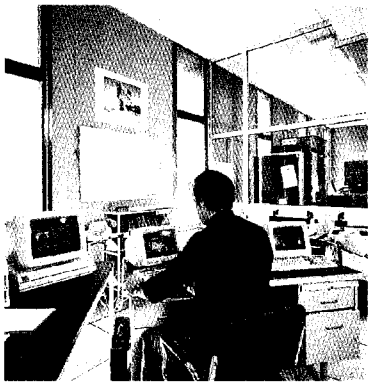
GLOBAL PROCESSING CENTERS



The onboard tape recorders are read out about every 100 minutes when one of the three ground stations (Gilmore Creek Alaska, Wallops Island Virginia and Lannion France) comes into visibility. Data are then transmitted to the NOAA, National Environmental Satellite, Data and Information Service (NESDIS) in Maryland, USA. The Argos data are extracted from those generated by other onboard units and transmitted to CLS at the Toulouse Space Center (CST, France) and to Service Argos Inc. (Landover, MD, near Washington DC, USA). Here, PTT locations are determined and the sensor data processed. Landover processes the data for North American users, Toulouse for users outside North America. Each center can take on the full operational workload if the other goes down.

Standard Service

Argos Global Processing Center (GPC) in Toulouse.

Standard service is provided by the main computer. The operations performed are location and sensor data processing.

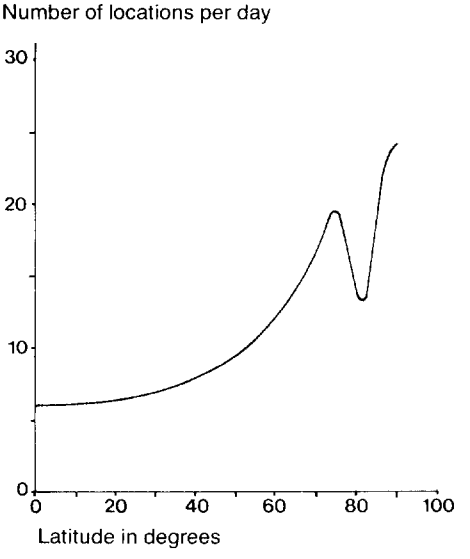
Location Principle

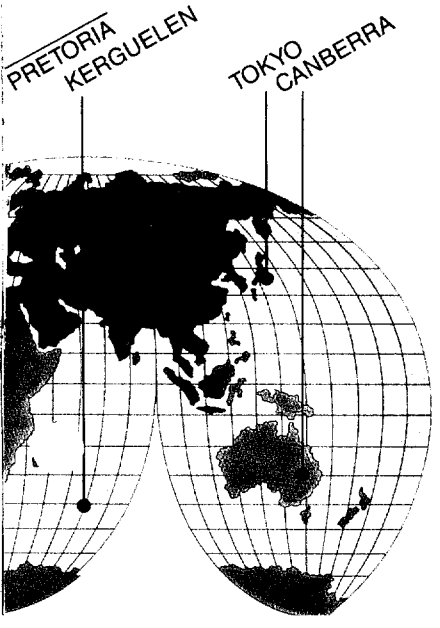
Platform location is achieved solely by measuring the Doppler shift in the carrier frequency of received messages. The transmit frequency must therefore remain stable throughout the pass. Each frequency measurement yields a set of possible PTT positions, the locus of which is a cone with the spacecraft at the apex and its velocity vector as the axis. Assuming the platform elevation is known, the intersection of these cones with the elevation sphere yields the solution. The location is valid if the spacecraft receives at least four messages during a single pass.

The location reference system comprises eleven special orbitography beacons installed around the world at precise geodesic positions: this is how the satellite position at any instant is determined.

Number of Locations

Number of locations per day as a function of latitude for standard service:





Location Accuracy

Regular-quality PTT oscillators under normal operating conditions give location accuracies on the order of 300 m, wherever the platform may be on Earth.

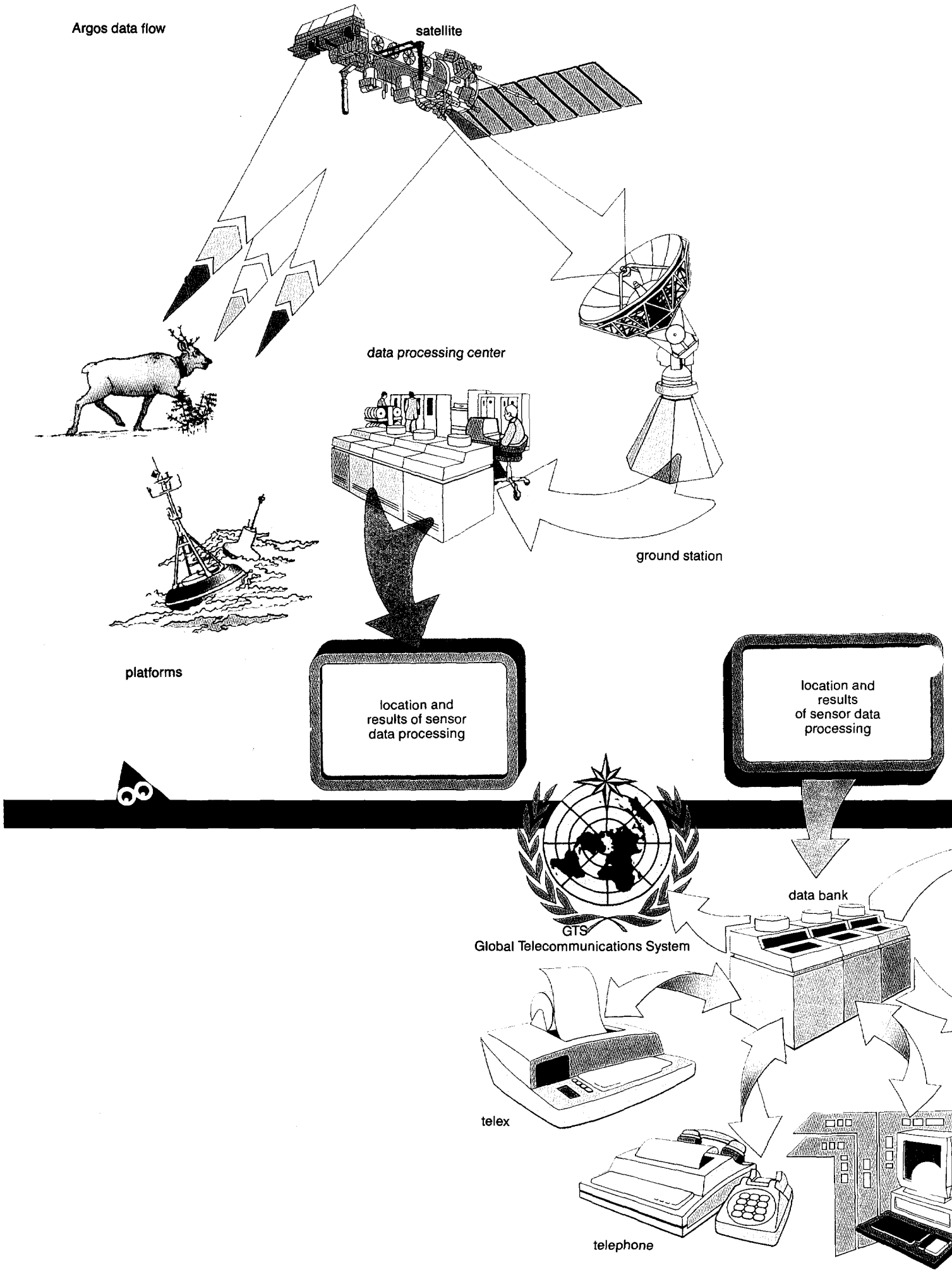
Primary sources of error:

