Shielded vs. Unshielded: Category Cable Comparison

Introduction

With the advent of consumer applications that require higher communication data rates (e.g. high definition video), copper cabling technologies that enable these data rates have been forced to evolve rapidly. In conjunction with this evolution, new obstacles have been discovered regarding not only the minimization of the noise coupling within the internal components of the cable, but also the noise coupling minimization involving other cables and external EMI sources.

The objective of this paper will be to show the most common method used to evaluate the effectiveness of EMI mitigation. Additionally, a comparison will be shown between the two most common types of category cables used in telecommunications, unshielded twisted pair (UTP) & foil over unshielded twisted pair (F/UTP).

Background

The data rate capacity of a telecommunications cable is given primarily by its usable frequency range (bandwidth) and the Signal to Noise Ratio (SNR), which is the difference between the strength of the signal transmitted and the electromagnetic noise coming from both internal and external sources. Due to this fact, noise mitigation is of imperative importance in the design of any telecommunications cable.

The most common method to achieve noise mitigation is through the twisting of the insulated wires into pairs, which reduces the magnetic coupling of the signal to a certain extent. However, when a cable will be installed in the vicinity of other EMI sources (i.e. other cables, electronic equipment, power lines, etc.) the twisting of the pairs becomes insufficient to guarantee its performance, giving way to network disruptions.

Test Setup

In order to determine the difference in external noise mitigation between an overall shielded and an unshielded cable, an ANEXT (Alien Near End Crosstalk) test setup based on TIA/EIA 568-C.2 was utilized. For this test, one cable (known as victim) is surrounded by six similar cables (commonly referred to as aggressors). The aggressor cables are then energized, and the signal is measured in each pair of the victim cable (Fig. 1). In this case, Category 6A cable was chosen to evaluate.

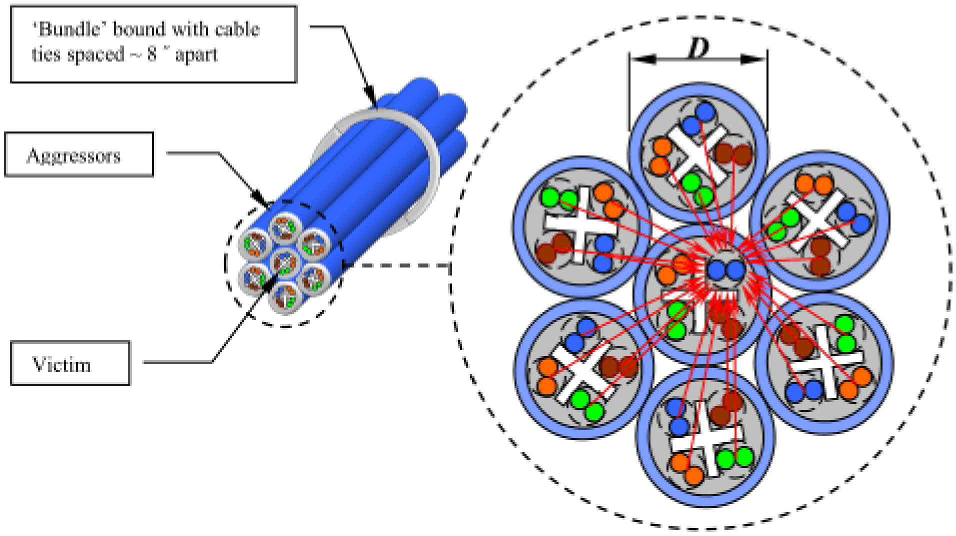
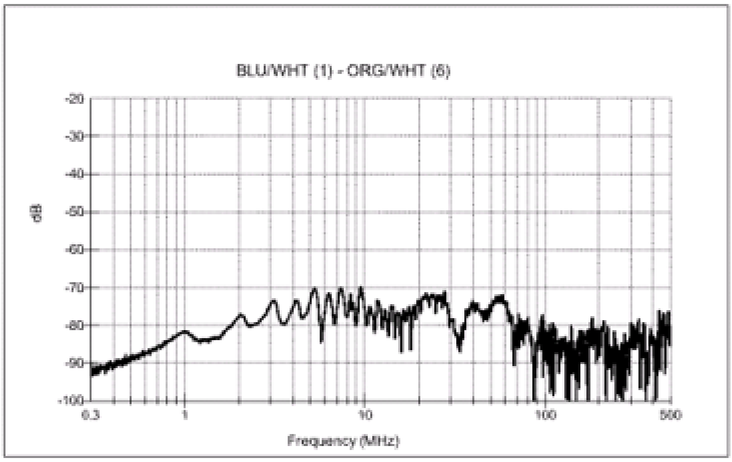


