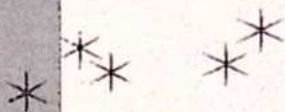


COMMUNICATIONS IN SPACE - EDITION 5.5



LAST
THE DXers GUIDE
TO THE GALAXY

by
George Wood

SR

Radio Sweden

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THE LAST DXers GUIDE TO THE GALAXY

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INTRODUCTION - SATELLITES

In the beginning, the Great Prophet Marconi cast his bread upon the waves. Long, medium, even short wave—the ether was filled, and at home listeners tuned the bands, and heard far away signals from Bonaire, Motala, and Oakland.

Then, on October 4, 1957, the world changed. The Soviet Union launched the Sputnik satellite, and listeners around the world tuned in to its signals just above 20 MHz. The Space Age had begun.

What we find is this...the skies are filled with satellites that can be monitored, some with simple equipment, some with more complex and expensive gear. Weather pictures, satellite TV, astronauts and cosmonauts, computer bulletin boards in the sky, are all there waiting.

We used to call satellite DXing the shortwave listening of the future. Well, the future is now. The signals are there, and more are coming. This guide is intended to help you tune in to signals from space. Equipment varies from USD 2000 for C-Band TVRO dishes and receivers to less than USD 200 for a scanner and discone antenna for monitoring weather satellites.

Communications satellites were first proposed by science fiction writer Arthur C. Clarke in 1945. Clarke pointed out that if a satellite was positioned high enough above the equator (36,000 kilometers or 23,000 miles), its orbit could be matched to the rotation of the Earth. The satellite would appear to remain fixed in one particular spot in the sky. Such a position would be ideal for relaying telephone, radio and television communications. Three such satellites located equidistant from each other could cover the entire Earth.

It took technology a while to catch up with Clarke's idea. In 1957 the Soviet Union launched Sputnik, the world's first artificial satellite. In 1962 the United States launched Telstar, the first communications satellite. Today there are more than 100 commercial TV and telecommunications satellites in geostationary orbit, and many more are scheduled for launch before the end of the century.

In addition, there are communications satellites in non-geostationary orbits (such as the former Soviet Molniya), weather and other Earth resources satellites, amateur radio satellites, and American and CIS space vehicles. All are accessible, if you have the right equipment.

The Third World

In many ways, Third World countries have more to gain from satellite communications than do the developed nations. Arthur C. Clarke is today a citizen of Sri Lanka, and a dedicated advocate of satellites for Third World development. As one of Sri Lanka's representatives at a UNESCO conference in 1981, Clarke said:

"To many developing countries, satellites are ESSENTIAL; they will make it unnecessary to build the elaborate and expensive ground systems required in the past. Indeed, to many countries, satellites could be a matter of life and death."

PART I: SATELLITE BROADCASTING-TVRO

Television Receive Only (TVRO) systems allow home monitors to tune in to radio and television from geostationary satellites. There are around 3.5 million TVRO installations in North America and more than 1 million in Europe. Numbers are rapidly increasing in India, China, and other parts of Asia. Latin America and Africa are areas of expansion, where satellites are generally used for relays to television stations and cable networks, rather than direct to home (DTH).

To tune in to broadcast satellites, you need a dish antenna and receiver. Antennas vary from 20 centimeters for the strongest DBS satellites to 3 meters or more for weak signals in the C-band. Antennas can also be fixed in one position, for reception of just one satellite, or motorised, to permit reception of many satellites. The signals are picked up by Low Noise Block amplifiers (LNBs) and fed by low loss cables to receivers. Fixed antennas can even have extra LNBs amounted to pick up additional satellites.

Different bands are used for satellite broadcasting. Some are more common in different parts of the world. Higher frequency bands generally require smaller dish antennas. The satellite TV bands are:

S-Band	1700-3000MHz
C-Band	3700-4200 MHz
Ku1-Band	10.9-11.75 GHz
Ku2-Band	11.75-12.5 GHz (DBS)
Ku3-Band	12.5-12.75 GHz
Ka-Band	18.0-20.0 GHz

1. North America

Most North American TVRO still uses the C-Band, although Ku-band use is increasing. C-band dish antennas are at least nine feet (3 meters) in diameter. Dishes and receiver prices start at around USD 1000 for motorized systems without decoders, and USD 1500 for systems with decoders. There are also fixed dish systems available for the Galaxy 5 satellite, which is currently the American "hot bird", offering a wide variety of free and subscription programming (see below). An antenna and receiver for Galaxy 5 is available for around USD 800, with a decoder for an extra USD 375.

Here are the North American C and Ku-Band downlink frequencies:

Channel 1 = 3720/11730 MHz	Channel 13 = 3960/12096 MHz
Channel 2 = 3740/11743	Channel 14 = 3980/12109
Channel 3 = 3760/11791	Channel 15 = 4000/12157
Channel 4 = 3780/11804	Channel 16 = 4020/12170
Channel 5 = 3800/11852	Channel 17 = 4040
Channel 6 = 3820/11865	Channel 18 = 4060
Channel 7 = 3840/11913	Channel 19 = 4080
Channel 8 = 3860/11926	Channel 20 = 4100
Channel 9 = 3880/11974	Channel 21 = 4120

Channel 10 = 3900/11987

Channel 22 = 4140

Channel 11 = 3920/12035

Channel 23 = 4160

Channel 12 = 3940/12048

Channel 24 = 4180

The Ku-Band frequencies are based on a 16 channel system. For the 32 channel format, half-spacing is used.

The 27 C and Ku-Band satellites above North America stretch from 69 degrees West longitude to 139 degrees West. They typically carry 24 transponders (each transponder can carry one analog TV channel and several radio channels or many voice and data channels). The older satellite transponders each transmit with 5 to 8 watts of power. The newer generation, such as Satcom C4 and Telstar 401, are 16 to 20 watts output.

American programmers, led by the pay-film channel Home Box Office, began scrambling signals in 1986. On April 27, 1986 a "video hacker" calling himself Captain Midnight (the hi-tech hero of a 1960's TV series) interrupted Home Box Office's broadcast of the film "Falcon and the Snowman". He transmitted a message over the satellite link, overpowering HBO's uplink to the Galaxy 1 satellite. The message was a protest against HBO's scrambling. (The choice of the film was apt, as it concerns military spy satellites.)

John McDougal, who called himself Captain Midnight, was traced to a Florida uplink station where he worked part-time. He was fined USD 5000.

Many popular American satellite channels now scramble their signals, using the VC II or VC II+ systems. Modern satellite receivers come equipped with decoders, and TVRO enthusiasts can subscribe to the coded channels, either by monthly payment to the stations directly, or to organizations offering special packages.

The company manufacturing VC II decoders, General Instruments, has a market monopoly. Separate decoders for receivers lacking them are extremely difficult to find, and can cost between USD 600 and 800. There is a lively underground of enthusiasts hacking decoders, hardware and software, in order to view pay channels for free. A digital compression system allowing up to 10 channels on a single transponder, General Instrument's, DigiCipher, is gradually being introduced.

American satellites have recently introduced a new system using only 2 degree spacing, which may result in interference from adjacent satellites with smaller dishes. Here are the satellites above North America, and some of the more interesting satellite channels (C-band and uncoded unless otherwise indicated):

Satcom C5 (139 degrees): Also known as Aurora II, it has reached its projected end-of-life, and is primarily used for non-video purposes. Alaska Satellite TV is on transponder 24.

Satcom C1 (137 degrees): Mainly the western coded feeds of network affiliates from Denver. The Fox Network is on transponder 19, with the Jade Channel in Chinese on transponder 5 and TV Japan, the NIK feed to United States, is on transponder 17.

NBC, which otherwise uses Ku-band on the K-2 satellite, has its eastern feed on transponder 8, which is sometimes in the clear.

Satcom C4 (135 degrees): This high-powered satellite was launched on August 31, 1992. Deutsche Welle is on transponder 5, Italy's RAI on 7, shopping channels on 9 and 10, music channel The Box on 11, the Travel Channel on 13, the Cable Health Club on 14, and C-SPAN2 from the U.S. Senate on 19. Viacom uses this satellite for its eastern coded services, including MTV, VH-1, Nickelodeon, and the new digitally-encrypted MTV Latino in Spanish.

Galaxy 1 (133 degrees): This satellite includes several popular coded services, including the Disney Channel (West), Comedy Central (West), The Cartoon Network, Cinemax (East), HBO (East), Showtime 2, and the Discovery Channel. Uncoded services include the TV Food Network, the Nostalgia Channel, shopping, religious, and Spanish language services Univision and Galavision. Other services have moved to Galaxy 5.

Satcom C3 (131 degrees): This powerful new satellite was launched on September 10, 1992. It carries many popular coded services, including the Family Channel, Lifetime, Arts and Entertainment, Showtime, and Nickelodeon. Uncoded services include the Learning Channel, Courtroom-TV, C-SPAN1, two shopping channels, and El Entertainment.

ASC-1 (128 degrees): 18 C-band and 6 Ku-band transponders. On C-band, the Home Dish Market Channel is on transponder 7, religious programming on transponder 12, Channel America on 20, and SCOLA, which carries news from TV stations around the world, in on 23. (News from Sweden's TV4 is now carried Monday to Friday at 7:30 AM Eastern time, and on Saturdays at 6:00 AM Eastern.) There are occasional transponders on Ku-band channels 23 and 24.

G-Star 2 (125 degrees) Ku-band only: Turner's Airport Channel is on transponder 20.

Galaxy 5 (125 degrees): This new satellite is the first of a new generation of high-powered satellites, and is somewhat similar to Europe's Astra as a "hotbird" target for fixed systems. It includes many popular coded services, including: the Disney Channel (transponder 1), Playboy (2), CNN (5), Turner Broadcasting (6), WGN (7), Home Box Office (8 and 15), ESPN (9), The Family Channel (11), the Discovery Channel (12), CNBC (13), the new ESPN 2 (14, and initially in the clear), Cinemax (16), TNT (17), The Nashville Network (18), the USA Network (19), CNN Headline News (22), and Arts and Entertainment (23). Uncoded services include a religious broadcaster (3), the Science Fiction Channel (4), a music channel (10), Black Entertainment TV (20), and Mind Extension University (21). Viacom is carrying out digital compression tests on transponder 24.

Telstar 303 (123 degrees): Carries mainly TVN pay-per-view programming. Fox (East) is on transponder 18, Fox (West) on transponder 23.

SBS-5 (123 degrees) Ku-band only: mostly college and pro sports feeds.

Morelos 1 (113.5 degrees) and Morelos 2 (116.8 degrees): Mexico's Morelos 1 offers a number of local stations and sports feeds, some coded and not available to the US market. Morelos 2 is less active, but Turner Broadcasting's TNT Latin America, coded and not available for the US market, is on transponder 12.

Anik E1 (111.1 degrees): Canadian channels and feeds. The TV Northern Canada service for Native Americans is on transponder 19, and TV5 Quebec is on transponder 17. Occasional transmissions of news and sports on Ku-band.

Anik E2 (107.3 degrees): Canadian stations including weather on transponder 1 and relays of the Canadian House of Commons on transponder 24, with sound in English and French on separate subcarriers. The CBC uses transponder 11 (Pacific), 15 (French), and 19 (Atlantic), and other transponders for feeds. CBC Newsworld on transponder 16 relays BBC World Service Television, but is coded in the Oak system, as are several other transponders. Visnews/London uses transponder 17. There are BBC feeds on transponder 7, including the final 10 minutes of BBC "Breakfast News" weekdays at 3:00 AM Eastern Time. Many Canadian Channels on Ku-band as well.

G-Star 4 (105 degrees) Ku-band only: News and sports feeds (CNN on transponders 21, 26, and 28), The Classroom Channel on transponders 31 and 32.

Galaxy 6 (103 degrees): Moved from 99 degrees, sports feeds, with the NHK feed to Tokyo on transponder 22.

G-Star 1 (103 degrees) Ku-band only: news and sports feeds.

Spacenet 4 (101 degrees): PBS uses transponders 4, 6, 8, 10, and 12. Newscasts from Britain's ITN can be found around 17:30 Eastern Time via PBS on transponder 10. There's a religious broadcaster on transponder 9. Three of the six Ku-band transponders have gone bad and are considered unusable.

Galaxy 4 (99 degrees): Has replaced Galaxy 6 and Westar 4 at this position. CBS makes extensive use of this satellite and Galaxy 7, with occasional transponders in the clear, especially relays of the "CBS Evening News" and sports feeds. CBS uses transponders 16, 17, 18, 19, 20, 21 and 24. Religious broadcasters on transponders 6, 15, and 23, Spanish on 8, 13, and 14. On Ku-band, NASA Select uses transponder 18, and the National Weather Net is on transponder 12. There are also many news and sports feeds.

SBS-2 (97 degrees) Ku-band only: NBC News Channel is on transponder 8, NBC feeds on transponders 3 and 9.

SBS-6 (95 degrees) Ku-band only: CONUS News feeds on transponders 12 and 13, Asia Net (coded) on transponder 14.

Galaxy 3 (93.5 degrees): The Caribbean Satellite Network is on transponder 14, ABC is occasionally in the clear on transponder 18, as is TV Asia (Hindi) on transponder 7. Other coded channels are Empire Sports Network (2) and Radio Television Portugal (5). There are religious broadcasters on transponders 11, 12 and 21, shopping channels on 10, 13, 15, and 17. The entertainment channel Showcase America is on transponder 22.

G-Star 3 (93 degrees): Ku-band only, in inclined orbit, only occasional reception is possible.

Galaxy 7 (91 degrees): This new high-powered satellite carries 24 transponders in the C-band (16 watts each), and 24 in the Ku-band (50 watts each). CBS is a major user on C-band, sometimes in the clear, with the Western network feed on transponder 2 and the Eastern feed on 19, and newsfeeds on 18. Many channels used for feeds, with the Fammily Network on transponder 14. On Ku-band, there are many college and pro sports feeds, the Asia-American Satellite Network in Chinese (12), The Asia Net in Korean (15), and the Fire and Emergency TV Network (17).

On December 6, 1993 Emirates Dubai TV began broadcasts on Galaxy 7 in Arabic and English.

Spacenet 3 (87 degrees): Nebraska Educational Television is on transponders 2 and 4. There are coded relays of local TV stations in Dallas, New York, and Los Angeles and several sports channels. CNN International and TNT Latin America is coded, not for the U.S. market, on transponder 16. CNN newsfeeds in Spanish, not coded, are on transponder 11. On Ku-band, there are sports feeds on transponders 6 and 10.

Satcom K-1 (85 degrees) Ku-band only: PrimeStar DBS pay channels in B-MAC.

Telstar 302 (85 degrees): Has taken over from Telstar 301 as a major feed satellite. Paramount uplinks such programs as "Star Trek: The Next Generation" and "Deep Space Nine" on transponder 3. Several coded services, including HBO 2 and 3, and Cinemax 2. The ABC Eastern feed on transponder 10 is sometimes in the clear.

Satcom K-2 (81 degrees) Ku-band only: NBC uses transponders 3 (East), 7 (Pacific), 10 (sports), 15 (news and sports), 19 (Central), 23 (newsfeeds), and 27 (newsfeeds). The No.American Chinese Television Netw. is on transponder 28.

SBS-4 (77 degrees) Ku-band only: NBC has acquired the entire capacity of this satellite, the first time a broadcast network has arranged to be the sole user of a satellite. The network will have access for occasional use until February, 1994, when it will have full-time access to all transponders. Hughes has allowed the satellite to move into an inclined orbit, which will mean NBC affiliates must have special tracking equipment, but the expected lifetime of the satellite has been extended by as much as ten years, until well into the next century.

Galaxy 2 (74 degrees): CNN feeds can be found on transponder 9, sports feeds on many others.

Satcom 2R (72 degrees): NASA Select TV, including live video from space shuttle missions, is on transponder 13. Programming is in four hour blocks, repeated during the broadcast day. The Arab Network of America on transponder 1 is a Saudi-financed channel seeking to reach the one million Arabic-speaking Americans and expatriates in the U.S. It hopes to broadcast 24 hours a day of news, entertainment and religious programming. New England Cable News is on transponder 21, NBC sports feeds on 20, the Outdoor Channel on 3, and shopping channels on 7 and 11.

Spacenet 2 (69 degrees West): The United States Information Agency's Worldnet uses transponder 3. There are Spanish feeds and programming on transponders 2 (GEMS TV), 4 (Canal SUR—coded), and 5 (NBC Canal de Noticias). Main Street TV is on transponder 7. On Ku-band there are news and sports feeds on transponders 4 and 10, educational programming on transponder 5.

Intelsat 513 (53 degrees): is also used to relay signals from Europe to North America. Australia uses the satellite to relay TV programs from London to Los Angeles. They are retransmitted to Australia from there on Intelsat 508 over the Pacific.

Panamsat 1 (45 degrees): used to relay across the Atlantic, to Latin America and the Caribbean on C-band and to North America and Europe on Ku-band. RTV Beograd is on 11.760 GHz to North America, TV Japan feeds on 11.920 GHz, and Peru's Canal Sur on 4.140 GHz.

Intelsat 601 (27.5 degrees), generally a European satellite, also carries NTSC transmissions to North America from Europe. During the lead up to the Gulf War its predecessor Intelsat VI-F4 was used for NTSC feeds from the United States, presumably programs for American soldiers in the Gulf, on Ku-band 11.056 and 11.090 GHz. BBC World Service Television is being relayed uncoded to the CBC on C-band transponder 4, presumably 3.780 GHz.

Intelsat-K (21.5 degrees): This Ku-band only satellite was launched in June, 1992, also to relay signals across the Atlantic. The satellite carries 32 high-powered television channels, which can be directed to North America (as far as the Midwest), Europe (as far east as Greece), and selected parts of South America. All beams will use 11.45-11.7 GHz, while 11.7-11.95 GHz will also be used to the Americas.

Deutsche Welle and Italy's RAI use this satellite to relay their services to North America.

Coming Channels and Satellites

Turner Broadcasting will introduce two new channels next year, a domestic feed of CNN International, and Turner Classic Movies. Turner Classic Movies will debut on April 14, 1994, the exact centennial anniversary of the first public movie showing in New York City. It will air hundreds of movies from the 1930's to the 1980's.

Time Warner and Spiegel Inc. have announced they will launch two cable television home shopping channels next year, including an interactive "video shopping mall". The joint venture marks the first attempt by either company to develop a home shopping business. The channels will feature clothes, accessories, and home furnishings from Spiegel's catalog and from its Eddie Bauer and other specialty divisions.

The interactive channel will make its debut next April on an experimental cable network Time Warner is building in Orlando, Florida. "The interactive channel will, in effect, be a video shopping mall," say the two companies. "Cable customers will be able to enter any catalog 'store' at any time, view a variety of merchandise in full motion video and make purchases on demand."

A more conventional home shopping channel with a working title of "The Catalog Channel" will start in the first quarter of next year on Time Warner's cable systems, the second largest in the US, with 7.1 million subscribers in 36 states. The channel will later be offered to other cable operators.

ValueVision International Inc., a TV home shopping network, has signed up for a C-band transponder on Hughes Communications' next-generation Galaxy 1-R satellite, set to be located at 133 degrees west longitude.

The video game company Sega is planning to launch The Sega Channel in 1994. Initially, viewers in 13 American cities will be offered a chance to download games for Sega's Genesis megadrive games machine, using a special decoder, before the service launches nationally in the United States. Sega has joined forces with Time Warner and the giant cable operator TCI to form the network. The 24-hour broadcast service will feature specially-engineered play games, previews, hints and tips. Users will supply their own video games machine and rent the decoder interface which enables them to utilise the programming carried by The Sega Channel. Sega is rumored to be seeking access to a transponder on Astra, for a European service next year.

