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DATA TRANSMISSION NETWORKS

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The High Resolution, High Frame Rate Video Technology (HHVT) project engineers wrote a task order to Analex Corporation to investigate data compression techniques that could be applied to the HHVT system, and both existing and planned downlink/uplink capabilities of the Space Shuttle and Space Station Freedom. Specifically, Analex Corporation was directed to do the following:

- (1) Investigate signal channel availability and determine both the maximum possible data rate and the average data rate
- (2) Identify time blocks for HHVT video transmission assuming time sharing and interruptions in the communications links
- (3) Determine the bit error rates to be expected
- (4) Define the transmit and receive interfaces

The formula used to determine the bit rate is as follows:

$$\text{Bit rate} = (\text{HR})(\text{VR})(\text{IR})(\text{FR})(\text{C})(\text{V})$$

where

- HR horizontal resolution in pixels
- VR vertical resolution in pixels
- IR intensity resolution in bits
- FR frame rate in frames/sec
- C 3 (for color), 1 (for monochrome)
- V number of views

For example, with HR = VR = 512 pixels, IR = 8 bits (which corresponds to 256 level resolution), FR = 30 frames/sec, C = 3 for color, and V = 1,

$$\text{Bit rate} = 512 \times 512 \times 8 \times 30 \times 3 \times 1 = 190 \text{ Mbits/sec}$$

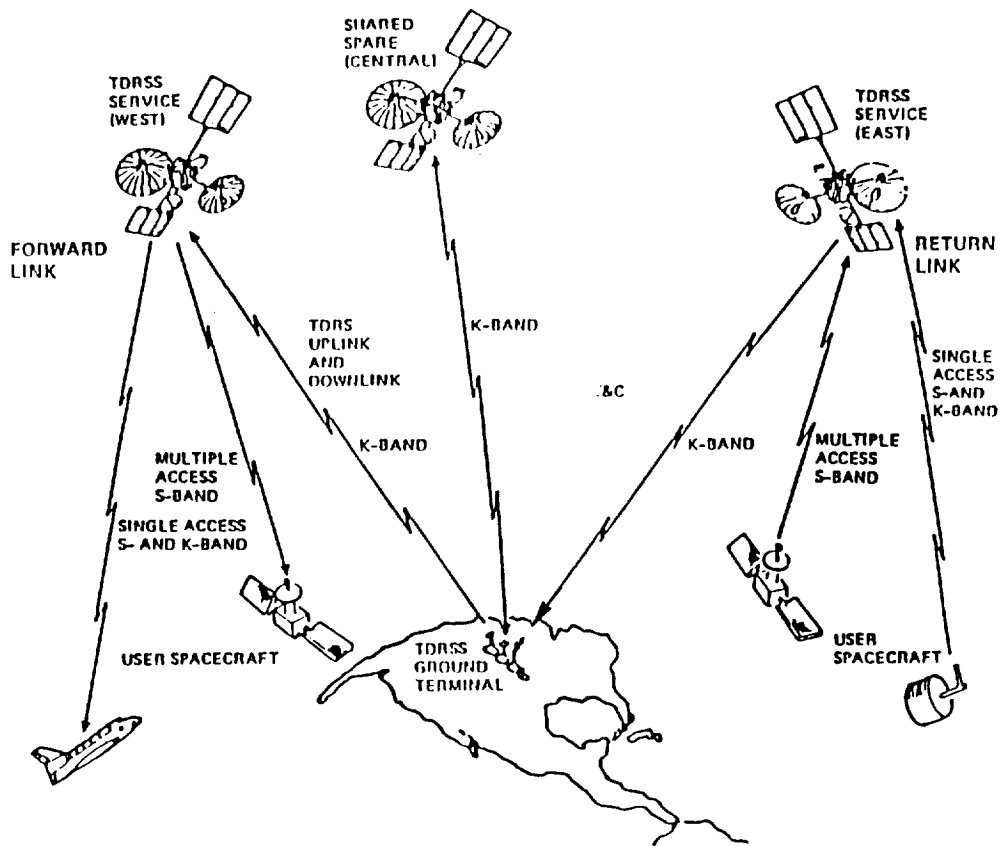
There are several constraints on the amount of data that can be downlinked at any given time. These constraints include the maximum possible data downlinking rate, geometric coverage, antenna blockage, data acquisition, and the fact that the data transmission network is a multiuser shared resource.

A summary chart of the data transmission capabilities for TRSS, the Space Shuttle, Space Station Freedom, Spacelab, and USLab is attached.