Fig.1
PowerSum Alien Crossstalk test cable configuration

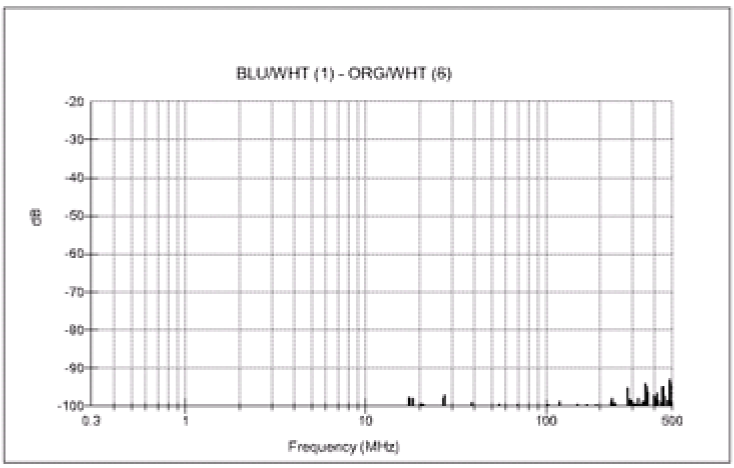
Test Results

The following are the resulting ANEXT graphs for a frequency sweep from 0.3 to 500 MHz. Only worst case pair combinations are shown. These tests were performed at the facilities of an industry recognized third party laboratory in the United States.

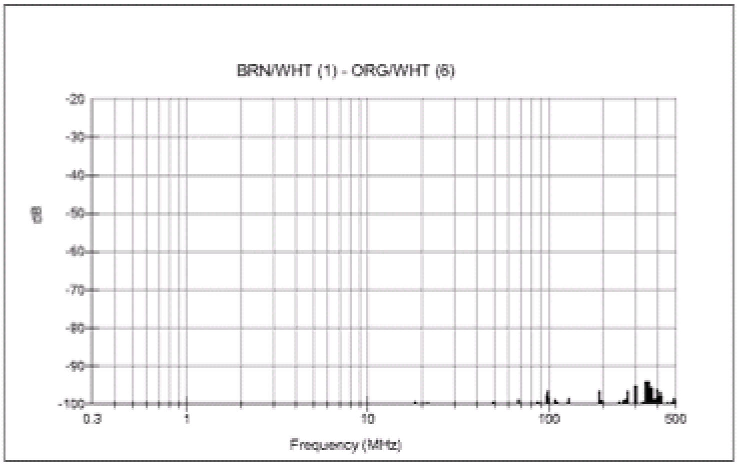
CAT 6A UTP



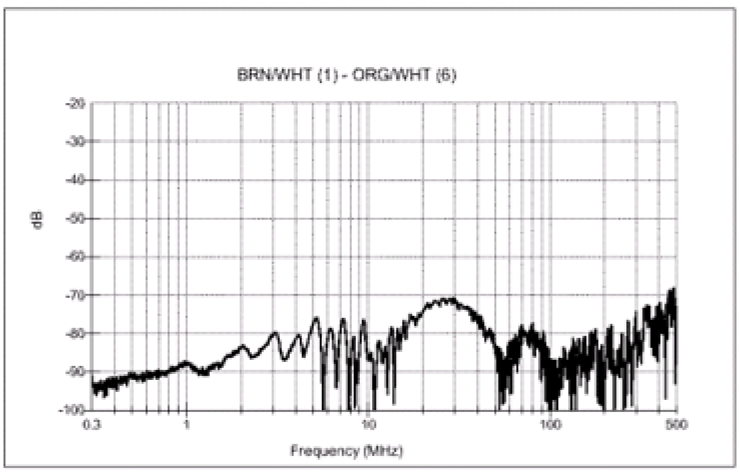
CAT 6A F/UTP



CAT 6A F/UTP



CAT 6A UTP



As demonstrated in the graphs, in the F/UTP cable the noise mitigation is almost 100% (barely any noise to be seen even @ high frequencies). By comparison, in the UTP cable, the electromagnetic radiation (noise) from the other cables is evident in the complete frequency range. Differences in noise reception can be as high as 30 dB from mid to high frequencies with a minimum of 8 dB at low frequencies.

Conclusion

Regardless if the original planning of a UTP solution is adequate to provide the desired network performance, the future performance and functioning of the system is unknown. This based on the fact that additional installations of EMI sources such as supplemental cables, power lines, high power circuits, etc. might cause the UTP solution network to fail. For this reason, the F/UTP solution will significantly increase the initial network performance as well as the future expectations of the network to function at the desired data rate level for a longer period of time.