

Radio Propagation for Fixed and Mobile Communication Systems

Knowledge of the radio propagation environment and the resulting path loss characteristics and link statistics in any area are key to determining, in advance, the performance of a wireless communication system and planning radio networks.



Factors Affecting Communication

For mobile services there is little or no control over the location of the user at any time.

For fixed services, whether indoors or outdoors, there will be limited flexibility in the position in which the user's transceiver antenna can be located and there is little that can be done to alter the path between this and the base station antenna location.

Major factors which affect the signal strength at any given location are:

- The transmitter location, height, power and frequency
- The topography of the terrain between the transmitter and receiver
- The 'clutter' (buildings, trees etc.) in the signal path.

- The materials in the immediate location (particularly where the receiver point is within a building)
- The fading environment

Fading can produce major variations in signal strength relative to the mean level at any location. Fades can be caused by interference effects due to multiple propagation paths between the transmitter and receiver. If the receiver happens to be located in a deep fade this will result in a substantial decrease in signal. If the receiver is moving it may pass through several fade regions. These can have different effects on overall system performance.

The signal strength is not the only factor affecting the ability of the communication system to operate successfully. Additional factors are the radio noise environment and interference.

Knowing, in advance of the introduction of a service, what the propagation conditions are going to be is a great advantage in planning the radio system and determining the coverage and the grade of service which will be available. This can be done by survey measurements, by the use of propagation prediction models, or by some combination of the two.

Propagation surveys are generally conducted by performing measurements at points within the area of interest. Typically, a trial transmitter site is installed and survey measurements of signal strength are taken in the surrounding area utilising a survey vehicle. For a within-building system, similar techniques are employed using trolley mounted or handportable receive systems. The data collected can be processed to determine the range, coverage and grade of service achievable.

Propagation Prediction Models

There have been many attempts to produce reliable prediction models and a number are available commercially. There are two basic types: empirically based and calculation based.

Empirical models are generally based, in some way, on the original work of Okumura in the mid 1960s. This provides coefficients which are applied to the ideal propagation figures depending on the nature of the terrain in the propagation path.

Calculation models make use of the known characteristics of objects in a propagation path. A detailed terrain and clutter database must then be used to calculate the propagation path loss from the transmitter to the point under consideration.

Plextek staff have used a range of propagation and network planning tools and have access to a variety of commercial software packages for use in projects.

Propagation Surveys

The general survey equipment module used by Plextek provides signal processing and data logging. This is normally mounted in a Range Rover used for wide area surveys but can be mounted in other vehicles, or on a trolley for performing local area surveys within buildings. The measured data can be presented as signal strength contour maps, scatter graphs or in other forms if required.



Plextek is equipped to perform local or wide area RF surveys of path loss, noise or channel occupancy at frequencies up to 40 GHz. It has experience of undertaking measurements beyond 90 GHz.

Plextek has wide experience in:

- The supply of equipment and training for propagation survey and radio system planning activities
- The development of propagation survey, link test and channel sounding equipment
- Performing propagation measurements and surveys
- The use and interpretation of propagation prediction models.

Plextek has performed a wide range of propagation surveys which include:

- 3-6GHz surveys for Formula 1 telemetry
- VHF surveys for messaging and remote meter reading telemetry
- 5GHz within-building survey for local area networks
- Wide area surveys for Fixed Wireless Access
- Surveys at 28GHz and 40GHz for broadband delivery systems

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