ETSI WG TM6
(ACCESS TRANSMISSION SYSTEMS ON METALLIC CABLES)

Permanent Document
TM6(06)05 – rev 0 - (draft)

Living List for Spectral Management
SpM - part 2
revision of TR 101 830-2

This document is the living list of current issues connected with ETSI's spectral management report TR 101 830, part 2 (*Technical methods for performance evaluations*).
This work item is focussed on the revision of "Part 2", dedicated to calculation and measurement methods for evaluating what the performance of xDSL systems will be for various scenarios. The target date for achieving "working group approval" from ETSI-TM6 is scheduled for February 2007
The issues related to "Part 1" or "Part 3", are beyond the scope of this living list.

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2. STUDY POINTS PART 2 (TECHNICAL METHODS FOR PERFORMANCE EVALUATIONS)

SP	Title	Owner	Status
2-1	Performance model for ADSL2	Bernd Heise (Infineon)	US
2-2	Performance model for ADSL2plus	Bernd Heise (Infineon)	US
2-3	Modelling sidelobe pick-up in DMT Receivers	Olivier van de Wiel (Broadcom	US
2-4	Multi node crosstalk models, restricted to the case that all LT nodes are co-located, and NT distributed	Czech Telecom (Milan Meninger)	US
2-5	Multi node crosstalk models, with both LT nodes and NT nodes distributed	Czech Telecom (Milan Meninger)	US
2-6			
2-7			
2-8			
2-9			

The current agreed procedure for changing the status of living list items is in Annex A of TM6 working methods.

Part 2 study points

SP 2-1 Performance model for ADSL2

The performance of ADSL2 is different from the performance of ADSL, and a dedicated calculation model is desired. A useful performance benchmark for ADSL2 is unfortunately lacking, since there are currently no reach requirements in a standard that pushes these modem with extend spectrum to their true performance limits. Therefore this study point has also to address the way of preventing the inclusion of models in the SpM-2 standard that are predicting overoptimistic results

Related Contributions:

- *034t33, Sophia 2003 - Receiver models for G.992.3@A and G.992.5@A - TI*

SP 2-2 Performance model for ADSL2plus

The performance of ADSL2plus is different from the performance of ADSL, and a dedicated calculation model is desired. A useful performance benchmark for ADSL2plus is unfortunately lacking, since there are currently no reach requirements in a standard that pushes these modem with extend spectrum to their true performance limits. Therefore this study point has also to address the way of preventing the inclusion of models in the SpM-2 standard that are predicting overoptimistic results

Related Contributions:

- *034t33, Sophia 2003 - Receiver models for G.992.3@A and G.992.5@A - TI*

SP 2-3 Modelling sidelobe pick-up in DMT Receivers

In order to improve the validity of performance models for DMT receivers, the impact of sidelobe pick-up in DMT receivers may be a useful addition to the model, including a model for input filtering that reduces the impact of sidelobe pick-up. The main issues are detailed in 041t22, and this study point is to develop the text that should be added to the description of the DMT performance model.

Related Contributions:

- *991t30, Villach 1999 - Adopting HDSL2 components in SDSL (Fig 1 & table 1)*
- *034w13, Sophia 2003 - Sidelobe pick-up in DMT receivers - Alcatel, Conexant*
- *041t22, Sophia 2004 - Sidelobe pick-up in ADSL DMT receivers - Alcatel*
- *041t23, Sophia 2004 - Modeling filtering in ADSL receivers - Alcatel*

SP 2-4 Multi node crosstalk models, restricted to the case that all LT nodes are co-located, and NT distributed (*for VDSL from the exchange*)

A commonly used simplification of modeling crosstalk coupling in a loop assumes a two-node topology, as if all disturbers are co-located at the NT side as well as the LT side. In some cases, more advanced models for crosstalk coupling are required, accounting for the fact that NT modems are not co-located but "scattered" along the loop, and connected with branches. These models (without branching) have been used in various "VDSL from the exchange" studies, but a *punctual* description of that approach is lacking.

This study point is to develop a literal text proposal on a mathematical description to specify such a multi-node crosstalk model.

- *033w07, Sophia 2003 – Method on Xtalk Calculations in a Distributed Environment*
- *051t21, Sophia, feb 2005 – Distributed cable tree installation scenario – Czech Telecom*
- *052t06, Sophia, june 2005 –Generic crosstalk model, for one/multi node collocation – Czech Telecom*
- *052t07, Sophia, june 2005 –Crosstalk model, based on distribution of coupling – Czech Telecom*
- *053t22, Ghent, sept 2005 –Editorial changes for draft text of SP 2-44 (see LL used for creating SpM-2) – Czech Telecom*

SP 2-5 Multi node crosstalk models, with both LT nodes and NT nodes distributed (*for VDSL from the cabinet*)

Somewhat similar to SP2-4, but now to model the crosstalk in case VDSL is deployed from the cabinet and other xDSL modems from the local exchange.