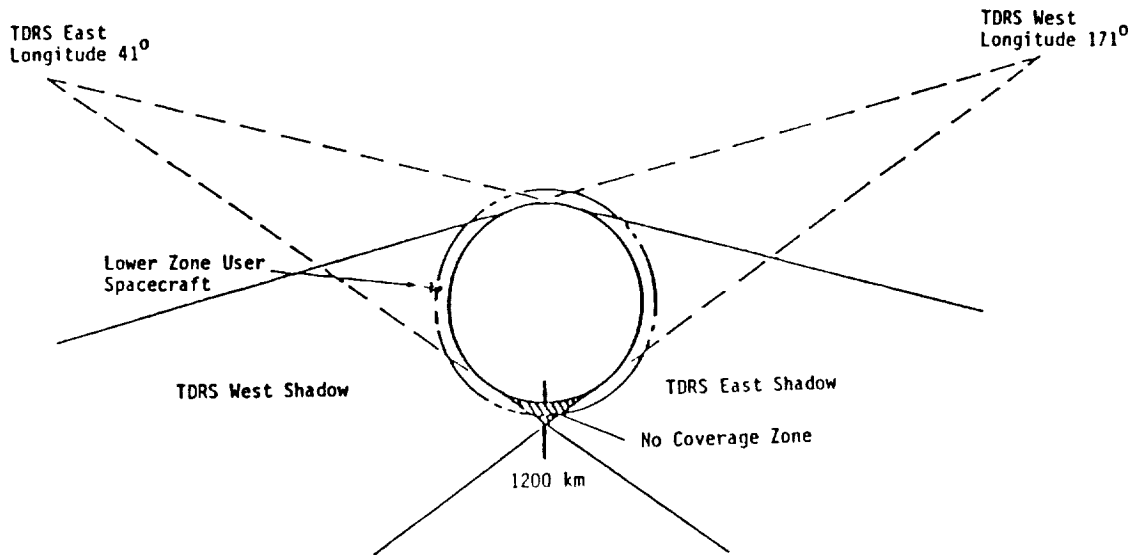
SCHEDULE OF RELATED SYSTEMS

	1989	90	91	92	93	94	95	96	97	98	99	2000
GSTDN												
TDRS(41W)												
TDRS(171W)												
ATDRSS												
STS												
SLS	I I		I I									
SS PHASE_1												
USLAB												
JEM												
COLUMBIA												

