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C O N T R I B U T I O N

TITLE: **DSL spectrum management applied to the BT UK access network**

SOURCE*: **British Telecommunications plc (BT)**

PROJECT: **DSM**

STATUS: **For information only**

ABSTRACT

This contribution is for information only. It provides the necessary references to enable the reader to access the recently amended standard governing DSL spectrum management in BT's UK metallic access network. The rules have been drawn together into a single standard covering the full loop (from Exchange/CO to NTP/NID) and the sub-loop (from Cabinet/RT to NTP/NID). This amended standard was approved by UK industry and endorsed by Ofcom (the UK Regulator) in September 2005.

The standard is also referred to as the Access Network Frequency Plan (ANFP) for the BT UK network. It should be noted that it has incorporated recent advances in Static Spectrum Management that BT has brought to the attention of ATIS NIPP NAI earlier in 2005.

The techniques used in the ANFP for spectral control may be of use in a North American mixed CO/RT deployment and can be viewed as useful input to the DSM project work.

NOTICE

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1. Introduction

The Access Network Frequency Plan (ANFP) is a regulatory standard produced by UK industry and endorsed by Ofcom, the UK Regulator. The purpose of it is to define the limits of allowable Power Spectral Density (PSD) that can be injected at defined points in BT's access network. The standard applies to both the incumbent operator (BT) and other competitive network operators (LLUOs) who may wish to connect xDSL systems in BT's access network to provide Broadband services to their customers. The ANFP is a vital tool to ensure that xDSL-based equipment that is connected to BT's access network is spectrally compatible.

2. A summary of the changes to the ANFP

The UK Access Network Frequency Plan has recently been revised to Issue 3 (ANFPi3) [1]. In this revision, four equipment location categories are considered, with PSD limits being defined for each:

- Exchange based,
- Cabinet based,
- Customer premise based and
- Exchange-outlet lines, where there is no cabinet.

The previous version of the ANFP (Issue 2) prevented the deployment of faster ADSL2+ transmission systems from the local exchange. This was to protect spectrum for use in providing high capacity from the street cabinet using VDSL, and had the effect of limiting ADSL2+ deployment from these cabinets by restricting the use of frequencies to between 1 MHz and 2.2 MHz.

Following extensive computer simulations it was revealed that a good joint compromise could be found, protecting the performance of ADSL/ADSL2+ from the exchange while actually improving the likely performance of ADSL2+/VDSL from the Cabinet. This could only be achieved if some of the spectrum is shared and reused at the Cabinet provided and that a complex spectral shaping is used at the Cabinet location.

In the new method, the complex downstream power shaping is made a function of the electrical distance (or loss) of the Cabinet from the Exchange. A cabinet assigned loss (CAL) value is computed for each of the ~88,000 Cabinets in the BT UK access network.

Three simple principles essentially define the chosen shaping method:

- At low frequencies, the cabinet based equipment must transmit at levels, which are the same as or lower than the levels at which signals would arrive at the cabinet from the exchange.
- Above a particular frequency, referred to as the maximum usable frequency, it is unlikely that xDSL signals from the exchange could offer any usable transmission capacity. Above this frequency, cabinet based equipment is allowed to transmit at significantly higher power[1].
- Frequencies in the region 3-5 MHz are reserved for VDSL upstream use. The use of frequencies above 7 MHz for systems deployed from the Cabinet or from the Exchange is not currently permitted and these are reserved for future use.

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[1] This method is the basis that ITU-T Q4/15 has agreed shall be supported in G.ploam (Issue 3.12) for use with VDSL2 and ADSL2+.

When equipment at the cabinet conforms to these PSD masks, both ADSL and ADSL2+ can be used from the exchange, delivering performance that is substantially unaffected by the signals being transmitted from the cabinet. Also, by sharing the bandwidth available from the exchange, VDSL from the cabinet can potentially deliver even more than it could do if bandwidth is unconditionally reserved for it in some compromise.

The price of this all-round high performance comes in complexity, both in the revision of spectral constraints that must apply at the cabinet, and more importantly on the operation and management of systems deployed at the cabinet.

The ITU-T VDSL2 Recommendation that is currently in the process of approval permits the power control that would be required to fully exploit such a management regime. The current revision of the ADSL2+ Recommendation (G.992.5) does not permit this shaping functionality. However, at the October ITU-T SG15/Q4 meeting in Edinburgh, draft text for the next revision of G.992.5 was presented [3]. This proposed the removal of the constraints on downstream PSD shaping and it was agreed that G.992.5 shall define a new set of valid MIB PSD masks based on the downstream power back off method defined in G.ploam for VDSL2.

In addition, Network Management standards would also need to be upgraded to allow for management control of the transmit power mask.

The ANFPi3 was finally approved by UK industry and endorsed by Ofcom in September 2005 and is now in force [1,2].

3. References

[1] "Specification of the Access Network Frequency Plan applicable to transmission systems connected to the BT Access Network", NICC Document ND1602:2005/08, Issue 3, September 2005.

http://www.nicc.org.uk/nicc-public/Public/interconnectstandards/dsltg_spec/nd1602_2005_08.pdf

[2] Mask definition spreadsheet to accompany [1].

http://www.nicc.org.uk/nicc-public/Public/interconnectstandards/dsltg_spec/nd1602_2005_08.xls

[3] ITU-T SG15 Q4 contribution ES-026R1, Edinburgh, October 2005, source BT.