

Measurement Based Design Series

PART I: Advances in High Speed Design in Dispersively Attenuating Environments: Backplanes, Cables.

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ABSTRACT

With new architectures, digital speeds on circuit boards and in cables have leapfrogged into a range where the combination of such effects as **loss, loss induced dispersion and feature size** strongly influence the integrity of design. It is shown that, in many cases, these effects totally dominate the limits of performance. Thus, effects such as material absorption (dielectric), skin effect, skew and structural complexity combine to produce data degradation that both elude modeling and determine totally the signal to noise ratio of high speed data. It is also shown that these effects accentuate the data dependent jitter and place new constraints on the limits of performance at speeds commensurate with Gigabit Ethernet, SONET, InfiniBand Architecture, XAUI and others. This presentation introduces the concept of measurement-based design that is particularly suited to the difficult environment of loss, accompanied by dispersion. It is shown that by judiciously combining accurate broadband measurements, simulation and equalization, correct performance is not only predicted but can be **enhanced by signal conditioning** and optimization. Both passive (filtering) and active (preemphasis, postemphasis, postamplification, regeneration) signal conditioning is discussed and illustrated. This presentation focuses on a total design approach for a number of difficult and practical design cases by combining prepared material with novel demonstrations of both high speed, time domain, and broadband, spectral measurements in the differential mode. Very dramatic effects of design optimizations are illustrated on **eye pattern diagrams** generated from measurement-based, high speed characteristics of a number of structures. The results are placed in the context of other data dependent propagation delay randomizing effects. Tradeoffs between **multi-foot backplanes and rates approaching 12.5 Gb/s** are particularly examined.