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TITLE **HDSL - Proposal for HDSL wander specification**

STATUS Proposal, for discussion

ABSTRACT The HDSL framestructure can result in large values of wander. Recent proposals to improve the specs do not take into account that HDSL is typically used in combination with SDH, PDH or ATM core networks. HDSL is nothing more than an access technology, and should affect no more than a small part of the overal network wander. This contributions proposes limits that do take this into account.

1. Discussion

In order to ensure proper operation of 2.048 Mbit/s connections the following wander (low frequency jitter) specifications are needed:

- wander generation limits for the 2.048 Mbit/s transmitting equipment.
- wander network limits for the 2.048 Mbit/s network. Nowadays this network is typically an SDH network that can have HDSL access over the copper access network.
- wander input tolerance limits for the 2.048 Mbit/s receiving equipment.

At this moment only the wander input tolerance limit is specified in ITU G.823 and ETSI DE/TM-03067. For an interim limit the wander generation of the transmitting equipment is neglected and therefore the ‘only’ specification needed is a network wander limit for an SDH/HDSL combined network. As an interim solution (until ETSI TM3 comes up with a wander limit for the 2.048 Mbit/s hierarchy) this could be an MTIE limit with the same values as the G.823 input tolerance limit. The wander of all the network elements that are involved in the connection will add up to the total amount of wander, because it is very difficult (and expensive) to filter out wander. The only simple way to eliminate wander is to enlarge the buffers, which increases the delay. This is different from jitter which can be filtered out quite easily. This implies that HDSL wander limits should be more stringent than this network limit, because HDSL is only a small part of the entire network connection consisting of 1 or 2 HDSL links and 10 or more SDH network elements. Also the transmitting side of one end usually synchronises at the incoming signal, which implies that from a timing point of view a typical application of HDSL contains 4 HDSL links.

The main contribution in wander in a 2.048 Mbit/s connection through SDH is the wander caused by the so called TU-12 pointer justification events. Pointer justification events are meant to solve frequency differences between SDH network elements and very slow wander that has a larger amplitude than the buffers can handle. TU-12 pointer justifications are typically 3.5 us in time but can also be 7 us (double pointer justification) if it has to step over the overhead. Figure 1 shows a measured respons at the 2.048 Mbit/s level for a single and double pointer justification event. Apart from this wander also SDH mapping wander will occur. A realistic value would be <2.3 us. For one HDSL link this implies that a maximum of (5.3 us - 2.3 us)/4 = 0.75 us is allowed between 1.67 and 0.01 Hz. This is rounded to 0.732 us (= 1.5 UI). Between 4.88 mHz (200 s) and 0.5 mHz this means that (11 us - 2.3 us)/4 = approx. 2 us (4 UI) is allowed. For reference clock stability reasons the MTIE increases at higher observation intervals. A common curve to follow (TM3) is $433ç^{0.2}$ +0.01ç ns.

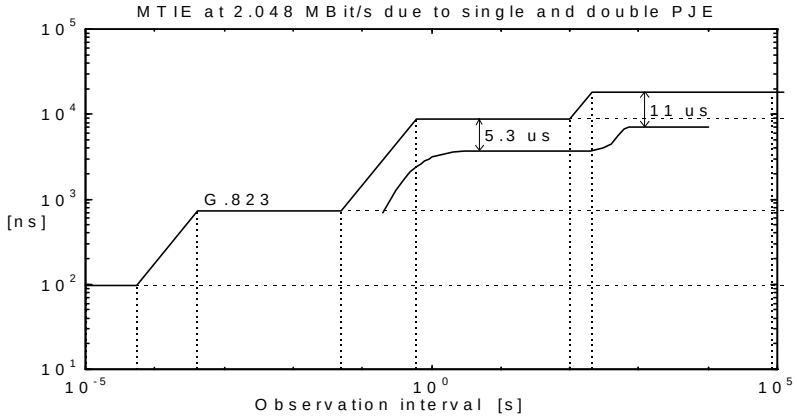

Figure 1: wander in MTIE due to single and double Pointer Justification Events.

Measurements on existing HDSL modem links (both 2B1Q and CAP) prove that these limits can be met (both 2B1Q and CAP measured less than 488 ns = 1 UI wander).

2. Proposed text for inclusion in ETR 152

Delete “and wander” from 7.1.3.3.3 and add a new sub-clause 7.1.3.3.4

7.1.3.3.4 Wander specifications

The maximum wander that may be experienced at the output of an HDSL system, expressed in MTIE, shall not exceed the values given in table 25. The resultant overall specification is illustrated in figure 39. The timing reference for the MTIE measurement shall be the same as used as a reference for the 2.048 Mbit/s random bitgenerator. The pseudo random test sequence shall be 2^{15}-1 according to ITU rec. O.151.

Table 25: maximum permitted values of output wander

MTIE	Observation interval
732 ns	0.05 < ç ó 100 s
13ç - 568 ns	100 < ç ó 200 s
2000 ns	200 < ç ó 2000 s
$433ç^{0.2}$ +0.01ç ns	ç > 2000 s

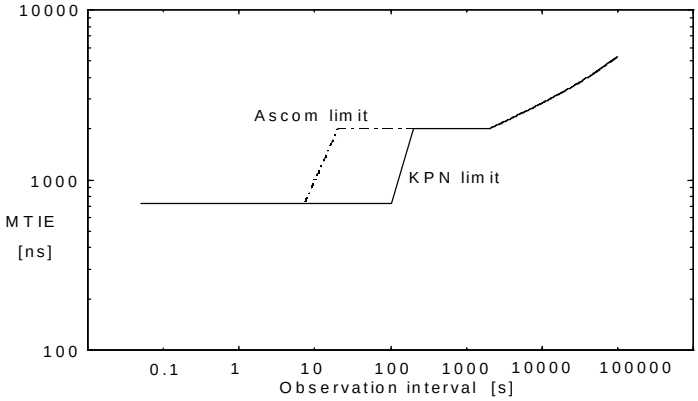

Figure 39: Maximum permitted values of output wander expressed in MTIE