TITLE **Complex impedance for calibrating the injected noise level**

PROJECTS ADSL, SDSL

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STATUS for decision

ABSTRACT This contribution proposes a complex impedance, to be used during the calibration mode of performance testing, for defining the ADSL reach requirements, and to solve the reach requirements for SDSL that appeared to be too tight at lower bitrates. The proposed impedance is a compromise between simplicity (one impedance representing all testloops) and realism (much better than a frequency independent value). The network has been taken from existing ETSI standards.

1. Description of the problem to be solved

For testing the performance of xDSL modems, noise is to be injected into the test setup as a current. The associated noise levels are well specified in the various xDSL standards, and hold under calibration conditions. The setup for this calibration mode is shown in figure 1.

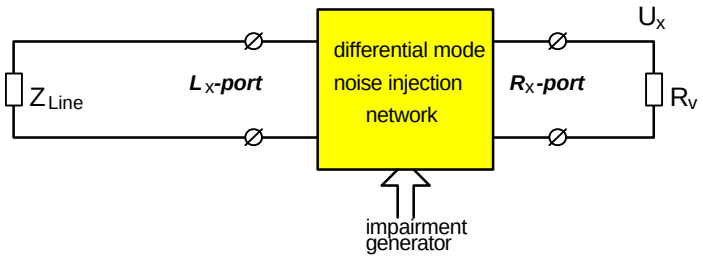

***Figure 1**. Proposed Impedance Z_{LINE}*

As an interim solution, the ADSL and SDSL standards have defined the left-hand impedance Z_{line} as a real impedance, that equals to the design impedance R_V of the modem under test. This is 100 ohm for ADSL and 135 ohm for SDSL.

When noise is calibrated into two 100 ohm resistors in parallel for ADSL (or 135 ohm for SDSL), and subsequently injected as a current into the test setup, the noise level during the performance testing mode will be higher then during the calibration mode. This is because the line impedance is higher than the 100 ohm (135 ohm) used during calibration.
In principle, there is nothing wrong with that, as long as the procedure is reproducable and everyone in the world is doing it that in exactly the same way.

The real problem with an actual noise level higher than the calibrated level was identified during the previous ETSI meeting for SDSL [1]. This behavior was not taken into account when the SDSL performance numbers were evaluated, so the consequences are that the published reach requirements for SDSL become a slightly unrealistic for lower bitrates due to this "blooper".
It is clear that this needs an adjustment, which has to be similar for all xDSL tests (ADSL, SDSL, VDSL, ..). The generic approach for calibration [2] has been incorporated in the recently published ADSL standard.

The most natural place to repair this in the standards is for the callibration mode, since that has caused the real problem. That's why the recently published ADSL standard has included a note that a frequency dependent model for Z_{line} would better represent the loop behaviour. Such an impedance would minimize the differences of noise power entering the modems between the calibration mode and performance testing mode.

This contribution proposes a definition for this Z_{line}.

2. Proposed impedance Z_{Line}

We propose to use the complex impedance specified in figure 2. This is based on the European harmonized complex impedance Z_R , specified in ETSI TR 101 728 [3], and modified in TR 102 139 [4] for requirements relating to ADSL frequencies.

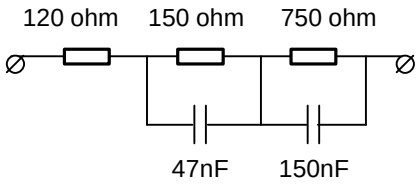

***Figure 2**. proposed Impedance Z_{LINE}*

Figure 3. 4 and 5 illustrate that this impedance is a fair representation of the line impedances (at NT side) of various testloops, used for ADSL and SDSL. These figures also demonstrate, that the variation of impedance among the different testloops is so wide, that it hardly makes any sense for trying a modification of the here proposed impedance. Therefore a value equal to what has been harmonized in the past by other ETSI standards is the most likely value for calibration purposes during xDSL performance tests.

