Evaluate Techniques for Penetrating a Shielded Enclosure Using Twisted Pair Wire

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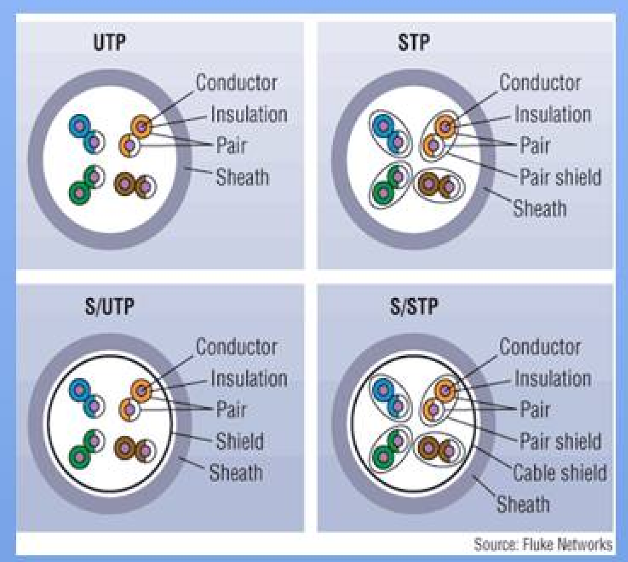
Abstract

The aim of this project is to demonstrate techniques for effectively penetrating a radio shielded enclosure using Ethernet cable (CAT-6). This process requires that we measure the shielding performance by means of testing and data orchestration to collect and analyze our data to present observations with different test cases. Each test case would represent a different penetration strategy that utilizes distinctive wire coupling and characteristics (i.e. the type of bulkhead link, the twist of each CAT-6 cable, the shielding type of each CAT-6 cable, and the length of the cable). As the different cable setups are fabricated a prototype evaluation of setup is conducted to measure the signal integrity of our testing configuration. Our signal integrity is measured through the analysis of different parameters found in the prototype evaluation such as RF leakage, impedance mismatch, and decay rate. As each of these data values are effectively collected and analyzed the most effective cable setup is selected based upon its ability to penetrate the shielded enclosure. The testing data is compared in conjunction with the cost of the manufacturing of the prototype wire penetration.

Introduction

The focus of this project is revolved around the development of an effective cable coupling technique that is equipped to penetrate an RF shielded enclosure. The parameters of this project are centered upon the type of cable and the shielding technique and characteristics of the enclosure. The type of cable that is being used for this application is Category 6 (CAT-6) twisted pair Ethernet cable. CAT-6 cable is defined by its shielding and twisted properties of the wires within the cable; it is distinguished by four main categories. These categories are unshielded twisted pair (UTP), foil twisted pair (FTP), shielded twisted pair (STP) and screened shielded twisted pair (SSTP).

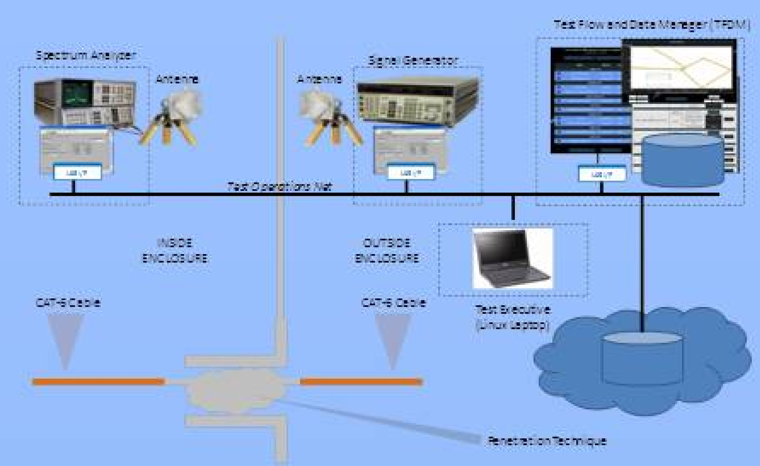
UTP cable is unshielded, meaning that the wires within the cable are simply twisted with absolutely no shielding between the twisted pairs. FTP cable is shielded by an outer foil shielded that protects the bundle of twisted pairs without individually shielding each twisted pair. STP cable means that the individual twisted pairs are shielded by a screen of foil. SSTP cable means that the cable is double shielded; each of the twisted pairs is shielded in addition to a metal shield of braid on the outside of them underneath the plastic of the cable. The diagram below shows this.