Text proposals, for inclusion in the revised SpM-2.

The text fragments below have been proposed for inclusion in the draft version of SpM part 2, but are still in the "under study" status. If agreement is achieved, they will be moved into the Draft

Text portions, proposed for inclusion in clause 8

8 Crosstalk models

> ED NOTE The text is based on 052t06r1, and is still too immature to be included directly into the draft. This needs to be improved first.

8.6. Topology crosstalk model for multi-node co-location

8.6 Generic Crosstalk Model for Multi-Node Co-Location

Two-node crosstalk model is suitable for network topology, where majority of customers (network termination points) is located practically at one place. Application of this model in a situations, where network termination points are distributed on the whole cable tree territory may result in:

- too pessimistic noise levels at NT points,
- rather optimistic noise level at LT point (if power cutback is not applied).

For these situations a one-node/multi-node crosstalk model was derived, which was completed with features capable to express some specifics of customer distribution it the network.

8.6.1 Architecture of one-node/multi-node cable tree model

One-node/multi-node cable tree installation scenario assumes homogeneous distribution of customers in network, which may be modelled by a hypothetical CT topology depicted on **Fig. 1**, where cable tree idealisation is based on the following fundamentals:

- Territory of customers covered by a cable tree is decomposed into small sub-areas called ***access cells*** treating customers living on their territory around a terminal distribution frame.
- Dimensions of all access cells are identical and have square shape.
- Interconnection of access cells with central office is modelled with a cable feeder network in shape of a fish skeleton, see Fig. 2, with gradual pair dropping in junctions or primary or secondary distribution frames, drawn as small circles.
- All NT transceivers of all DSLs in one access cell are collocated at one point.
- There is identical number of DSLs, with identical technological mixture in all access cells.

