
SOURCE: KPN (PTT Telecom, KPN Research)
author: Rob van den Brink

CONTACT R.F.M. van den Brink
KPN Research,
PO Box 421
2260 AK Leidschendam
The Netherlands
tel: +31 70 3325389
fax: +31 70 3326477
email: R.F.M.vandenBrink@research.kpn.com

TITLE **ADSL - Simplifying the testloop configurations**

STATUS Proposal.

The ADSL draft has currently adopted 8 loop configurations, for each of the 4 transport classes and the 2 noise models. This makes 64 testloops for ADSL in total. These 64 testloops are all restricted to cables ranging between 100-120Ω. This is not a representation of an average European configuration. Furthermore, the mutual difference in performance between loop configuration 1-7 is small; perhaps too small. This is demonstrated by figure 1.

- When ADSL is so critical that this small difference is really significant, then we need ***hundreds*** maybe thousands of exotic testloops, to demonstrate that ADSL works on a wide range of European cables. Hundreds or thousands of loops are ***unacceptable***.
- When these small differences are irrelevant, and this is what we believe, the current set of ADSL-loops is an overkill of similar loops, representing only the very low end of cable impedances.

We do not think that the small functional differences between most ADSL loop configurations, justify the prescription of so many refinements. (One of them is a cascade of 4 different sections.) Our opinion is that the number of possible loop configurations must be kept as small as possible. They should be restricted to those having *significant* different transmission and reflection characteristics.

We propose to reduce the complexity of the ADSL testloop configurations, by restricting the loops to one class of matched testloops and two classes of mismatched testloops. (See figure 2). Loops in the same class are all based on the same cable, but may differ in length. This was proposed in TD25 for VDSL as well.

- The matched loops must be based on cables having the adopted design impedance (135Ω).
- The first class of mismatched test loops must be based on cables causing a worstcase mismatch, which is probably the lowest (100 Ω) or highest (150 Ω) characteristic impedance value of major interest.
- The second class of mismatched test loops is based on loops having bridge taps, as currently described in the ADSL draft (see figure 2 as well).

The insertion loss of all loops must be specified at the adopted design impedance (135Ω). Each loop is specified by its insertion loss, not by its length.

Choosing similar loops for VDSL and ADSL is strongly preferred, because it enables the application of general purpose testloops for high bit-rate transmission. Of course, they will differ in length.

Our opinion is that the length of each testloops should not be specified in the ADSL standard. This is because there are so many differences in cables (wire diameter, dielectric, type) and variation between wire pairs. We prefer to delete these tables from the current ADSL-draft, and to restrict them to table 1 of this proposal. If not, table 2 of thgis proposal can be used to update these ADSL tables.

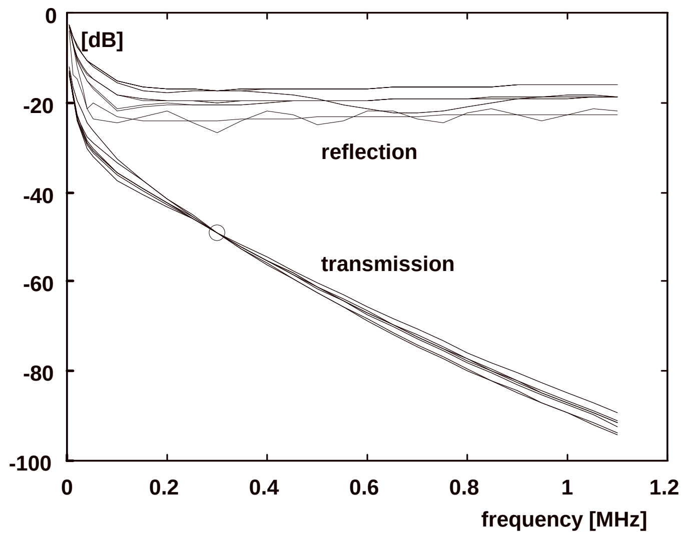

Figure 1 *Transmission and reflection in testloop 1-7 of the ADSL draft, when powered from and terminated with 135W. This figure illustrates that all these loops have similar performance. The simulation is based on the cable parameters specified in the ADSL draft. The length 'X' in table 9 of the ADSL draft is somewhat adjusted to give all loops –49dB transmission (+49dB insertion loss) at 300kHz and 135W.*

