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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: CC Docket No. 98-147

Dear Ms. Salas:

On July 23, 1999, Patrick H. Stanley, Guy Gill, and Jack Terry of Elastic Networks, Inc., and Julie Hammand of Nortel Networks, met with Dale Hatfield, Stagg Newman, and Doug Sicker of the FCC's Office of Engineering and Technology, and Michael Jacobs and Vincent Paladini of the Common Carrier Bureau to discuss spectral compatibility issues related to an Elastic Networks proprietary technology, EtherLoop. Elastic Networks distributed the attached document at that meeting.

Sincerely,

Michael Jacobs
Policy and Program Planning Division
Common Carrier Bureau
Federal Communications Commission

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EtherLoop Spectral Compatibility

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EtherLoop Spectral Compatibility Overview

FCC

Washington, D.C.

July 23, 1999

Patrick H. Stanley, P.E.
Principal Systems Engineer
Elastic Networks, Inc.
A Subsidiary of Nortel Networks

Public Benefit from xDSL

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Timely Deployment of Advanced Data Services

- One goal of Telecommunications Act of 1996 is to encourage deployment of advanced telecommunications capability to all Americans in a reasonable and timely manner

Markets ready for xDSL

- Markets appear ready to accept xDSL service, and vendors have products ready for customer delivery

Other technologies ready for deployment

- Other access technologies are, or soon will be ready for volume deployment: cable modems, broadband wireless

Delays could skew the marketplace

- Delays of xDSL deployment could skew competitive marketplace, and deny consumers of many of the attractive capabilities of xDSL systems, which use the existing copper infrastructure

Why the Elite Modem ?

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Burst Mode systems can "listen" between bursts

- The burst nature of the Elite modem allows the modem to sense loop conditions during silent periods between bursts. This allows both pre-training of other speeds and spectral measurements for the Spectrum Manager function

Ubiquitous Service

- Inherent adaptability of Elite modem increases likelihood of deploying high-speed services regardless of location or loop conditions -- leading to more ubiquitous service offerings from both CLEC's and ILEC's

Automatic adaptation to actual coupling levels

- Advanced, spectrally agile systems such as the Elite modem prevent crosstalk interference with other services on adjacent loops by sensing the presence of the other sources of energy and automatically adapting their power levels at various frequencies so that interference is avoided with other services.

Why the Elite Modem? (Part 2)

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Eliminates the need for engineering the loops

- As an adaptive service, NO REQUIREMENT EXISTS TO ENGINEER OUTSIDE PLANT LOOPS based on fixed PSD masks prior to deployment. This levels the playing field for competition in the unbundled environment, because no one is relying on their competitors for proper binder grooming to segregate services. Even in a single provider environment, deployment time is significantly reduced by removing the burden of binder grooming

Maximizes data bandwidth of the copper plant

- Adaptive systems will enable a greater number of loops to be utilized, since the fixed criteria for effective data transmission no longer exist

Adapts to dynamic noise environment without interrupting service

- Since the Elite modem pre-trains alternate communication "speeds", the modem can quickly (< 1 mSec) adapt to a dynamic noise environment (impulse noise, etc.) WITHOUT interrupting service to the user

