Bit Rates

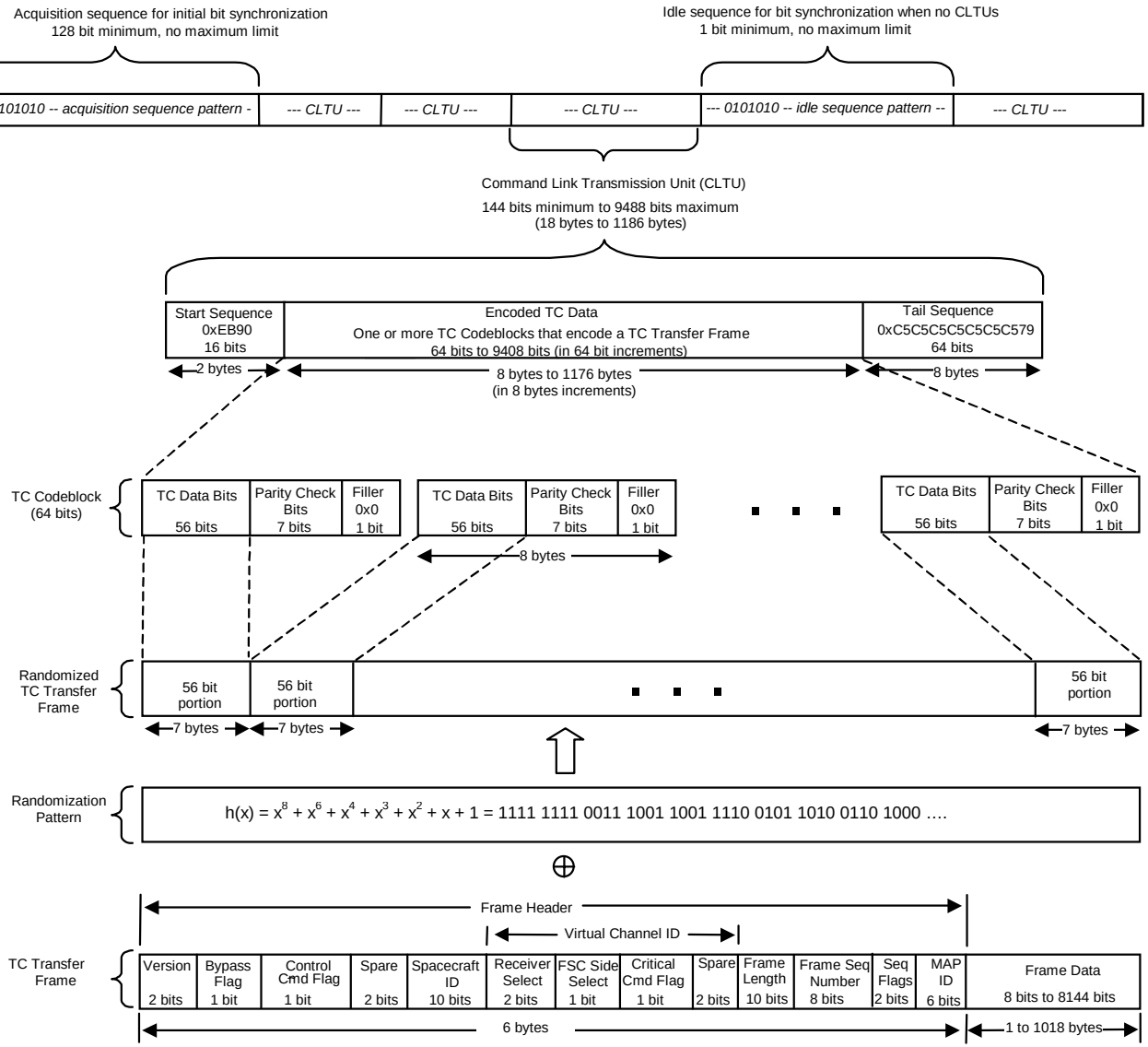
June 27, 2001

Data Rate Summary

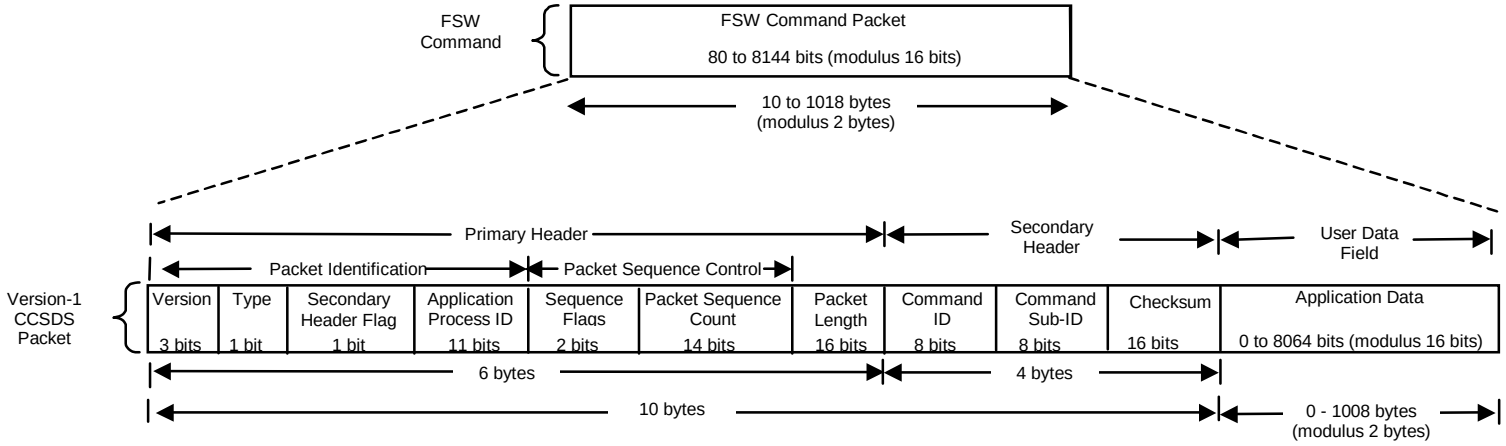
- **Forward Link Data Rates**
  - **Fixed by capabilities of the on-board receiver**
  - **2,000 bits/sec**

