RCRU

DETAILS OF PLANS TO MAKE SITE DIVERSITY MEASUREMENTS USING STENTOR

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Artist's impression of STENTOR. The propagation package will consist of two beacons, one at 20.7 GHz and the other at 41.4 GHz.It will be launched into a geostationary orbit at 11ºW. Both beacons will transmit Right Hand Circular Polarisation signals.

STENTOR, the French experimental satellite, has been built as a test bed for future technologies. Its scheduled launch is Spring 2002. T propagation payload on the satellite provides the UK with an opportunity to increase the knowledge base of slant path propagation loss Ka and V-Band. Having already collected data from OLYMPUS and ITALSAT measurements we now have the possibility to record slant pa data for a period of more than 10 years from one site. In addition, by having close involvement with the experimental measureme campaign we are developing close links with French groups who intend to make the first measurements of V-Band slant path loss from tropical site (Guyana).

This experiment should serve to answer important questions about the cost effectiveness of site diversity as a fade mitigation techniqu and also serve as an important step in the process of understanding the spatio-temporal structure of rain and rain cells.

Our measurements from the two beacons on STENTOR will be from two sites, Chilbolton and Sparsholt. At Sparsholt, there will be receivers for both the 20.7 and the 41.4 GHz beacons, while at Chilbolton there will be another 20.7 GHz receiver and possibly a 41.4 GHz receiver owned by the University of Portsmouth. Limited European coverage at 41.4 GHz will be available during the first six months of the experiment. Along with measurements taken from the meteorological instruments at the two sites, data from the radar at Chilbolton, CAMRa, will be used to provide valuable information on the spatio-temporal characteristics of rain cells, leading to a broader understanding of the physical mechanism underlying tropospheric propagation.

Rain causes the most significant propagation loss to satellite communication systems operating above 10 GHz. In addition, at the higher frequencies, propagation factors like cloud and light rain are also likely to degrade system performance.

Rain and clouds change in time and space. Intense rain cells that cause large amounts of attenuation on Earth-space links often have horizontal dimensions of no more than a few kilometres. Site diversity employs two or more ground stations receiving the same satellite signal with a separation distance usually greater than the diameter of the rain cells. The sites in a properly configured arrangement experience the rain at different times and switching to the site experiencing the least fading improves system performance considerably.

The 20.7 GHz receiver set up in the receive cabin.

	Sparsholt	Chilbolton
STENTOR receivers	20.7 GHz 41.4 GHz	20.7 GHz
ITALSAT receivers	18.7 GHz (ITALSAT F2)	
Radiometer	37.5 GHz radiometer	
5km link receiver	38 GHz (54/55 GHz)	
Meteorological instruments and measurements	Drop counting rain gauge Joss distrometer. Tipping bucket rain gauge Wind speed Wind direction Air temperature Dew point temperature Solarimeter Pressure	Drop counting rain gauge Joss distrometer Wind speed Wind direction Air temperature Dew point temperature Pressure
Radar		3 GHz multiparameter CAMRa

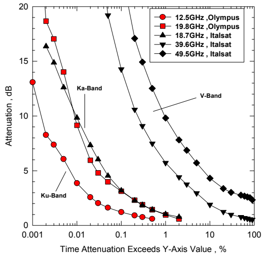
Listing of receivers, meteorological instruments and their locations

RCRU ground station at Sparsholt Hampshire (above).

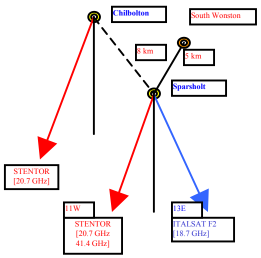
Close up of the electronics of the 41.4 GHz STENTOR receiver buil within RCRU (above). The cogs and belt on the right hand side of the receiver box form part of the tracking mechanism.

An RCRU built 20.7 GHz Stentor receiver nearing completion(left).

Map showing the European broadcast footprint of STENTOR (right). European coverage will be centred at 47.05º N and 2.24º E.



Annual total cumulative attenuation statistics measured in the south of England at Ku, Ka and V band (above). This illustrates the comparative levels of attenuation experienced at these bands. The ITALSAT data at 49.5, 39.6 and 18.7 GHz was measured from April 1997 to March 1998, while the Olympus data at 19.8 and 12.5 GHz was measured in 1993 at the same site.



Schematic diagram of the location of the receiver sites and their relative positions (above). The 5km link from Sparsholt to South Wonston is a terrestrial path operating at 34 GHz.

Both sites are located in Hampshire, Sparsholt is at 51º 04' N, 01º 26' W, and Chilbolton is 51º 08' N, 01º 26'W.

Aims of the project

To undertake a long term and detailed study of site diversity at Ka-Band. The use of two or more communication satellite ground stations that are linked is perceived as a way to minimise the loss that can result from rainfall along one slant path. This so-called site diversity is a fade mitigation technique that is being actively considered by operators of such systems. Results from the STENTOR measurements will be the first Ka-Band satellite observations of this type to be made in the UK that we are aware of. By combining these measurements with those from the CAMRa meteorological radar we will be able to confirm the way in which the spatio-temporal characteristics of rain cells in Southern England should influence the orientation and separation of such ground stations.

To study orbital diversity by making concurrent measurements from STENTOR and ITALSAT F2. The possibility to observe the slant path loss to two Ka Band satellites from the same location on the ground provides a rare opportunity to study the propagation statistics associated with this arrangement of geostationary satellites. (In this instance the satellites will be separated by 24 degrees.)

To investigate the effects of interference experienced when slant path signals in the same band follow different paths to a receiver at the ground. As a result of the spatial variation in rain, one radio signal may experience interference from another when there is significant loss along the primary signal path. From our experimental configuration we can measure the differential attenuation between two such paths and use the resulting data in the study of interference.