

# PROPAGATION ANALYSIS PROGRAM™

## ANALYZE PROPAGATION IMPAIRMENTS IN AN EARTH-SATELLITE LINK AT C, X, KU, OR KA-BAND



The Propagation Analysis Program (PAP) is a state-of-the-art software tool for computing propagation impairments in an earth-satellite link for fixed satellite service. The user can select any one of six built-in models for calculating propagation impairments. The program computes the individual propagation impairments, their combined effect, and the cross-polarization discrimination, for both the uplink and the downlink. The models are valid for C, X, Ku, and Ka-bands.

The COMSAT® DAH (Dissanayake, Allnutt, Haidara) model is a superior engineering tool for the most accurate results at C, X, Ku, or Ka-band. Independent studies compared the output of several propagation models with ITU and ACTS measured propagation data, and concluded that the COMSAT DAH model provided the best performance. The ITU-R model (based on the most recent recommendation ITU-R Rec. P.618-8) is recommended by ITU and can be used for regulatory issues and inter-system coordination. Previous versions of the ITU-R model (ITU-R P.618-6, and P.618-7) have also been retained for comparison and backwards compatibility. The COMSAT PAP model was originally used by Intelsat®, but has since been replaced by the DAH model. The Crane Two-Component model has traditionally been more popular within the USA, especially for US government applications.

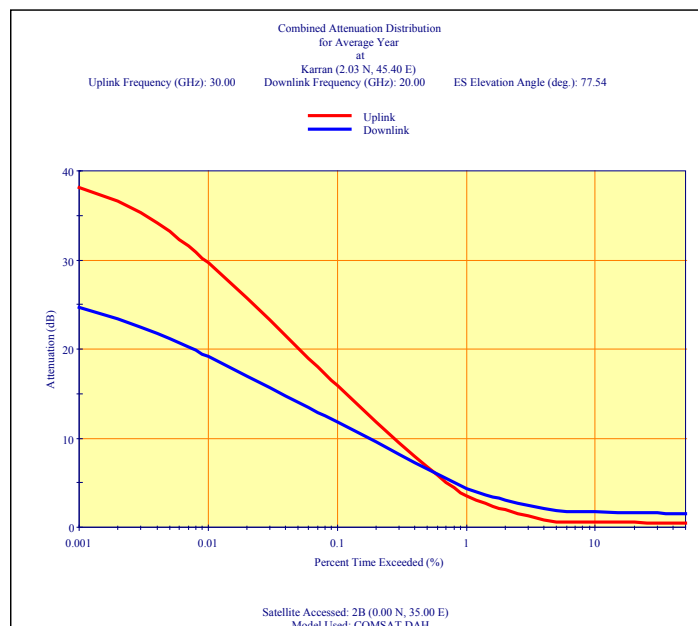
All results are presented in the form of annual or worst-month cumulative statistics. They therefore represent the total time that

a given impairment level is expected to be exceeded, after the impairment levels for all events in a year (or worst month) have been accumulated statistically.

### FEATURES

- COMSAT DAH model predicts attenuation due to rain, cloud, melting layer, gaseous absorption, tropospheric scintillation, and low-angle fading.
- ITU-R Rec. P.618-6 model predicts attenuation due to rain, gaseous absorption, tropospheric scintillation, and low-angle fading.
- ITU-R Rec. P.618-7 and P.618-8 models predicts attenuation due to rain, gaseous absorption, cloud attenuation, tropospheric scintillation, and low-angle fading.
- COMSAT PAP model predicts attenuation due to rain and tropospheric scintillation.
- Crane Two-Component model predicts attenuation due to rain.
- All models predict cross-polarization discrimination and downlink degradation due to increased noise temperature caused by the absorptive propagation impairments.
- Models Faraday rotation effects for linear polarization.

**DATA ENTRY SCREEN:  
EARTH STATION INFORMATION**



**OUTPUT PLOT: COMBINED ATTENUATION  
DISTRIBUTION DUE TO UPLINK  
AND DOWNLINK IMPAIRMENTS**

## ADDITIONAL FEATURES

- Includes comprehensive precipitation and climate databases and digitized rain maps for all models – PAP can automatically look up climate statistics from Rice-Holmberg, ITU or Crane rain zone maps, or the user may specify climatic data.
- Easy-to-use graphical user interface for defining satellites, and earth stations.
- Detailed plots and reports showing individual component contributions to link impairments, and their combined effect.
- Propagation impairments automatically computed at 50 different percentage availability values, ranging from 50% to 99.999%.
- List Manager application to enable sharing data with other Optimal Satcom™ software products such as Antenna Coverage Program (ACP) and Link Budget Calculator (LINK).
- Can operate in two modes - either as a stand-alone application, or integrated as a component of the COMSAT STAR® Suite.
- When used as part of COMSAT STAR Suite, PAP can retrieve satellite and earth-station data directly from the Satellite System Database (SSDB) making it even easier to use. The SSDB is a part of COMSAT STAR and supports both Oracle® and Sybase® databases.

Propagation Analysis Program - D:\Business\Brochures\BAP\BAP1.pap

File Edit View Lists Analysis Reports Plots Options Window Help

Icons: [New] [Open] [Save] [Print] [Copy] [Paste] [Find] [Find Next] [Help] [Zoom In] [Zoom Out]

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Satellite:

Satellite ID:  System:

Nominal Longitude (deg. E):  Retrieve from List...