The Public Broadcasting System, PBS, together with WGBH in Boston and WNET in New York, are planning to launch a channel devoted exclusively to cultural programming. The new channel, called Horizons TV, is expected to be running by the end of 1994.

PBS is expanding enormously when it moves to the Telstar 401 satellite, which was launched on December 15, 1993. The satellite is to begin regular operation in February, 1994.

PBS intends to move to 6 Ku-band transponders on the new satellite, 3 digital and 3 analog. C-band transmissions on Spacenet 4 transponder 4 would remain analog for dish owners.

On Telstar 401 PBS will be using DigiCipher digital compression techniques to squeeze 8 to 10 channels into each transponder. PBS plans to provide a total of more than 40 Ku-band channels, creating what is being described as an "education neighborhood". Most of these new channels will be used for educational programming to schools. The plans include two way contact, in which participating classes would interact with the programming, sending data from computers over the telephone to the closest PBS station, which would relay signals to the satellite.

One transponder would carry the PBS national schedule A and B programs, along with a high definition television program. While HBO and other programmers will be using the General Instrument's DigiCipher II technology, PBS will be using the non-consumer DigiCipher I technology and those digital signals are not compatible with the other system.

Other users of Telstar 401 will include ABC and Paramount, for relays of such programs as "Star Trek" and Entertainment Tonight". A second satellite is to be launched in early 1994, and a third (to be used as a spare) is scheduled for orbit in late 1994 or early 1995.

The NBC Network has acquired the entire capacity of the Ku-band SBS-4 satellite. NBC will use the satellite on an occasional-use basis until September, 1994, when the network will have full-time access. SBS-4 was launched in 1984 and carries ten 20-watt Ku-band transponders at 77 degrees west longitude. Hughes operates the satellite in an inclined geosynchronous orbit, enabling it to use less fuel with north-south station keeping. SBS-4 is expected to provide service until 2004.

NBC has also signed an agreement with GE Americom Communications for Ku-band satellite capacity aboard its GE-1 satellite. Capacity will be used from 1996. Like the SBS-4 transponders, NBC will use GE-1 transponders for feeds and program distribution.

NBC has also increased its interest in American Television Network, a partnership that produces health and medical programmes aimed at consumers and physicians. NBC plans to transform the network into a 24-hour cable channel at a later stage.

Non-Video Signals

Communications satellites carry much more than TV signals. There are also telephone channels, transmissions by international news agencies, stock market reports, commodity news, and hundreds of radio network relays.

There are two main kinds of audio signals. Audio subcarriers are extra signals transmitted along with the video signal. The video information on a satellite transponder typically occupies the space 0- 4.2 MHz. Subcarriers are added at frequencies higher than the video. Usually they will be on 6.2 or 6.8 MHz, but any frequency between 5 and 8 MHz can be used.

There are more than 70 audio only signals available on North American satellites. Here are a sample:

<i>Satellite/Channel</i>	<i>Program</i>	<i>Frequency(ies)</i>
Spacenet 2/3	Voice of America	5.92 MHz
Spacenet 2/4	SUR Radio (Spanish)	5.8
Spacenet 2/7	Spanish Christian Radio	5.94
Spacenet 2/20	AFRTS Radio	7.4
Satcom 2R/1	ANA Arab Net	6.8
Satcom 2R/7	Project Saturn Global	5.8
Satcom 2R/18	Radio Tropical (French)	7.6
Satcom 2R/23	Christian Music Network	6.2 7.6
Spacenet 3/2	Nebraska Public Radio	5.76 5.94
Spacenet 3/9	Modern Country	5.76 5.94
Spacenet 3/15	KLON-FM (Jazz/NPR)	5.58 5.76
	Radio Sedeye Iran	6.17
Spacenet 3/21	Let's Talk Radio	5.8
Galaxy 3/22	KGAY Denver	7.46

(off the air, Sept, 1993)

Galaxy 4/8	Hispanic Radio Broad. Net.	7.75 7.93
Galaxy 4/20	WCBS New York	7.4
Anik E2/16	CBC Radio East	5.76 5.94
	CBC Radio Atlantic	6.12 6.3
	Voice Print-Reading Service	7.44
Anik E2/20	CBC Radio East French	5.4 5.58
Anik E2/22	CBC Radio Pacific	5.76 5.94
	CFMI-FM	6.8
	CBC Radio News B.C.	7.36
Anik E1/17	Radio France International	5.41 6.12
ASC-1/23	World Radio Network	6.2
Galaxy 5/18	WSM Nashville	7.38 7.56
Galaxy 5/22	CNN Headline News	7.56
Satcom C5/24	KSKA-FM Anchorage/NPR	7.38 7.56

The Word Radio Network, which carries programs from NPR and many international broadcasters over an Astra transponder to Europe, has started a similar multi-lingual service to North America. The service uses SCOLA's transponder 23, audio 6.2 MHz, on the ASC-1 satellite. Radio Sweden is among the international broadcasters relayed to North America, heard daily at 01:00 and 21:00 hrs UTC.

The satellite and cable station C-Span carries broadcasts from the American Congress. C-Span also has two special audio channels. One rebroadcasts BBC World Service 24 hours a day, the other carries a variety of international broadcasters, including Deutsche Welle, Radio Japan, "As It Happens" from the Canadian Broadcasting Corporation, and Radio Sweden's program "Sweden Today", which is carried on Saturdays at 9:30 AM Eastern Time. Other broadcasters are the Voice of America daily at 1:00-8:00 PM, Radio Havana Cuba at 8:00 and 11:00 PM, Deutsche Welle during the week and Radio Japan weekends at 10:00 PM, and China Radio International at midnight. Radio Japan is carried weekdays at 6:00 AM, and programs from the Canadian Broadcasting Corporation are at 8:00 AM.

C-Span has been on transponder 24 on the Galaxy 3 satellite at 93.5 degrees West. BBC World Service uses the subcarrier at 5.4 MHz. The international broadcasters are on 5.22 MHz.

"Let's Talk Radio" was a program about radio and television on Spacenet 3 transponder 21, using the 6.2 MHz subcarrier (daily at 6:00 PM-1:00 AM Eastern Time). However it lost use of its subcarrier in late 1993, and there are no indications when or if it would be returning.

KGAY, a new radio network for gays and lesbians, moved from Spacenet 3R to Galaxy 6, transponder 17, using the audio subcarrier at 7.48 MHz. However it stopped satellite relays in September, 1993, and it is uncertain if it will return.

The Becker Satellite Network provides a common channel to a variety of eccentric programmers. According to "Popular Communications" magazine, it's a place where

would-be pirate broadcasters can reach listeners legally. Among the programmers are the former pirate Radio New York International, the Satellite Information Service, the Johnny Lightning Show, the World Jazz Federation, and DBI Satellite Radio Talk. The Becker Satellite Network is on Spacenet 2, transponder 7, audio 7.5 MHz.

Project Saturn Global is to be the world's first all educational 24 hour international satellite radio network. Regular broadcasts to North America were due to begin in January, using the Galaxy 5 satellite, transponder 7, audio subcarrier 5.80 MHz. Programs will originate from Los Angeles at 16:00 hrs daily.

Worldwide coverage is planned for April, 1993. The daily programming is drawn from an audio library of more than 2000 programs, aimed at all ages, with subjects ranging from fairy tales to computer technology. Programs are to be repeated every eight hours to accommodate global time zones, and will include hourly educational news.

There are several digital satellite radio services in the United States:

Digital Cable Radio transmits to American and Mexican subscribers and cable systems on Satcom C3, transponder 9. Launched in May, 1990, DCR was the first digital cable audio service marketed in the United States. DCR currently provides 28 CD-quality radio channels. On May 1st this is increasing to 56. DCR says that additional music, information, news, talk and foreign language channels are set to be introduced, along side additional commercial formats (background music) for business users. DCR hopes to provide 250 channels within a few years.

DCR plans to expand into Canada and is currently seeking regulatory approval. DCR has long-term plans to launch the service in Europe, the Far East and parts of Latin America.

Another service called Digital Music Express, or DMX, is available to more than 10 million cable subscribers in the United States. It offers themed channels of various types of music without the need for DJs, jingles, or commercials. The DMX decoder, manufactured by Scientific Atlanta, displays information on the music being played, such as the name of the artist, song and album title, composer, and chart position.

International Cablecasting Technologies Inc. has signed a USD 20 million contract with Spar Communications Group for the supply of digital audio receivers that will receive DMX's coming 120 channel service by DBS satellite.

DMX initially started with a 30 channel offering, but the company is in the middle of an aggressive service and geographical expansion programme. With the new receivers, customers can tune into 120 20Khz CD-quality music channels at the touch of a button. The new offering will be initially restricted to the North American marketplace, and it will enable the company to expand its business music offering, DMX for Business, which provides commercial-free, DJ-free music to stores, offices and factories.

A 75 cm antenna will be used to receive broadcasts throughout the USA and North America from the SBS-5 satellite. Each receiver is fully addressable, enabling special

broadcasts to be sent to subscribers. There is also the capability to offer generic corporate programming broadcasts on under-utilised channels, switching in receivers as required.

The second system of sending audio by satellite is SCPC (single channel per carrier). This involves dividing up an entire transponder into individual non-video channels. There is both FM and single side band (SSB) SCPC. Most of the high quality audio (and data) services today use FM/SCPC. It is typically used for network relays.

The American non-commercial radio network National Public Radio has 16 audio channels on Galaxy 6, on transponders 2, 3, and 4 (which are used for many other SCPC services as well, such as NPR's rival, American Public Radio. The BBC World Service is carried for some 8 hours a day on an APR SCPC channel.

There are special SCPC receivers, but SCPC can be monitored with a satellite-TV receiver and a continuous coverage scanner or VHF-UHF communications receiver, although the quality may be less than with a dedicated SCPC receiver. Some (older) TVRO receivers have intermediate or downblock frequencies at 70 or 134 MHz. If this signal is available, a scanner or VHF-UHF receiver can be used to monitor the frequencies 18 MHz to either side of these channels on appropriate transponders.

On more modern TVRO set-ups, a splitter can be installed in the cable from the LNB to the satellite receiver, and the extra output can be fed through a DC block to an FM scanner that covers the LNB's 950- 1450 MHz range.

Universal Electronics has developed the first consumer-priced SCPC decoder, which can be attached easily to an ordinary satellite receiver. Universal sells the SCPC-100 for USD 400, plus shipping. More details from: Universal Radio, 6830 Americana Parkway, Reynoldsburg, Ohio, 43068, USA.

SSB/SCPC includes many digital services offering news or business information. Fine tuning will reveal many radioteletype (RTTY) signals which can be monitored with the proper RTTY interface.

Many satellites carry telephone services. One single transponder can hold 9000 telephone channels. These services can be monitored by hooking an SSB communications receiver to the 0-4.2 MHz output of a TVRO receiver, if this is available. The telephone services, on satellites such as Satcom 5 and Galaxy 2, can usually be found by tuning the SSB receiver between 3720 and 4180 MHz.

Radio Netherlands is using PanAmSat (PAS-1) to broadcast to Latin America and the Caribbean, but this is a digital audio signal (64 kb/s in a 10 kHz audio channel). This Ku-band signal is downlinked in Florida and uplinked on C-band to receiving stations in the Caribbean.

IBM, NBC, and a company called NuMedia are to test a system of "news on demand" delivered via satellite. The system, which would be called NBC Desktop News, would allow people to scan lists of headlines using personal computers and recall the stories that interest them. It involves text, graphics, video and sound extracts in a multimedia PC system.

North American DBS

Most North American satellite television has been in the C-Band, which is really intended for professional relays and not for home viewing. Many American TVRO enthusiasts have added extra low noise block amplifiers for Ku-Band, however. The NBC network, for example, has stopped using C-Band, and can be found only in the Ku-Band, on the K-2 satellite.

There are also several plans for European-style direct broadcast satellites (DBS) to North America, using the Ku-band. The first proposals came in early 1990, when General Electric announced a joint venture with 9 major cable operators to deliver 10 channels of programming using medium power in the Ku-band.

The service, called PrimeStar, began in November, 1990, using the K-1 satellite stationed at 85 degrees West. It now uses 12 transponders on the satellite. Three of the channels are pay per view, the others so-called Super Stations, and include the Family Channel, the Nashville Network, and Japan's NIKK. Other services include PrimeAudio (digital audio and radio) and a range of news services delivered as data to the desktop including X*Press X*Change and X*Press X*Press Executive, provided by X*Press Corp.

General Instrument Corp. has signed an agreement with Primestar to upgrade the DBS service with GI's DigiCipher digital video compression technology for all channels carried on the satellite. Up to 70 channels may be included by the end of 1994.

Primestar Partners is a joint venture between many US cable companies, including TCI, Time Warner, Cox and Comcast, and GE American Communications.

Hughes Communications and United States Satellite Broadcasting are starting a DBS system, called DirecTV. Two satellites would be able to carry up to 150 channels, including regular cable channels, pay-per-view networks, and high definition television services.

The first DirecTV satellite, DBS-1, was launched from French Guiana on December 17, 1993. Tests will begin in January, 1994 and receiving equipment going on sale in April. A second satellite will be launched in June, 1994. There will be separate services from USSB and Hughes' DirecTV. Together they will offer 100 subscription channels and 50 more pay-per-view channels, using digital compression techniques.

Both satellites will be located at 101 degrees West, and will deliver news, sports, movies, and other programming to American homes equipped with 45 cm (18 inch) antennas. Receiving systems will cost USD 700 plus installation. The cost of subscribing to 100 channels will be around USD 50 a month.

Among the broadcasters lined up for DirecTV are several channels from Turner Broadcasting: CNN International, CNN, Headline News, TNT, Cartoon Network, Superstation TBS, and Turner Classic Movies. Other broadcasters signed up include the USA Network, the Sci-Fi Channel, the Nashville Network, Country Music Television, Discovery, the Learning Channel, E! Entertainment, the Family Channel,

Courtroom Television Network, The Weather Channel, Playboy TV, The Golf Channel and The Travel Channel.

There are pay-per-view agreements with Paramount, Sony, MGM, Disney, and Columbia Tristar. Around 50 PPV films will be carried on the 150 channel system once launched.

USSB has announced that their programming lineup contains 14 premium feeds (HBO 1, 2, and 3, Cinemax 1 and 2, and Showtime 1 and 2, East and West in all cases) and six or seven basic channels (MTV, VH-1, Nickelodeon, Comedy Central, E! Entertainment, All News Channel).

The Federal Communications Commission has awarded direct broadcast satellite orbital slot assignments and channel frequencies to two companies called Direct Broadcasting Satellite Corporation and Directsat. DSBC has been assigned 11 transponders at both the 61.5 degrees and 175 degrees West orbital slots, with DSAT receiving 10 transponders at 119 degrees West, one at 110 degrees West and 11 at 175 degrees West. Final launch approval is to be granted by the FCC by March, 1994.

The FCC hopes competition from DirecTV and other DBS ventures will provide much-needed rivalry for cable systems, nearly all of which operate as local monopolies. The cable companies are concerned about the potential competition. There are fears of a different kind in Canada, where the intrusion of 150 channels of south-of-the-border cultural imperialism has led to DirecTV being dubbed "The Death Star", referring to the "Star Wars" films. There will be two Canadian channels on DirecTV, however. The CBC is providing an international version of its Newsworld service, while the privately-owned Power Broadcasting will provide the Northstar Channel, a compilation of the best of Canadian drama, arts, and entertainment.

Other observers have asked what people will do with 150 or 500 channels. Large chunks, of course, will be allocated to pay-per-view blockbuster movies, with the same film starting every 20 or 30 minutes so viewers will never have to wait longer than that. One DBS expert has pointed to the proliferation of magazines on store racks, and suggested that the magazine racks of the future will be satellites offering scores, or even hundreds, of narrow channels appealing to various interests. There are already cable systems in the United States offering 500 video channels.

The cable giant TCI has ordered two Tempo DBS satellites, to be launched in June and October 1996. Each will feature 32 high-powered transponders at 107 watts, switchable to 16 transponders at 200+ watts.

II. Latin America and the Caribbean

Latin American signals can be found on a number of satellites, such as Intelsats K, 601, and 513. There are extensive relays from Europe as well on Panamsat and more planned on Hispasat. Many Latin American services from North America are on Spacenet 2 (the women's channel GEMS TV on transponder 2, Canal SUR on transponder 4, and Canal

de Noticias NBC on transponder 5), and Galaxy 4 (Telemundo on transponders 8 and 14).

Mexico's Galavision is on Galaxy 1 transponder 20, and Univision on transponder 6.

Canal SUR (Sistema Unida de Retransmision) is a coded satellite service in Spanish and Portuguese from Latin America to North America. It includes broadcasts from stations in Argentina, Brazil, Chile, Colombia, Ecuador, and Peru.

There are two new services to Spanish-speaking people in the United States, both using the DigiCipher digital compression system. MTV started its MTV Latino service in October, 1993 from Miami. Initially MTV Latino is reaching 1.9 million homes in 10 Latin American countries and some parts of the United States, but hopes to eventually reach 3 to 5 million homes. MTV Latino is on the Satcom C3 satellite. MTV hopes its sister channels, VH-1 and Nickelodeon, will follow into Latin America.

The American pay-film channel Home Box Office has also launched a Spanish-language version of its regular schedule of movies, original programming, and sports to major Hispanic markets in the United States. "HBO en Espanol" will be available soon in San Francisco, Houston, Albuquerque, El Paso, and San Diego.

When consumer DigiCipher receivers become available in mid to late 1994, it is expected that these and other DigiCipher services will be sold to home dish owners.

The Caribbean Satellite Network went on the air in December, 1992, appropriately following the 500th anniversary of the arrival of Christopher Columbus in that part of the world. Signals are uplinked from Miami to the Galaxy 3 satellite, transponder 14. Programing concentrates on music, but there will also be documentaries based on life in the Caribbean, news, and situation comedies. European relays are also planned.

Turner Television's Cartoon Network began broadcasts in May to Latin America, transmitting to 300,000 subscribers mainly in Argentina. The channel will eventually have three audio subcarriers for English, Spanish, and Portuguese. CNN International and TNT Latin America broadcast coded on Spacenet 3 transponder 16.

Fox has recently launched a small cable channel to South America. Brazil has its own satellite, Brasilsat, which was launched in 1986 and is located at 70 degrees West. This C-band only satellite carries a variety of Brazilian stations, all in M-PAL.

Mexico's two Morales satellites are listed above. Mexico is following up with two new communications satellites called Solidaridad, built by Hughes. Besides Mexico, they will have spot beams to cover the southern United States, the Caribbean, and South America. The new satellites will have three times the capacity of the two Morales satellites. Solidaridad-1 was launched on November 19, 1993, and will be placed at 109 degrees West. Solidaridad-2 is scheduled for launch in 1994.

Radiotelevision Espanola's Canal Iberoamericano Television will use Spain's Hispasat satellite to reach Latin America. 18 hours a day of broadcasts from Valencia are to begin by the end of this year.

BBC World Service Television, Reuters, and Telemundo are negotiating on creating a 24 hour Spanish-language news service for Latin America, Spain, and the United States. Telemundo currently operates a Spanish language channel on the Spacenet 2 satellite which by satellite and cable reaches 85 percent of the Hispanic households in the United States. The new channel would broadcast from Miami by satellite and cable, and would start later this year.

Grupo Televisa and the the largest cable operator in the US, TCI, have agreed to form a joint venture to provide cable, pay-TV, and multi-channel television to Mexico and other Latin American countries.

