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TITLE: G.fast: The need for wideband reference models of loop segments within twisted pair cable topologies

ABSTRACT

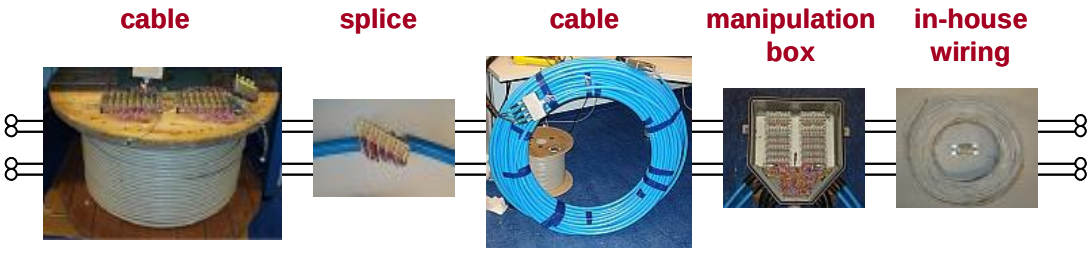
This contribution proposes to develop wideband reference models (up to hundreds of MHz) of the various loop segments within the last copper drop. The purposes of these models is to enable realistic performance studies to design G.fast transceivers and for specifying future test loops for G.fast.

1. Introduction

G.fast transceivers are envisaged to work over twisted pair cabling and to utilize frequencies up to hundreds of Megahertz. To develop transceivers for this, detailed knowledge is needed about the transmission properties of the last copper drop of such loops at these high frequencies. These properties include insertion loss, impedance, crosstalk coupling, etc. Such knowledge is commonly available for frequencies up to 30 MHz but this does not hold for frequencies up to hundreds of MHz

A cable topology describing the last copper drop is a combination of all kinds of wiring elements, such as cable sections, splices and manipulation boxes. A loop through such a cable topology connect two (sets of) transceivers and consists of at least two wires. A loop can also include multiple wires when bonding or MIMO techniques are being used.

An arbitrary loop can always be described by a cascade of individual wiring elements. This is illustrated in the example below, showing a cascade of (a) a multi-quad cable section, (b) a cable splice interconnecting cable sections, (c) another multi-quad cable section, (d) a manipulation box where a technician can make cross connects and (e) in-house wiring.



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To characterize the full loop, one can characterize the individual loop segments as two-ports or multi-ports via measurements and/or modeling, and one can perform a mathematical cascade of all these elements via simulations. Such an approach is essential to characterize an infinite number of loops by characterizing only a limited number of loop segments and by scaling and cascading these loop elements in a pure mathematical manner.
In order to predict the characteristics of arbitrary loops via computer simulations, it is convenient to break down this approach into smaller steps, including;

- Wide band transfer measurements on twisted pair cables
- Wide band transfer measurements on irregularities like splices and manipulation boxed
- Parametric modeling of twisted pair cables as two-ports (wire pairs only, so without any crosstalk)
- Parametric modeling of twisted pair cables as multi-ports (multiple wires, so including crosstalk)
- Simulation of loop characteristics via a mix of models and measurements

These predictions are essential to estimate the maximum achievable bitrate of G.fast for given loop topologies, to design the associate transceivers and to specify future test loops.

It is the intention of TNO to assist with the development of the reference models needed for predicting loops

2. Summary

This paper should be presented under the G.fast agenda item.

The paper highlights the need for reference models to describe the various wiring elements within a twisted pair cable topology, suitable for frequencies up to hundreds of MHz.

It is proposed to agree to add the following new issue to the G.fast issues list:

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