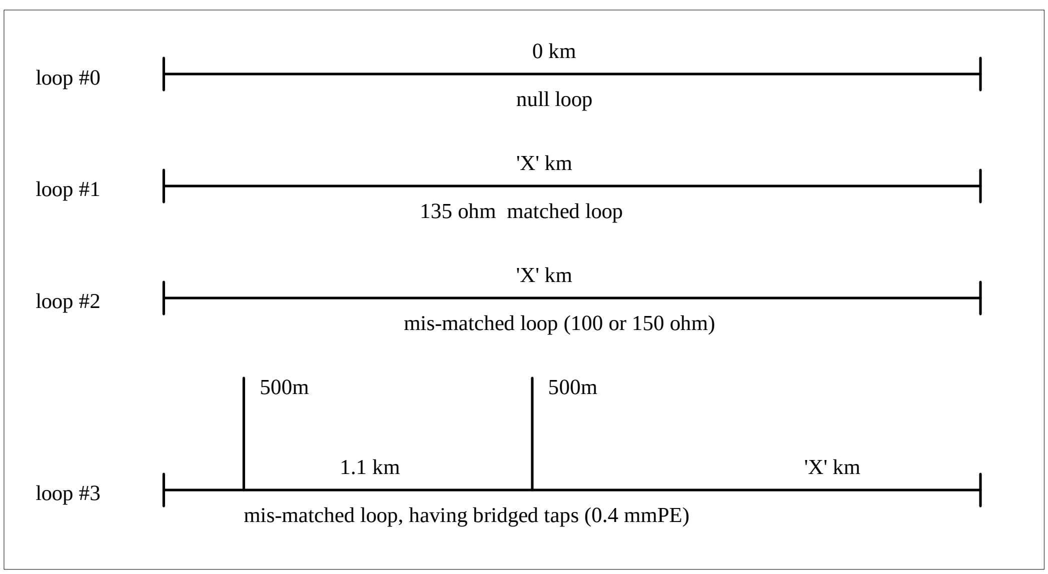

Figure 2 *Simplified ADSL testloops, for transport classes 2M1, 2M2, 2M3/1 and 2M3/2 with noise model A and B. (see current ADSL draft). For the loop with bridge taps, see the description in the current ADSL draft.*

transport class	noise model A	noise model B	remarks
2M1	41 dB	25 dB	6 Mb/s
2M2	46 dB	30 dB	4 Mb/s
2M3/1	49 dB	34 dB	2 Mb/s
2M3/2	51 dB	36 dB	2 Mb/s

Table 1 *Total insertion loss of the ADSL-testloops, at 300kHz. The looplength 'X' must be adjusted to meet these insertion loss requirements at 300kHz, when powered from and terminated with an impedance of 135W.*

transport class	noise model A			noise model B			remarks
	100Ω	135Ω	150Ω	100Ω	135Ω	150Ω	
2M1	?	?	4.6km	?	?	2.8km	6 Mb/s
2M2	?	?	5.2km	?	?	3.4km	4 Mb/s
2M3/1	?	?	5.5km	?	?	3.8km	2 Mb/s
2M3/2	?	?	5.8km	?	?	4.1km	2 Mb/s

Table 2 *Nominal value of adjustable length 'X' in km, that meets the Insertion loss requirements of table 1. The primary line constants given in table 3 are used to calculate the lengths at 135W source and termination impedance. Calculation of the nominal length of 100W cables can be based on the RLC-values of current ADSL-draft (table 14 or 15 of the Vienna 1996 version).*

freq. [kHz]	R [Ω/km]	L [μH/km]	C [nF/km]	G [mS/km]
0.0	168.1	755.6	36.3	0.000
2.5	168.2	755.6	35.7	0.012
10.0	168.3	755.5	35.3	0.049
20.0	168.9	755.2	35.0	0.098
30.0	169.9	754.8	34.8	0.147
40.0	171.3	754.3	34.7	0.197
50.0	173.0	753.6	34.6	0.246
100.0	186.7	748.1	34.2	0.491
150.0	206.9	740.1	33.9	0.737
200.0	230.8	730.7	33.8	0.983
250.0	256.0	721.0	33.6	1.229
300.0	280.8	711.7	33.5	1.474
350.0	304.4	703.1	33.4	1.720
400.0	326.4	695.5	33.4	1.966
450.0	346.6	688.7	33.3	2.211
500.0	365.3	682.8	33.2	2.457
550.0	382.5	677.7	33.2	2.703
600.0	398.6	673.2	33.1	2.948
650.0	413.7	669.2	33.1	3.194
700.0	428.0	665.7	33.1	3.440
750.0	441.6	662.6	33.0	3.686
800.0	454.6	659.8	33.0	3.931
850.0	467.2	657.2	33.0	4.177
900.0	479.3	654.9	32.9	4.423
950.0	491.1	652.8	32.9	4.668
1000.0	502.6	650.9	32.9	4.914
1050.0	513.8	649.1	32.9	5.160
1100.0	524.7	647.5	32.8	5.405

Table 3 *Primary line constants of a 150W twisted pair cable. It is a sample of a PE quad cable that is commonly used in the Netherlands (norm 86, 50*4*0.5mm, sample L1/28). The parameters have been extracted from twoport measurements on a section of 500m Note that this sample is not a worst case sample nor a typical sample. We observed up to 1.5dB/km variation in insertion loss (ranging between 8.5-10 dB/km) for various wire pairs at 300kHz.*