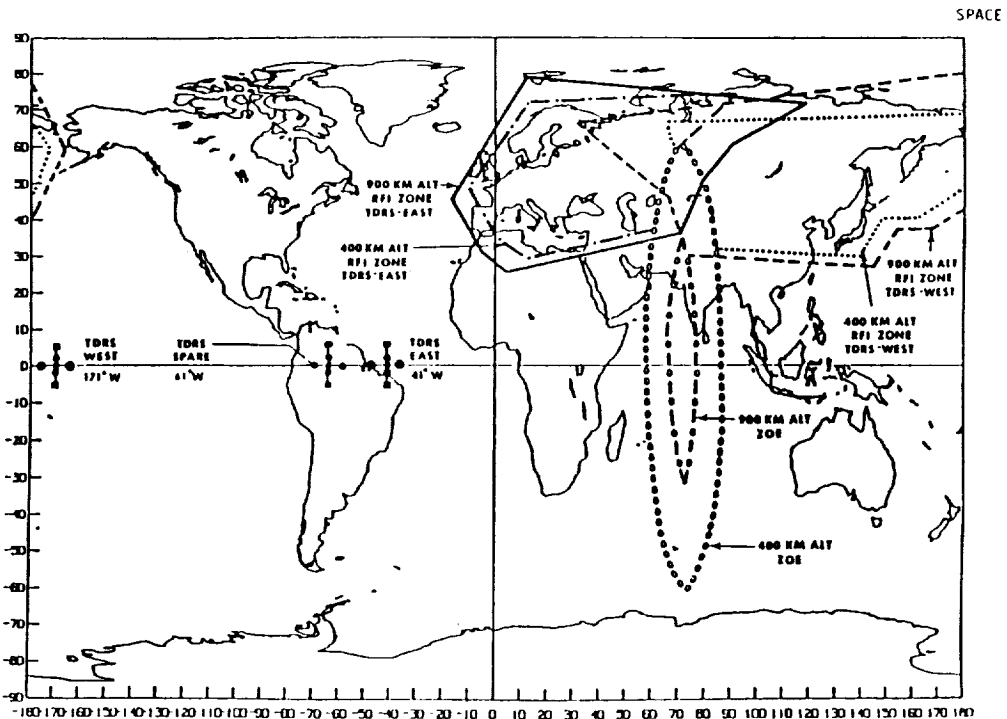
TDRSS SPACE SEGMENT

