

Performance Evaluation of a Handheld Network Analyzer for Testing of Balanced Twisted-Pair Copper Cabling

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Abstract — Performance evaluation of a handheld network analyzer (field tester) for certifying balanced twisted-pair copper cabling is carried out in this paper. Some key parameters such as return loss, near-end cross-talk, and insertion loss for cabling have been investigated, in order to comply with the newly proposed IEC-61935 standard. Accuracy of the field tester is then compared with a four-port vector network analyzer (with fixtures) in laboratory. Good agreements have been observed which demonstrate its measurement capability up to 2 GHz.

Index Terms — Electromagnetic coupling, measurement technique, standard, twisted-pair cabling

I. INTRODUCTION

Transmission technology over a twisted-pair copper cable has been of great interest to the industry, since it has met each increase in data rate at a lower cost than optical fiber successfully. Some organizations such as IEC (International Electrotechnical Commission) and TIA (Telecommunications Industry Association) have started to develop a 40-Gbps transmission scheme, and been drafting the specification for cabling testing.

For the balanced twisted-pair copper cabling, return loss, near-end cross-talk (NEXT) and insertion loss are found to be some severe issues which can degrade the cabling performance [1]. An accurate and fast measurement solution is therefore required during the cabling installations to track these parameters. In the market, one of the solutions is the WireXpert developed by Psiber Data [2] which complies with the current specifications in IEC-61935 standard [1] with a frequency up to 600 MHz.

Recently, a draft revision of IEC-61935 standard [3] has been proposed for transmission scheme to a higher frequency. Correspondingly, the compliance of WireXpert with new specifications and its accuracy at a higher frequency (e.g. 2 GHz) is needed to be evaluated. In this paper, a preliminary investigation is therefore performed and reported.

II. BALANCED TWISTED-PAIR COPPER CABLING AND TESTING

A. Twisted-Pair Copper Cable

Twisted-pair cable is composed of two insulated copper wires twisted around each other and bundled together with

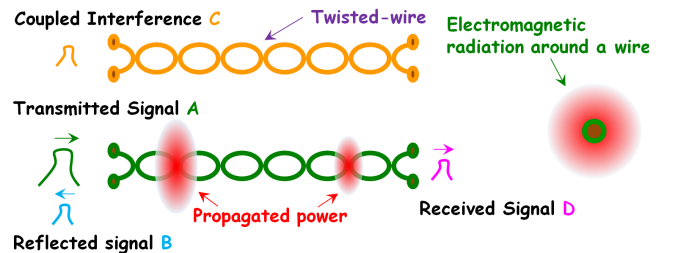


Fig.1. Demonstration of electromagnetic propagation and radiation around a twisted-pair copper cable.

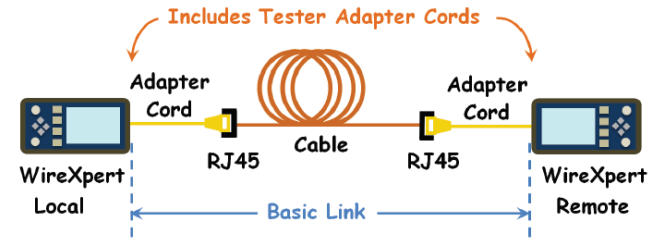


Fig.2. Measurement configuration using a pair of Psiber handheld network analyzers: WireXpert.

other 3 pairs in a jacket. Due to the electromagnetic radiation around the copper wire and impedance mismatch at the connectors, coupling (cross-talk) and signal reflection could severely degrade the cabling performance. In this paper, these main parameters such as the return loss (B/A) at connectors, near-end cross-talk (C/A) and insertion loss (D/A) as shown in Fig.1 will be discussed and measured in terms of scattering parameters (S -parameter). It is noted that different from single-ended measurements (i.e. unbalanced measurements referenced to ground) [4], testing of twisted-pair copper cabling is differential (i.e. balanced).

B. Measurement Configurations for Cabling Testing

The WireXpert developed by Psiber Data [2] is actually a handheld network analyzer with “local” and “remote” modes designed for balanced measurements. Fig.2 presents a testing configuration using a pair of WireXperts (or similar instruments) with 2 adapter cords for in-field cabling.