- **Return Link Data Rates**
  - **Controlled by clock and data rates output by the FAME Spacecraft Controller (FSC) to the transmitter**
  - **1,000,000 bits/sec**
  - **500,000 bits/sec**
  - **250,000 bits/sec**
  - **100,000 bits/sec**
  - **8,000 bits/sec**
  - **1,000 bits/sec**

Forward Link Transport Layer (1 of 2)

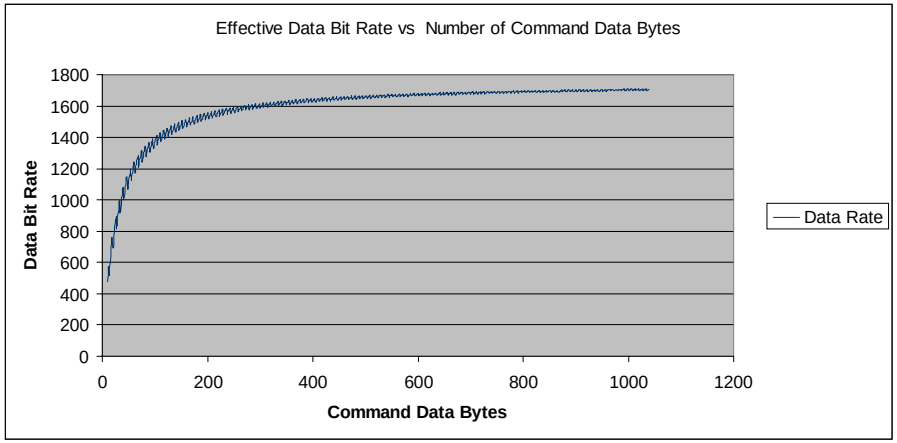


Forward Link Transport Layer (2 of 2)

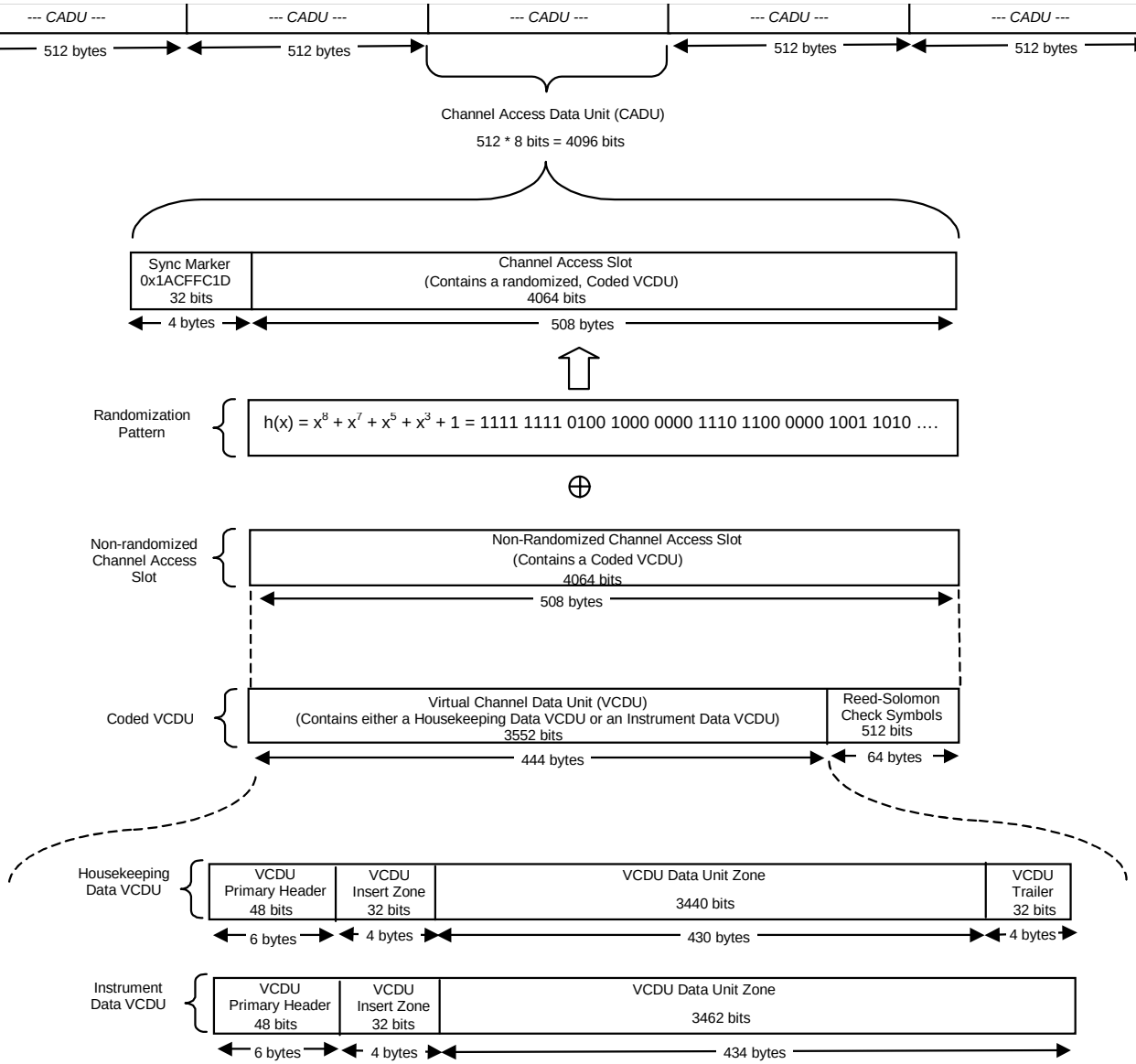


Forward Link Overhead

Command data	10	1008	Bytes
Overhead:			
CCSDS Packet	10	10	Bytes
TC Transfer Frame	6	6	Bytes
TC Code Block Fill	2	5	Bytes
TC Code Block Parity	4	147	Bytes
Command Link Transmission Unit	10	10	Bytes
Total Bytes for the command	42	1186	Bytes
Overhead Percentage	76.2%	15.0%	
Overhead Bit Rate for fully utilized uplink	1524	300	Bits/sec
Data Bit Rate for fully utilized uplink	476	1700	Bits/sec