Two major Christian shortwave broadcasters, HCJB in Ecuador, and Trans World Radio, have announced they are launching a 24 hour Latin American satellite radio network. The target date was November 20, 1993 and they'll be using digital technology to reach a network of affiliate stations from the US-Mexican border to the southern tip of Chile.

III. Europe and Astra

The Soviet Union's Ghorizont was the first TV satellite over Europe. While, the Ghorizont satellites operate mainly in the C-Band, Western European satellites use several sections of the Ku-Band for different purposes. The Ku1-Band 10.9-11.75 GHz is, like the American C-Band, intended for professional relays and not for home viewing. Home reception was originally intended for the Ku2 (DBS) Band 11.75-12.5 GHz. The Ku3-Band 12.5-12.75 GHz, or Telecom Band, is also not intended for home viewing.

The first Western European satellites were from Eutelsat, which is made up of the PTTs and Telecom administrations of Western European countries. The intention was that individual countries would offer home viewing to their own residents over high-powered DBS satellites offering only a few channels. Astra, operated by Luxembourg's SES, has changed all that.

Because Astra's several medium-powered satellites are at the same spot in the sky, viewers with relatively small fixed antennas (60-90 cm) can tune into all available channels.

Here are the channels on Astra 1A, 1B, and 1C (as of Jan., 1994):

<i>Ch.</i>	<i>Transponder</i>	<i>Frequency</i>	<i>Language</i>
1	RTL 2	11.214 GHz	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	English/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	FilmNct+ (to Scandinavia)	11.362	English (pay channel)
12	Sky News	11.377	English
13	RTL 4	11.391	Dutch
14	Pro 7	11.406	German (partly pay)
15	MTVEurope (northern Eur.)	11.421	English
16	Sky MoviesPlus	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	MTVEurope (southern Eur.)	11.538	English
23	UK Gold	11.553	English (free-coded)
24	JSTV	11.567	Japanese
25	N3	11.582	German
26	Sky Gold/TV Asia	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	Cinemanía	11.656	Spanish (pay channel)
31	TV3 Norway (D2-MAC)	11.670	English/Norwegian
32	Documanía	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	Discovery/Country Music TV	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	11.156	English (pay channel)
47	Sky Sports 2	11.171	coming (pay)
48	SWF 3	11.186	German
49	FilmNet Movies	10.921	English (pay channel)
64	KTL 5	10.936	Dutch (pay channel)

Odd-numbered transponders carry horizontal polarization, while the even transponders are vertically polarized. All channels are PAL unless D2-MAC is indicated. Pay channels use a variety of scrambling systems, although the emerging standards seem to be Videocrypt for PAL channels and Eurocrypt M for D2-MAC. The Sogecable Spanish transponders (30, 32, 36, and 40) use Nagravision.

Until Sky Sports 2 comes on the air, transponder 47 will be used to provide Astra technical information. First reports said Sky Sports 2 would begin operation on February 1, 1994, but now it is said that British Sky Broadcasting could wait for improved technology to launch the channel on a pay-per-view basis.

China News and Entertainment uses transponder 35 during the night for uncoded broadcasts from the Far East, between 1:00 AM and 3:00 AM British time. This channel brings together reports from Hong Kong, China, and Taiwan, in English, Cantonese, and Mandarin.

Astra uses the Ku-Band for medium-powered signals, with 16-18 channels per satellite. Astra 1A, 1B, and 1C are currently in orbit at 19.2 degrees East. Astra 1A and 1B carry mono channel sound on 6.50 MHz, with many stations carrying stereo as well on 7.02/7.20. Most Astra 1C outlets have stereo-only TV sound on 7.02/7.20. Astra 1C carries two transponders, 63 and 64, which cannot be received on ordinary receivers, although LNBs are being produced that will cover these frequencies. They are part of the channel plan for later satellites, using 10.7 to 10.95 GHz, and intended for cable systems rather than home viewers.

British Sky Broadcasting, the company formed by the merger of Sky Television and British Satellite Broadcasting in 1990, is a major user of the Astra satellites. BSkyB's channels are Sky News, the entertainment channel Sky One, Sky Movies Plus, the Movie Channel, Sky Movies Gold, and Sky Sports. Sky Sports 2 is planned for transponder 47. Sky News is uncoded, while the other channels are videocrypt encoded. A number of other channels are included in BSkyB's Multi-Channels Package: Discovery, Bravo, UK Gold, UK Living, CMT, QVC, Children's Channel, Family Channel, and Nickelodeon.

FilmNet is offering viewers in the Netherlands and Belgium the chance to subscribe to a five-channel package of Astra channels, scrambled in Videocrypt. The package, called "MultiChoice", will consist initially of three "basic" channels and two premium channels. Discovery, The Children's Channel and Country Music Television will form the basic package, with The Adult Channel and FilmNet forming the two premium channels. It is hoped that such channels as Nickelodeon, Nick-at-Nite, TV Asia, and RTL-5 may join the package.

FilmNet will utilise its out-of-band Astra transponder (10.920 GHz) for "FilmNet: The Complete Movie Channel" as part of the package. While the basic channels and The Adult Channel will continue using the conventional flavor of UK Videocrypt, FilmNet will broadcast in Videocrypt Europe, also known as Videocrypt 2. Videocrypt 2 receivers are compatible with existing Videocrypt broadcasts, although it is understood

that Videocrypt 2 transmissions will not be decoded by existing (UK type) Videocrypt decoders, even with the correct smartcard.

By early 1994, the package is to be extended to Portugal, and eventually will be available to other European countries, including the Czech Republic, Slovakia, Hungary and Scandinavia. Larger European countries such as Germany and France are expected to be catered for by the soon-to-be-announced Sky

re7 deal. Rumors suggest that Sky could soon begin selling its channels, including Movies and Sports, on a Europe-wide basis.

Nickelodeon is owned by MTV's parent, Viacom. The Nick-at-Nite service is due to share the transponder, beginning next year. MTV's music channel for somewhat older audiences, VH-1 is to join the Multi-Channels package on May 1, 1994, probably taking over MTV's transponder 15. At that time, both MTV and VH-1 will probably encrypt.

Eurosport has ceased providing a French audio soundtrack on its Astra and Eutelsat service. Viewers wishing to watch in French will need to subscribe to the Canal Plus package to receive "TV Sport", the French version of Eurosport.

Landmark Communications Inc, the US media conglomerate which owns The Weather Channel and The Travel Channel, has confirmed that it is to launch The Travel Channel in Europe in early 1994. The development plans include Britain, the Benelux, and Scandinavia. There are reports The Travel Channel may use Astra transponder 24 during the day and early evening, before JSTV takes over the channel.

Other Astra hopeful is the Afro-Caribbean Satellite Channel, which wants to broadcast for 6 hours nightly after midnight, carrying films, sports, general entertainment and news. This channel hopes to eventually reach the emerging African cable market.

There are a number of other Astra hopefuls, but the three satellites are now completely filled. Now that NBC has bought and revamped Super Channels, a move to Astra would be welcomed by many. There are, however, reports that some current broadcasters could be departing from the high-cost Astra transponders. Eurosport may leave Astra to rely solely on Eutelsat, while the German channel Vox is in danger of closing due to low viewership. The 4 Scansat channels, the TV3 transmissions to Sweden, Norway, and Denmark and TV1000, might leave Astra in favor of the Swedish Space Corporation's new Sirius satellite (the former Marco Polo 1), to be positioned together with Tele-X at 5 degrees East.

Astra 1D, with a further 18 channels, is due for launch in the third quarter of 1994. It will carry 18 more transponders in the Fixed Satellite Service range. The 1D transponders and frequencies are:

49	10.714 Ghz	57	10.832
50	10.729	58	10.847
51	10.744	59	10.852
52	10.758	60	10.876
53	10.773	61	10.891

54	10.788	62	10.906
55	10.803	63	10.921(also on Astra 1C)
56	10.817	64	10.935(also on Astra 1C)

As with the other Astra satellites, odd-numbered transponders have horizontal polarization, while even transponders have vertical polarization.

Astra 1D will also carry digital programming in the BSS band on transponders 65 to 82 between 11.720 and 12.051 GHz.

Thames Television has taken options on two transponders on Astra 1D. Thames hopes to launch another two themed channels on these transponders, although it has not yet announced any details. Germany's ZDF has also announced it has booked a transponder on Astra 1D. China News and Entertainment, with programming aimed at the Chinese community in Europe, hopes to offer a subscription service over Astra 1D, beginning in late 1994, extending its output then to ten hours a day.

Astra 1A, 1B, 1C, and 1D together will provide 64 channels of DTH (direct to home) programming to viewers in Europe.

Astra 1E is to be launched early in 1995 and will carry 18 transponders with 85 watts each (compared to 45 watts on Astra 1A). The similar Astra 1F is to be launched in 1996. Astra 1E and 1F will provide 40 transponders for digital broadcasting services. 1E will operate in the 11.7 to 12.1 GHz range, while 1F will cover between 12.1 and 12.5 GHz. Astra is reportedly planning to launch an Astra 1G in 1997. This would provide a back-up to the digital TV services on 1E and 1F.

The use of digital compression techniques will allow the transmission of eight to ten channels per transponder, and British Sky Broadcasting is reported to be planning to use several to transmit pay-per-view films, where a film would be starting every 20 minutes.

Other European Ku1-Band satellites include:

Intelsat 602	63 degrees East	Italy/Iran
Intelsat 604	60 degrees	4 Turkish transponders
Statsionar 5	53 degrees	EBU Moscow
DFS 2 Kopernikus	28.5 degrees	German broadcasters
DFS 3 Kopernikus	23.5 degrees	German transponders
Eutelsat I-F5	21.5 degrees	feeds
Eutelsat II-F3	16 degrees	Middle Eastern, Eastern Europe
Eutelsat II-F1	13 degrees	many European programs
Eutelsat II-F2	10 degrees	Italian, Iberian, Turkish
Eutelsat II-F4	7 degrees	Turkish/Greek/EBU
Intelsat 512	1 degree West	Norwegian channels/Israel
Statsionar 11	11 degrees	WTN Moscow
Statsionar 4	14 degrees	Reuters TV
Intelsat 515	18 degrees	Norwegian channels

Intelsat K	21.5 degrees	trans-Atlantic feeds
Intelsat 601	27.5 degrees	European (BBC, CMT, Wire TV)
Intelsat 603	34.5 degrees	EBU Sarajevo
PAS 1	45 degrees	mostly feeds (PAL and NTSC)

Eutelsat

The Eutelsat II satellites are higher-powered than their predecessors, and approach Astra in strength. The most interesting Eutelsat is II-F1 at 13 degrees East, which includes the following transponders:

Eurosport	10.970 GHz	Sports
Super Channel	10.987	Radio: BBC World Service
Der Kabelkanal	11.052	D2-MAC, German
Viva	11.006	German music videos
TV5 Europe	11.080	French
RTL 2	11.095	German
Deutsche W/World N	11.161	Radio: DW, VOA
TRT	11.181	Turkish
MBC	11.554	Arabic, Radio: Vatican
Euronews	11.575	Multi-lingual sound
interStar	11.596	Turkish
Emirates Dubai TV	11.638	Arabic, some English
MTV Europe	11.658	
FilmNet (Holland)	11.678	Digital sound
VisEurope	12.521	coded newsfeeds
Maxat	12.560	newsfeeds
France Telecom	12.585	HD-MAC tests

Germany's international radio broadcaster, Deutsche Welle, has taken over the facilities of the Berlin-based American TV station RIAS, and is broadcasting on Eutelsat II-F1 with three two hour blocks after 16:00 hrs European time on 11.161 GHz. The first 90 minutes of each block is in German, followed by 30 minutes in English. There are also Spanish programs. Managing Director Dieter Weirich announced at the Internationale Funkausstellung in Berlin on August 30, 1993 that Deutsche Welle TV will be expanding to 24 hour a day service from 1994. However, the expansion from 16 hours at present would only be possible if ARD and ZDF agree to work together.

The American government's World Net uses this same transponder at 10:00-15:30 hrs European time daily. The transponder also carries radio programs from both Deutsche Welle and VOA Europe. It's hard to say what will happen to World Net if Deutsche Welle goes to 24 hours. World Net was kicked off the French TV5 transponder for exactly the same reason.

The European Broadcasting Union's all-news station, Euronews, went on the air at 14:00 hrs on January 1, 1993 from Eutelsat II-F1 at 11.575 GHz. There are no presen-

ters, instead the news footage is accompanied by soundtracks in five languages on various audio subcarriers: German on 6.65 Mhz, English on 7.02, French on 7.20, Spanish on 7.38, Italian on 7.56, (and probably Arabic on 7.74) MHz.

The American TV network NBC has bought Super Channel, which was started as a "Best of British TV" channel (as UK Gold later became), but was forced to abandon this because of opposition from the British Actors' Union. A controlling interest was bought by an Italian music video company, and Super Channel has carried an unfocused mix of music videos, B movies, and news programs. NBC has cut back on the videos, and has added such programs as the "Today Show", the "NBC Nightly News", "The Tonight Show", and other news programs from NBC and its financial channel CNBC.

Emirates Dubai TV is mostly in Arabic, but there are English newscasts at 15:00 and 18:00 hrs British time. It uses half the former Filmnet transponder, and there are reports the other half, 11.678 GHz, may be used to launch a European version of the Sci Fi Channel in April, 1994.

Turning to the other Eutelsats:

II-F3 (16 degrees East) carries largely programs from the Middle East and Eastern Europe. Egypt's ESC is on 11.178 GHz, and that country's new foreign language channel, Nile TV International, has been testing with extremely low power on 11.146 GHz. Other Middle Eastern broadcasters are RTV Marocaine on 10.970, Turkey's TGRT on 11.090 and HBB on 11.615, and TV7 Tunisie on 11.658. Telepace from Rome, which carries daily programming from the Vatican, is on 11.575 GHz. Albania's TV Shqiptar uses this transponder between 17:30 and 20:30 hrs British time.

Eastern European broadcasters include Croatia's HTV on 10.986 GHz (shared with Eurostep), Polonia TV on 11.080, Hungary's Duna TV on 11.596, and Polsat on 11.675.

Eutelsat II-F2 (10 degrees East) is a largely "Latin" or Mediterranean satellite. Spain's TVE is at 11.149 GHz. Italy's RAI has two transponders (10.972 and 11.095). The Portuguese RTP International service is at 11.658 GHz. RTP also transmits to Africa on Ghorizont 12 at 40 degrees East, at 3.925 MHz. There are three private Turkish stations: A-TV on 10.986, Show TV on 11.575, and interStar on 11.617. The American AFRTS uses the B-MAC system for broadcasts on 11.175.

Eutelsat II-F4 (7 degrees East) has Greece's ETI on 11.174 GHz and PIK from Cyprus at 11.141, Turkey's Kanal 6 at 11.162 and a new service are on 11.578, with Serbia's RTS Sat Beograd at 11.536 GHz. There are also EBU feeds using the sound-in-synch system on a number of transponders.

Greece's ERT has announced the establishment of a satellite channel called ERT International. As it is to broadcast to Europe, North Africa, and the Middle East, it will probably use Eutelsat.

The venerable Eutelsat I-F1 is being redeployed to improve coverage of Russia and the CIS. Both 36 and 50 degrees East have been mentioned as new locations. But Eutelsat II-F5 is due to be launched on January 21, 1994 and is to be located at 36 degrees East.

Eutelsat II-F6 is to be co-located with Eutelsat II-F1 at 13 degrees east, now dubbed the "Hot Bird" position. The satellite, due to be launched in October, 1994, will be able to relay 16 70 watt high-powered television channels. Eutelsat is already taking bookings on the satellite. According to a statement issued by Eutelsat, in order to guarantee that the 13 degrees east position "can be reinforced as Europe's principal slot for television for cable and direct-to-home reception, the new satellite will only carry entertainment services at prime-time (17:00-01:00 CET)."

MTV has already booked a transponder on Eutelsat II-F6, to carry four digitally compressed feeds for European cable networks, probably versions of MTV tailored for specific countries and regions. A second transponder for four more channels is under consideration. This could carry European versions of Viacom's American services, such as The Comedy Channel, The Movie Channel, and Flix, or foreign language versions of Nickelodeon.

Eutelsat plans a third satellite for 13 degrees east, called "Hot Bird Plus". It would be launched in early 1996, with 20 110 watt transponders. This would mean reception in most of Europe with 40 cm antennas. "Hot Bird Plus" will enable Eutelsat to meet demands for digital television, offering such future options as interactive television, video-on-demand, pay-per-view, etc.

The problem for Eutelsat is "too little too late". Next year it will have 29 transponders at 13 degrees East. Today, Astra has 50 at its position, and by the time the first "Hot Bird" launches, Astra will already have the equivalent of "Hot Bird Plus" in orbit, the Astra 1D satellite, which will be followed in 1995 by Astra 1E, and the following year by Astra 1F.

Eutelsat's only chance is that it may be able to serve Eastern Europe better than Astra, and there might be a greater demand for satellite capacity than Astra can meet. Also, Eutelsat's transponders have a wider bandwidth (36 MHz) than Astra (25 MHz). This means more digital channels can be squeezed in.

Intelsat

Another interesting satellite (which may be virtually vacated by the end of the year) is Intelsat 601 at 27.5 degrees West. This has carried CNN, Discovery, Bravo, and the Children's Channel, all of which (have moved to Astra. What's left are broadcasts from the British Parliament (11.095 GHz), Country Music Television Europe (24 hours on 11.509, using a weak half transponder), the shopping center entertainment channel Wire TV (coded) and The Learning Channel (uncoded) sharing a transponder (11.505), Sweden's D2-MAC coded FilmMax (11.665), the SAVE coded British forces SSVc (11.563), and BBC World Service Television (10.995).

In January, 1993 BBC World Service Television switched to D2-MAC, encoded in Eurocrypt M. Subscriptions are available from TV Extra in Motala, Sweden, at telephone number +46-141-355-12. The system uses the same smartcards as Filmnet, and in Scandinavia and the Benelux, Filmnet is handling subscriptions.

Intelsat 603 was launched in 1990, but a mistake put it into a useless orbit. In May, 1992 the American space shuttle Endeavour successfully captured the satellite and relaunched it into its proper orbit (34.5 degrees West). This carries C-band feeds to Greenland and the Canary Islands. EBU feeds from Sarajevo are on 11.475 GHz.

Intelsat-K at 21.5 degrees West is intended to relay signals across the Atlantic. Intelsat's first Ku-band only satellite, it carries 32 high-powered transponders, which can be directed to North America (as far as the Midwest), Europe (as far east as Greece), and selected parts of South America. All beams use 11.45-11.7 GHz, while 11.7-11.95 GHz is also used to the Americas, and 12.5-12.75 GHz to Europe.

Feeds from North America to Europe can be found on 11.531, 11.558, 11.593, 11.652, and 11.681 GHz, using both horizontal and vertical polarization. The CBS "This Morning" program, for rebroadcast by Sky News, is carried weekdays 12:50-14:00 hrs European time on 11.558 vertical. When NBC took over Super Channel, relays of many shows, including the "The Today Show" and programming from CNBC could be found on 11.616 GHz, although this has recently disappeared.

PanAmSat

Alpha Lyracon, now known as Panamsat, has taken on the massive Intelsat, seeking to provide an alternative international satellite organization. PAS-1, launched in 1988, is located at 45 degrees West, carries the American Galavision to Europe, along with several channels for newsfeeds.

PAS-2, to be launched in May, 1994, will be placed above the Pacific. PAS-3, to be launched in late 1994, will complement PAS-1 from 43.5 degrees, reaching farther into Scandinavia and the Middle East. Other parts of the world are to be covered by PAS-4 and 5 above the PAS-4 will be placed over the Indian Ocean at 72 degrees East in March, 1995. M-Net and the South African Broadcasting Corporation have already booked transponders.