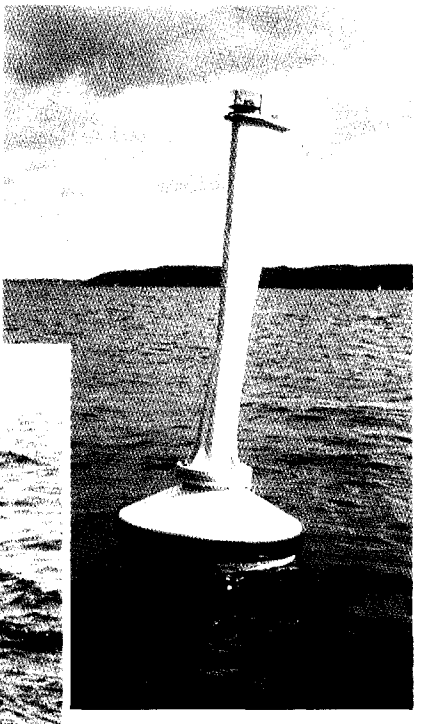
- accuracy of PTT elevation information. While this is clear for maritime applications (drifting buoys, shipping, marine animals, etc), there can be a problem with programs involving balloons or terrestrial animals, for example.
- stability of PTT oscillator frequency during the 10-minute (mean) satellite overpass. For fixed positions or slow moving mobiles

Data Processing

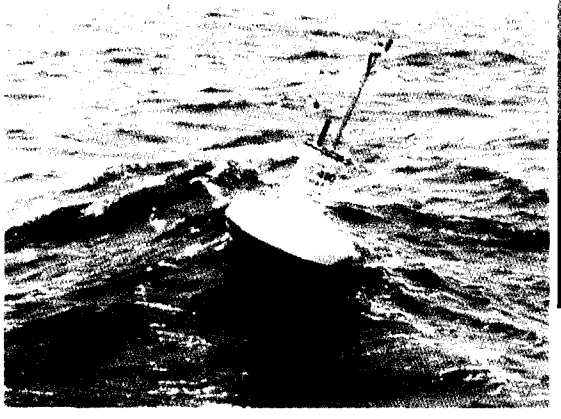
Data generated by different sensors can be processed independently, the user choosing between two options for data conversion:

- conversion to numeric form (decimal, hexadecimal, etc)
- conversion to physical units (°C, mbar, etc)

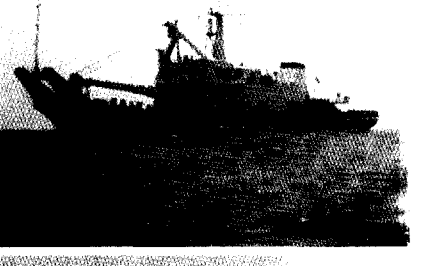

Argos data flow
satellite
data processing center
ground station
platforms
location and results of sensor data processing
location and results of sensor data processing
data bank
GTS
Global Telecommunications System
telex
telephone