Return Link Transport Layer (1 of 3)

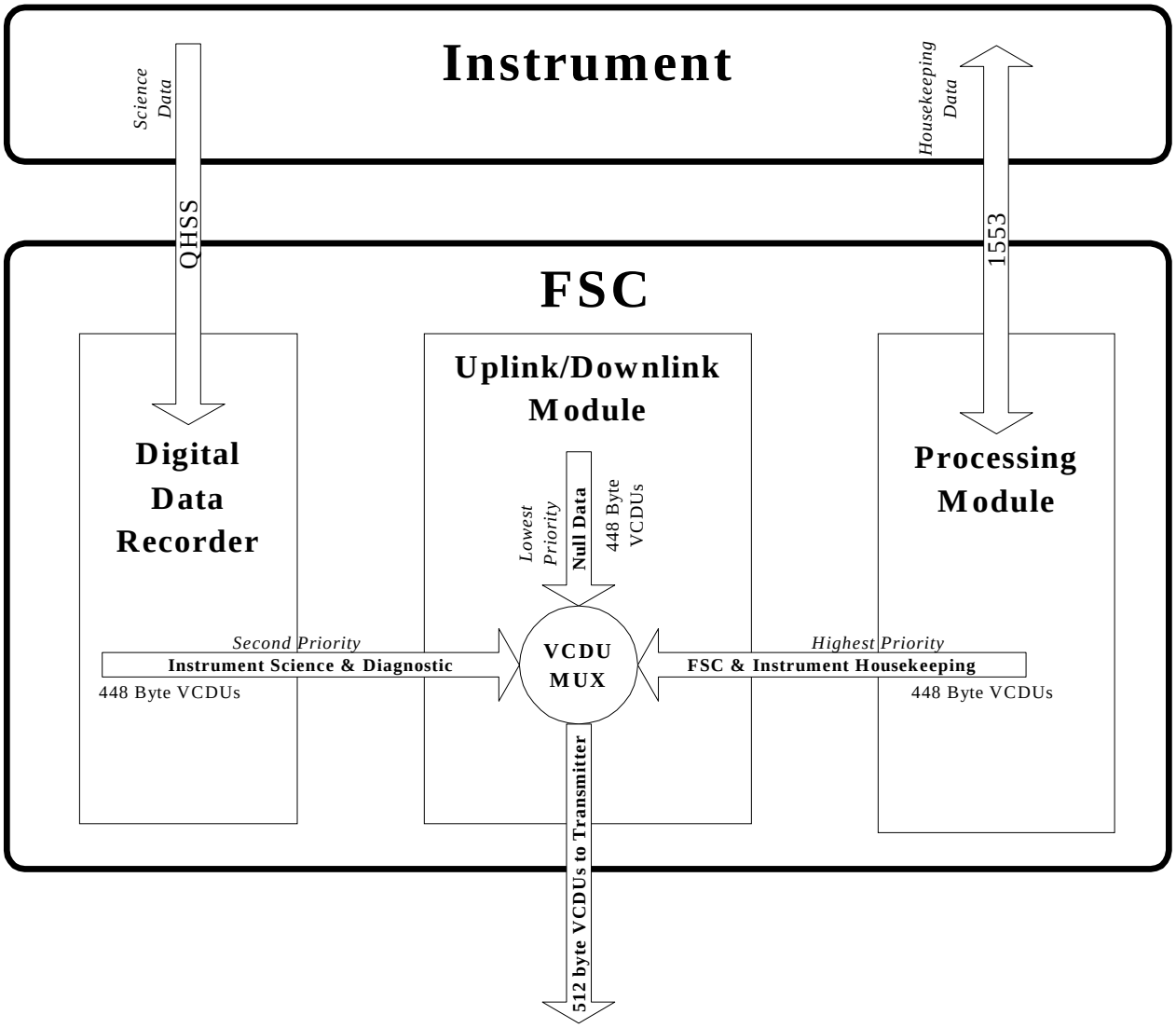


Return Link - Notes

- **FSC Return Link Data:**
  - **Under nominal conditions, the FSC Housekeeping Bandwidth is targeted for 8000 bits/sec**
  - **For diagnostic support, the FSC Bandwidth utilization can be commanded higher**
  - **The FSC Return Link Data includes both Bus and Instrument Housekeeping information**
  - **Instrument housekeeping data will be obtained by the FSC from the Instrument via the 1553 I/F**
  - **FSC Return Link Data has priority over the Instrument Return Link Data**

- **Instrument Return Link Data**
  - **Data flows to the FSC Digital Data Recorder via the QHSS I/F**
  - **Contains all instrument science data and instrument engineering data**
  - **Instrument diagnostics and memory downloads may utilize this interface (under review)**

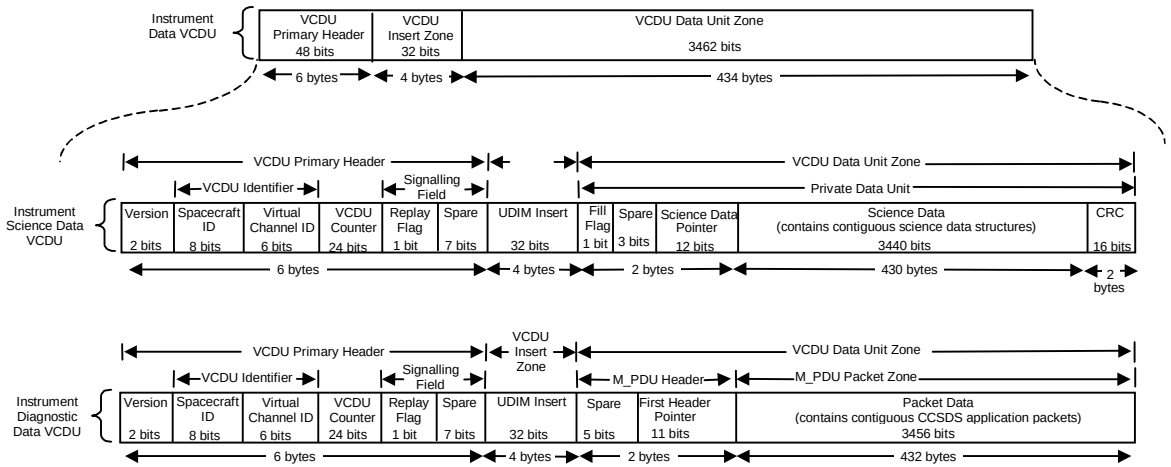
VCDU Multiplexing



Return Link Transport Layer (2 of 3)