Crosstalk Issues for xDSL

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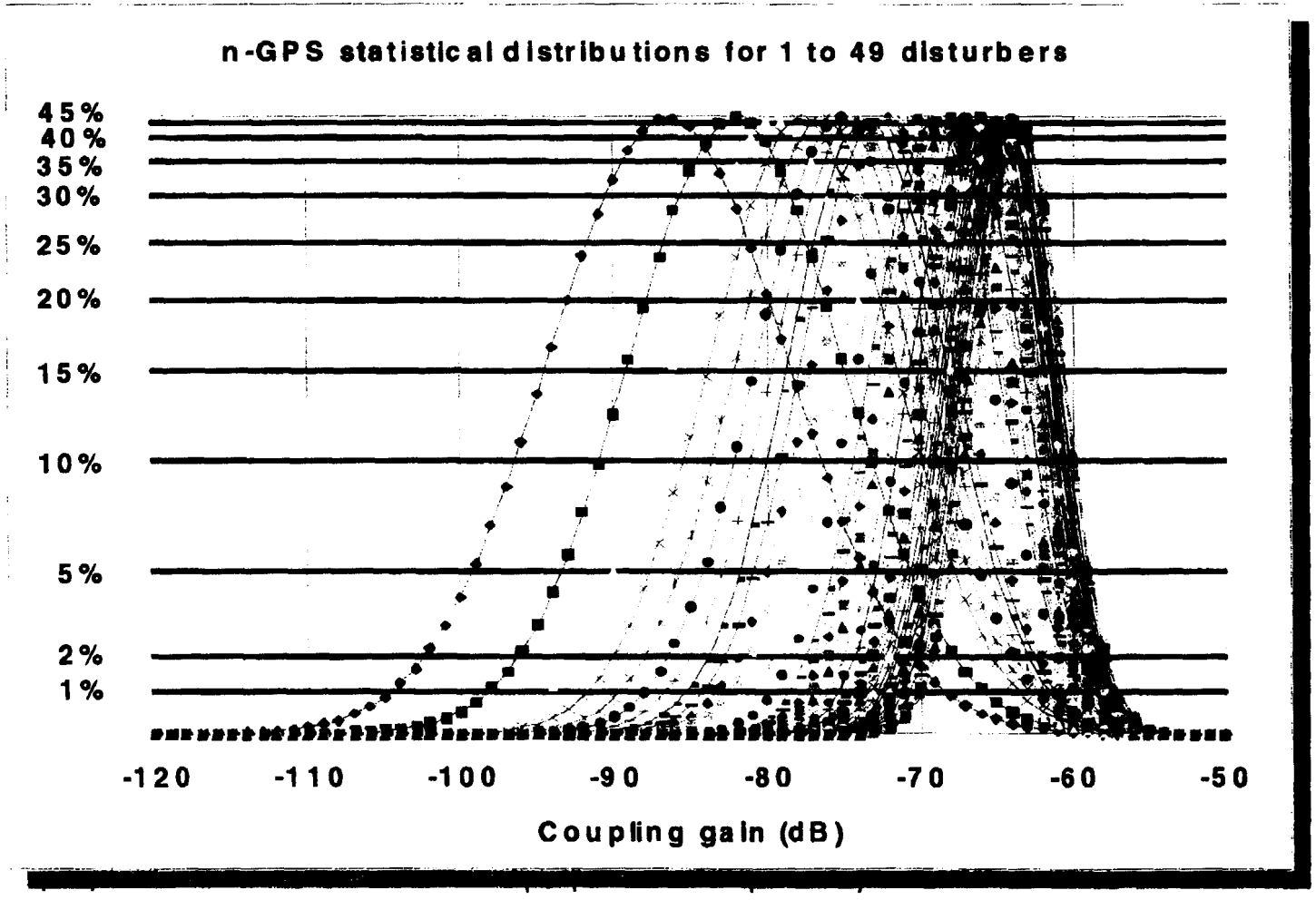
Statistical View of NEXT, Far Left Curve is for 1 Disturber, Far Right Curve is for 49 Disturbers



Fixed PSD Mask Systems

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Fixed PSD Systems designed for worst case

- Systems with fixed Power Spectral Density (PSD) (measured in dBm/Hz) masks must be designed to ensure spectral compatibility under 99th percentile worst case coupling conditions

Too conservative most of the time

- This imposes overly conservative restrictions to bandwidth and deployment when this worst case coupling is not present, which is the majority of the time

Spectrally agile systems maximize the throughput of the entire binder

- Spectrally agile systems, such as the Elite modem can measure the actual coupling environment, on a loop-by-loop basis, and maximize the throughput of the binder

Spectrum Manager Function

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Measures before transmitting

- Each modem takes a spectral measurement before transmitting any power levels that are beyond the "Safe Mode" constraints, which comply with T1.413 Issue 2 PSD mask

Adapts to NEXT environment

- After the modem has determined that no significant coupling exists with any asymmetric services, the PSD mask is relaxed to "Native Mode" constraints

"Native Mode" Spectrally compatible with symmetric services

- The "Native Mode" constraints have been shown to be spectrally compatible with the self-NEXT limited digital services (T1, HDSL, ISDN), and POTS by independent analysis and testing performed by Telcordia Technologies (Formerly Bellcore) [1],[2]

"Safe Mode" Spectrally compatible with asymmetric services

- The "Safe Mode" constraints comply with T1.413 Issue 2 PSD masks, which are an industry standard for spectral compatibility of asymmetric services. These levels are even lower than those shown to be spectrally compatible by independent testing conducted by Telcordia Technologies