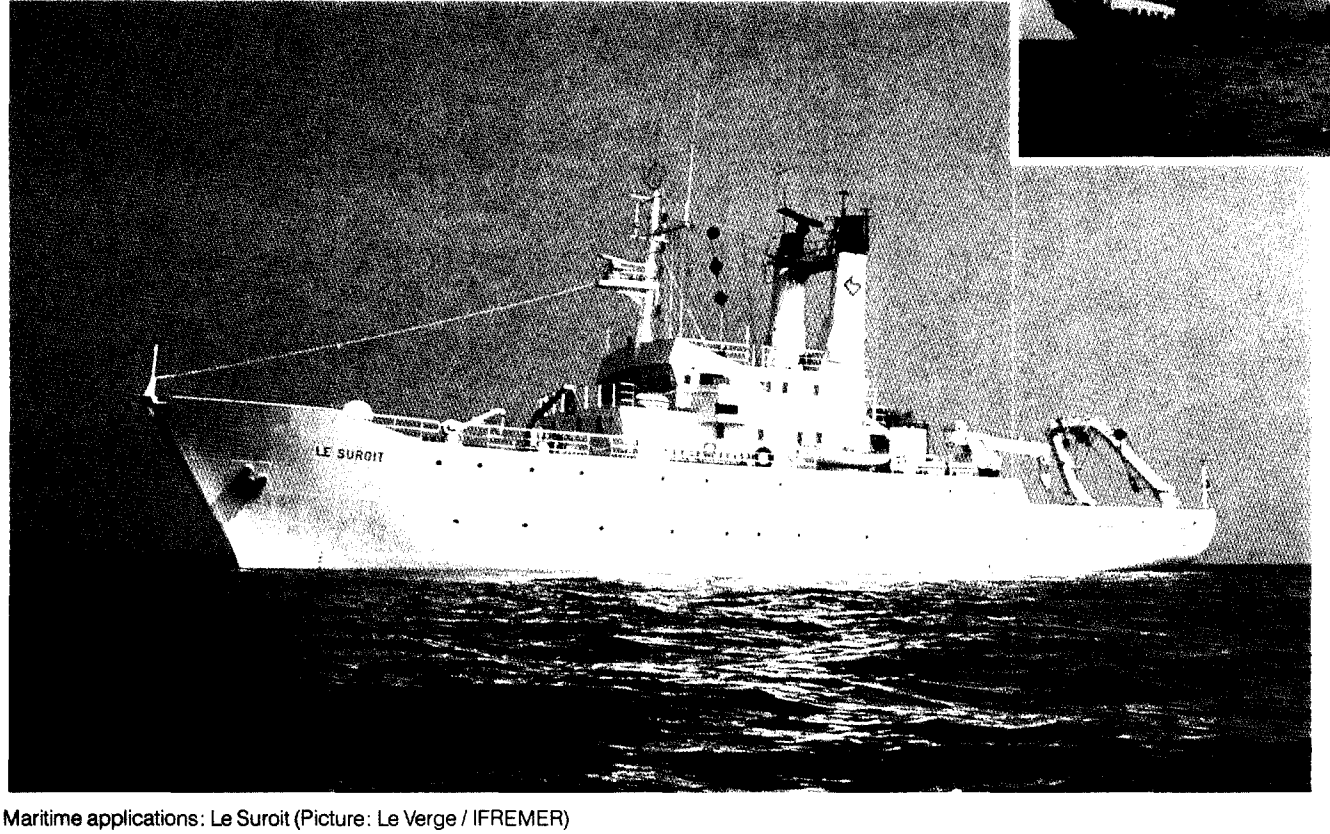


Drifting buoy

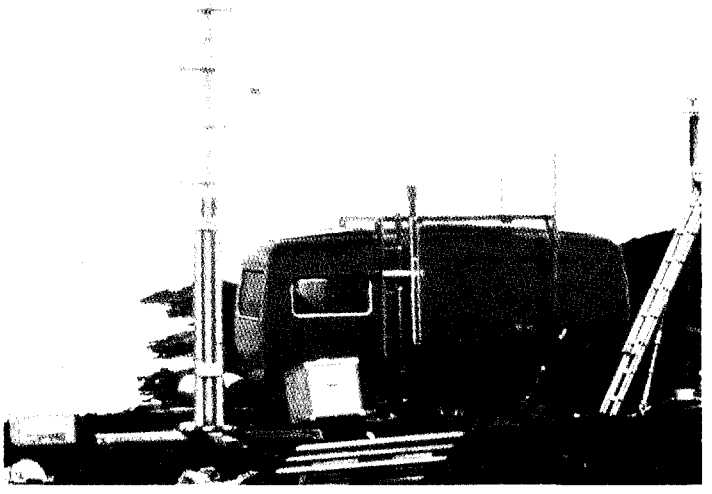


Moored buoy

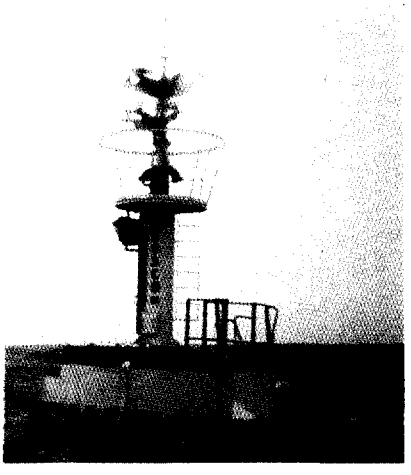




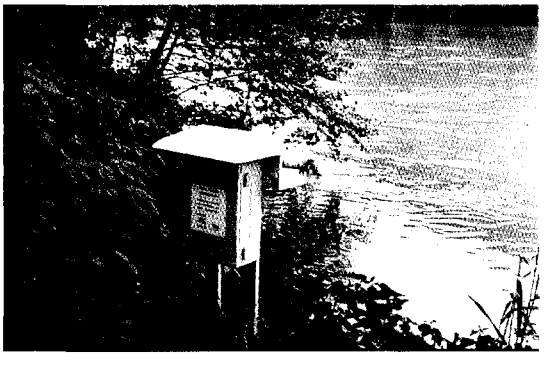
Maritime applications: Le Suroit (Picture: Le Verge / IFREMER)



Weather station in Greenland



Moored buoy



Hydrological Station

With features like global coverage, location, PTT microcircuitry and guaranteed continuity, Argos is chosen across a broad range of applications devoted to environmental studies and major economic activities.

Meteorology

Weather data collection programs are of two main types:

• World-scale research programs relying mainly on buoys and balloons, including:
– GARP (Global Atmospheric Research Program), which confirmed operational status for Argos right at its start in 1978
– TOGA (Tropical Ocean and Global Atmosphere), the objective here being to determine the climatic mechanisms leading to such phenomena as drought in the Sahel and El Niño events,
– WOCE (World Ocean Circulation Experiment), aiming to increase our knowledge of ocean-atmosphere interchanges on a planetary scale.

• The World Weather Watch (WWW), using data from moored and drifting weather buoys, ship terminals and fixed stations in such hostile areas as Greenland and the Antarctic.

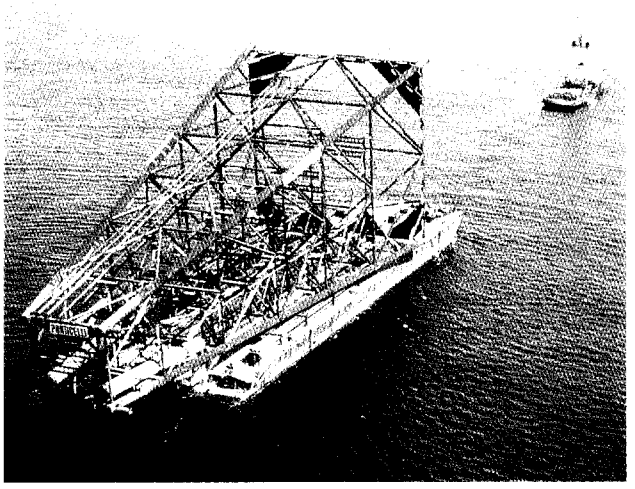
Oceanography

Argos is routinely used for the study of: the general ocean circulation; wave formation, spectrum and propagation; current direction and speed; ocean thermal structure (using bathythermographic sounding techniques or thermistor strings), and tide amplitude and anomalies. Such field measurements complement and provide vital ground truth for satellite remote sensors, and are exceptionally useful in fishing and shipping.