Instrument Science Data and Diagnostic VCDUs

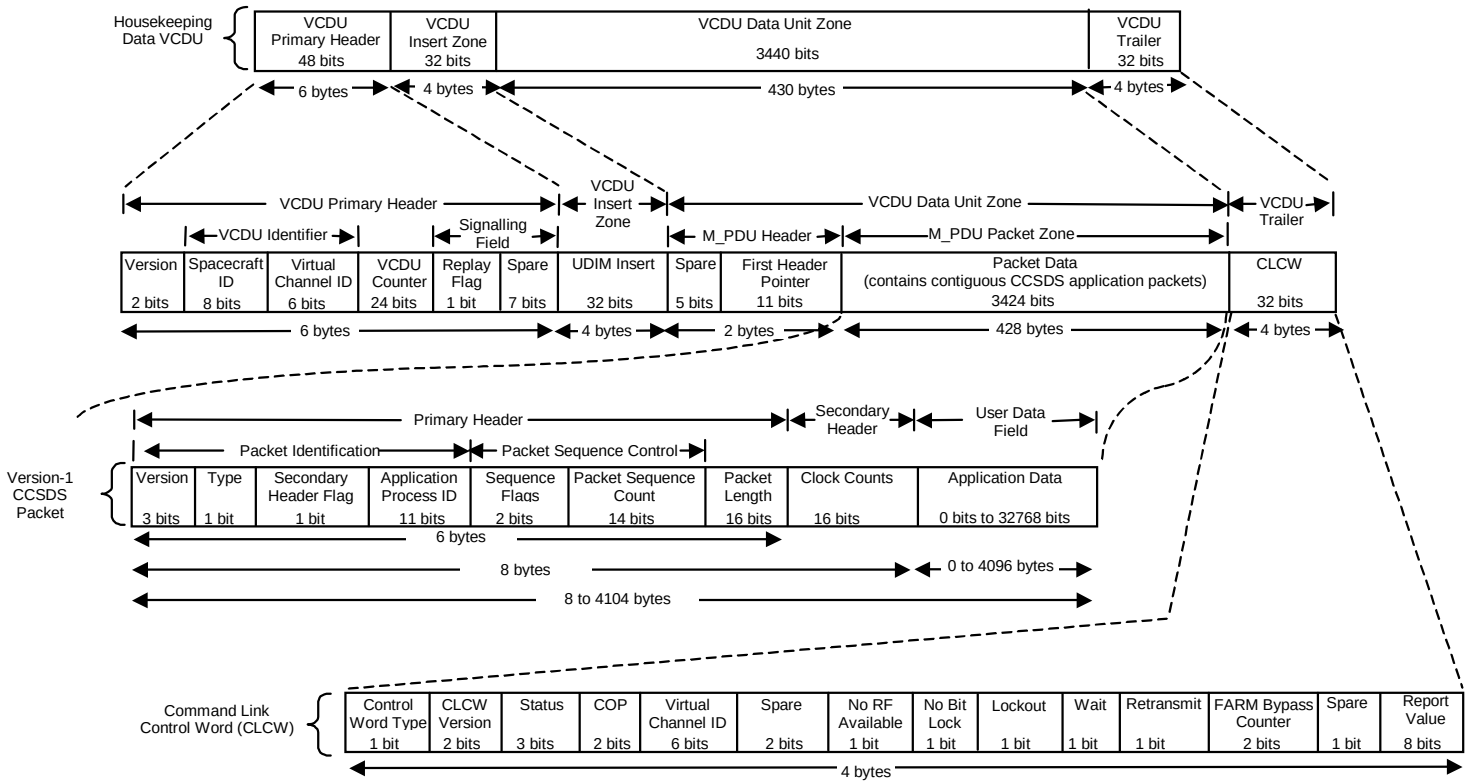
Format for Data flow from Instrument to FSC via QHSS



Return Link Transport Layer (3 of 3)