Eastern European Satellites

A Soviet Ghorizont was the first television satellite over Europe. However, the Soviets concentrated on the C-band, while European satellite broadcasting has used the Ku-band. But there are in fact Ku-band transponders on the Ghorizont (or Stasionar) satellites used by the former Soviet Union. Each of the Ghorizonts over Europe, at 53 degrees East, 14 degrees West and 11 degrees West, has a transponder at 11.525 GHz. The Ghorizont at 53 degrees East carries EBU feeds, 14 degrees carries Reuters TV (formerly Visnews), while 11 degrees has WTN.

The Russian satellite ZSSRD at 16 degrees West carries two very interesting Ku-band transponders, using to relay signals from the MIR space station. Data information is car-

ried at 11.375 GHz, which can often be seen as flashing lines on the screen. More interesting is the transponder at 10.835 GHz, which carries video from MIR in clear SECAM. Unfortunately this frequency is slightly below that covered by most satellite receivers.

MIR video has also been reported from the Ghorizont at 11 degrees West on 11.525 GHz.

While the dishes used for Ku-band monitoring in Europe are generally too small for C-band reception, the introduction of new sensitive C-band LNBs has made it possible to receive the very strong Russian C-band signals using dishes as small as 1.5 meters. The Russian signals on 3.675 GHz at 40.5 degrees East and 14 degrees West are perhaps one hundred times stronger than other C-band signals in Europe.

Molniya satellites use a highly elliptical orbit that makes it possible to reach high latitudes out-of-reach of geostationary satellites (which would be too low on the horizon). These carry satellite broadcast television, relaying Double II (the East Siberian version of the second TV program) on 3.875 GHz.

The first of Russia's new Ekspress satellites, which will replace the current Ghorizonts, is to be in orbit at the end of the year. The satellites will better be able to maintain the correct inclination in orbit, and will carry 24 channels, as well as four back-up transponders.

Antenna Hungaria, the Hungarian telecommunications company, says that it plans to launch a 16-channel European satellite called "Domestic" in 1996, offering Eastern Europe's first commercial satellite service.

Telecom Band

There are 8 European satellites currently using the 12.5-12.75 GHz Telecom band:

DFS Kopernikus 2	28.5 degrees	Germany
DFS Kopernikus 3	23.5 degrees	Germany
Eutelsat II-F3	16 degrees	European
Eutelsat II-F1	13 degrees	European
Eutelsat II-F2	10 degrees	European
Telecom 1C	3 degrees	France
Telecom 2B	5 degrees West	France
Telecom 2A	8 degrees	France

To Astra's disappointment, French TV broadcasters have not booked any Astra channels. Instead, France is using its own Telecom 2A satellite, at 8 degrees West, for direct to home broadcasting. The French government having surrendered its demand for D2-MAC programming, eleven channels are now using Telecom 2A. Eight are in coded SECAM, and three in widescreen D2-MAC.

The SECAM channels are coded in Nagravision: MCM on 12.543 GHz, Paris 1:ere on 12.564, Planete Cable on 12.585, Cine Cinéfil on 12.626, Canal Plus on 12.648, Cine

Cinemas on 12.666, Eurosport France on 12.710, and Canal Jimmy on 12.732 GHz. France 2 is broadcasting in D2-MAC on 12.606 GHz. Widescreen D2-MAC with Eurocrypt is being used by Canal Plus on 12.522, Cine Cinéfil on 12.564, and Cine Cinemas on 12.689 GHz.

Telecom 2B (5 degrees West) carries the following uncoded channels in SECAM: M6 (12.522), France 2 (12.564), Arte (12.606), Monte Carlo TMC (12.658), and TFI (12.689). Cine Cinemas on 12.669 GHz uses Eurocrypt and D2-MAC. Luxembourg's RTL Television began relays of its French service in October, 1993 on 12.732 GHz.

Telecom 1C has now been moved to 3 degrees East, where it is used for feeds in PAL, D2-MAC, and B-MAC.

France's TFI is to launch a satellite and cable news channel during the first half of 1994.

Germany's DFS Kopernikus 3 has taken over from Kopernikus 1 at 23.5 degrees East. Kopernikus 1 has moved to 33.5 degrees East. Kopernikus 2 is operating from 28.5 degrees East.

European DBS

Direct Broadcast Satellites (DBS) are intended to beam a few (2-5) high-powered signals directly to homes in a single country. Viewers require dish antennas less than 30 cm in diameter. A number of DBS satellites have been orbited above Europe:

Tele-X	5 degrees East	Sweden
Thor	0.8 degrees West	Norway
Olympus	18.8 degrees	Western Europe (gone)
TDF-1 and TDF-2	19 degrees	France
TV-SAT 2	19.2 degrees	Germany
Hispasat 1A and 1B	30 degrees	Spain
Marco Polo 1	31 degrees	Britain (for sale)

Astra's hopes to attract Spanish customers are threatened by Spain's two Hispasat direct broadcast satellites. Hispasat 1A was launched on September 10, 1992 and carries 5 DBS channels and 18 transponders in other parts of the Ku-band. Most will be directed towards Spain and the Canary Islands, but two will be aimed at the Americas.

TVE International is in the clear on 12.160 GHz, with feeds and sports on 12.588. Tele 5 is coded in Nagravision on 12.631 GHz. The three Spanish radio stations Antena Tres, Ole, and Serie Oro are also on Hispasat.

This satellite, however, has antenna problems, displacing the footprint towards the north, which hopefully will be rectified now following the launch of Hispasat 1B on July 22, 1993. Five new television channels are to begin broadcasts. The first of these are to go on the air in December, a cultural channel called Canal Clasico and Teleporte with exclusively sports programs, to be operated RTVE in the clear. Later they will be joined by Telesat 5, Antena 3 Television Sat, and an as yet unnamed outlet from Canal Plus, all of which will be encrypted.

The European Space Agency announced August 26, 1993 that it has terminated the four-year-old mission of its troubled Olympus satellite, 11 months ahead of schedule. The ESA says it sent the satellite to a lower, non-operational orbit where it would not collide or interfere with other satellites. Olympus had started spinning and did not have enough fuel to return to its proper geostationary orbit. Olympus had carried broadcasts from Italy, an Irish sports channel, and relays of news from the Canadian Broadcasting Corporation, and was also used to test advanced communications technologies, including high-definition television. Two years ago the satellite's position had to be corrected after it went into an uncontrolled drift around the world.

A DBS war has been fought between Sweden and Norway. Both the Swedish Space Corporation and Norwegian Telecom bid on Britain's Marco Polo 2 satellite. The Norwegians won, and moved the satellite to 0.8 degrees West, renaming it Thor. They are offering a package of CNN (11.785 GHz), Eurosport (11.862), Children's Channel/Discovery (11.938), FilmNet (12.015), and MTV (12.092) to Scandinavian viewers, with hopes of increasing to 15 channels by co-locating other DBS satellites at that position.

Intelsat 512 is already at this position, (with the entertainment channel TV Norge in clear PAL on 11.016 GHz) and is to be replaced with a stronger satellite, adding to the offerings at this position. FilmNet, in fact, sold its 85 percent ownership of Tele-X back to the Swedish Space Corporation and moved its transmissions to Thor.

However, having won the satellite battle, the Norwegians lost the standards war. They chose two of Europe's most obscure standards, D-MAC and Eurocrypt S, available to few satellite viewers. (The exception is FilmNet, which uses D2-MAC and Eurocrypt S.) Writing in the magazine "Elektronikvrlden", Sweden's satellite guru, Bertil Sundberg, referred to the Thor coding as "Norwegian Harakiri". Finally, after several months, on December 16, 1993 the Norwegians backed down and all Thor channels now use D2-MAC (itself a doomed standard, if less obscure than D-MAC). It is unclear if the Norwegians have also abandoned their allegiance to the even more obscure Eurocrypt S system.

The potential audience is in Finland and northern Norway and Sweden, which are outside the main Astra footprint. FilmNet is distributing subscription cards for Thor.

Norway's approach to satellite broadcasting has been eccentric. Initially, most of the country's satellite channels were on Intelsat 512 at 1 degree West. Besides the Norwegian public broadcaster NRK, these are the new Norwegian terrestrial commercial station TV 2, the private TV Norge, and Swedish Television 1 and 2, which are uplinked from Oslo for use by cable systems in Spitsbergen and on North Sea oil platforms.

In late 1992, these channels cloned themselves onto Intelsat 515 at 18 degrees West. Moving away from 1 degree West was a bit strange, since it happened at exactly the same time Norway was moving Marco Polo 2/Thor to that same position.

Bertil Sundberg in "P TV" magazine has pointed out that there are now Norwegian programs on 5 satellites at 4 different positions. They use a bewildering array of standards: PAL, D2-MAC in both Eurocrypt M and Eurocrypt S, and D-MAC. This, he says, may explain why 80 percent of satellite systems in Norway are motorized.

The Norwegians are the traditional target of Swedish jokes. But Norwegian satellite broadcasting seems to have become a Norwegian joke in itself.

Sweden's Tele-X carries Sweden's TV4 (12.207 GHz) and TV5 Nordic (12.475), both in clear PAL, and Norway's NRK (12.332) in D-MAC. Sweden has fought back, and in December, 1993 NSAB, owned by the Swedish Space Corporation and Swedish Telecom, succeeded in buying the second Marco Polo satellite, apparently after Norway tried to block the sale. The satellite, renamed Sirius, is to be moved to Tele-X's position, where a rival package to Scandinavia is to be marketed. Together the two satellites should carry 7 channels. The first broadcasts are expected to begin in March, 1994. The Sirius frequencies are identical to those on Thor.

At the instruction of the Nordic prime ministers, the public service broadcasters of Sweden, Norway, Finland, and Iceland have presented a proposal for a joint Nordic television channel. The broadcasters say the Nordic satellite channel "Nordstjärnan", or "North Star", could be on the air by the end of 1994 or early 1995 (however, the Nordic Council's Ministerial Council has vetoed allocating funds to the project). The fifth Nordic country, Denmark, is not participating in the project because the channel would not be available to all viewers. The Danes would prefer to strengthen the current Nordvision co-operation.

Despite this Spanish/Nordic activity, the DBS idea seems to have been made obsolete by improving technology. Viewers want more than 2-5 channels and they want channels from other countries (which is why both Filmnet and Norwegian Telecom are now talking about co-locating several DBS satellites). A 60 cm Astra dish that can deliver 16, 32, or 48 channels is more desirable than a 30 cm dish with access to only 3 stations.

With the failure of the British BSB system on Marco Polo (it was bought out by Sky in 1990), the decision of the French government not to build a third direct broadcast satellite, to follow up the existing TDF-1 and TDF-2 satellites (after the breakdown of TDF-1), and the failure of Olympus, the DBS idea seems to be virtually dead. French Minister for Post, Communications, and Space Paul Quilès has announced the satellites will be replaced in due course by a new generation of spacecraft. In the meantime, France is concentrating on its medium-powered Telecom satellites.

Similarly, Germany's Kopernikus (and the German channels on Astra) have proved to be more popular than TV-SAT.

Eutelsat's answer to Astra was to be Europesat, a series of high-powered satellites being called "second generation DBS" all located at 19 degrees West. However, that project has been abandoned in May, 1993 in favor of the "Hot Bird" position at 13 degrees East.

C-Band

New C-band LNBs have made possible C-band reception on smaller dishes. However, over Europe just about the only signals that can be picked up on standard Ku-band dishes of less than 1.5 meters are from the Russian Ghorizonts, which are much stronger than other C-band signals. The American TDRS A4 at 41 degrees West has recently begun relaying a station from Denver, Gala Americana, in PAL on 3.920 GHz. A radio station has been heard on 5.80 MHz.

HDTV and Digital Technology

The European Commission has abandoned its plans for the forced introduction of the D2-MAC standard, as a step towards the future introduction of a system called HD-MAC for high definition television. Instead broadcasters are moving directly towards digital HDTV, after years of conflict over D2-MAC.

A memorandum of understanding to work together to find a common standard for digital HDTV has been signed by a group of satellite operators, broadcasters, manufacturers and regulators. The group, known as the European Launching Group for Digital Video Broadcasting project, comprises of 85 members including one Japanese electronics firm.

NTL and Eutelsat have completed joint tests to prove the viability of wideband satellite transponders for carrying both conventional analog FM television signals and the new digitally compressed TV signals of the NTL System 2000. A single Eutelsat transponder was shown to be able to carry simultaneously either a single FM channel and four digitally compressed channels or a total of eight digital channels at broadcast quality.

The compatibility, within one transponder, of a high power analog transmission and lower power digitally compressed signals means that operators can more easily migrate from analog to digital, with its attractive cost reductions. Eutelsat says that its wideband transponders are especially attractive since the premium for the additional bandwidth is much less than the extra cost of a whole transponder.

Radio

There are more than 100 radio channels on European satellites, using audio subcarriers, slowly approaching the number in North America.

Astra is a radio pioneer, with many interesting stations, both new channels and established international broadcasters. There are music stations, such as Sky Radio, Super Gold, and Quality Europe FM. Sunrise Radio is a commercial medium wave station in London for the Indian community there, now on satellite as well.

Radio Sweden is on the Sky Movies Gold transponder at 11.597 GHz, audio subcarrier 7.74 MHz. Our satellite schedule is also transmitted over the Tele-X direct broadcast satellite, using the TV4 transponder at 12.207 GHz, audio subcarrier 7.38 MHz. Radio Sweden is also part of the World Radio Network package of English language broadcasters on Astra.

Also on the Sky Movies Gold transponder (at 7.38 MHz) is Radio Asia, which broadcasts over Spectrum Radio in London. Spectrum's full schedule is to be broadcast over this channel in the near future.

Another shortwave broadcaster on Astra is Swiss Radio International, on the Teleclub transponder at 11.332 GHz, audio subcarrier 7.2 MHz. SRI is changing its programming to fit satellite broadcasts by April, 1994. SRI is planning to expand to four satellite channels, three relaying the national services in German, French, and Italian, complemented by SRI programs in those languages. The fourth would be a 24 hour English channel, consisting of a repeated and updated 2 hour program block.

According to one report, some British local ILR stations are to appear on the Discovery and Bravo transponders in the near future.

MTV reportedly may be planning to join up with the American network ABC in launching a pan-European radio channel.

List of Radio stations broadcasting from the ASTRA satellites

<i>Station</i>	<i>Frequency</i>	<i>Subcarrier(s)</i>	<i>TV station</i>
Deutsche Welle	11.229	7.38	RTL-Plus
Deutsche Welle	11.229	7.56	RTL-Plus
Deutschlandfunk	11.288	7.38/7.56	Sat. 1
Deutschlandf. Int.	11.288	7.74	Sat. 1
Deutschlandf. Int.	11.288	7.92	Sat. 1
Sky Radio	11.317	7.38/7.56	Sky One
Radio 538	11.317	7.74/7.92	Sky One
Swiss Radio Int.	11.332	7.20	Teleclub
Radio Eviva	11.332	7.74/7.92	Teleclub
Virgin 1215	11.376	7.38/7.56	Sky News
Super Gold	11.376	7.92	Sky News
RTL Radio 1	11.391	7.38/7.56	RTL-4
RTL Radio 2	11.391	7.74/7.92	RTL-4
Star*Sat Radio	11.406	7.38/7.56	Pro-7
Radio-Ropa	11.406	7.74/7.92	Pro-7
RMF	11.420	7.74/7.92	MTV-Europe
Quality Europe FM	11.435	7.38/7.56	Sky Movies
ASDA storecast FM	11.435	7.74	Sky Movies
MDR Sputnik	11.464	7.38/7.56	Premiere
Sunrise Radio	11.479	7.38	Movie Ch.
Holland-FM	11.479	7.56	Movie Ch.
Sudwestfunk 3	11.493	7.38/7.56	ARD
Q-CMR	11.509	7.38	Sky Sports
United Christian Broad.	11.509	7.56	Sky Sports
World Radio Network	11.538	7.74	MTV-Europe
BBC WS	11.553	7.38	UK Gold

BBC Radio 4	11.553	7.56	UK Gold
BBC Radio 1	11.553	7.74	UK Gold
BBC Radio 5	11.553	7.92	UK Gold
NDR 2	11.582	7.38/7.56	N3
NDR 4	11.582	7.74/7.92	N3
Radio Asia	11.597	7.38	Sky Gold
Radio Sweden	11.597	7.74	Sky Gold
CNN Radio	11.626	7.92	CNN
Cadena Principales	11.686	7.38	Cinermania
Cadena Dial	11.686	7.56	Cinermania
Cadena SER	11.686	7.74	Cinermania

The World Radio Network relays English language programs from a number of broadcasters. The current schedule (British local time) is:

00:00 NPR "All Things Considered" 01:30 Radio Netherlands 04:00 Radio Canada International 04:30 Vatican Radio 05:00 BBC "News Hour" and "Europe Today" 06:00 NPR "All Things Considered" 08:00 Radio Australia 09:00 Radio Korea 10:00 Radio Moscow 10:30 Radio Netherlands 11:30 Voice of Israel 12:00 Radio France International 13:00 NPR "Morning Edition" 15:00 Radio Finland 15:30 WRN info 16:00 Radio Australia 17:00 Radio Moscow 17:30 Radio Netherlands 18:30 Radio Telefis Eireann (Ireland) 19:00 NPR "Talk of the Nation" 21:00 RADIO SWEDEN 21:30 BBC "Europe Today" 22:00 NPR "All Things Considered"

The schedule varies slightly on weekends.

Astra apparently wants to use the 6.50 MHz audio subcarriers on the 1C satellite for digital radio or business data transmissions. Astra is also carrying out research into satellite radio broadcasting, to small antennas, without the need for a receiving dish. This would apparently be introduced with the upcoming Astra 1D and 1E satellites. Presumably this is DAB-Satellite, also called BSS-Sound, allocated frequencies by last year's World Administrative Radio Conference.

There are also a number of interesting radio stations on Eutelsat II-F1:

BBC WS	10.987	7.38	Super Channel
BBC External	10.987	7.56	Super Channel
France Info	11.080	7.02	TV5 Europe
France Inter	11.080	7.20	TV5 Europe
Radio Victor	11.080	7.38	TV5 Europe
Radio Free Europe	11.095	7.74/7.92/8.10	RTL-2
Deutsche Welle	11.163	7.02	Deutsche Welle
Deutsche Welle	11.163	7.20	Deutsche Welle
VOA Europe	11.163	7.38/7.56	Deutsche Welle
Deutsche Welle	11.163	7.74	Deutsche Welle
Radio Finland	11.163	8.10	Deutsche Welle
Bonn Rundfunk	11.163	8.28	Deutsche Welle

World Radio Network	11.554	7.74	MBC
Super FM	11.596	8.10	Interstar
Radio Contact	11.638	7.02	FilmNet Plus
Radio Contact	11.638	7.20	FilmNet Plus
Radio 10 Gold	11.678	7.92/8.10	FilmNet Plus
Digital Radio	12.542	digital	

Radio Free Europe uses separate audio subcarriers for news feeds in Czech, Baltic languages, and Polish. VOA Europe is now being carried digitally on Eutelsat II-F4. The analog relay on II-F1 will continue until the end of 1994. VOA Europe is also carried on Intelsat 601 at 27.5 degrees West, and Intelsat 505 at 66 degrees East. The service will also soon be available on Intersputnik 1 and 2.

The World Radio Network relays Vatican Radio in many languages and Radio Canada International in Russian. NPR relays were here before the Astra service began.