Hydrology

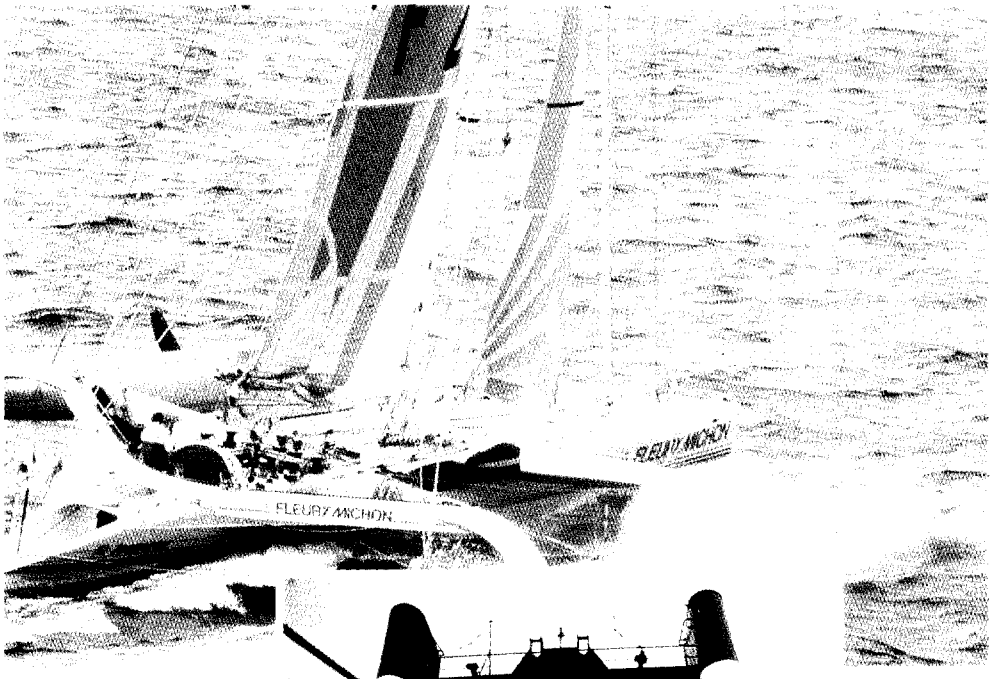
Hydrological networks using Argos predict flood conditions and assess water resources; examples include the Amazon, Niger, Loire and Seine basins.

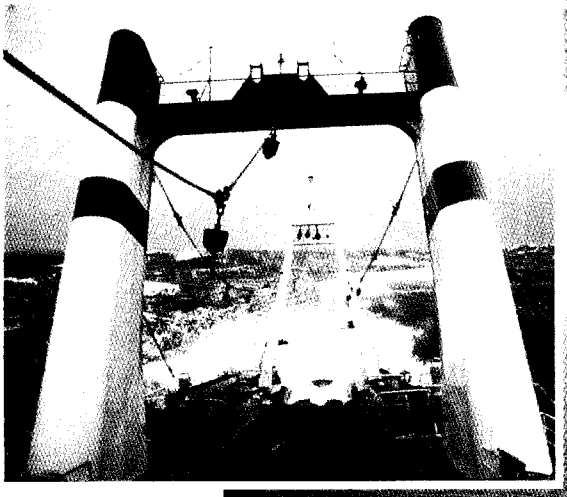
Barge towing (Picture: ELF AQUITAINE)



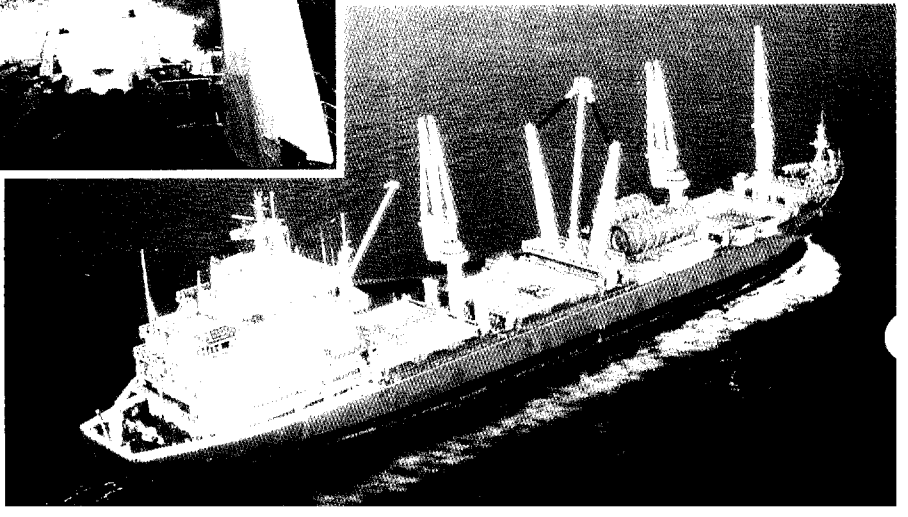
Glaciology

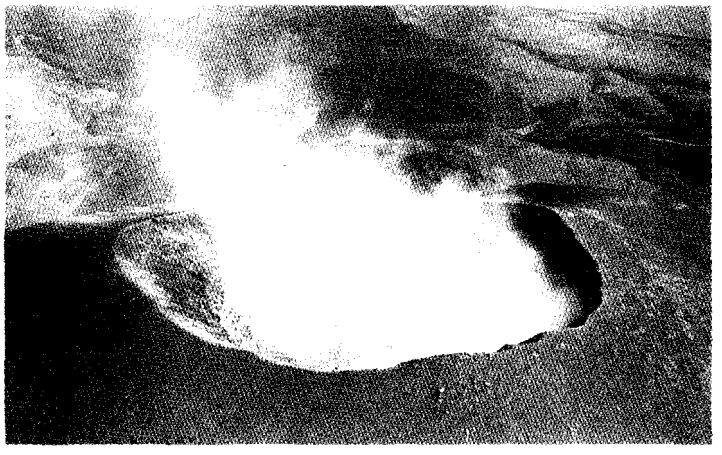
Ocean races
(Picture SCOPE 2 / Jacques Alain Raynaud / FLEURY MICHON)





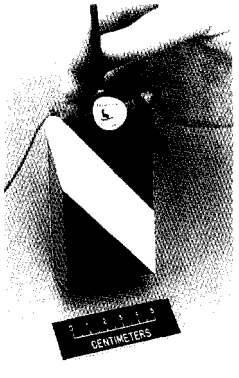
Fishing





Volcanology

Animal tracking



Caribou transmitter

Animal tracking

Glaciology / Snow Studies

Argos PTTs monitor the polar current, ice drift, glacier movement and iceberg trajectories. By measuring the snow cover, the system also helps assess avalanche risks and water resources in mountain areas.

Wildlife

This application, basically animal tracking, covers the study of animal behavior and the vulnerability of their ecosystems to man-induced disturbances.

Significant progress in PTT miniaturization, together with the matching of packaging to specific features of animal ecosystems and to individual species now permit close tracking of a broad range of species, including: caribou, ibex, singlehumped camel, dugong, whale, etc.

The system is also used to monitor the habits of endangered species.

