Resolving Discontinuities in the COST 231 Extended Okumura-Hata Model in the Propagation Modeling Website (PMW) Software

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For the last 40-50 years, The Institute for Telecommunication Sciences (ITS) has developed and evaluated several propagation models. For the past five years, ITS has been developing a web-based Geographic Information System (GIS) system called the Propagation Modeling Website (PMW). Users of this system can run propagation analyses to predict the coverage of user-defined transmitters. PMW uses several propagation models, such as Longley-Rice or TIREM, to produce the analyses. Part of the on-going process in developing PMW is to add additional propagation models to the system based on DoD and civilian government agency requirements. There are two PMW products available to government agencies, one for Very High Frequency (VHF) models and one for High Frequency (HF) models.

Recently, ITS added the COST 231 Extended Okumura-Hata model to the available suite of models in PMW. This model is a combination of the original Okumura-Hata model and the COST 231 Hata model. During the process of adding this extended model, ITS staff found two discontinuities in the output of the model.

The first discontinuity came when combining the original Okumura-Hata and the COST 231 Hata models. For PMW, ITS uses the original Okumura-Hata model up to 1500 MHz and then changes to the COST 231 Hata model from 1500 MHz to 2000 MHz. Unfortunately, there is a discontinuity at 1500 MHz between the two models.

The second discontinuity is in the original Okumura-Hata model. For the dense urban terrain, the height correction factor has one equation for frequencies below or equal to 200 MHz and another equation for frequencies above or equal to 400MHz. There is no equation for frequencies between 200 and 400 MHz. When this discontinuity is mentioned in the literature, the recommended solution is generally to choose one frequency (e.g. 200 MHz, 300 MHz, or 400MHz) and have the two equations to meet at that frequency without adjusting either equation. Unfortunately, this solution causes a discontinuity in the height correction when the model changes from one equation to the other.

For the PMW COST 231 Extended Okumura-Hata model, ITS uses blending functions to correct the discontinuities. This gives the users a smooth transition from 200MHz to 400 MHz and at 1500 MHz.