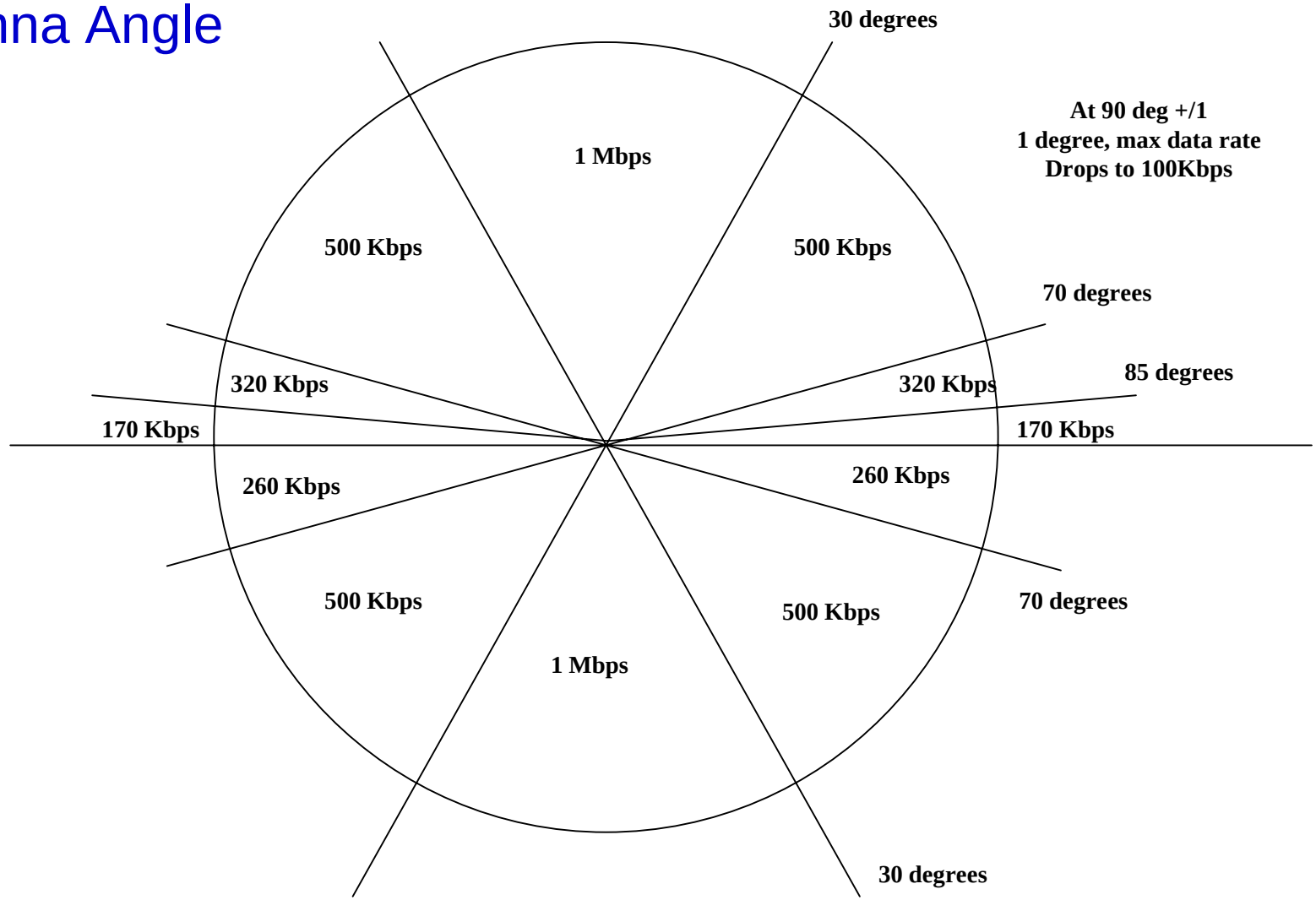
Spacecraft Housekeeping Data VCDUs

Format for Housekeeping Data flow from FSC
including
Housekeeping Data from Instrument to FSC via 1553



Selection Basis for the Return Link High Data Rates

Max Data Rate Vs. Antenna Angle



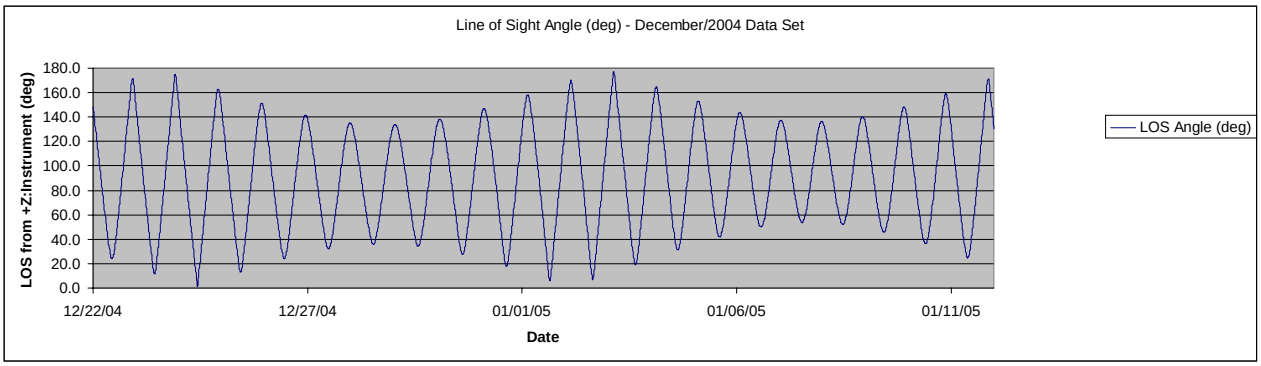
Return Link Overhead

Data Bytes Available in Science VCDU	430
Overhead (bytes):	
Sync Marker	4
VCDU Primary Header	6
VCDU Secondary Header	6
CRC	2
Reed-Solomon Check Symbols	64
Total Bytes (Channel Access Data Unit):	512
Overhead Percentage	**16.0%**

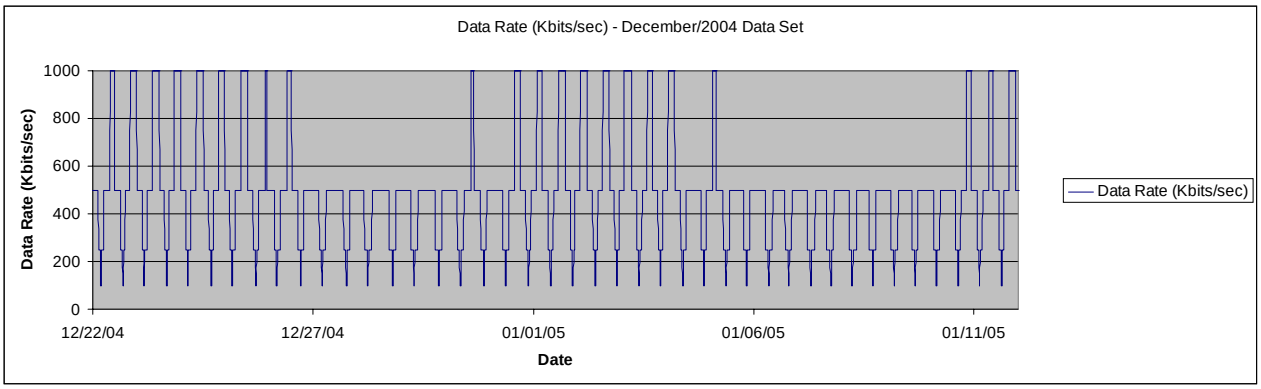
Return Link Bit Rate	Less Bandwidth Used by FSC	Overhead	Instrument Data Bit Rate	Instrument Data Bandwidth Utilization
Bits/Second	(8000 Bits/Second)		Bits/Seconds	
100000	92000	16.0%	77266	77.3%
250000	242000	16.0%	203242	81.3%
500000	492000	16.0%	413203	82.6%
1000000	992000	16.0%	833125	83.3%

FAME Bit Rate Profile

The line of sight covers a sample period of 23 days from December 22nd, 2004 until January 12th, 2005. The data rate information was based on antenna angles and the associated maximum bit rates.