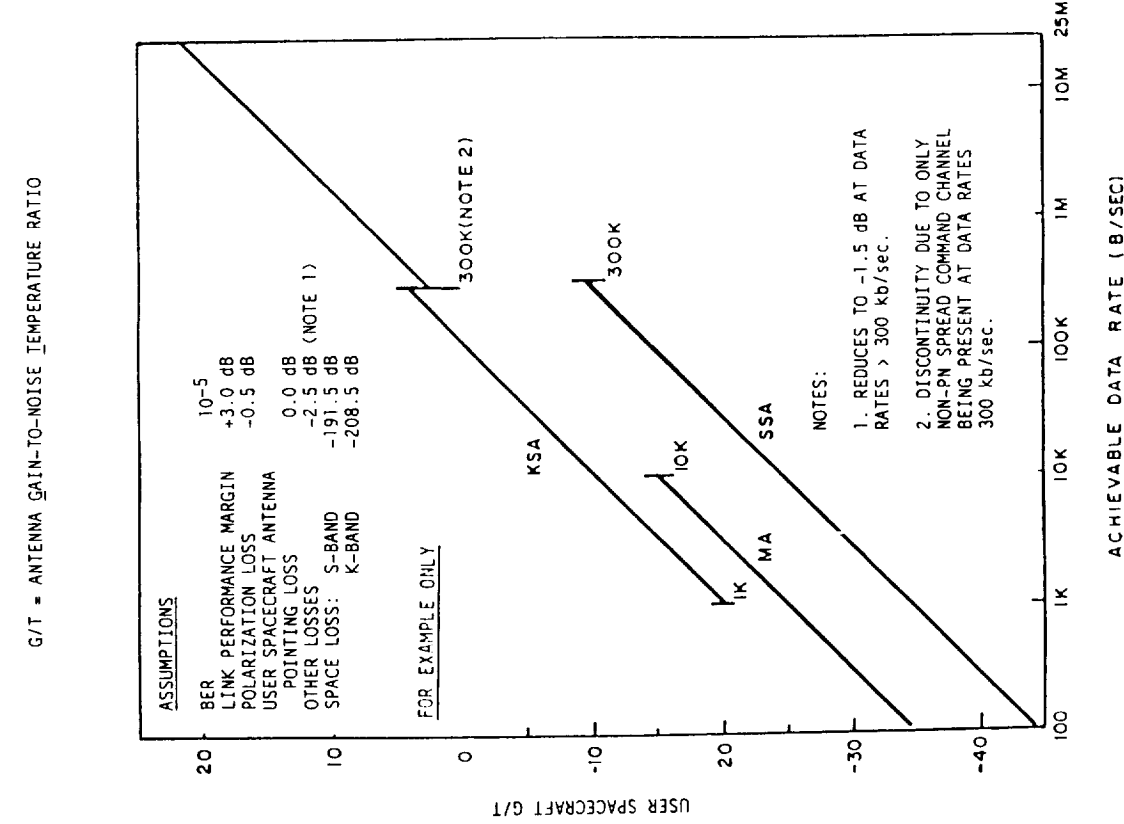
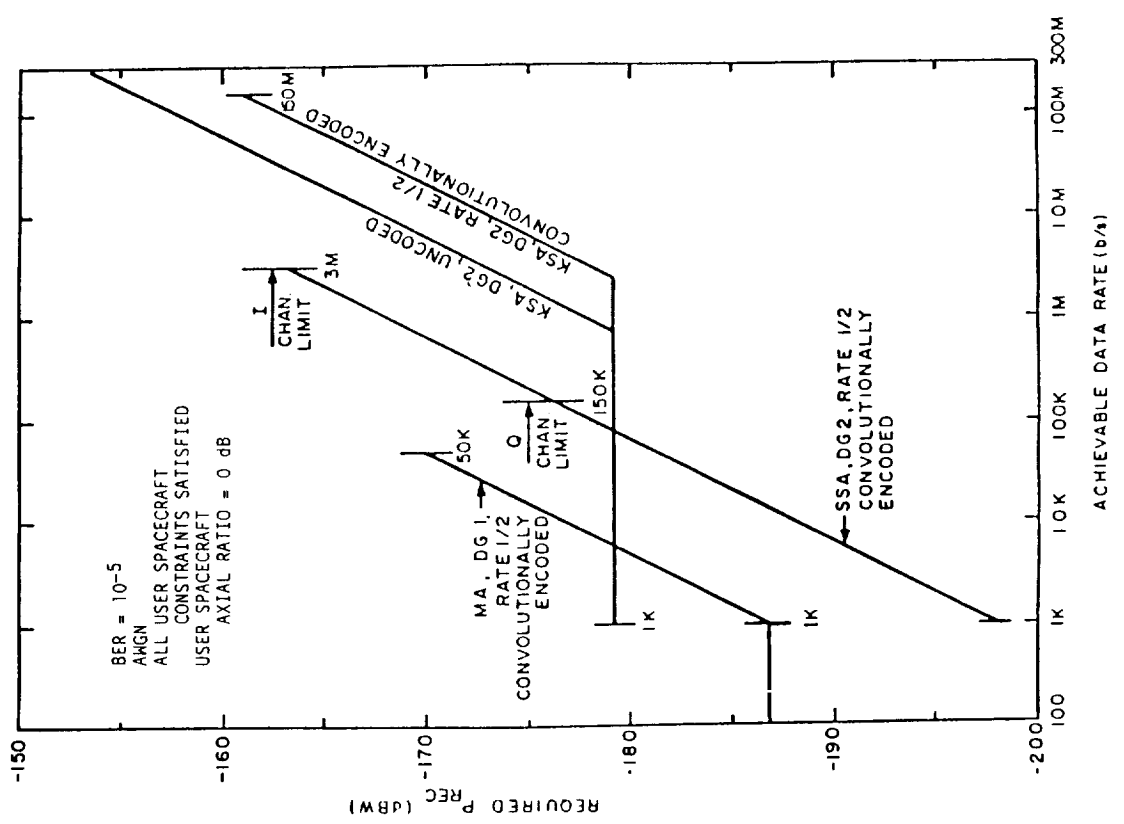


