Coupling of electromagnetic pulses between communication channels

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Abstract: Data transmission systems are particularly susceptible to the effects of electromagnetic disturbance. While a direct lightning strike, or other similar threat is unlikely, it is more probable that energy will couple from one transmission line to another through near field coupling. The effect of this indirect coupling could be disastrous to any digital equipment affected by such a mechanism. It is important to be able to undertake an analysis of the level of possible threat posed by the routing of the communications transmission lines.

A promising method of performing this threat analysis is presented in this paper. A transmission-line matrix (TLM) model of a communications channel is used to simulate the passage of a pulse. This 'threat' communications line is coupled to a second 'victim' line by treating the first line as an array of antennas. The 'victim' communications channel is similarly modelled using the TLM method.

The benefits of this approach are:

- The simulation is undertaken in the time domain and actual induced pulse shapes on the threat line can be reproduced exactly. Multiple pulses if varying duration can be modelled in this way.
- The use of TLM allows the electrical parameters, shape and construction of the communications channels, as well as their separation, to be varied arbitrarily with length. Further, the key desired parameters, namely the effective output of the two ends of the victim wire, can be determined as both functions of time and of frequency.

The full paper will discuss the TLM model of the communications channels and describe the antenna approach to studying the coupling. It will present results to illustrate the effect of pulse shape, and duration, and variation of the electrical parameters of the communications channel on the coupling from a 'threat' communications channel to a 'victim' communications channel.