

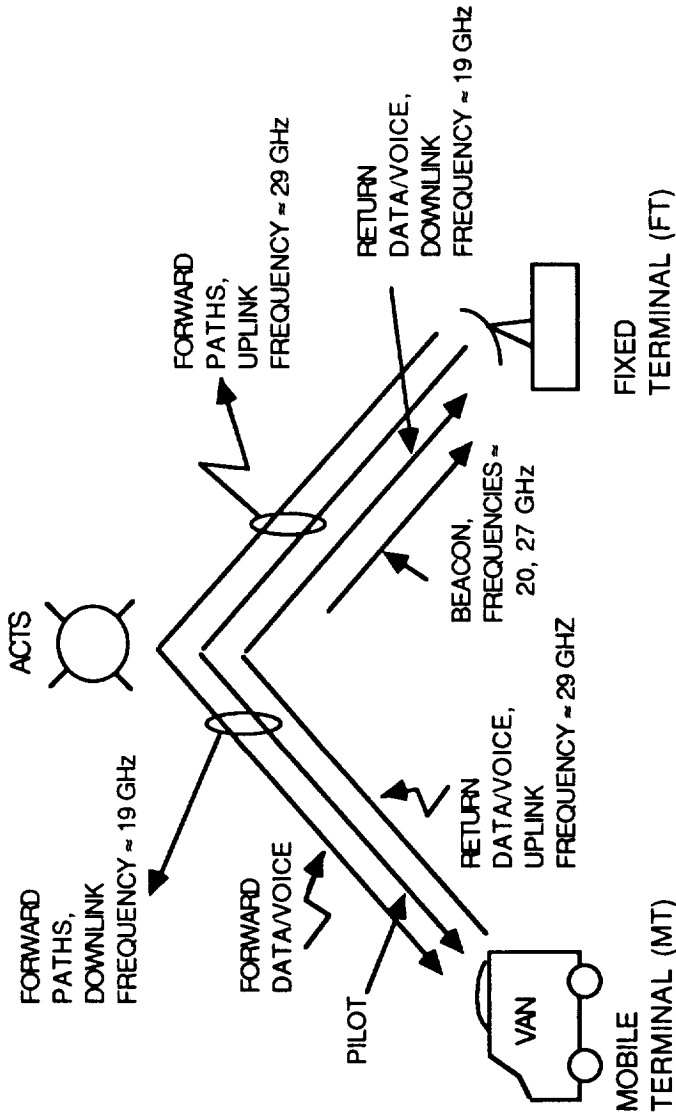
JPL

**RAIN COMPENSATION ALGORITHM
USING
ADAPTIVE LINEAR PREDICTION**

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- RAIN COMPENSATION ALGORITHM IMPLEMENTS DATA RATE CHANGES (BETWEEN 2.4, 4.8 AND 9.6 kbps) TO COMPENSATE FOR PATH ATTENUATIONS BETWEEN ACTS AND BOTH THE MOBIL (MT) AND FIXED (FT) TERMINALS
- BEACON SIGNALS AT 20 AND 27 GHZ CAN BE UTILIZED TO DETERMINE BOTH UP AND DOWNLINK PATH ATTENUATIONS BETWEEN ACTS AND THE FT -- HOWEVER, ONLY PILOT SIGNAL AT 19 GHZ IS AVAILABLE FOR ESTIMATING PATH ATTENUATIONS BETWEEN ACTS AND THE MT

- PURPOSE: CONTROL DATA RATES IN FORWARD OR RETURN LINKS
- INPUTS: ESTIMATES OF UPLINK RAIN ATTENUATION, AU, AND DOWNLINK ATTENUATION, AD

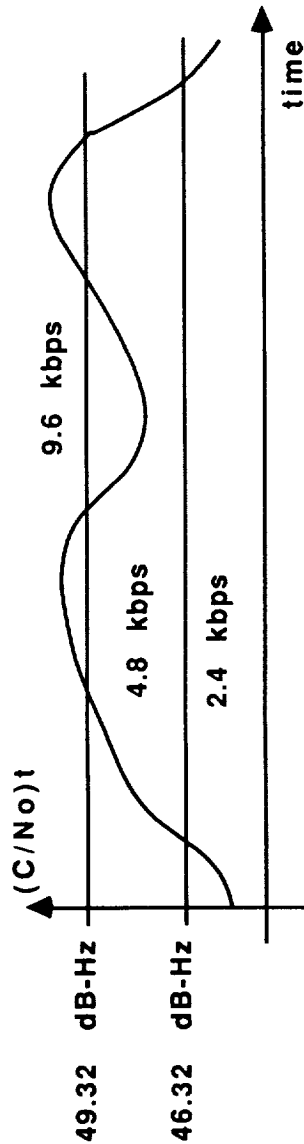
- METHOD:

- (1) COMPUTE OVERALL FORWARD (OR RETURN) RECEIVED CNR:

$$(C/No)t = 1/\{ [AU/(C/No)u] + [AD/(C/No)d] \} ,$$

where: (C/No)_{u,d} = clear-sky uplink(u)/downlink(d) received CNR

- (2) THRESHOLD (C/No)_t TO DETERMINE DATA RATE:



- SOURCES OF ERROR: EXTRAPOLATIONS OF ATTENUATION IN FREQUENCY (20/30 GHz) AND TIME (\approx 1-2 sec)



EMPIRICAL BASIS FOR REDUCING ATTENUATION EXTRAPOLATION ERRORS

- REFERENCE: Stutzman, et al., "Communication and Propagation Experiments Using the Olympus Spacecraft - Report on the First Year of Data Collection", JPL SATCOM Report 202, October 1991
- SAMPLE OBSERVATIONS -- PREDICTING 30 GHZ ATTENUATION 1 SEC AHEAD:

Method	RMS Error
CRC Scaling	0.66 dB
Current 30 GHz data	0.48 dB
20 predicting 30	0.55 dB
30 predicting 30	0.39 dB

↑
Prediction provides 0.27 dB improvement over simple scaling
↑

Notes:

- (1) Data set obtained from heavy rain event on 6 Nov 1990 (0000-0100 UT)
- (2) Both 15-th order FIR linear prediction and 1-st order IIR linear prediction filters examined with comparable results
- (3) Prediction filter coefficients obtained by least squares fit to this data set -- also applied to other data sets with good results

TENTATIVE CONCLUSIONS:

- (1) 0.66-0.48 = 0.18 dB of 0.27 db improvement due to frequency extrapolation errors
- (2) 0.48-0.39 = 0.09 dB due to time extrapolation (prediction) -- possibly even better results could be obtained if prediction coefficients are estimated adaptively ???
- (3) For AMT-RCA at the MT, we must use 20/30 GHz frequency scaling -- but possibly adaptive prediction (20 predicting 20 + scaling) could improve RCA performance ??



CANDIDATE ADAPTIVE 1-POLE PREDICTION FILTER FOR APPLICATION TO AMT-RCA (at the MT)