The digital radio channels are the following French stations: Europe 2, FIP, Fun Radio, Modulation France, Nostalgie, and NRJ.

The Swedish news agency TT has been heard on Swedish Radio since its pioneer days. TT is now making hourly newscasts available to community radio stations around Sweden, over Tele-X, using the TV5 Nordic transponder at 12.475 GHz, audio 7.56 MHz. Radio Sweden uses 7.38 MHz on the TV4 transponder. The Copenhagen local station The Voice is on 7.74/7.92 on the same transponder. Curiously, Radio Sweden and the Voice have appeared on the same audio subcarriers on the TV5 Nordic transponder, for no apparent reason. Some of Sweden's new commercial radio stations may be networked as well over Tele-X.

Other audio subcarriers can be found on:

DFS Kopernikus 3 (German channels, DSR) Eutelsat II-F3 (Morocco, Poland, Croatia, Hungary, Egypt and Tunisia) Eutelsat II-F2 (Spain, Portugal, Turkish, RL/RFE) Eutelsat II-F4 (Serbian) Intelsat 512, 515 (Norwegian channels) Telecom 2B, 2A, TDF-1/2 (French channels) TV-Sat (DSR as on Kopernikus 3) Intelsat 601 (BBC WS and British Forces Broadcasting) Hispasat (Spain)

Taiwan's Voice of Free China says that within the next couple of years they would be coming to Europe via satellite, through the help of Deutsche Welle.

Digital Radio on Satellite

Digital Satellite Radio (DSR) is a German-developed technology, providing CD quality satellite radio. Unfortunately DSR cannot be broadcast terrestrially, which means it will be replaced when Digital Audio Broadcasting (DAB) starts in the next couple of years. Currently 16 DSR channels in German are on DFS-3 Kopernikus at 23.5 degrees East on 12.625 GHz and on TV-Sat at 19.2 degrees West on 11.977 GHz.

A number of international broadcasters have taken part in tests of DSR on Eutelsat II-F3 (16 degrees East). Transponders 26 (11.078 GHz) and 34A (11.650 GHz) have been

used, and among the 8 channels are Voice of America, Radio France International, Deutsche Welle, and BBC World Service.

Two digital satellite radio services from the United States are expanding into Europe. Digital Music Express, or DMX, is already available to more than 10 million cable subscribers in the United States. Thirty themed channels of various types of music would be made available to European subscribers, without the need for DJs, jingles, or commercials. The 30 types of music would include:

US hottest hits, European hottest hits, contemporary jazz, classic jazz, country, big band, world beat, blues, reggae, golden oldies, heavy metal, classic rock, chamber music, and opera.

Signals are being relayed from DMX's Atlanta studios to a C-band transponder aboard Intelsat 601, before being cross-linked to a Ku-band transponder. Signals would be downlinked by cable operators.

DMX, has launched a new pan-European consumer marketing campaign, which will be initially run in the UK, Denmark and Norway before being rolled out throughout Europe as distribution contracts are signed with carriers. British Sky Broadcasting is reported to be close to signing an agreement with to relay DMX over Astra from June 1994.

The DMX decoder, manufactured by Scientific Atlanta, displays information on the music being played, such as the name of the artist, song and album title, composer, and chart position.

Another service called Digital Cable Radio currently provides 56 CD-quality radio channels to North American subscribers and cable systems. DCR plans to bring 68 themed radio channels to Europe, under the name Music Choice Europe. A number of cable operating and distribution agreements have already been signed in the Netherlands, Britain, and Switzerland, giving it a potential subscriber base in excess of three million homes.

Digital Audio Broadcasting, or DAB, will replace FM in the next few years. The World Administrative Radio Conference held in Spain in January, 1992 approved frequencies for satellite DAB, which would be receivable on small portable receivers. Various countries, including Sweden and Britain, have been conducting test broadcasts of DAB, prior to its expected introduction in 1995. The BBC used the Olympus satellite for DAB tests as well.

Other Non-Video Signals

We have had no reports yet of European SCPC. But a number of news agencies are using satellites to distribute their signals. BBC Monitoring is now subscribing to the Russian ITAR-TASS news agency, via a data link on Intelsat 601. The BBC will receive information from Moscow in English and Russian, replacing the previous intricate system of communications cables.

IV. Middle Eastern Satellite Broadcasting

The Middle East is an expanding area for satellite broadcasting, centering around the Arab League's Arabsat satellites and Turkey's broadcasts to Turkish emigrants in Western Europe and the newly independent countries of Central Asia.

Arabsat 1B is drifting eastward and has reached at least 43 degrees East. Both Arabsat 1B and 1C have 25 C-Band transponders, as well as one strong S-Band transponder around 2600 MHz. 1B has been used to relay programs from Morocco, Saudi Arabia, Oman, and Mauritania. One transponder has been used for Inter-Arab news, co-ordinated via Tunis.

Arabsat 1C (31 degrees East) is now the main Middle Eastern satellite, and includes:

MBC	2 560 GHz	PAL
Canal France International	3 811	PAL
CNN International	3 829	PAL
Libyan feeds	3 867	PAL
UAE TV1 Dubai	3 956	PAL
Saudi Arabia TV1	3 977	SECAM
RMT 1 Morocco	4 008	SECAM
UAE TV2 Dubai	4 033	PAL
Saudi Arabia TV2	4 051	SECAM
Oman TV	4 063	PAL
Mauritanian TV	4 081	SECAM
MBC	4 107	PAL
Jordanian TV	4 144	PAL
Egyptian Space Channel	4 164	PAL
KTS Kuwait	4 180	PAL

The Middle East Broadcasting Centre (MBC) is a London-based Arabic channel. Although it is Saudi-backed (the chairman is the brother-in-law of Saudi Arabia's King Fahd), the channel was briefly banned in Saudi Arabia for its bare-headed female announcers. Parallel transmissions continue to Europe on Eutelsat II-F1. The station is working together with the Saudi-financed Arab Network of America in the United States.

The MBC is to launch a package of three to six subscription channels for the Middle East in 1994. These would include a family channel, a general entertainment channel, and a movie channel. The current MBC Europe channel would become MBC1, a free service offering news and teasers for the other channels. NTL's digital compression system is to be used for the package, which would be carried on an Arabsat.

The Kuwait Satellite Channel carries a news bulletin in English at around 19:30 UTC. BBC World Service TV is planning on starting a 24 hour Arabic service to the Middle East from Arabsat in April, 1994.

The new Arabsat 1D at 20 degrees East has carried test signals on two transponders (3.760 and 3.840 GHz) for "ART - Arabic Radio and Television".

The Arab Space Communications Corporation has awarded a contract for two new Arabsats. The first would be launched in 1996. Besides 18 C-band channels, and 2 S-band channels, they would also carry 12 Ku-band transponders, making reception possible with 60 to 80 cm dishes.

Eutelsat II-F3 is the main satellite for broadcasts from Arabic countries to North Africa and Europe. Tunisia's first satellite channel, RTT (or TV7 Tunisie), is on 11.660 GHz. The new external service of Tunisian Radio is carried on the subcarrier at 7.02 MHz (7.20 also reported). English is heard at 13:00 hrs, German at 14:00 hrs, and French at 15:00 hrs. The international service, RTCI, broadcasts mainly in French.

Morocco's RTM is on 10.970 GHz, with sound in Arabic on 6.60 MHz, Berber on 7.20, and a multi-lingual service on 7.38. The RTM International service in Arabic uses 7.02, with RTM Morocco on 7.56.

The Egyptian Space Channel is on 11.178 GHz, with radio stations on 7.02, 7.20, and 7.38 MHz. The International Service Nile TV International, began low-powered test transmissions on 11.156 GHz on October 10, 1993. Initial broadcasts are between 17:00 and 19:00 hrs UTC, most in English. When the channel is officially launched there will be two hours in English and one hour in French daily.

Dubai launched its 24 hour "Emirates TV Dubai" satellite service to Europe, North and Central America on December 6, 1993. Most programming is in Arabic, but there are newscasts at 15:00 and 18:00 hrs British time in English. Broadcasts to Europe are on Eutelsat II-F1, while the Americas are reached through Galaxy 7.

Iraq is to launch the Iraq International Television station during the last quarter of this year. Broadcasts are to be to Europe and North Africa on Eutelsat and to the Middle East on Arabsat and another satellite known as "al-Jisr".

Arabsat 1D at 20 degrees East is to carry four Lebanese channels: Future on 3.787 GHz, and ART with a sports channel on 3.788, an entertainment channel on 3.844, and a children's channel on 3.626 GHz.

Intelsat 602 at 63 degrees East carries Iran's IRIB TV1 and TV2 on Ku-band 10.990 and 11.150 GHz, and the American AFRTS on 11.470 GHz.

Iran has announced it plans to broadcast six hours a day of television to Europe and Asia. According to the report "a number of satellites will be hired."

There are Turkish channels on several Eutelsats: TGRT and HBB are on II-F3. A-TV, Show-TV, and interStar are on II-F2. Kanal 6 and Kanal Market are on II-F4. The Turkish State Television's TRT International broadcasts to Europe on Eutelsat II-F1. There have been news bulletins in English and German following the Turkish news at 21:00 hrs European time.

TRT began satellite broadcasting 4 channels to Central Asia on April 1, 1992, using Ku-band transponders on Intelsat 604 at 60 degrees East (10.974, 11.138, 11.647, and 11.683 GHz). TRT hopes to reach as many as 57 million Turkic speakers in the 6 new Moslem states of the former Soviet Union.

Turkey's first 16 transponder Turksat is due to be launched on January 20, 1994, with a second satellite 6 to 12 months later. CNN has applied to lease a transponder on Turksat. According to reports, Turkey has also reached agreement to lease transponders to Kazakhstan, Azerbaijan, Kyrgyzstan, and Georgia. Presumably, the 5 TRT channels and the current 6 or more private Turkish broadcasters will also find homes on Turksat.

Israel broadcasts from Intelsat 512 on 11.015, 11.174, and 11.590 GHz. The domestic Radio Israel uses 7.20 MHz and the international service Kol Israel uses 7.38 and 7.56 MHz on the 11.590 GHz transponder. Israel's Amos DBS, carrying 6 or 7 Ku-Band transponders, is due to be launched, probably from French Guyana, in 1994.

V. African Satellite Broadcasting

In Africa, satellite broadcasting is expanding, particularly to South Africa. European satellites can be monitored in southern Africa, and there are even reports of reception of Astra (with a 4 meter dish)! An important satellite is Intelsat 601 at 27.5 degrees West. While European broadcasters use this satellite for Ku-band transmissions, C-band is used to Africa. Broadcasters include:

BBC World Service Television	3.650 Ghz	PAL
Deutsche Welle/WorldNet	3.743	PAL
Canal Horizons (French)	3.803	PAL
Canal France International	3.915	SECAM
Algerian TV	4.003	PAL
CNN International	4.048	PAL

The BBC is encrypted using the IRDETO system, requiring a decoder from the South African-based M-Net company, which shares the transponder with BBC. (This is in fact the same system used by the Dutch RTL-4 on Astra, but known there as Luxcrypt.)

Sky News was due to start 12 hours a day of broadcasts to South Africa, beginning October 3, 1993, using a relay from Intelsat.

The South African Broadcasting Corporation's external services have changed their name to Channel Africa. This includes both Radio RSA and a television service on the Intelsat 605 satellite at 24.5 degrees West, at 4.166 GHz. This consists of African news, information, and educational material in English and French, weekdays at 12:00-13:00 hrs for rebroadcast by stations in other parts of Africa. The SABC intends to move from the C-band to the Ku-band in 1994.

Intelsat 505 (66 degrees East) carries WorldNet/Deutsche Welle, as well as Zaire, South Africa's SAIS and Bop-TV, and France's Canal France International. Intelsat 602 (63 degrees) carries South Africa's M-Net and SABC.

The international French-speaking channel TV5 Afrique is now broadcasting to Africa via the former Soviet Ghorizont 12 at 40 degrees East (on 3.730 GHz). Besides TV5, Portugal's RTP International (3.930 GHz) is on this satellite. Unfortunately, Ghorizont 12 is in an inclined orbit, which means that Earth stations must be able to track the satellite as it drifts in a "figure eight" pattern.

M-Net and the South African Broadcasting Corporation have booked transponders on PAS-4, set to launch in March, 1995, for southern Africa's first direct to home broadcasting service.

The planned Afro-Caribbean Satellite Channel, which is to begin operations aimed at Europe, hopes to eventually reach the emerging cable systems of Africa. The American Black Entertainment Network also plans to expand into the African market.

VI. Asia and the Pacific

There are nearly 30 geostationary satellites in orbit above Asia and the Pacific. Five are former Soviet satellites, another five are from Intelsat. The Intelsat satellites provide a variety of C-Band services. Intelsat 508 at 180 degrees relays in C-band Australia's Nine Network and Network 10, as well as Japan's NHK, and the American CNN, ABC, CBS, NBC, ESPN, and WorldNet/Deutsche Welle. There's an RFO-France relay to Tahiti and WTN news feeds. In the Ku-band, there are transponders carrying Turner Broadcasting and Fuji TV.

Intelsat 505 (66 degrees East) carries WorldNet/Deutsche Welle, and several Chinese channels, as well as television from Malaysia. Intelsat 602 (63 degrees) carries two channels from Thailand.

Intelsat has relocated Intelsat 501 to 91.5 degrees East to provide expanded coverage to the Asia-Pacific countries.

On October 22, 1993 the first of the new 7th generation Intelsats, Intelsat 701, was launched by an Ariane rocket. The satellite will be used to provide services in the Asia-Pacific region from 174 degrees East. The satellite is the first of nine Intelsat 7's scheduled for launch before the end of 1995.

There are Ghorizonts at 80, 90, 96.5, and 103 degrees East. Each has 6 C-Band transponders, and the first three have experimental Ku-Band transponders as well (presumably on 11.525 GHz).

The Soviet satellite Ekran at 99 degrees East carries a transponder on UHF 714 MHz. This is between Japanese channels 53 and 54 and European channels 51 and 52, and is reported to be available all over Asia. This carries the Orbita service from Moscow. India's first state-wide cable network, Asianet in Kerala, has booked another Ekran transponder on 751 MHz (European UHF channel 56) to relay a program in Malayalam to systems around the state.

Star-TV

Asiasat-1, the first commercial satellite designed for Asian countries, was launched in April, 1990 by a Chinese Long March rocket. Located at 105.5 degrees East, it carries 24 C-Band transponders, half dedicated to a North Beam covering northern Asia, the rest to a South Beam covering southern Asia.

Here are the channels on Asiasat:

Mongolian TV	3.760	North beam	SECAM
Pakistan TV	3.780	South	PAL
Star TV Sport	3.800	North	NTSC
MTV Asia	3.840	North	NTSC
Star TV Sport	3.860	South	PAL
BBC WS TV Asia	3.880	North	NTSC
MTV Asia	3.900	South	PAL
Star Mandarin TV	3.920	North	NTSC
BBC WS TV Asia	3.940	South	PAL
Star TV Plus	3.960	North	NTSC
Zee TV	3.980	South	PAL
Yunnan TV	4.040	North	PAL
Star TV	4.060	South	PAL
CCTV-4	4.120	North	NTSC
Myanmar TV (Burma)	4.140	South	NTSC

The first pan-Asian satellite broadcaster, Star-TV, began broadcasts on Asiasat in August, 1991. It is owned by Hong Kong's Hutchvision, which became part of Rupert Murdoch's News Corporation media empire in 1993. Star-TV now reaches at least 1.8 million homes from Asiasat 1. It includes 6 channels, 4 on both beams (N/S):

- 1) Star-Sports (3.80 GHz/3.86 GHz)
- 2) MTV Asia (3.84 GHz/3.90 GHz)
- 3) BBC World Service Television (3.88 GHz/3.94 GHz)
- 4) Star TV (entertainment) (3.96 GHz/4.02 GHz)
- 5) Mandarin TV (3.92 GHz) NTSC
- 6) Zee TV (3.98 GHz) PAL

Zee TV is Star's Hindi language channel to South Asia. The Hong Kong authorities have also given permission for Star-TV to broadcast in Cantonese. This service will begin after the system's three year trial ends.

News Corporation is expected to begin new Star-TV pay channels. Star is offering four subscription channels to Hong Kong's first cable TV network: Star Asian Movie Channel, Star Movie Channel, Star Children's Channel, and the Asian News and Business Channel. Japan's Mitsui company, NBC in the United States and Pearson plc, owner of the "Financial Times", are behind the 24 hour Asian News and Business Channel. Presumably these channels will also be carried on Asiasat.

News Corporation has tried to terminate the BBC's 10 year contract (after only 2 years) claiming that the BBC's planned Arabic service from Arabsat would overlap with Star. The BBC has blocked the attempt, but it is possible News Corporation would like to carry its own Sky News instead.

At the annual meeting of News Corporation in October, 1993 Rupert Murdoch announced the splitting of Star-TV, into four divisions, one each for China, India, Indonesia and the Middle East.

Asiasat has signed a contract for an Asiasat-2, with an option for a further satellite. Asiasat-2 will have 40 C-band transponders, and 9 Ku-band transponders at 100.5 degrees East. It would be launched in March 1995, and would have an unprecedented footprint reaching from Tokyo to Berlin, and south to Australia.

British Telecom has booked 5 transponders, Australia's Nine Network another 10. Deutsche Welle also plans to use Asiasat-2.

Palapa

The main competition to the Star-TV service is on Indonesia's Palapa B2P satellite at 113 degrees East. CNN, ESPN, Home Box Office, the Australian Broadcasting Corporation, and Hong Kong's TVB have agreed to co-ordinate efforts to broadcast their programs on one satellite, initially B2P. CNN is on 3.840 GHz, ESPN on 4.042 GHz, both in B-MAC.

The Australia Television International service to Asia began on February 17, 1993 via Palapa B2P. The programs, which are hoped to reach 30 Asian-Pacific countries, include news reporting, special international topics, Asian-Pacific socio-cultural aspects, reports on scientific and technical developments, and education.

TVB, which has an enormous library of Chinese language films, has not yet begun transmissions on the satellite.

Asia's first business television channel began broadcasts on November 1, 1993 on the same satellite. Among the owners of Asia Business News are Dow Jones, the American cable giant TCI, Television New Zealand, and the Singapore Broadcasting Corporation.

Canal France International is also broadcasting over Palapa B2P on 3860 MHz. The network beams a variety of programs including news, features, films, debates, sports, and children's programs produced by the main French channels TF1, France 2 and France 3.

B2P also provides television for Thailand, Malaysia, and the Philippines as well as Indonesia.

Hughes Communications has signed an agreement to build a third generation of satellites for Indonesia, Palapa-C. The first two satellites will be delivered in July 1995 and January 1996, with an option for a third, which expires in 1999. Each satellite will carry 30 C-band and 4 Ku-band transponders, providing coverage through-out south-east Asia and parts of China and Australia. Arianespace has signed a contract to launch Palapa C1 in October 1995. It will replace Palapa B2P at 113 degrees East, and will have an expected life of 14 years.

China's commercial satellite launch service has signed a contract with Hong Kong's APT Satellite to launch the 24 transponder Apstar-1 satellite in June, 1994. The satellite will be made by Hughes, which will also make Apstar-2, due to be launched a year later. The Star rivals on Palapa B2P are to move to Apstar-1 after its launch.

These services hope to move in to the lucrative Chinese market, which may be difficult following the Chinese government's recent restrictions on satellite television.

Another potential broadcaster to China is Australia's state-owned multicultural broadcasting network, the Special Broadcasting Service or SBS. SBS is holding talks with potential Asian and North American partners to establish an international satellite television service in several languages with English subtitles. SBS currently broadcasts television and radio in 63 languages across Australia.

