**Title and Subtitle**
Communication Platform Payload Definition (CPPD) Study Final Report, Volume III Addendum

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**Abstract**
This is the Ford Aerospace & Communications Corporation Final Report for the Communication Platform Payload Definition (CPPD) Study program conducted for NASA Lewis Research Center under contract No. NAS3-24235.

This report presents the results of the study effort leading to five potential platform payloads to service CONUS and WARC Region 2 traffic demand as projected to the year 2008. The report addresses establishing the data bases, developing service aggregation scenarios, selecting and developing 5 payload concepts, performing detailed definition of the 5 payloads, costing them, identifying critical technology, and finally comparing the payloads with each other and also with non-aggregated equivalent services.

**Key Words (Suggested by Author(s))**
Communications Platform
Geostationary Platform
Satellite Communications
Telecommunication Forecast
Fixed Satellite Services
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APPENDIX A

NASA FSS TRAFFIC MODEL (for year 2008)

A-1 - DESCRIPTION

The various ways in which the NASA provided distribution between SMSAs was processed is described in Section 4.2.3.1.1. The two "intermediate" stages used for traffic (beam to beam being the final stage) were 84x84 and 20x20 matrices, the latter being used for the Ka-band fixed spot beams.

This appendix provides two "mapping" printouts, i.e., which SMSAs are in which region or spot beam. An 84x84 matrix for the total voice trunking traffic in 2008 is included, as well as a 20x20 matrix for year 2008 Ka fixed beam traffic. The latter represents 15,150,000 voice circuits, multiplied by a .6 digital/analog factor, and also includes 1,576,000 equivalent HVC for video conferencing. This total was then multiplied by .73 to obtain the traffic between the 20 fixed beams (see Figure 4.3.9). Distributions for the remaining 27% can be derived from the beam to beam matrix of Appendix G.1.1.
A-2 – MAPPING OF FUTURE SYSTEMS, INC.

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| IO2 | 868  | KS2 | 516  | KY1 | 194  | KY2 | 766  |
| LA1 | 466  | LA2 | 868  | ME1 | 254  | ME2 | 228  |
| MI3 | 4328 | MN1 | 166  | MN2 | 874  | MD1 | 1082 |
| MO2 | 310  | MS2 | 490  | MT1 | 92   | MT2 | 104  |
| NC1 | 1308 | NC2 | 284  | ND1 | 112  | ND2 | 266  |
| NE2 | 578  | NE1 | 246  | NM1 | 172  | NM2 | 92   |
| NV1 | 98   | NV2 | 166  | OEL | 2418 | OK1 | 240  |
| OK2 | 550  | OR1 | 446  | SCI | 476  | SC2 | 1044 |
| SD2 | 138  | TN1 | 952  | TN2 | 1152 | TX1 | 154  |
| TX2 | 128  | TX3 | 378  | TX4 | 1120 | TX5 | 470  |
| TX6 | 1782 | UT1 | 296  | WA1 | 578  | WA2 | 286  |
| WI1 | 326  | WI2 | 2062 | WY2 | 98   |      |      |
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| ML3       | 1588 MN1     | 80   MN2     | 706  MO1     | 996  7348 |
| MD2       | 246  MS2     | 278  MT1     | 60   MT2     | 90   7348 |
| NC1       | 666  NC2     | 320  ND1     | 932  NV1     | 146  7348 |
| NE2       | 568  NH      | 140   NJ     | 646  NY3     | 90   7348 |
| NV2       | 244  NY1     | 430  NY2     | 410  PA1     | 584  7348 |
| OH1       | 1180 OH2     | 890  GR1     | 232  SC2     | 342  7348 |
| PA2       | 1084 RI      | 128  SC1     | 474  TX4     | 788  7348 |
| SD2       | 92   TN1      | 630  TN2     | 396  VA1     | 180  7348 |
| TX5       | 430  TX6      | 1452 UT1     | 520  WA2     | 216  7348 |
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| IO1 | 396 | IO2 | 1292 | KS2 | 1130 | KY1 | 204 |
| KY2 | 716 | LA1 | 780 | LA2 | 1384 | MAS | 2134 |
| MD | 1660 | ME1 | 296 | ME2 | 138 | ME3 | 3836 |
| MN1 | 270 | MN2 | 1616 | MO1 | 1846 | MO2 | 552 |
| MS2 | 674 | MT1 | 422 | MT2 | 98 | NC1 | 1568 |
| NC2 | 840 | ND1 | 308 | ND2 | 574 | NE2 | 1280 |
| NH | 472 | NJ | 2220 | NM1 | 790 | NM2 | 332 |
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| ME2 | 150 | MT1 | 5638 | MN1 | 198 | MN2 | 1826 |
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| FL2 | 3396 | FL3 | 14236 | FLA | 6168 | GA2 | 4044 |
| ID2 | 700 | IN1 | 64 | IN2 | 372 | KS2 | 4684 |
| KY1 | 272 | KY2 | 1864 | LA1 | 3052 | LA2 | 6250 |
| MA5 | 12516 | MD | 12754 | ME1 | 1412 | ME2 | 630 |
| MI3 | 914 | MD1 | 4612 | MD2 | 2476 | MS2 | 2798 |
| MT1 | 602 | MT2 | 724 | NC1 | 9920 | NC2 | 4766 |
| ND1 | 822 | ND2 | 2172 | NE2 | 4926 | NH | 2386 |
| NJ | 14900 | NM1 | 1532 | NM2 | 550 | NV1 | 678 |
| NV2 | 1464 | NY1 | 8238 | NY2 | 10686 | NY3 | 17894 |
| OH1 | 3642 | OH2 | 6638 | OK1 | 1578 | OK2 | 5638 |
| OR1 | 3360 | PA1 | 11022 | PA2 | 17894 | RI | 1958 |
| SC1 | 3466 | SC2 | 4592 | SD2 | 978 | TN1 | 7942 |
| TN2 | 6884 | TX1 | 1260 | TX2 | 934 | TX3 | 2558 |
| TX4 | 7814 | TX5 | 2760 | TX6 | 14094 | UT1 | 2554 |
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| FL3 | 5664 | GA1 | 1040 | GA2 | 862 | ID2 | 162 |
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| ND2 | 392 | NE2 | 1262 | NH | 778 | NJ | 5444 |
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| OK2 | 1506 | OR1 | 848 | PA2 | 1682 | RI | 790 |
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| TX2 | 226 | TX3 | 634 | TX4 | 2142 | TX5 | 766 |
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| WA2 | 458 | WV1 | 490 | WV2 | 4288 | WV2 | 128 |

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    PHEA PIMA PONY PRRI REP1 SPCT STCT TRNJ VINJ WACT WIPA WIDE Woma Yopa
FX2  33
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    GRMH HAGH ININ JAMI KAMI KAIL KOIN LAIN LAMH LOOH MAOH MUOH MURI
    NEOH SOIN SPOH TEIN TOOH
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FX8  13
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FX9  12
    BAME BOMA BRMA BRMA CLAY LAMA LENA LEHA LINS MAXI MINH MINE MONE PONH
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    CLEN EVIN LEKY LOKY NATI NWKY SIMO
FX11 11
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FX12 10
    COMO JOMO KAMO LAKS LINE OMEH SIMO SMBO TOKS WIKS
FX13 10
    ALLA BALA BIMS JAMS MIAL MOLA NELA PAMS PIAR TULU
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    DUMN EAMI MIIN ROMN STNM WAMI
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    BIAL FTFL HUAL MINAL NAIL PFEI PEEF
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APPENDIX B

INTELSAT TRAFFIC MODEL

B-1 - DESCRIPTION

The August 1984 INTELSAT Traffic Data Base (Ref. 9) was entered for the year 1995. Printouts for the AOR and POR for this year follow. Also included are outputs from the "Grouping" program - described in Section 4.2.3.1.1- which are useful in estimating such factors as ISL capacity requirements.

The INTELSAT traffic forecast was used primarily for international/regional payload design for Scenario VI-A, (with Canada on VI-B).
The following pages are a listing of the AOR voice circuit traffic for 1995 as based upon the Intelsat forecast of August 1984.

The final pages of this section list the grouped country traffic for the AOR for year 1995.
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- ITALY: 29 KENYA: 18 NORDIC GRP: 5 SAUDI AR: 20
- SWITZERLAND: 42 U.K.: 44 U.S.: 15

**SURINAM Total = 153**
- NETHERLANDS: 153

**SWITZERLAND Total = 2107**
- ARGENTINA: 41 BRAZIL: 38 CAMEROON: 24 CANADA: 68
- CHILE: 28 COLUMBIA: 25 CONGO: 15 EQUADOR: 15
- EGYPT: 17 EL SALVADOR: 28 GABON: 12 IRAQ: 35
- ISRAEL: 16 IVORY COAST: 7 JORDAN: 12 KENYA: 20
- KUWAIT: 42 LEBANON: 33 MEXICO: 41 NIGERIA: 32
- PANAMA: 9 PARAGUAY: 15 PERU: 14 SAUDI AR: 61
- SOUTH AF.: 40 SUDAN: 42 TANZANIA: 6 TOGO: 12
- VENEZUELA: 35 ZIMBABWE: 9

**TANZANIA Total = 275**
- BELGIUM: 9 CANADA: 22 FRANCE: 12 GERMANY, FR: 23
- ITALY: 22 MOZAMBIQUE: 9 NORDIC GRP: 15 SWITZERLAND: 6

**TOGO Total = 318**
- BELGIUM: 11 FRANCE: 132 GABON: 25 GERMANY, FR: 18
- ITALY: 8 IVORY COAST: 44 SENEGAL: 21 SWITZERLAND: 12

**TRIN/TOBAGO Total = 557**
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**TUNISIA Total = 181**
- CANADA: 9 IRAQ: 12 IVORY COAST: 7 JORDAN: 12
- KUWAIT: 7 NORDIC GRP: 19 SAUDI AR.: 34 SENEGAL: 11
- TURKEY: 7 U.S.: 56 YUGOSLAVIA: 7

**TURKEY Total = 503**
- ALGERIA: 15 CANADA: 18 GERMANY, FR: 109 IRAN: 43
- ISRAEL: 14 LIBYA: 21 SAUDI AR.: 61 SPAIN: 40
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B-3 - AOR GROUPED COUNTRY TRAFFIC
### Group Distributions (AOR) -- 1995

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**Group 2 CANADA**

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- BARBADOS
- GUATEMALA
- MEXICO
- COSTA RICA
- DOM. REP.
- EL SALVADOR

**Group 4 ARGENTINA**
- BOLIVIA
- EQUADOR
- PARAGUAY
- CHILE

**Group 5 AUSTRIA**
- BELGIUM
- GREECE
- FRANCE
- COLUMBIA

**Group 6 ALGERIA**
- ANGOLA
- CHAD
- CONGO
- ETHIOPIA
- CAMEROON

**Group 7 ICELAND**
- U.K. (ASC)
- U.K. (BER)

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Total (one-way) = 135026
The following pages are a listing of the POR voice circuit traffic for 1995 as based upon the Intelsat forecast of August 1984.

The final page of this section lists the grouped country traffic for the POR for year 1995.
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Total For Matrix = 32223
B-5 - POR Grouped Country Traffic
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Group 2  CANADA
Group 3  MEXICO
Group 4  CHINA(PEK)  MALAYSIA  CHINA(TAI)  SINGAPORE  HONG KONG  THAILAND  JAPAN  KOREA
Group 5  AUSTRALIA  PHILIPPINES  FIJI  U.S.-GUAM  FRANCE (NC)  INDONESIA  NEW ZEALAND

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Total (one-way) = 32223
APPENDIX C

TRAFFIC MODELS FOR CANADA, MEXICO, AND BRAZIL

As part of the study, Ford Aerospace developed some very rough distribution models (in addition to the total traffic requirements from Task 1 - see Section 2) for Canada, Mexico, and Brazil. This was done because of the multiple reuse required in these countries to meet year 2008 demands. Distributions for Canada and Brazil were developed to the province or state level, while Mexico was defined to consist of North, Central, and South regions. See section 2.3 for a description of how the distributions were derived. The subsequent printouts in this Appendix provide the resulting traffic matrices.
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C-2 - MEXICO TRAFFIC MODEL
Mexico Voice -- Year 2008

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South America Forecast -- 2008

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*Notes:*
- The table lists the total number of forecasted events for each state.
- The states are grouped by region: ACRE, ALAGOAS, BAHIA, GOIAS, MINAS GERAIS, PERNAMBUCO, and RIO GR. S.
- The values represent the number of forecasted events for each state.
- The forecasted events are not specified in the text provided.
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APPENDIX D

TRAFFIC SURVEY BY SATELLITE SYSTEMS ENGINEERING (SSE)

D-l - SCOPE OF SURVEY

SSE conducted a survey to determine the demand for those data services considered most suitable for transmission via non-FSS. Services included are as follows:

1. Remote Job Entry (RJE).

This is a process by which an operator can manipulate data for a specific job from a remote site. RJE involves both manipulation of received data and transmission of the output to the originator after processing.

In the industry survey SSE found that oil and gas companies engaged in gas and oil exploration at remote sites, and institutions of higher education were most likely to use remote job entry data services.

Interviews with oil and gas exploration companies, such as Geosource/SBS Communications, Inc., Drilling Information Service Company and Schlumberger Services, indicate that these companies have different levels of operation, ranging from strictly domestic to international services to over 95 countries. However, all these companies engage in seismic data collection, manipulation and transmission of data from remote locations. Typically, data is transmitted at 4.8 to 56 kbps using transportable antennas.

Interviews with the University of Maryland and the National Technological University also revealed a need for remote job entry and time sharing data services (explained below).
The University of Maryland provides instructional services to over 50 countries. It also has 15 locations in the U.S. that provide remote job entry capability using four channels and IBM computers. The University of Maryland expressed a need for providing remote job entry capability to their overseas locations.

The National Technical University plans to offer graduate engineering courses on a national basis. The University will provide interactive timesharing entry and remote job capability to students.

2. Inquiry/Response

This service is transmitted in a real time manner through operator entered inquiries. The industry survey conducted by SSE revealed that the most common application of this service will be made by companies engaged in ticket and reservation systems, such as for airline reservations and stock exchange quotations by brokerage firms such as Piper, Jeffers and Hopward, which SSE interviewed.

3. Timesharing

This process involves the shared use of centrally located computer facilities by several operators. The computer facilities can store, manipulate and transmit data simultaneously among several users generally on a real time basis. Transmission speeds vary from 1.2 to 9.6 kbps.

SSE interviewed Milliper Corporation and Prime Computers, Inc., which provide wide area network coverage for data transmission. At present, market service is provided only to large users. However, in a recent joint venture with Vitalink, Prime Computer hopes to market capability to many users via Vitalink's earth stations.

D-2
4. **Point of Sale**

This will involve payments made by consumers in stores, gas stations, etc., which will automatically be entered into the banking system, rather than being made by credit cards or check. Point of sale terminals will be used for credit authorization, sales transactions and some inquiry functions.

SSE's interviews with the oil and gas company ARCO, supermarket chains such as Safeway and Kroger, and department stores such as Sears, Montgomery Ward and K-Mart, reveal that as these companies have from several thousand operating centers, they will make extensive use of point of sale data services. The minimum capability for data transmission needed is 1.8 kbps, or about 100 characters of information.

In addition to the services mentioned above, SSE found that these companies would also use point of sale terminals for regulation of inventory flow. This application will make use of separate display terminals in each store. Purchase orders will be entered into existing databases. This will allow quantities and type of merchandise to be weighed, and costs could be calculated in terms of retail sales dollars. In the future when home shopping via television becomes widespread, inquiry/response and point of sale services are expected to become integrated.

3. **Videotex/Teletext/Viewdata**

Videotex is a generic term which subsumes Teletext and Viewdata. Both are electronic text systems which display textual information on a video screen. These systems require a computerized data base and transmission links to provide information to the people who want it. The data
base can be alpha-numeric and/or graphic. The information can be transmitted via a telephone line or a satellite. Teletext flashes pages of text on a TV screen. The user, by punching a code, can abstract some specific information from a text. Examples of services are news, sports, weather. Viewdata is an interactive service and will allow people to access a library of information such as restaurant and movie reviews, and of airline schedules. Although Videotex is still in its infancy, its interactive capability will make it possible to have services like home banking, tele-shopping, and advertising, because this service can operate over a wide range of transmission systems, from broadcast to terrestrial lines, or two-way cable systems.

SSE's interviews with Coca-Cola and Citibank indicate that they are interested in using some Videotex systems for advertising and home banking.

6. Telemonitoring Services

This provides electronic monitoring from a central location. These services are provided by the following companies SSE interviewed:

--- ADT Security and Technicomsystems provide security and alarm systems.

--- National Rural Utilities will provide telemonitoring services for instant meter readings.

--- Railroad companies, such as Norfolk Southern and Southern Pacific, and transportation companies, in addition to mail and package delivery companies like United Parcel Service (UPS) and Federal Express, and long haul and trucking companies such as Leaseway Transportation and Mayflower, will use monitoring services for telemetry, control and dispatch.
7. Secure Voice

SEE's interviews with firms engaged in financial transactions (Citibank--electronic funds transfer; and Piper, Jeffers and Hopward--brokerage services) revealed these companies have a need to prevent interception of messages that might divulge proprietary or sensitive information on their daily transactions. As the trend toward replacement of telephone wires (which require a physical tap) with microwave radio and/or satellite transmission become more prevalent, the need to prevent interception of data will become more urgent. Secured voice services will provide encrypted dedicated private lines.
From among the data service categories outlined, SSE estimates that in particular inquiry-response, point of sale, and videotext/teletext data services will become more integrated. This is because of the need to provide customers with the ease of product or service selection, purchase, and adjustment of account in one simple process.

SSE's industry survey also indicates that a great demand exists for telemonitoring and remote job entry services in the long-haul trucking, gas and oil exploration, and railroad industries. Express mail and package delivery companies like United Parcel Service and Federal Express also demonstrated this need. From the interviews and literature survey SSE expects this demand to be satisfied most economically by mobile communications satellites.

With advancing technological capabilities and proliferation of computer terminals, the demand for timesharing data services will also continue to increase. However, by 1990 and 2000 SSE estimates that a greater percentage of this service will be transmitted via fiber optics because most of the traffic will be urban areas. The satellite addressable demand for this service may decrease in 1990 and 2000.
SSE's industry survey also reveals that as more and more information is transmitted electronically, the need for secure voice services will increase significantly. This is because of the need for companies to prevent interception of transmission of proprietary information.

The thrust toward the provision and control of data services from a central location, such as with point of sale and inquiry response services, will give rise to the development of regional or central systems. This means that in the future more data traffic will be long-haul.

It is estimated that as single cell terrestrial cellular radio systems become more numerous, the pressure for mobile services from "roamer" traffic, with the demand from companies engaged in trucking and dispatch services, will increase. This in turn will provide impetus for the provision of integrated, ubiquitous mobile services. The future trend will be for satellite mobile services to be compatible with terrestrial cellular mobile radio services.

SSE's review of Western Union's demand forecast and NASA's synthesis, combined with SSE's own demand estimates for data traffic based on interviews with industry experts, shows only a very slight variation in end traffic demand forecasts. SSE, therefore, considers it reasonable to accept NASA's synthesis of traffic demand forecast for the data services listed above for the years 1990 and 2000.
D-3 - LIST OF INDUSTRY SURVEY RESPONDENTS
NAMES AND ADDRESSES OF PEOPLE CONTACTED IN THE INDUSTRY SURVEY

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APPENDIX E

SATELLITE SYSTEM PROFILES

The following profiles of current and projected satellite systems were prepared by Satellite Systems Engineering (SSE). The summary is as of January 1985.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>INTELSAT V MCS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>COMSAT GENERAL for INMARSAT</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>4 maritime communication subsystem payloads on INTELSAT V spacecraft.</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>May 1983, October 1983, March 1984</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>60 &amp; 63 East, 53 &amp; 18.5 West</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>1.6, 6/1.5, 5 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>15 MHz</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>Two 7.5 MHz channels, capacity about 7 voice circuits per spacecraft</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Telephony, data, facsimile, and telex between coastal earth stations and ships at sea.</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>Already operational</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td></td>
</tr>
</tbody>
</table>
System Name: MARISAT
Operator: COMSAT GENERAL for INMARSAT
Number of Satellites: 3 in orbit
Date of Launch(es): February, June and October 1976
Orbital Position(s): 14.5 West, 72.5 and 176.5 East
Frequencies: 1.6, 6/1.5, 5 6 GHz
Total Bandwidth, MHz: 8 MHz
Number of Transponders: 2 4-MHz wide channels
Services Provided: Maritime mobile satellite services such as telephony, data, facsimile and telex.
Probability of Operation: Already operational
Discussion: Spacecraft formed first commercial maritime mobile service system. Transponders were subsequently leased by INMARSAT. MARISAT also carries a military payload not used by INMARSAT. Capacity only one voice circuit when military payload used.
System Name: MARECS
Operator: ESA for INMARSAT
Number of Satellites: 2 in orbit
Date of Launch(es): December 1981 and November 1984
Orbital Position(s): 24.5 West and 177.5 East
Frequencies: 1.6, 6/1.5, 5 GHz
Total Bandwidth, MHz: 11 MHz
Number of Transponders: 1 5.9 MHz mode ship to shore channel, 1 shore to ship 4.75 MHz channel. Capacity about 35 voice circuits.
Services Provided: Telephony, data, facsimile and telex services between coastal earth stations and ships at sea.
Probability of Operation: Already operational
Discussion: Spacecraft were built by MESN Consortium, headed by British Aerospace and based on OTS/ECS bus.
System Name: INTELSAT
Operator: International Telecommunication Satellite Organization
Number of Satellites: 9 in orbit over AOR, 3 in orbit over IOR, 2 in orbit over POR. 8 INTELSAT IV and IV-A spacecraft in orbit were built by Hughes Aircraft Co. 5 INTELSAT V's in orbit by Ford Aerospace. 5 additional under construction by Ford (INTELSAT V-A and V-B series). 5 under construction by Hughes (INTELSAT VI series).
Date of Launch(es): First INTELSAT V launched December 1980. First INTELSAT V-A in March 1985. 1986 planned for INTELSAT VI.
Orbital Position(a): 1, 3, 18.5, 21.5, 24.5, 27.5, 31, 34.5, 50 and 53 West (AOR), 57, 60 and 63 East (IOR), and 174, 177 and 179 East (POR). 66 East (IOR) and 177 (POR) currently unoccupied. Positions include spare domestic lease and planned international business service location.
Frequencies: 6/4 and 14/11 GHz
Total Bandwidth, MHz: 2000-3000 (Frequency reuse)
Number of Transponders: 12 C-band (INTELSAT IV)
20 C-band (INTELSAT IV-A)
21 C-band, 6 Ku-band (INTELSAT V)
32 C-band, 6 Ku-band (INTELSAT V-A)
38 C-band, 10 Ku-band (INTELSAT VI)
per satellite in each series
Services Provided: telephone, television, teletype and data transmission, domestic leases, international business services, VISTA
Probability of Operation: already operational
Discussion: INTELSAT has been providing reliable international telecommunication services by satellite since the early 1960s. INTELSAT V F-4 and F-8 each carry one additional maritime transponder used by INMARSAT.
**Employment of Intelsat IV, IV-A, and V Series Spacecraft in February 1985,**
Before launch of first V-A spacecraft

<table>
<thead>
<tr>
<th>Service Area</th>
<th>AOR</th>
<th>AOR</th>
<th>AOR</th>
<th>AOR</th>
<th>AOR</th>
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<th>AOR</th>
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<th>AOR</th>
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<tbody>
<tr>
<td>Service Type</td>
<td>IBS</td>
<td>IBS</td>
<td>MFI</td>
<td>SPARE</td>
<td>SPARE</td>
<td>PRIMARY</td>
<td>SPARE</td>
<td>MP2</td>
<td>SPARE</td>
</tr>
<tr>
<td>Location</td>
<td>307</td>
<td>310</td>
<td>325.5</td>
<td>329</td>
<td>332.5</td>
<td>335.5</td>
<td>338.5</td>
<td>341.5</td>
<td>356</td>
</tr>
<tr>
<td>Spacecraft Series</td>
<td>V</td>
<td>IV</td>
<td>V</td>
<td>IV-A</td>
<td>V</td>
<td>V</td>
<td>IV-A</td>
<td>V</td>
<td>IV-A</td>
</tr>
<tr>
<td>Number</td>
<td>F-8</td>
<td>F-1</td>
<td>F-2</td>
<td>F-1</td>
<td>F-4</td>
<td>F-3</td>
<td>F-4</td>
<td>F-6</td>
<td>F-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Area</th>
<th>IOR</th>
<th>IOR</th>
<th>IOR</th>
<th>IOR</th>
<th>POR</th>
<th>POR</th>
<th>POR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Type</td>
<td>SPARE</td>
<td>PRIMARY</td>
<td>MP</td>
<td>SPARE</td>
<td>PRIMARY</td>
<td>SPARE/MP</td>
<td>SPARE</td>
</tr>
<tr>
<td>Location</td>
<td>57</td>
<td>60</td>
<td>63</td>
<td>66</td>
<td>174</td>
<td>177</td>
<td>179/180</td>
</tr>
<tr>
<td>Spacecraft Series</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>IV-A</td>
<td>IV-A</td>
<td>IV-A</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>F-7</td>
<td>F-7</td>
<td>F-5</td>
<td>F-6</td>
<td>F-3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**  
Intelsat V-A F-10 to be positioned at 332.5, Intelsat V F-4 to be then moved. Intelsat V-A F-11 to be positioned at 335.5 East after launch. Intelsat V F-3 to be moved to 307 East.