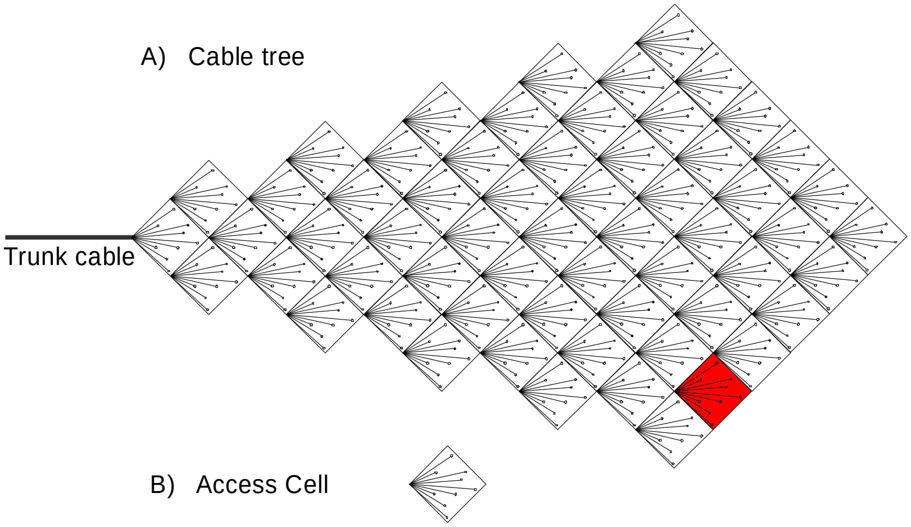

Fig. 1 Approximation of cable tree with a network of access cells

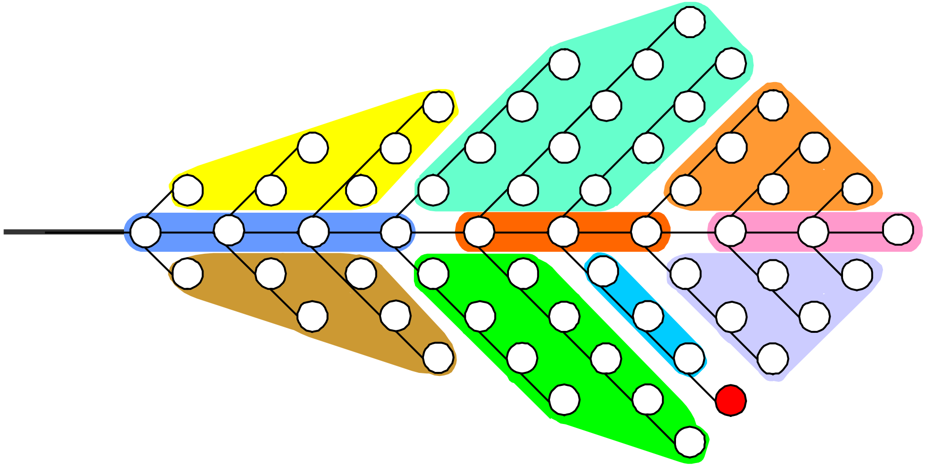

Fig. 2 Feeder network interconnecting access cells of the cable tree at Fig. 1

8.6.2 Cable Tree Topology Simplification Rules

Architecture of the cable tree drawn on **Fig. 1** and **Fig. 2** is for spectral simulations rather complex. Its simplification is based on association of access cells into groups, which are replaced by multiple parallel lines designed and distributed in the cable tree according to the following rules:

- Access cell, which contains a line, which is the subject of spectral analysis is not associated with any other cell, in Fig. 1 this cell is highlighted by red colour,
- Remaining cells are separated into groups. Lines of each group are replaced with multiple parallel lines terminated in a common multiple branch termination point. Separation of access cells into groups is illustrated in Fig. 2 by underlying colour spots. Number of cells associated in one group depends on accuracy, which should be achieved.

NOTE: It is convenient to arrange cells into groups symmetrical around the cable tree backbone, which can be further merged into one multiple branch termination point representing twofold number of original cells without loss of accuracy, see areas A – A' and B – B' at **Fig. 3**.

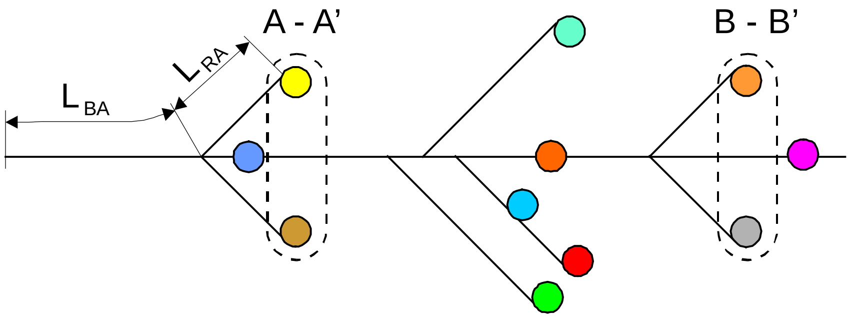

Fig. 3 Cable tree after its topology simplification

Final length L_X and other coordinates of a multiple line assigned to a group X are defined by expression 1.

$$L_X = L_{BX} + L_{RX} + L_C$$

$$L_{BX} = \frac{\sum_{i\in X} l_{iX} m_{iX}}{\sum_{i\in X} m_{iX}}$$

$$L_{RX} = C\frac{\sum_{i\in X}\sum_{j=1}^{m_{iX}} j}{\sum_{i\in X} m_{iX}}$$

where

C	Is the length of access cell edge;
L_{BX}	Is the coordinate of branching point from the cable tree backbone of the multiple line constituting group X;
L_{RX}	Is the length of X multiple line feeder tap;
L_C	Is the substituting length of lines in access cell. It may be used e.g. the average length $0{,}765C$ or the maximum length which yields $C\times\sqrt{2}$;
$\sum_{i\in X}$	denotes summation performed on branches constituting group X;
l_{iX}	Is the coordinate of branching point of the i–th original cable tree branch belonging to group X
m_{iX}	Is the number of cells of original i–th branch belonging to group X;

NOTE 1: Transformation process is illustrated in Fig. 3, where are indicated coordinates of a new multiple branch termination point A.

NOTE 2: In case of grouping access cells laying only on the CT backbone $L_{RX} \equiv 0$.

Expression 1: Rules for calculation of branch coordinates of one-node/multiple-node cable tree model

8.6.3 Crosstalk characteristics in one-node/multi-node cable tree model

Crosstalk transfer functions used in one-node/multi-node cable tree model differ a bit from those of straight cable section, described in Clause 8.3.3.1. Reason is in the fact that they have to include also signal transmission over cable sections at which no relevant crosstalk occurs. This situation is illustrated by **Fig. 4** and modelled by Expression 2, where L_{CJX} stands for the pair concurrency length of branches J and X.

