Ensuring Shield Integrity in Field Testing

SMART BUILDINGS TECHNOLOGY

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Introduction

Shielded cabling provides much stronger noise immunity compared to UTP if carefully installed. A proper installation should ensure consistent shield protection across the length of a channel. Improper shielding even on a short stretch of the channel can significantly deteriorate noise immunity of the whole channel. It is important to note that seemingly small operator errors or misunderstandings can deprive an installation of the benefits of shielding even after spending all the money. This article describes DC and AC discontinuities that compromise shield integrity, and then goes on to describe reliable methods of confirming shield continuity in the field using AEM's TestPro or NSA testers.

What is Shield Discontinuity?

The most common cause of compromised shield integrity is unintended use of unshielded components in a shielded channel. A typical example is use of UTP cord and/or an unshielded connector in otherwise shielded channel. Unshielded components have significantly lower immunity against surrounding electro-magnetic interference (EMI). Unfortunately, noise coupled into this unshielded stretch of the channel, however small it might be, propagates across the channel; eventually appearing at the receiver and causing deterioration in transmission performance.

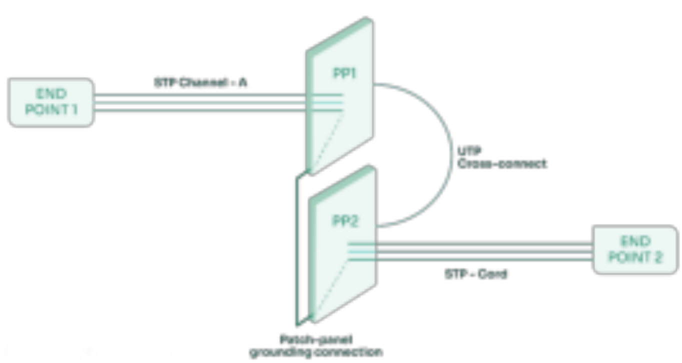

Fig 1 - DC continuity present but shielding compromised

Commonly, shield integrity is verified by simple DC continuity measurements. However, there are situations where shield integrity might be compromised despite having end-to-end DC connection of the shield conductor. Even when the channel has one or more unshielded components, there may be an alternate DC conduction path, for example, through grounding of the patch-panels (Fig. 1). When such alternate conduction path is present for shield, simple continuity measurement may give a false PASS. The good news is, even in such cases, testers like TestPro and NSA can detect shield discontinuities through AC (RF) measurements. Further, these tools pin-point the location where shield discontinuity is detected, which is extremely useful information while troubleshooting the shield issues.

In addition to detecting shield faults, it is also useful to be able to detect transitions in shield construction e.g. when F/UTP and S/FTP components are used in the same cabling channel. Unintended mixing of construction types may deteriorate the electro-magnetic immunity performance of the cabling. TestPro and NSA can also detect such mismatch of cable construction technologies.

How do AEM Testpro and NSA find shielding errors?

Although the technical details of measurement methods employed to detect shielding errors are beyond the scope of this document, here we describe the overall idea about how the testers perform the shield measurements.

Fig 2 - Cable with good shielding and broken shield (DC shield discontinuity)

First, a regular check on DC continuity is performed using wiremap measurement. Fig. 2 shows two scenarios, one with good shield, and second with open shield. After performing DC continuity check, as an integral part of the RF measurements, the tester performs a special type of measurement called CMRL (common mode return loss) on each pair of the cabling. By analysing the variations on CMRL along the length of the cable, shield defects and be accurately identified (even in the presence of alternative DC conduction path). Let's look at how this is done.

Twisted pair cabling provides inherent noise immunity because of differential transmission. The two wires of a pair are applied voltages with opposite polarity. Note that while signals on the two wires have opposite polarity; because of the proximity of the two wires, noise pickup by each wire is in the same polarity. The receiver on the far end always reads data by measuring the difference in voltage between two wires of a pair. This means, the noise (having the same voltage on both wires) gets practically eliminated while signal is augmented. Because signal had opposite polarity on the wires to begin with, the subtraction process at the receiver amplifies it. The test instruments also use this differential signaling for measuring parameters such as insertion loss, return loss, NEXT, ACRF etc. However, for the specific purpose of measuring shield integrity, the tester applies signal in the same polarity on both wires of a pair. When the cable is shielded cable, shielding provides return path for this, so-called common mode signal. Applying common mode signal can be viewed as injecting noise on purpose. The instrument then analyses reflected signal by adding the voltages on the two wires instead of usual subtraction (as noise is what we are interested in for the purpose of this measurement). It then finds magnitude and delay of this reflected common mode signal. A strong reflection means discontinuity in the shield. The delay associated with this strong reflection represents the location of the discontinuity.

Fig 3 - Cable with AC shielding discontinuity
and its time domain locator plot

As seen from Fig. 3, a cable having AC shield discontinuity is detected by the tester accurately. The tester also provides a locator (time-domain) plot of the measurement for in-depth analysis of the cable behaviour.

Unique Technique of AEM Testers for Better Accuracy

In the measurement method described above, the AEM testers perform further post processing of data to find actual impedance changes along the length of the cable on common mode signals. In addition to improving measurement reliability, this also gives unique ability to identify transition of cabling construction technologies, such as from SSTP to FTP.

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