Bit Rate ID	LOS (deg) >	LOS (deg) <	Bit Rate (Kbits/Sec)
1	150	30	1000
2	110	70	500
3	95	89	250
4	90	90	100

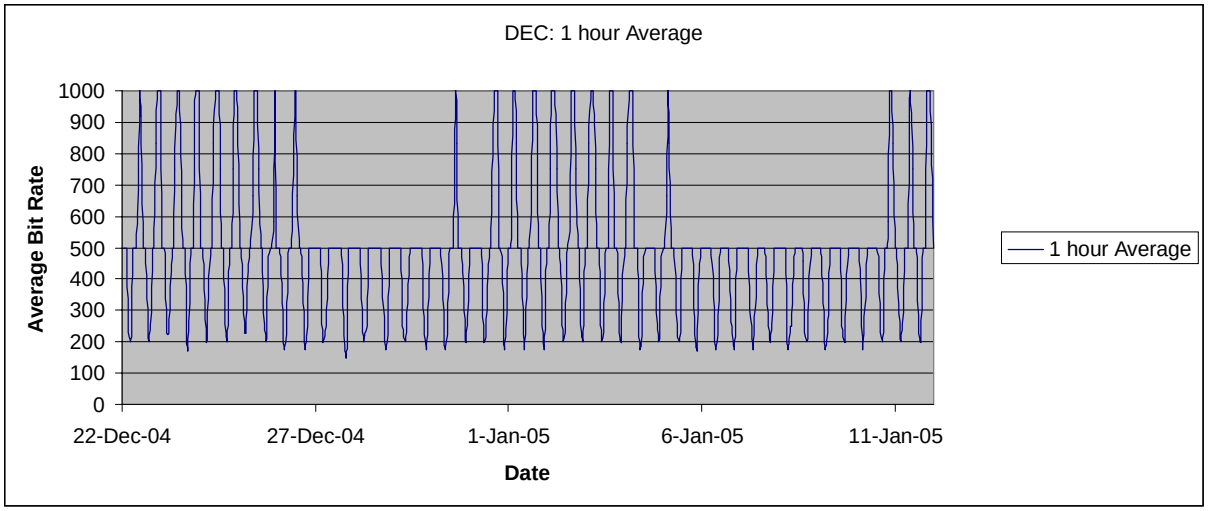


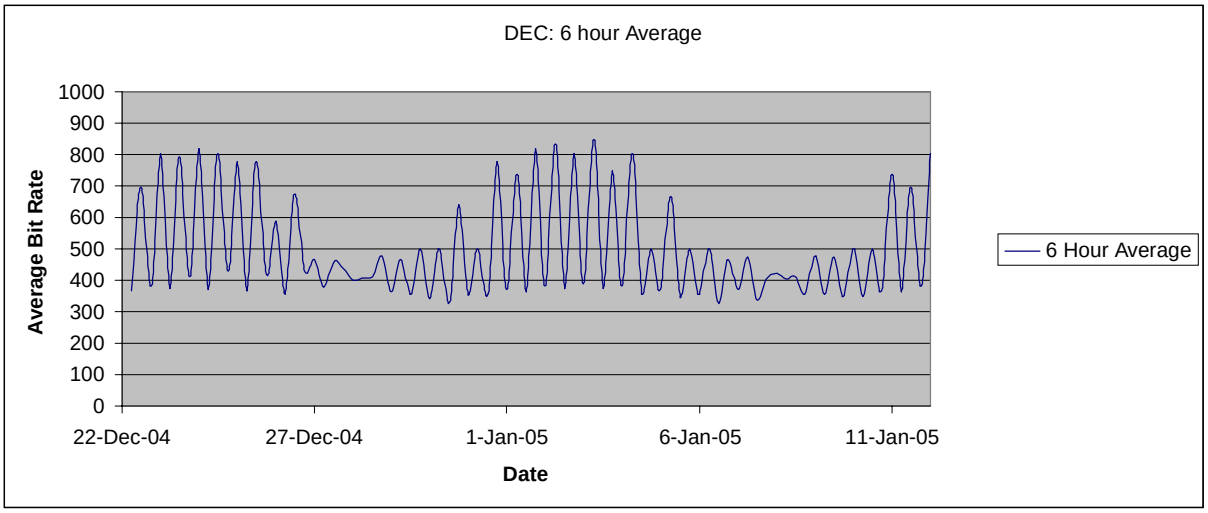
Dec-2004 Data Set				
	Bit Rate (Kbits/sec)			
	1000	500	250	100
Duration %	13.8%	59.5%	22.8%	3.9%
Equivalent Kbits/Sec Average	138	297	57	4
Data %	27.8%	59.9%	11.5%	0.8%
Overall Average Data Rate (Kbits/sec)				496.5

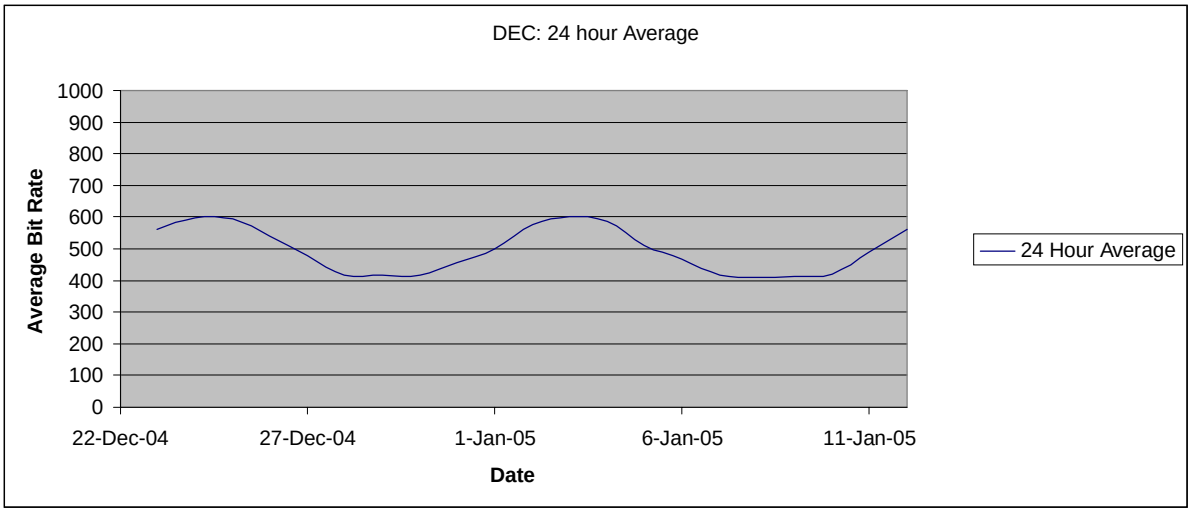
Duration in minutes at each bit rate				
	Bit Rate (Kbits/Sec)			
	1000	500	250	100
Max	250	570	130	40
Average	190	281	82	28
Min	70	160	50	20