Volcanology / Seismology

Volcanological seismology is based on volcano monitoring: locating and measuring the amplitude and frequency of microseisms facilitate the location of rising magma and the forecasting of volcanic eruptions. Such high-risk sites as dams and nuclear power stations can similarly be remotely monitored.

Argos applications also extend into major economic activities:

- **offshore oil production and exploration**, using the system for weather forecasting, iceberg drift prediction, ice floe tracking, pollution tracking and towing surveillance;
- **maritime transportation**: weather routing and forecasting, data transmission and performance monitoring;
- **deep-sea fishing**: weather cover, guidance to fishing areas and assessment of fish stocks.

CLS AND SERVICE ARGOS INC.

CLS, a subsidiary of CNES and IFREMER, is established in Toulouse, France and is the contact point for all users outside North America. Service Argos Inc., the CLS subsidiary established in Landover, MD, USA, handles relations with North American users. The activities of both organizations are supervised by the French-American (CNES-NOAA) Operations Committee.

CLS and Service Argos Inc. activities include:

- exploitation, maintenance and development of GPCs;
- technical certification of prototype PTTs;
- attending exhibitions, organizing system promotion conferences and supplying literature;

In a broader framework CLS and its US based subsidiary, North America CLS, develop activities relative to:

- design and development of new services and products and of turnkey systems for specific applications;

Additionally these two organizations are developing new applications using satellite-based systems, both geostationary and orbiting, in the field of data collection and location.

INFORMATION

- FOR FURTHER INFORMATION:
* CLS and Service Argos Inc. have additional information - please ask!

C.L.S.
18 avenue Edouard-Belin
31055 Toulouse Cedex
France
Tél. 61 27 43 51
Télex: 531 752 F
Télécopie: 61 27 35 76

North American CLS
Suite 10, 1801 Mc Cormick Drive
Landover MD 20785
USA
Tél. (301) 925 4411
Télex: 898 146
Fax: (301) 925 89 95
Service Argos Inc.
Suite 10, 1801 Mc Cormick Drive
Landover MD 20785
USA
Tél. (301) 925 4411
Télex: 898 146
Fax: (301) 925 89 95
Service Argos Inc.
Regional Office
Bin C. 15700
7600 Sand Point Way NE
Seattle, WA 98115-0070
USA
Tél. (206) 526 18 13
(206) 526 18 14

* The Argos Newsletter, a bilingual magazine, is available on request.

Also Available:

* Brochures:
  - maritime applications
  - animal tracking
  - "ocean races"...
* Product data sheets:
  - ship terminals
  - "XBT terminals"...
* Conference proceedings

Using the System

* When you are near ready to begin your project, request a User's Guide and Program Application Form
* Also available: List of manufacturers of certified hardware, PTT specifications

JULY 87 - ALS CONSEIL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of the Application of	)	
	)	
STARSYS, INC.	)	File No. _____
	)	
For Authority to Construct a Low Earth Orbit Communications Satellite to be Stationed in an Inclined Non-Geostationary Orbit	)	

APPLICATION

STARSYS, Inc. ("STARSYS" or "Applicant"), pursuant to Sections 308, 309, and 319 of the Communications Act of 1934, as amended, hereby applies for authority to construct a low earth orbit communications satellite ("STARNET F1") that will operate in the 137-138 MHz frequency band for Space-to-Earth transmissions, and in the 148-149 MHz band for Earth-to-Space transmissions, or in sub-bands thereof, depending on frequency modulation selected by the Commission. STARSYS requests the Commission to allow STARNET F1 to be randomly deployed in a low earth, non-geostationary inclined orbit between 50 and 60 degrees.

The satellite for which construction authority is requested herein is an integral component of the STARNET system that is being developed by STARSYS. STARNET F1 is one of 24 in-orbit components of the STARNET system for which STARSYS is requesting Commission construction approval.

A. Applicant is:

STARSYS, Inc.
2000 K Street, N.W.
Suite 620
Washington, D.C. 20006

B. Correspondence concerning this application may be addressed to:

Dr. Ashok Kaveeshwar
President
STARSYS, Inc.
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With a copy for Counsel:

Raul R. Rodriguez
Stephen D. Baruch
Leventhal, Senter & Lerman
2000 K Street, N.W.
Suite 600
Washington, D.C. 20006-1809

C. The radio frequency plan is set forth in Tables 1 and 2.

TT&C frequency assignments are intraband.

VHF band frequencies (using spread spectrum techniques) are:

Earth-to-Space (Uplink)	148 to 149.0 MHz
Space-to-Earth (Downlink)	137 to 138.0 MHz

(In the event that a non-spread spectrum basis is selected by the Commission, the STARNET component spacecraft will operate in sub-bands of these frequencies.)

D. Applicant requests authority to deploy this component of the STARNET system in an inclined (between 50 degrees and 60 degrees), non-geostationary, low earth orbit. A discussion of the factors influencing the orbit selection process is included in Part VII of the STARSYS application.

E. The STARNET system component's receive antenna gain contours and transmission antenna EIRP contours are stated below:

1. Outbound uplink channels analysis (ground station to satellite):

Ground station transmitting/channel	12 dBW
Ground station transmitter losses	-0.7 dB
G/T	+16 dBi
Max range (3500 km)	-146.6 dB
G/T at 5 degree elevation angle	+5 dBi
Satellite receiver loss	-2.5 dB
Polarization loss	-3 dB
To receiver	-201 dBW/Hz
9600 bps	39.82 dBHz
C/No	80.20 dBHZ
Eb/No	+4.5 dB
Uplink Margin	> 30 dB

2. Outbound downlink channels analysis (satellite to users' terminals)

Satellite transmitting/channel	9 dBW (7.95 watts)
Satellite transmitter loss	-0.7 dB
G/T at 60 degree off-axis	+4 dBi
Max range (3500 km)	-145.93 dB
G/T at 5 degree elev. angle	+2.5 dB
Terminal receiver loss	-2.5 dB
Polarization loss	-3 dB
To receiver	-200 dBW/Hz
9600 bps	39.83 dBHz
Eb/No with coding	+2.5 dB
Downlink margin	+3 dB
Power flux density at the ground (dBW/m2/4 KHz) (1300 km)	-141.50 dBW/m2/4 KHz

3. Inbound uplink channels analysis (terminal to satellite)

Ground terminal	0 dBW (1.0 watt)
Terminal transmission loss	-0.7 dB
G/T at 5 degree elev. angle	+3 dBi
Max range (3500 km)	-146.6 dB
Satellite G/T at 60 deg. off-axis	+4 dBi
Receiver loss	-2.5 dB
Multipath propagation effect	-3 dB
Polarization loss	-3 dB
To satellite	-201 dBW/Hz
4800 bps	36.82 dBHz
Eb/No (10 -5) with coding	+4.5 dB
Uplink margin	+9.9 dB