To evaluate its performance at higher frequency for new specifications in IEC-61935 standard, comparisons with a four-port Vector Network Analyzer (VNA) are then carried

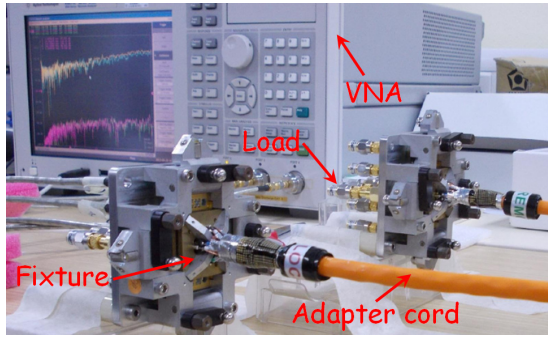


Fig.3. Configuration of VNA measurements for balanced twisted-pair copper cable with fixtures at NMC, A*STAR.

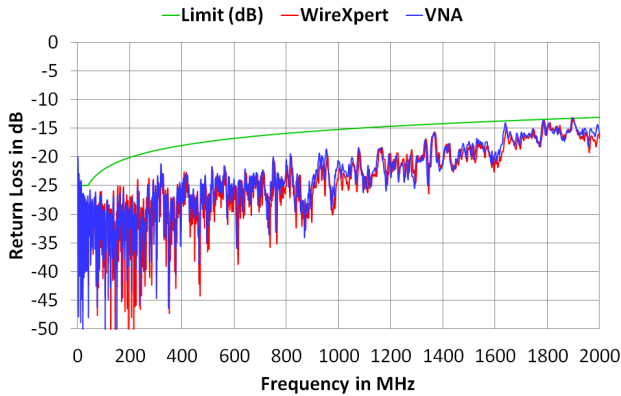


Fig.4. Typical results for return loss measurements in dB.

out. Fig.3 shows the VNA configuration for balanced twisted-pair cable measurements with fixtures [5] when applying the method of mixed-mode S -parameters.

III. RESULTS AND ANALYSIS

Measurement results of a 26-m Category-8.2 Cable [6] are shown in Fig.4 to Fig.6 for performance evaluation of WireXpert with VNA. The green line indicates the new performance limitation for cabling. It can be observed that the cable under testing meets the requirements.

Most importantly, the results measured using the WireXpert and VNA with fixtures indicate very good agreements. High correlation has been observed for the return loss as shown in Fig.4. For the near-end cross-talk (NEXT), some deviations between the results from WireXpert and VNA are induced by the un-avoided cable movements between the measurements.

IV. SUMMARY

This paper reports a performance evaluation of a field tester, WireXpert, for certifying balanced twisted-pair copper cabling up to 2 GHz. Good agreements have been observed compared to the measurements using a four-port VNA with fixtures. To have a comprehensive view, error analysis of measurements with WireXpert will be performed in the near future.

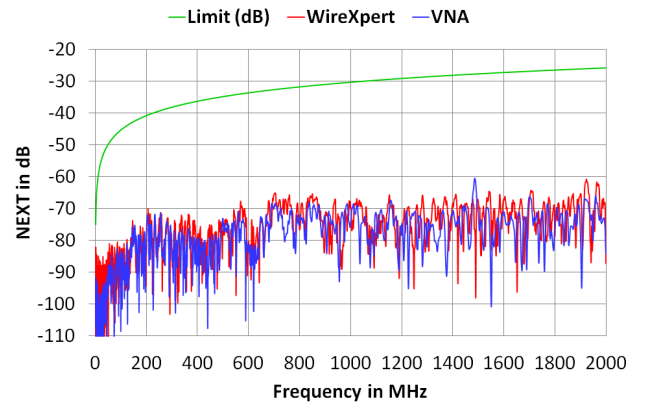


Fig.5. Typical results for near-end cross-talk (NEXT) measurements in dB.

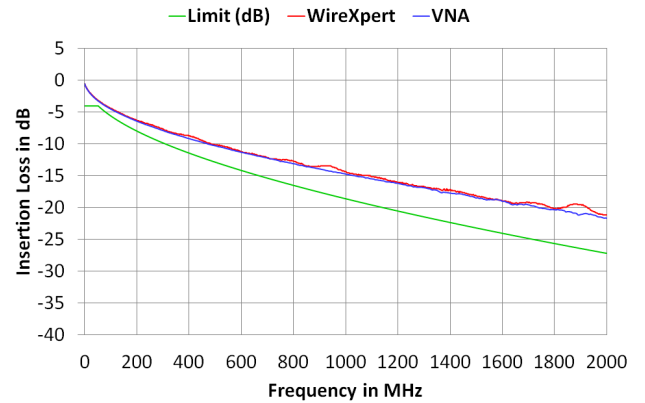


Fig.6. Typical results for insertion loss measurements in dB.

ACKNOWLEDGEMENT

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