Average Bit Rates (Kbits/sec)	DEC/04 Average Period		
	1 Hour	6 Hour	24 Hour
Min	150	328	409
Average	496	496	496
Max	1000	847	600

These plots show average bit rates over 1 hour periods, 6 hour periods and 24 hour periods. This data was derived from the December/2004 data set.

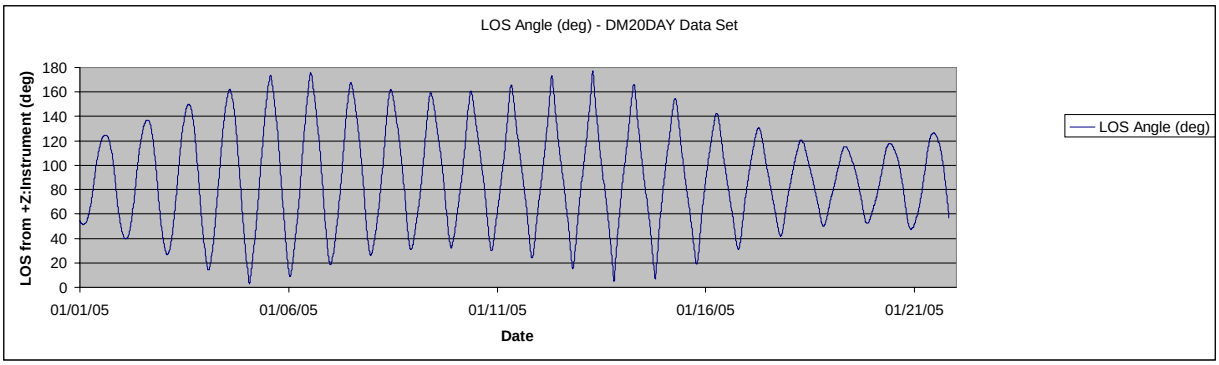




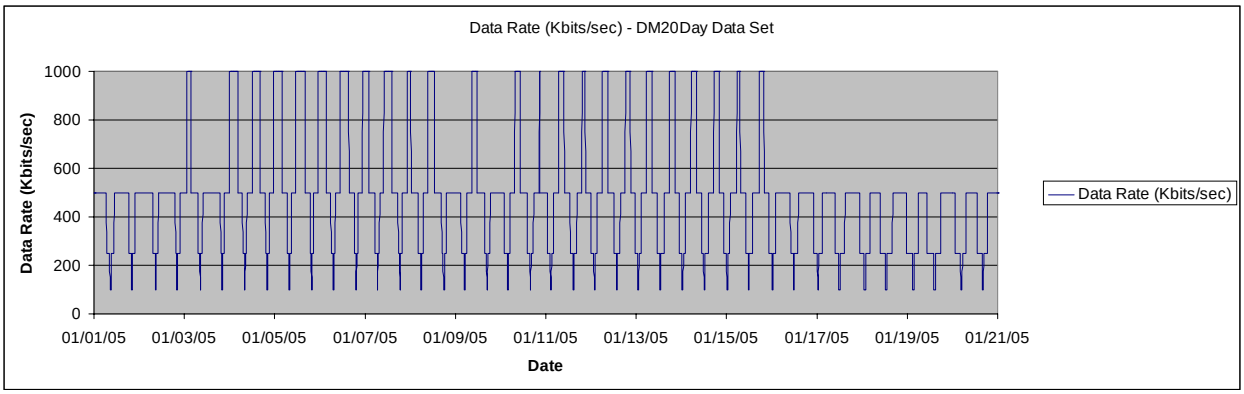


FAME Bit Rate Profile

The line of sight covers a sample period of 20 days from using an arbitrary start date. The data rate information was based on antenna angles and the associated maximum bit rates received from Dave Monet on June 11, 2001



Bit Rate ID	LOS (deg) >	LOS (deg) <	Bit Rate (Kbits/Sec)
1	150	30	1000
2	110	70	500
3	95	89	250
4	90	90	100