Spare position may be used for domestic lease.

*IBM = International Business Service  
NP = Major Path*

**Ford Aerospace & Communications Corporation**
System Name: CYGNUS
Operator: Cygnus Satellite Corp.
Number of Satellites: 2 in orbit and a spare planned
Date of Launch(es): 1987 planned
Orbital Position(s): 43 and 45 West requested in pending applications to FCC
Frequencies: 14/11-12 GHz
Total Bandwidth, MHz: 1000 (Frequency reuse)
Number of Transponders: 16 active 54 MHz Ku-band transponders per satellite
Services Provided: voice, video and data transmission
Probability of Operation: low/medium
Discussion: Cygnus Satellite still has to obtain authorization, secure financing and show a customer base for its proposed transatlantic services. President Reagan has determined that private international systems are in the U.S. national interest and the FCC is determining how to process these applications. After FCC approval, these systems will still face the difficulty of international coordination; i.e., with INTELSAT, and obtaining foreign PTT correspondents.
System Name: ISI

Operator: International Satellite, Inc.

Number of Satellites: 2 in orbit planned

Date of Launch(es): 1987 planned

Orbital Position(s): 56 and 58 West requested in pending application to FCC

Frequencies: 14/11-12 GHz

Total Bandwidth, MHz: 2000 (dual frequency reuse)

Number of Transponders: 32 active 54 MHz Ku-band transponders per satellite

Services Provided: video distribution, data transmission, teleconferencing

Probability of Operation: low/medium

Discussion: International Satellite still has to obtain authorization and show a customer base for its proposed transatlantic services. President Reagan has determined that private international systems are in the U.S. national interest and the FCC is determining how to process these applications. After FCC approval, these systems will still face the difficulty of international coordination; i.e., with INTELSAT, and obtaining foreign PTT correspondents.
System Name: ORION

Operator: Orion Satellite Corp.

Number of Satellites: 2 in orbit planned

Date of Launch(es): 1987 planned

Orbital Position(s): 38.5, 37 and 50 West requested in pending application to FCC

Frequencies: 14/11 GHz

Total Bandwidth, MHz: 1000 (frequency reuse)

Number of Transponders: 22 active 36-MHz Ku-band transponders per satellite

Services Provided: voice, video and data transmission services for private customers

Probability of Operation: low/medium

Discussion: Orion still has to obtain authorization, secure financing, and show a customer base for its proposed transatlantic services. President Reagan has determined that private international systems are in the U.S. national interest and the FCC is determining how to process these applications. After FCC approval, these systems will still face the difficulty of international coordination; i.e., with INTELSAT, and obtaining foreign PTT correspondents.
System Name: UNISAT

Operator: United Satellites, Ltd.

Number of Satellites: 3 possibly already under construction by British Aerospace-led consortium in England

Date of Launch(es): 1986/87 planned

Orbital Position(s): 31 West authorized for broadcast services

Frequencies: 14/11-12 and 17/11/12 GHz

Total Bandwidth, MHz: 1000 (frequency reuse)

Number of Transponders: 6 active 36-MHz Ku-Band and 2 active DBS transponders per satellite

Services Provided: telephone, telex, data and direct broadcast satellite services

Probability of Operation: low/medium

Discussion: Continued funding of project unclear. On the one hand, the BBC is interested in using the DBS channels. On the other hand, opponents state that the spacecraft will be too expensive and argue for buying from a U.S. spacecraft manufacturer.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>Pacific Basin Satellite System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Pacific Telecommunications Council</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>1 or 2 in orbit, 1 spare</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1987 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>160 possible, 1 FRB not yet notified</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>6/4 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>500</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>8 to 12 per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Telephony, telegraphs, data and television distribution</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Pacific Telecommunication Council has studied satellite system. If financing can be obtained a satellite could be launched as early as 1987. Systems would have to be internationally coordinated to avoid interference.</td>
</tr>
</tbody>
</table>
Ford Aerospace &
Communications Corporation

System Name: ALASCOM AURORA
Operator: Alascom, Inc.
Number of Satellites: 1 in orbit/operational, 3 more planned, including ground spare
Date of Launch(es): Oct 1982
Orbital Position(s): 143 West occupied
Frequencies: 6/4 GHz
Total Bandwidth, MHz: 1000 (Frequency Reuse)
Number of Transponders: 24 active 36-MHz C-band transponders
Services Provided: message toll, private line, audio and video transmission; tele-conferencing, teletext and video-text planned.
Probability of Operation: System already is operational; 60% for 3 satellites
Discussion: Alascom Inc. is owned by Pacific Telecom. The company purchased RCA Satcom V in 1982 and renamed it AURORA. The ground segment currently comprises over 190 earth stations in Alaska. ALASCOM-3 would actually be a replacement for ALASCOM-1.

<table>
<thead>
<tr>
<th>Year</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>95</td>
<td>24</td>
<td>72</td>
</tr>
</tbody>
</table>

E-12
System Name: AMERICAN SATELLITE

Operator: American Satellite Company

Number of Satellites: 2 or 3 under construction by RCA Astro-Electronics
2 advanced hybrids planned

Date of Launch(es): 1985, 1986 and 1987 planned
1989 planned for 2nd Gen.

Orbital Position(s): 81 and 128 West authorized by FCC

Frequencies: 6/4 and 14/12 GHz
also 30/20 GHz for 2nd Gen

Total Bandwidth, MHz: 1500 with partial frequency reuse
3000 for 2nd Gen.

Number of Transponders: 12 36-MHz and 6 72-MHz C-band,
6 72-MHz Ku-band for first S/C,
24 C-band, 19 Ku-band and 3 Ka-band
transponders planned for 2nd Gen.

Services Provided: voice, video and data transmission,
in particular electronic mail, videoconferencing and computer
network services planned

Probability of Operation: Ground segment already operational
using Western Union WESTAR satellites

Discussion: American Satellite has 10 years of
operational experience and an
extensive network of earth stations
installed for its private and
government customers. The company
is owned by Fairchild Industries and
Continental Telecom and has secured
a $300 million credit line for its
planned satellite system.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>CABLESAT GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Cablesat General Corp.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>2 in orbit and a ground spare planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>mid-80s planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>one position each between 60-70 and 140-150 West requested in pending application to FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>6/4 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency Reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>24 active 36-MHz transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>television and audio broadcast, in particular to cable networks, experimental amateur radio</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Cablesat General has received a turnkey proposal from RCA Astro-Electronics to build the satellites but has yet to obtain FCC license. Financing and customer base need to be demonstrated.</td>
</tr>
</tbody>
</table>
System Name: COLUMBIA COMMUNICATIONS

Operator: Columbia Communications Corp.

Number of Satellites: 2 planned

Date of Launch(es): mid 1980s planned

Orbital Position(s): 62.5 and 147.5 West requested in pending application to FCC

Frequencies: 6/4 GHz

Total Bandwidth, MHz: 1000 (Frequency Reuse)

Number of Transponders: 24 active 36-MHz transponders per satellite

Services Provided: transponder services

Probability of Operation: low

Discussion: Columbia Communications plans to raise the required capital for its system by selling all transponders to individual partnerships. The company has yet to demonstrate this kind of financing works.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>COMSTAR C-BAND</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>AT&amp;T and GTE</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>3 in orbit, of which two are colocated and nearing retirement</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>July 1976, June 1978 and February 1981</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>76.5, 76, and 127 West occupied</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>6/4 GBz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency Reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>24 active 36-MHz C-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>telephone, telegraph, data and television transmission</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>Already in operation</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>These satellites are to be replaced by AT&amp;T TELSTAR and GTE SPACENET systems, respectively.</td>
</tr>
</tbody>
</table>
System Name: COMSTAR KU-BAND

Operator: Comsat General Corp.

Number of Satellites: 3 in orbit planned

Date of Launch(es): April 1988, August 1988 and January 1989 planned

Orbital Position(s): 93 and 101 West requested in pending application to FCC

Frequencies: 14/12 GHz

Total Bandwidth, MHz: 1000 (Frequency Reuse)

Number of Transponders: 16 active 54-MHz transponders per satellite

Services Provided: video distribution, private network and transponder services

Probability of Operation: medium

Discussion: Comsat General still has to obtain FCC authorization for its system, demonstrate financing and customer base, however, if the DBS industry continues to evolve towards medium power satellites, and STC is delayed further, these satellites could have a bright future.
System Name: DCBS

Operator: Palmer Associates

Number of Satellites: 2 in orbit planned initially (Phase I)*

Date of Launch(es): 1987 planned (Phase I)

Orbital Position(s): 119 to 132 West requested in pending application to FCC

Frequencies: 30/20 and 14/12

Total Bandwidth, MHz: 2000 (frequency reuse)

Number of Transponders: 3 Ka-band, undetermined number of Ku-band

Services Provided: Television distribution, data transmission, videoconferencing probable.

Probability of Operation: low

Discussion: Customer base and financing unclear

* 2 more planned for Phase 2 and a platform planned for Phase 3.
System Name: DIGISAT

Operator: Digital Telesat, Inc.

Number of Satellites: 3 planned

Date of Launch(es): 1988, 1989 and 1991 planned

Orbital Position(s): 57 and 134 West requested in pending application to FCC

Frequencies: 6/4 and 14/12 GHz

Total Bandwidth, MBz: 1000 (Frequency Reuse)

Number of Transponders: 24 active 36-MHz C or Ku-band transponders per satellite

Services Provided: voice, video and data transmission for digital networks, in particular cellular mobile radio and paging systems

Probability of Operation: low

Discussion: Digital Telesat has to demonstrate its financing and customer base. The system design calls for co-location of a C- and Ku-band satellite at 57 West, intersatellite links and an additional Ku-band satellite at 134 West.
System Name: EQUASTAR

Operator: Equatorial Communication Services, Inc.

Number of Satellites: 2 operational and a spare planned

Date of Launch(es): 1987 and 1988 planned

Orbital Position(s): 93 and 122 West requested in pending application to FCC

Frequencies: 6/4 GHz

Total Bandwidth, MHz: 1000 (Frequency Reuse)

Number of Transponders: 24 active 36-MHz transponders per satellite

Services Provided: data transmission between spread spectrum networks

Probability of Operation: ground segment already operational; medium

Discussion: Equatorial is currently leasing transponder space on Western Union WESTAR satellites. Equatorial still has to demonstrate customer base and financing for its system. Typical example of satellite user/earth station manufacturer wanting to put up own satellite system.
System Name: FEDNET

Operator: Federal Express Corp.

Number of Satellites: 2 in orbit plus a ground spare planned

Date of Launch(es): Jan. and Mar. 1988 planned

Orbital Position(s): 101 and 134 West requested in pending application to FCC

Frequencies: 14/12 GHz

Total Bandwidth, MHz: 2000 (2x frequency reuse)

Number of Transponders: 32 active 56-MHz and 16 active 112-MHz Ku-band transponders per satellite

Services Provided: low-speed electronic document and data transmission to on-premise terminals

Probability of Operation: medium/high

Discussion: Still looking for interim capacity for its ZAP-MAIL electronic mail service.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>FORDSAT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Ford Aerospace Satellite Services, Inc.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>3 operational planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1988 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>73, 93 and 101 West requested in pending application to FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>6/4 and 14/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>2000 (Dual frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>24 36-MHz C-band and 24 36-MHz Ku-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>transponder services for independent telephone companies, intracity TDMA networks, television distribution</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Ford has yet to announce a customer base, secure financing and obtain FCC authorization. Ford argues that economics of sale will lower its transponder costs, interconnectivity between C and Ku band make system attractive to users.</td>
</tr>
</tbody>
</table>
System Name: GALAXY (C-BAND)

Operator: Hughes Communications Galaxy, Inc.

Number of Satellites: 3 in orbit built by Hughes Aircraft Co. 1 more planned for launch in 1986.


Orbital Position(s): 74, 93.5 and 134 West occupied 137 West requested in pending application to FCC

Frequencies: 6/4 GHz

Total Bandwidth, MHz: 1000

Number of Transponders: 24 active 36-MHz C-band transponders per satellite

Services Provided: telephony (up to 2500 FDM/FM voice channels per transponder), television distribution (to cable operators) and data transmission (1.5 Mb/s and 60 Mb/s digital)

Probability of Operation: already operational

Discussion: The Hughes GALAXY system already has several customers for television distribution and telephony and has implemented an earth station network in several major cities in the U.S.
System Name: GALAXY (KU-BAND)

Operator: Hughes Communications Galaxy, Inc.

Number of Satellites: 3 in orbit/operational planned

Date of Launch(es): 1987 and 1988 planned

Orbital Position(s): 73, 75 and 93 West requested in pending application to the FCC

Frequencies: 14/12 GHz

Total Bandwidth, MHz: 1000 (Frequency reuse)

Number of Transponders: 16 active Ku-band transponders per satellite

Services Provided: telephony (up to 4000 FDM/FM voice channels per carrier), data transmission (1.5 Mb/s and up to 80 Mb/s) and video distribution to cable networks

Probability of Operation: medium

Discussion: Hughes has to demonstrate customer base and financing for this additional system. Their track record is good.
System Name: HUGHES KA-BAND
Operator: Hughes Communications Galaxy, Inc.
Number of Satellites: 2 in orbit planned
Date of Launch(es): 1989 planned
Orbital Position(s): 91 and 93 West requested in pending application to FCC
Frequencies: 30/20
Total Bandwidth, MHz: 2000 (frequency reuse)
Number of Transponders: 32 active 20-W Ka-band TWTA's
Services Provided: Wideband data transmission, video-conferencing
Probability of Operation: low/medium
Discussion: System still requires authorization from FCC. Problem may arise due to FCC allocation of 18 GHz band to former terrestrial 12 GHz users and new DTS applicants. Only 500 MHz of planned satellite downlink band 19.7 to 20.2 GHz currently exclusively allocated to satellite users, the rest (17.7 to 19.7 GHz) must be shared.
**System Name:** GSTAR

**Operator:** GTE Satellite Corp.

**Number of Satellites:** 3 built by RCA Astro-Electronics, or in final stages of construction

**Date of Launch(es):** First launch planned for April 1985, 1985 to 1987 planned for later launches

**Orbital Position(s):** 103 and 106 West authorized 101 West requested in pending application to FCC

**Frequencies:** 14/12 GHz

**Total Bandwidth, MHz:** 1000 (Frequency reuse)

**Number of Transponders:** 16 54-MHz Ku-band transponders per satellite

**Services Provided:** full transponder audio and video services, end-to-end digital channels and private network services

**Probability of Operation:** high

**Discussion:** GTE has gained operational expertise with the COMSTAR system and the installation of earth station networks. However, their customer base is unknown, and there must be doubt about the launch of the first satellite unless their marketing improves.
System Name: MARTIN MARIETTA

Operator: Martin Marietta Communications Systems, Inc.

Number of Satellites: 2 in orbit planned, plus a ground spare

Date of Launch(es): September 1988 planned

Orbital Position(s): 73 and 75 West requested in pending application to FCC

Frequencies: 14/12 GHz

Total Bandwidth, MHz: 1000 (Frequency reuse)

Number of Transponders: 8 54-MHz Ku-band CONUS and 10 235-MHz Ku-band SPOT transponders per satellite

Services Provided: voice, data, facsimile, teleconferencing and video services

Probability of Operation: medium

Discussion: The satellite system features frequency reuse through dual polarization and spacial isolation of spot beams. Martin Marietta still needs to show its customer base.
System Name: RCA SATCOM (C-BAND)

Operator: RCA American Communications, Inc.

Number of Satellites: 5 operational, 1 more under construction RCA Astro-Electronics, 3 more planned


Orbital Position(s): 67, 72, 83, 131 and 139 authorized by FCC, 61, 63 and 65 West requested in pending application to FCC

Frequencies: 6/4 GHz

Total Bandwidth, MHz: 1000 (Frequency reuse)

Number of Transponders: 24 36-MHz C-band transponders per satellite

Services Provided: telephony, telegraph, data transmission and television distribution

Probability of Operation: already operational

Discussion: RCA is a well established operator and has also installed several earth station networks
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>RCA SATCOM (KU-BAND)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>RCA American Communications, Inc.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>3 under construction by RCA Astro-Electronics, 3 more planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>67, 77 and 87 West authorized by FCC, 61, 63 and 65 West requested in pending application to FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>14/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>16 54-Mhz Ku-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>voice and data transmission, radio and television distribution</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>high</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>RCA is a well established operator, experienced in the installation of earth station networks.</td>
</tr>
</tbody>
</table>
System Name: SBS


Number of Satellites: 4 in orbit/operational, 2 more under construction by Hughes Aircraft Co., 3 more planned


Orbital Position(s): 95, 97, 99, 101 and 124 West authorized by FCC

Frequencies: 14/12 GHz

Total Bandwidth, MHz: 500-1000 (Frequency reuse)

Number of Transponders:
- SBS 1-4: 10 43-MHz Ku-band transponders per satellite
- SBS 5: additional 4 110-MHz Ku-band transponders on each satellite
- SBS 6-9: 19 43-MHz Ku-band per satellite

Services Provided: digital voice, data, facsimile and videoconferencing, television distribution transponder services

Probability of Operation: already in operation

Discussion: SBS is an established operator with an extensive earth station in place.
System Name: SPACENET

Operator: GTE Spacenet Corp.

Number of Satellites: 3 built by RCA Astro-Electronics

Date of Launch(es): May 1984 launched; Nov. 1984, March 1985 and 1986 planned

Orbital Position(s): 69, 91 and 120 West authorized by FCC, 101 West requested in pending application to FCC

Frequencies: 6/4 and 14/12 GHz

Total Bandwidth, MHz: 1500 (Partial frequency reuse)

Number of Transponders: 12 36-MHz and 6 72-MHz C-band and 6 72-MHz Ku-band transponders per satellite

Services Provided: SPRINT voice and data transmission, switched and private line services

Probability of Operation: already operational

Discussion: GTE is a well-established operator and its affiliate GTE Spacenet owns the SPRINT earth station network, which will use space segment on SPACENET.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>SPOTNET (C-BAND)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>National Exchange, Inc.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>3 planned (2 in orbit and a spare)</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1987 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>75 &amp; 101 West</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>6/4 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>24 36-MHz C-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>High density point-to-point trunking, broadcast audio and video services, teleconferencing</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>National Exchange still has to demonstrate it can secure financing and show a customer base.</td>
</tr>
<tr>
<td><strong>System Name:</strong></td>
<td>SPOTNET (KU-BAND)</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Operator:</strong></td>
<td>National Exchange, Inc.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>4 planned (2 colocated pairs in orbit)</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1987 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>75 and 101 West requested in pending application to FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>14/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>24 active 36-MHz transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>electronic mail, videoconferencing, teletext</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>National Exchange has yet to demonstrate it has secured financing and show a customer base.</td>
</tr>
</tbody>
</table>
System Name: TELSTAR

Operator: American Telephone and Telegraph Co.

Number of Satellites: 2 in orbit/operational, 2 more under construction by Hughes


Orbital Position(s): 76, 88.5 and 96 authorized by FCC, 127 West requested in pending application to FCC

Frequencies: 6/4 GHz

Total Bandwidth, MHz: 1000 (Frequency reuse)

Number of Transponders: 24 active 36-MHz C-band transponders per satellite

Services Provided: SKYNET audio and television broadcast, 1.5 Mb/s data transmission, transponder lease, up to 3900 voice channels per transponder

Probability of Operation: already operational

Discussion: AT&T is a well-established operator servicing an extensive earth station network.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>USAT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>U.S. Satellite Systems, Inc.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>2 possibly already under construction by Hughes, 3 more planned, including ground spare</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>Nov. 1986, March 1987, 2 in 1988/89 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>73 and 83 West requested in pending application to FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>14/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>20 active 43-MHz Ku-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>digital voice, data and video satellite transmission services</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>U.S. Satellite Systems has reportedly secured $23 million, but has yet to show a customer base. In 1985, the FCC rescinded the conditional construction permit for the first two spacecraft. The other applications are still pending.</td>
</tr>
</tbody>
</table>
System Name: WESTAR (C-BAND)

Operator: Western Union Telegraph Co.

