TITLE **Results of ad hoc meeting on Noise Injection**

PROJECTS ADSL

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STATUS for information

ABSTRACT This WD discusses and describes means for how to provide a more accurate description of the noise levels that are to be injected during xDSL performance testing.

During the meeting an ad-hoc group discussed about how to define the way the noise shall be injected in the testloops when testing modem performance. The discussion has originated within the ADSL project, but the approach should be applicable to SDSL and VDSL as well.

There was consensus about the fact that (differential mode) noise injection method shall be current injection in nature. Common mode noise injection was not discussed, but this issue remains for further study.

There was consensus about the fact that the ADSL document must describe (a) an equivalent circuit diagram of the noise injector, (b) a setup for checking/calibrating the defined noise levels, and (c) the interpretation of these noise levels in case the noise injector is terminated by other impedances then when used during calibration.

To avoid that the calibration of the noise must be ajusted each time a testloop is changed in length and type, a single well-defined callibration method is desired, with clearly defined impedances. There was some discussion if this impedance has to be the design impedance of the modem under test, or the chosen normalization impedance. (for more technical background on this topic, see TD16). Calibration at the design impedance (100 Ω for ADSL) is much closer to the actual impedance of the modem under test then when the normalization impedance (135Ω) would have been used. That's why a preference does exist for using the design impedance, while some delegates indicated that other values could make sense.

Proposal:
To add a section between section 5.1 and 5.2, carrying the following text and figures.

0.1. Noise injection Network

The adding network in figure 3 facilitates the injection of the differential mode and common mode noise from the impairment generator into the test cable.

0.1.1. Differential mode noise injection

The noise injector for differential mode noise is a two-port network in nature, and may have additional ports connected to the impairment generator. The Norton equivalent circuit diagram is shown in figure [x]. The current source I_x is controlled by the impairment generator. The parasitic shunt impedance Z_x shall have a value of $|Z_x|>4k\Omega$ in the frequency range from 100 Hz to 2 MHz.

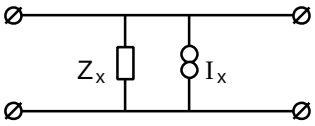

Figure [x] Norton equivalent circuit diagram of the differential mode noise injector.

EDITORIAL NOTE It may make sense to allow a small amount of insertion loss (eg <0.25 dB) by adding series resistors. This is for further study.

The noise levels are specified in sub clause [*] for the condition that the differential mode noise injector is terminated at both ends by the design impedance $\mathbf{R_V}$ of the modem under test (the "null" loop). This is illustrated in figure [y].
The noise level is specified in terms of power $\mathbf{P_x}$ at the port that will be connected to the input of the victim modem under test. $\mathbf{R_v}$=100Ω for ADSL. The rms voltage $\mathbf{U_x}$ (in figure [y]) across the load impedance $\mathbf{R_v}$ is therefore equal to $\mathbf{U_x} = \sqrt{(\mathbf{P_x} / \mathbf{R_v})}$.

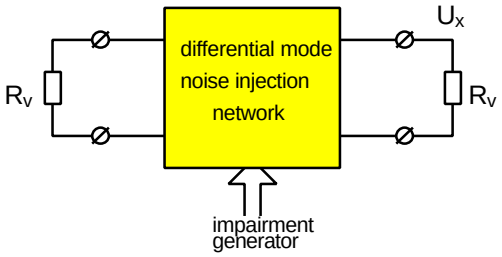

Figure [y] for which the noise level is defined, and applicable for calibration purposes..

During performance testing the noise injector will be part of the circuit diagram in figure [z]. In this configuration the termination impedances at both ports of the differential mode noise injector can be different from the values $\mathbf{R_v}$ used in figure [y] since the cable impedance and the actual impedances of the xDSL modem under test will be a slightly different from the design impedance $\mathbf{R_v}$. As a result the noise voltage $\mathbf{U'_x}$ in figure [z] can be a slightly different from noise voltage $\mathbf{U_x}$ in figure [y].

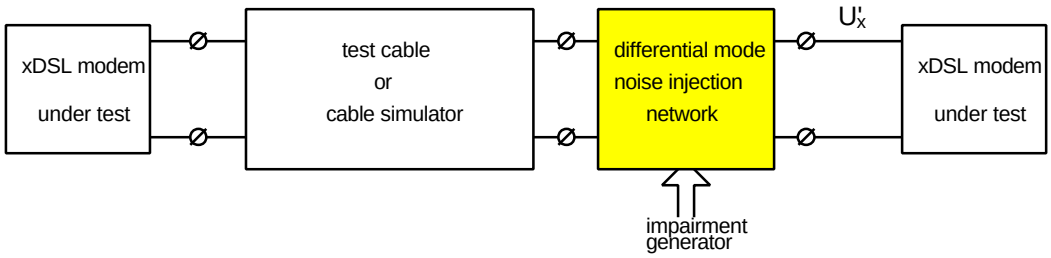

Figure [z] Usage of the noise injector during performance testing.

0.1.2. Common mode noise injection

<for further study>