TDRSS COVERAGE GEOMETRY



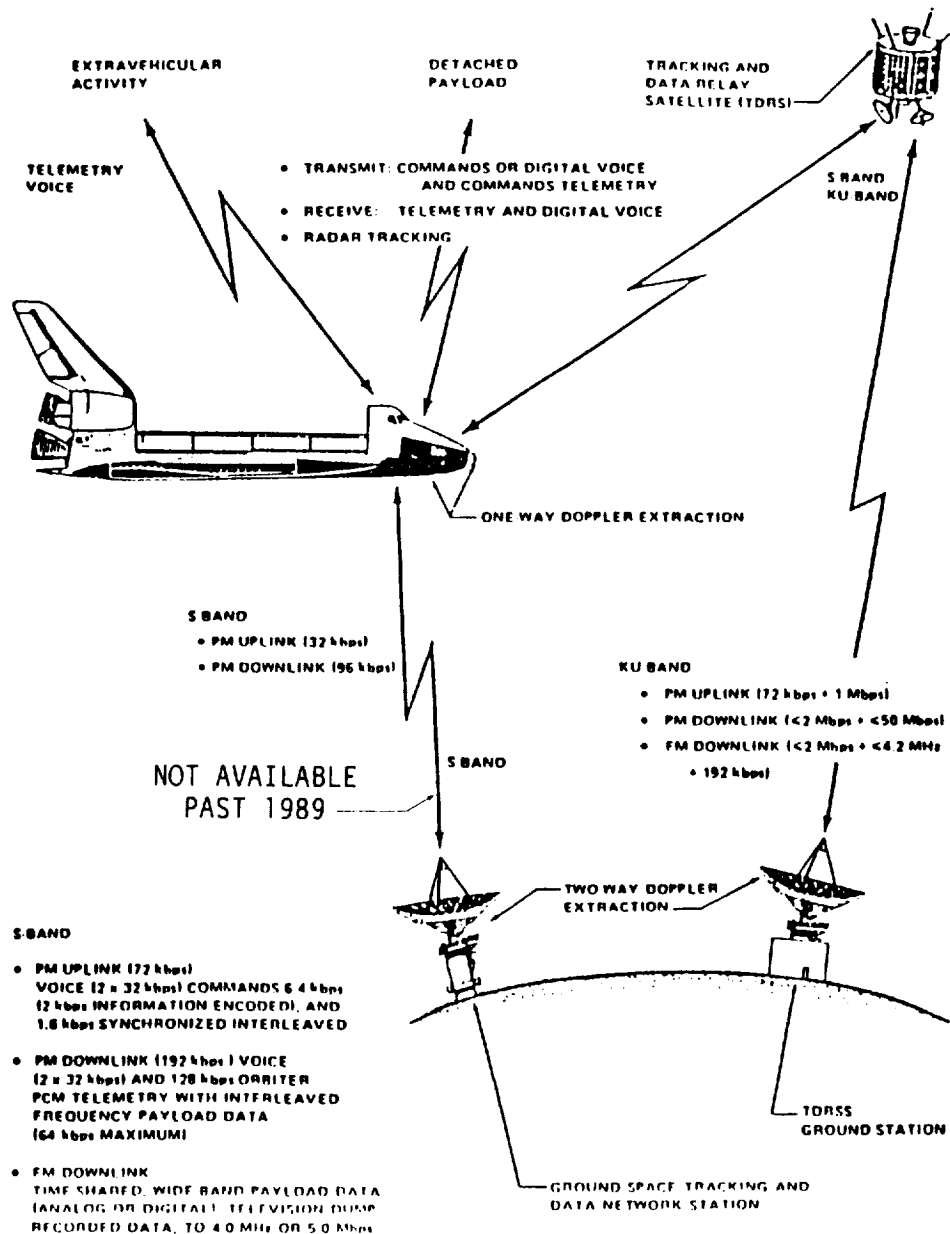
TDRSS COVERAGE ZONE





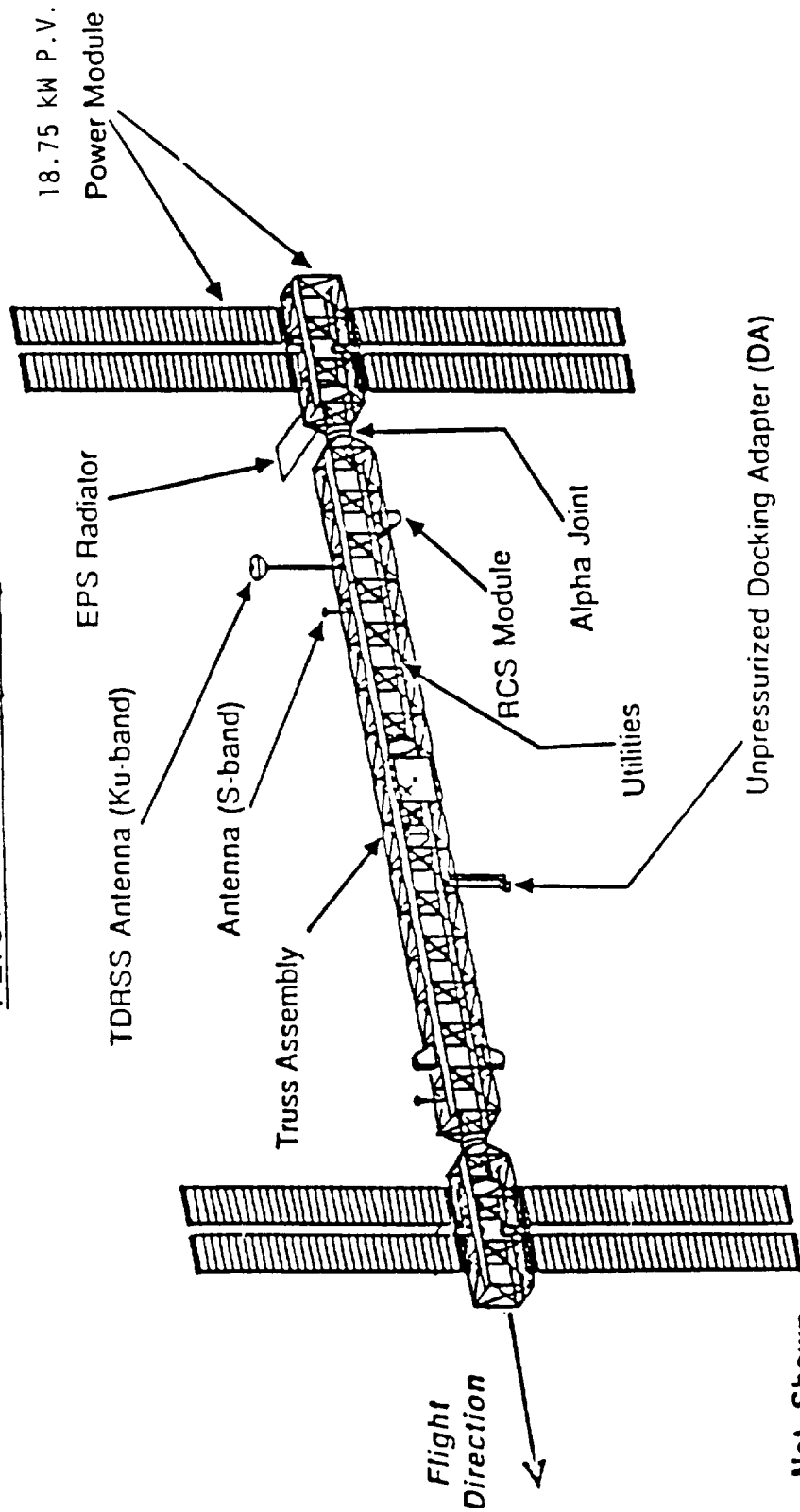
ORIGINAL PAGE IS OF POOR QUALITY

SHUTTLE ORBITAL COMMUNICATIONS LINKS



SPACE STATION POWER MODULE AND TRUSS

FLIGHT No. 2 (MB-2)