Number of Satellites: 4 in orbit/operational, a total of 7 in orbit planned


Orbital Position(s): 79, 91, 99 & 123 West occupied 87, 93 and 130 West requested in pending application to FCC

Frequencies: 6/4 GHz

Total Bandwidth, MHz: 500-1000 (Frequency reuse)

Number of Transponders: Westar II & III: 12 active 36-MHz C-band transponders per satellite, all others 24 active C-band transponders

Services Provided: telephony, telegraph, data transmission, television distribution

Probability of Operation: already operational

Discussion: Western Union is a well-established operator with several customers and serves and extensive earth station network. It should be noted that Western Union's supply of available transponders will get a major boost when ASC switches over their dedicated system.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>WESTAR (KU-BAND)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Western Union Telegraph Company</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>3 in orbit planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>2 in 1988, 1 in 1989</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>87, 91 and 93 West requested in pending application to the FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>14/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>16 active 54-MHz Ku-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>transponder lease for audio and video distribution, TELEX, TWX</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Western Union is a well-established operator with several customers. However, the customer base for this Ku-band system remains unknown.</td>
</tr>
</tbody>
</table>
System Name: DBSC
Operator: Direct Broadcast Satellite Corporation
Number of Satellites: 2 or 3 to be built by Ford Aerospace & Communications Co.
Date of Launch(es): 1988 planned
Orbital Position(s): 101, 148 West requested, but not yet authorized by the FCC.
Frequencies: 17/12 GHz
Total Bandwidth, MHz: 1000
Number of Transponders: 6 active 2000 W. 1/2 CONUS and 12 active 45 W. spot beams
Services Provided: Direct broadcast satellite services, such as television, stereo broadcast, HDTV
Probability of Operation: low/medium
Discussion: DBSC still has to demonstrate a customer base. A $177 million contract has been signed with Ford Aerospace, and timely payments are being made.
System Name: DVSS
Operator: Dominion Video Satellite Systems, Inc.
Number of Satellites: 2 in orbit and 1 spare planned
Date of Launch(es): 1987 planned
Orbital Position(s): 119 West authorized
Frequencies: 17/12 GHz
Total Bandwidth, MHz: 500
Number of Transponders: 4 active 230 W. TWTA's
Services Provided: Direct broadcast satellite services such as television and radio broadcasting
Probability of Operation: low/medium
Discussion: Company has met due diligence and signed contract with Hughes Aircraft Co. for construction of satellites based on HS-394 bus. System cost is estimated at $250 million. Satellites will have to be co-located in orbit at 119 West or other orbital position obtained from FCC.
System Name: RCA-DBS

Operator: RCA American Communications

Number of Satellites: 2 in orbit planned

Date of Launch(es): late 1989 planned

Orbital Position(s): to be determined

Frequencies: 17/12 GHz

Total Bandwidth, MHz: 1000

Number of Transponders: 16 100 W. Transponders

Services Provided: Direct broadcast satellite services such as HDTV, videotext

Probability of Operation: low/medium

Discussion: RCA has postponed its original plan to provide DBS service in the mid-80's.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>STC-DBS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Satellite Television Corporation</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>2 under construction by RCA Astro-Electronics</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1986 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>101 West authorized by FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>17/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>500</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>3 active 200 W. TWTA's</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Direct broadcast satellite services such as television and sound distribution, HDTV</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>COMSAT has reportedly &quot;abandoned&quot; project, status of satellites unclear.</td>
</tr>
</tbody>
</table>
System Name: USSB-DBS


Number of Satellites: 2 in orbit and 1 spare to be built by RCA Astro-Electronics

Date of Launch(es): 1988 planned

Orbital Position(s): 10 and 148 West authorized by FCC

Frequencies: 17/12 GHz

Total Bandwidth, MHz: 500

Number of Transponders: 6 active 200 W. TWTA's

Services Provided: Direct broadcast satellite services such as television and stereo broadcast, HDTV

Probability of Operation: low/medium

Discussion: USSB has met FCC due diligence requirement and signed $100 - 150 million contract with RCA to build satellites.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>HUGHES-DBS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Hughes Communications Galaxy, Inc.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>2 in orbit planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1989 and 1990 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>119 West requested pending FCC authorization</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>17/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>16 active 100 W. TWTA's</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Direct broadcast satellite services such as television, voice and data transmissions, teleconferencing</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Construction permit by FCC (2nd round DBS applicant). Design uses HS-394 bus.</td>
</tr>
<tr>
<td><strong>System Name:</strong></td>
<td>NCN-DBS</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Operator:</strong></td>
<td>National Christian Network</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>2 in orbit and 1 spare planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1987/88 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>101, 148 West requested pending FCC authorization</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>17/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>500</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>6 active 230 W. TWTA's</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Direct broadcast satellite services such as television program distribution.</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Construction permit granted by FCC. (2nd round DBS applicant).</td>
</tr>
</tbody>
</table>
System Name: SDT-DBS

Operator: Satellite Development Trust

Number of Satellites: 3 including in orbit spare planned

Date of Launch(es): 1987 planned

Orbital Position(s): 61.5, 148 West requested pending FCC authorization

Frequencies: 17/12 GHz

Total Bandwidth, MHz: 1000

Number of Transponders: 16 active 50 W. TWTA's

Services Provided: Direct broadcast satellite services such as television distribution

Probability of Operation: low/medium

Discussion: Construction permit granted by FCC. (2nd round DBS applicant). Applicant design based on HS-393 bus. Customer base and financing must be demonstrated (due diligence).
System Name: SSS-DBS

Operator: Satellite Syndicated Systems, Inc.

Number of Satellites: 2 in orbit and a spare planned

Date of Launch(es): 1989 planned

Orbital Position(s): 101, 148 West requested

Frequencies: 17/12 GHz

Total Bandwidth, MHz: 500

Number of Transponders: 6 active 230 W. TWTA's

Services Provided: Direct broadcast satellite services such as television, voice and data.

Probability of Operation: low/medium

Discussion: Construction permit granted by FCC. (2nd round DBS applicant). Customer base and financing must be demonstrated (due diligence).
System Name: NEX-DBS

Operator: National Exchange, Inc.

Number of Satellites: 2 planned

Date of Launch(es): 1988 and 1990 planned

Orbital Position(s): 101 West requested pending FCC authorization

Frequencies: 17/12 GHz

Total Bandwidth, MHz: 1000

Number of Transponders: 16 active 50 W. TWTA's

Services Provided: Direct broadcast satellite services such as television program distribution and data transmission.

Probability of Operation: low/medium

Discussion: Construction permit awarded by FCC. Customer base and financing must be demonstrated (due diligence).
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>ACC-DBS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Advanced Communications Corporation</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>3 including in orbit spare planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1987 and 1988 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>101 and 148 West requested pending FCC authorization</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>17/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>500</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>6 active 200 W. TWTA's</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Direct broadcast satellite services such as television program distribution</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Conditional construction permit authorized by FCC. Customer base an financing must be demonstrated (due diligence).</td>
</tr>
</tbody>
</table>
System Name: \(\text{GEOSTAR}\)

Operator: Geostar Corporation

Number of Satellites: 3 in orbit planned

Date of Launch(es): 1987 planned

Orbital Position(s): 70, 100, 130 West requested pending FCC authorization

Frequencies: \(1.6, 6 \text{ GHz/} 2.5 \text{ GHz, and } 5/6 \text{ GHz}\)

Total Bandwidth, MHz: 160 MHz

Number of Transponders: 10 16 MHz wide channels

Services Provided: Radiodetermination services, e.g. position location and ancillary voice and message services.

Probability of Operation: low/medium

Discussion: Geostar still has to obtain FCC authorization, find customers, provide earth station networks and space segment.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>MOBILSAT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Mobile Satellite Corp.</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>2 in orbit plus a ground spare planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>1987 and 1988 planned</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>85 and 125 West requested in pending application to FCC</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>1.6/1.5 and 14/12 GHz and UHF</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>20 MHz required at UHF, 30 MHz at L-band and 360 MHz at Ku-band</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>1 UHF, 1 L-band and 2 Ku-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>experimental land and aeronautical mobile voice communications, inter-exchange trunking</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Mobile Satellite Corp. still has to secure financing, show a customer base and obtain FCC authorization.</td>
</tr>
</tbody>
</table>
System Name: SKYLINK
Operator: Skylink Corporation
Number of Satellites: 2 to 3 in orbit planned
Date of Launch(es): 1987 planned
Orbital Position(s): 75, 105 and 135 West requested in pending application to FCC
Frequencies: 800 MHz band
Total Bandwidth, MHz:
Number of Transponders: 4
Services Provided: Land mobile radio communications in rural areas
Probability of Operation: low/medium
Discussion: This system is similar to proposed Canadian M-SAT system.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>OMNINET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Omninet Corporation</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>1 - 2 in orbit planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>N.D.</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>N.D.</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>800/900 MHz, 1.6/1.5 and 14/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>&gt; 500 probable</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>N.D.</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Land mobile radio communications</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Company has not yet filed application to FCC</td>
</tr>
</tbody>
</table>
System Name: ANIK D (C-BAND)

Operator: Telesat Canada

Number of Satellites: 2 built by Hughes Aircraft Co. together with Spar Aerospace of Canada.

Date of Launch(es): August 1982 and November 1984

Orbital Position(s): 104.5 and 111.5 West

Frequencies: 6/4 GHz

Total Bandwidth, MHz: 1000 (Frequency Reuse)

Number of Transponders: 24 active 36-MHz C-Band transponders

Services Provided: telephony, telegraph, data television transmission

Probability of Operation: Already in operation

Discussion: Government owned, several customers, established earth station network. Next generation likely around 1990, with 3-4 planned. 2nd ANIK O is in storage orbit.
System Name: ANIK C (KU-BAND)

Operator: Telesat Canada

Number of Satellites: 3 built by Hughes Aircraft Co. together with Spar Aerospace of Canada

Date of Launch(es): November 1982, June 1983 1985 planned

Orbital Position(s): 105, & 117.5 West occupied, 109 West planned

Frequencies: 14/12 GHz

Total Bandwidth, MHz: 1000 (Frequency Reuse)

Number of Transponders: 16 active 54-MHz Ku-band transponders per satellite

Services Provided: telephony, telegraph, data and video transmission, including low-power DBS

Probability of Operation: already in operation

Discussion: Government owned system with several customers and already established earth station network. Due to apparent overplanning ANIK C-1, scheduled for launch in February 185, is up for sale. Telesat says they have no need for any capacity on the satellite. Spacecraft to be launched are placed into storage orbit.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>Argentine Satellite System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Argentine Government</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>1 or 2 in orbit planned</td>
</tr>
<tr>
<td><strong>Date of Launch(es):</strong></td>
<td>late 80's/early 90's possible</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>N.D.</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>6/4 and/or 14/12 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 MHz (frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>N.D.</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>Telephony, data transmission, television distribution</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>low/medium</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>System is under study by Argentine Space Agency. Funding as yet unclear, Argentina has an established earth station network and leases transponders from INTELSAT.</td>
</tr>
</tbody>
</table>
System Name: Andean Satellite System
Operator: ASETA
Number of Satellites: 1 or 2 planned
Date of Launch(es): 1989 planned
Orbital Position(s): 60 to 75 West
Frequencies: 6/4 GHz
Total Bandwidth, MHz: 500 to 1000
Number of Transponders: 12 to 24
Services Provided: Telephony, telegraph, data transmission, television distribution
Probability of Operation: low/medium
Discussion: This system has also been studied for a long time. After Columbia rejected the bids for proposal for a dedicated national satellite, it revived the then dormant ASETA program.
System Name: MORELOS

Operator: Mexican Government

Number of Satellites: 2 built or under final construction by Hughes Aircraft Company

Date of Launch(es): June and September 1985 planned

Orbital Position(s): 113.5 and 116.5 West planned

Frequencies: 6/4 and 14/12 GHz

Total Bandwidth, MHz: 1500 (Partial frequency reuse)

Number of Transponders: 12 36-MHz and 6 72-MHz C-band, and 4 108-MHz Ku-band transponders per satellite

Services Provided: television distribution, telephony and data transmission

Probability of Operation: high

Discussion: Mexico already has an extensive earth station network in operation and is using transponders leased from INTELSAT for television distribution.
System Name: PANAMSAT

Operator: Pan American Satellite Corp.

Number of Satellites: 1 in orbit and a spare planned

Date of Launch(es): 1987 planned

Orbital Position(s): 57 West requested in pending application to the FCC

Frequencies: 6/12 and 6/4 GHz

Total Bandwidth, MHz: 2000 (dual frequency reuse)

Number of Transponders: 12 active 72-MHz C/Ku-band and 24 active 36-MHz C-band transponders per satellite

Services Provided: Audio and video distribution between eastern U.S. (N.Y. and Miami) and the Caribbean, Central and South America, as well as intra-regional traffic in South and Central America.

Probability of Operation: low/medium

Discussion: Pan American Satellite still has to obtain authorization, must coordinate with INTELSAT, secure financing and demonstrate a customer base which would involve at least bilateral agreements. Recent INTELSAT decision to provide better Latin American coverage on advanced INTELSAT V spacecraft may detract potential customers.
System Name: SATCOL

Operator: Colombian Government

Number of Satellites: 2 to 3 planned

Date of Launch(es): late 1980s planned

Orbital Position(s): 76 and 75.4 West planned

Frequencies: 6/4 GHz (possibly also 14/12 GHz)

Total Bandwidth, MHz: 1000-1500 (Frequency reuse)

Number of Transponders: 24 36-MHz C-band transponders per satellite probable, possibly also some Ku-band transponders

Services Provided: telephony, television distribution, data transmission

Probability of Operation: low

Discussion: Program has experienced several delays. Colombia is currently leasing transponders from INTELSAT and has an earth station network for domestic services. Program may have been temporarily filed while ASETA or CONDOR project is pursued, as had been done in the past. See ASETA.
<table>
<thead>
<tr>
<th><strong>System Name:</strong></th>
<th>SBTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator:</strong></td>
<td>Brazilian Government</td>
</tr>
<tr>
<td><strong>Number of Satellites:</strong></td>
<td>2 built by Spar Aerospace, Canada with Hughes Aircraft Co.</td>
</tr>
<tr>
<td><strong>Orbital Position(s):</strong></td>
<td>65 West occupied, 60 West planned</td>
</tr>
<tr>
<td><strong>Frequencies:</strong></td>
<td>6/4 GHz</td>
</tr>
<tr>
<td><strong>Total Bandwidth, MHz:</strong></td>
<td>1000 (Frequency reuse)</td>
</tr>
<tr>
<td><strong>Number of Transponders:</strong></td>
<td>24 active 36-MHz C-band transponders per satellite</td>
</tr>
<tr>
<td><strong>Services Provided:</strong></td>
<td>telephone, telegraph and data transmission, television distribution</td>
</tr>
<tr>
<td><strong>Probability of Operation:</strong></td>
<td>high</td>
</tr>
<tr>
<td><strong>Discussion:</strong></td>
<td>Brazil is already leasing several transponders from INTELSAT and has an extensive earth station network in place.</td>
</tr>
</tbody>
</table>
APPENDIX F

U.S. EARTH STATION POPULATION

The material for this appendix was prepared by the Satellite Systems Engineering (SSE).
INTRODUCTION

The following report offers various data (quantities, characteristics, distribution etc.) on the current population of earth station in the U.S.

The report is divided into three sections: Section 1 analyses the total earth station population, both licensed and unlicensed, by type, size and geographic distribution; Section 2 gives more detail on the Receive Only (RO) earth stations; and Section 3 looks at the Transmit Receive (T/R) earth stations.

This analysis is based on a combination of sources: in-house data at SSE; contacts with satellite system operators and resellers, trade associations, industry periodicals and consultants, and users; and extensive use of the FCC data base of licensed earth stations.

As the population of earth stations is growing at a very rapid pace, this analysis is somewhat superficial, and should serve as a general overview of the industry, rather than as an in-depth study. The estimation of "backyard TVRO's" is especially approximate, and the range of guesses as to the installed base varies from 300,000 - 700,000.
F-2 - TOTAL EARTH STATION POPULATION
### Chart 1

**Total Earth Station Population**

*By Service*

<table>
<thead>
<tr>
<th>Service</th>
<th>Licensed</th>
<th>Unlicensed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Receive Only</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TVRO</td>
<td>5707</td>
<td>506,793¹</td>
<td>512,500</td>
</tr>
<tr>
<td>Audio/Data RO</td>
<td>710</td>
<td>5890</td>
<td>6,600</td>
</tr>
<tr>
<td><strong>Transmit/Receive</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrier (i.e. shared use)</td>
<td>575</td>
<td>575</td>
<td></td>
</tr>
<tr>
<td>Dedicated (On Premise)</td>
<td>615</td>
<td>615</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>98</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>7705</td>
<td>512,683¹</td>
<td>520,388</td>
</tr>
</tbody>
</table>

¹ Of this seemingly 'exact' number, 500,000 are unlicensed backyard TVRO's and represent a very approximate estimate.
ASSUMPTIONS
(for Chart 1)

- Data on the licensed earth stations comes from the Facilities and Services Division of the FCC's Common Carrier Bureau, July 1984.

- Data on the unlicensed earth stations comes from a variety of sources listed in the following charts on the specific services.

- The numbers on unlicensed TVRO's are approximate at best as this industry is very loosely structured and growing fast.

- All transmitting earth stations are licensed.

- 90% of all T/R's operating in Alaska are owned by Alascom and are shared usage carriers. Very few T/R's in either Alaska or Hawaii are for private, dedicated use.

SOURCES: See all sources referenced in the following charts.
### CHART 2-A

**LICENSED EARTH STATIONS IN THE CONUS**

(By Type & Region)

<table>
<thead>
<tr>
<th>REGION</th>
<th>Audio R/O</th>
<th>TVRO</th>
<th>T/R</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>EASTERN</td>
<td>289</td>
<td>2,337</td>
<td>393</td>
<td>41</td>
<td>3,060</td>
</tr>
<tr>
<td>CENTRAL</td>
<td>277</td>
<td>2,245</td>
<td>264</td>
<td>18</td>
<td>2,804</td>
</tr>
<tr>
<td>ROCKY MTN.</td>
<td>55</td>
<td>449</td>
<td>77</td>
<td>11</td>
<td>592</td>
</tr>
<tr>
<td>WESTERN</td>
<td>78</td>
<td>635</td>
<td>208</td>
<td>23</td>
<td>944</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>699</strong></td>
<td><strong>5,666</strong></td>
<td><strong>942</strong></td>
<td><strong>93</strong></td>
<td><strong>7,400</strong></td>
</tr>
</tbody>
</table>

### CHART 2-B

**LICENSED EARTH STATIONS IN ALASKA & HAWAII**

<table>
<thead>
<tr>
<th></th>
<th>Audio R/O</th>
<th>TVRO</th>
<th>T/R</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALASKA</td>
<td>9</td>
<td>30</td>
<td>235</td>
<td>2</td>
<td>276</td>
</tr>
<tr>
<td>HAWAII</td>
<td>2</td>
<td>11</td>
<td>13</td>
<td>3</td>
<td>29</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>11</strong></td>
<td><strong>41</strong></td>
<td><strong>249</strong></td>
<td><strong>5</strong></td>
<td><strong>305</strong></td>
</tr>
</tbody>
</table>
ASSUMPTIONS
(for Chart 2)

- The East Coast has the heaviest percentage (41%) of all types of licensed earth stations, followed by the central region with 38%. Together, the Rocky Mountain and West Coast areas have 21% of all the licensed earth stations in the Continental U.S.

- In Alaska, because of the large number of earth stations in the Alascom network, there is a much higher percentage of T/R's to RO's than in the CONUS.

- Also, while the licensed earth stations include all the Transmit/Receive earth stations, they are only a very small percent at the Receive Only earth stations. See Section 2 for further on RO's.

- The "Other" category consists of earth stations listed at the FCC but with no information on sizes, being a combination of developmental, temporary or earth stations in place since before 1978, when the FCC first asked for such details in license applications.

SOURCES: FCC Common Carrier Bureau; Earth Station Application Lists.
### CHART 3-A
LICENCED EARTH STATIONS IN THE CONUS
(BY TYPE & SIZE)

<table>
<thead>
<tr>
<th></th>
<th>TVRO</th>
<th>Audio RO</th>
<th>T/R</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 3.5 m.</td>
<td>188</td>
<td>612</td>
<td>--</td>
<td>26</td>
<td>826</td>
</tr>
<tr>
<td>3.6 - 7.0 m.</td>
<td>4,984</td>
<td>87</td>
<td>389</td>
<td>40</td>
<td>5,500</td>
</tr>
<tr>
<td>over 7.0 m.</td>
<td>494</td>
<td>--</td>
<td>553</td>
<td>27</td>
<td>1,074</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,666</td>
<td>699</td>
<td>942</td>
<td>93</td>
<td>7,400</td>
</tr>
</tbody>
</table>

### CHART 3-B
LICENCED EARTH STATIONS IN ALASKA & HAWAII
(BY TYPE AND SIZE)

<table>
<thead>
<tr>
<th></th>
<th>TVRO</th>
<th>Audio RO</th>
<th>T/R</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 3.5 m.</td>
<td>3</td>
<td>--</td>
<td>22</td>
<td>1</td>
<td>26</td>
</tr>
<tr>
<td>3.6 - 7.0 m.</td>
<td>18</td>
<td>9</td>
<td>205</td>
<td>2</td>
<td>234</td>
</tr>
<tr>
<td>over 7.0 m.</td>
<td>20</td>
<td>2</td>
<td>21</td>
<td>2</td>
<td>45</td>
</tr>
<tr>
<td>TOTAL</td>
<td>41</td>
<td>11</td>
<td>248</td>
<td>5</td>
<td>305</td>
</tr>
</tbody>
</table>

"--" = less than 1% of the total.
ASSUMPTIONS
(for Chart 3)

- Please note that because of the very small look angle in Alaska, combined with the problem of being outside the footprint of many of the satellites, the size of the antennas is much larger on the average than for the CONUS earth stations.