Actual

Latitude (deg. N):  Radius (km):

Longitude (deg. E):  Config. Plan:

Uplink Data:

Polarization:  Frequency (GHz):

Downlink Data:

Polarization:  Frequency (GHz):

Faraday Time Period

Month Start Year End Month Year

Earth Stations:

ID	Latitude (de...	Longitude (d...	Elevation A...
Kairan	2.03000	45.40000	77.5

Buttons: [Edit List...] [Remove From List] [Clear List]

### DATA ENTRY SCREEN: SATELLITE AND LINK INFORMATION

## INPUT PARAMETERS

- Earth station location in latitude ( $^{\circ}\text{N}$ ), longitude ( $^{\circ}\text{E}$ ), altitude (m) and technical parameters.
- Satellite location in latitude ( $^{\circ}\text{N}$ ), longitude ( $^{\circ}\text{E}$ ), and altitude or radius (km).
- Annual rainfall (mm) and ratio of thunderstorm to total rainfall, or 0.01% Rain Rate (mm/hr) – default values from rain databases are available corresponding to the earth station location.
- Atmospheric parameters – default values from climate databases are available corresponding to the earth station location.
- Clear-weather earth station equivalent noise temperature ( $^{\circ}\text{K}$ ).
- Uplink and downlink frequencies and polarization.

Microsoft Excel - PAP Examples.xls

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Type a question for help

D:\123											
Prepared by:											
Company:											
Subject:											
Filename: PAP Example.pap											
Date: Tue Sep 07 2004 15:00:43											
Included Impairments											
Computation Model: COMISAT DAH											
Station Type: ITU-R P.618-7 (2001)											
Rain Rate Model: Y (Y/N/N/A)											
Rain Fade: Y (Y/N/N/A)											
Topographic Sortation: G (Y/N/N/A)											
Gas Absorption: Y (Y/N/N/A)											
Melting Layer Attenuation: Y (Y/N/N/A)											
Cloud Admixture: Y (Y/N/N/A)											
Satellite Data											
Satellite System: OPTIMAL SAT-1											
Satellite ID: 0.00 Degrees N											
Longitude: 35.00 Degrees E											
Altitude: 35786 m											
Radius: 42014 m											
Link Parameters											
Uplink Frequency: 14.000 GHz											
Uplink Polarization: Horizontal											
Downlink Frequency: 11.000 GHz											
Downlink Polarization: Vertical											
Earth Station Parameters											
Lat Station ID: 2.801 Degrees N											
Longitude: 45.40 Degrees E											
Altitude: 10 m											
Elevation: 11.0 m											
Elevation Angle: 77.54 Degrees											
Uplink Trk Angle: 78.08 Degrees											
Downlink Trk Angle: 111.11 Degrees											
LNA Noise Temperature: 119.28 K											
System Noise Temperature: 119.28 K											
Annual Rainfall: 2.97 mm / year											
Thunderstorm Component: E (ITU-R P.600-4 (1996))											
Rain Rate: 24.36 mm/hr											
0.01% Rain Rate: 62.96 mm/hr											
Average Temperature: 24.00 C											
Average Humidity: 67.5 %											
Average Pressure: 1019.9 hPa											
Refraction Gradient Probability: 18.0 % Annual											
Percent Time (%)Rain Attn. (dB) Trop. Scin. (dB) Gas. Absorp. (dB) Mel. Layer (dB) Cloud Attn. (dB) Total Attn. (dB)Rain XPD (dB)											
50.000 0.00 0.00 0.12 0.00 0.08 0.20 N/C											
45.000 0.00 0.00 0.12 0.00 0.09 0.22 N/C											
40.000 0.00 0.01 0.11 0.00 0.07 0.24 N/C											
35.000 0.00 0.01 0.13 0.00 0.14 0.27 N/C											
30.000 0.00 0.01 0.13 0.00 0.18 0.30 N/C											
25.000 0.00 0.02 0.13 0.00 0.22 0.36 N/C											
20.000 0.00 0.02 0.13 0.00 0.28 0.43 N/C											
15.000 0.00 0.03 0.14 0.00 0.41 0.54 N/C											
10.000 0.28 0.04 0.14 0.00 0.61 0.75 67.35											
5.000 0.11 0.04 0.14 0.00 0.72 0.80 69.00											
0.000 0.34 0.04 0.14 0.00 0.75 0.80 69.58											
8.000 0.38 0.04 0.14 0.00 0.85 0.99 66.18											
6.000 0.43 0.07 0.15 0.00 0.97 1.04 65.29											
4.000 0.43 0.07 0.15 0.00 1.04 1.04 64.29											
2.000 0.49 0.05 0.15 0.00 1.27 1.58 64.84											
0.000 0.59 0.05 0.15 0.00 1.35 1.31 58.19											
0.000 0.73 0.06 0.16 0.00 1.38 1.27 58.19											
2.500 0.83 0.06 0.15 0.00 1.93 1.40 56.58											
2.000 0.88 0.07 0.15 0.00 2.26 1.46 55.83											
1.800 1.06 0.07 0.15 0.00 2.44 1.49 55.08											
1.600 1.15 0.07 0.15 0.01 2.64 1.53 55.69											
1.400 1.27 0.07 0.16 0.01 2.89 1.59 54.65											
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0.900 1.85 0.08 0.16 N/C N/C 2.01 52.68											
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0.700 2.50 0.09 0.16 N/C N/C 2.61 50.88											
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Percent Time (%)Rain Attn. (dB) Trop. Scin. (dB) Gas. Absorp. (dB) Mel. Layer (dB) Cloud Attn. (dB) Total Attn. (dB)Rain XPD (dB)											
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35.000 0.00 0.01 0.08 0.00 0.09 0.37 0.54 N/C											
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Ready

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## OUTPUT REPORT: UPLINK ATTENUATION AND DOWNLINK DEGRADATION – INDIVIDUAL IMPAIRMENTS AND COMBINED DEGRADATION (EXCEL)

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