both poles of the earth (orbit plane displaced 90 degrees from the equatorial plane). An inclination of 180 degrees would have the satellite orbiting again directly over the equator, but in the opposite direction of the Earth's rotation. Inclination is given as a real number of degrees between 0.0 and 180.0 degrees.

INTERNATIONAL DESIGNATOR: An internationally agreed upon naming convention for satellites. Contains the last two digits of the launch year, the launch number of the year and the piece of the launch, ie. A-indicates payload, B-the rocket booster, or second payload, etc.

LATITUDE (LAT): Also called the geodetic latitude. the angle between the perpendicular to the Earth's surface (plane of the horizon) at a location and the equatorial plane of the earth.

LONGITUDE (LONG): The angular distance from the Greenwich (zero degree) meridian, along the equator. This can is measured either east or west to the 180th meridian (180 degrees) or 0 to 360 degrees west. For example, Ohio includes 85 degrees west longitude, while India includes 85 degrees east longitude. But 85 degrees east longitude could also be measured as 275 degrees west longitude.

LOSS OF SIGNAL (LoS): The time at which a particular ground station loses radio signals from a satellite.

MEAN ANOMALY (MA): This number represents the angular distance from the perigee point (closest point) to the satellite's mean position. This is measured in degrees along the orbital plane in the direction of motion. This number is entered like the argument of perigee, as a value between 0.0 and 360.0.

MEAN MOTION (MM): This is the number of complete revolutions the satellite makes in one day. This number may be entered as a value greater than 0.0 and less than 20.0. (See DECAY)

NASA: U.S. National Aeronautics and Space Administration.

ORBITAL ELEMENTS: Also called Classical Elements, Satellite Elements, Element Set, etc. Includes the catalog Number; epoch year, day, and fraction of day; period decay rate; argument of perigee, inclination, eccentricity; right ascension of ascending node; mean anomaly; mean motion; revolution number at epoch; and element set number. This data is contained in the TWO LINE ORBITAL ELEMENTS provided by NASA.

OSCAR: Orbiting Satellite Carrying Amateur Radio.

PERIOD DECAY RATE: Also known as Decay. This is the tendency of a satellite to lose orbital velocity due to the influence of atmospheric drag and gravitational forces. A decaying object eventually impacts with the surface of the Earth or burns up in the atmosphere. This parameter directly affects the satellite's MEAN MOTION. This is measured in various ways. The NASA Two Line Orbital Elements use revolutions per day.

PERIGEE: The point in the satellite's orbit where it is closest to the surface of the earth.

POSIGRADE ORBIT: Satellite motion which is in the same direction as the rotation of the Earth.

RETROGRADE ORBIT: Satellite motion which is opposite in direction to the rotation of the Earth.

REVOLUTION NUMBER: This represents the number of revolutions the satellite has completed at the epoch time and date. This number is entered as an integer value between 1 and 99999.

REVOLUTION NUMBER AT EPOCH: The number of revolutions or ascending node passages that a satellite has completed at the time (epoch) of the element set since it was launched. The orbit number from launch to the first ascending node is designated zero, thereafter the number increases by one at each ascending node.

RIGHT ASCENSION OF THE ASCENDING NODE (RAAN): The angular distance from the vernal equinox measured eastward in the equatorial plane to the point of intersection of the orbit plane where the satellite crosses the equatorial plane from south to north (asecending node). It is given and entered as a real number of degrees from 0.0 to 360.0 degrees.

SATELLITE SITUATION REPORT: A report published by NASA Goddard Space Flight Center listing all known man-made Earth orbiting objects. This report lists the Catalog Number, International Designator, Name, Country of origin, launch date, orbital period, inclination, beacon frequency, and status (orbiting or decayed).

TLM: Short for telemetry.

TRANSPONDER: A device aboard a spacecraft that receives radio signals in one segment of the radio spectrum, amplifies them, translates (shifts) their freuency to another segment and retransmits them.

TELEVISION RECEIVE ONLY (TVRO): A TVRO terminal is a ground station set up to receive downlink signals from 4-GHZ or 12-GHZ commerical satellites carrying TV programming.

TWO LINE ORBITAL ELEMENTS (TLE): See ORBITAL ELEMENTS.

UPLINK: A radio link originating at a ground station and directed to a spacecraft.

VERNAL EQUINOX: Also known as the first point of Aries, being the point where the Sun crosses the Earth's equator going from south to north in the spring. This point in space is essentially fixed and represents the reference axis of a coordinate system used extensively in Astronomy and Astrodynamics.

UPLINK

By Bob Grove, *Publisher*

Can the FCC Catch UP?

It's no secret that the Federal Communications Commission (FCC) has been feeling the pinch of fiscal budget cuts for several years; staff reductions and a recent massive reorganization added little to morale or performance. The enormous success of spectrum auctioning may be a boon to that agency, but its effects have not yet filtered down to staff levels.

But money isn't everything; technical competence and conscientious decision making must keep pace. And judging from complaints throughout the telecommunications industry, the FCC is moving at a snail's pace in a speed-of-light era.

In the U.S., manufacturers are still waiting for a go-ahead on the Digital Audio Radio Service (DARS); the market for CD-quality, digitized satellite transmissions to the automotive and trucking industry is mature, and vendors are understandably anxious to get the green light.

In over a year, DARS contenders American Mobile Radio Corporation, CD Radio Incorporated, Digital Satellite Broadcasting Incorporated, and Primosphere L.P. still have no word on the status of their applications.