India

India began using the American ATS-6 satellite for rural education, the SITE experiment, in 1975. The first Insat satellite was launched in 1983. The most recent, Insat 2-A, is at 74 degrees East, and three regional Indian television channels have moved to it from ArahSAT. Tamil Nadu programs are on 4.115, Karnataka on 4.135, and Maharashtra on 4.175 GHz. Insat 2-B was launched in July, 1993, and placed at 93.5 degrees East. A new package of 5 channels, in an effort to compete with Star-TV, which has made tremendous inroads in India, was inaugurated on Indian Independence Day, August 15th.

A survey in January indicated that 3.3 million Indian homes were watching Star and Zee TV. Another survey revealed that satellite TV has reached 4 percent of India's half a million villages, where English-language soap operas are the most popular programming.

A group of non-resident Indian businessmen has started another Hindi-language channel, Asian TV Network, from Ghorizont 19 (96.5 degrees East), on 3.800 GHz.

India's first state-wide cable network, Asianet in Kerala, has booked a transponder on the Russian Ekran satellite at 99 degrees East on 751 MHz (European UHF channel 56) to relay a program in Malayalam to systems around the state. Other transponders may be booked on the (now dormant) Ekran satellites at 48, 64, 84, and 95 degrees East.

A new 9 channel satellite television service to India is to begin on January 1, 1994. The nine channels carried by the joint American-India network are to cover: religious and spiritual programming; politics; children's programming, entertainment, music and movies; sports; medicine, health, fitness and sex education; business and economy; and development, environment, and women's issues, science, and technology. Broadcasts are to be over two satellites, the Russian Statsionar 21 at 103 degrees East, and Asiasat.

The Insat 2-C satellite, to be launched in 1995, will bring Doordarshan programs to viewers in the Middle East and Asia. It will carry more than the eight transponders on 2-B, including Ku-band transponders.

Japan

Japan has been a pioneer in direct satellite broadcasting, as might be expected from its consumer electronics industry. The world's first direct broadcast satellite was Japan's BS-2. Its successors, BS-3A and BS-3B, are positioned at 110 degrees East. They each carry three 12 GHz transponders, and one wide-band data channel. Programs are provided by the Japanese public service broadcaster NHK and the commercial JSB.

BS-3B also broadcasts High Definition Television using the Japanese Hi-Vision system on 11.880 GHz.

On February 26, 1992 an Ariane rocket put into orbit Japan's Superbird B-1 at 162 degrees East. Superbird carries six new satellite TV stations, including CNN International and MTV. This satellite carries 19 Ku-band transponders and 10 Ka-band transponders, and can be received on 20-24 cm dish antennas.

Three television stations have started new satellite channels, bringing the number of Japanese satellite channels to 9. The three are SVN Space Vision (entertainment and sports), Let's Try Life Design (hobby and cultural programs), and Asahi Newstar (news and documentaries). At present there are only 58,000 satellite subscriptions in Japan, far short of the targeted 200,000. One reason for the sluggish demand is the high cost of equipment. Currently, antennas and receivers cost around 200,000 yen. New receivers, cheaper by tens of thousands of yen, will be marketed later this year.

BBC World Service Television also plans to broadcast its 24 hour news and information channel to Japan, together with Japanese partner the Nissho Iwai Corporation. While programs will be sold to terrestrial broadcasters in Japan, the service will also include direct to home broadcasts, presumably via Superbird, beginning in early 1994. Viewers will be able to choose between English and Japanese sound.

Other Japanese satellites are JCSat 1 and 2 (at 150 and 154 degrees respectively) each with 32 Ku-Band transponders. CS-3a (132 degrees) carries 2 C-Band and 10 Ka-Band (17.7-19.45 GHz) transponders.

Nihon Keizai Shimbun, Television Tokyo Channel 13 Limited and five sub-affiliates say that they will start broadcasting programs by satellite from 1997 using the BS-4 satellite, which is set to be launched in 1997. The satellite operator TXN will simulcast HDTV broadcasts alongside conventional broadcasts, and the service will be split between pay-TV services and advertising supported.

Other Asian Satellite Broadcasters

China's DFH2-A1 is at 87.5 degrees East and DFH2-A2 at 110.5 degrees. Each carries 4 C-band transponders.

China's CCTV-3 service has begun relays from the Chinasat-5 satellite at 115.5 degrees East, on 3720 MHz.

The Portuguese Marconi company has signed an agreement with China to deliver a satellite TV service to all of China and South East Asia, called Telesat. Based in Macao, Telesat would start in late 1994, and will offer what a Hong Kong newspaper called "European TV channels".

Taiwan's DPP political party is reported to be leasing four transponders on the American NASA's TDRSS satellite at 174 degrees West.

After reaching a compromise with Asiasat, Thailand's Thaicom 1 and Thaicom 2 satellites will be co-located at 78.5 degrees east. Thaicom 1 was launched by Ariane in December, 1993. The second satellite is to go into orbit by June, 1994. The satellites will cover South East Asia, eastern China, the Korean peninsula, and Japan. The two Hughes-built satellites will carry 12 transponders each, 10 C-band and 2 Ku-band.

The Pacific

Australia's 3 Aussats are located at 156, 160, and 164 degrees East. They provide television to the Australian Outback, New Zealand, and the Pacific, using B-MAC. Each satellites has 15 Ku-Band transponders in the 12.25-12.75 GHz range. They are being replaced by the new Optus B series.

Australia's Optus B1 satellite went into service on December 16, 1992. This satellite carries 15 Ku-band transponders, is at 160 degrees East. Australia is to use B1 and its follow-up B2 to carry a 6 channel subscription TV service, due to begin operation in early 1994. Unfortunately the B2 satellite was destroyed while being launched from China on December 14, 1992.

Moreover, the awarding of the pay-TV franchises has been called by "Satnews": "The biggest farce arguably in broadcasting history...Ever since the Australian government first announced that four channels could be broadcast by satellite aboard an Optus satellite, the whole affair has been dogged by errors, omissions and plain stupidity. This time two private companies with the same owners, and related to an unsuccessful previous bidder, have been granted the licences to broadcast...Only a few weeks ago two companies failed to come up with money pledged for the licences. Ucom Pty Limited and Hi Vision Limited paid significantly over the odds against over 50 rivals including seasoned veterans such as News Corp. to secure the licences."

A third licence has been reserved for the state-owned broadcasting company ABC.

Rupert Murdoch's News Corp. has joined forces with Australia's largest telephone company Telestra to form an alliance to exploit the Asian media market. The new venture will pursue interests and investments in activities such as pay television, home shopping and interactive services. Telestra and News Corp. have already taken a stake in Australian terrestrial broadcaster Seven Network Limited, and the Australian Broadcasting Authority is examining the deal for evidence of unfair competition.

There are many new Pacific satellite services being planned:

Panamsat, the company behind the trans-Atlantic satellite PAS-1, is preparing to reach the Pacific. PAS-2, to be launched in May, 1994, will cover the Pacific region from China and Japan to Western Canada.

Tonga has run into problems on two sides with its Rimsat project. Panamsat claims Tonga has booked too many orbital slots for such a small country, while Tonga claims that one of the Indonesian Palapa satellites is in the orbital slot for the first Tongasat. In 1992 Indonesia moved its Palapa B-1 satellite, in orbit since 1982, to 134 degrees East, a position claimed by Tonga, and registered with the International Frequency Registration Board.

Tongasat 1, a Russian Ghorizont satellite, was to be moved into that position on July 20, 1993. When diplomatic efforts to get Indonesia to leave the slot failed, Tonga threatened to move its satellite to one of Indonesia's existing orbital positions, switch it on, and cause tremendous havoc to Indonesia's satellite communications service.

In December, 1993, Indonesia announced the two countries had settled their dispute, although this was supposed to involve both sharing the orbital position, a questionable option. Tongasat plans to place Russian-launched satellites at 134 and 130 degrees. Five more Russian satellites are to be launched for Rimsat over the next few years.

When Tongasat 1 is in operation from its proper position, it is expected to provide coverage from Iran and India to Hawaii. Behind Tongasat are two American companies, Rimsat and Unicom, as well as Asian investors.

The American company TRW has filed to launch Pacificom 1 in 1994, to operate in both the Ku and C bands from 172 degrees East. The footprints would reach from the American West coast into Asia and Australasia. There would be 11 high-powered Ku band transponders for DBS services, along with 8 C-band transponders.

Pacific Satellite Company hopes to launch Paestar 1 into an orbital slot at 167.5 degrees East in late 1994. This will cover the US West Coast, Pacific islands, and East Asia.

New Zealand is also planning a satellite TV service across the Western Pacific and East Asia.

Asian and Pacific Satellite Radio

Japan launched the world's first nationwide digital radio system, using BS-3A. The broadcasts use pulse code modulation, or PCM, matching the quality of compact disks, and free from the usual radio hissing noises.

A Japanese company currently provides 440 cable radio channels. There are plans to expand the system to 1000 channels within 5 years, with the ultimate aim of 2000 channels. The offerings include the sounds of steam trains, roosters, cows, and ringing bells.

The American company Digital Music Express, DMX, planned to start in Australia during 1993. DMX services are relayed from the United States via satellite and then transmitted to customers using a microwave distribution system. A small roof-mounted antenna

would be used to receive the signals. Twenty audio channels would initially be offered, in addition to a special Australian channel.

VII. Global Satellite Channels

The war in Vietnam was called the first television war, with the pictures of violence and horror on American TV screens night after night contributing to the feelings that fed the growing peace movement. The conflict in the Gulf was the first live TV war, broadcast around the world by satellite, and underlining the arrival of the first global TV broadcaster, the Cable News Network, CNN.

Arthur C. Clarke, the English visionary who first proposed communications satellites in 1945, watched what he called "the first's first satellite war" from his home in Sri Lanka.

In an interview with Reuters, Clarke said communications is power, and the forces unleashed by satellites in the Gulf War have the potential for making the world a safer place. The further development of a satellite communications network with the wider availability of telephone, fax, and television, Clarke says, will make us one global family, whether we like it or not.

The conflict in the Gulf was also a boost for the BBC's long discussed plans for World Service Television, which became a reality on March 11th, 1991, taking over the existing BBC-TV Europe service on Intelsat VI-F4 (now Intelsat 601). In October, 1991 the 24 hour a day service to Asia via Asiasat began. An African service, also on Intelsat 601, began in May, 1992.

Beginning November, 1992 the Canadian Broadcasting Corporation and BBC World Service Television began exchanging daily news video. Under the terms of the deal, the CBC has exclusive Canadian rights to broadcast BBC WS TV's news, business, and weather reports. These are carried on the English and French domestic networks as well as the 24 hour cable news channel CBC Newsworld (which is carried scrambled on Anik E2, transponder 16). The service is being relayed uncoded to North America on Intelsat 601 at 27.5 degrees West, using the C-band transponder 4.

World Service Television is going ahead with plans to start a bilingual service to Japan and a 24 hour service in Arabic to the Middle East via Arabsat. Future plans are to expand into the United States, the Pacific and Latin America.

What seems to be becoming the third global broadcaster, and the only competition to CNN and BBC World Service, is Rupert Murdoch's News Corporation, which owns British Sky Broadcasting in Europe, Fox Broadcasting in North America, Star-TV in Asia, and is branching out into Africa and South America. In a speech to Sky advertisers in London, Murdoch announced "Plans are well advanced to take Sky News, or a parallel service, to all continents of the world, where we will be seeking local partners, both national and regional."

Murdoch's News International has contracted NTL to join a group developing a multi-channel digital TV system for direct satellite reception in the home. NTL will develop

the encoding, decoding and multiplexing technology. The eventual domestic receiver will be mass-produced under licence for the consumer market in Europe, Asia and elsewhere.

Deutsche Welle has also become a global broadcaster, working with the United States Information Agency's World Net in sharing many transponders. Besides broadcasts to Europe on Eutelsat II-F1, Deutsche Welle is using the Intelsat-K satellite to reach North America. The signal is then relayed on Spacenet 2 transponder 3, and Satcom C4 transponder 5.

Deutsche Welle is also relayed to Africa on Intelsat 601 at 27.5 degrees West at 3.745 GHz. Africa, Asia, and the Pacific are covered by transmissions on Intelsat 505 at 66 degrees East at 4.177 GHz. Finally, Deutsche Welle is also transmitting to the Far East and Pacific on Intelsat 508 at 180 degrees East on 3.993 GHz.

Deutsche Welle's Waldemar Krmer has told Radio Sweden: "In the middle or end of 1994 we'll begin broadcasting on Asiasat-2, and we'll then cover the world from Eastern Europe to East Asia. There are plans to reach Africa as well. Currently we can be seen for two hours a day in North Africa, using transponders leased by the American WorldNet."

It was announced at the Internationale Funkausstellung in Berlin on August 30th that Deutsche Welle TV will be expanding from 16 to 24 hour a day service from 1994.

Another global broadcaster in the making is the French-language TV5, which has been broadcasting to Europe on Eutelsat I-F1 on 11.080 GHz, and to North America on Anik E1 transponder 17. TV5 Afrique launched on September 30, 1992 via Ghorizont 12 at 40 degrees East. TV5 plans to expand to Latin America using Panamsat-1.

TV5 carries programs from France (TF1, France 2 and 3), Belgium (RTBF), Switzerland (SSR), and Quebec (Radio Canada). France also transmits its Canal France International to Africa on Intelsats 601 and 505, to the Middle East on Arabsat 1C, and to East Asia on Palapa B2P.

The Arab world's MBC, which owns the international news agency UPI, broadcasts to the Middle East and North Africa on Arabsat, to Europe on Eutelsat, and is working with the Arab Network of North America.

International Radio Broadcasting By Satellite

While the BBC, Radio France, and Deutsche Welle can put out 24 hour services in their native languages by satellite, services which can be relayed over cable networks, it's much harder for small broadcasters. Both Radio Sweden and Swiss Radio International now have satellite channels. But what cable system would relay them, each with a series of programs in varying languages?

One possibility is for many international broadcasters to share several satellite radio channels, one for English, one for French, one for German, etc. Cable operators in Britain, for example, could offer one channel with alternating English programs, say from Sweden, the Netherlands, Switzerland, Germany, Austria, and so on.

This is what is being pioneered by the World Radio Network with its WRN1 service in English on Astra, which began in September, 1993. If the effort is a success, services in other languages will follow.

There are some other options farther into the future, such as Digital Audio Broadcasting (DAB) by satellite, also called BSS-Sound. This would provide high quality radio reception to portable receivers. BSS-Sound was approved by the World Administrative Radio Conference held in Torremolinos, Spain during February, 1992.

The conference agreed that 1.5 GHz was the most technically suitable frequency range, as it offers best reception for portable receivers, without interference from the terrain or buildings. Small whip antennas can be used and the satellites will be cheaper to build.

However, politically many countries could not agree, one of the reasons being that their existing users at 1.5 GHz in some cases include the military. The conference reached absolute deadlock on this subject, and it was only in its very last stages that a compromise was drawn up. This provided the world with three separate allocations for BSS-Sound. One is at 1.5 GHz—with a small portion of the band available immediately, another allocation at 2.6 GHz, and a separate band for the US at 2.3 GHz. The result is that digital satellite radio is now just around the corner. Provided, of course, satellites are built and receivers brought on to the market.

Worldspace, based in Washington, DC, plans a service called Afrispace, which would broadcast 9 digital radio channels to Africa and the Middle East. The planned portable receivers are expected to cost around USD 100 each. Afristar 1 would be located at 12 degrees West, and Afrispace hopes to be operating by late 1994. Radio Netherlands has already signed a contract with Afrispace to broadcast 24 hours a day to Africa and the Middle East.

An American company called the International Radio Satellite Corporation, or RadioSat, has announced plans to create a worldwide direct broadcast satellite service for international broadcasters. RadioSat plans to launch three high-powered satellites, each with more than 200 channels to be leased to international broadcasting organizations. RadioSat says the VOA, BBC World Service, Radio Moscow and 5 other broadcasters have expressed interest. RadioSat hopes to launch the first of its three spacecraft in 1995.

PART II. WEATHER AND OTHER "UTILITY" SATELLITES

If TVRO is the satellite version of shortwave broadcast DXing, then these satellites provide the equivalent of utility monitoring and scanning. The equipment required can be much less elaborate and much less expensive than for TVRO. On the other hand, transmissions may be less comprehensible, without the necessary expensive or unobtainable equipment for decoding.

1. Wefax

WEFAX or Weather Facsimile, is the method used to transmit photographs and weather satellite maps via radio and telephone lines. The satellite version is known as APT. There are many low orbit weather satellites using this system in the 136-138 MHz band.

Some of the active satellites that can be monitored are the American NOAA and the former Soviet Meteors:

NOAA beacons	136.770 MHz	
Meteor 3-3, 3-4 and 3-5	137.300 MHz	APT
NOAA 10 and 12	137.500 MHz	APT
NOAA 9 and 11	137.620 MHz	APT
NOAA beacons	137.770 Mhz	
Meteor 2-21	137.850 MHz	APT

Meteor 2-21 is a new satellite, launched on August 31, 1993. Meteors 3-4 and 3-5 are currently not transmitting. Meteor 3-6 is to be launched soon. NOAA 13 was launched on August 9, 1993. Unfortunately, contact with the satellite was lost on August 21, 1993. The launch of NOAA 14 has been moved up to early 1994. China has orbited several polar orbiting WEFAX satellites in its Fengyun-1 series. None are currently operational, but the frequencies used are 137.06, 137.80, and 137.795 MHz.

The satellite APT provides a continuous strip of image as the satellites circle the globe in polar orbit. The NOAAs orbit at around 800 kilometers, while Meteors are in a higher orbit at around 1200 kilometers. This means that NOAA satellites pass overhead at the same time every day (for example NOAA 11 passes over Britain travelling northbound at around 15:30 hrs UTC and southbound at around 03:00 hrs). Meteors, on the other hand, because of the higher altitude, tend to arrive earlier each day by 10 to 20 minutes. NOAAs provide both visible and infrared images (and can be monitored during darkness), while the Meteors are more irregular in providing infrared images.

The satellites are quite strong, and can be heard on simple scanners and antennas. However, since the bandwidth of the APT signal is wider than the narrowband FM bandwidth of ordinary scanners, which is around 15 to 35 kHz. The best images are received with receivers having an IF bandwidth of 45 kHz. Dedicated WEFAX receivers are sold by a number of companies, including Vanguard Labs and Hamtronics in the US and Timestep in the UK. For those who find a dedicated receiver too expensive, Software Systems Consulting in the US sells a specially modified scanner for around USD 150.

It is possible to obtain images using an ordinary scanner or receiver, such as the ICOM R7000, although the detail will be less clear.

Small non-directional antennas, such as ground planes, discones, or active antennas are usually all that are required to receive satellites in low orbit. The satellites are so strong that even a quarter length whip for the amateur 145 MHz band will result in clear reception.

The best antenna to receive polar orbiting satellites, however, is a crossed dipole or turnstile cut specifically for 137 MHz. It's important that the antenna be omnidirectional, but also have a high angle of elevation, to receive signals from satellites passing overhead. Most scanner and amateur radio antennas are designed to have a low angle of elevation, to boost reception of terrestrial signals. Crossed dipoles can be built fairly easily (there are plans in the *Weather Satellite Handbook* and the *PC GOES/WEFAX User's Reference Manual*, for example). There are also a number of commercially available antennas.

