ITU - Telecommunication Standardization Sector Temporary Document 11RV-023

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Question: 4/15

SOURCE[1]: TNO

TITLE: G.fast: Enhanced model for FEXT

ABSTRACT

This contribution proposes a parametric model for far-end crosstalk, and proposes to include this model in G.fast for specifying reference models for crosstalk. The model is a first order enhancement of the legacy model for FEXT, and prevents unrealistically high crosstalk values at higher frequencies. Further details about this parametric model, and how it can match with measurements are provided in a separate contribution.
We also propose to use this enhancement in studies to channel capacity for G.fast.

1. Introduction:

The estimation of channel capacity for G.fast requires adequate models for transmission as well as for crosstalk.
The legacy model for far-end crosstalk [2] has several limitations and one of them is that it predicts unrealistic high crosstalk values at higher frequencies. We discussed this in a separate contribution [1] and showed in that contribution how that aspect can be solved by means of a first-order enhancement of the legacy model. But further improvement of the model is needed as well.
This contribution proposes to include an enhanced parametric model in G.fast, to use them in capacity estimations for G.fast and for defining the crosstalk in reference topologies. As a first step, we also proposes a first-order enhancement to the legacy model, for preventing unrealistic high crosstalk values at higher frequencies.

2. Proposed first order enhancement in FEXT modelling

We propose a first-order enhancement to the model for FEXT, to be included in G.fast. The model we propose is defined below, and details about the rationale behind this model can be found in a separated contribution [1].

$$H_{fext}(f,L,K_{xf}) = \left(\frac{j \cdot K_{xf} \left(f / f_0 \right) \times \sqrt{L / L_0}}{1 + j \cdot K_{xf} \left(f / f_0 \right) \times \sqrt{L / L_0}} \right) \times s_T(f,L)$$

- Variable f identifies the frequency. Constant f_0 identifies a chosen reference frequency for dimensioning purposes, commonly set to f_0 = 1 MHz.
- Variable L identifies the physical length of the loop. Constant L_0 identifies a chosen reference length for dimensioning purposes, commonly set to L_0 = 1 km.
- Function $s_T(f, L)$ represents the frequency and length dependent transmission through the actual loop, normalized to a reference impedance R_n. This value equals $s_T=s_{21}$, where s_{21} is the forward scattering parameter of the loop normalized to R_n.
- Constant K_{xf} identifies an empirically obtained number that scales the FEXT transfer function $H_{fext}(f, L, K_{xf})$.

[1]

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We propose the above model as a parametric model only, since the value for K_{xf} is cable specific, and is to be specified for each scenario being studied. A commonly used value (in dB) for generic European studies on VDSL2 [2], was K_{xf_dB} = -45 dB for f_0 = 1 MHz and L_0 = 1 km. That value was not dedicated to any particular cable or region, and could be used as starting point for studying G.fast.

3. Summary

This paper should be presented under the G.fast agenda item, and addresses issue 5.1.x and 4.7.2.1.x

The paper proposes a parametric model for far-end crosstalk, for inclusion into G.fast. It is a first-order enhancement of the commonly used legacy model for FEXT, and solves the problem that the old model predicts unrealistically high crosstalk values for higher frequencies

It is proposed to add the following new issues to the G.fast issues list and agree to them.

5.1.a	open	Should an enhanced parametric model for FEXT be included in G.fast for use as reference model for predicting crosstalk?	11RV-023 (11RV-022)
5.1.b	open	Should the parametric model for FEXT, as proposed in section 2 of 11RV-023, be included in G.fast as a first-order enhancement until further enhancements are discovered?	11RV-023 (11RV-022)

4. References

[1] TNO (Rob van den Brink, Bas van den Heuvel), "*G.fast: Far-end crosstalk in twisted pair cabling; measurements and modelling*" , ITU contribution 11RV-022, Richmond, Nov 2011.

[2] ETSI TR 101 830-2, Transmission and Multiplexing (TM); Access networks; "*Spectral management on metallic access networks; Part 2: Technical methods for performance evaluations*." 2008.

[3] TNO (Rob van den Brink, Bas van den Heuvel), *"G.fast: The need for wideband reference models of loop segments within twisted pair cable topologies"*, ITU contribution 11BM-020, April 18, 2011.

[4] TNO (Rob van den Brink, Bas van den Heuvel), *"G.fast: Wideband transfer and crosstalk measurements on twisted pair cables"*, ITU contribution 11BM-021, April 18, 2011.

[5] TNO (Rob van den Brink, Bas van den Heuvel), "*G.fast: Wideband modeling of twisted pair cables as two-ports*" , ITU contribution 11GS3-028, Geneva Sept 2011.