- Also, while the licensed earth stations include all the Transmit/Receive earth stations, they are only a very small percent at the Receive Only earth stations. See Section 2 for further on RO's.

- The "Other" category consists of earth stations listed at the FCC but with no information on sizes, being a combination of developmental, temporary or earth stations in place since before 1978, when the FCC first asked for such details in license applications.

SOURCES: FCC Common Carrier Bureau, Earth Station Application Lists.
F-3 - RECEIVE ONLY EARTH STATION POPULATION
CHART 4

RECEIVE ONLY EARTH STATION TOTALS
(LICENSED AND UNLICENSED)

COMMERCIAL TVRO's: 12,500
AUDIO RO's: 6,600
BACKYARD TVRO's: 500,000
ASSUMPTIONS
(for Chart 4)

- The category of "Commercial TVRO's" includes the services of Broadcast TV (including networks, independent stations and public broadcasting stations), Cable TV, SMATV (Private Cable), Low power TV, Subscription TV, MDS and Videoconferencing. See Chart 5 for further information on these services.

- The category of "Audio RO's" includes radio and data services, which are further broken down in Chart 6.

- "Backyard TVRO's" while mainly those dishes privately owned, also include some commercial ownership such as motels, bars, trailer parks and a few apartment buildings. See Chart 7 for more detail.

SOURCES: See the sources given for the following three charts.
<table>
<thead>
<tr>
<th>Type</th>
<th>Total</th>
<th>3.5 m.</th>
<th>3.6-7.0 m.</th>
<th>7.1 m.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Broadcast TV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Networks &amp; Independents:</td>
<td>900</td>
<td>18</td>
<td>910</td>
<td>72</td>
</tr>
<tr>
<td>PBS:</td>
<td>195</td>
<td>--</td>
<td>18</td>
<td>177</td>
</tr>
<tr>
<td><strong>Cable TV</strong></td>
<td>8,500</td>
<td>170</td>
<td>7,650</td>
<td>690</td>
</tr>
<tr>
<td>SMATV: (Private Cable)</td>
<td>1,500</td>
<td>1,125</td>
<td>375</td>
<td>--</td>
</tr>
<tr>
<td>MDS:</td>
<td>250</td>
<td>--</td>
<td>Do not know</td>
<td>--</td>
</tr>
<tr>
<td>LPTV:</td>
<td>150</td>
<td>--</td>
<td>Do not know</td>
<td>--</td>
</tr>
<tr>
<td>STV:</td>
<td>150</td>
<td>--</td>
<td>Do not know</td>
<td>--</td>
</tr>
<tr>
<td>Videoconferencing:</td>
<td>750</td>
<td>--</td>
<td>750</td>
<td>--</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>12,500</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ASSUMPTIONS
(for Chart 5)

BROADCAST TV:
(Commercial Networks & Independents:)

- As of August 6, 1984, out of 880 commercial TV stations, approximately 65% have 1 earth station; 30% have 2 earth stations, and a further 5% have 3 or more. We estimate the total number to be approximately 900 earth stations.

/Public Broadcasting Systems:)

- There are approximately 195 PBS affiliates, with each one having 1 earth station. There are 7 uplinks (T/R) in the network.

SOURCES: Robert Wold Company;
TV Fact Book (TV Week, Publishers);
American Broadcasting Company;
Columbia Broadcasting System;
National Broadcasting Company;
Public Broadcasting System.

CABLE:

- There are an estimated 6,300 total cable systems in the U.S., (all with earth stations), and accounting for the small percent that have more than 1 earth station, there are a total of 8,500 dishes, as of August, 1984.

- As far as which satellites are being looked at by the dishes, the following numbers have been suggested by the NCTA:

  SATCOM III R: approx. 7,600
  SATCOM IV: approx. 1,117
  COMSTAR D IV: approx. 120
  WESTAR V: approx. 641
  GALAXY I: approx. 1,747

These numbers are estimated from which programs are being watched (according to programmer's data). Because several programs are carried on more than one satellite, and because many earth stations have actuators enabling them to change direction easily, these numbers are illustrative only.
(Chart 5 Assumptions Cont’d)

SOURCES: National Cable Television Association;
TV Fact Book (TV Week, Publishers);
Society for Private and Commercial Earth Stations
(SPACE)

SMATV: ("Private Cable")

- As of August 1984, the number of households passed by
  Private Cable systems is nearly 1 million, with an
  estimated 300,000 subscribers. Of the known Private
  Cable systems, each one has its own earth station, but
  very few, if any, have more than one dish. This makes
  the estimated number of systems (1,500) a fair
  approximation of the number of earth stations.

- Because the Private Cable systems are constructed for
  the least possible cost, 75% of them are smaller than
  3.5 meters in diameter.

SOURCES: National Satellite Cable Association;
Society for Private and Commercial Earth Stations
(SPACE).

MULTIPOINT DISTRIBUTION SYSTEMS (MDS):

- While the number of MDS operating systems is
  approximately 300, the number of earth stations in use
  is estimated to be around 250, with some use of
  microwave relays for program delivery.

SOURCES: Richard Vega and Associates;
MDS Trade Association;
COMBAND Communications.

LOW POWER TV (LPTV):

- As in MDS, the number of earth stations estimated to be
  used by LPTV Systems (150) is lower than the total
  estimated systems (400). In Alaska, where there are
  approximately 200 LPTV stations, distribution is mainly
  by microwave; and in CONUS, a number of LPTV stations
  generate their own programs.

SOURCES: LPTV Association;
Global Village Research Group.
(Chart 5 Assumptions Cont'd)

**SUBSCRIPTION TV (STV):**

- The approximate number of STV systems in operation as of August, 1984 is 150, with one dish per system.

**SOURCES:** STV Association; Richard Vega Associates.

**VIDEOCONFERENCING:**

- The largest videoconferencing network is the Hi-Net network with approximately 350 4.6 m earth stations. Other include PSSC, Hilton, Satellite Age and many others.

**SOURCES:** Hi-Net Network; Robert Wold & Associates; PSSC; 1984 Satellite Directory
# AUDIO RO's

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPI, AP</td>
<td>1,650</td>
</tr>
<tr>
<td>NPR, Mutual, State Radios</td>
<td>2,350</td>
</tr>
<tr>
<td>ABC, CBS, NBC, RKO</td>
<td>2,100</td>
</tr>
<tr>
<td>MUZAC, Bonneville, Reuters, Commodity Reports</td>
<td>500</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6,600</td>
</tr>
</tbody>
</table>
ASSUMPTIONS
(for Chart 6)

Audio/Data:

- There are approximately 710 licensed audio/data receive only earth stations, and another 5,890 unlicensed earth stations. The type of service and satellite used is as follows:

  WESTAR III, XPONDER 1: UPI = 750 E.S.
  AP = 900 E.S.

  WESTAR III, XPONDER 2: State Radio = 1,300 E.S.

  WESTAR IV, XPONDERS 1+2: NPR = 250 E.S.

  SATCOM IR: ABC, CBS, NBC
  RKO = 2,100 E.S.

  VARIOUS SATELLITES: Muzac, Bonneville, = 500 E.S.
  Reuters, Commodity Report etc.

- The NPR earth stations are all 4.5 m. (18 uplinks and the rest downlinks only; the AP and UPI earth station are in the 3.0 m. range, and 90% of the remaining earth stations are in the 2.5 m. - 3.5 m. range.

SOURCES: Satellite Audio Report;
National Public Radio.
### CHART 7

**BACKYARD TVRO's**

<table>
<thead>
<tr>
<th></th>
<th>Under 3.5 m.</th>
<th>3.6-7.0 m.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial</strong></td>
<td>60,000</td>
<td>15,000</td>
<td>75,000</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>403,750</td>
<td>21,250</td>
<td>425,000</td>
</tr>
</tbody>
</table>
ASSUMPTIONS
(for Chart 7)

Backyard TVRO's:

- There are an estimated 400,000 - 500,000 backyard TVRO's, with the number growing daily. Of these, 80-85% are for "backyard" use only i.e., for personal use, and the remaining 15-20% are situated at hotel/motels, bars, trailer parks and those apartments and condominiums who choose to stay out of the "legitimate" SMATV industry.

- Note that approximately 20-25% of all Backyard TVRO's have an actuators, and that nearly half of all TVRO's being sold currently are sold with actuators. This means that the satellite direction of the dish can be changed by the push of a button, making an estimate of which satellites are being looked at nearly incalculable.

SOURCES: Society for Private & Commercial Earth Stations (Space)
Satellite Television Technologies, Inc.
Brown & Finn Law Firm;
Satellite Dish Magazine;
Coop's Satellite Digest.
F-4 - TRANSMIT/RECEIVE EARTH STATION POPULATION
## CHART 8

**Transmit/Receive Earth Station**  
**Shared Usage Only**

<table>
<thead>
<tr>
<th>Carriers</th>
<th>SBS</th>
<th>AMSAT</th>
<th>W.U.</th>
<th>RCA</th>
<th>GTE</th>
<th>Spacenet</th>
<th>AT&amp;T</th>
<th>Hughes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<th>Voice &amp; Data Resellers</th>
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<th>ISACOMM</th>
<th>Equatorial</th>
<th>Vitalink</th>
<th>Others</th>
<th>Total</th>
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<th>Video Resellers (incl. videoconf.)</th>
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<th>Bonneville</th>
<th>Hughes</th>
<th>Netcom</th>
<th>Others</th>
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**Grand Total =** 350
ASSUMPTIONS
(for Chart 8)

- All data is for CONUS only; the Alaska T/R earth stations are mostly Alascom and Alaska Bush networks.

- The number of earth stations for the carriers represents each carrier's backbone network and includes multiple earth stations at single locations. Virtually all of these earth stations are larger than 7.0 m. (most are in the 10-13 m. range).

- While Cylix and ISACOMM are the largest of the nationwide voice and data resellers, there are a number of regional networks (e.g., TCI, Western Telecommunications, etc.)

- The four companies named as video resellers, e.g., WOLD, Bonneville, Hughes and Netcom, make their living from a combination of part-time uplinking for the TV networks and from videoconferencing. In addition, three are a number of regional companies owning a few uplinks for videoconferencing purposes only.

## CHART 9

**Transmit/Receive Earth Station**
**Private Dedicated Use**

<table>
<thead>
<tr>
<th>Carrier Owned ES</th>
<th>SBS</th>
<th>Amsat</th>
<th>Others</th>
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<table>
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<th>Privately Owned ES</th>
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<th>Broadcast TV</th>
<th>Corp. Nets</th>
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**Grand Total = 590**
ASSUMPTIONS
(for Chart 9)

- All data is for CONUS only; the Alaska T/R earth stations are mostly Alascom and Alaska bush networks.

- The carrier-owned earth stations are those earth stations situated on customer premises for a customer's dedicated usage, but owned by the carrier and sold as a total package with the satellite capacity. The great majority of dedicated corporate networks fall into this category. Examples include Hercules, Inc. (10 sites - SBS); Gannet (15 sites - Amerisat); Traveller's Insurance (4 sites - Amerisat) and many others.

- Vitalink and Equatorial in the next few months will greatly expand their business with recent FCC approval of their respective types of cheap low speed earth stations.

- Most of the cable and broadcast industry uplinks are located in either California or New York. The 3 television networks are in the midst of going to an all satellite delivery system and will increase the number of T/R earth stations at their disposal.

- As mentioned previously, virtually all the present private corporate networks have carrier owned earth stations on premises. Two examples of exception to this are Federal Express and Citicorp. This category will grow dramatically with the deregulation of the satellite industry and the dramatically decreasing costs in small, low-speed T/R earth stations.

SOURCES: FCC Common Carrier Bureau
Satellite Marketing Digest
Satellite Directory
Trade Publications
Direct Contacts with carriers, resellers and users.

F-25
APPENDIX G

PAYLOAD DETAILS FOR SCENARIO II

G-1 - KA-BAND FSS PAYLOAD

The total trunking digital voice and video conferencing forecasts were scaled by factor of .15 (N=6.7 satellites), and the traffic assigned to both the fixed and scan beams - the resulting Beam to Beam Matrix is included in this appendix. Abbreviations, such as "FX1" or "SCN3" are used to denote each beam. The "class" (KATRK) is used by the SNIPS programs to identify different traffic classes - in this case there was only one.

Also included is the corresponding transponder loading. Each line represents one transponder, identified by a Beam (FX1) and a channel(H-1). The code used for channel identifies is H/V for horizontal/vertical, first digit is the receiver number at that polarization and the last digit identifies the 500 MHz channel number(See Figure 5.2.3-1 of Vol. II). The "TO" column identifies the routing used. Here it is all SS/TDMA, except channel 1 for FX1 and FX2, which are hardwired.
G-1.1 Ka-Band Fixed Beam Locations
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G-1.2 Beam To Beam Loading For Ka-Band Trunking
Beam to Beam Matrix
Digital Voice and Video Conferencing
(Year 2008 Equivalent HVC)

Class = KATRK

From:
FX1  FX2  FX3  FX4  FX5  FX6  FX7  FX8  FX9  FX10  FX11  FX12  FX13  FX14  FX15  FX16  FX17  FX18  FX19  FX20  SCN1  SCN2  SCN3  SCN4  SCN5  SCN6
FX2  48123  FX3  12132  FX4  5204  FX5  18517  FX6  17922  FX7  10105  FX8  12534  FX9  1115  FX10  9387  FX11  8727  FX12  8329  FX13  8317  FX14  6088  FX15  5459  FX16  4250  FX17  4805  FX18  4534  FX19  4129  FX20  4309  SCN2  2218  SCN4  5997  SCN5  11841  SCN6  10209
FX3  FX1  48123  FX2  14860  FX4  3085  FX5  1746  FX6  12144  FX7  9309  FX8  8918  FX9  7793  FX10  1537  FX11  7581  FX12  8784  FX13  7464  FX14  4997  FX15  4524  FX16  3513  FX17  3951  FX18  4469  FX19  3846  FX20  4310  SCN2  2930  SCN4  3909  SCN5  10436  SCN6  8825
FX4  FX1  12132  FX2  14860  FX3  2120  FX5  6835  FX6  3167  FX7  4378  FX8  5841  FX9  4124  FX10  3280  FX11  3620  FX12  3316  FX13  3679  FX14  2278  FX15  2378  FX16  1606  FX17  1763  FX18  1848  FX19  1592  FX20  1877  SCN2  150  SCN3  673  SCN4  1881  SCN5  4387  SCN6  3998
FX5  FX1  18517  FX2  1746  FX3  6835  FX4  5865  FX6  5403  FX7  3525  FX8  3891  FX9  3267  FX10  2574  FX11  3050  FX12  3045  FX13  2828  FX14  2330  FX15  1872  FX16  1397  FX17  1572  FX18  1591  FX19  1422  FX20  1558  SCN2  1587  SCN3  3902  SCN4  3453  SCN5  1425
FX6  FX1  18517  FX2  1746  FX3  6835  FX4  5865  FX5  5010  FX7  4288  FX8  3297  FX9  2368  FX10  1240  FX11  4009  FX12  2087  FX13  2875  FX14  302  FX15  1672  FX16  1605  FX17  1783  FX18  2060  FX19  1845  FX20  1574  SCN2  1325  SCN3  65  SCN4  1746  SCN5  3426  SCN6  4219

G-6
<p>| FX1  | FX2  | FX3   | FX4   | FX5   | FX6   | FX7   | FX8   | FX9   | FX10  | FX11  | FX12  | FX13  | FX14  | FX15  | FX16  | FX17  | FX18  | FX19  | FX20  | SCN2  | SCN3  | SCN4  | SCN5  |
|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 17922| 12144| 3167  | 5403  | 5010  | 4108  | 3424  | 2408  | 903   | 2942  | 2819  | 2376  | 1697  | 304   | 1252  | 1338  | 1644  | 1286  | 600   | 314   | 449   | 866   | 3691  |
| FX1  | FX2  | FX3   | FX4   | FX5   | FX6   | FX7   | FX8   | FX9   | FX10  | FX11  | FX12  | FX13  | FX14  | FX15  | FX16  | FX17  | FX18  | FX19  | FX20  | SCN2  | SCN3  | SCN4  | SCN5  |
| 10105| 9309  | 4378  | 3525  | 4288  | 4108  | 3324  | 1665  | 2467  | 3485  | 3008  | 1746  | 1524  | 1825  | 1523  | 1521  | 850   | 1735  | 936   | 314   | 330   | 1513  | 2341  |
| FX1  | FX2  | FX3   | FX4   | FX5   | FX6   | FX7   | FX8   | FX9   | FX10  | FX11  | FX12  | FX13  | FX14  | FX15  | FX16  | FX17  | FX18  | FX19  | FX20  | SCN2  | SCN3  | SCN4  | SCN5  |
| 12534| 8918  | 5841  | 3891  | 3297  | 3424  | 3324  | 1812  | 2251  | 2420  | 1947  | 2801  | 1171  | 1110  | 1039  | 1092  | 1219  | 994   | 1225  | 415   | 1076  | 290   | 651   | 2965  |
| FX1  | FX2  | FX3   | FX4   | FX5   | FX6   | FX7   | FX8   | FX9   | FX10  | FX11  | FX12  | FX13  | FX14  | FX15  | FX16  | FX17  | FX18  | FX19  | FX20  | SCN2  | SCN3  | SCN4  | SCN5  |
| 1115 | 7793  | 4124  | 3267  | 2368  | 2408  | 1665  | 1812  | 1420  | 1770  | 1213  | 1161  | 977   | 719   | 716   | 802   | 675   | 657   | 621   | 790   | 254   | 908   | 1497  | 1776  |
| FX1  | FX2  | FX3   | FX4   | FX5   | FX6   | FX7   | FX8   | FX9   | FX10  | FX11  | FX12  | FX13  | FX14  | FX15  | FX16  | FX17  | FX18  | FX19  | FX20  | SCN2  | SCN3  | SCN4  | SCN5  |
| 9387 | 1537  | 3280  | 2574  | 1240  | 903   | 2467  | 2251  | 1420  | 1688  | 1308  | 1647  | 1251  | 517   | 778   | 850   | 1100  | 881   | 448   | 353   | 788   | 234   | 746   | 2538  |
| FX1  | FX2  | FX3   | FX4   | FX5   | FX6   | FX7   | FX8   | FX9   | FX10  | FX11  | FX12  | FX13  | FX14  | FX15  | FX16  | FX17  | FX18  | FX19  | FX20  | SCN2  | SCN3  | SCN4  | SCN5  |
| 8727 | 7581  | 3620  | 3050  | 4009  | 2942  | 3485  | 2420  | 1770  | 1688  | 2560  | 2168  | 1500  | 1169  | 863   | 3554  | 1654  | 2220  | 1193  | 359   | 975   | 339   | 1056  | 4845  |
| FX1  | FX2  | FX3   | FX4   | FX5   | FX6   | FX7   | FX8   | FX9   | FX10  | FX11  | FX12  | FX13  | FX14  | FX15  | FX16  | FX17  | FX18  | FX19  | FX20  | SCN2  | SCN3  | SCN4  | SCN5  |
| 8329 | 6784  | 3316  | 3045  | 2087  | 2819  | 3008  | 1947  | 1213  | 1308  | 2560  | 1883  |</p>
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**Totals 1591377**
G-1.3 Transponder Loading For Ka-Band Trunking
Transponder Loading  
Digital Voice and Video Conferncing

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**Totals**

KATRK : 1591377
The coverage of the six scan beams, relative to the 84 regions used for most beam design work, is shown. As in Appendix G-1.1, a Beam to Beam Matrix and a Transponder Loading are given; the scale factor used was .143 (7 satellites) although the interconnection shown on the printout is "SS", the routing is in fact through the BBP, but from a loading aspect, this is equivalent to an SS/TDMA switch. Channelization is to the 240 MHz level, i.e., "CI-3" is the third 500 MHz channel in Scan Beam 1, and it is broken down into "CI-3A" and "CI-3B".
G-2.1 Ka-Band Scan Beam Coverage
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## Ka-Band Scan Beam Coverages

### Page 9

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G-2.2 Beam Definition For Ka-Band Scan Beam To SMSA's
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G-2.3 Ka-Band Scan Beam To Beam Loading
Beam to Beam Matrix
CPS Voice, Data, and Video Conferencing

Class = KACPS

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**SUMMARY**

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G-2.4 Ka-Band Scan Transponder Loading
Transponder Loading
CPS Voice, Data, and Video Conferencing

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Totals
KACPS : 6565264
A combined run for C and Ku-bands was done. Beam Coverages are defined with each of the 84 regions assigned to the smallest beam - see Section 4 of Vol. II for a description of the concept of nested beams and overflows. The beams Ku-W and Ku-E are nested within Ku-CNS, which in turn is nested within C-CNS. Thus traffic from AK1 to OH1 could be loaded to transponders connected either Ku-W to Ku-CNS, or Ku-CNS to Ku-CNS.

The Beam to Beam Matrix introduces multiple traffic classes. No traffic is originally assigned to ANVC; this class is used to differentiate between Ku and C-band transponders. Overflows from Ku-band to C-band also "overflow" from ANVK to ANVC classes (Analog Voice/C to Analog Voice/K). This is shown in the Transponder Loading.