Other omnidirectional antennas that work well with polar orbiting satellites include the linblad, quadrifilar helix, and the vertical helix. It's advantageous to use low-loss cable, and a preamplifier, usually mounted at the antenna end of the cable. Tuned amplifiers, such as those used for the amateur radio 2 meter band, work much better than broadband amplifiers, which do have the advantage of being much less expensive. Do not use a broadband amplifier with a broadband scanner or discone antenna.

To interpret the satellite signals and view the images, computers and special interfaces are necessary. These are available from the same vendors who sell receivers, as well as many others. Check out articles and advertisements in such magazines as "Monitoring Times" and "Popular Communications" in the US and "Shortwave Magazine" in Britain. Note that many interfaces are solely for reception of HF Wefax from short-wave. These will NOT work with satellite APT. We've tested the PC GOES/WEFAX demodulator for MS-DOS computers from Software Systems Consulting. It seems to work very well.

Most of the available software is for MS-DOS computers, although there are interfaces and software for other machines, such as the BBC Micro and Sinclair Spectrum. In most cases the interface is connected to an available serial port on the computer, and to the headphone or external speaker jack of the receiver. Some receivers have separate line output jacks, but the levels there are usually too low.

It can be useful to plug a "Y" cable into the headphone jack, with one end connected to the interface and the other to a small speaker (preferably with its own volume control), so that the monitor can listen to the channel at the same time that it is permanently connected to the interface. (Cable, small speakers, and even cables with built-in volume controls can be found at suppliers such as Radio Shack/Tandy.)

Unlike geostationary satellites, the polar orbiting satellites move. While it can be interesting to tune in from time to time, or remember when the daily passes of the NOAA satellite occur, the easiest way to know when to look for the satellites is with a satellite tracking program. Some interface software, such as PC GOES/WEFAX, come with tracking programs included. There are a number of programs for amateur radio satellite tracking available that work very well with WEFAX satellites. Some are public domain or shareware, and can be found in BBS's or in data libraries in online systems such as CompuServe. Others are available through AMSAT in various countries.

II. Geostationary Weather Satellites

Geostationary satellites provide 24 hour WEFAX transmissions from a single position in the sky. No tracking or waiting for a satellite to come in range is required, but the greater distance and higher frequencies require more expensive equipment than that required to monitor polar orbiting satellites.

The currently operational geostationary weather satellites are:

Meteosat-4	0 degrees
Meteosat-5	8 degrees West
Meteosat-3	75 degrees
GOES-6	75 degrees
GOES-7	112 degrees
GOES-2	135 degrees
GOES-3	176 degrees
GMS-4	140 degrees East

The American geostationary GOES satellites downlink on 1691 MHz, while the European Space Agency's Meteosats use 1694.5 MHz. Other Meteosat frequencies include 1695.73 and 1695.76 MHz. Meteosat-3 was originally positioned at 50 degrees West longitude, but in early 1993 it was moved to 75 degrees West, to cover for the failure of a GOES satellite. When the system is fully operational, there should be GOES satellites at 59, 112, and 135 degrees West. Meteosat-4 is at 0 degrees longitude. Meteosat-5 is positioned nearby, and would have replaced Meteosat-4 but suffered from imaging faults. The satellite has now been reactivated and is scheduled to replace Meteosat-3 at 75 degrees West in early 1994. The Japanese GMS-4 is at 140 degrees East.

Meteosat-6 was launched from French Guiana on November 19, 1993. It is to replace Meteosat-4 at the end of January, 1994.

China is scheduled to launch its FENGYUN-2A satellite into geostationary orbit on February 23, 1994. This will be positioned at 105 degrees East. To receive geostationary satellites, it is often easiest to build upon a receiving station for polar orbiting satellites. A sensitive antenna for 1690 MHz is required, usually a dish of around 1 meter or one or more stacked looped yagis. To this is connected a block down converter and preamplifier, which converts the signal from 1690 MHz down to 137 MHz. This is important because cable absorbs more energy at 1690 MHz than at 137 MHz.

The GOES and Meteosat satellites use the same APT format as found on the polar orbiting satellites. They also supply higher quality PDUS and HRPT images, which require specialized receiving equipment, which is also available. The GMS satellites use a wide band FM format that is incompatible with APT. They use a frequency deviation of 150 kHz, which requires receivers with that bandwidth.

The European Space Agency plans to launch a new Meteosat in late 1993 and NOAA has scheduled launches of new GOES satellites in April, 1994 and in 1995. Meteosat, operat-

ed by the European Space Agency on behalf of the European Meteorological Office, will be undergoing in-flight tests before it enters service at 0 degrees longitude at the end of January 1994. Tests will be conducted while the satellite drifts from its current orbital position at 19 degrees west.

The first on-board test images will be relayed back towards the end of this week.

Once operational Meteosat 6 will replace Meteosat 4, which will become a back up satellite. Meteosat 5 will then be drifted to cover the Americas to replace Meteosat 3, presently on loan to the US Weather Service — NOAA — which has suffered the loss of many of its satellites (Satnews passim). Meteosat only has a lifespan of a few months left.

Meteosat 7 and 8 are scheduled to be launched by the end of 1995, just before Eumetsat takes over all the operation off Meteosat satellites from ESA.

III. Other "Utility" Satellites

There are many other satellites using the 136-138 MHz band. Many use narrow band FM to transmit their telemetry. Britain's Prospeo satellite is on 137.56 MHz. Temisat transmits on 137.72 MHz. Japan's Marine Observation Satellites MOS 1 and 1B can be heard on 136.11 MHz. India's Bhaskara 1 (137.230 MHz) and 2 (137.380 MHz) also use narrow band FM. A Transit navigational satellite can be heard on 136.65 MHz. Sweden's Freja-1 auroral research satellite uses 137.50 MHz, a frequency generally used by the NOAA satellites.

Other satellites monitored in this band in the past include NASA's ATS-3 (136.37), Transit (136.65), IUE (136.86), Marecs A/B (137.17), Okean (137.4), and Intercosmos (137.45). There have been, and will be, many other satellites in this band.

Other interesting satellites on nearby frequencies include the American Hilat (149.988 MHz narrow band FM) and Geosat (150.015 and 400 MHz CW).

The American Transit and former Soviet CosNav satellites provide navigational data to ships and submarines. They transmit simultaneously on two frequencies:

Channel 1—149.910 and 399.762 MHz Channel 2—149.940 and 399.842 MHz
Channel 3—149.970 and 399.922 MHz Channel 4—150.000 and 400.200 MHz
Channel 5—150.030 and 400.082 MHz

The CosNavs may also use 148.91 and 388.84 MHz.

Scientific and research satellites use the following bands: 400-402 MHz, 1400-1429 MHz, and 2655-2700 MHz.

Sweden's Freja-1 research satellite, investigating the Northern Lights, has a beacon on 400.55 MHz. Other satellites monitored around 400 MHz include DOD (401-401.5) and DCS (401.5-403). Various DOD satellites are listed using the band between 406 and 425 MHz.

Maritime are geo-stationary satellites carrying transponders for maritime mobile and aeronautical communications. Maritime Mobile use 1535-1543 MHz downlinks while Aero Mobile uses 1458-1542 MHz for downlinks.

The American Landsat operates around 2 GHz, as do the Franco-Swedish Spot photo satellites.

The Global Positioning System (GPS) is a new American system that will eventually include 24 Navstar satellites in a 55 degree inclined orbit at 20 to 200 kilometers above the Earth. These provide accurate longitude, latitude, and altitude information to hand-held units that monitor 3 to 4 satellites. They use spread spectrum transmissions around 1575.42 MHz. Besides the commercial version, which provides accuracy to around 100 meters, there is a more accurate military system which was used by American Army Intelligence during the Gulf War. This uses an additional signal on around 1227.6 MHz to compensate for various delays between the satellites and the receiver.

Although GPS satellites don't transmit a signal that can be listened to in a traditional sense, the status of the entire system can be monitored on a shortwave receiver. WWV transmits an update the system every 14 minutes on 2.5, 5, 10, 15, and 20 MHz.

The similar former Soviet GLONASS (Global Navigation Satellite Systems) system uses 1250, 1597, 1603, and 1617 MHz. There are to be 24 GLONASS satellites in orbit.

PART III. Amateur Radio in Space

Besides governments and corporations, radio amateurs have also launched many satellites. The first communications satellite was in fact the Moon, which radio amateurs bounced have bounced signals off for years. In 1960 a group of radio amateurs in the United States formed the Project Oscar ("Orbiting Satellite Carrying Amateur Radio") Association to design and build satellites for use in the amateur radio bands.

Oscar was succeeded by the Amateur Satellite Corporation (AMSAT) in 1969. There are national AMSAT societies in many countries, and the international headquarters is in Washington, DC.

Amateur Radio Satellites:

<i>Satellite</i>	<i>Orbit</i>	<i>Beacon or Downlink</i>	<i>Modes/Comments</i>
<i>Oscar 10</i>	elliptical	145.810/145.987MHz	
<i>Oscar 11</i>	circular	145.826/435.025	
<i>RS 10/11</i>	circular	29.357/408	RS-10 CW 145.857/903 " 29.407/453 RS-11 CW 145.907/953
<i>Oscar 13</i>	elliptical	145.812/435.651	
<i>JO-14</i>	circular	435.070	
<i>PO-16</i>	circular	437.02625/437.0513	
<i>DO-17</i>	circular	145.825	voice synth.

WO-18	circular	437.0751/437.102	slowscan TV
LO-19	circular	437.1258/437.15355	packet BBS
FO-20	circular	435.795/435.910	packet BBS
AO-21		145.987	FM packet dnlk
		145.800/819/838/948	beacons
UO-22	circular	435.120(see below)	packet BBS
RS-12/13	circular	29.408/454	
RS-12	CW	145.912/959	
	"	29.458/504	
RS-13	CW	145.862/908	"
KO-23	circular	435.175	packet BBS
AO-24	elliptical	2446.47	2 meter failure
KO-25	circular	435.175/500	packet BBS
IO-26	circular	435.867/822	packet and voice
AO-27	circular	436.800	packet and FM
PO-28	circular	435.250/435.275	occasional

The easiest way to get started in amateur satellite monitoring is to listen to the RS satellites in the 10 and 15 meter bands on an ordinary shortwave receiver. Radio amateurs with a shortwave receiver and a 2 meter transmitter (even a handheld) can work the RS satellites. An ordinary longwire antenna is all that is needed for shortwave, and simple quarter wavelength 2 meter whips will do for transmitting.

Most users use more sophisticated equipment. Omnidirectional antennas will work the satellites in low earth orbit, although most active users prefer directional gain antennas, such as crossed yagis, on a motorised rotor run from a satellite tracking program.

Tracking programs are vital for finding amateur radio satellites. Some are public domain or shareware, and can be found in BBS's or in data libraries in online systems such as CompuServe. Others are available through AMSAT in various countries. We've tested one of the best programs for the MS-DOS computers, RealTrak, which is highly recommended. The more sophisticated programs can interface with antenna rotors.

Most amateur radio satellites use some kind of digital packet radio mode. Terrestrial packet radio operators can move up to satellite operation fairly easily, although a variety of packet modes are used, and new modems to connect to existing TNCs will be needed in most cases. Conventional packet radio uses a system known as AFSK (Audio Frequency Phase Shift Keyed) modulation. This was used by some earlier satellites, such as UO-11, and is used by Dove. UO-11 uses an older ASCII system, AMSAT-TTY, similar to Bell 202, but at 1200 baud.

Because of the Doppler Effect (frequency shift from high speed), satellite packet generally uses a different system called PSK (Phase Shift Keyed) modulation. AO-13 and 21 use a system with 400 baud ASCII. The first "microsats" (AO-16, WO-18, LO-19, FO-20, and AO-21) use a 1200 baud system where the uplink is Manchester coded AFSK (FM), while the downlink is BPSK (SSB). UO-22, KO-23 and 25, and PO-28 use what may be the amateur satellite of the future, FSK (FM) at 9600 baud. Some of the second generation

"microsats", AO-27 and IO-26, are more flexible, with up and downlinks at varying speeds up to 9600 baud.

Oscar 10 and 13 have elliptical orbits, which mean that they tend to "hover" over the Northern Hemisphere, making for long periods for contacts with little adjustment needed in tracking antennas. However, they require antennas with higher gain than those used for the circular orbit satellites.

The former Soviet RS-10/11 and RS-12/13 are each two separate packages on the same satellite. UO-14 (UoSat-3), PO-16 (PacSat), DO-17 (Dove), WO-18 (WeberSat), LO-19 (LuSat) are known as "microsats" because of their small size. They were launched together with an Ariane rocket in January, 1990.

UO-14 was made by the University of Surrey in Britain. UO-15, launched with UO-14, stopped transmitting the day after launch. Owned by Volunteers in Technical Assistance, UO-14 carries a packet radio BBS, which is used to transmit free medical information to universities in East Africa. The service, known as HealthNet, is operated by an organization called Satel-Life. Health-Net transmissions use packet radio at 9600 baud, with downlinks on 428.01 and 429.985 MHz.

PO-16 was built by AMSAT-North America, and LO-19 by AMSAT Argentina. They contain PSK packet radio BBS's. Dove is a Brazilian-made "peace satellite". It has a voice synthesizer and also transmits standard packet AFSK-FM on 145.825 MHz. WO-18 was built by Weber State University in Utah. It contains an onboard camera that downlinks its pictures by packet radio. The Japanese JO-20 also carries a packet BBS, with similar up and downlink frequencies to PO-16 and UO-19.

The French satellite SARA is an amateur astronomy satellite, with a beacon on 145.955 MHz. Its use of an amateur radio frequency is controversial, and probably illegal.

South Korea's KO-23 downlinks ordinary packet radio at 9600 baud on 435.175 MHz. The satellite can also photograph the Earth and measure cosmic rays. It carries an amateur radio electronic mail system, and will conduct experiments in voice broadcasting. It's described as a near clone of UO-14 and UO-22. KITSAT-B (KO-25), launched with the second set of microsats on September 5, 1993, is virtually identical, as is the amateur radio part of Portugal's PoSat (PO-26), launched at the same time.

The Kitsats are in near circular orbit 1300 kilometers from the Earth, with an inclination of 66 degrees, which make them available to users much farther to the north and to the south than most amateur radio satellites.

Arsene, launched with Astra 1C in May, 1993, orbits over the equator. It's farthest distance from the Earth is 37,000 kilometers, just about the same distance as geostationary satellites, but since it gets as close as 17,500 kilometers, it appears to slowly drift from west to east. The high orbit means access time of nearly 20 hours a day. ARSENE was supposed to function as a packet radio repeater in the sky, relaying

AFSK packet down to Earth. However, the 2 meter equipment has failed, and the satellite can only be worked on voice in S mode with a downlink on 2446.54 MHz. There is also a beacon on 2446.47 MHz. The Italian amateur radio satellite IO-28 (Itamsat) downlinks voice FM as well as ordinary AFSK packet at 1200 baud and PSK at 1200 and 9600 baud. Uplinks can vary between 1200, 4800, and 9600 baud. The American commercial satellite Amrad (AO-27) will sometimes relay digital (300-9600 baud) and FM voice amateur radio signals.

There are plans for many more amateur radio satellites. UNAMSAT from Mexico and RS-15 from Russia are awaiting launch. UNAMSAT will carry a packet PSK BBS, with a downlink on 437.200 MHz. CESat-1 from Chile, SUNSAT from South Africa, Finland's HUTSAT, the American Sedsat, and Guerwin-1 from Israel are under construction. Guerwin will probably be a packet PSK BBS, with a downlink around 435.250 MHz.

Radio amateurs are particularly looking forward to the Phase 3-D satellite, a follow-up to the aging Oscars 10 and 13. Phase 3-D will carry a matrix of separate transmitters and receivers that can be linked together, rather than discrete transponders. The satellite will carry equipment for 145 and 435 MHz, as well as 1.2, 2.4, 5.6, and 10 GHz.

Phase 3-D will cost around USD 5 million, as much as a geostationary satellite. Many radio amateurs are looking forward to the day when there will be geostationary amateur radio satellites, what is called Phase 4. But AMSAT has decided to go ahead with Phase 3-D, because a single geostationary satellite would only benefit one third of the world's amateur radio population. Three would be needed to provide communications for radio amateurs everywhere. But we can look forward to the day when radio amateurs will have access to 24 hour communications, without the bother of tracking programs and rotors to complicate things.

Then there's Northern California's Project Oscar, which orbited the first amateur radio satellite, which has now proposed installing the first repeater on the Moon. The group hopes to get "Project Moonray" off the ground by the turn of the century.

Part IV. MONITORING THE SPACE SHUTTLE, MIR, AND THE MILITARY

1. The Space Shuttle and MIR

Space shuttle communications have been relayed on shortwave from a number of amateur radio clubs at NASA bases. These are in single side band (SSB), and the frequencies to look for are 3862, 7185, 14295, 21395, and 28650 kHz from WA3NAN at the Goddard Space Flight Center in Maryland; 3840, 14280, 21350, and 28495 kHz from the Johnson Space Center in Texas; and 3840 and 21280 kHz from the Jet Propulsion Laboratory in California.

Here are some reported frequencies connected with the shuttle missions:

Shortwave (SSB):

Western Test Range	5700 kHz 13218
Eastern Test Range	5190
NASA Tracking Ships	5180 5187
Launch Support Ships	11104 19303
NASA Kennedy Operations	7675
USAF Cape Radio	6837 6896 11414 11548 19640 23413
Shuttle-Mission Control	11201
NASA Ascension Island tracking	20186
NASA CB Radios	27065

VHF/UHF (AM):

Military aircraft emergency frequency	243.0
MHz Primary shuttle communications	259.7
Shuttle space suits	279.0
Primary UHF downlink	296.0
Air-to-ground or orbiter-to-suit	296.8

S-Band (Wideband FM) via TDRS satellites:

NASA downlink	2205.0 MHz 2217.5 2250.0 2287.5
Primary digital downlink	2287.5

North American satellite TV monitors can watch live video from the shuttle missions via NASA Select on Satcom 2R transponder 13. A voice TV schedule update can be heard by calling American telephone number 1-202-755-1788. Missions with German astronauts may be relayed on one of the Kopernikus satellites to Europe. Space launches may also be carried on Intelsat 504 at 31.4 degrees West, on 11.133 GHz.

Amateur Radio on the Shuttle

There have been many amateur radio operations from the shuttles, known as SAREX (Shuttle Amateur Radio Experiment). The first was Dr. Owen Garriott, W5LFL, from "Columbia" in 1985. He was heard by tens of thousands of listeners and made two way contact with some 350 stations using FM with a downlink on 145.55 MHz.

With the resumption of shuttle missions after the "Challenger" crash, amateur radio operations have resumed as well, with both FM voice and packet radio. Unfortunately most shuttle flights maintain an orbital inclination of 28 degrees, which restricts radio contacts to stations within around 30 degrees of the Equator. Occasional missions use a greater inclination, up to 57 degrees, which make it possible for many more people to listen to and contact the shuttle.

STS-37, on "Atlantis" in April, 1991, was particularly noteworthy, as all five crew members were licensed radio amateurs. There were hundreds of contacts with amateur radio operators on Earth. While a problem curtailed packet radio and slowscan television operation, the first television picture ever received on board a spacecraft was carried out using fast scan television. The Atlantis crew was also able to hear the Soviet cosmonauts on MIR, but were unable to complete two way communications.

The entire crew of STS-45, in March, 1992, were also radio amateurs. At least nine of the current astronauts have amateur radio licenses, which means that virtually every launch will have an amateur onboard. The usual downlink frequency is 145.55 MHz.

MIR

The former Soviet MIR space station can easily be heard with its powerful FM signals on 143.625 MHz, but this channel is now only being used over Europe, when the station is in range of the ground station in the Crimea. Funding cuts dictated that the communications ships off Sable Island, Madeira, etc., which were relaying MIR by shortwave, are no longer operational.