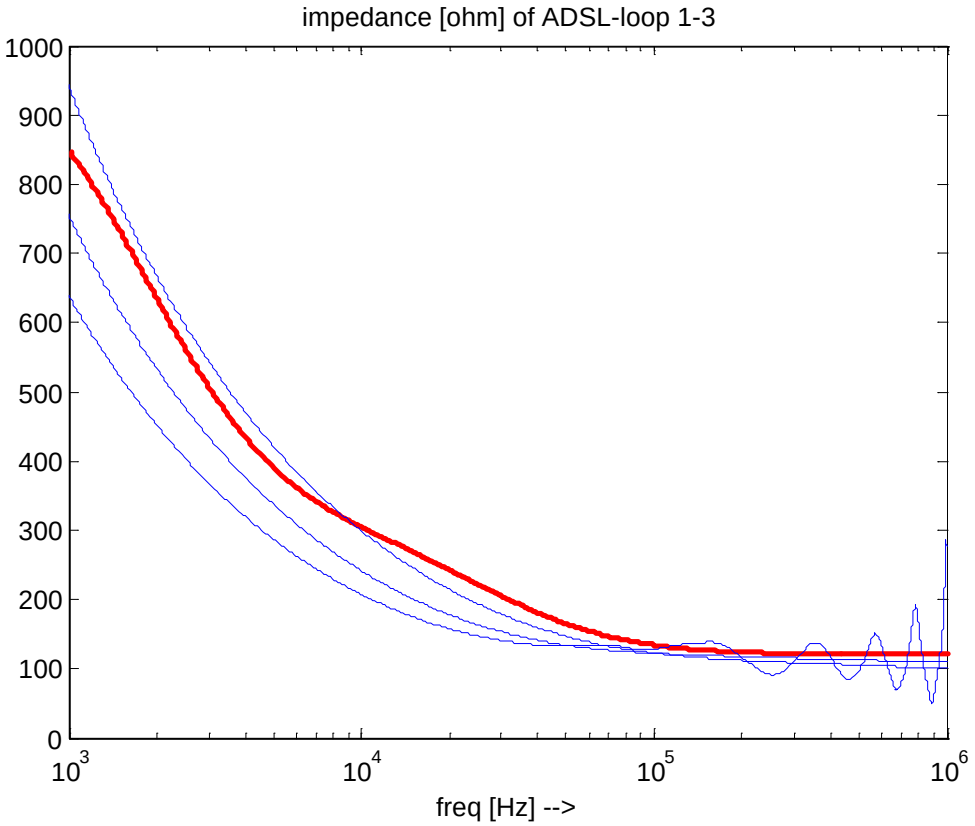

***Figure 3**. Comparison of the proposed impedance of Z_{line} and ADSL testloops 1-3*

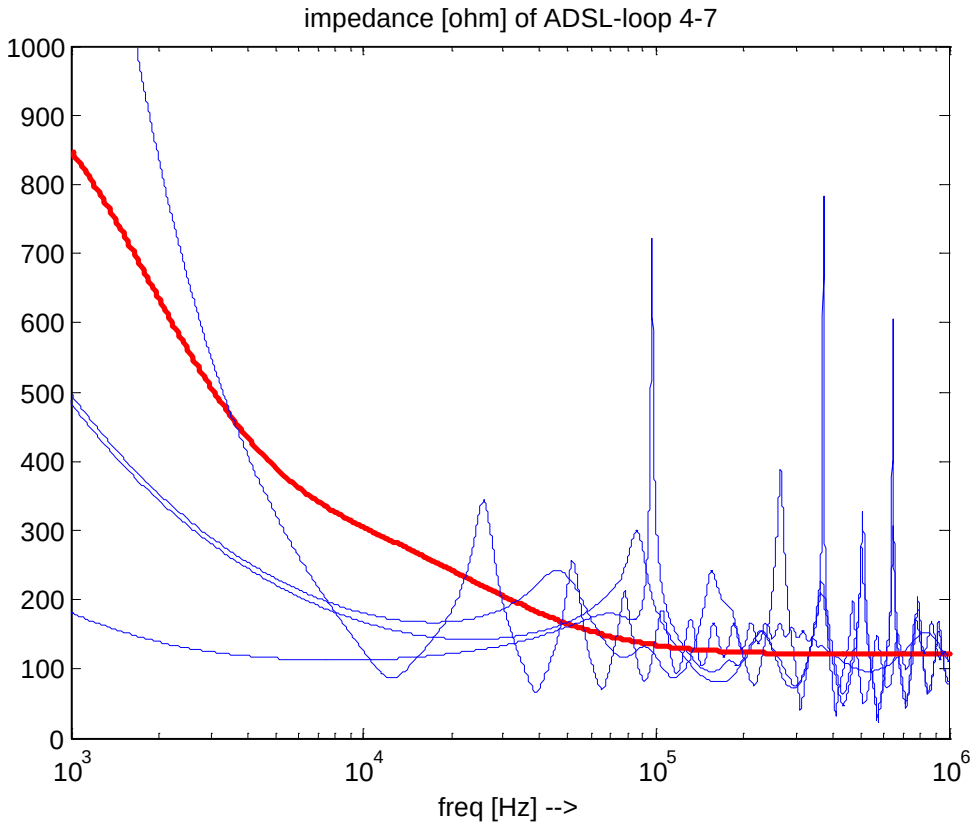

Figure 4 *.Comparison of the proposed impedance of* Z_{line} *and ADSL testloops 4-7*

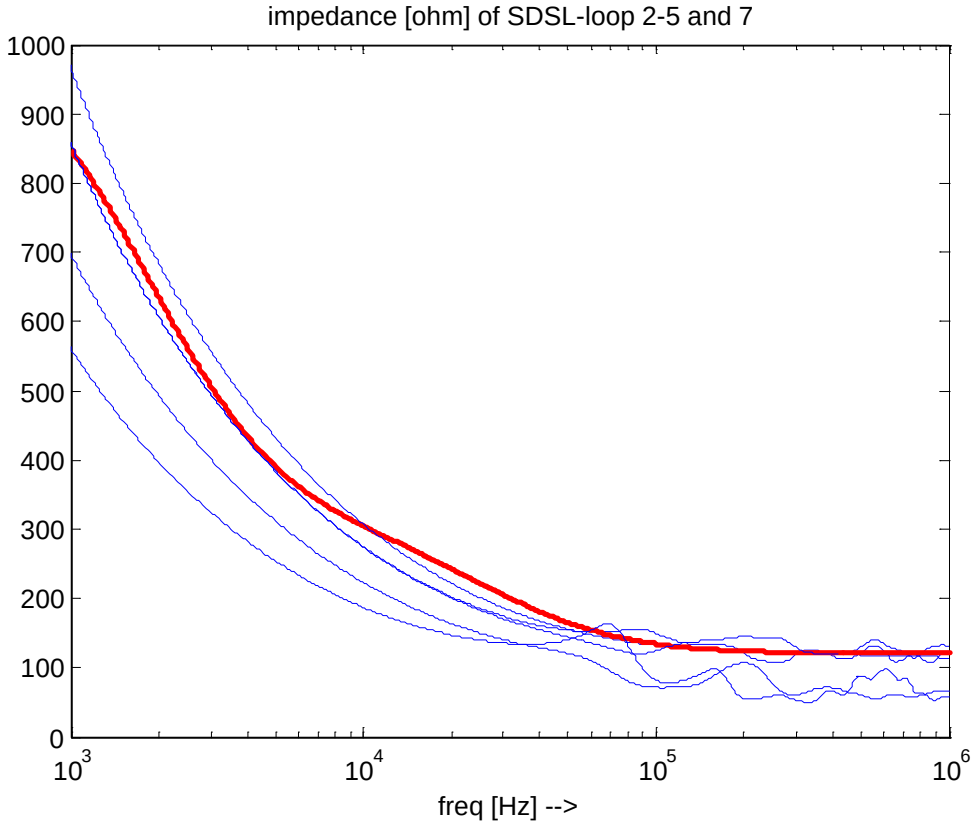

Figure 5*. Comparison of the proposed impedance of* Z_{line} *and SDSL testloops 2-5 and 7*

3. References

[1] Marc **Kimpe**, ADTRAN, *Noise Injection PSD Variations Due To Impedance Mismatch.* Contribution TD15 (013t15.pdf) , ETSI-TM6 meeting sep 2001, Stockholm, Sweden.

[2] Rob F.M. van den **Brink**, KPN-Research, *Solution for Noise Injection and calibration of their level* , Contribution WD09 (013w09.pdf) , ETSI-TM6 meeting sep 2001, Stockholm, Sweden.

[3] **ETSI TR 101 728** V1.1.1 (2000-12) *Access and Terminals (AT); Study for the specification of the low pass section of POTS/ADSL splitters.*

[4] **ETSI TR 102 139** V1.1.1 (2000-06) *Compatibility of POTS terminal equipment with xDSL systems.*