Not Shown

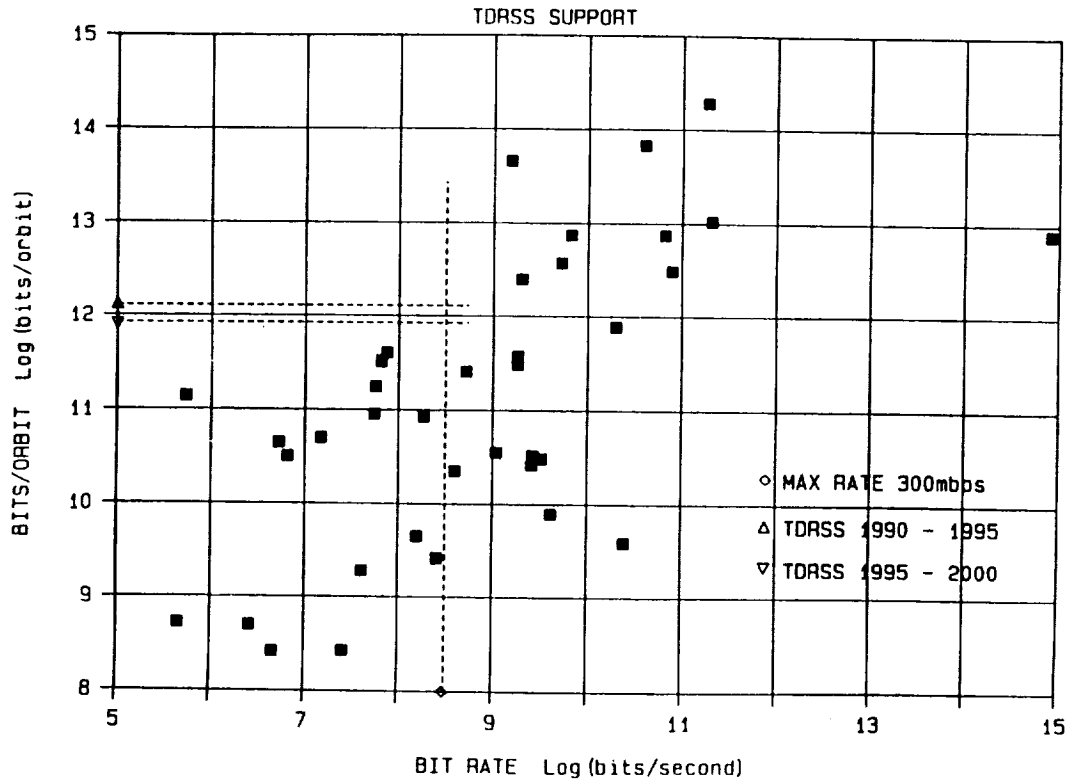
- CMG's
- Tank Farm
- EPS Equipment

Flight Mode

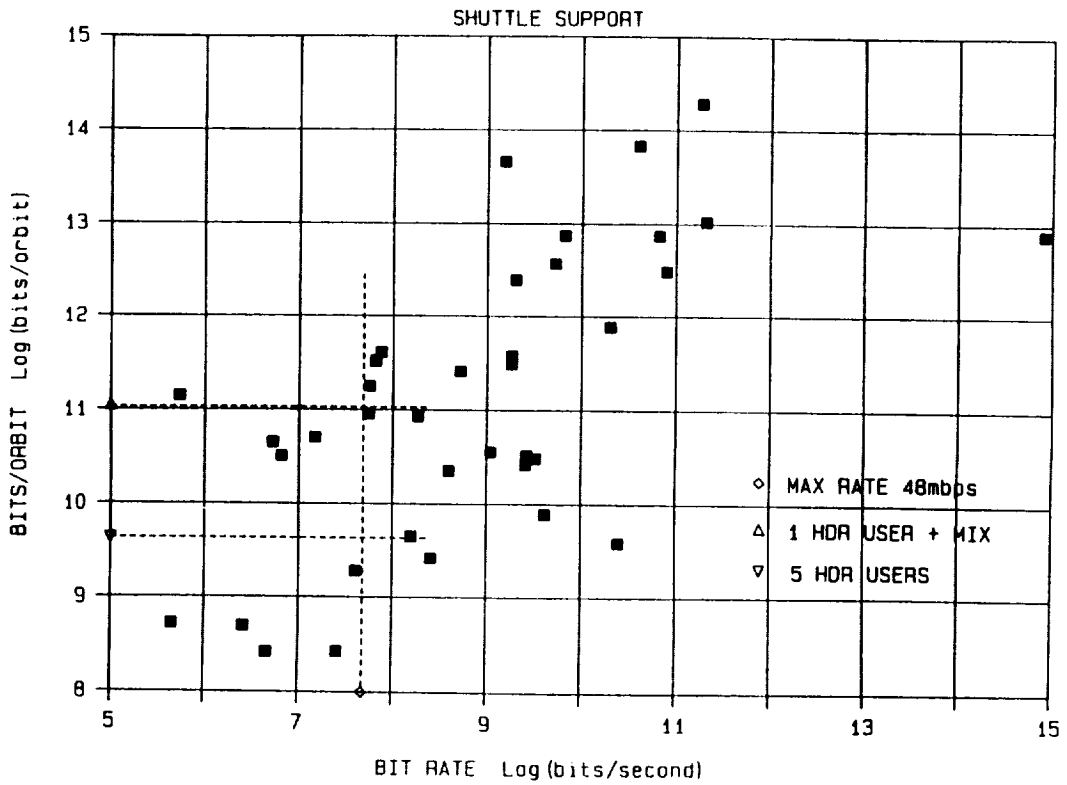
Arrow

P.V. Arrays Feathered

USER REQUIREMENTS

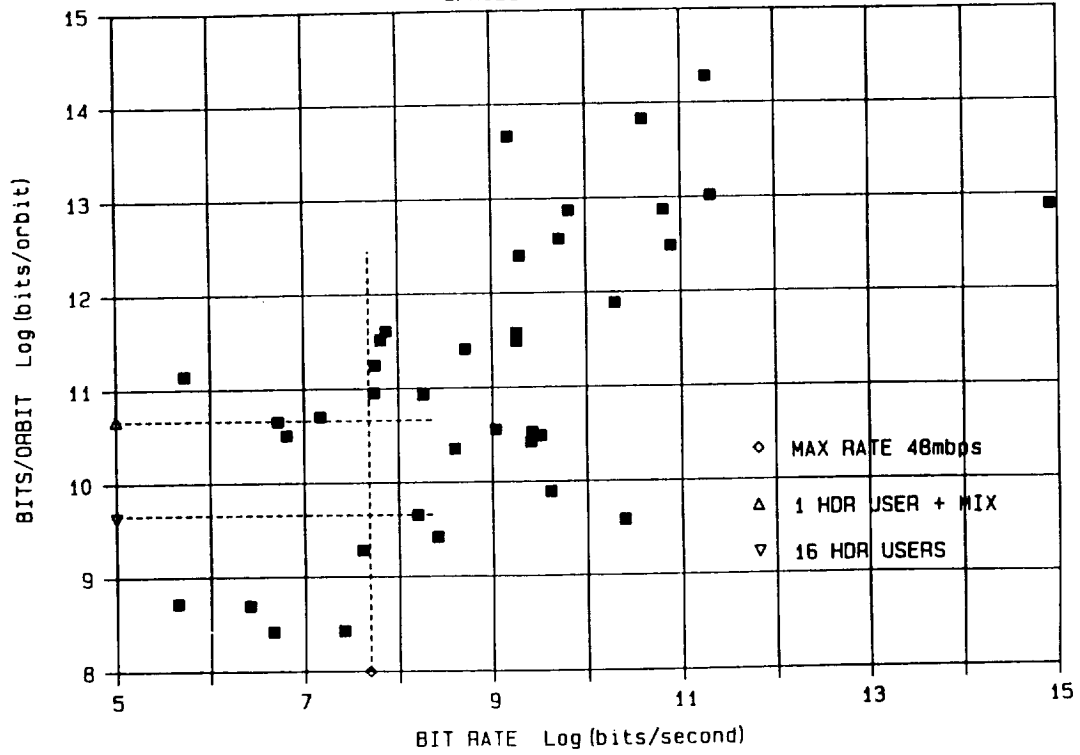