Voice communications have also been reported on 143.42 and 142.42 MHz, as well as a beacon on 121.75 MHz. Data communications from MIR have been heard on 166.130 (or possibly 165.875) MHz. Other frequencies reported from the former Soviet space program are:

Soyuz T-11 space vehicle telemetry	20008
Soyuz T-11 voice communications	142.423 MHz
Soyuz TM-3 and TM-4	121.750
Progress 7 supply ship	166.000

When out of range of the CIS ground stations, MIR communications are now often relayed through the "Luch" or "Altair" transponder systems of CIS geostationary satellites. The Soviet satellite tracking network is called SDRN, the Satellite Data Relay Network. Downlinks are on 10.8, 11.3, and 13.7 GHz. The relay most used over Europe is via the satellite at 16 degrees West listed as ZSSRT-2 (an abbreviation of the Russian words "Zemlya S Sputnik Radio Translator", meaning "Western geostationary satellite transponder"). There is also an eastern relay at 167 degrees East.

The SECAM color signals from MIR are listed at 10.835 GHz, but are actually carried at 10.829 GHz (unfortunately just below the range of most satellite TVRO receivers). Monitors can look for the satellite by tuning in to the strong data signals on 11.375 GHz, which can often be seen as flashing lines on the screen. Voice signals from MIR can be heard near the TV frequency, on a 300 kHz SSB subcarrier, but only when no TV signals are being relayed.

MIR video has also been reported on the Ghorizont at 11 degrees West, on 11.525 GHz.

The Molniya satellites are also used for relaying manned space voice communications.

Amateur Radio on MIR

Several MIR cosmonauts have been radio amateurs. In 1988 amateur radio stations U1MIR, U2MIR, and U3MIR operated on 145.550 and 145.400 MHz FM. Musa, U2MIR, was on the air frequently in 1990 and 1991.

Britain's first astronaut, Helen Sharman, spent 8 days on MIR in May, 1991. She operated the amateur radio station there, under the call sign GB1MIR. Contacts on 145.55

MHz continued in 1992, and are expected to continue in 1993, in both FM as U6MIR and packet radio with the callsign U6MIR-1. MIR reception reports can be sent, along with a self-addressed envelope and USD 1 to 5 to:

RV3DR, Sergai Samburov, Space QSL Manager P.O. Box 141070, Box 73 Kaliningrad-10 City Moscow Area Russia

II. Military Communications in Space

Military communications are usually coded, but occasionally some transmissions are in the clear. Most military satellites are in geo-stationary orbit. These include FLEETSATCOM satellites at 72, 75, 77, 100, 105, 145, and 177 degrees West. These use frequencies in the 240 to 399 MHz range, as well as around 7, 8, 19, 20, 30, and 44 GHz.

FLEETSATCOM are the most popular satellites for listeners as they have some unencrypted FM channels. The most active are between 261 and 263 and between 269 and 270 MHz.

During the Gulf War, monitors reported that American military communications in the Gulf could be heard from the FLEETSATCOM satellite network between 240 and 270 MHz, with most of the voice traffic in the 260 MHz range, and most coded. One monitor reported to "Popular Communications" American AWACS planes on 263.825 MHz and Saudi forces on 249.325 MHz. Other active frequencies reported were 261.825, 262.200, 262.150, 262.425, and 263.525 MHz. According to another report, traffic on Fleetsatcom 7 has been heard on 249.125, 250.350, 262.300, and 263.825 MHz.

Since the shooting down of an American U-2 surveillance plane over the then Soviet Union in 1960, the United States has developed a network of spy satellites, some of which monitor radio communications. The most recent generation known to the public is KH-11, first launched in 1976, and the first spy satellite to transmit images in real time. A new type, called "Advanced KH-11" was first put into orbit by the space shuttle Discovery in 1989.

In order to communicate with ground stations the KH-11 satellites use a system of satellites in polar orbits. The 14 current satellites in this Satellite Data System (SDS) seem to use frequencies around 240 MHz and in the 1700-1900 MHz range. As there have been no SDS launches since 1988, there is a good possibility that the American Tracking and Data Relay Satellites (TDRS) are taking over the task of relaying data from the KH-11 satellites.

The next generation of American military satellites is called Milstar. Funding for 6 Milstars has been approved. They will be the most sophisticated communications satellites ever designed, putting all military communications in the same system, making possible communications between the various services. "Popular Communications" says there are 10 assigned positions, but only 2 or 3 are known to be in orbit at this time. Milstars use frequencies around 2, 20, and 45 GHz.

The former Soviet satellite tracking network is called SDRN, the Satellite Data Relay Network. Downlinks are on 10.8, 11.3, and 13.7 GHz.

The Molniya satellites use a highly elliptical orbit that makes it possible to reach high latitudes out-of-reach of geo-stationary satellites (which would be too low on the horizon). Molniya 1 uses 800 MHz and 1 GHz, while Molniya 3 satellites use 4 and 6 GHz. These carry satellite broadcast television as well as military and manned space voice communications.

PART V. HORIZONS

Space exploration can be expected to continue. The American space station Freedom is scheduled for launch in the late 1990's. AMSAT and the ARRL have submitted a formal proposal to NASA for a permanent amateur radio station on Freedom. The proposal includes downlinks in the 145, 435, and 2401 MHz bands. Three geostationary satellites would be used to relay continuous communications from Freedom. AMSAT hopes to have its own geostationary satellites in orbit in the near future. Until then, the system would use the TDRS satellites used for shuttle communications.

Project Oscar has called for an amateur radio repeater on the Moon.

Farther into the future, it may be possible to monitor communications from proposed Moon bases, expeditions to Mars, or future space colonies in Earth orbit.

Moving deeper into space, radio astronomy probes the limits of the universe on wavelengths other than those of light used by conventional astronomy. To this belongs SETI, the Search for Extra Terrestrial Life. The first SETI project was carried out by Dr. Frank Drake at the National Radio Astronomy Observatory in Greenback, West Virginia, in 1960. He listened to two relatively close stars for two weeks on one particular frequency.

Project META, a SETI project at Harvard University, funded by the Planetary Society and film director Steven Spielberg (the maker of "E.T." and "Close Encounters of the Third Kind") is monitoring sweeps across the sky on 8.4 million discrete frequencies. After five years of observations, there are 11 interesting "events" that satisfy all but one of the criteria for a genuine alien signal. As astronomer Carl Sagan, President of the Planetary Society, writes in "Parade Magazine":

"We've never been able to find any of them again. We look back at that part of the sky three minutes later, there's nothing. We look the following day—nothing. Examine it a year later, or six years later, and still there's nothing."

NASA started its new SETI program on October 12, 1992, using a radio telescope in California's Mohave Desert, and another at the Arecibo Observatory in Puerto Rico. In the first year, 164 strong "candidate" signals were found for closer examination. Unfortunately, in the Fall of 1993, the U.S. Congress, looking to reduce the budget deficit, cut the USD 10 million dollar a year funding for the program.

Carl Sagan writes about the effect finding intelligent life on other worlds could have on us: "The knowledge that such other beings exist and that, as the evolutionary process requires, they must be very different from us would have a striking implication:

Whatever differences divide us down here on Earth are trivial compared to the differences between any of us and any of them. Maybe it's a long shot, but discovery of extraterrestrial intelligence might play a role in unifying our squabbling and divided planet. It would be a rite of passage for our species, a transforming event in the ancient quest to discover our place in the universe."

There may be a role in the SETI quest for amateurs. Speaking to "Monitoring Times", astronomer Kent Cullers of the NASA Ames Research Center in California says that amateurs could try searching the 1-1.4 GHz range, because "interstellar noise is relatively low there." "Monitoring Times" points out that antennas are critically important, and suggests dishes, quads, and helical antennas. A computer can be programmed to scan frequencies. If signals are passed through a digitizer, the computer can break the information into small slices and can reject certain kinds of local interference.

For More Information

One way to keep up with the amateur radio satellites is to listen to one of the AMSAT nets on shortwave. Here are some:

International Net—Sundays 19:00 hrs UTC on 14282 kHz European Net—Saturdays 10:00 hrs on 14280 kHz Asian-Pacific Net—Sundays 11:00 hrs on 14305 kHz

AMSAT and its national societies publish newsletters and sell computer hardware and software for use in monitoring amateur radio satellites. The main AMSAT address is: Box 27, Washington, DC, 20044, USA. AMSAT-UK is at 94 Herongate Road, Wanstead Park, London E12 5EQ, England. AMSAT-Sweden is at Box 1311, S-600 43 Norrköping, Sweden.

There are a number of computer bulletin boards for space enthusiasts in the United States:

1-205-895-0028 NASA BBS
1-512-852-8194 AMSAT Software Exchange BBS
1-214-394-7438 Downlink BBS (AMSAT)
1-214-340-5850 NSITU BBS
1-513-427-0674 Celestial RCP/M BBS
1-904-786-8142 Starship Enterprise BBS
1-804-743-0559 Astro BBS (amateur astronomy)

There are also resources on the Internet of interest to space enthusiasts, such as: NASA News, NASA Spacelink, Shuttle and Satellite Images, the NASA/IPAC Extra Galactic Database, and news groups such as alt.radio.amateur.packet, alt.satellite.tv.*, and others.

The CompuServe HamNet Forum has a section devoted to amateur radio satellites. The Consumer Electronics Forum has a TVRO section. There are a number of other space forums on CompuServe, including a NASA section with news from the American space agency. CompuServe now has local access nodes around the world, especially in Western Europe and Japan. For more information contact: CompuServe, 5000 Arlington Centre Blvd, Box 20212, Columbus, OH 43220, USA.

The FIDO network contains several conferences about satellite television, amateur radio satellites, and packet radio.

There are several BBS's for WEFAX enthusiasts in Britain. The Dartcom BBS (0822-88249) is located at a WEFAX equipment supplier. The Remote Imaging Group operates the RIG BBS (0945-85666) for members.

Two very interesting newsletters about satellite broadcasting are available over data networks. Both of which were used extensively in compiling this booklet, and we'd like to thank both for making themselves available to us.

SatNews is huge, so big that the fortnightly uploads have to be divided into two or three files. There's probably more here about the electronics and satellite industries than any one person wants, but all the important news is included. Editor Darren Ingram does a great job, but it caters to business interests, at business prices. Fortunately they offer a special rate to non-commercial subscribers: GBP 50 or USD 100 for one year to an Internet-compatible mailbox. If you need this kind of information, it's well worth it. You can contact SatNews at the Internet mailbox satnews@cix.compulink.co.uk for more information.

Skyguide is a short weekly newsletter covering satellite and cable broadcasting, concentrating on the UK. Fortunately, it's free, although distribution has been uneven recently. You can find Skyguide every week on London's CIX conferencing system, in the Skyguide conference, the Fidonet Satellite TV echo, and the packet radio network. Skyguide is now available on the Internet in the alt.satellite.tv.europe.newsgroup.

Dial-a-Shuttle is a telephone number available during shuttle missions, with news updates and live relays from the astronauts. The number is 1-900-909-6272.

Europeans can access interesting, if uneven, rumors and news about satellite broadcasting from the *In Orbit* teletext pages, on Super Channel beginning on page 375 and on UK Gold, pages 333 and 334. The content of the services vary slightly - Super Channel's version is consistently more critical of Astra and Sky, while the UK Gold version appears (at the moment) to be more neutral.

There's a very good source of up-to-date satellite news, most of it in German, from a fax polling number in Germany. If you have a fax machine, you just dial up the number, and automatically receive pages of news. The initial number is +49-89-418-608. Then there are two more numbers for the different services.

99 gets you a list of satellite channels in the S-band, C-band, and Ku-band, between 66 degrees East and 10 degrees East. 49 gets a similar list between 7 degrees East and 53 degrees West. 97 is for satellite programming news, and 98 for satellite industry news. 94 is for satellite data communications news, compiled by English by Darren Ingram, editor of "Satnews".

The *World Radio TV Handbook* contains a section on World Satellite Broadcasts, which lists current and some planned geostationary broadcast satellites, with detailed

lists of transponder usage. We made extensive use of the WRTH in compiling the section on Asian satellites. Unfortunately, there are no satellite listings in the ordinary section of the handbook. If you look up Radio Sweden or Swiss Radio International, or the BBC in the WRTH, you'll find the shortwave schedules, but not a word about the satellite relays. The only indication is a tiny little dish symbol next to the appropriate broadcaster. These refer to the "World Satellite Broadcasts" section.

Nevertheless, you still have to know what you're looking for, and it would make a lot of sense to include this information under the regular listings as well. This can get complicated, of course.....where do you list information on Deutsche Welle's broadcasts on satellites over North America, under Germany, Canada, or the USA? But there ought to be a solution.

The *World Satellite Annual*, compiled by Mark Long, has just about everything you could possibly want to know about communications satellites. It lists all the current and many planned satellites in geosynchronous orbit, with footprint maps and channel tables. There are chapters on satellite launch vehicles for the 1990s, the status of DBS in America, updates on Intelsat and Eutelsat, European Scrambling Systems, and the Satellite News Gathering Revolution. The book is expensive, at USD 100 plus postage. But for the serious satellite DXer, it's well worth it. For more information contact MLE Inc., Box 159, Winter Beach, Florida, 32971, USA.

Together with Jeffrey Keating, Mark Long has also written *The World of Satellite Television*, a basic guide to installing, operating, and maintaining a backyard satellite dish antenna. Available for USD 13 from Quantam Publications, Box 310, Mendocino, CA 95460, USA.

Communications Satellites, by Larry Van Horn, covers U.S. and Soviet manned space missions, military, weather, navigational, and communications satellites. It's available for USD 13. (*)

The Hidden Signals on Satellite Television, by Thomas Harrington and Bob Cooper Jr., goes into detail about SCPC, audio subcarriers, teletext, and other non-video signals on North American satellites. It also covers the equipment needed. Available for USD 20. (*)

The three books above are the best guides for satellite radio and TV DXing. Those interested in weather satellites should look into:

The New Weather Satellite Handbook by Dr. Ralph Taggart is the most comprehensive book around about monitoring weather satellites. The new 4th edition is available for USD 20 from the American Radio Relay League, Newington, CT, USA, or from Metsat Products, Box 142, Mason, MI 48854, USA. (*)

AMSAT and the American Radio Relay League have published an excellent guide to amateur radio satellites called *The Satellite Experimenter's Handbook*. (*) The 2nd edition is available for USD 20, from: AMSAT, Box 27, Washington, DC 20044, USA. The later Satellite Anthology ought to update the handbook, but it doesn't. Instead it

reprints articles from *QST* magazine, some of which are very out-of-date. AMSAT also publishes *Satellite Journal* magazine and *Amateur Satellite Report*.

Most of these books are available from a number of sources. Many of the ones marked (*) should be available from the following: 73 Magazine, Forest Road, Hancock, NH 03449, USA; Grove Enterprises, 140 Dog Branch Road, Brasstown, NC 28902, USA; Universal Electronics, 4555 Groves Road, Suite 3, Columbus, Ohio 43232, USA; and EEB, 323 Mill St. NE, Vienna, VA 22180, USA.

Some books of interest to Europeans may be ordered from PW Publishing, Enefco House, The Quay, Poole, Dorset BH15 1PP, Britain.

The best program listing for North American TVRO monitors is *Satellite TV Week*, available for USD 48 a year from Satellite TV Week, Box 308, Fortuna, CA 95540, USA.

There are a couple of British monthlies with channel listings and satellite news, *What Satellite* (57-59 Rochester Place, London NW1 9JU) and *Satellite TV Europe* (5 Riverpark Estate, Berkhamsted HP4 1HD).

Transponder is a British newsletter, filled with information about satellite broadcasting. Published 24 times a year, it's available in the UK for GBP 37, in Europe for GBP 60, and outside Europe for GBP 75, from: Transponder, Box 112, Crewe Cheshire, CW2 7DS, England.

Satellite Watch Newsletter is the magazine of the video pirate satellite underground, people who regard any kind of coding as a violation of American Constitutional rights. Lots of details on descrambler hardware and software. But 12 issues are available for USD 35, from: Walker Media Group, 6599 Commerce Ct. No. 103, Gainesville, VA 22065, USA.

Radio Netherlands publishes an interesting leaflet called *Weather Satellite Fact Sheet*, as well as *Satellites for the Shortwave Listener*. Both are available for free from: Radio Netherlands, Box 222, NL-1200 JG Hilversum, the Netherlands.

The Fall, 1990 edition of *Whole Earth Review* has an excellent article by Robert Horvitz called "Tabletop Earth-Watch Stations" about monitoring WEFAX, with the WER's usual good guide to sources. Available for USD 7 (more for postage abroad) from: Whole Earth Review, Box 38, Sausalito, CA 94966, USA.

The American magazines *Monitoring Times* and *Popular Communications* have columns with the latest on North American satellite TVRO. *73 Magazine* has a column on amateur radio satellites. The British sister magazines *Short Wave Magazine* and *Practical Wireless* cover satellites very well from the European perspective. The emphasis in the former is on TVRO and WEFAX, in the latter on amateur radio satellites.

If you're into cyberpunk, *Wired* magazine from San Francisco covers everything from the Internet and Virtual Reality to satellite television in Asia and special effects on "Star

Trek". When he was being interviewed for the magazine, Arthur C. Clarke took one look at it and thought it should have been spelled "Weird".

For the story of telecommunications, from the first Atlantic cable to his own original proposal of communications satellites, and up to the present, science and science fiction writer Arthur C. Clarke's *How the World Was One* is a fascinating read.

CNN: The Inside Story by Hank Whitmore is the story of Turner Broadcasting's early years, published in connection with CNN's 10th anniversary in 1990. Since it was released by CNN, it's not likely to contain anything really negative or overly-revealing, but it is a fascinating behind-the-scenes look at how the satellite TV industry got started, and how CNN works. Our only complaint is that there's too little about CNN International and the network's expansion beyond North America (which has largely happened after 1990).

For information about amateur radio astronomy, you can contact the British Amateur Radio Astronomy Society, c/o Steven Newberry, 19 Oakway, Kingsley Park, Birkenshaw, Bradford, West Yorkshire BD11 2PG, Britain.

For more information about the Planetary Society, write to: The Planetary Society, 65 N. Catalina Ave., Pasadena, CA 91108, USA.

Reason notwithstanding, the universe continues unabated, terribly huge and terribly complicated. "The DXers Guide to the Galaxy", while relatively short, and undoubtedly filled with much that is wildly wrong, out-of-date, or of marginal interest, is nevertheless greatly inspired by (some might say plagiarized from) Douglas Adams and "The Hitch-Hikers Guide to the Galaxy".

We hope he doesn't mind too much.

For more information on this engrossing subject, consult the books and magazines mentioned above. We did to write this. Repeatedly. Please note that things change rapidly in this field, numbers to computer bulletin boards even faster. This is as accurate as we could get it on the day it went to the printers, in January, 1994. There were undoubtedly mistakes then, stuff left over from earlier editions, and many changes since. We disclaim all responsibility for anything that happens due to these mistakes or changes.

Should you have any information you would like to pass along, in order to rectify or update any of these unavoidable errors, you can contact Radio Sweden's DX Editor George Wood through any of the following electronic means:

*CompuServe Mail 70247,3516 MCI Mail to the CompuServe address
Internet 70247.3516@compuserve.com*

Fidonet to George Wood at 2:201/697

Packet Radio to SM0IIN on the SM0ETV mailbox Telefax +468-667-6283

In case of electrical failure the mail will also work:

Radio Sweden S-105 10 Stockholm Sweden ®