4. Inbound downlink channels analysis (satellite to ground station)

Satellite transmitter/channel	-3 dBW
Satellite transmission losses	-0.7 dB
G/T at 60 degrees off-axis	+4 dBi
Max range (3500 km)	-145.93 dB
G/T	+16 dBi
Ground station receiver loss	-2.5 dB
Polarization loss	-3 dB
To receiver	-200 dBW/Hz
4800 bps	36.83 dBHz
Eb/No (10 -5)	+4.5 dB
Downlink margin	+5.5 dB
Power flux density at the ground in any 4 KHz band (dBW/m2/4 KHz)	-153.5 dBW/m2/4 KHz

5. The communication system block diagram is shown in Figure 1.

F. Physical Characteristics of STARNET Components

The STARNET component spacecraft will be designed to meet the following antenna pointing accuracy requirements:

Pitch	+/- 5º
Roll	+/- 5º
Yaw	not required

The mission requires orientation of the antennas to approximate local vertical, with no requirement for yaw stability. A motorized boom provides the necessary inertia configuration for gravity-gradient stabilization. Energy dissipation for stability is provided by four passive magnetic hysteresis rods, one in each solar panel spar. Passive gravity-gradient stabilization such as this has been demonstrated on numerous spacecraft. Energy dissipation to assure stability will be provided by two passive ball-in-tube nutation dampers. Attitude knowledge is required to perform the maneuvers necessary for the stabilization adjustment phase. This is provided by a three-axis vector magnetometer and digital sun sensors. Magnetometer and sun sensor data are telemetered and ground processing enables attitude determination.

The STARNET component spacecraft will have a design lifetime of 5 years. Lifetime is determined by a number of factors including component failures, aging effects, and fuel depletion.

The power subsystem will have sufficient battery capacity to power the spacecraft during periods of solar eclipse lasting up to approximately 45 minutes. Details of the specific power subsystem design will be available when the spacecraft contractor has been selected during the competitive procurement phase.

G. Emission Limitations

Given the use of spread spectrum techniques and the fact that STARNET is a low earth orbit system, however, it is expected that the level of spurious emissions will be negligible. Applicant will minimize any spurious emission anomalies.

H. Dates by which construction will be commenced and completed, launch date, and estimated date of placement into service.

The complete constellation of twenty-four (24) STARNET in-orbit component spacecraft will be launched within forty-eight (48) months after Commission approval. Component spacecraft will be designed and quality controlled twelve (12) months after program inception. Delivery of STARNET component spacecraft will commence twenty-four (24) months after Commission approval. Manufacturers are to deliver three (3) component spacecraft per quarter over (8) quarters. Spacecraft integration on the launcher is four (4) months for the first launch, and one (1) month for subsequent launches.

Launches will be conducted at a rate of three (3) every quarter. The launch period will start in the fourth quarter of 1993 and continue into the third quarter of 1995, assuming Commission approval in the second quarter of 1991.

I. The STARSYS application sets forth the public interest considerations, and the legal, financial, and technical qualifications of the Applicant. All information contained in the STARSYS application that is pertinent to this Application, but that may not be reproduced herein, is hereby incorporated by reference.

J. STARSYS waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests construction authority in accordance with this Application. All statements made in the attached exhibits are a material part hereof, and are incorporated herein as if set out in full in this Application.

K. The undersigned certifies for STARSYS that the statements made in this Application are true, complete, and correct to the best of his knowledge and belief, and are made in good faith.

WHEREFORE, STARSYS respectfully requests the Commission to grant this Application.

Respectfully submitted,

STARSYS, INC.