There are also some channels designated as BDCST; these were manually precalculated (based on the scale factor of .0375, or N=26.7 satellites).
G-3.1 C And Ku-Band FSS Beam Coverage
### Beam Coverages

#### Beam: C-CNS
- AL1
- KY1
- OH1
- FL1
- IN1
- IN2

#### Beam: KU-CNS
- AL2
- KY2
- TN1
- LA2
- MI3
- MS2

#### Beam: KU-W
- AK1
- CA3
- IO1
- MN2
- ND1
- NV1
- SD2
- TX5
- WI1
- AK2
- CO2
- IO2
- MO1
- ND2
- NV2
- TX1
- TX6
- WI2
- AZ2
- ID2
- KS2
- MO2
- NE2
- OK1
- TX2
- UT1
- CA1
- IL1
- LA1
- MT1
- NM1
- OK2
- TX3
- WA1
- CA2
- IL2
- NL1
- MT2
- NM2
- OR1
- TX4
- WA2

#### Beam: KU-E
- CON
- GA2
- NC1
- NY2
- RI
- VT
- DEL
- MAS
- NC2
- NY3
- SC1
- WV1
- FL2
- MD
- NH
- OH2
- SC2
- WV2
- FL3
- ME1
- NJ
- PA1
- VA1
- GA1
- ME2
- NY1
- PA2
- VA2

---

G-39
G-3.2  C And Ku-Band Beam To Beam Matrix
Beam to Beam Matrix
Data and Analog Voice -- Scenario II
(KB/S or KVC)

**Class = DATA**

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**Class = ANVK**

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G-41
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G-3.3 C And Ku-Band Transponder Loading
## Transponder Loading
### Data, Analog Voice, and Broadcast Video
#### Scenario II

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**Totals**

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G-4 - LINK BUDGETS FOR SCENARIO II
### TABLE 1 - SCENARIO II - C-BAND (FSS) - LINK BUDGET

**MODULATION:** CSSB, Suppressed Carrier (6000 HVC/36 MHz)

<table>
<thead>
<tr>
<th>Parameter</th>
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<td><strong>Mid-band Downlink Freq.</strong></td>
<td>3.95 GHz</td>
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<tr>
<td><strong>Mid-band Uplink Freq.</strong></td>
<td>6.15 GHz</td>
</tr>
<tr>
<td><strong>Uplink Free Space Loss</strong></td>
<td>200.0 dB</td>
</tr>
<tr>
<td><strong>No. of Channels, N</strong></td>
<td>6000</td>
</tr>
<tr>
<td><strong>Saturated EIRP</strong></td>
<td>36.0 dBW</td>
</tr>
<tr>
<td><strong>SFD</strong></td>
<td>-84.0 dBW/m²</td>
</tr>
<tr>
<td><strong>Satellite Gain</strong></td>
<td>161.1 dB</td>
</tr>
<tr>
<td><strong>Satellite G/T</strong></td>
<td>-2.1 dB/K</td>
</tr>
<tr>
<td><strong>Transmitter Power</strong></td>
<td>10.0 dBW</td>
</tr>
<tr>
<td><strong>Transmit Line Loss</strong></td>
<td>1.3 dB</td>
</tr>
<tr>
<td><strong>Transmitting Antenna Gain</strong></td>
<td>25.0 dBi</td>
</tr>
<tr>
<td><strong>Output Backoff</strong></td>
<td>5.0 dB</td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
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</tr>
<tr>
<td><strong>Total Load</strong></td>
<td>22.6 dBm0</td>
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<td><strong>Reference Power EIRP, Pr</strong></td>
<td>6.1 dBW</td>
</tr>
<tr>
<td><strong>Free Space Loss</strong></td>
<td>196.1 dB</td>
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<tr>
<td><strong>Pointing Loss</strong></td>
<td>0.5 dB</td>
</tr>
<tr>
<td><strong>Atmospheric Degradation</strong></td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>196.6 dB</td>
</tr>
<tr>
<td><strong>Power Flux Density</strong></td>
<td>-134.0 dBW/m²</td>
</tr>
<tr>
<td><strong>Receiving Antenna Gain</strong></td>
<td>50.1 dBi</td>
</tr>
<tr>
<td><strong>Receive Line Loss</strong></td>
<td>0.1 dB</td>
</tr>
<tr>
<td><strong>System Noise Temperature</strong></td>
<td>19.4 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>30.7 dB/K</td>
</tr>
<tr>
<td><strong>Boltzmann's Constant</strong></td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td><strong>Downlink Pr/No</strong></td>
<td>68.8 dB-Hz</td>
</tr>
<tr>
<td><strong>Uplink Pr/No</strong></td>
<td>71.6 dB-Hz</td>
</tr>
<tr>
<td><strong>Downlink Interference Pr/Io</strong></td>
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</tr>
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<td><strong>Uplink Interference Pr/Io</strong></td>
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<td><strong>Terrestrial Pr/Io</strong></td>
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<td><strong>Cross-polarization Pr/Io</strong></td>
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<td><strong>Overall Pr/No</strong></td>
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<td><strong>Required Pr/No</strong></td>
<td>61.9 dB-Hz</td>
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<tr>
<td><strong>Pr/No Margin</strong></td>
<td>0.3 dB-Hz</td>
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G-47
### TABLE 2 - SCENARIO II - C-BAND (FSS) - UPLINK BUDGET

**MODULATION:** FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 6.15 GHz

<table>
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<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
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<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>54.0 dBi</td>
<td>10 m dish, 60% eff.</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>79.9 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>200.0 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>200.5 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-82.8 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>25.0 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.3 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.1 dB-K</td>
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</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>-2.1 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-95.6 dBW</td>
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</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
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<td>Received C/kT</td>
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<td>Received C/N</td>
<td>33.4 dB</td>
<td>Worst-case</td>
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*Allocation*
TABLE 3 - SCENARIO II - C (FSS) - DOWNLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 3.95 GHz

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<tr>
<td>Transmit Line Loss</td>
<td>1.3 dB Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>25.0 dBi Gridded Reflector</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>EIRP</td>
<td>30.7 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>196.1 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>196.6 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-132.0 dBW/m² (Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>50.1 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.1 dB Allocation</td>
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<tr>
<td>System Noise Temperature</td>
<td>19.5 dB-K</td>
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<tr>
<td><strong>Receive G/T</strong></td>
<td>30.6 dB/K (Clear Sky)</td>
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<td>Received Carrier Level</td>
<td>-115.8 dBW</td>
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<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
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<tr>
<td>Received C/kT</td>
<td>93.3 dB-Hz</td>
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<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>20.7 dB</td>
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<tr>
<td>Required C/N</td>
<td>18.0 dB Studio Reception</td>
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<td>Link Margin</td>
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<tr>
<td>Overall C/N</td>
<td>20.5 dB 33.4 dB Uplink C/N</td>
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<tr>
<td>Weighted (S/N)w Ratio</td>
<td>51.5 dB CCIR Type M</td>
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<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB Quality: Excellent (TASO)</td>
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<tr>
<td><strong>(S/N)w Margin</strong></td>
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</table>
TABLE 4 - SCENARIO II - Ku-BAND (FSS) - LINK BUDGET

MODULATION: CSSB, Suppressed Carrier (6000 HVC/36 MHz)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-band Downlink Freq.</td>
<td>11.95 GHz</td>
</tr>
<tr>
<td>Mid-band Uplink Freq.</td>
<td>14.25 GHz</td>
</tr>
<tr>
<td>Uplink Free Space Loss</td>
<td>207.3 dB</td>
</tr>
<tr>
<td>No. of Channels, N</td>
<td>6000</td>
</tr>
<tr>
<td>Saturated EIRP</td>
<td>39.0 dBW</td>
</tr>
<tr>
<td>SFD</td>
<td>-84.0 dBW/m</td>
</tr>
<tr>
<td>Satellite Gain</td>
<td>171.4 dB</td>
</tr>
<tr>
<td>Satellite G/T</td>
<td>1.3 dB/K</td>
</tr>
<tr>
<td>Transmitter Power</td>
<td>5.4 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>35.2 dBi</td>
</tr>
<tr>
<td>Output Backoff</td>
<td>5.0 dB</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>34.5 dBW</td>
</tr>
<tr>
<td>Total Load</td>
<td>22.6 dBmO</td>
</tr>
<tr>
<td>Reference Power EIRP, Pr</td>
<td>12.0 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>209.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-128.2 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.3 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.4 dB/K</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dB/Hz-K</td>
</tr>
<tr>
<td>Downlink Pr/No</td>
<td>65.6 dB/Hz</td>
</tr>
<tr>
<td>Uplink Pr/No</td>
<td>70.5 dB-Hz</td>
</tr>
<tr>
<td>Downlink Interference Pr/Io</td>
<td>78.2 dB-Hz</td>
</tr>
<tr>
<td>Uplink Interference Pr/Io</td>
<td>75.9 dB-Hz</td>
</tr>
<tr>
<td>Intermodulation Pr/IMo</td>
<td>68.9 dB-Hz</td>
</tr>
<tr>
<td>Terrestrial Pr/Io</td>
<td>86.6 dB-Hz</td>
</tr>
<tr>
<td>Cross-polarization Pr/Io</td>
<td>85.5 dB-Hz</td>
</tr>
<tr>
<td>Overall Pr/No</td>
<td>62.7 dB-Hz</td>
</tr>
<tr>
<td>Required Pr/No</td>
<td>61.9 dB-Hz</td>
</tr>
<tr>
<td>Pr/No Margin</td>
<td>0.8 dB-Hz</td>
</tr>
</tbody>
</table>

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TABLE 5 - SCENARIO II - Ku (FSS) - UPLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/54 MHz)

Mid-band Frequency = 14.25 GHz

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td><strong>84.0 dBW</strong></td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td><strong>210.9 dB</strong></td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-78.7 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>29.0 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td><strong>1.3 dB/K</strong></td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-97.8 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kt</td>
<td>103.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
<td>24 MHz IF Bandwidth</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td><strong>29.2 dB</strong></td>
<td>CONUS, Worst-case</td>
</tr>
</tbody>
</table>

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TABLE 6 - SCENARIO II - Ku (FSS) - DOWNLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/54 MHz)

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>5.4 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>35.2 dBi</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>36.5 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>206.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-126.2 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>34.2 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.1 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>93.0 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>19.2 dB</td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
</tr>
<tr>
<td>Link Margin</td>
<td>1.2 dB</td>
</tr>
<tr>
<td>Overall C/N</td>
<td>18.8 dB</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>50.0 dB</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB</td>
</tr>
<tr>
<td>(S/N)w Margin</td>
<td>2.0 dB</td>
</tr>
</tbody>
</table>

3.50 Watts Allocation
Gridded Reflector
38700 km; 30° Elev. Ang.
Allocation
7 m dish, 60% eff.
Allocation

24 MHz IF Bandwidth

SSS55SSS 1.2 dB
29.2 dB Uplink C/N

CCIR Type M
Quality: Excellent (TAS0)

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# TABLE 7 - SCENARIO II - Ku-BAND (FSS) - UPLINK BUDGET

**MODULATION:** SS/TDMA/8-ary PSK

**Information Data Rate** = 108 Mb/s

**Mid-band Frequency** = 14.25 GHz

<table>
<thead>
<tr>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW 800.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi 7 m dish, 60% efficiency</td>
</tr>
<tr>
<td><strong>EIRP</strong></td>
<td>87.0 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB 38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB Allocation</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>210.9 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-75.7 dBW/m² (Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>29.0 dBi Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>1.3 dB/K (Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-94.8 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/κT</td>
<td>105.0 dB-Hz</td>
</tr>
</tbody>
</table>
TABLE 8 - SCENARIO II - Ku-BAND (FSS) - DOWNLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>5.4 dBW</td>
<td>3.5 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>35.2 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>EIRP</td>
<td>39.5 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>206.4 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-123.2 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-110.1 dB</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dB/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>96.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>80.3 dB-Hz</td>
<td>108 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>1.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>14.0 dB</td>
<td>BER=10⁻⁶</td>
</tr>
<tr>
<td>Required C/kT</td>
<td>95.8 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>C/kT Margin</td>
<td>0.2 dB</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 9 - SCENARIO II - Ku-BAND (DBS) - UPLINK BUDGET
MODULATION: FM-FDMA Video channel (1 video/24 MHz)
Mid-band Frequency = 17.55 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>60.0 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>88.8 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>209.1 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>212.7 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-73.9 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>29.8 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.9 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>1.9 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-94.1 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>106.6 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
<td>24 MHz IF Bandwidth</td>
</tr>
<tr>
<td>Received C/N</td>
<td>32.8 dB</td>
<td>Mountain, Worst-case</td>
</tr>
</tbody>
</table>
**TABLE 10 - SCENARIO II - Ku (DBS) - DOWNLINK BUDGET**

**MODULATION:** FM-FDMA Video channel (1 video/24 MHz)

**Mid-band Frequency = 12.45 GHz**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>8.1 dBW</td>
<td>6.50 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>31.4 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>38.4 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>206.1 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>2.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>208.7 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-124.3 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>57.0 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>34.5 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.3 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>92.8 dB-Hz</td>
<td>24 MHz IF Bandwidth</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
<td></td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>19.0 dB</td>
<td></td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
<td>Studio Reception</td>
</tr>
<tr>
<td><strong>Link Margin</strong></td>
<td>1.0 dB</td>
<td></td>
</tr>
<tr>
<td>Overall C/N</td>
<td>18.9 dB</td>
<td>32.8 dB Uplink C/N</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>50.1 dB</td>
<td>CCIR Type M</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB</td>
<td>Quality: Excellent (TASO)</td>
</tr>
<tr>
<td><strong>(S/N)w Margin</strong></td>
<td>2.1 dB</td>
<td></td>
</tr>
</tbody>
</table>

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TABLE 11 - SCENARIO II - Ka-BAND (FSS) - UPLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK
Mid-band Frequency = 28.75 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>23.0 dBW</td>
<td>200.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>64.3 dBi</td>
<td>7 m dish, 60% efficiency</td>
</tr>
<tr>
<td>EIRP</td>
<td>86.3 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>213.4 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>10.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>224.9 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-76.4 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>53.0 dBi</td>
<td>Solid Reflectors</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>28.8 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>24.2 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-85.6 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kt</td>
<td>114.2 dB-Hz</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 12 - SCENARIO II - Ka-BAND (FSS) - DOWNLINK BUDGET

**MODULATION:** SS/TDMA/8-ary PSK  
**Mid-band Frequency** = 18.95 GHz

<table>
<thead>
<tr>
<th>Remarks</th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>14.8 dB</td>
<td></td>
<td>30.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0 dB</td>
<td></td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>53.0 dBi</td>
<td></td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>EIRP</td>
<td>66.8 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>209.8 dB</td>
<td></td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td></td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>10.0 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>221.3 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-96.0 dBW/m²</td>
<td>(Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>60.7 dBi</td>
<td></td>
<td>7 m dish, 60% efficiency</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0 dB</td>
<td></td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>26.0 dB-K</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>34.7 dB/K</td>
<td>(Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-93.8 dBW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Received C/kT</strong></td>
<td>108.9 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>89.8 dB-Hz</td>
<td></td>
<td>960 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0 dB</td>
<td></td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>14.0 dB</td>
<td></td>
<td>BER=10⁻⁶</td>
</tr>
<tr>
<td><strong>Required C/kT</strong></td>
<td>105.8 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C/kT Margin</strong></td>
<td>3.0 dB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 13 - SCENARIO II - Ka-BAND (Scan) - UPLINK BUDGET

MODULATION: SS/TDMA/QPSK
CODING: Convolutional, r=1/2, k=7; Viterbi Decoding Algorithm, Q=8
Mid-band Frequency = 28.75 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Coded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>23.0</td>
<td>23.0 dBW</td>
<td>200.0 W uncoded; 200.0 W coded</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>61.4</td>
<td>61.4 dBi</td>
<td>5 m dish, 60% efficiency</td>
</tr>
<tr>
<td>EIRP</td>
<td>83.4</td>
<td>83.4 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>213.4</td>
<td>213.4 dB</td>
<td></td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5</td>
<td>0.5 dB</td>
<td></td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0</td>
<td>1.0 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0</td>
<td>10.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>214.9</td>
<td>224.9 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-79.3</td>
<td>-79.3 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>50.8</td>
<td>50.8 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
<td></td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>28.8</td>
<td>28.8 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>22.0</td>
<td>22.0 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-80.7</td>
<td>-90.7 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>119.1</td>
<td>109.1 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>86.8</td>
<td>83.8 dB-Hz</td>
<td>480 Mb/s; 240 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0</td>
<td>2.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>10.5</td>
<td>6.5 dB</td>
<td>Coding Gain=4.0 dB; BER=10⁻⁶</td>
</tr>
<tr>
<td>Required C/kT</td>
<td>99.3</td>
<td>92.3 dB</td>
<td></td>
</tr>
<tr>
<td>C/kT Margin</td>
<td>19.8</td>
<td>16.8 dB</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 14 - SCENARIO II - Ka-BAND (Scan) - DOWNLINK BUDGET

MODULATION: SS/TDMA/QPSK  
CODING: Convolutional, r=1/2; k=7; Viterbi Decoding Algorithm, Q=8  
Mid-band Frequency = 18.95 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Coded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>8.8</td>
<td>18.8 dBW</td>
<td>7.5 W uncoded; 75.0 W coded</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>50.8</td>
<td>50.8 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>EIRP</td>
<td>58.6</td>
<td>68.6 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>209.8</td>
<td>209.8 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0</td>
<td>1.0 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0</td>
<td>10.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>211.3</td>
<td>221.3 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-104.2</td>
<td>-94.2 dB/m² (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>61.4</td>
<td>61.4 dBi</td>
<td>5 m dish, 60% efficiency</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>26.0</td>
<td>26.0 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>35.4</td>
<td>35.4 dB/K (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-91.3</td>
<td>-91.3 dB</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6</td>
<td>-228.6 dB/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kt</td>
<td>111.3</td>
<td>111.3 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>86.8</td>
<td>83.8 dB-Hz</td>
<td>480 Mb/s; 240 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0</td>
<td>2.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>10.5</td>
<td>6.5 dB</td>
<td>Coding Gain=4.0 dB; BER=10⁻⁶</td>
</tr>
<tr>
<td>Required C/kt</td>
<td>99.3</td>
<td>92.3 dB</td>
<td></td>
</tr>
<tr>
<td>C/kt Margin</td>
<td>12.0</td>
<td>19.0 dB</td>
<td></td>
</tr>
</tbody>
</table>

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APPENDIX H

PAYLOAD DETAILS FOR SCENARIO IV

H-1 - LINK BUDGETS FOR SCENARIO IV

The following tables show the projected link budgets for the Ku-Band FSS and Ku-Band DBS services.
TABLE 1 - SCENARIO IV - Ku-BAND (FSS) - UPLINK BUDGET

MODULATION: FM-FDMA Video channel (1 video/24 MHz)

Mid-band Frequency = 14.25 GHz

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>87.0 dB</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>210.9 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-75.7 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>29.0 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>1.3 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-94.8 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>106.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
<td>24 MHz IF Bandwidth</td>
</tr>
<tr>
<td>Received C/N</td>
<td>32.2 dB</td>
<td>CONUS, Worst-case</td>
</tr>
</tbody>
</table>

H-2
TABLE 2 - SCENARIO IV - Ku (FSS) - DOWNLINK BUDGET

MODULATION: FM-FDMA Video Channel (1 video/24 MHz)

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>17.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>29.0 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>44.9 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>205.4 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-117.9 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-104.8 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>101.4 dB-Hz</td>
<td>24 MHz IF Bandwidth</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Received C/N</td>
<td>27.6 dB</td>
<td></td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
<td>Studio Reception</td>
</tr>
<tr>
<td>Link Margin</td>
<td>9.6 dB</td>
<td></td>
</tr>
<tr>
<td>Overall C/N</td>
<td>26.3 dB</td>
<td>32.2 dB Uplink C/N</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>57.5 dB</td>
<td>CCIR Type M</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>56.0 dB</td>
<td>Broadcast Quality</td>
</tr>
<tr>
<td>(S/N)w Margin</td>
<td>1.5 dB</td>
<td></td>
</tr>
</tbody>
</table>
**TABLE 3 - SCENARIO IV - Ku-BAND (DBS) - UPLINK BUDGET**

**MODULATION: FM-FDMA Video channel (1 video/24 MHz)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-band Frequency</td>
<td>17.55 GHz</td>
<td></td>
</tr>
<tr>
<td>Transmitter Power</td>
<td>27.0 dBW</td>
<td>500.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>60.0 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>85.8 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>209.1 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>212.7 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-76.0 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>32.8 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.9 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>4.9 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-93.1 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kt</td>
<td>107.6 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
<td>24 MHz IF Bandwidth</td>
</tr>
<tr>
<td>Received C/N</td>
<td>33.8 dB</td>
<td>Mountain, Worst-case</td>
</tr>
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</table>
TABLE 4 - SCENARIO IV - Ku (DBS) - DOWNLINK BUDGET

MODULATION: FM-FDMA Video channel (1 video/24 MHz)

Mid-band Frequency = 12.45 GHz

<table>
<thead>
<tr>
<th>Description</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>23.0 dBW</td>
<td>200.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmit Antenna Gain</td>
<td>33.7 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>55.6 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>206.1 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>209.7 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-107.1 dB/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>57.0 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.5 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-97.1 dB</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dB/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>109.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>73.8 dB-Hz</td>
<td>24 MHz IF Bandwidth</td>
</tr>
<tr>
<td>Received C/N</td>
<td>35.2 dB</td>
<td></td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
<td>Studio Reception</td>
</tr>
<tr>
<td>Link Margin</td>
<td>17.2 dB</td>
<td></td>
</tr>
<tr>
<td>Overall C/N</td>
<td>31.4 dB</td>
<td>33.8 dB Uplink C/N</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>62.7 dB</td>
<td>CCIR Type M</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>56.0 dB</td>
<td>Broadcast Quality</td>
</tr>
<tr>
<td>(S/N)w Margin</td>
<td>6.7 dB</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX I

PAYLOAD DETAILS FOR SCENARIO V

I-1 - KU-BAND FSS PAYLOAD

In Scenario V, the Ku- and C-Band runs were made separately, and the overflow from Ku was loaded to C.

Beam coverages are defined, and the acronyms used on the printouts are correlated to beam numbers used in Figures 5.4.2-2 and 5.4.5-2 of Volume II. The C-band beams are also included here for proper assignment of traffic in areas not covered by Ku beams.

Following the transponder loading tables, is an overflow matrix; it is exactly the same format as the original beam to beam matrix, but contains traffic not loaded to the Ku-band transponders.

The first set of printouts is for the case where all broadcast video is carried by Scenario IV platforms. An identical set of printouts is included for the case where broadcast video uses Scenario V channels.