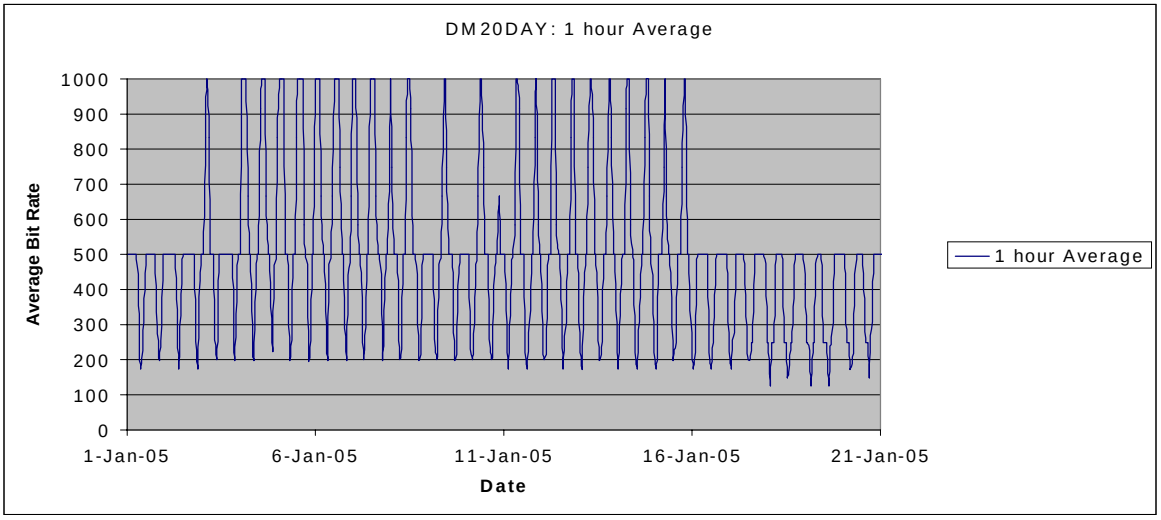


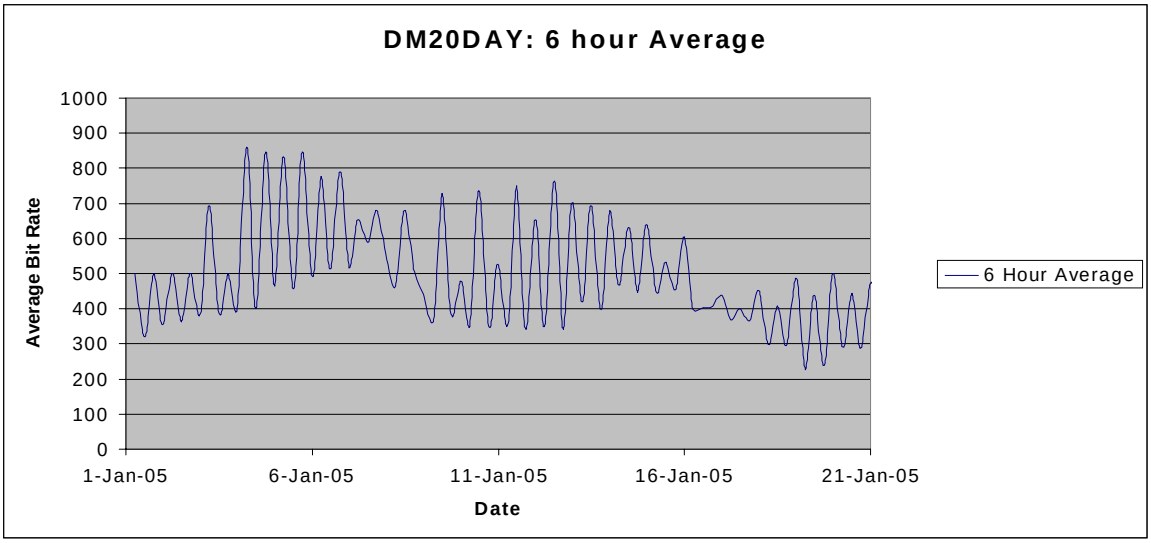
Dave Monet 20 Day Data Set				
	Bit Rate (Kbits/sec)			
	1000	**500**	**250**	**100**
Duration %	15.2%	55.3%	25.2%	4.4%
Equivalent Kbits/Sec Average	152	276	63	4
Data %	30.7%	55.8%	12.7%	0.9%
Overall Average Data Rate (Kbits/sec)				495.6

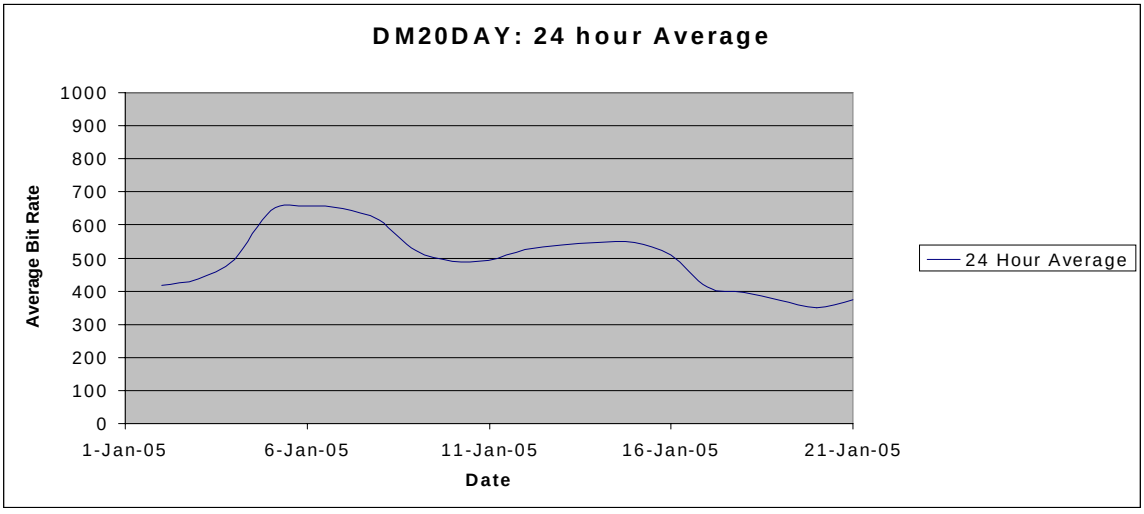
Duration in minutes at each bit rate				
	Bit Rate (Kbits/Sec)			
	1000	**500**	**250**	**100**
Max	290	570	210	60
Average	190	248	90	31
Min	20	130	40	20

Average Bit Rates (Kbits/sec)	**DM20DAY Average Period**		
	1 Hour	**6 Hour**	**24 Hour**
Min	125	225	350
Average	496	496	500
Max	1000	861	657

These plots show average bit rates over 1 hour periods, 6 hour periods and 24 hour periods. This data was derived from the Dave Monet data set provided on 06/11/2001.







Bit Rate Profile Comparison

Comparison of two ~20 day bit rate profiles

- A typical bit rate profile
- A profile with longer periods at the lower and higher bit rates

Value	Typical Profile	Longer at Extremes
Percentage of time spent at each bit rate:		
100Kbps	3.90%	4.40%
250Kbps	22.80%	25.20%
500Kbps	59.50%	55.30%
1000Kbps	13.80%	15.20%
Longest Duration (in minutes) at each bit rate:		
100Kbps	40	60
250Kbps	130	210
500Kbps	570	570
1000Kbps	250	290
Minimum Average Bit Rate (Kbps) over a time span		
1 Hour	150	125
6 Hours	328	225
24 Hours	409	350
Maximum Average Bit Rate (Kbps) over a time span		
1 Hour	1000	1000
6 Hours	847	861
24 Hours	600	657