Spectrum Manager Function (Part 2)

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Proper categorization independently verified

- The correlation used by Spectrum Manager to categorize the NEXT environment has been shown to be effective with both simulated and measured cross talk profiles by an independent analysis performed by Telcordia Technologies [3]

Continuous Protection

- The Elite modems continue to take spectral measurements and make adjustments to power levels, as necessary, during normal operation of the modem

Errs on the side of caution

- Design choices made to ensure protection of other services
- The Elite modems are quick to switch to "Safe Mode", and slower to switch to "Native Mode" in order to protect other services that may be trying to train up in the binder in the presence of coupling with the Elite modem.

T1E1.4 Spectrum Management Project

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T1E1.4 Contributions show Spectral Compatibility of Elite modem

- Several Contributions have been made to the T1E1.4 working group, demonstrating, through analysis and testing, the spectral compatibility of the Elite modem with other digital services and POTS. Sources include Telcordia Technologies and Elastic Networks[1],[2],[3],[4]

T1E1.4 Contributions show spectral compatibility of Burst Mode Systems

- Several other Contributions have been made, addressing the time domain constraints of burst mode systems that ensure spectral compatibility with other digital services and POTS. Sources include Paradyne, Elastic Networks, AGCS/Lucent, GlobeSpan, Texas Instruments, Alcatel,3Com[4]-[12]

Spectrum Management Standards Activity

- The first issue of the Draft Proposed American National Standard (dpANS) Spectrum Management Standard was submitted by the T1E1.4 Working Group to the T1E1 Technical Subcommittee for letter ballot at the June Plenary Meeting

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T1E1.4 Spectrum Management (Part 2)

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Two Methods of Demonstrating Spectral Compatibility

- The standard states that a service is spectrally compatible if it either:
  - A) fits within the PSD mask of one of the 6 defined classes, or
  - B) is demonstrated by analysis, using "Method B", to cause interference with the same or less impact than from the defined classes

Unanimous Agreement on Burst Mode Systems

- At that meeting, which was attended by representatives from all of the parties that commented on the Elite Part 68 Waiver Petition, it was unanimously agreed that short term stationary (burst mode) systems that meet the time domain criteria for short term stationary systems outlined in the document (based on text contributed by Elastic Networks, Paradyne, AGCS/Lucent, GlobeSpan and Texas Instruments [5]), and meet the PSD constraints listed above, are spectrally compatible with guarded systems

Elite modem conforms to the dpANS Spectrum Management Standard

Petition for Waiver

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Petition Filed December 9, 1998

- On December 9, 1998, Nortel Networks (Northern Telecom Inc.) filed a Petition for Waiver of section 68.308(e)(1) of the Commission's rules (Petition) so that it may register its Elite modem under Part 68.200 of the Commission's rules.

Metallic voltage limitations are the only issue

- In all respects other than the metallic voltage limitations, 68.308(e)(1), the Elite modem complies with Part 68 rules for directly connected terminal equipment.

The Elite modem is designed to not cause harm to the network, which is the underlying purpose of Part 68 equipment registration.

Crosstalk is the key issue for xDSL systems

- Crosstalk interference is the critical issue with xDSL systems due to the use of higher-frequency spectral energy. As outlined above, the Elite modem in "Native Mode" has been shown (Method B) to be spectrally compatible with the symmetric guarded systems (T1, HDSL, ISDN, etc.), and has been shown to be capable of identifying when significant coupling exists with asymmetric guarded systems (ADSL, G.Lite, etc.) [3], in which case it enters "Safe Mode," which complies with the T1.413 Issue 2, non-overlapped, PSD Mask.