Scale factors used were .114 (N=8.8 satellites) for the case where no broadcast video is assigned, and .0875 (N= 11.4 satellites) if video is carried.
I-1.1 Ku-Band Beam Coverages
<table>
<thead>
<tr>
<th>BEAM NO.</th>
<th>BEAM ACRONYMN</th>
<th>BEAM DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NE-AC</td>
<td>Northeastern Section of U.S encircling NE-NYC</td>
</tr>
<tr>
<td>2</td>
<td>W-MW</td>
<td>Wisconsin, Iowa, and parts of Missouri/Illinois</td>
</tr>
<tr>
<td>3</td>
<td>SE-GC</td>
<td>Gulf Coast and inland section of Southeast</td>
</tr>
<tr>
<td>4</td>
<td>NE-NYC</td>
<td>Smaller Northeastern Section centered around New York</td>
</tr>
<tr>
<td>5</td>
<td>EONW</td>
<td>Southern Michigan, Ohio, Indiana (split)</td>
</tr>
<tr>
<td>6</td>
<td>NW-PC</td>
<td>Northwest quadrant of CONUS</td>
</tr>
<tr>
<td>7</td>
<td>SW-OC</td>
<td>Colorado/New Mexico, Arizona, and most of California/Nevada/Utah</td>
</tr>
<tr>
<td>8</td>
<td>SW-GC</td>
<td>Texas/Oklahoma</td>
</tr>
<tr>
<td>9</td>
<td>SE-AC</td>
<td>South Carolina, Georgia, and Florida</td>
</tr>
</tbody>
</table>
**BEAM COVERAGES**

<table>
<thead>
<tr>
<th>Beam: DUMMY</th>
<th>ME1</th>
<th>ME2</th>
<th>NH</th>
<th>NY1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME1</td>
<td>PA1</td>
<td>PA2</td>
<td>VA2</td>
<td>VT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beam: NE-AC</th>
<th>IL1</th>
<th>IL2</th>
<th>IO1</th>
<th>IO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NY2</td>
<td>W2</td>
<td>W1</td>
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<table>
<thead>
<tr>
<th>Beam: W-MW</th>
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<th>AL2</th>
<th>FL1</th>
<th>LA1</th>
</tr>
</thead>
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<td>IL1</td>
<td>W2</td>
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<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Beam: SE-OC</th>
<th>AL1</th>
<th>AL2</th>
<th>FL1</th>
<th>LA1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK2</td>
<td>MS2</td>
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<tr>
<th>Beam: NE-NYC</th>
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<th>M11</th>
<th>NJ</th>
<th>NY3</th>
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<tbody>
<tr>
<td>CON</td>
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<table>
<thead>
<tr>
<th>Beam: E-MW1</th>
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<th>O2</th>
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<th></th>
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<table>
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<tr>
<th>Beam: NW-PC</th>
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<th>MN1</th>
<th>MN2</th>
<th>MT1</th>
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<tr>
<td>NZ2</td>
<td>ND1</td>
<td>ND2</td>
<td>NE2</td>
<td>NV1</td>
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<table>
<thead>
<tr>
<th>Beam: SW-PC</th>
<th>CA2</th>
<th>CA3</th>
<th>CO2</th>
<th>NM1</th>
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<tr>
<td>AZ2</td>
<td>NX2</td>
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</table>

<table>
<thead>
<tr>
<th>Beam: SW-OC</th>
<th>CK2</th>
<th>TX1</th>
<th>TX3</th>
<th>TX4</th>
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</thead>
<tbody>
<tr>
<td>NO2</td>
<td>TK2</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beam: SE-AC</th>
<th>FL2</th>
<th>GA1</th>
<th>GA2</th>
<th>NC1</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC2</td>
<td>SC1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Beam: B1-NE</th>
<th>VA1</th>
<th>W1</th>
<th>IN2</th>
<th>KY2</th>
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</table>

<table>
<thead>
<tr>
<th>Beam: B2-NE</th>
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<tr>
<td>WV1</td>
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<td>IN2</td>
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</table>

**I-4**
Beam: B3-MW
KY1  TN1  AK1  KS2

Beam: B4-W
CK1

Beam: E-MW2
IN1
I-1.2 Ku-Band Beam Coverage To SMSA's
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<th>LONGITUDE</th>
</tr>
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<td>1</td>
<td>ALNY  ALBANY-SCHENECTADY-TROY NY</td>
<td>42.40</td>
<td>73.49</td>
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<tr>
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<td>78.23</td>
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<td>BAMD  BALTIMORE MD</td>
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<td>76.38</td>
</tr>
<tr>
<td>1</td>
<td>BAME  BANGOR ME</td>
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<td>68.47</td>
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<tr>
<td>1</td>
<td>BINY  BINGHAMTON NY-PA</td>
<td>42.06</td>
<td>75.55</td>
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<tr>
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<td>BUNY  BUFFALO NY</td>
<td>42.52</td>
<td>78.55</td>
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<tr>
<td>1</td>
<td>BUVT  BURLINGTON VT</td>
<td>44.28</td>
<td>73.14</td>
</tr>
<tr>
<td>1</td>
<td>CHVA  CHARLOTTESVILLE VA</td>
<td>38.02</td>
<td>78.29</td>
</tr>
<tr>
<td>1</td>
<td>CUMD  CUMBERLAND MD-WV</td>
<td>39.40</td>
<td>78.47</td>
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<tr>
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<td>ELNY  ELMIRA NY</td>
<td>42.06</td>
<td>76.50</td>
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<tr>
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<td>ERPA  ERIE PA</td>
<td>42.07</td>
<td>80.05</td>
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<tr>
<td>1</td>
<td>GLNY  GLENS FALLS NY</td>
<td>43.17</td>
<td>73.14</td>
</tr>
<tr>
<td>1</td>
<td>HAMD  HAGERSTOWN MD</td>
<td>39.39</td>
<td>77.44</td>
</tr>
<tr>
<td>1</td>
<td>HAPA  HARRISBURG PA</td>
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<td>76.54</td>
</tr>
<tr>
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<td>JOPA  JOHNSONTOWN PA</td>
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<td>78.56</td>
</tr>
<tr>
<td>1</td>
<td>LAPA  LANCASTER PA</td>
<td>40.01</td>
<td>76.19</td>
</tr>
<tr>
<td>1</td>
<td>LEME  LEWISTON-AUBURN ME</td>
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<td>70.14</td>
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<td>76.26</td>
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<tr>
<td>1</td>
<td>NOVA  NORFOLK-VIRGINIA BEACH-PORTSMO VA-NC</td>
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<td>76.18</td>
</tr>
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<tr>
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<td>75.10</td>
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<tr>
<td>1</td>
<td>PIPA  PITTSBURGH PA</td>
<td>40.26</td>
<td>80.00</td>
</tr>
<tr>
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<td>POME  PORTLAND ME</td>
<td>43.41</td>
<td>70.18</td>
</tr>
<tr>
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<td>PONH  PORTSMOUTH-DOVER-ROCHESTER NH-ME</td>
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<td>70.47</td>
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<tr>
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<td>REPA  READING PA</td>
<td>40.20</td>
<td>75.55</td>
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<td>77.27</td>
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<td>77.37</td>
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<td>80.30</td>
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<td>40.48</td>
<td>77.52</td>
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<tr>
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<td>SYNY  SYRACUSE NY</td>
<td>43.03</td>
<td>76.10</td>
</tr>
<tr>
<td>1</td>
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<td>43.06</td>
<td>75.15</td>
</tr>
<tr>
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<td>75.02</td>
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<td>WADC  WASHINGTON DC-MD</td>
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<td>----------------------------------------</td>
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<td>-----------</td>
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<tr>
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<td>APWI APPLETON-OSHKOSH WI</td>
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<td>89.00</td>
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<td>CEIA CEDAR RAPIDS IA</td>
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<td>CHIL CHAMPAIGN-URBANA-RANTOUL IL</td>
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<td>2</td>
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<tr>
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<td>DEIL DECUR IL</td>
<td>39.51</td>
<td>88.57</td>
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<td>DEIA DES MOINES IA</td>
<td>41.35</td>
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<td>DUIA DUBUQUE IA</td>
<td>42.31</td>
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<tr>
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<td>EAWI EAU CLAIRE WI</td>
<td>44.50</td>
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<td>FLORENCE AL</td>
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03/26/85  14.365  (UNCOVERED AREA)
I-1.3 Ku-Band Beam To Beam (No Broadcast Video)
### Beam to Beam Matrix

**Analog Voice and Data — Scenario V**

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I-1.4 Transponder Loading (No Broadcast Video)
## Ku Transponder Loading

**Analog Voice and Data -- Scenario V**

(No Broadcast Video)

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I-37
**May 30 13:30 1985 Sku.ov Page 2**

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I-38
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Beam to Beam Matrix  
Overflow from Ku Beams  
Scenario V  
(Broadcast Video)

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I-1.7 Transponder Loading (Including Broadcast Video)
Ku Transponder Loading
Analog Voice and Data -- Scenario V
(Broadcast Video)

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As pointed out in Appendix I-1.1, the C-Band loadings were separate computer runs, using overflows from Ku-Band. The C-Band matrices were derived from the Ku Overflow Matrices presented in Appendix I.1.1. Relative traffic between C/Ku overlaps were used, and overflow data was assumed to be low rate data at 9.6 kb/s for a HVC.
I-2.1 C-Band Beam Coverage

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I-49
**BEAM COVERAGE**

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**I-50**
I-2.2 C-Band Coverage To SMSA's
# C-Band Beam Coverages

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I-2.3 Beam To Beam Matrix - C-Band (No Broadcast Video)
Beam to Beam Matrix
Overflow to C Beams
Scenario V

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C Transponder Loading  
Scenario V  
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**Totals**

| ANVC       | 178263      |
I-2.5 C-Band Beam To Beam Overflow From Ku-Band

(Including Broadcast Video)
Beam to Beam Matrix  
Overflow to C Beams  
Scenario V  
(Broadcast Video)

**Class = ANVC**

**From:**  
- B1-NE  
- B2-NE  
- B3-MW

**To:**  
- B2-NE 4823  
- B3-MW 3051  
- B4-W 328  
- B2-NE 4823  
- B2-NE 7935  
- B3-MW 14387  
- B4-W 8795  
- B1-NE 4823  
- B2-NE 14387  
- B3-MW 9980  
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May 30 14:16 1985 Sc ov Page 1
I-2.6 C-Band Beam To Beam Matrix

(Including Broadcast Video)
Beam to Beam Matrix
Analog Voice and Data -- Scenario V
(Broadcast Video)
(HVC or KB/S)

Class = ANVK

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To: W-MW

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May 30 14:10 1985 Sku.hm Page 2

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**I-73**
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Totals 529922 466878
I-2.7  C-Band Transponder Loading

(Including Broadcast Video)
C Transponder Loading
Scenario V
(Broadcast Video)

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I-76
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**Totals**

- **ANVC**: 94525

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I-3 - LINK BUDGETS FOR SCENARIO V
TABLE 1 - SCENARIO V - C-BAND (FSS) - LINK BUDGET

MODULATION: CSSB, Suppressed Carrier (6000 HVC/36 MHz)

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<tr>
<th>Parameter</th>
<th>Value</th>
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<td>Mid-band Downlink Freq. =</td>
<td>3.95 GHz</td>
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<tr>
<td>Mid-band Uplink Freq. =</td>
<td>6.15 GHz</td>
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<tr>
<td>Uplink Free Space Loss =</td>
<td>200.0 dB</td>
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<tr>
<td>No. of Channels, N =</td>
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<tr>
<td>Transmit Power</td>
<td>0.7 dBW</td>
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<tr>
<td>Transmit Line Loss</td>
<td>1.3 dB</td>
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<tr>
<td>Transmitting Antenna Gain</td>
<td>36.8 dBi</td>
</tr>
<tr>
<td>Output Backoff</td>
<td>5.0 dB</td>
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<tr>
<td><strong>Net EIRP</strong></td>
<td><strong>31.2 dBW</strong></td>
</tr>
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<td><strong>Total Load</strong></td>
<td><strong>22.6 dBm0</strong></td>
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<tr>
<td>Reference Power EIRP, Pr</td>
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<tr>
<td>Free Space Loss</td>
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</tr>
<tr>
<td>Pointing Loss</td>
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<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
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<tr>
<td><strong>Net Path Loss</strong></td>
<td><strong>196.6 dB</strong></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-131.5 dBW/m²</td>
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<tr>
<td>Receiving Antenna Gain</td>
<td>50.1 dBi</td>
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<tr>
<td>Receive Line Loss</td>
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<tr>
<td>System Noise Temperature</td>
<td>19.4 dB-K</td>
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<td><strong>Receive G/T</strong></td>
<td><strong>30.7 dB/K</strong></td>
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<tr>
<td>Boltzmann's Constant</td>
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<tr>
<td>Downlink Pr/No</td>
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<td>Uplink Pr/No</td>
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<td>Downlink Interference Pr/Io</td>
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<td>Uplink Interference Pr/Io</td>
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<td>Intermodulation Pr/IMo</td>
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<td>Terrestrial Pr/Io</td>
<td>89.2 dB-Hz</td>
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<td>Cross-polarization Pr/Io</td>
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<td><strong>Overall Pr/No</strong></td>
<td><strong>64.3 dB-Hz</strong></td>
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<td>Required Pr/No</td>
<td>61.9 dB-Hz</td>
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<tr>
<td><strong>Pr/No Margin</strong></td>
<td><strong>2.4 dB-Hz</strong></td>
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</table>

Saturated EIRP = 36.0 dBW
SFD = -84.0 dBW/m²
Satellite Gain = 161.1 dB
Satellite G/T = 1.8 dB/K

1.18 Watts
Allocation
Gridded Reflector

Gridded Reflector

38700 km; 30° Elev. Ang.

10 m dish, 60% eff.

Beam 4V, Worst-case

14.7 dB = P1/P3
### TABLE 2 – SCENARIO V – C-BAND (FSS) – UPLINK BUDGET

**MODULATION:** FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 6.15 GHz

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<td>Transmit Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>54.0 dBi</td>
<td>10 m dish, 60% eff.</td>
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<td>Input Back-Off</td>
<td>3.0 dB</td>
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<td><strong>Net EIRP</strong></td>
<td>79.9 dBW</td>
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<tr>
<td>Free Space Loss</td>
<td>200.0 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>200.5 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-82.8 dBW/m²</td>
<td>(Clear Sky)</td>
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<tr>
<td>Receiving Antenna Gain</td>
<td>28.9 dBi</td>
<td>Gridded Reflector</td>
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<tr>
<td>Receive Line Loss</td>
<td>1.3 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.1 dB-K</td>
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</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>1.8 dB/K</td>
<td>(Clear Sky)</td>
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<td>Received Carrier Level</td>
<td>-91.7 dBW</td>
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<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
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<td>Received C/kT</td>
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<td><strong>Received C/N</strong></td>
<td>37.3 dB</td>
<td>Beam 4V, Worst-case</td>
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### TABLE 3 - SCENARIO V - C-BAND (FSS) - DOWNLINK BUDGET

#### MODULATION: FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 3.95 GHz

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<td>Transmit Line Loss</td>
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<tr>
<td>Transmitting Antenna Gain</td>
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</tr>
<tr>
<td>Output Back-Off</td>
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</tr>
<tr>
<td><strong>EIRP</strong></td>
<td>33.2 dBW</td>
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<tr>
<td>Free Space Loss</td>
<td>196.1 dB</td>
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<tr>
<td>Polarization Loss</td>
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<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>196.6 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-129.5 dBW m$^2$ (Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>50.1 dBi</td>
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<tr>
<td>Receive Line Loss</td>
<td>0.1 dB</td>
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<tr>
<td>System Noise Temperature</td>
<td>19.5 dB-K</td>
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<tr>
<td><strong>Receive G/T</strong></td>
<td>30.6 dB/K (Clear Sky)</td>
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<tr>
<td>Received Carrier Level</td>
<td>-113.3 dBW</td>
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<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW Hz-K</td>
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<td>Received C/kT</td>
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<td>Receiver IF Bandwidth</td>
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<td><strong>Received C/N</strong></td>
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<tr>
<td>Required C/N</td>
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<td><strong>Link Margin</strong></td>
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<td>Overall C/N</td>
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TABLE 4 - SCENARIO V - Ku-BAND (FSS) - LINK BUDGET

MODULATION: CSSB, Suppressed Carrier (6000 HVC/36 MHz)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-band Downlink Freq.</td>
<td>11.95 GHz</td>
</tr>
<tr>
<td>Mid-band Uplink Freq.</td>
<td>14.25 GHz</td>
</tr>
<tr>
<td>Uplink Free Space Loss</td>
<td>207.3 dB</td>
</tr>
<tr>
<td>No. of Channels, N</td>
<td>6000</td>
</tr>
<tr>
<td>Uplink Free Space Loss</td>
<td>207.3 dB</td>
</tr>
<tr>
<td>Saturated EIRP</td>
<td>39.0 dBW</td>
</tr>
<tr>
<td>Saturated EIRP</td>
<td>39.0 dBW</td>
</tr>
<tr>
<td>SFD</td>
<td>-84.0 dBW/m²</td>
</tr>
<tr>
<td>Satellite Gain</td>
<td>171.4 dB</td>
</tr>
<tr>
<td>Satellite G/T</td>
<td>5.7 dB/K</td>
</tr>
<tr>
<td>Transmitter Power</td>
<td>0.6 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>39.9 dBi</td>
</tr>
<tr>
<td>Output Backoff</td>
<td>5.0 dB</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>34.4 dBW</td>
</tr>
<tr>
<td>Total Load</td>
<td>22.6 dBmO</td>
</tr>
<tr>
<td>Reference Power EIRP, Pr</td>
<td>11.8 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>209.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-128.3 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.3 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.4 dB/K</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Downlink Pr/No</td>
<td>65.5 dB-Hz</td>
</tr>
<tr>
<td>Uplink Pr/No</td>
<td>74.8 dB-Hz</td>
</tr>
<tr>
<td>Downlink Interference Pr/Io</td>
<td>78.1 dB-Hz</td>
</tr>
<tr>
<td>Uplink Interference Pr/Io</td>
<td>75.8 dB-Hz</td>
</tr>
<tr>
<td>Intermodulation Pr/IMo</td>
<td>68.9 dB-Hz</td>
</tr>
<tr>
<td>Terrestrial Pr/Io</td>
<td>86.5 dB-Hz</td>
</tr>
<tr>
<td>Cross-polarization Pr/Io</td>
<td>85.3 dB-Hz</td>
</tr>
<tr>
<td>Overall Pr/No</td>
<td>63.1 dB-Hz</td>
</tr>
<tr>
<td>Required Pr/No</td>
<td>61.9 dB-Hz</td>
</tr>
<tr>
<td>Pr/No Margin</td>
<td>1.2 dB-Hz</td>
</tr>
</tbody>
</table>
TABLE 5 - SCENARIO V - Ku (FSS) - UPLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)
Mid-band Frequency = 14.25 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>84.0 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>211.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-78.7 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>33.4 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>5.7 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-93.9 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>106.9 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td>Received C/N</td>
<td>34.4 dB</td>
</tr>
</tbody>
</table>

**Allocation**
- 800.00 Watts
- 7 m dish, 60% eff.
- 38700 km; 30° Elev. Ang.
### TABLE 6 - SCENARIO V - Ku (FSS) - DOWNLINK BUDGET

**MODULATION:** FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>0.6 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>39.9 dBi</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td><strong>36.4 dBW</strong></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td><strong>206.9 dB</strong></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-126.3 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td><strong>34.2 dB/K</strong></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.7 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>92.4 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td><strong>19.8 dB</strong></td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
</tr>
<tr>
<td><strong>Link Margin</strong></td>
<td><strong>1.8 dB</strong></td>
</tr>
<tr>
<td>Overall C/N</td>
<td>19.7 dB</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>50.7 dB</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB</td>
</tr>
<tr>
<td><strong>(S/N)w Margin</strong></td>
<td><strong>2.7 dB</strong></td>
</tr>
</tbody>
</table>

**Allocation**
- 1.15 Watts
- 38700 km; 30° Elev. Ang.
- 7 m dish, 60% eff.
- 18 MHz IF Bandwidth

**Quality:** Excellent (TASO)

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TABLE 7 - SCENARIO V - Ka-BAND (FSS) - UPLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Mid-band Frequency = 28.75 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>23.0 dBW</td>
<td>200.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>64.3 dBi</td>
<td>7 m dish, 60% efficiency</td>
</tr>
<tr>
<td>EIRP</td>
<td>86.3 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>213.4 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>10.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>224.9 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-76.4 dBW/m² (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>53.0 dBi</td>
<td>Solid Reflectors</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>28.8 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>24.2 dB/K (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-85.6 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>114.2 dB-Hz</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 8 - SCENARIO V - Ka-BAND (FSS) - DOWNLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Mid-band Frequency = 18.95 GHz

<table>
<thead>
<tr>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>14.8 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>53.0 dBi</td>
</tr>
<tr>
<td>EIRP</td>
<td>66.8 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>209.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>10.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>221.3 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-96.0 dB/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>60.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>26.0 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.7 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-93.8 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>108.9 dB-Hz</td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>89.8 dB-Hz</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0 dB</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>14.0 dB</td>
</tr>
<tr>
<td>Required C/kT</td>
<td>105.8 dB</td>
</tr>
<tr>
<td>C/kT Margin</td>
<td>3.0 dB</td>
</tr>
</tbody>
</table>

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TABLE 9 - SCENARIO V - Ka-BAND (Scan) - UPLINK BUDGET

MODULATION: SS/TDMA/QPSK
CODING: Convolutional, r=1/2, k=7; Viterbi Decoding Algorithm, Q=8

Mid-band Frequency = 28.75 GHz

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<thead>
<tr>
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<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>23.0</td>
<td>23.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>61.4</td>
<td>61.4 dBi</td>
</tr>
<tr>
<td>EIRP</td>
<td>.83.4</td>
<td>.83.4 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>213.4</td>
<td>213.4 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0</td>
<td>10.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>214.9</td>
<td>224.9 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-79.3</td>
<td>-79.3 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>50.8</td>
<td>50.8 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>28.8</td>
<td>28.8 dB-K</td>
</tr>
<tr>
<td>Receive C/T</td>
<td>22.0</td>
<td>22.0 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-80.7</td>
<td>-90.7 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>119.1</td>
<td>109.1 dB-Hz</td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>86.8</td>
<td>83.8 dB-Hz</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0</td>
<td>2.0 dB</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>10.5</td>
<td>6.5 dB</td>
</tr>
<tr>
<td>Required C/kT</td>
<td>99.3</td>
<td>92.3 dB</td>
</tr>
<tr>
<td>C/kT Margin</td>
<td>19.8</td>
<td>16.8 dB</td>
</tr>
</tbody>
</table>
TABLE 10 - SCENARIO V - Ka-BAND (Scan) - DOWNLINK BUDGET

MODULATION: SS/TDMA/QPSK  
CODING: Convolutional, r=1/2, k=7; Viterbi Decoding Algorithm, Q=8  
Mid-band Frequency = 18.95 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Coded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>8.8</td>
<td>18.8 dBW</td>
<td>7.5 W uncodded; 75.0 W coded</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>50.8</td>
<td>50.8 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>EIRP</td>
<td>58.6</td>
<td>68.6 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>209.8</td>
<td>209.8 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>1.0</td>
<td>1.0 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0</td>
<td>10.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>211.3</td>
<td>221.3 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-104.2</td>
<td>-94.2 dBW/m²</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>61.4</td>
<td>61.4 dBi</td>
<td>5 m dish, 60% efficiency</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.0</td>
<td>1.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>26.0</td>
<td>26.0 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>35.4</td>
<td>35.4 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-91.3</td>
<td>-91.3 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kt</td>
<td>111.3</td>
<td>111.3 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>86.8</td>
<td>83.8 dB-Hz</td>
<td>480 Mb/s; 240 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0</td>
<td>2.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>10.5</td>
<td>6.5 dB</td>
<td>Coding Gain=4.0 dB; BER=10⁻⁶</td>
</tr>
<tr>
<td>Required C/kt</td>
<td>99.3</td>
<td>92.3 dB</td>
<td></td>
</tr>
<tr>
<td>C/kt Margin</td>
<td>12.0</td>
<td>19.0 dB</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX J

