TITLE	R**eturn loss proposal on VDSL**
PROJECT	VDSL
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STATUS	Proposal, for decision
ABSTRACT	Proposes a >27dB return loss requirement on VDSL to restrict the signal power uncertainty on the lines to 1 dB due to a 10% impedance tolerance.

The proposed text below, can be copied literally into the VDSL draft, when accepted

8.4 Interface return loss & balance about earth

8.4.1 Return loss

The purpose of a minimum return loss requirement is to limit signal power uncertainties due to line interface impedance tolerances.
A 10% tolerance of the impedance, with respect to the design impedance R_V = 135Ω, enables these line interface impedances to range between 121Ω and 149Ω. This impedance tolerance causes about 1 dB maximum[1] uncertainty in signal power on 135Ω lines when that power is specified under test loop #0 conditions (see subclause 9.1).
The return loss, $1/\Gamma = (Z+R_V)/(Z-R_V)$, is an alternative way to specify an impedance **Z**, normalized to the chosen design impedance $\mathbf{R_N}$. This makes impedance tolerance and minimum return loss similar quantities. Its definition is independend on the characteristic impedance $\mathbf{Z_0}$ of the cable because VDSL can handle a wide range of cable types having significant different $\mathbf{Z_0}$ values.

The return loss of the line interface of the VDSL transceiver shall be[2] >27dB ($= 20\times{}^{10}\log(|1/\Gamma|)$) from $\mathbf{f}_L$ to $\mathbf{f}_H$ when measured against a reference impedance $\mathbf{R_N}$ (see sub-clause 8.2).

8.4.2 Balance

contributions are still invited

[1] Consider a VDSL transceiver with ($R_V+\Delta R$) impedance, and compare the power in a nominal case (R_V termination) with a worst case ($R_V-\Delta R$ termination). This yields a $\Delta R/R_V$ relative voltage uncertainty.
[2] ***Editorial note*:** A resistance that is 10% too high equals 1.1×135Ω and makes $1/\Gamma$=2.1/0.1=21. This factor is equivalent to 26.44 dB.
If 0.5 dB power uncertainty appears to be more appropriate, a 5% impedance tolerance is required, ranging between 128Ω and 142Ω. In this case, the worst case return loss equals $1/\Gamma$=2.05/0.05=41 or 32.3 dB. This set a >33dB requirement on return loss.