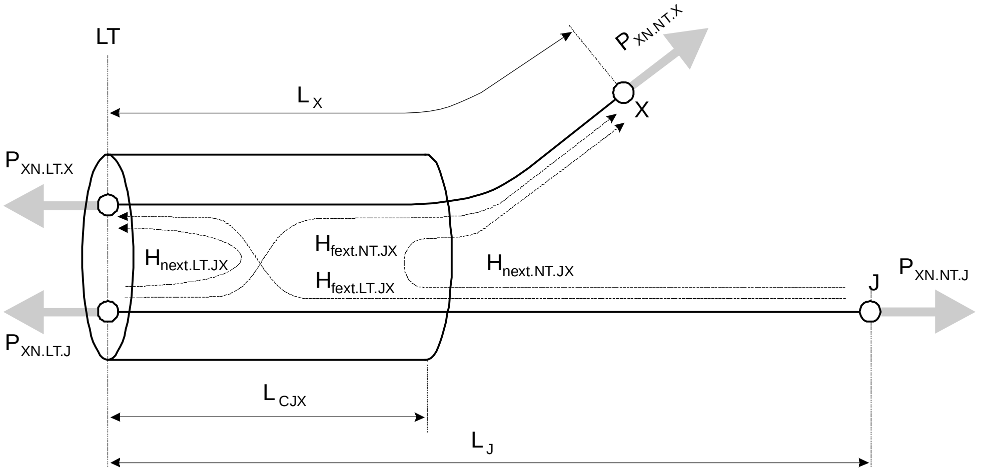

Fig. 4 Transmission parameters of cable tree branches *J* and *X*

$$H_{nextNT.JX}(f,L_X,L_J)=K_{xn}\times\left(f/f_0\right)^{0.75}\times\sqrt{1-\left|s_T(f,L_{CJX})\right|^4}\times\left|s_T(f,L_X+L_J-2L_{CJX})\right|$$

$$H_{next.LT.JX}(f,L_X,L_J)=K_{xn}\times\left(f/f_0\right)^{0.75}\times\sqrt{1-\left|s_T(f,L_{CJX})\right|^4}$$

$$H_{fext.NT.JX}(f,L_X,L_J)=K_{xf}\times\left(f/f_0\right)\times\sqrt{L_{CJX}/L_0}\times\left|s_T(f,L_X)\right|$$

$$H_{fext.LT.JX}(f,L_X,L_J)=K_{xf}\times\left(f/f_0\right)\times\sqrt{L_{CJX}/L_0}\times\left|s_T(f,L_J)\right|$$

Note 1: A victim pair belongs always to branch X.

Note 2: Crosstalk transfer function in one-node/multi-node model is generally related to two cable tree branches referred by their lengths L_X and L_J. In case, when modelled crosstalk occurs only between pairs of one cable tree branch, the crosstalk transfer function parameter description degenerates only to one length parameter, which is L_X .

Expression 2: Crosstalk transfer functions for one-node/multi-node model

8.6.4 Signal transmission in one-node/multi-node cable tree model

Noise spectra at NT and LT points of a victim pair in a branch X are given by Expression 3, where B denotes number of multiple line branches constituting the final cable tree model.

$$P_{XNNT.X}(f)=\left|H_{fextNT.X}(f,L_X)\right|^2P_{d.eqLT.X}(f)+\left|H_{nextNT.X}(f,L_X)\right|^2P_{d.eqNT.X}(f)+P_{bnNT}+$$

$$+\sum_{\substack{J=1\\J\neq X}}^{B}\left|H_{fextNT.JX}(f,L_X,L_J)\right|^2P_{d.eqLT.J}(f)+\sum_{\substack{J=1\\J\neq X}}^{B}\left|H_{nextNT.JX}(f,L_X,L_J)\right|^2P_{d.eqNT.J}(f)$$

$$P_{XNLT.X}(f)=\left|H_{fextLT.X}(f,L_X)\right|^2P_{d.eqNT.X}(f)+\left|H_{nextLT.X}(f,L_X)\right|^2P_{d.eqLT.X}(f)+P_{bnLT}+$$

$$+\sum_{\substack{J=1\\J\neq X}}^{B}\left|H_{fextLT.JX}(f,L_X,L_J)\right|^2P_{d.eqNT.J}(f)+\sum_{\substack{J=1\\J\neq X}}^{B}\left|H_{nextLT.JX}(f,L_X,L_J)\right|^2P_{d.eqLT.J}(f)$$

Where

$P_{XN.NT.X}$ is the total crosstalk power induced into a victim pair of branch X at NT side

$P_{d.eq.NT.X}$ is the cumulated noise power from interferers located at NT side of branch X.

Expression 3: Evaluation of the crosstalk power levels that flow into the noise injection blocks of the one-node/multi-node model

End of literal text proposals