PAYLOAD DETAILS FOR SCENARIO VI-A

J-1 - C-BAND INTERNATIONAL PAYLOAD

Beam coverages and acronym definitives for this payload are given as the first part of this appendix. Three of the beams (CONUS, AOOREUR, PORLAN) are "pseudo beams"; ISLs, of course, do not really cover Europe or Africa. The use of pseudo beams simplifies the payload data base. Conus is a single pseudo-beam representing all of the U.S. The NASA total forecasts included circuits routed to gateway stations, so this pseudo-beam represents a portion of the VI-A traffic loaded to U.S. transponders. A scale factor of 1.0 was used, i.e., all requirements can be carried on a single satellite. Traffic loading is provided for year 2008.
J-1.1 Beam Definition And Coverage

The beam definition and associated coverage areas for Scenario VI-A are as follows:

<table>
<thead>
<tr>
<th>BEAM NO.</th>
<th>BEAM ACRONYM</th>
<th>BEAM DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAM-N</td>
<td>Northern portion of Central America</td>
</tr>
<tr>
<td>2</td>
<td>CARIB</td>
<td>Caribbean Islands (Haiti, Dominican Republic, etc.)</td>
</tr>
<tr>
<td>3</td>
<td>SAM-CI</td>
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| Beam: SAM-CI | BARBADOS | FRANCE (FG) | FRANCE (MA) | SURINAM | TRIN&TOBAGO |
| Beam: VENEZ | VENEZUELA |
| Beam: COLUMB | COLUMBIA |
| Beam: CAM-S | COSTA RICA | EQUADOR | NICARAGUA | PANAMA |
| Beam: SAM-MP | BOLIVIA | PARAGUAY | PERU |
| Beam: BRAZIL | BRAZIL |
| Beam: SAM-S | ARGENTINA | CHILE | URUGUAY |
| Beam: CONUS | U.S. |
| Beam: AOREUR | ALGERIA | ANGOLA | AUSTRIA | BAHAMAS | BAHRAIN |
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| | CYPRUS | EGYPT | ETHIOPIA | FRANCE | GABON |
| | GERMANY, FR | GHANA | GREECE | ICELAND | IRAN |
| | IRAQ | IRELAND | ISRAEL | ITALY | IVORY COAST |
| | JORDAN | KENYA | KUWAIT | LEBANON | LIBERIA |
| | LIBYA | MALAWI | MALI | MAURITANIA | MOROCCO |
| | MOZAMBIQUE | NETHERLANDS | NIGER | NIGERIA | NORDIC CEP |
| | POLAND | PORTUGAL | QATAR | ROMANIA | SAUDI AR. |
| | SENEGAL | SIERRA LEONE | SOUTH AF. | SPAIN | SUDAN |
| | SWITZERLAND | TANZANIA | TOGO | TUNISIA | TURKEY |
| | UPPER VOLTA | U.S.S.R. | YEMEN, A.R. | YUGOSLAVIA | ZAIRE |
| Beam: PORCAN | AUSTRALIA | CANADA | CHINA (PEK) | CHINA (TAI) | FIJI |
| | FRANCE (NC) | HONG KONG | INDIA | INDONESIA | JAPAN |
| | KOREA | MALAYSIA | NEW ZEALAND | PHILIPPINES | SINGAPORE |
| | SRI LANKA | THAILAND | U.S.-GUAM | U.S.-HAW |  |

J-3
J-1.2 International C-Band Beam To Beam Matrix
Beam to Beam Matrix  
Voice -- Scenario VI-A

Class = ANVC

From: CAM-N  
         CAM-S  
         CARIB  
         SAM-CI  
         VENEZ  
         COLUMB  
         CONUS  

To:  
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Voice -- Scenario VI-A  

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Totals

ANVC : 365103

J-10
TABLE 1-A - SCENARIO VI-A - C-BAND (FSS) INTERNATIONAL - UPLINK BUDGET

MODULATION: FDM-FM-FDMA

Mid-band Frequency = 6.15 GHz
No. of Voice Channels, N = 2,800

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<th>Parameter</th>
<th>Value</th>
<th>Allocation</th>
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<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 watts</td>
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<td>Transmit Line Losses</td>
<td>0.1 dB</td>
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<tr>
<td>Transmitting Antenna Gain</td>
<td>54.0 dBi</td>
<td>10-m dish, 60% eff.</td>
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<td>Output Back-Off</td>
<td>5.0 dB</td>
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<td>Net EIRP</td>
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<td>200.0 dB</td>
<td>38,700 km; 30° Elev. Angle</td>
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<td>Pointing Loss</td>
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<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
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<tr>
<td>Rain Margin</td>
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<tr>
<td>Net Path Loss</td>
<td>200.5 dB</td>
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<tr>
<td>Power Flux Density</td>
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<td>Receiving Antenna Gain</td>
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<td>Receive Line Losses</td>
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<td>System Noise Temperature</td>
<td>27.1 dB-K</td>
<td>Referred to antenna output</td>
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<td>Receive G/T</td>
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<td>36.0 MHz IF Bandwidth</td>
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<td>Received C/N</td>
<td>28.1 dB</td>
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**Table 1-B - Scenario VI-A - C-Band (FSS) International - Downlink Budget**

**Modulation:** FDM-FM-FDMA

- **Mid-band Frequency:** 3.95 GHz
- **No. of Voice Channels, N:** 2,800

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<td>Output Back-Off</td>
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<td><strong>Net EIRP</strong></td>
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<td>Power Flux Density</td>
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<td>Boltzmann's Constant</td>
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**J-13**
TABLE 2 - SCENARIO VI-A - C-BAND (FSS) INTERNATIONAL - UPLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 6.15 GHz

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dB</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>54.0 dBi</td>
<td>10 m dish, 60% eff.</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net EIRP</td>
<td>79.9 dB</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>200.0 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>200.5 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-82.8 dB/ m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>33.6 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.3 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.1 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>6.5 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-87.0 dB</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dB/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>114.5 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
<td>18 MHz IF Bandwidth</td>
</tr>
<tr>
<td>Received C/N</td>
<td>42.0 dB</td>
<td>Worst-case</td>
</tr>
</tbody>
</table>

J-14
### TABLE 3 - SCENARIO VI-A - C-BAND (FSS) INTERNATIONAL - DOWNLINK BUDGET

**MODULATION:** FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 3.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Transmitter Power</td>
<td>4.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.3 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>33.6 dBi</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>EIRP</strong></td>
<td>33.3 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>196.1 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>196.6 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-129.5 dBW/m² (Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>50.1 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>19.5 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>30.6 dB/K (Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.3 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>95.9 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>23.3 dB</td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
</tr>
<tr>
<td><strong>Link Margin</strong></td>
<td>5.3 dB</td>
</tr>
<tr>
<td><strong>Overall C/N</strong></td>
<td>23.3 dB</td>
</tr>
<tr>
<td><strong>Weighted (S/N)w Ratio</strong></td>
<td>54.3 dB</td>
</tr>
<tr>
<td><strong>Minimum (S/N)w</strong></td>
<td>48.0 dB</td>
</tr>
<tr>
<td><strong>(S/N)w Margin</strong></td>
<td>6.3 dB</td>
</tr>
</tbody>
</table>

Studio Reception

42.0 dB Uplink C/N

CCIR Type M

Quality: Excellent (TASO)

J-15
TABLE 4 - SCENARIO VI-A - C-BAND (MARITIME) - UPLINK BUDGET

FORWARD LINK: Shore-to-Satellite

MODULATION: SCPC/FM (Voice Channel)

Mid-band Frequency = 6.433 GHz

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<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
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<tr>
<td>Transmitter Power</td>
<td>19.0 dBW</td>
<td>80.00 Watts/Channel</td>
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<tr>
<td>Transmit Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>54.4 dBi</td>
<td>10-m dish, 60% eff.</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net EIRP/Channel</strong></td>
<td>70.3 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>200.8 dB</td>
<td>40775 km; 10° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.4 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>201.7 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-92.9 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>18.2 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.4 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>29.7 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>-11.5 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.2 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td><strong>Received C/kT</strong></td>
<td>85.7 dB-Hz</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 5 - SCENARIO VI-A - L-BAND (MARITIME) - DOWNLINK BUDGET

**FORWARD LINK:** Satellite-To-Ship

**MODULATION:** SCPC/FM - Standard A (Voice Channel)

Mid-band Frequency = 1.538 GHz

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<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Transmit Line Loss</td>
<td>1.5 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>18.2 dBi</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net EIRP/Channel</strong></td>
<td>14.6 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>188.4 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.2 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>199.1 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-148.5 dB/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>22.0 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.6 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>25.0 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>-4.0 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-152.4 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td><strong>Received C/kT</strong></td>
<td>50.1 dB-Hz</td>
</tr>
<tr>
<td>Overall C/kT</td>
<td>50.1 dB-Hz</td>
</tr>
</tbody>
</table>

J-17
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>13.6 dBW</td>
<td>23.00 Watts/Channel</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>22.5 dBi</td>
<td>1-m dish, 60% eff.</td>
</tr>
<tr>
<td>Net EIRP/Channel</td>
<td>36.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>188.9 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>40775 km; 10° Elev. Ang.</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>189.6 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-127.2 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>18.2 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.6 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.8 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>-9.6 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-135.4 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/KT</td>
<td>65.4 dB-Hz</td>
<td></td>
</tr>
</tbody>
</table>
**TABLE 7 - SCENARIO VI-A - C-BAND (MARITIME) - DOWNLINK BUDGET**

**RETURN LINK: Satellite-to-Shore**

**MODULATION: SCPC/FM - (Voice Channel)**

Mid-band Frequency = 3.6105 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>-18.2 dBW</td>
<td>0.015 Watts/Channel</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>18.2 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td><strong>Net EIRP/Channel</strong></td>
<td>-1.2 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>195.8 dB</td>
<td>40775 km; 10° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.4 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>196.7 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-164.4 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>49.4 dBi</td>
<td>10-m dish, 60% eff.</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>20.5 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>28.9 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-148.5 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td><strong>Received C/kT</strong></td>
<td>59.5 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Overall C/kT</td>
<td>58.5 dB-Hz</td>
<td>65.4 dB Uplink C/kT</td>
</tr>
</tbody>
</table>
### TABLE 8 - SCENARIO VI-A - TRANSATLANTIC CROSSLINK BUDGET

**MODULATION:** QPSK

**Frequency** = 60.0 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Uncoded</th>
<th>5.0 Watts</th>
</tr>
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<tbody>
<tr>
<td>Transmitter Power</td>
<td>7.0 dBW</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.5 dB</td>
<td>3 m Dish, 70% Eff.</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>64.0 dBi</td>
<td>Allocation</td>
</tr>
<tr>
<td><strong>EIRP</strong></td>
<td>69.5 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>226.4 dB</td>
<td>83330 km, 160° apart</td>
</tr>
<tr>
<td>Polarization Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td><strong>Total Path Loss</strong></td>
<td>226.5 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-99.9 dBW/m²</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>64.0 dBi</td>
<td>3 m Dish, 70% Eff.</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>29.1 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>34.9 dB/K</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-93.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td><strong>Received C/kT</strong></td>
<td>106.5 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>91.8 dB-Hz</td>
<td>1.5 Gb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>10.5 dB</td>
<td>BER = 10⁻⁵</td>
</tr>
<tr>
<td><strong>Required C/kT</strong></td>
<td>104.3 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Link Margin</td>
<td>2.2 dB</td>
<td></td>
</tr>
</tbody>
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APPENDIX K

PAYLOAD DETAILS FOR SCENARIO VI-B

K-1 - C-BAND NON-CONUS PAYLOAD

Non-U.S. domestic requirement loadings are contained in this appendix. Canada, Mexico, and Latin America are each treated separately, so there are three sets of Beams coverage, Beam to Beam Matrices, and Transponder Loadings. The scale factor used was 1.0 in all three cases. Traffic loading is provided for year 2008.
K-1.1 C-Band Beam Coverage

The C-Band beam definitions for Scenario VI-6 are as follows:

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<thead>
<tr>
<th>BEAM NO.</th>
<th>BEAM ACRONYMN</th>
<th>BEAM DESCRIPTION</th>
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<tbody>
<tr>
<td>1</td>
<td>CAN-W</td>
<td>Western Canada</td>
</tr>
<tr>
<td>2</td>
<td>CAN-C</td>
<td>Central Canada</td>
</tr>
<tr>
<td>3</td>
<td>CAN-E</td>
<td>Eastern Canada</td>
</tr>
<tr>
<td>4</td>
<td>MEX-N</td>
<td>Northern Mexico (split)</td>
</tr>
<tr>
<td>5</td>
<td>MEX-S</td>
<td>Southern Mexico (split)</td>
</tr>
<tr>
<td>6</td>
<td>--</td>
<td>Central America/Caribbean</td>
</tr>
<tr>
<td>7</td>
<td>SAM-N</td>
<td>Northern South America (split)</td>
</tr>
<tr>
<td>8</td>
<td>SAM-S</td>
<td>Southern South America (split)</td>
</tr>
<tr>
<td>9</td>
<td>BRAZC</td>
<td>Brazil (Rio/Sao Paulo)</td>
</tr>
<tr>
<td>Beam Type</td>
<td>Beam Coverage</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>---------------</td>
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<tr>
<td></td>
<td>ONTARIO 2</td>
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<td></td>
<td>NEW ENGLAND</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOVA SCOTIA</td>
<td></td>
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<td></td>
<td>PR. ED. IS.</td>
<td></td>
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<tr>
<td></td>
<td>QUEBEC 2</td>
<td></td>
</tr>
<tr>
<td>SPOT1</td>
<td>ONTARIO 1</td>
<td></td>
</tr>
<tr>
<td>SPOT2</td>
<td>QUEBEC 1</td>
<td></td>
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<tr>
<td>ISL</td>
<td>ISL</td>
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</tbody>
</table>
K-1.2 C-Band Beam To Beam Matrix
Beam to Beam Matrix  
Scenario VI-B -- Canada  
(HVC)

Class = DVCC

<table>
<thead>
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<th>From:</th>
<th>To:</th>
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<tr>
<td>SPOT2</td>
<td>5807</td>
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Totals

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**K-2 - KU-BAND NON-CONUS PAYLOAD**

**K-2.1 Ku-Band Beam Description**

The Ku-Band beam description for Scenario VI-B is as follows:

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BEAM COVERAGES

Beam: MEX-N1
MEXICO N.

Beam: MEX-N2
MEXICO C.

Beam: MEX-S
MEXICO S.

Beam: MEX-KU
K-2.2 Ku-Band Mexican Beam To Beam Matrix
Beam to Beam Matrix
Scenario VI-B -- Mexico
(RVC)

Class = SCPC

|MEX-N1| MEX-N2| MEX-S| MEX-KU|
---|---|---|---|
MEX-N1 | 1540 | 3850 | 2310 |
MEX-N2 | 3850 | 9625 | 5775 |
MEX-S | 2310 | 5775 | 3465 |

SUMMARY

| | | | |
---|---|---|---|
MEX-N1 | 7700 |
MEX-N2 | 19250 |
MEX-S | 11550 |
MEX-KU | 0 |
Totals | 38500 |
K-2.3 Ku-Band Mexican Transponder Loading
Transponder Loading
Scenario VI-B -- Mexico

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Totals

SCPC : 38500
K-2.4 Ku-Band Brazilian Beam Coverage
May 21 17:51 1985 6bsa.bm Page 2

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K-15
K-2.5 Brazilian Ku-Band Beam To Beam Matrix
Beam to Beam Matrix
Scenario VI-B -- South America
(HVC)

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SAM-N1
SAM-N2
SAM-S1
SAM-S2
BRAZC
BRAZK1
BRAZK2
To:
SAM-N1 11360
SAM-N2 95 SAM-S2 763 BRAZC 1790
SAM-S1 8680
SAM-N2 763 SAM-S2 6245 BRAZC 14651
SAM-N2 1790 SAM-S2 14651 BRAZC 34357

SUMMARY
SCPC-
SAM-N1 11360
SAM-N2 2648
SAM-S1 8680
SAM-S2 21659
BRAZC 50798
BRAZK1 0
BRAZK2 0
Totals 95145
K-2.6 Brazilian Ku-Band Transponder Loading
## Transponder Loading
### Scenario VI-B -- South America

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<td>V-4</td>
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<td>V-5</td>
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<td>BRAZC</td>
<td>BRAZK1</td>
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<tr>
<td>BRAZC</td>
<td>BRAZC</td>
<td>V-7</td>
<td>SCPC</td>
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<td>BRAZC</td>
<td>SAM-S2</td>
<td>V-8</td>
<td>SCPC</td>
<td>1800</td>
</tr>
<tr>
<td>BRAZC</td>
<td>BRAZC</td>
<td>V-9</td>
<td>SCPC</td>
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<td>BRAZC</td>
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<td>SCPC</td>
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<td>SCPC</td>
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<tr>
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<td>H-5</td>
<td>SCPC</td>
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<td>SCPC</td>
<td>1800</td>
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<td>SCPC</td>
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<tr>
<td>BRAZK2</td>
<td>BRAZK2</td>
<td>H-8</td>
<td>SCPC</td>
<td>1800</td>
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<tr>
<td>BRAZK2</td>
<td>BRAZK2</td>
<td>H-9</td>
<td>SCPC</td>
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<td>BRAZK2</td>
<td>H-10</td>
<td>SCPC</td>
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</tr>
<tr>
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<td>BRAZK2</td>
<td>H-11</td>
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<td>1800</td>
</tr>
<tr>
<td>BRAZK2</td>
<td>BRAZK2</td>
<td>H-12</td>
<td>SCPC</td>
<td>1800</td>
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</table>

**Totals**

| SCPC | 95145 |

---

K-19
K-3 - LINK BUDGETS FOR SCENARIO VI-B
TABLE 1-A - SCENARIO VI-B - C-BAND (FSS) - UPLINK BUDGET
MEXICO, CARIBBEAN ISLANDS, AND SOUTH AMERICA

MODULATION: SCPC/FM - 1,800 HVC/36 MHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-band Frequency</td>
<td>6.15 GHz</td>
<td></td>
</tr>
<tr>
<td>No. of Channels, N</td>
<td>1,800</td>
<td></td>
</tr>
<tr>
<td>E/S Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Losses</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>54.0 dBi</td>
<td>10-m Dish, 60% efficiency</td>
</tr>
<tr>
<td>Earth Station EIRP</td>
<td>82.9 dBW</td>
<td></td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Loading Factor</td>
<td>32.6 dB</td>
<td>10 log N</td>
</tr>
<tr>
<td>Net EIRP/SCPC Channel</td>
<td>47.4 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>200.0 dB</td>
<td>38,700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>200.5 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-79.8 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>24.7 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Losses</td>
<td>1.3 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.1 dB-K</td>
<td>Referred to antenna output</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>-2.4 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-128.4 dBW</td>
<td>per SCPC Channel</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 DBW/Hz-K</td>
<td>per SCPC Channel</td>
</tr>
<tr>
<td>Uplink C/kT</td>
<td>73.1 dB-Hz</td>
<td>per SCPC Channel</td>
</tr>
<tr>
<td>IF BW/Channel</td>
<td>43.0 dB-Hz</td>
<td>20.0 kHz</td>
</tr>
<tr>
<td>Uplink C/N per Channel</td>
<td>30.1 dB</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 1-B - SCENARIO VI-B - C-BAND (FSS) - DOWNLINK BUDGET
MEXICO, CARIBBEAN ISLANDS, AND SOUTH AMERICA

<table>
<thead>
<tr>
<th>MODULATION: SCPC/FM - 1,800 HVC/36 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mid-band Frequency</strong> = 3.95 GHz</td>
</tr>
<tr>
<td><strong>No. of Channels, N =</strong> 1,800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satellite Transmitter Power</th>
<th>11.1 dBW</th>
<th>13.0 watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Line Losses</td>
<td>1.3 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>26.3 dBi</td>
<td>Solid Reflector</td>
</tr>
<tr>
<td>Satellite EIRP</td>
<td>36.1 dBW</td>
<td></td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Loading Factor</td>
<td>32.6 dB</td>
<td></td>
</tr>
<tr>
<td>VOX Advantage</td>
<td>4.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net EIRP/SCPC Channel</td>
<td>4.6 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>196.1 dB</td>
<td></td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td></td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>196.6 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-126.6 dBW/m(^2) (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>50.1 dBi</td>
<td></td>
</tr>
<tr>
<td>Receive Line Losses</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>19.5 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>30.5 dB/K (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-141.9 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Downlink C/(K)</td>
<td>67.2 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Uplink C/(K)</td>
<td>73.1 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Total Channel C/(K)</td>
<td>66.2 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Required Total Channel C/(K)</td>
<td>55.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>C/(K) Margin</td>
<td>11.2 dB</td>
<td></td>
</tr>
<tr>
<td>IF Bandwidth/Channel</td>
<td>43.0 dB-Hz</td>
<td></td>
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<tr>
<td>Total C/N per Channel</td>
<td>23.2 dB</td>
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K-22
### TABLE 2 - SCENARIO VI-B - C-BAND (FSS) - UPLINK BUDGET

**MODULATION: FM-FDMA Video channel (2 video/36 MHz)**

**Mid-band Frequency = 6.15 GHz**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>54.0 dBi</td>
<td>10 m dish, 60% eff.</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td><strong>79.9 dBW</strong></td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>200.0 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td><strong>200.5 dB</strong></td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-82.8 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>24.7 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.3 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.1 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td><strong>-2.4 dB/K</strong></td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-95.9 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/ KT</td>
<td>105.6 dB-Hz</td>
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</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
<td>18 MHz IF Bandwidth</td>
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<td>Received C/N</td>
<td>33.1 dB</td>
<td>Beam 8V, Worst-case</td>
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<td>Value</td>
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</tr>
<tr>
<td>-------------------------------------------------------</td>
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<tr>
<td>Transmitter Power</td>
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</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.3 dB</td>
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</tr>
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<td>Transmitting Antenna Gain</td>
<td>26.3 dBi</td>
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<tr>
<td>Output Back-Off</td>
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<td></td>
</tr>
<tr>
<td>EIRP</td>
<td>33.1 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>195.1 dB</td>
<td></td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
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<td>Atmospheric Degradation</td>
<td>0.0 dB</td>
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</tr>
<tr>
<td>Net Path Loss</td>
<td>196.6 dB</td>
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</tr>
<tr>
<td>Power Flux Density</td>
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<tr>
<td>Receiving Antenna Gain</td>
<td>50.1 dBi</td>
<td></td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>19.5 dB-K</td>
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</tr>
<tr>
<td>Receive G/T</td>
<td>30.6 dB/K</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.4 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>95.7 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Received C/N</td>
<td>23.2 dB</td>
<td></td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
<td></td>
</tr>
<tr>
<td>Link Margin</td>
<td>5.2 dB</td>
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</tr>
<tr>
<td>Overall C/N</td>
<td>22.8 dB</td>
<td></td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>53.8 dB</td>
<td></td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB</td>
<td></td>
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<tr>
<td>(S/N)w Margin</td>
<td>5.8 dB</td>
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</tr>
</tbody>
</table>