By: /S/ Ashok Kaveeshwar
Dr. Ashok Kaveeshwar
President

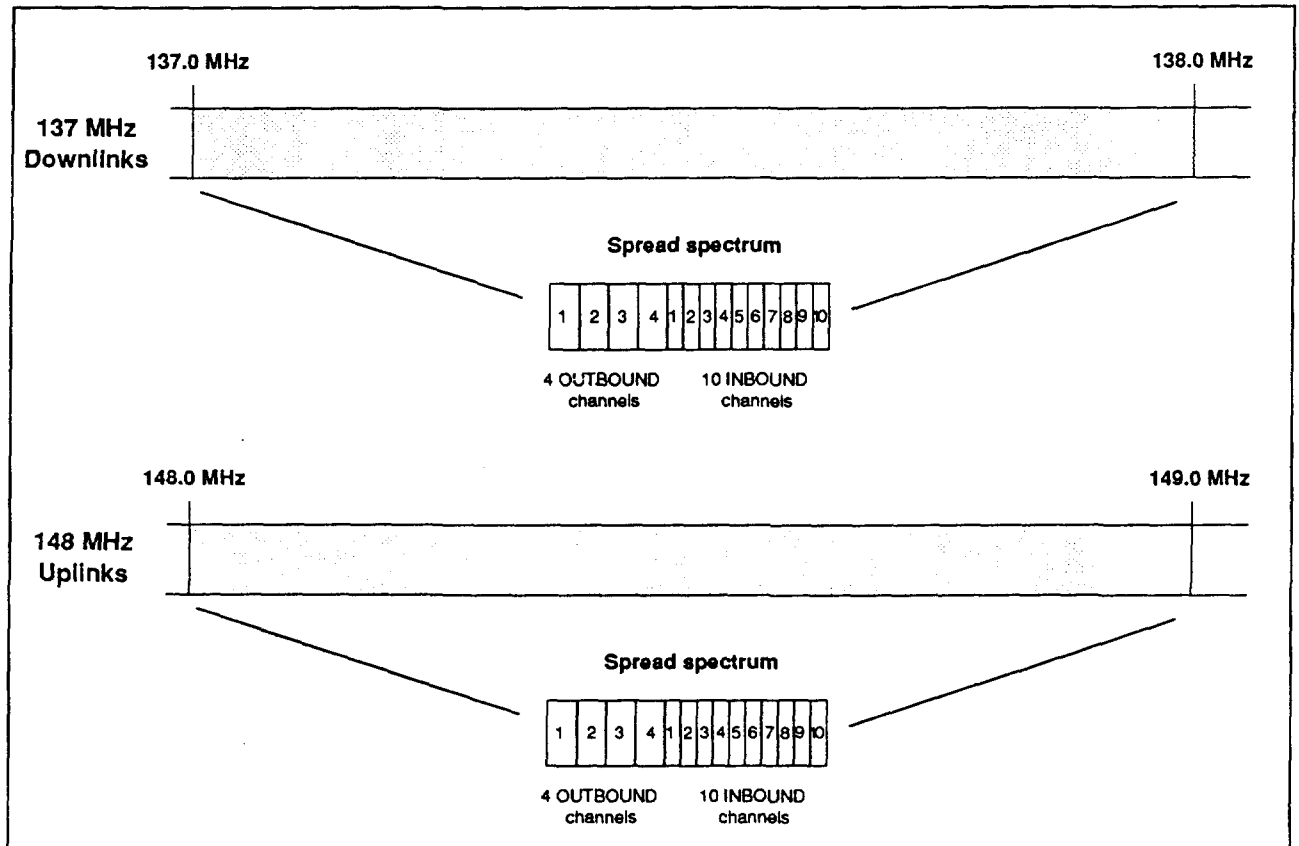
Date: May 4, 1990

TABLE 1

STARNET component spacecraft will operate on a Modified Primary Basis in the U.S. in the following VHF bands:

Nominally using spread spectrum techniques (Solution A)

Earth to space (uplink)	148	to	149.0 MHz
Space to earth (downlink)	137	to	138.0 MHz

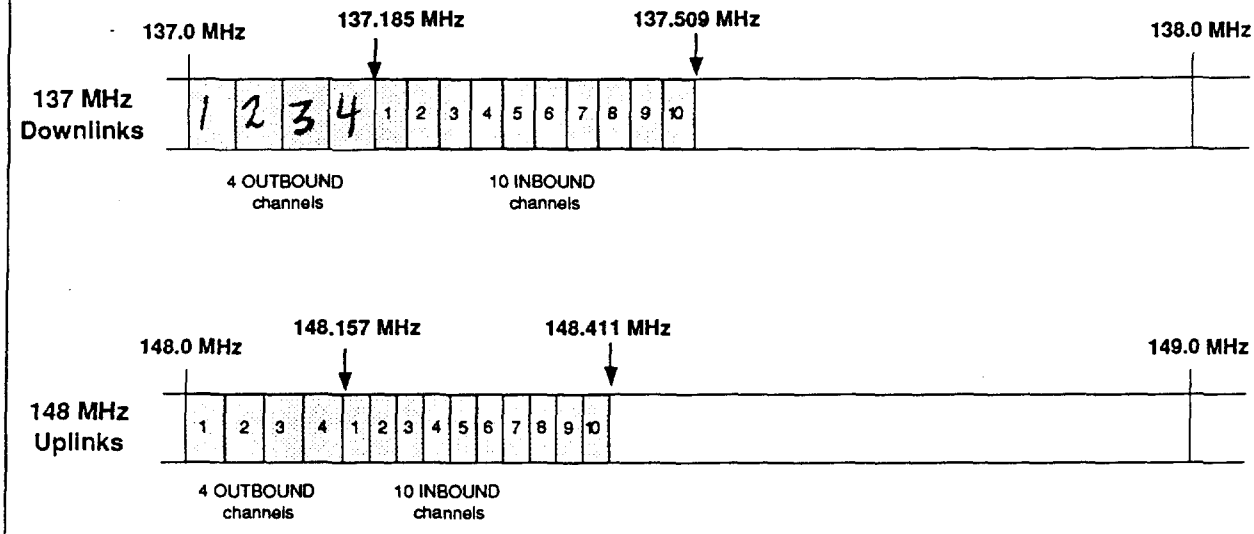


Base line STARNET spectrum proposal (solution A)

TABLE 2

Or alternatively without using spead spectrum techniques (Solution B)

Earth to space (uplink)	148	to	148.411 MHz
Space to earth (downlink)	137	to	137.509 MHz



Base line STARNET spectrum proposal (solution B)