USER REQUIREMENTS



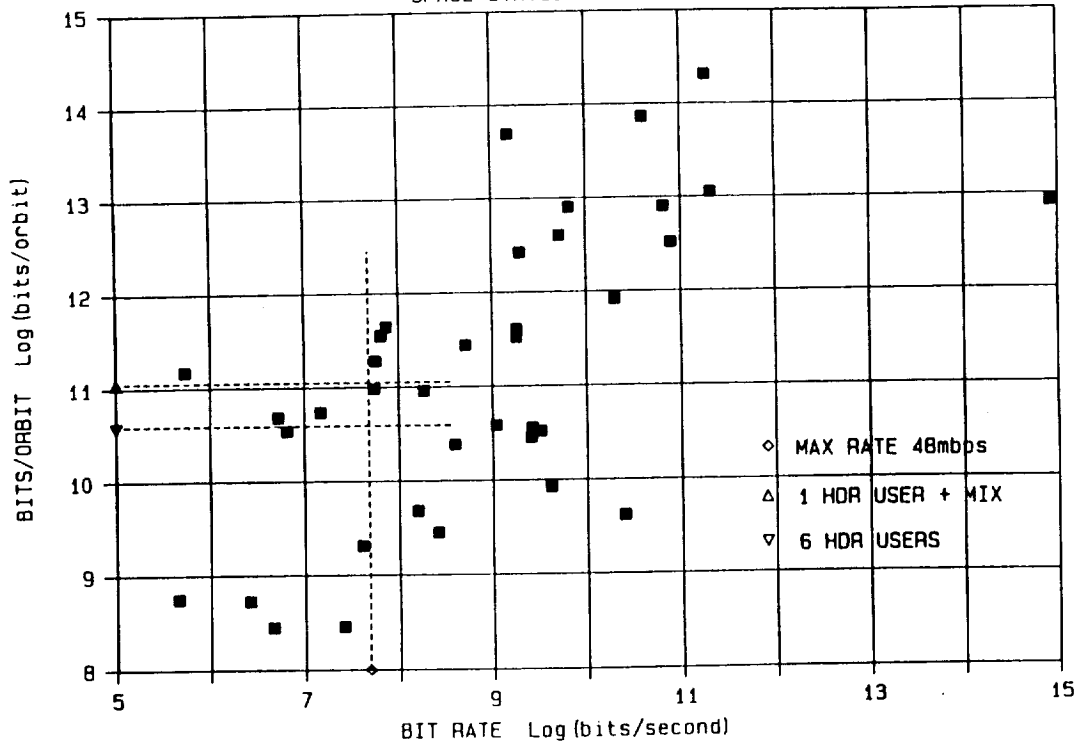
USER REQUIREMENTS

SPACELAB SUPPORT

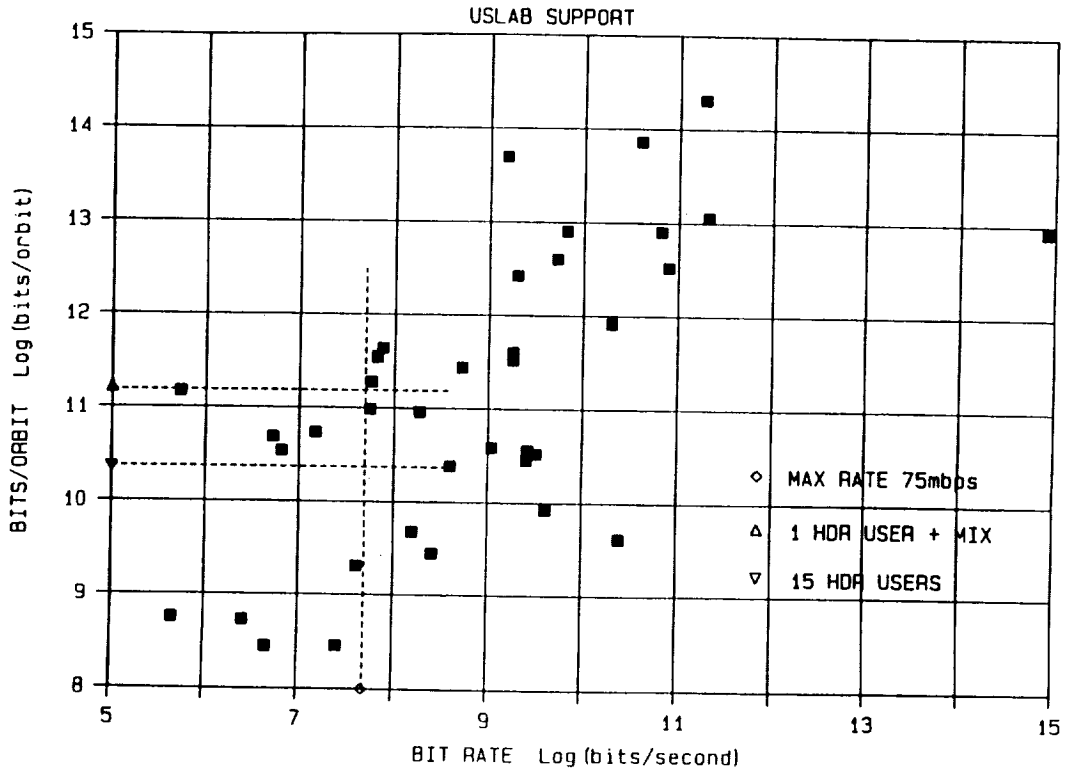


USER REQUIREMENTS

SPACE STATION SUPPORT



USER REQUIREMENTS



DATA SUPPORT SUMMARY

	MAX RATE mbps	PROB UPPER BOUND bits/orbit	LOWER BOUND bits/orbit
TDRSS	300	1.3E12	7.9E11
SHUTTLE	48	1.0E11	4.3E9
SPACELAB	48	4.8E10	3.0E9
SPACE STATION	48	1.1E11	3.7E10
USLAB	75	1.7E11	2.2E10