Left to Right (CONEC Jack, Brass Nipple, Amphenol Socaphex Jack, L-COM Port)

Methods

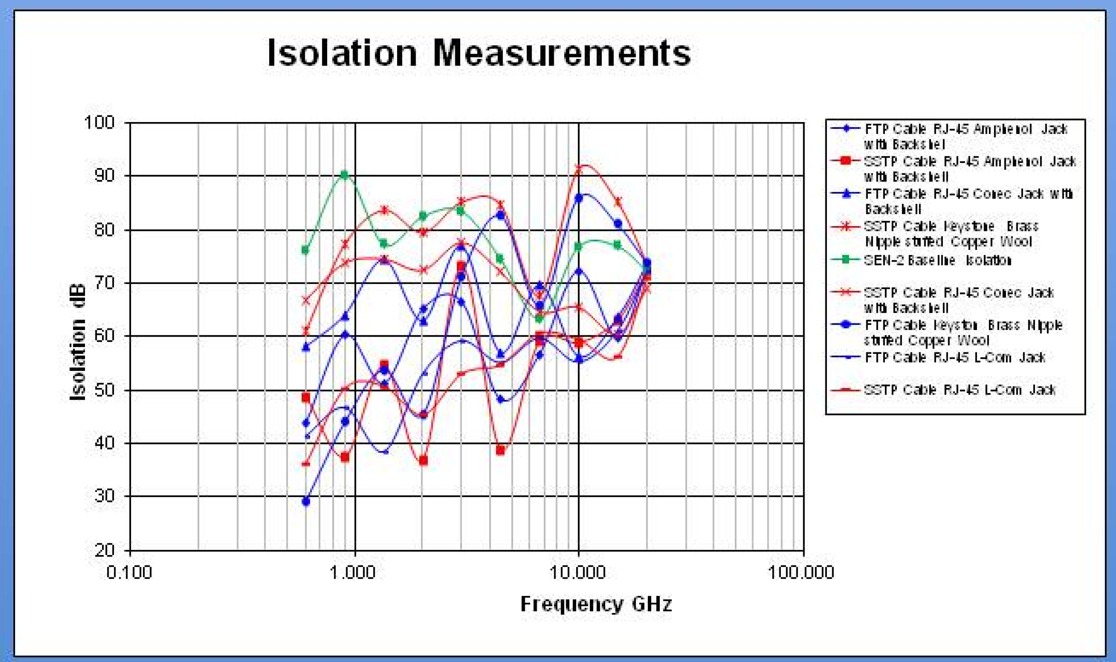
As each of these cables is built onto a connector and then coupled with a different bulkhead and mounted onto the wall of the shielded enclosure a measurement of each technique is taken. We want to know how well each penetration technique is able to attenuate any unwanted signals over each particular port of interest. This measurement is called attenuation and is measured in decibels (dB). In order to perform this experiment we needed a specific test bed setup and this is shown on the diagram to the right.



Our test setup here is executed through a test executive that operates a Test Flow and Data Manager through Lab VIEW software which allows us to test, collect, retrieve and analyze our data so that we can make valid observations.

Results/Discussion

In conclusion we found our results through several isolation measurement trial sweeps from several test setups. The results of each cable configuration are shown below.



Conclusion

In conclusion, according to the results we evaluated, the best way to penetrate a radio shielded enclosure is to use a brass nipple stuffed with copper wool. Our average isolation for this particular curve was 79.01 dB which was the best according to the isolation measurements.

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