Upstream PSD Comparisons

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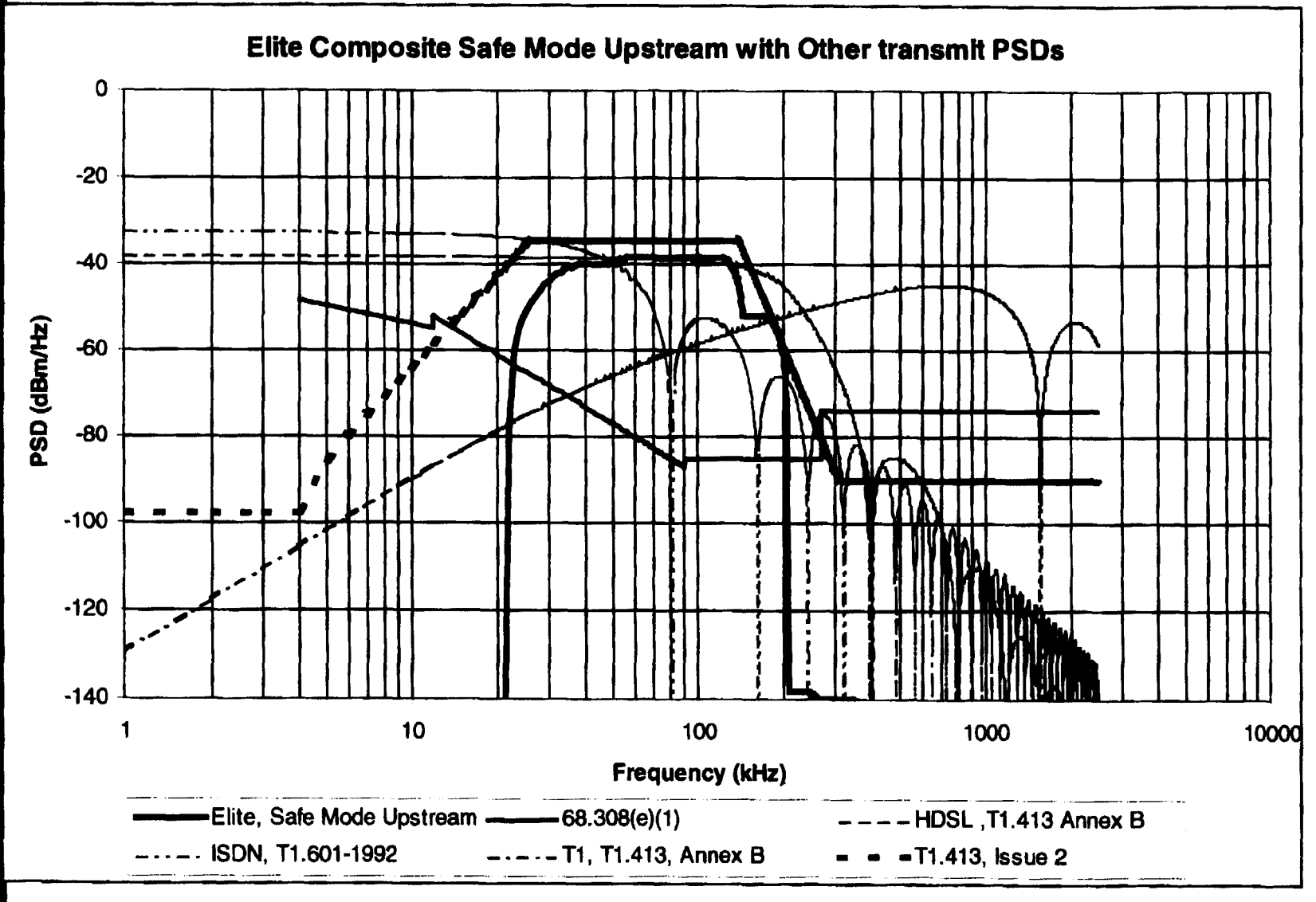

Reply Comments

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Reply Comments Filed February 12, 1999

- On February 12, 1999, Nortel Networks (Northern Telecom Inc.) filed replies to all of the comments filed by other parties

Three general concerns

- The commenting parties raised three general concerns with Nortel Networks' waiver request
  - i) Compliance to PSD masks
  - ii) the effect of burst mode product technology on ADSL-based systems
  - iii) sufficient testing coverage of the spectral compatibility claims of the Elite modem

The following responses address these concerns, indicating that the waiver should be granted

** TOTAL PAGE.14 **

Compliance to PSD masks

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dpANS Spectrum Management Standard states 2 methods of demonstrating spectral compatibilty

- The standard states that a service is spectrally compatible if it either:
  - A) fits within the PSD mask of one of the 6 defined classes, or
  - B) is demonstrated by analysis, using "Method B", to cause interference with the same or less impact than from the defined classes
- Even the PSD masks used are generic classes, and not tied to a single standardized service. The intention is to encourage innovation by not causing new services to wait for standardization of each new PSD mask
- All commenting parties participate in the T1E1.4 working group that unanimously agreed to both methods