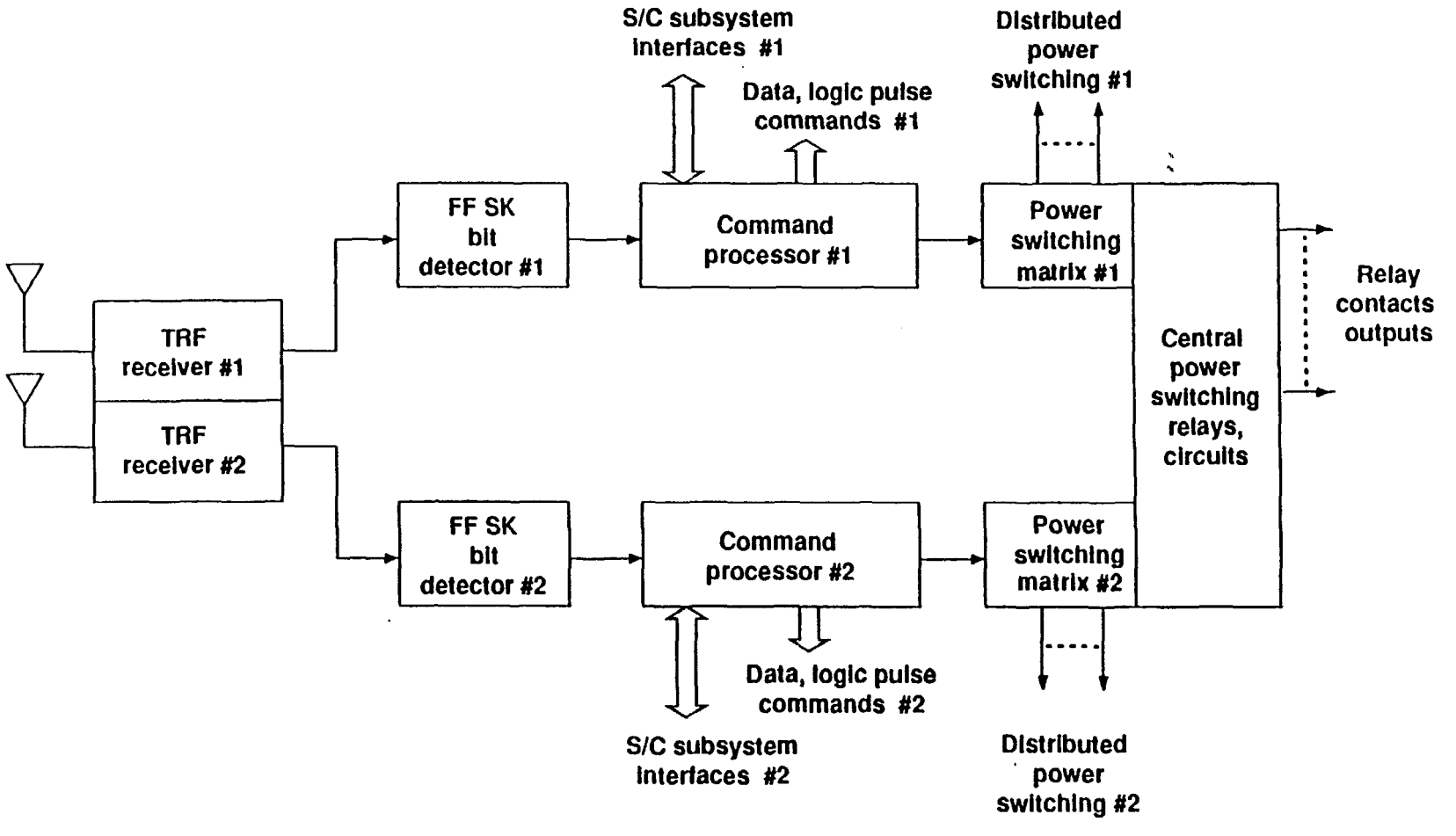

S/C subsystem
interfaces #1
Data, logic pulse
commands #1
Distributed
power
switching #1
FF SK
bit
detector #1
Command
processor #1
Power
switching
matrix #1
TRF
receiver #1
TRF
receiver #2
Central
power
switching
relays,
circuits
Relay
contacts
outputs
FF SK
bit
detector #2
Command
processor #2
Power
switching
matrix #2
Data, logic pulse
commands #2
S/C subsystem
interfaces #2
Distributed
power
switching #2

Figure 1

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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	)	
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	)	
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STARSYS, Inc. ("STARSYS" or "Applicant"), pursuant to Sections 308, 309, and 319 of the Communications Act of 1934, as amended, hereby applies for authority to construct a low earth orbit communications satellite ("STARNET F2") that will operate in the 137-138 MHz frequency band for Space-to-Earth transmissions, and in the 148-149 MHz band for Earth-to-Space transmissions, or in sub-bands thereof, depending on frequency modulation selected by the Commission. STARSYS requests the Commission to allow STARNET F2 to be randomly deployed in a low earth, non-geostationary inclined orbit between 50 and 60 degrees.

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Downlink margin	+3 dB
Power flux density at the ground (dBW/m2/4 KHz) (1300 km)	-141.50 dBW/m2/4 KHz

3. Inbound uplink channels analysis (terminal to satellite)

Ground terminal	0 dBW (1.0 watt)
Terminal transmission loss	-0.7 dB
G/T at 5 degree elev. angle	+3 dBi
Max range (3500 km)	-146.6 dB
Satellite G/T at 60 deg. off-axis	+4 dBi
Receiver loss	-2.5 dB
Multipath propagation effect	-3 dB
Polarization loss	-3 dB
To satellite	-201 dBW/Hz
4800 bps	36.82 dBHz
Eb/No (10 -5) with coding	+4.5 dB
Uplink margin	+9.9 dB

4. Inbound downlink channels analysis (satellite to ground station)

Satellite transmitter/channel	-3 dBW
Satellite transmission losses	-0.7 dB
G/T at 60 degrees off-axis	+4 dBi
Max range (3500 km)	-145.93 dB
G/T	+16 dBi
Ground station receiver loss	-2.5 dB
Polarization loss	-3 dB
To receiver	-200 dBW/Hz
4800 bps	36.83 dBHz
Eb/No (10 -5)	+4.5 dB
Downlink margin	+5.5 dB
Power flux density at the ground in any 4 KHz band (dBW/m2/4 KHz)	-153.5 dBW/m2/4 KHz

5. The communication system block diagram is shown in Figure 1.

F. Physical Characteristics of STARNET Components

The STARNET component spacecraft will be designed to meet the following antenna pointing accuracy requirements:

Pitch	+/- 5º
Roll	+/- 5º
Yaw	not required

The mission requires orientation of the antennas to approximate local vertical, with no requirement for yaw stability. A motorized boom provides the necessary inertia configuration for gravity-gradient stabilization. Energy dissipation for stability is provided by four passive magnetic hysteresis rods, one in each solar panel spar. Passive gravity-gradient stabilization such as this has been demonstrated on numerous spacecraft. Energy dissipation to assure stability will be provided by two passive ball-in-tube nutation dampers. Attitude knowledge is required to perform the maneuvers necessary for the stabilization adjustment phase. This is provided by a three-axis vector magnetometer and digital sun sensors. Magnetometer and sun sensor data are telemetered and ground processing enables attitude determination.

The STARNET component spacecraft will have a design lifetime of 5 years. Lifetime is determined by a number of factors including component failures, aging effects, and fuel depletion.

The power subsystem will have sufficient battery capacity to power the spacecraft during periods of solar eclipse lasting up to approximately 45 minutes. Details of the specific power subsystem design will be available when the spacecraft contractor has been selected during the competitive procurement phase.

G. Emission Limitations

Given the use of spread spectrum techniques and the fact that STARNET is a low earth orbit system, however, it is expected that the level of spurious emissions will be negligible. Applicant will minimize any spurious emission anomalies.

H. Dates by which construction will be commenced and completed, launch date, and estimated date of placement into service.

The complete constellation of twenty-four (24) STARNET in-orbit component spacecraft will be launched within forty-eight (48) months after Commission approval. Component spacecraft will be designed and quality controlled twelve (12) months after program inception. Delivery of STARNET component spacecraft will commence twenty-four (24) months after Commission approval. Manufacturers are to deliver three (3) component spacecraft per quarter over (8) quarters. Spacecraft integration on the launcher is four (4) months for the first launch, and one (1) month for subsequent launches.

Launches will be conducted at a rate of three (3) every quarter. The launch period will start in the fourth quarter of 1993 and continue into the third quarter of 1995, assuming Commission approval in the second quarter of 1991.

I. The STARSYS application sets forth the public interest considerations, and the legal, financial, and technical qualifications of the Applicant. All information contained in the STARSYS application that is pertinent to this Application, but that may not be reproduced herein, is hereby incorporated by reference.

J. STARSYS waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests construction authority in accordance with this Application. All statements made in the attached exhibits are a material part hereof, and are incorporated herein as if set out in full in this Application.

K. The undersigned certifies for STARSYS that the statements made in this Application are true, complete, and correct to the best of his knowledge and belief, and are made in good faith.

WHEREFORE, STARSYS respectfully requests the Commission to grant this Application.

Respectfully submitted,

STARSYS, INC.

By: /S/ Ashok Kaveeshwar
Dr. Ashok Kaveeshwar
President

Date: May 4, 1990