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ABSTRACT

A new section “Spectrum Management” is proposed for WT-026-v2.

NOTICE

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CONTRIBUTION

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ABSTRACT

This contribution was supplied by the DSL Forum Operations and Network Managment chair Greg Bathrick for our interest and information in discussing dynamic spectrum management within T1E1.4. In a conference call on June 15, 2001, several persons stated that did not have access to the contribution and asked for it to be posted to the T1E1.4 web site. It is not intended that this contribution be presented, and is provided only for courtesty so that T1E1.4 members can read it.

NOTICE

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Introduction

ADSL service providers will want to be able to predict which lines can support ADSL and at what transmission rate. They will want deployment rules they can trust, to feed the service viability process.

Service viability partly depends on the line's transmission properties; estimation of these is already discussed in WT-026, by radial distance, record checking, measurements, etc. However ADSL performance also depends on crosstalk from other systems in the same cables - this is the main noise source for the ADSL channel. Protection of the ADSL capacity would require rules limiting the power of transmitters connected to the cable. Without such protection even a previously working service might be compromised by a new service starting on an adjacent line.

In the current version of WT-026 the "service viability process" includes a service compatibility check which looks for the presence of an incompatible service on the line being considered for ADSL service. This component of the process can be enlarged to include a check on the presence of potential crosstalk interferers on adjacent pairs in a binder group.

The technical issues around spectral compatibility are complicated, and are not necessarily well understood: they are only just being discussed in the standards bodies, such as in the ANSI T1E1.4 project on "spectral compatibility".

It is proposed that this should be discussed in WT-026 by text in a new section "Spectrum Management", in the "Provision" process.

Proposed Text

3.1.4 Spectrum Management

The spectrum management process seeks to control use of the lineplant so that best use is made of its potential capacity. The dominant source of the noise which limits ADSL system performance is crosstalk, so the potential capacity of the line plant is a shared resource.

The spectrum management process has two parts:

- Limit transmitter levels
- Produce deployment rules

Limiting the levels of signals transmitted into the lineplant is intended to control the crosstalk levels experienced by other users. This part of the process would be done by the owners of the line plant, and the limits would apply to all equipment – ADSL and everything else. However, in the ADSL band the limits will be different in different locations, to support asymmetric service.

Once crosstalk is bounded the service providers can deduce what capacity a given line can support. They will then produce their own deployment rules.

<u>Limiting Transmitter Levels</u>

The line plant owner will establish the limits on transmitter levels, expressed as rules which the transmitters must obey. Ideally, this would be done before any service commences. (After service commences the rules will be enforced as part of the 'repair' process).

The transmitter limits will apply to all new transmitters connected to the line plant, irrespective of the transmitter technology. For existing equipment the line plant owner will want the rules to be liberal enough to permit those systems already common in its network. If, however, existing systems create levels of crosstalk that are incompatible with ADSL then, if they are to remain in the network, local loop records must contain sufficient information that loops that are at risk can be identified during the service compatibility component of the service viability process.

The transmitter limits will in general vary with location, for example different signals are permitted at the two ends of an ADSL line.

The permissible levels will vary between local loop populations. Amongst the varying factors are:

- maximum cable fill permitted by the line plant owner - not all will permit 100% cable fill.
- demographic distribution of line lengths.
- RFI risk – includes the amount of line plant above ground, the national allocation of radio spectrum, and the balance quality of the lineplant

Failure to limit transmitter levels will mean the loudest signals swamp everything else. In practice a failure to co-ordinate use is expected to mean that service providers may find useful ADSL capacity, but only on the shortest lines, and this is always at risk of being lost to new equipment with more powerful transmitters (power boosted ADSL, leakage from home networks, etc.).

Frequency Plan

One approach is the 'frequency plan', in which each location's limit is a power spectral density (a 'mask'). A transmitter is permissible at a particular location if and only if its power spectrum is at or below the mask, at each frequency separately. Masks generally differ at different locations, and in different directions along the cable at the same location.

One example of this is RADSL service, where transmitters are all limited to a common mask (different in each direction), and each system gets the best capacity it can in the resulting environment : capacity is not guaranteed, and operation implicitly relies on the absence of rogue systems.

In some networks "power back off" can extend service reach : for this the frequency plan would prescribe varying customer end masks, with lower power for short lines.

Ideally the crosstalk limiting rules should be designed explicitly to give

- best real use of the potential capacity
- a rational basis - to reduce the risk of the plan being challenged

Deployment Rules

The transmitter limits above allow some estimation of a given line's capacity. Such estimation also requires knowledge of the line plant's transmission properties, such as:

- typical attenuation factors of the cable types
- typical crosstalk coupling
- how long the line is, and what cable types it is constructed from
- unusual defects (aged cable, adjacent T1 system, etc.)
- RFI ingress expected (e.g. radio hot spots near TV transmitters),

A service provider will produce their own deployment rules, to enable the 'service viability process'. These will necessarily be informed by the capacity estimate for a line, but may also be based on commercial considerations, such as the target proportion of 'reworks' (mistaken decisions to be expected from the service viability process), and the confidence in available information. Typically uncertainty is absorbed by making planning rules more conservative.

ADSL equipment is available with *many* options. Therefore, separately, the service provider will also have to determine how to configure the ADSL equipment to meet the transmitter power limits.