TABLE 3 - SCENARIO VI-B - C-BAND (FSS) - DOWNLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 3.95 GHz

- EIRP: 33.1 dBW
- Free Space Loss: 195.1 dB
- Net Path Loss: 196.6 dB
- Power Flux Density: -129.6 dBW/m² (Clear Sky)
- Receive G/T: 30.6 dB/K (Clear Sky)
- Received Carrier Level: -113.4 dBW
- Boltzmann’s Constant: -228.6 dBW/Hz-K
- Received C/kT: 95.7 dB-Hz
- Receiver IF Bandwidth: 72.6 dB-Hz
- Received C/N: 23.2 dB
- Required C/N: 18.0 dB
- Overall C/N: 22.8 dB
- Weighted (S/N)w Ratio: 53.8 dB
- Minimum (S/N)w: 48.0 dB
- (S/N)w Margin: 5.8 dB

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TABLE 4 - SCENARIO VI-B - C-BAND (FSS) - UPLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Information Data Rate = 72 Mb/s
Mid-band Frequency = 6.15 GHz

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<tr>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>54.0 dBi</td>
</tr>
<tr>
<td>EIRP</td>
<td>82.9 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>200.0 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>200.6 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-79.8 dBW/m² (Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>24.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.3 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.1 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>-2.4 dB/K (Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-93.0 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>108.5 dB-Hz</td>
</tr>
</tbody>
</table>

K-25
TABLE 5 - SCENARIO VI-B - C-BAND (FSS) - DOWNLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Mid-band Frequency = 3.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>11.1 dBW</td>
<td>13.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>-1.3 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>26.3 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td><strong>EIRP</strong></td>
<td><strong>36.1 dBW</strong></td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>196.1 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td><strong>196.7 dB</strong></td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-126.6 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>50.1 dBi</td>
<td>10-m dish, 60% efficiency</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>19.5 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td><strong>30.6 dB/K</strong></td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-110.5 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td><strong>Received C/kT</strong></td>
<td><strong>98.6 dB-Hz</strong></td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>78.6 dB-Hz</td>
<td>72 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>2.0 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>14.0 dB</td>
<td>BER=10⁻⁶</td>
</tr>
<tr>
<td><strong>Required C/kT</strong></td>
<td><strong>94.6 dB-Hz</strong></td>
<td></td>
</tr>
<tr>
<td><strong>C/kT Margin</strong></td>
<td><strong>4.1 dB</strong></td>
<td></td>
</tr>
</tbody>
</table>

Remarks

- Allocation
- Gridded Reflector
- 10-m dish, 60% efficiency
- BER=10⁻⁶

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TABLE 6 - SCENARIO VI-B - Ku-BAND (FSS) CANADA - LINK BUDGET

MODULATION: CSSB, Suppressed Carrier (3000 HVC/36 MHz)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-band Downlink Freq.</td>
<td>11.95 GHz</td>
<td>Saturated EIRP</td>
<td>39.0 dBW</td>
</tr>
<tr>
<td>Mid-band Uplink Freq.</td>
<td>14.25 GHz</td>
<td>SFD</td>
<td>-84.0 dBW/m²</td>
</tr>
<tr>
<td>Uplink Free Space Loss</td>
<td>207.3 dB</td>
<td>Satellite Gain</td>
<td>171.4 dB</td>
</tr>
<tr>
<td>No. of Channels, N</td>
<td>3000</td>
<td>Satellite G/T</td>
<td>21.1 dB/K</td>
</tr>
<tr>
<td>Transmitter Power</td>
<td>-8.2 dBW</td>
<td>0.15 Watts</td>
<td></td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
<td></td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>48.8 dBi</td>
<td>Grided Reflector</td>
<td></td>
</tr>
<tr>
<td>Output Backoff</td>
<td>5.0 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net EIRP</td>
<td>34.5 dBW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Load</td>
<td>19.6 dBmO</td>
<td>-15.2 + 10 Log N</td>
<td></td>
</tr>
<tr>
<td>Reference Power EIRP, Pr</td>
<td>14.9 dBW</td>
<td>Net EIRP - Total Load</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
<td></td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
<td></td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>209.4 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-128.3 dBW/m²</td>
<td>(Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
<td>7 m dish, 60% eff.</td>
<td></td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
<td></td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.3 dB-K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.4 dB/K</td>
<td>(Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downlink Pr/No</td>
<td>58.6 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uplink Pr/No</td>
<td>93.2 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downlink Interference Pr/Io</td>
<td>81.2 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uplink Interference Pr/Io</td>
<td>78.9 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermodulation Pr/IMo</td>
<td>71.9 dB-Hz</td>
<td>14.7 dB = P1/P3</td>
<td></td>
</tr>
<tr>
<td>Terrestrial Pr/Io</td>
<td>89.6 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-polarization Pr/Io</td>
<td>88.4 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Pr/No</td>
<td>66.4 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Pr/No</td>
<td>61.9 dB-Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pr/No Margin</td>
<td>4.5 dB-Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### TABLE 7 - SCENARIO VI-B - Ku (FSS) CANADA - UPLINK BUDGET

**MODULATION: FM-FDMA Video channel (2 video/36 MHz)**

**Mid-band Frequency = 14.25 GHz**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>-84.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>-210.9 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-78.7 dB/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>48.8 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>-21.1 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-78.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kt</td>
<td>122.8 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
<td>18 MHz IF Bandwidth</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>50.3 dB</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 8 - SCENARIO VI-B - Ku (FSS) CANADA - DOWNLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>-8.2 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>48.8 dBi</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>36.5 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>206.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-126.3 dBW/m² (Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>34.2 dB/K (Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.2 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/KT</td>
<td>92.9 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>20.4 dB</td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
</tr>
<tr>
<td>Link Margin</td>
<td>2.4 dB</td>
</tr>
<tr>
<td>Overall C/N</td>
<td>20.4 dB</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>51.4 dB</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB</td>
</tr>
<tr>
<td>(S/N)w Margin</td>
<td>3.4 dB</td>
</tr>
</tbody>
</table>

Allocation (Clear Sky)

7 m dish, 60% eff.

38700 km; 30° Elev. A

Studio Reception

50.3 dB Uplink C/N

CCIR Type M

Quality: Excellent (TASO)

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TABLE 9 - SCENARIO VI-B - Ku-BAND (FSS) CANADA - UPLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Information Data Rate =  72 Mb/s
Mid-band Frequency =  14.25 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dB</td>
<td>800.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
<td>7 m dish, 60% efficiency</td>
</tr>
<tr>
<td><strong>EIRP</strong></td>
<td><strong>87.0 dBW</strong></td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td><strong>210.9 dB</strong></td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-75.7 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>48.8 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td><strong>21.1 dB/K</strong></td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-75.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>125.8 dB-Hz</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 10 - SCENARIO VI-B - Ku-BAND (FSS) CANADA - DOWNLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>-8.2 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>48.8 dBi</td>
</tr>
<tr>
<td>EIRP</td>
<td>39.5 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>206.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-123.3 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-110.2 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>95.9 dB-Hz</td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>78.6 dB-Hz</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>1.5 dB</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>14.0 dB</td>
</tr>
<tr>
<td>Required C/kT</td>
<td>94.1 dB-Hz</td>
</tr>
<tr>
<td>C/kT Margin</td>
<td>1.9 dB</td>
</tr>
</tbody>
</table>

Remarks:
- 0.15 Watts
- Allocation
- Grided Reflector
- 38700 km; 30° Elev. Angle
- Allocation
- 7 m dish, 60% efficiency
- Allocation
- (Clear Sky)
- 72 Mb/s
- Allocation
- BER=10⁻⁶
- K-31
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-band Frequency</td>
<td>14.25 GHz</td>
<td></td>
</tr>
<tr>
<td>No. of Channels, N</td>
<td>1,800</td>
<td></td>
</tr>
<tr>
<td>E/S Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Losses</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
<td>7-m Dish, 60% efficiency</td>
</tr>
<tr>
<td>Earth Station EIRP</td>
<td>87.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Loading Factor</td>
<td>32.6 dB</td>
<td>10 log N</td>
</tr>
<tr>
<td>Net EIRP/SCPC Channel</td>
<td>51.5 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
<td>38,700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>210.9 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-75.7 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>29.8 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Losses</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
<td>Referred to antenna output</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>2.1 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-129.6 dBW</td>
<td>per SCPC Channel</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Uplink C/kT</td>
<td>71.3 dB-Hz</td>
<td>per SCPC Channel</td>
</tr>
<tr>
<td>IF BW/ Channel</td>
<td>43.0 dB-Hz</td>
<td>20.0 kHz</td>
</tr>
<tr>
<td>Uplink C/N per Channel</td>
<td>28.3 dB</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 11-B - SCENARIO VI-B - Ku-BAND (FSS) MEXICO - DOWNLINK BUDGET

MODULATION: SCPC/FM - 1,800 HVC/36 MHz

Mid-band Frequency = 11.95 GHz  
No. of Channels, N = 1,800

<table>
<thead>
<tr>
<th>Satellite Transmitter Power</th>
<th>10.4 dBW</th>
<th>11.0 watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Line Losses</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>29.8 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Satellite EIRP</td>
<td>39.1 dBW</td>
<td></td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Loading Factor</td>
<td>32.6 dB</td>
<td></td>
</tr>
<tr>
<td>VOX Advantage</td>
<td>4.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net EIRP/SCPC Channel</td>
<td>7.6 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
<td></td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td></td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>209.4 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-123.6 dBW/m^2 (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
<td></td>
</tr>
<tr>
<td>Receive Line Losses</td>
<td>0.2 dB</td>
<td>7-m dish, 60% efficiency</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-145.1 dBW per SCPC Channel</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K per SCPC Channel</td>
<td></td>
</tr>
<tr>
<td>Downlink C/kt</td>
<td>61.0 dB-Hz per SCPC Channel</td>
<td></td>
</tr>
<tr>
<td>Uplink C/kt</td>
<td>71.3 dB-Hz per SCPC Channel</td>
<td></td>
</tr>
<tr>
<td>Total Channel C/kt</td>
<td>60.6 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Required Total Channel C/kt</td>
<td>55.0 dB-Hz 51-56 dB-Hz Acceptable</td>
<td></td>
</tr>
<tr>
<td>C/kt Margin</td>
<td>5.6 dB</td>
<td></td>
</tr>
<tr>
<td>IF Bandwidth/Channel</td>
<td>43.0 dB-Hz 20.0 kHz</td>
<td></td>
</tr>
<tr>
<td>Total C/N per Channel</td>
<td>17.6 dB</td>
<td></td>
</tr>
</tbody>
</table>

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### TABLE 12- SCENARIO VI-B - Ku (FSS) MEXICO - UPLINK BUDGET

**MODULATION:** FM-FDMA Video channel (2 video/36 MHz)

*Mid-band Frequency* = 14.25 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
<td>7 m dish, 60% eff.</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>84.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
<td>38700 km; 30° Elev. Ang.</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>210.9 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-78.7 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>29.8 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
<td></td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>2.1 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-97.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/KT</td>
<td>103.8 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
<td>18 MHz IF Bandwidth</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>31.3 dB</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 13 - SCENARIO VI-B - Ku (FSS) MEXICO - DOWNLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>10.8 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>29.8 dBi</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>36.5 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>206.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-126.3 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>34.2 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.2 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>93.0 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td><strong>Received C/N</strong></td>
<td>20.4 dB</td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
</tr>
<tr>
<td><strong>Link Margin</strong></td>
<td>2.4 dB</td>
</tr>
<tr>
<td>Overall C/N</td>
<td>20.1 dB</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>51.1 dB</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB</td>
</tr>
<tr>
<td>(S/N)w Margin</td>
<td>3.1 dB</td>
</tr>
</tbody>
</table>

38700 km; 30º Elev. A

(7 m dish, 60% eff.)

18 MHz IF Bandwidth

31.3 dB Uplink C/N

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TABLE 14 - SCENARIO VI-B - Ku-BAND (FSS) MEXICO - UPLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Information Data Rate = 72 Mb/s
Mid-band Frequency = 14.25 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
<td>800.0 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
<td>7 m dish, 60% efficiency</td>
</tr>
<tr>
<td>EIRP</td>
<td>87.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>(210.9 dB)</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-75.7 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>29.8 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>2.1 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-94.0 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>106.8 dB-Hz</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 15 - SCENARIO VI-B - Ku-BAND (FSS) MEXICO - DOWNLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK
Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>10.8 dBW</td>
<td>12.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>29.8 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>EIRP</td>
<td>39.5 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>206.4 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-123.3 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
<td>7 m dish, 60% efficiency</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-110.2 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>96.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>78.6 dB-Hz</td>
<td>72 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>1.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>14.0 dB</td>
<td>BER=10⁻⁶</td>
</tr>
<tr>
<td>Required C/kT</td>
<td>94.1 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>C/kT Margin</td>
<td>1.9 dB</td>
<td></td>
</tr>
</tbody>
</table>

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### TABLE 16-A - SCENARIO VI-B -Ku-BAND (FSS) BRAZIL - UPLINK BUDGET

**MODULATION: SCPC/FM - 1,800 HVC/36 MHz**

Mid-band Frequency = 14.25 GHz  
No. of Channels, N = 1,800

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E/S Transmitter Power</td>
<td>29.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Losses</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
</tr>
<tr>
<td>Earth Station EIRP</td>
<td>87.0 dBW</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Loading Factor</td>
<td>32.6 dB</td>
</tr>
<tr>
<td>Net EIRP/SCPC Channel</td>
<td>51.5 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>210.9 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-75.7 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>27.3 dBi</td>
</tr>
<tr>
<td>Receive Line Losss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>-0.4 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-132.1 dBW</td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Uplink C/kT</td>
<td>68.8 dB-Hz</td>
</tr>
<tr>
<td>IF BW/Channel</td>
<td>43.0 dB-Hz</td>
</tr>
<tr>
<td>Uplink C/N per Channel</td>
<td>25.8 dB</td>
</tr>
</tbody>
</table>

800.0 Watts  
Allocation  
7-m Dish, 60% efficiency  
38,700 km; 30° Elev. Angle  
Allocation  
Gridded Reflector  
Allocation  
Referred to antenna output  
(Clear Sky)  
Referred to antenna output  
(Clear Sky)  
per SCPC Channel  
per SCPC Channel  
20.0 kHz

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TABLE 16-B - SCENARIO VI-B - Ku-BAND (FSS) BRAZIL - DOWNLINK BUDGET

MODULATION: SCPC/FM - 1,800 HVC/36 MHz

Mid-band Frequency = 11.95 GHz
No. of Channels, N = 1,800

<table>
<thead>
<tr>
<th>Satellite Transmitter Power</th>
<th>13.0 dBW</th>
<th>20.0 watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Line Losses</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>27.3 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>Satellite EIRP</td>
<td>39.2 dBW</td>
<td></td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Loading Factor</td>
<td>32.6 dB</td>
<td></td>
</tr>
<tr>
<td>VOX Advantage</td>
<td>4.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net EIRP/SCPC Channel</td>
<td>7.7 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
<td></td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td></td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>209.4 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-123.5 dBW/m² (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
<td></td>
</tr>
<tr>
<td>Receive Line Losses</td>
<td>0.2 dB</td>
<td></td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K (Clear Sky)</td>
<td></td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-145.0 dB</td>
<td></td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dB/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Downlink C/kt</td>
<td>-61.1 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Uplink C/kt</td>
<td>68.8 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Total Channel C/kt</td>
<td>60.4 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Required Total Channel C/kt</td>
<td>55.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>C/kt Margin</td>
<td>5.4 dB</td>
<td></td>
</tr>
<tr>
<td>IF Bandwidth/Channel</td>
<td>43.0 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Total C/N per Channel</td>
<td>17.4 dB</td>
<td></td>
</tr>
</tbody>
</table>

K-39
TABLE 17 - SCENARIO VI-B - Ku (FSS) BRAZIL - UPLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)

Mid-band Frequency = 14.25 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
</tr>
<tr>
<td>Input Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net EIRP</strong></td>
<td>84.0 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
</tr>
<tr>
<td><strong>Net Path Loss</strong></td>
<td>210.9 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-78.7 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>27.3 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
</tr>
<tr>
<td><strong>Receive G/T</strong></td>
<td>-0.4 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-99.5 dBW</td>
</tr>
<tr>
<td>Boltzmann’s Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kt</td>
<td>101.3 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td>Received C/N</td>
<td>28.8 dB</td>
</tr>
</tbody>
</table>

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TABLE 18 - SCENARIO VI-B - Ku (FSS) BRAZIL - DOWNLINK BUDGET

MODULATION: FM-FDMA Video channel (2 video/36 MHz)
Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>13.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>27.3 dBi</td>
</tr>
<tr>
<td>Output Back-Off</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Net EIRP</td>
<td>36.2 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>206.4 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-126.5 dBW/m²</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-113.4 dBW</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
</tr>
<tr>
<td>Received C/kt</td>
<td>92.7 dB-Hz</td>
</tr>
<tr>
<td>Receiver IF Bandwidth</td>
<td>72.6 dB-Hz</td>
</tr>
<tr>
<td>Received C/N</td>
<td>20.7 dB</td>
</tr>
<tr>
<td>Required C/N</td>
<td>18.0 dB</td>
</tr>
<tr>
<td>Link Margin</td>
<td>2.1 dB</td>
</tr>
<tr>
<td>Overall C/N</td>
<td>19.6 dB</td>
</tr>
<tr>
<td>Weighted (S/N)w Ratio</td>
<td>50.6 dB</td>
</tr>
<tr>
<td>Minimum (S/N)w</td>
<td>48.0 dB</td>
</tr>
<tr>
<td>(S/N)w Margin</td>
<td>2.6 dB</td>
</tr>
<tr>
<td>Studio Reception</td>
<td></td>
</tr>
<tr>
<td>CCIR Type M</td>
<td></td>
</tr>
<tr>
<td>Quality: Excellent (TASO)</td>
<td></td>
</tr>
</tbody>
</table>

38700 km; 30° Elev. A
7 m dish, 60% eff.
18 MHz IF Bandwidth
28.8 dB Uplink C/N
TABLE 19 - SCENARIO VI-B - Ku-BAND (FSS) BRAZIL - UPLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Information Data Rate = 72 Mb/s
Mid-band Frequency = 14.25 GHz

<table>
<thead>
<tr>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>29.0 dBW</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>0.2 dB</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>58.2 dBi</td>
</tr>
<tr>
<td>EIRP</td>
<td>87.0 dBW</td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>207.3 dB</td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>3.0 dB</td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>210.9 dB</td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-75.7 dB/m² (Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>27.3 dBi</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>27.7 dB-K</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>-0.4 dB/K (Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-96.5 dB</td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dB/Hz-K</td>
</tr>
<tr>
<td>Received C/kT</td>
<td>104.3 dB-Hz</td>
</tr>
</tbody>
</table>

Transmitter Power = 800.0 Watts
Allocation
7 m dish, 60% efficiency

Allocation
38700 km; 30° Elev. Angle
Allocation
Gridded Reflector
Allocation
27.3 dB-K
TABLE 20 - SCENARIO VI-B - Ku-BAND (FSS) BRAZIL - DOWNLINK BUDGET

MODULATION: SS/TDMA/8-ary PSK

Mid-band Frequency = 11.95 GHz

<table>
<thead>
<tr>
<th></th>
<th>Uncoded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power</td>
<td>13.0 dBW</td>
<td>20.00 Watts</td>
</tr>
<tr>
<td>Transmit Line Loss</td>
<td>1.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Transmitting Antenna Gain</td>
<td>27.3 dBi</td>
<td>Gridded Reflector</td>
</tr>
<tr>
<td>EIRP</td>
<td>39.2 dBW</td>
<td></td>
</tr>
<tr>
<td>Free Space Loss</td>
<td>205.8 dB</td>
<td></td>
</tr>
<tr>
<td>Pointing Loss</td>
<td>0.5 dB</td>
<td>38700 km; 30° Elev. Angle</td>
</tr>
<tr>
<td>Atmospheric Degradation</td>
<td>0.1 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Rain Margin</td>
<td>0.0 dB</td>
<td></td>
</tr>
<tr>
<td>Net Path Loss</td>
<td>206.4 dB</td>
<td></td>
</tr>
<tr>
<td>Power Flux Density</td>
<td>-123.5 dBW/m²</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Receiving Antenna Gain</td>
<td>56.7 dBi</td>
<td>7 m dish, 60% efficiency</td>
</tr>
<tr>
<td>Receive Line Loss</td>
<td>0.2 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>System Noise Temperature</td>
<td>22.5 dB-K</td>
<td></td>
</tr>
<tr>
<td>Receive G/T</td>
<td>34.2 dB/K</td>
<td>(Clear Sky)</td>
</tr>
<tr>
<td>Received Carrier Level</td>
<td>-110.4 dBW</td>
<td></td>
</tr>
<tr>
<td>Boltzmann's Constant</td>
<td>-228.6 dBW/Hz-K</td>
<td></td>
</tr>
<tr>
<td>Received C/kT</td>
<td>95.7 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>Information Bit Rate</td>
<td>78.6 dB-Hz</td>
<td>72 Mb/s</td>
</tr>
<tr>
<td>Implementation Loss</td>
<td>1.5 dB</td>
<td>Allocation</td>
</tr>
<tr>
<td>Required Eb/No</td>
<td>14.0 dB</td>
<td>BER=10⁻⁶</td>
</tr>
<tr>
<td>Required C/kT</td>
<td>94.1 dB-Hz</td>
<td></td>
</tr>
<tr>
<td>C/kT Margin</td>
<td>1.6 dB</td>
<td></td>
</tr>
</tbody>
</table>

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