Frequency Agile Systems Maximize the Capacity of the existing Copper Plant

- The Elite modem detects the incidence of actual cross-talk coupling and dynamically adjust its PSD mask profile to be ensure spectral compatibility. In the majority of cases, where significant coupling does not exist, the throughput is not unnecessarily constrained

Faster, more ubiquitous deployment

- The need for engineering the binders is eliminated

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Burst Mode Effects

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Burst mode systems unanimously agreed to be Spectrally Compatible

- The dpANS Spectrum Management Standard states that short term stationary (Burst Mode) systems that meet the specified constraints are spectrally compatible with guarded systems
- All commenting parties participate in the T1E1.4 working group that unanimously agreed to the short term stationary text

Burst Mode Systems can "listen" between bursts

- This enables the Spectrum Manager to adjust the transmit power levels to maximize total binder throughput, while ensuring spectral compatibility

Burst Mode Systems can quickly react to dynamic environment

- The Elite modem pre-trains other "speeds" between bursts, and stores the parameters in tables
- When the current speed becomes unreliable, due to new crosstalk, or impulse noise, the Elite modem is able to switch to a new "speed" nearly instantaneously, without interrupting service to the user

Testing Coverage

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dpANS Spectrum Management Standard outlines required test cases

- The dpANS Spectrum Management Standard defines a set of guarded services with which new services must be spectrally compatible
- Furthermore, the dpANS Spectrum Management Standard specifies a set of loops and binder fill cases that must be included in the analysis

Elite modem conforms to the dpANS Spectrum Management Standard

Summary

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Spectrally Agile Systems Speed Deployment of High Speed Telecommunication Services to all Americans

- No engineering rules or binder grooming required

Spectrally Agile Systems create a more ubiquitous service offering

- Engineering rules not required
- Throughput of the entire binder is maximized

Burst Mode Systems adapt quickly to dynamic noise environment

- Alternate Speeds are Pre-trained between bursts
- Changing speeds occurs nearly instantaneously

Elite modem conforms to the dpANS Spectrum Management Standard

- All commenting parties participate in T1E1.4, which has unanimously agreed to spectral compatibility of burst mode systems and to using analysis as an alternative to compliance to a fixed PSD mask. Waiver can avoid delays while this standard works it way through the committee process.

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References

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[1] Bellcore, Elastic Networks, "Analytical Study of the Spectral Compatibility of ADSL, HDSL, ISDN, T-Carrier and POTS with EtherLoop," ANSI T1E1.4/98-334, December 1998.

[2] AU-931, *Spectral Compatibility Analysis of the Elastic Networks EtherLoop Transceiver*, Telcordia Technologies Technical Analysis Report, April 1999.

[3] Telcordia (formerly Bellcore), Elastic Networks, "Spectral Compatibility and EtherLoop's Spectrum Manager," ANSI T1E1.4/99-191R1

[4]Elastic Networks, "Analysis of Spectral Compatibility of EtherLoop with DMT Services," ANSI T1E1.4/99-204

[5] AGCS/Lucent, Elastic Networks, GlobeSpan, Paradyne, Texas Instruments,"Proposed Text for Conformance Criteria Applied to Short-Term Stationary DSL Transmitters," T1E1.4/99-263, June 7 1999.

[6] Paradyne, "Modeling and Estimation of Short-Term Stationary Crosstalk From Multiple Disturbers," T1E1.4/99-262, June 7 1999.

[7] Paradyne,"Power Spectral Density Bound for Non-Stationary Systems," T1E1.4/99-230, April 20 1999.

References (Part 2)

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[8] Paradyne, "Adaptation to Non-stationary Processes," T1E1.4/99-228, April 20 1999

[9] Alcatel, "G.gen: Quiescent Mode," ITU WP 1/15, Temporary Document PO-038R1, January 18 1999.

[10] 3Com, "Proposal for Quiescent Mode for G.Lite and G.dmt," T1E1.4/98-279, August 31 1998

[11]Paradyne,"Proposed Text for Informative Annex on 'The Time Varying Behavior of T1 and DDS Systems'," ANSI T1E1.4/99-300

[12] AGCS/Lucent," Proposed Text for Informative Annex on 'Non-Continuous CO Signaling Events',", ANSI T1E1.4/99-331

** TOTAL PAGE.06 **