Anti-DARS lobbying by terrestrial broadcasters, headed by the National Association of Broadcasters (NAB), has added its share of static to the issue.

In space, the FCC's track record is even worse. With over 80 satellites (including 41 replacements) to be launched within the next five years, the Commission still has no international coordination plan for the low-earth orbiting (LEO) satellites, urgently needed by the emerging Personal Communications Service (PCS).

Motorola's Iridium project, eventually comprising 66 satellites, could begin its first dozen launches in 1996 by China Great Wall Industry Corporation of Beijing, but government charges of predatory pricing by the Chinese have caused friction.

Iridium is up against challengers Globestar (48 satellites), Odyssey (12 satellites), Ellipso (14 satellites) and Constellation (48 satellites). All five applicants have until January to present the FCC with required financial and technical specifications on their cellular-like, worldwide, telephone satellite systems.

After a long wait, Orbcomm finally received, on October 20th, an official ok on their long-standing application to launch up to 36 VHF satellites for paging, position determination and data links, beating out contenders Starsys and VITA.

But even with the Commission's nod of approval on this one application, many more applicants–some with satellites already in orbit–sit at the FCC's door with proposals for more systems and more frequencies. Teledesic alone proposes an operational system by 2001 consisting of 840 polar-orbiting satellites!

Can they afford the $9 billion price tag? Chief shareholders are Bill Gates (computer-dominant Microsoft) and Craig McCaw (the nation's largest cellular provider). Even Teledesic's rival, Spaceway, opting for a Clarke Belt slot, is championed by formidable GM Hughes Electronics. Supplemental cash will come from multinational investors–big players with big bucks.

A division of GM Hughes, Hughes Electronics, is planning a Central and South American satellite service as early as next year, then on to Europe, Asia and Africa. Services will include TV broadcasting, business teleconferencing and mobile telephones.

And this is just the beginning. Spaceway, Teledesic and dozens of other marketeers are looking hard at the undeveloped Ka band (26-40 GHz), the next frontier for orbiting intercommunication.

Other nations will not look favorably on a country which launches its electronic payloads–often dozens in a constellation–helter-skelter. We need coordination and dialogue now to avoid severe interference and to expect foreign cooperation in the future.

As long as there are holes in an orbit and frequencies without signals, speculators will vie for slots and compete for spectrum. But just because U.S. industrialists win launch approvals and satellite service licenses does not mean that nations over which the birds fly will allow their licensees to hook up.

The FCC must discipline itself to think globally, not regionally, as it has in the past. The United States is not alone in viewing the heavens as the last refuge for communications loading.

The FCC must display wisdom in spectrum management leadership, issuing appropriate rulemakings and responding promptly to applicants. They are now dealing with superpowers, not CB. ST

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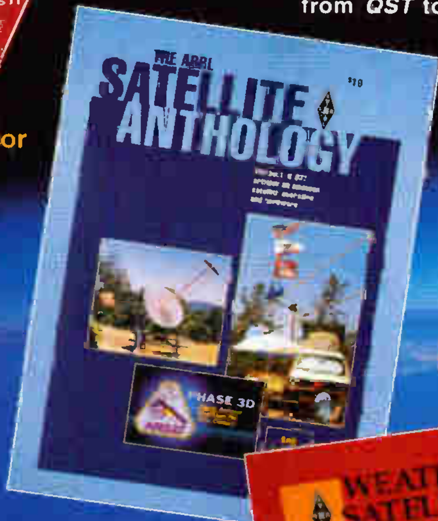

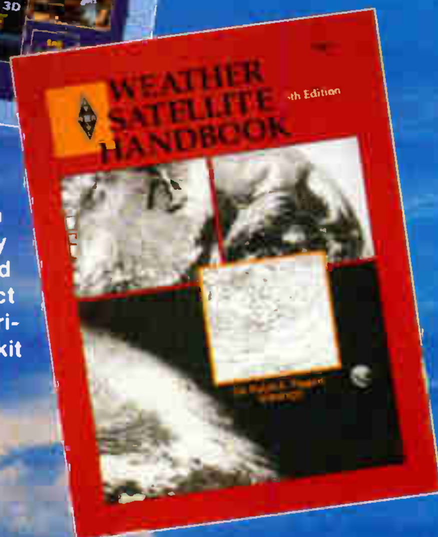

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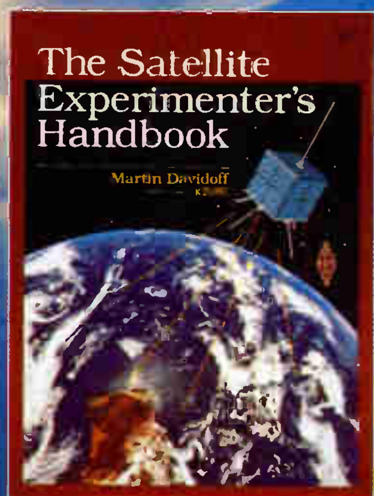

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by Martin Davidoff, K2UBC

This title focuses on satellites built by and for the international amateur radio community and will be your guide to using and designing satellites. You'll also get a fascinating look at how you can put orbiting spacecraft to practical use.
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Satellite operation with the IC-820H's **Built-In Satellite Functions** has never been this easy. These include **Normal and Reverse Tracking** for different modes of satellite communications; **Independent Uplink/Downlink Control** for Doppler shift compensation; **Separate Satellite VFO** and **10 Dedicated Satellite Memories** provide quick switching from normal to satellite operation as well as easy recall of satellite and downlink frequencies.

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